Chapter 18

Feasibility Study - Bekasi

18. Feasibility Study -Bekasi

18.1 Area Background

Bumi Bekasi Baru is a large residential estate developed for middle and low income families by Perum Perumnas and located 4 km southeast from the old city of Bekasi and about 30 km from downtown Jakarta. This feasibility study area consists of 2 parts : Area I and II as shown in Fig. 18-1-1 indicating area and number of houses.

Table 18-1-1 Number of Houses in Feasibility Study Area

Bumi Bekasi Baru	Area (ha)	No. of Houses
Area I	87.5	3,301
Area II	65.0	4,440

Source : Perumnas

House construction of Area I has already finished and more than 90% of houses are occupied. Almost all of the roads in Area I are paved by concrete bricks. Area II is now under construction and people are beginning to live in the northern part of Area II. Within Area II, there are some parts which remain still unprocured. Those parts are excluded from the feasibility study since we do not have any prospect when houses will be built there.

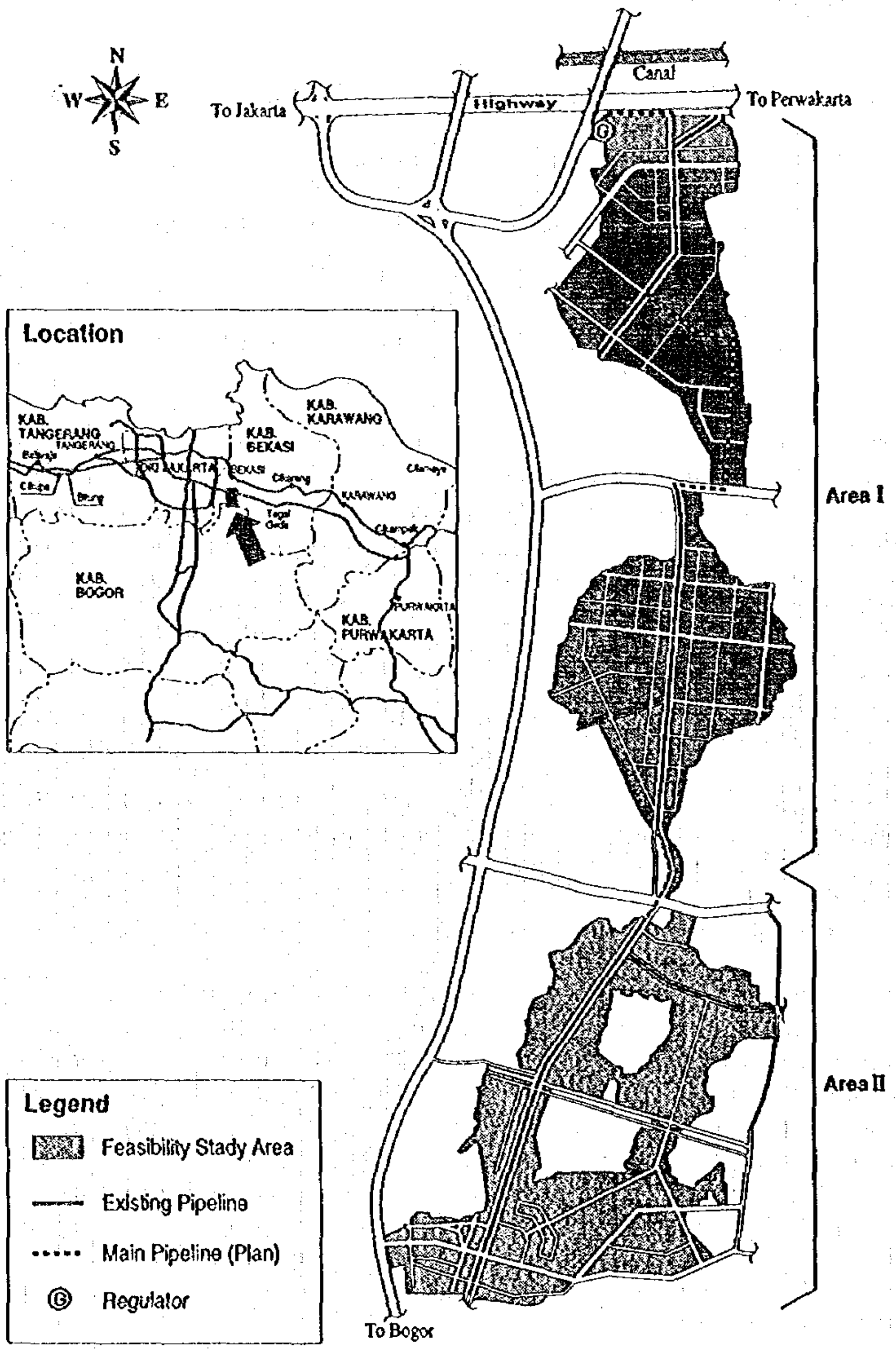
There are several neighboring estates around Bumi Bekasi Baru such as Taman Narogong Indah, Bojong Menteng and so on. Also there exist several factories at the west side of the national road to Bogor.

PGN's existing high pressure main is located about 0.5 km north of Bumi Bekasi Baru. This pipeline comes from the Tegal Gede Offtake Station and the current operating pressure is about 10 bar.

18.2 Estimated Demand for Urban Gas

In estimating the gas demand in Bumi Bekasi Baru, we use the average fuel consumption coefficients(monthly consumption per meter) for medium- and low income group since the area has been developed as a housing estate for medium- and low-income residents by the government. Though LPG is currently used in the area, we assume that all the residents in the estate will use urban gas when introduced as it was revealed in the survey that a high percentage of the existing LPG customers would choose the urban gas if the gas price is to be at the same level as current LPG price. Although there are several estates in the adjacent areas of Bumi Bekasi Baru with a large number of residents, our projection is limited to Bekasi Baru area since their potential demand has been incorporated in the master plan study.. Table 18-2-1 shows our demand projection.

Fig. 18-1-1 Outline of Bekasi Feasibility Study Area



Source : JICA Team

Table 18-2-1 Gas Demand in Bumi Bekasi Baru for Feasibility Study

Year	1997		1998		1999	
	1st half	2nd half	1st half	2nd half	1st half	2nd half
No. of Customers		1,650	3,300	5,520	7,740	7,740
Unit Consumption (m^3/y)	331	331	334.6	334.6	338.1	338.1
Gas Demand (1000 m^3/y)	100		1,200		2,400	

Year	2000	2005	2010	2020
No. of Customers	7,740	7,740	7,740	7,740
Unit Consumption (m^3/y)	344.4	353.3	366.7	389
Gas Demand (1000 m^3/y)	2,700	2,700	2,800	3,000

Source : JICA Team

The following conditions are assumed in calculating the values in Table 18-2-1.

(1) Pipeline construction is conpleted in two tears
(2) Half year is necessary for pipeline construction and another half year for gas distribution
(3) Fuel conversion to urban gas is assumed to proceed at a constant ratio.

Giving an example of 1997, pipeline construction for 1,650 house units is expected in the first half of the year. (Since this is the starting year, the number of houses is smaller than the following year.) Gas ditribution to these customers starts in the second half of the year and gas is distributed to all of 1,650 customers until the end of the year. Therefore the gas demand in 1997 is calculated from

$$1{,}650\text{units} \times 331\text{m}^3 / \text{year} \times \frac{1}{4}\text{year} \cong 100 \times 1000\text{m}^3 / \text{year}.$$

18.3 Proposed Distribution Network

18.3.1 Method of Grid Design

The design of gas pipeline grids in the feasibility area was conducted in the following steps.

(1) Confirmation of customer's location
(2) Selection of roads where pipelines will be laid
(3) Measurement of pipe length and drawing of network diagram
(4) Load estimation and pipeline load assignment
(5) Analysis of pipeline network and decision on pipe diameters

We confirmed the customer's location and selected the roads where pipelines are necessary using Perumnas site plan maps with 1/2,000 scale. These maps are also used to measure pipe length and to make network diagram drawings. In order to estimate pipeline loads, the information on the number of customers and design load per customer are necessary. The number of customers are also counted from Permunas maps. As for the design load per customer, we adopted 0.128 m^3/h per customer which is induced by multiplying 0.60 (the maximum load of one customer) and 0.231 (the simultaneous consumption ratio for n=7700). (cf. Appendix) The load is assigned to nodes in accordance with the number of housing units which are covered by the node. Since we adopt medium pressure gas distribution system whose pressure is from 0.1 to 1 bar and whose minimum pipe diameter is 32 mm, we first set 63 mm for the pipes located in wide roads and 32 mm for the pipes located in narrow roads. Using the network diagram prepared, we conducted a network analysis in order to determine the most suitable pipe diameters. When we found the nodes whose pressure were lower than 0.1 bar or the pipes whose flow velocity were higher than 20 m/sec, we enlarged the pipe diameters. We iterated this process until we found the most suitable pipe diameters.

18.3.2 Results of Designing

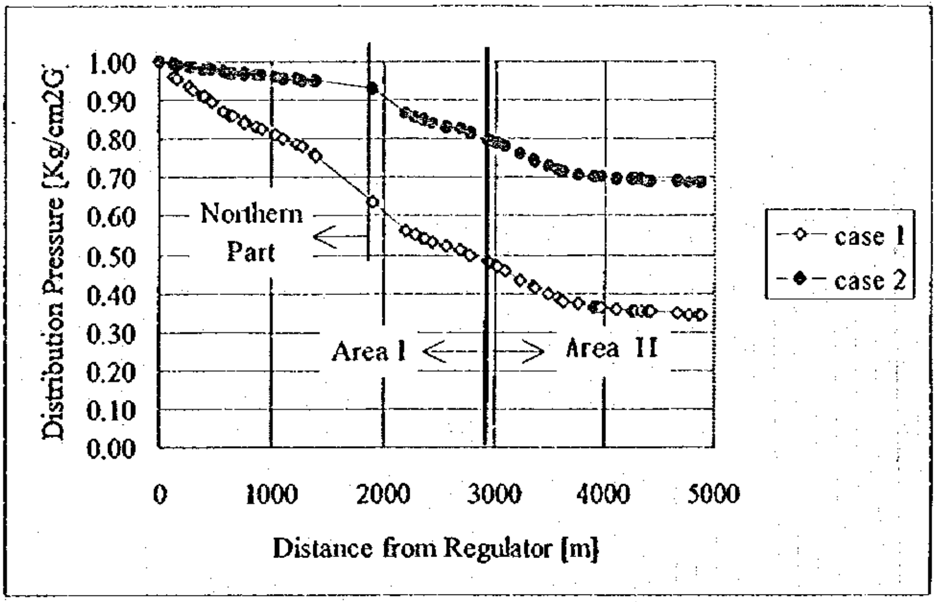
Since the existing main pipeline is located at the north of the feasibility study area, we decided to install a regulator which reduces gas pressure from 10 bar to 1 bar at the northern edge of the feasibility study area. Also we decided to install a distribution main pipeline from the regulator to the southern edge of the feasibility study area so that the pipeline conveys gas down to Area II. As for the diameter of this main pipeline, we found two alternative cases, one is the case that all sections of the pipeline have 125 mm diameter, and the other is the case that sections in the northern half of Area I have 180 mm diameter and the remaining sections 125 mm. (Table 18-3-1)

Table 18-3-1 Alternative Cases for Main Pipe Diameter

Alternative Case	Case 1	Case 2
Diameter of Main	Diameters in all sections are 125 mm.	Diameters in northern part of Area I are 180 mm. Diameters in the remaining area are 125 mm.

We conducted the network analysis for both Case 1 and Case 2 and the results are shown in Fig. 18-3-1.

Fig. 18-3-1 Distribution Pressure along Main Pipeline



Source : JICA Team

As shown in Fig. 18-3-1, the pressure at the terminal point in Case 1 is much lower than that in Case 2. We understand that Case 1 is a kind of the maximum capacity design and gives us an economical grid design. On the other hand, Case 2 has some amount of capacity surplus. Table 18-3-2 shows the quantity of surplus capacity in both cases which are calculated from formula $b = \sqrt{\frac{P_1^2 - P_{2,min}^2}{P_1^2 - P_{2,cmt}^2}} - 1$ where b is the surplus capacity (current load = 1.0), P_1 is the source pressure [Kg/cm^{2}A], $P_{2,cmt}$ is the current minimum pressure [Kg/cm^{2}A], and $P_{2,min}$ is the design minimum pressure [Kg/cm^{2}A].

Table 18-3-2 Surplus Capacity in Each Case

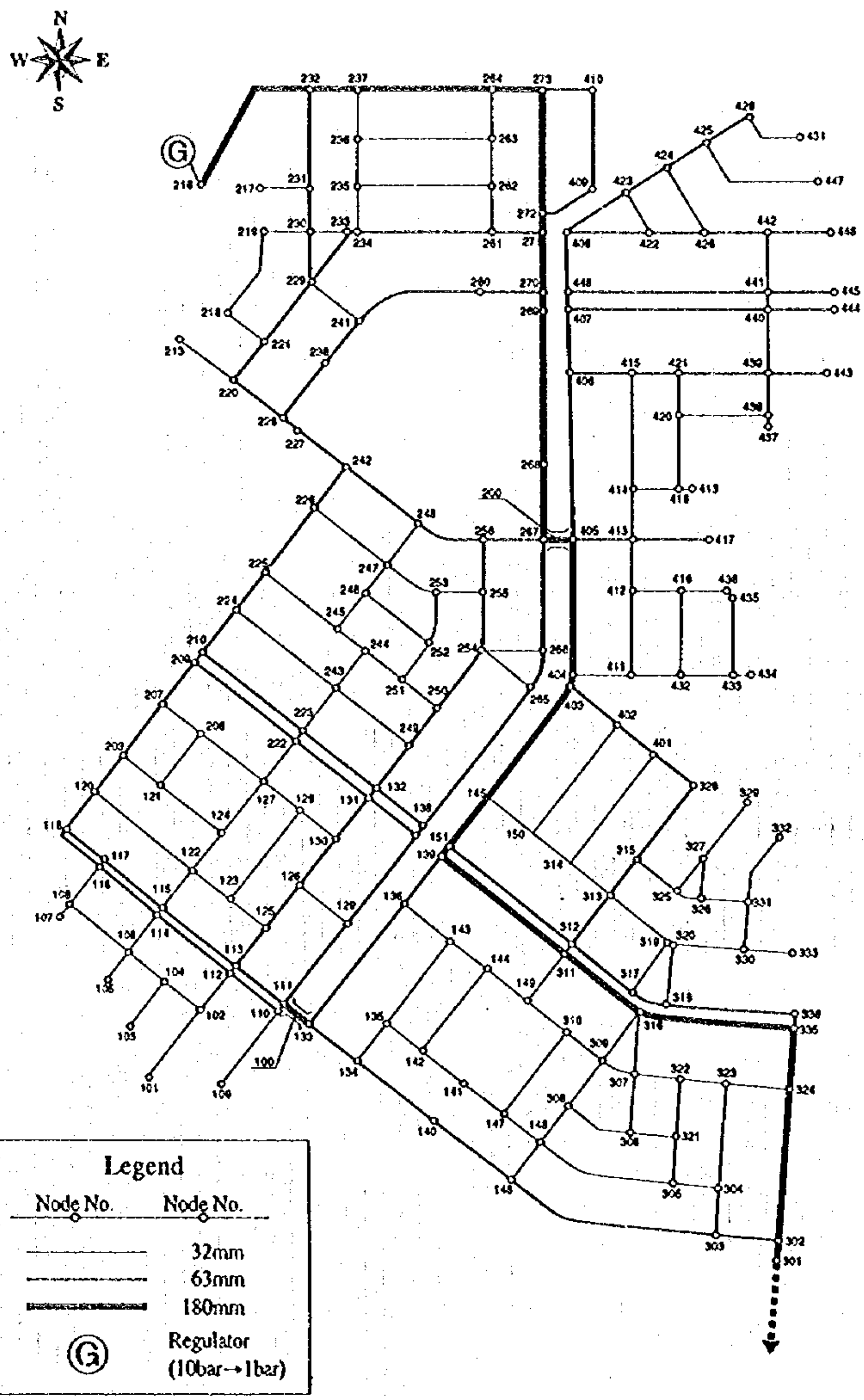
Case	P_1 [Kg/cm^{2}G]	$P_{2,cmt}$ [Kg/cm^{2}G]	$P_{2,min}$ [Kg/cm^{2}G]	b (%)
Case 1	1.000	0.344	0.100	12.8%
Case 2	1.000	0.687	0.100	55.7%

Source : JICA Team

As shown in Table 18-3-2, Case 2 gives us about 55 % capacity surplus. Therefore, if we target to develop not only the feasibility study area but also neighboring estates, it is recommended to choose Case 2.

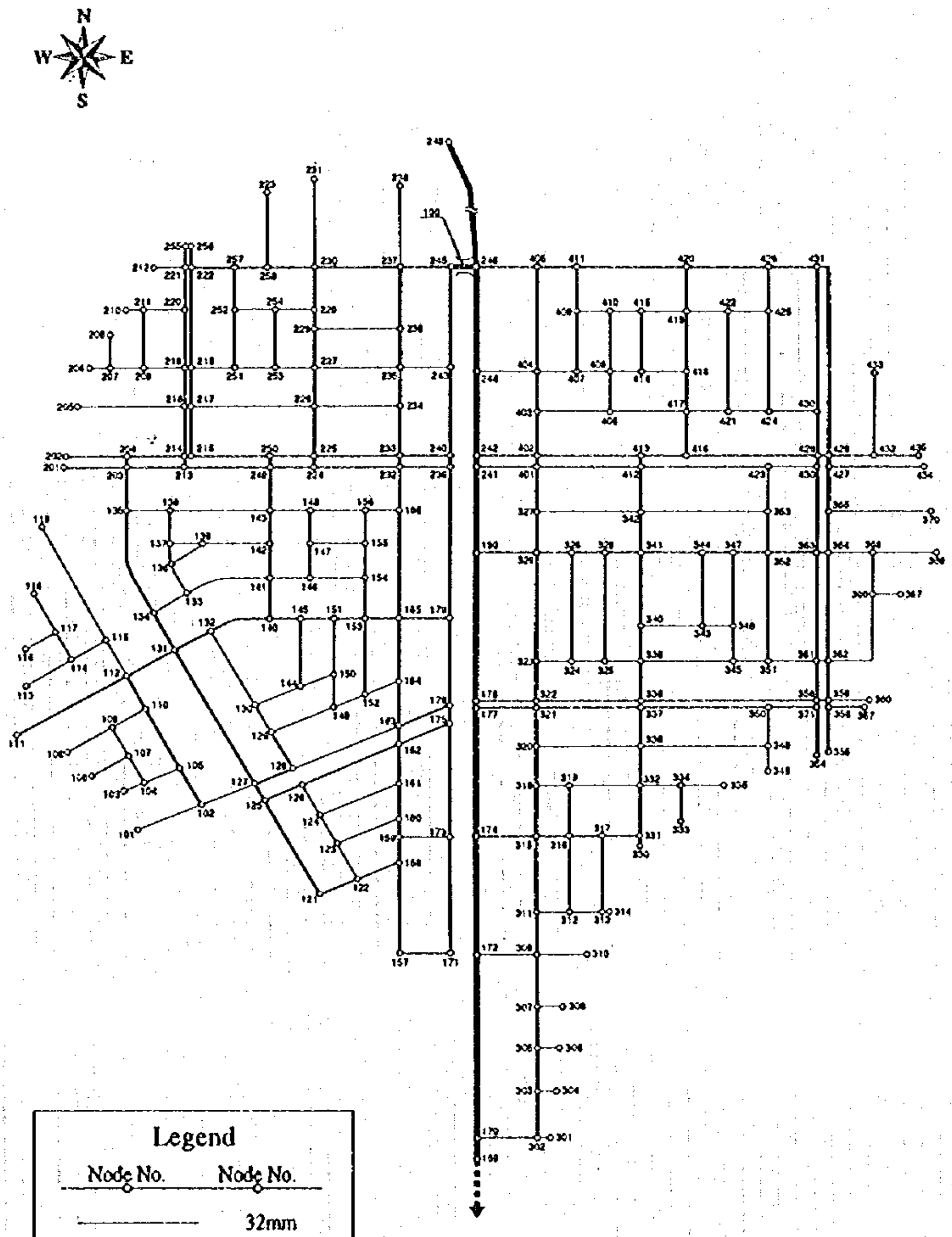
Fig. 18-3-2, Fig 18-3-3, Fig. 18-3-4 and Fig. 18-3-5 show the locations and diameters of the pipelines planned in the feasibility study area. Also Table 18-3-3 shows the length and cost of pipelines.

Fig. 18-3-2 Distribution Pipeline Plan (Area I , North)



Source : JICA Team

Fig. 18-3-3 Distribution Pipeline Plan (Area I , South)



Legend

Node No. Node No.

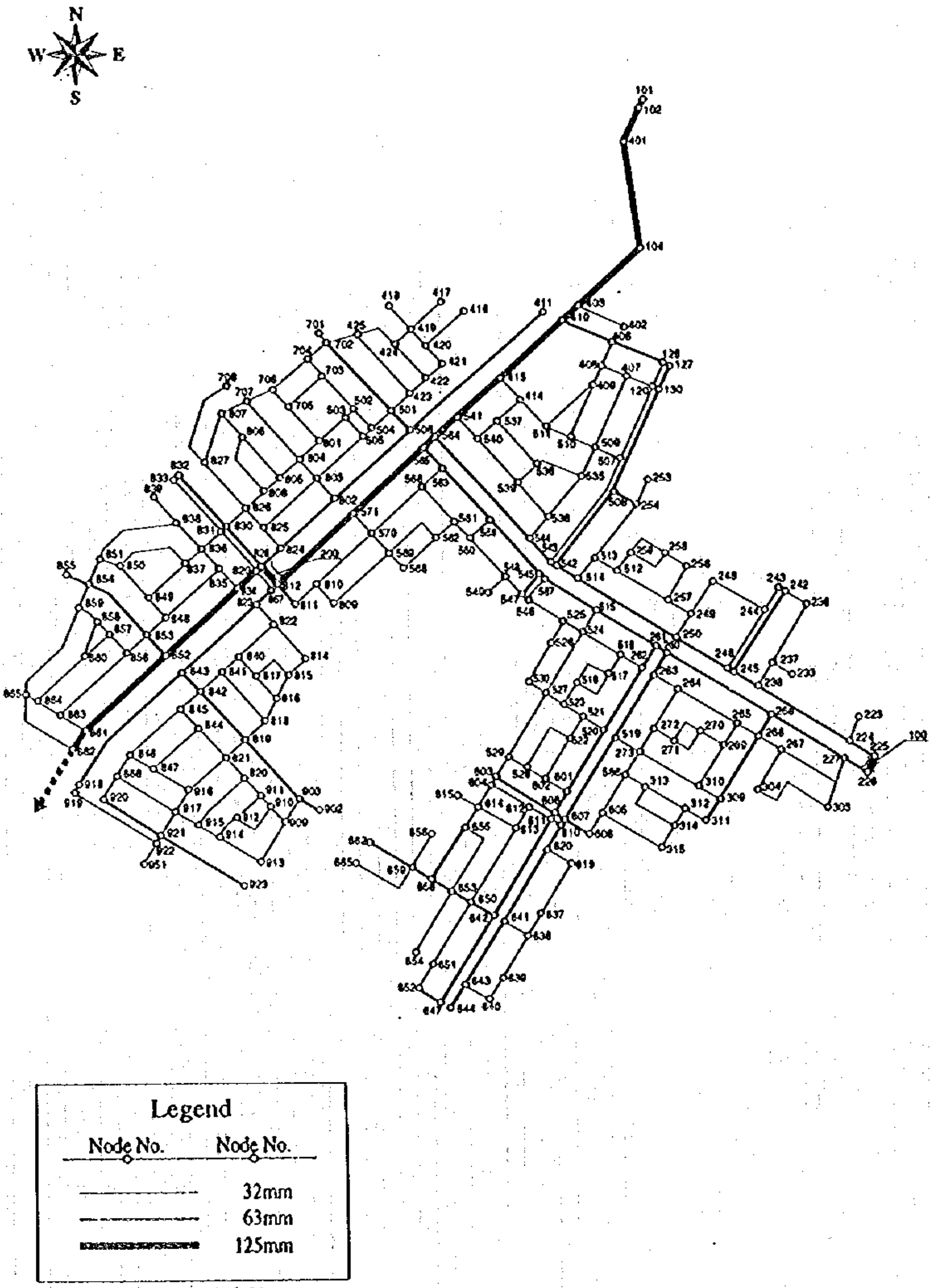
32mm

63mm

125mm

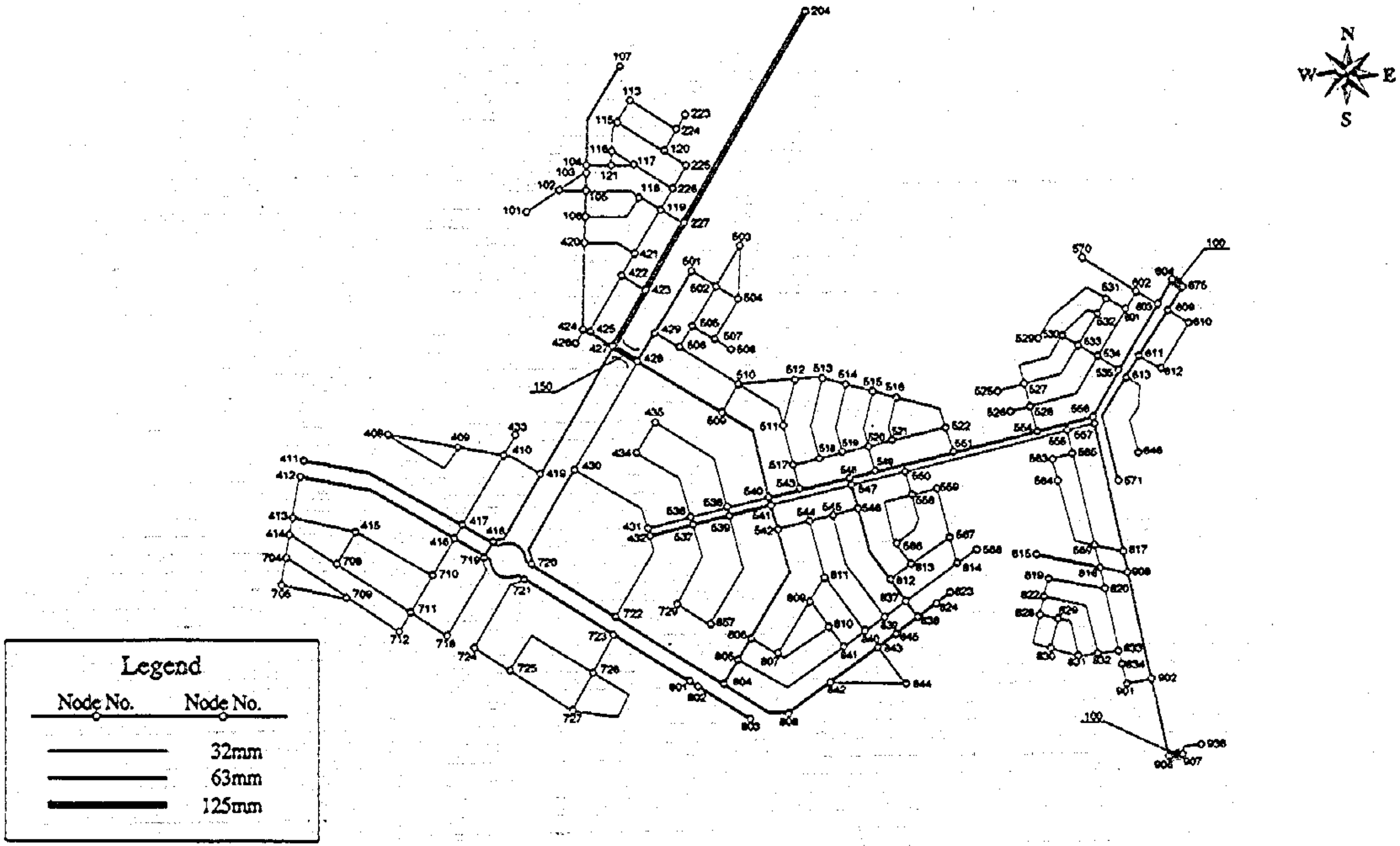
Source : JICA Team

Fig. 18-3-4 Distribution Pipeline Plan (Area II, North)



Source : JICA Team

Fig. 18-3-5 Distribution Pipeline Plan (Area II, South)



Source : JICA Team

Table 18-3-3 Pipeline Necessary in Bekasi F/S Area

	Diameter (mm)	Length (m)			Cost (MM Rp.-)		
		Area I	Area II	Total	Area I	Area II	Total
Case 1	32	13,136	25,264	38,400	315	606	922
	63	13,740	10,976	24,716	1,154	922	2,076
	90	0	0	0	0	0	0
	125	2,918	1,864	4,782	397	254	650
	180	0	0	0	0	0	0
	Total	29,794	38,104	67,898	1,866	1,782	3,648
	100	48	56	104	7	8	15
	150	24	68	92	4	13	17
	200	0	0	0	0	0	0
	Total	72	124	196	12	21	32
	All Total	29,866	38,228	68,094	1,878	1,803	3,681
Case 2	32	13,136	25,264	38,400	315	606	922
	63	13,740	10,976	24,716	1,154	922	2,076
	90	0	0	0	0	0	0
	125	1,040	1,864	2,904	141	254	395
	180	1,878	0	1,878	359	0	359
	Total	29,794	38,104	67,898	1,970	1,782	3,751
	100	48	56	104	7	8	15
	150	0	68	68	0	13	13
	200	24	0	24	5	0	5
	Total	72	124	196	12	21	33
	All Total	29,866	38,228	68,094	1,982	1,803	3,785

Source : JICA Team

18.4 Gas Supply

Gas will be supplied from an existing high pressure pipeline. The availability of gas is confirmed in the Master Plan making and we assume no problem in the supply.

In order to convey gas from the existing pipeline to the feasibility study area, the extension of high pressure pipeline which crosses a canal and a highway is necessary. The cost of the pipeline is shown in Table 18-4-1.

Table 18-4-1 Cost Estimation of Pipeline to F/S Area

Specification	Length	Cost
8 inches sch.40 API 5L, Grade B (Design Pressure 40 bar)	340 m including canal crossing (40m) & highway crossing (47m)	US$ 346,500

Source : JICA Team

18.5 Economic and Financial Assessment-Bekasi

18.5.1 Assumptions

In formulating the financial projections of Bekasi, we assume transmission pipeline of PGN from their high pressure line to Bekasi area would be installed in the first year of the project, and distribution pipelines would be installed in two years, whereas In the third year maximum number of houses are start using city gas replacing LPG.

Consumption volume per customer is estimated from results of our master plan, considering income level of this area.

We did projections for each case as master plan, from case 1 to case 5.

Material cost are the price of gas purchased from PGN. We set it as 330Rp, which is K1 considering the total sales volume of this project and is higher than estimated price in master plan which is 315 Rp/m3.

Assumed salaries are average salaries of PGN, in the category of white collar and blue collar worker and that of separate utility is two third of them (except pension plans). Those are same as in master plan. We assume higher labor efficiency compared to that of PGN now, which is used in master plan. There are some reasons to verify this assumption as follows.

1. We assume administrative staffs and workers to be minimum requirement for this project. It might be no incremental employees needed actually if PGN will accomplish this project. Even in separate utility case, in assuming PGN will be in charge of all works or negotiations with governmental agency, we could consider just a minimum administrative staffs and workers for this project.
2. PGN is now promoting rehabilitation program of old low pressure distribution pipelines, while in Bekasi facilities are newly installed. So that labor efficiency of those workers who should be in charge of safety maintenance of distribution pipelines in Bekasi area would be much higher than that of current PGN.

The next table shows plans of the project. Detailed plans are shown in Appendices O.

Table 18-5-1 Plans for Bekasi

		1997	1998	1999	2000	2005	2010	2015	2020
(Gas Demand)									
Residential	(1000m3)	137	1,152	2,429	2,666	2,735	2,838	2,928	3,011
(Number of Customers)		1997	1998	1999	2000	2005	2010	2015	2020
Residential		1,650	5,520	7,740	7,740	7,740	7,740	7,740	7,740
(Sales Volume per Customer)		1997	1998	1999	2000	2005	2010	2015	2020
Residential	(1000m3)	0.08	0.21	0.31	0.34	0.35	0.37	0.38	0.39
(Investment Plan)		1997	1998	1999	2000	2005	2010	2015	2020
Transmission pipeline	(km)	0.3							
Distribution pipeline	(km)	29.9	38.2						
Cumulative distribution pipeline	(km)	29.9	68.1	68.1	68.1	68.1	68.1	68.1	68.1
Cumulative A governor	(units)	1	1	1	1	1	1	1	1
Cumulative B governor	(units)	2	6	8	8	8	8	8	8
SP/customer	(1000Rp)	100	100	100	100	100	100	100	100
HR+meter/customer	(1000Rp)	126	126	126	126	126	126	126	126
Transmission pipeline	(mil Rp)	814							
Distribution pipeline	(mil Rp)	1,878	1,603						
Total SP	(mil Rp)	165	387	222	0	0	0	0	0
Total HR+meter	(1000$)	88	207	119	0	0	0	0	0
	(mil Rp)	208	488	280	0	0	0	0	0
A governor	(1000$)	51	0	0	0	0	0	0	0
	(mil Rp)	119	0	0	0	0	0	0	0
B governor	(1000$)	50	100	50	0	0	0	0	0
	(mil Rp)	117	235	117	0	0	0	0	0
Total investment (PGN)	(mil Rp)	3,302	2,913	619	0	0	0	0	0
(Number of Workers)		1997	1998	1999	2000	2005	2010	2015	2020
Administrative staff (except safety)	(persons)	1	1	1	1	1	1	1	1
Administrative workers (except safety)	(persons)	0	0	0	0	0	0	0	0
Administrative staff (for safety)	(persons)	0	0	0	0	0	0	0	0
Administrative workers (for safety)	(persons)	0	0	0	0	0	0	0	0
Sales	(persons)	5	3	1	1	1	1	1	0
Meter reading	(persons)	1	3	4	4	3	2	2	1
Collecting	(persons)	2	5	7	6	5	3	3	2
Low pressure (safety)	(persons)	4	9	8	8	5	4	2	2
Meter administration	(persons)	2	2	2	2	2	2	2	2
Total	(persons)	15	23	23	22	17	13	11	8

Sources:JICA team, Appendices O

18.5.2 Results of Projections-Bekasi

The next tables are the summary of case 5 of Bekasi feasibility study. First cash flow is for separate utility, the second is economic analysis, and the third is for PGN. Detailed analyses for each case are in Appendices O.

Table 18-5-2 Results for Case 5

(Financial Feasibility Analysis)

		1997	1998	1999	2000	2005	2010	2015	2020
Gas sales	(mil Rp)	109	922	1,943	2,133	2,188	2,271	2,342	2,409
Gas material cost	(mil Rp)	45	380	802	880	902	937	966	994
Gross profit	(mil Rp)	64	541	1,142	1,253	1,285	1,334	1,376	1,415
Property tax	(mil Rp)	2	4	4	4	2	1	1	0
Labor cost	(mil Rp)	149	179	188	179	159	129	129	100
Administrative expenses	(mil Rp)	45	54	57	54	48	39	39	30
Maintenance & other expenses	(mil Rp)	47	106	118	118	118	118	118	118
Total investment	(mil Rp)	2,368	2,913	619	0	0	0	0	0
Before tax cash flow	(mil Rp)	-2,548	-2,713	155	899	959	1,047	1,089	1,167
IRR of before tax cash flow		15%							
NPV as of 10%	(mil Rp)	1,971							
NPV as of 15%	(mil Rp)	-138							

(Social Benefit & Loss Analyses of Bekasi Project)

		1997	1998	1999	2000	2005	2010	2015	2020
Social benefit for residential customers	(Rp/m3)	800	800	800	800	800	800	800	800
Total social benefit from gas sales	(mil Rp)	109	922	1,943	2,133	2,188	2,271	2,342	2,409
Social loss for gas supplied	(Rp/m3)	167	167	167	167	186	217	242	267
Total social loss from gas supplied	(mil Rp)	23	192	406	445	509	616	709	804
Gross social benefit	(mil Rp)	86	729	1,538	1,687	1,679	1,655	1,634	1,605
Total investment	(mil Rp)	3,302	2,913	619	0	0	0	0	0
LPG bottle repurchase	(mil Rp)	330	774	444	0	0	0	0	0
In house pipeline installation	(mil Rp)	660	1,548	888	0	0	0	0	0
Imported facilites (included)	(mil Rp)	444	723	397	0	0	0	0	0
Imported tax	(mil Rp)	0	0	0	0	0	0	0	0
Net social loss for facilities	(mil Rp)	3,632	3,687	1,063	0	0	0	0	0
Labor cost	(mil Rp)	214	325	318	308	240	194	162	132
Income tax (included)	(mil Rp)	23	34	33	32	26	21	18	15
Administrative expenses	(mil Rp)	64	97	95	93	72	58	49	40
Maintenance & other expenses	(mil Rp)	66	124	137	137	137	137	137	137
Value tax (included)	(mil Rp)	13	22	23	23	21	19	19	18
Net social benefit	(mil Rp)	-3,853	-3,448	-19	1,205	1,277	1,306	1,324	1,329
EIRR		13%							
NPV as of 10%	(mil Rp)	1,917							
NPV as of 15%	(mil Rp)	-715							

(Financial feasibility of PGN in Separate Utility Case)

		1997	1998	1999	2000	2005	2010	2015	2020
Gas sales	(mil Rp)	45	380	802	880	902	937	966	994
Gas material cost	(Rp/m3)	162	168	174	183	212	230	252	277
Gas material cost	(mil Rp)	22	193	424	487	579	654	738	834
Gross profit	(mil Rp)	23	187	378	393	323	282	228	160
Property tax	(mil Rp)	1	1	1	1	0	0	0	0
Labor cost	(mil Rp)	65	146	130	130	81	65	32	32
Administrative expenses	(mil Rp)	19	44	39	39	24	19	10	10
Maintenance & other expenses	(mil Rp)	19	19	19	19	19	19	19	19
Investment	(mil Rp)	933	0	0	0	0	0	0	0
Net cash flow	(mil Rp)	-1,014	-22	190	205	199	179	167	99
IRR of the cash flow		15%							
NPV as of 10%	(mil Rp)	403							
NPV as of 15%	(mil Rp)	9							

Sources:JICA team, Appendices O

The next tables shows FIRR, NPV as of 10% discount rate, and NPV as of 15% discount rate for each case. In case 5, results are for the separate utility. Downside contingency when sales volume decreases by 2% and investment costs rise by 10% has been done. Cases when in house pipeline installation cost would be paid by the gas utilities have also been done. Results of economic analyses are shown at the bottom of the table.

Consecutively we show financial feasibility of PGN in case 5, and equity return for separate utility when we consider financing of the separate utility.

Table 18-5-3 Results of Projections-Bekasi

(%,mil Rp)

	Case 1	Case 2	Case 3	Case 4	Case 5
FIRR	-------------	7.3%	-------------	13.6%	14.5%
NPV(10%)	-------------	-1,722	-------------	1,489	1,971
NPV(15%)	-------------	-3,383	-------------	-376	-138
(Downside contingency)					
FIRR	-------------	6.1%	-------------	12.2%	12.4%
NPV(10%)	-------------	-2,586	-------------	945	1,134
NPV(15%)	-------------	-4,108	-------------	-801	-829
(Analysis with in house pipeline installation)					
FIRR	-------------	5.7%	-------------	10.4%	11.4%
NPV(10%)	-------------	-2,995	-------------	216	698
NPV(15%)	-------------	-4,548	-------------	-1,540	-1,302
(Downside contingency with in house pipeline installation)					
FIRR	-------------	4.7%	-------------	9.4%	9.7%
NPV(10%)	-------------	-3,859	-------------	-329	-140
NPV(15%)	-------------	-5,272	-------------	-1,965	-1,993
(Economic Analysis)					
EIRR	11.4%	11.4%	11.4%	11.4%	13.3%
NSB(10%)	832	832	832	832	1,917
NSB(15%)	-1,513	-1,513	-1,513	-1,513	-715

[Financial Feasibility of PGN, in Case 5]

Assumptions:PGN will invest only in transmission pipeline to Bekasi

PGN will supply gas to separate utility at 330 Rp/m3

PGN will be in charge of safety maintenance of pipelines but will not be paid for their labor cost

Financial feasibility for PGN can be considered with FIRR. Investment for PGN here is marginal, so that we do not suppose any financing restrictions for PGN in this case.

Results:

FIRR=15.2%

NPV(10%)=403

NPV(15%)=9

[Equity Return of Separate Utility]

Assumptions:Total equity invested 2,000 mil Rp
Total equity invested /Total facility investment=33.9%
Interest rate for cash deposits=5%
Interest rate for long term and short term debt=10%

Results:
IRR of equity=12.4%

(Source:JICA Team, Appendices O, Bekasi)

18.5.3 Assessment

In case 1 and case 3, annual cash flows are all minus, so that it does not make sense to see NPV of the project actually. In such a case as Bekasi, where demand is solely residential, it would be impossible to make the project feasible if utility entity could not raise its sales price to customers.

In case 2, PGN would still be not financially feasible even though we are seeing this financial projection in 20 years term.

In case 4, PGN would be financially feasible. It would be the only realistic case in financial sense except case 5.

In case 5, separate utility and PGN are both financially feasible. PGN's financial feasibility would depend on labor efficiency of safety maintenance of the distribution pipelines. To give PGN incentive to keep safety level of distribution pipelines, it would be realistic separate utility would pay for labor cost of PGN. To make it possible for separate utility, PGN will need lower price of gas to supply for separate utility which is set at 330 Rp/m3 in this projection.

Economic analysis is showing this project is economically feasible at 10% discount rate level but not feasible at 15% discount rate level. This might indicate in such area like Bekasi, Governmental support is rather reasonable. Governmental might be expected to support to invest in distribution pipelines as an infrastructure if economic feasibility would further become worse. In case 5 economic feasibility is slightly better than other cases. It is because labor costs per worker or staff of separate utility are set lower than that of PGN.

Equity investment would bear 12.4% IRR with the investment of 2000 mil Rp, which is 33.4% of total facility investment.

In residential area, urban gas may accelerate occupancy rate to increase. Then there would be synergy effect for the developer of the residential area to invest in urban gas equity.

Chapter 19

Feasibility Study - BSD
(Bumi Serpong Damai)

19. Feasibility Study--BSD (Bumi Serpong Damai)

19.1. Area Background

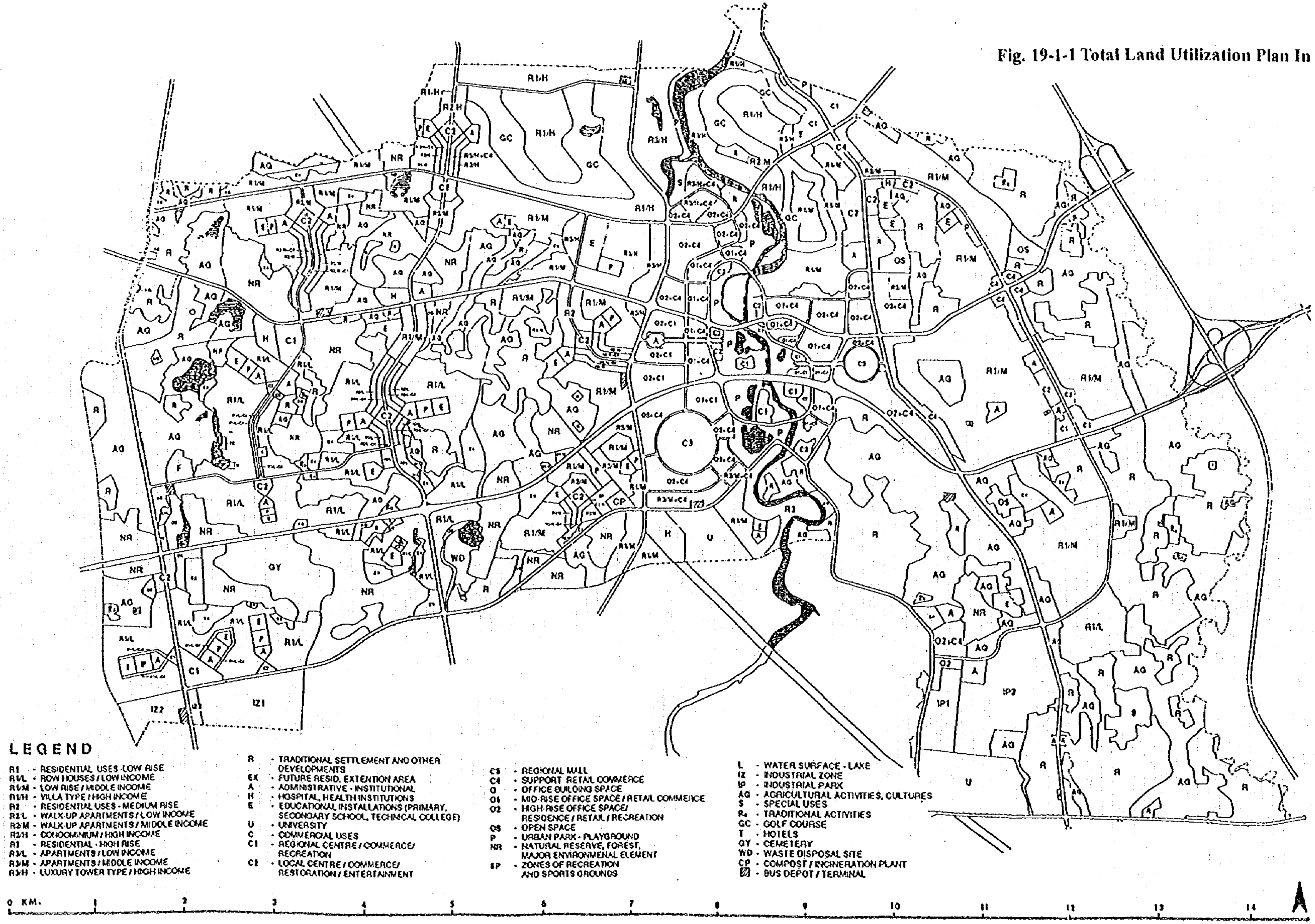
BSD (Bumi Serpong Damai) is the area where land improvement of approximately 6,000 ha is currently being promoted by PT. BSD (land developing company) in accordance with its Master Plan for general utilization of land in the west part of Jakarta and the south part of Tangerang. This Master Plan includes construction of residences amounting to approximately 123 thousand houses, commercial facilities, office buildings, a university, hospitals, hotels, high technology industrial zone, etc.
Foreseeing the city function of Jakarta currently coming to saturation, PT. BSD plans to establish the head offices of business, which do not need routine information exchange with the governmental authorities in Jakarta, into this area.

According to the Master Plan, PT. BSD has already completed necessary preparations for construction of schools for German and Japanese children into/near this area for the promotion of foreigners' residences in this area. Since the startup of land improvement for housing lots, PT. BSD has promoted up to now the construction of main traffic roads, housing lots, buildings, small-scale commercial facilities, etc. in the area. As a result, it is forecast that the population and residences as of the end of January 1997 will have reached 25,000 persons and 11,553 households receptively. Thus, residences will reach a certain extent of scale and, therefore, construction of facilities such as expressways, a double-lane railway, large-scale commercial facilities, hotels, medium-storied office buildings, etc. will be started in the medium-period plan. Along this medium-period plan, hospital, etc. are already under construction. To expand city gas as an energy source for air conditioning in office buildings, and other commercial facilities, it is necessary to clarify the feasibility of supplying city gas in the phase of commencing the basic design of buildings structures. In this view, we believe this feasibility study has been well-time.

19.1.1 Area Layout

Fig.19-1-1 shows BSD's total land utilization plan. As shown, the area is further divided into two areas by Ci Sadane River along the east side of the central part of the area. Taking into consideration this topographic feature, the development schedule in the master plan is divided into first period and second period schedules respectively by each divided area. And it is planned that the center of the office and commercial zone will be situated along Ci Sadane River and furthermore houses for high- and low-income families will be laid out from the north to the south of the area whole.

Fig. 19-1-1 Total Land Utilization Plan In BSD



Source: Final Master Plan Report for Bumi Serpong Damai New City by PT BSD

19.1.2. Prediction of Population and Household/Buildings in the Area

Construction of housing lots was started in 1989. Table 19-1-1 shows the population and number of residences planned in the future.

Table 19-1-1 Estimated Population in the BSD Acquired Area

	1995	2000	2005	2010	2015
BSD Acquired Area Housing Unit ※	10.7	27.5	55.0	95.0	123.0
Average Family Size in BSD Acquired Area	4.8	4.5	4.2	4.0	4.0
BSD Acquired Area Population ※	46.2	123.7	231.0	380.0	492.0

Source: Master Plan of PT.BSD ※unit thousand

19.1.3. Scope of the Feasibility Study

(1) Area

The first-period work zone under the BSD Master Plan has been defined as the zone of this feasibility study. In detail, this zone will be the development coverage zone of PT. BSD situated at the east side of Ci Sadane River, that is, at the north side of the Serpong-Jakarta railway.
Further, even within this area our zone includes only quarters where construction projects are estimated to be completed by 2010, and other quarters are considered out of the scope of this feasibility study unless they have a great effect on the design of city gas supply network.

2) Demand for Urban Gas

Energy for home use, air conditioning energy for commercial facilities and offices, and boiler fuel for hotel and hospitals were considered as the field of city gas demand and CNG fuel for natural gas vehicles was excluded from the said fields. In addition, the demand of city gas under the IPP Plan which is currently under study to supply electric power into the BSD zone was also excluded from the coverage of this feasibility study.

19.2 Estimated Demand for Urban Gas

19.2.1 Residential Gas Demand Projection

The demand projection in BSD is defined on 18 blocks as divided by the Team, excluding other blocks where the development plan is unknown. We counted the number of potential houses in 11 blocks of those 18, for which we got detail maps showing the area per house. At the same time, the number of households in remaining 7 blocks will be calculated by using the specific number of households per block area for each of high-, middle- and low-income housing sites.

The residential gas demand projection was made by multiplying the number of residences estimated from the above method by specific consumption volume of urban gas for residential use, e.g., high income: 594m3/y, middle income: 394m3/y and low income: 312m3/y. The result is shown in the Table below:

Table 19-2-1 Residential Gas Demand Projection

Area No.	Area(m^2)	Income Level	No. of Household	Gas Demand	No/are
1	128,310	High	216	128,400	16.83
2	2,335,778	Inc.Golf Cou	323	192,000	1.38
3	431,239	High	770	457,700	17.86
4	85,520	High	212	126,000	24.79
5	241,736	High	434	258,000	17.95
6	219,749	Middle	464	182,600	21.11
7	311,608	Middle	615	242,100	19.74
8	223,440	Middle	565	222,400	25.29
9	396,306	High	319	189,600	8.05
10	93,258	Middle	312	122,800	33.46
11	331,085	Middle	824	324,400	24.89
12	411,507	Middle	1,024	403,200	24.89
13	91,239	Middle	227	89,400	24.89
14	213,983	Low	1,123	350,100	52.46
15	398,552	Low	2,091	652,000	52.46
16	506,112	Middle	1,260	495,900	24.89
17	77,581	Low	407	153,000	52.46
18	268,012	Low	1,406	438,500	52.46
Total	6,765,015		12,591	5,028,100	

Source: PT.BSD

Note ; Dark parts are the data from PT.BSD and clear parts are figures which we calculated or estimated.

19.2 Estimated Demand for Urban Gas

19.2.1 Residential Gas Demand Projection

The demand projection in BSD is defined on 18 blocks as divided by the Team, excluding other blocks where the development plan is unknown. We counted the number of potential houses in 11 blocks of those 18, for which we got detail maps showing the area per house. At the same time, the number of households in remaining 7 blocks will be calculated by using the specific number of households per block area for each of high-, middle- and low-income housing sites.

The residential gas demand projection was made by multiplying the number of residences estimated from the above method by specific consumption volume of urban gas for residential use, e.g., high income: 594m3/y, middle income: 394m3/y and low income: 312m3/y. The result is shown in the Table below:

Table 19-2-1 Residential Gas Demand Projection

Area No	Area(m^2)	Income Level	No. of Household	Gas Demand	No/are
1	128,310	High	216	128,400	16.83
2	2,335,778	Inc.Golf Cou	323	192,000	1.38
3	431,239	High	770	457,700	17.86
4	85,520	High	212	126,000	24.79
5	241,736	High	434	258,000	17.95
6	219,749	Middle	464	182,600	21.11
7	311,608	Middle	615	242,100	19.74
8	223,440	Middle	565	222,400	25.29
9	396,306	High	319	189,600	8.05
10	93,258	Middle	312	122,800	33.46
11	331,085	Middle	824	324,400	24.89
12	411,507	Middle	1,024	403,200	24.89
13	91,239	Middle	227	89,400	24.89
14	213,983	Low	1,123	350,100	52.46
15	398,552	Low	2,091	652,000	52.46
16	506,112	Middle	1,260	495,900	24.89
17	77,581	Low	407	153,000	52.46
18	268,012	Low	1,406	438,500	52.46
Total	6,765,015		12,591	5,028,100	

Source: PT BSD

Note : Dark parts are the data from PT.BSD and clear parts are figures which we calculated or estimated

19.2.2 Commercial Gas Demand Projection

The plot size is calculated from BCD's Master Plan Map and the total floor area is determined using the maximum floor area ratio.

We got the list of maximum plot coverage and maximum floor area ratio in the commercial area, shown below:

Table 19-2-2 Plot Coverage and Floor Area Ratio

		M.P.C. (%)	M.F.A.R.
C1	Shopping (Regional Center)	90	1.5
C2	shopping (Local Center)	80	1.0
C3	Shopping (Regional Mall)	70	2.5
C4	Shopping (Support Retail commerce)	80	1.8
O1	Office (High-Rise)	90	4.0
O2	Office (Mid-Rise)	70	2.0
T	Hotel	40	2.5
H	Hospital	40	2.5
A	Administrative, Institutional	30	1.0

Source: PT. BSD

Note M.P.C. Maximum plot coverage
M.F.A.R. Maximum floor area ratio

Total floor area is determined by the formula (plot area) x (maximum floor area ratio) x 0.8 x 0.8, considering that the actual floor area ratio in the applicable area is around 80% of the permissible upper limit value (according to staff of PT.BSD) and assuming that effective plot area is reduced by around 20% for road space because the current plots are further divided for building construction.

The marketable gas demand was calculated based on the unit energy consumption by type of business by kind of gas usage and each gas penetration rate as prescribed in Chapter 9.

The results are shown in Appendices in detail and Table 19-2-3 below shows the obtained major numerical values.

Table 19-2-3 Commercial Gas Demand Projection

	Floor area	Cooking		Boiler			Air conditioning			Total gas sale:
	m2	m3/h	m3/y	Ton	m3/h	m3/y	RT	m3/h	m3/y	m3/y
Office	1,947,200	2,921	2,920,800	0	0	0	26,517	9,095	18,281,621	21,202,421
Hotel	48,000	166	165,600	5.7	431	649,947	1,218	418	1,299,700	2,115,247
Hospital	16,000	23	23,010	1.2	88	70,848	206	71	220,286	314,174
Shopping	1,229,440	3,799	3,798,970	0	0	0	35,912	12,318	38,624,092	42,423,061
Total	3,240,640	6,908	6,908,410	6.9	519.2	720,794.6	63,854.1	21,901.9	58,425,699	66,054,904

Source: JICA Team

19.2.3 Total Gas Demand Projection

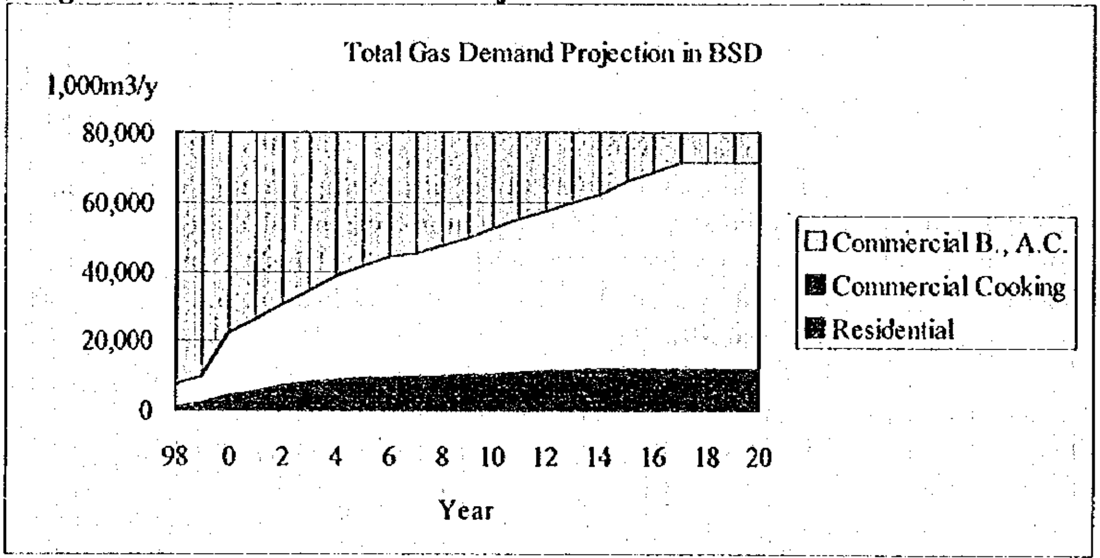
The total gas demand projection in BSD is summarized in chronological order based on information about the construction schedule obtained from PT. BSD, and is shown below:

Table 19-2-4 Total Demand Projection in BSD

Gas Market Developme		Year	1998	2000	2005	2010	2015	2020
	Residential		126,000	1,121,550	96,000	0	0	0
	Commercial	Cooking	921,475	1,384,531	305,405	401,674	113,453	0
		Boiler & A.C	6,747,121	10,305,008	2,572,326	2,695,734	3,425,588	0
	Total	m3/y	7,794,596	12,811,090	2,973,731	3,097,408	3,539,041	0
Cumulative Gas Deman		Year	1998	2000	2005	2010	2015	2020
	Residential		126,000	1,800,050	4,932,100	5,028,100	5,028,100	5,028,100
	Commercial	Cooking	921,475	2,670,298	4,273,115	5,560,629	6,908,411	6,908,411
		Boiler & A.C	6,747,121	17,976,554	32,336,566	41,832,709	53,678,016	59,086,595
	Total	m3/y	7,794,596	22,446,902	41,541,781	52,421,438	65,614,527	71,023,106

Source: JICA Team

Fig. 19-2-1 Total Gas Demand Projection in BSD



Source: JICA Team

19.3 District Cooling Business

19.3.1 Applicable Area

The key to success in a district cooling business is whether the thermal energy load density is high enough or not, and a commercial area with a high load density may be considered as a potential cooling business area. In this view, we consider the feasibility of this business in the 2nd business zone which is composed of medium- and high-storied buildings as shown in Fig. 19-3-1.

19.3.2 Projection of Energy Load

The energy load in the 2nd business zone can be summarized as follows from the energy load list of each block obtained in Section 19.2:

Table 19-3-1 Composition of Cooling Load

Type of Business	Floor Area 1,000m2	Capacity of Air Conditioner		
		Centralized RT	Decentralized RT	Total RT
Office	1,881	30,000	33,500	63,500
Shopping	405	11,000	3,500	14,500
Total	2,286	41,000	37,000	78,000

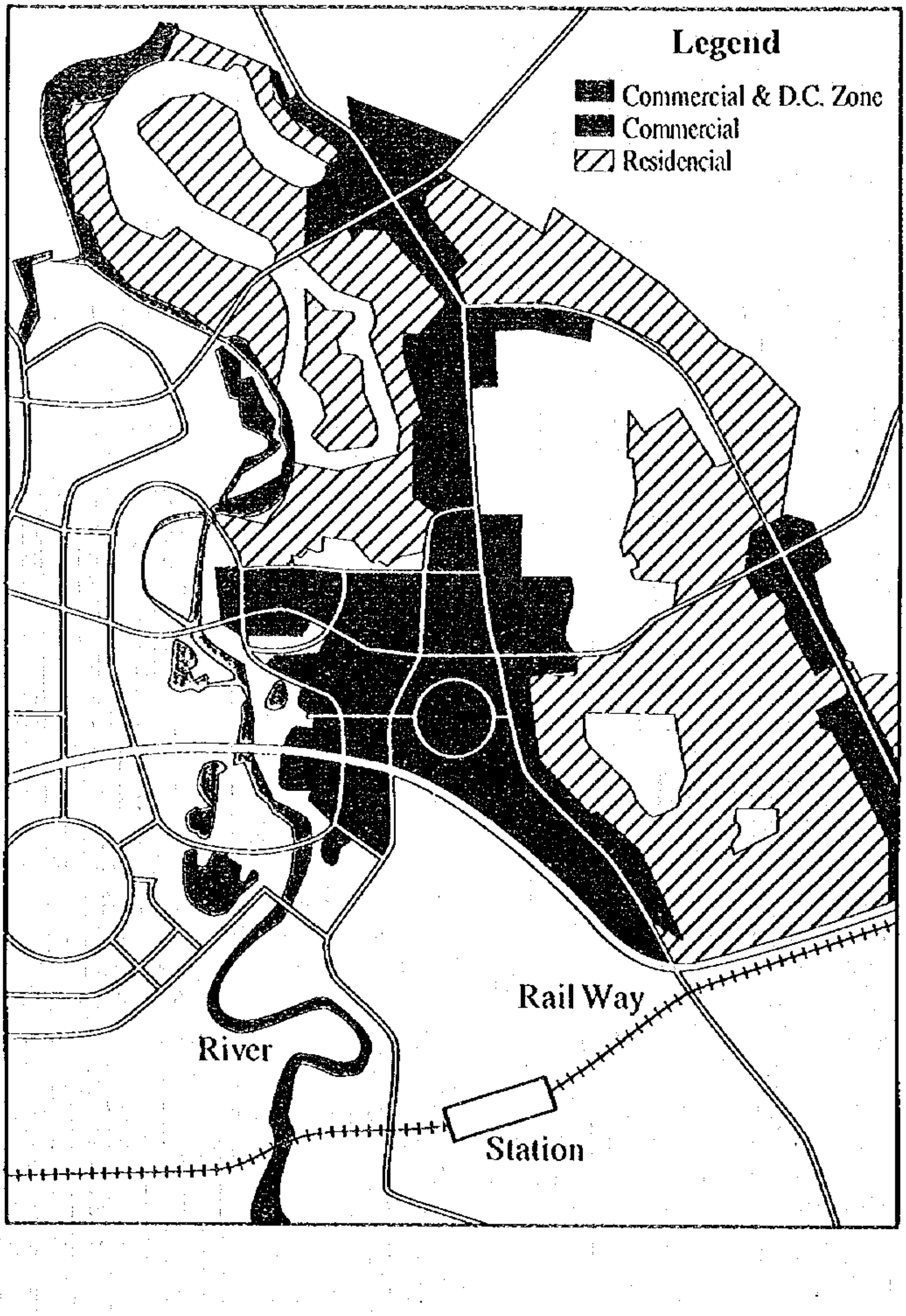
Source: JICA Team

The forecast integrated cooling load in the applicable area is approximately 63,000RT in office buildings and 14,000RT in shopping centers, approximately 78,000RT in total.

19.3.3 Cases to Be Studied

The feasibility of a district cooling business will be examined by economic comparison of introduction of "area cooling system using urban gas as energy source" with installation of air conditioners in individual buildings. The main purpose of energy consumption in the considered zone is air conditioning and power generation because the zone is mainly composed of office buildings and shopping buildings; in other words, hotels and hospitals are not located there. Therefore, the feasibility study will cover the systems which combine gas air conditioning, electric air conditioning and co-generation. Further, regarding a district cooling system, the feasibility study will cover two systems; conventional cooling systems and new co-generation systems. The conventional cooling system, that is, gas direct firing absorption chillers (the capacity of single unit :1,000 RT max), is not realistic due to the required capacity of approximately 80,000 RT. Due to this, we will assume a chilled water manufacturing system that uses " steam boiler + steam absorption type chiller (a little less than 10,000 RT per unit)".

Fig. 19-3-1 Scope of District Cooling Area



A co-generator will use a turbine of several ten thousand kW per unit as its driving force instead of an engine of several thousand kW which is at maximum capacity per unit.

Regarding independent systems, the feasibility study will cover two cases; one case where all buildings adopt electric air cooling system (the case where gas pipelines are not installed) and another case where the gas pipelines are already installed and gas absorption chillers and GHPs are introduced in the air conditioning market at the gas conversion rate analyzed in Chapter 9 as a case of maximum sales effort of PGN.

The table below shows the feasibility study cases.

Table 19-3-2 Cases to Be Studied

	District Cooling System				Independent Air Conditioning System			
	Case-A		Case-B		C-Case		D-Case	
	Conventional Type		Cogene Type		Gas/Elec. Air Con. Type		Elec. Air Con Type	
Office	Steam Abs.	82,000RT	Gas Turbine	40,000kW	Abs Chiller	25,500RT	Elec Chiller	30,000RT
	Boiler	394Ton/h	Steam Abs	82,000RT	GHP	0RT	EHP	33,500RT
			Boiler	334Ton/h				
					Elec.Chiller	4,500RT		
					EHP	33,500RT		
Shopping					Abs Chiller	10,500RT	Elec.Chiller	11,000RT
					GHP	1,500RT	EHP	3,500RT
					Elec.Chiller	500RT		
					EHP	2,000RT		

Source: JICA Team

Note

a. In a district cooling system, total cooling load in the zone is 78,000RT, but we increased this value by 5% up to 82,000RT considering heat radiation loss.

b. The generation capacity of co-generator is 40,000 kW based on approx. 0.5kW /RT for limited application to electric power required by the energy plant. (20,000 kW x 2 co-generators)

c. The steam absorption chiller is subject to COP= 1.2. Such a model as to consume steam of 4.8kg/RT was selected.

d. Gas turbine used for the co-generator is assumed at 25% of generation efficiency. In that case, 3kg/kWh of steam is recovered from combusted exhaust gas. Namely, steam of 60Ton/h x 2 units can be obtained. This means that boiler can fully cover the load by its capacity of 394Ton/h - 60tTon/h (1 set portion) =334Ton/h.

19.3.4 Study Method

The feasibility study judges the potentiality of the district cooling business, assuming that the thermal charge to customers is equal to total energy cost of "fuel cost + equipment depreciation + maintenance cost + personnel cost (operators) + machine room rental charge", and comparing to the independent cooling systems. If the total energy cost of independent systems is equal to the thermal charge, the district cooling business is considered acceptable, considering premium values such as convenience, stability, improvement of landscape, etc., due to thermal service from a district cooling enterprise which is difficult to quantitatively evaluate.

Further, sensitivity of business feasibility is analyzed considering the parameters of "demand fixation period" which greatly affect the success of a district cooling business. And we also analyzed business feasibility taking into account the premium values of district cooling systems as 1.1 or 1.2 times over independent systems. This assumes the higher thermal rate is accepted by customers.

19.3.5 Calculation of Initial Cost

Table below shows the calculated initial cost in each case:

Table 19-3-3 Comparison of Initial Costs (1,000 Rp)

	District Cooling System				Independent Air Conditioning System			
	Case-A		Case-B		Case-C		Case-D	
	Conventional Type		Cogene Type		Gas/Elec. Air Con. Type		Elec. Air Con Type	
Major Appliances	S.Abs	167,492	Power Gen.	34,893	Abs	137,170	Chiller	119,113
	Boiler	14,833	S.Abs	167,492	GHP	9,479	EHP	103,716
			Boiler	12,826	Chiller	14,527		
					EHP	109,908		
Piping, Wiring Pumps, C.T. etc.		204,254		220,697		143,825		174,761
District Piplines of Chilled Water		57,504		57,504		0		0
Total		444,083		493412		414909		397,590

Source: JICA Team

Note The energy plant is assumed to be installed in a big building paying rental fee in the central part of the area.
C.T : cooling tower
Engineering cost, civil works cost and insurance are included.

19.3.6 Calculation of Energy Cost

(1) Energy Load Pattern

The energy load can be calculated, as in Table 19-3-4, from the air conditioning load patterns obtained in Chapter 9, using the fundamentals to meet the equipment capacity in this cooling area.

Table 19-3-4 Energy Load Pattern

Type of business	Floor area	Cooling Load	Peak Load	Annual Full Rate Hours		Total Load
	m2	kcal/m2.h	Mcal/h	Power	Cooling	Gcal/y
Office	1,691,200	113.5	192,024	2,222.2	2,010.0	385,968
Shopping	406,000	108.0	43,848	2,625.0	3,136.0	137,507
Total			235,872			523,476

Source: JICA Team

(2) Specifications of Plant Facilities

The table below summarizes the main specification of each heat source unit. The required power of auxiliary equipment and water consumption in the table were based on the related experimental data in Japan.

Table 19-3-5 Specification of Main Appliances

	C.O.P. (L.H.V.)	Average Auxli. power(kW)	Consumption of water
Gas Turbine	0.250	0.050 kW/kW	0.000 m3/kW
Steam Abs Chiler	1.200	0.361 kW/RT	0.018 m3/RT
Gas Abs Chiller	1.111	0.361 kW/RT	0.019 m3/RT
Steam Boiler	0.900	4.312 kW/Ton	0.020 m3/Ton
Electric Chiller	4.000	0.300 kW/RT	0.013 m3/RT
GHP	0.967	0.152 kW/RT	0.000 m3/RT
EHP	3.000	0.152 kW/RT	0.000 m3/RT

Source: JICA Team

(3) Utility Charges

Power supply:
Calculation is made by application of charge class U-4/LV (For large-scale commercial use: capacity charge 5,180 Rp/kVA.M, usage charge Peak 240.5 Rp/kWh Off Peak 178.5 Rp/kWh) to independent air conditioning systems and application of charge class I-5/H (For large-scale industrial use: capacity charge 4,780 Rp/kVA.M, usage charge 109.5 Rp/kWh) to the district cooling systems.

Urban gas:
Application of charge class K1 (330 Rp/m3) to independent air conditioning systems, and application of charge class K2 (315Rp/m3) to district cooling systems.

City water:
Water consumption of 2,500m3/M minimum and charge 3,650 Rp/m3 is applied to both systems, based on the city water tariff in Tangerang.

(4) Other Given and Assumed Conditions for Calculation of Energy Cost

Maintenance cost:
The ratio of the maintenance cost to the equipment installation cost is assumed as 3% in district cooling systems and 4% in independent air conditioning systems. The difference of 1% between the systems comes from the economy of scale in the district cooling systems. Further, the cost incurred by chilled water pipeline work for district cooling system was excluded from the applicable equipment.

Personnel cost:
The district cooling system assumes 24 operators and one managerial person for the system control, subject to adoption of three-shift working system. On the other hand, the independent air conditioning system assumes arrangement of two operators per building from the forecast that approximately 70 buildings will be constructed within the area (from BSD Perth Model). Further, the personnel cost is assumed as 22,000K Rp/year for a manager and 14,000 K Rp/year for an operator.

Space rent:
Space cost is evaluated from conversion of the rent for a machinery room. The respective machine space areas for district cooling systems are calculated based on typical systems in Japan as of machinery area of 0.30m2/RT with co-generator and 0.28m2/RT without co-generator, assuming independent air conditioning systems to be 20% larger than that of district cooling systems. As regards the evaluated price of office space, 50,000*0.8*0.7=28,000 Rp/m2/month was adopted based on the price per m2 amounting to 50,000 Rp/m2/month in DKI, considering that BSD is located outside the central urban area (equivalent to 80% of the amount) and, in addition, assuming the price of machinery space (basement) to be equivalent to 70% of the said price because of its lower price than office spaces.

General expenses: Assuming 20,000 Rp/RT/year

Insurance premium: Assuming 0.2% of the investment amount for equipment

Depreciation: Equipment will depreciate at the rate of 10% of salvaged book value and a 15-year constant amount. In other words, annual depreciation of 6% will be applied for 15 years.

Table 19-3-6 Comparison of Energy Costs in Each Case

Source: JICA Team

			District Cooling System		Independent Air Conditioning System	
			Conventional	Co-generation	Gas/Elec Mix	Electricity
Heat Load	Cooling Load	RTh	173,107,000	173,107,000	173,107,000	173,107,000
	Transmission Loss	RTh	8,655,350	8,655,350		
	Total	RTh	181,762,350	181,762,350	173,107,000	173,107,000
Processed Energy	Steam Absorption	RTh	181,762,350	181,762,350		
	Gas Absorption	RTh			79,895,538	
	GHP	RTh			3,328,981	
	Electric Chiller	RTh			11,096,603	90,992,141
	EHP	RTh			78,785,878	82,114,859
	(Total Cooling Load)	RTh	181,762,350	181,762,350	173,107,000	173,107,000
	Gas Steam Boiler	Ton	760,613	458,929		
	Waste Heat Boiler	Ton		301,552		
	(Total Steam Amount)	Ton	760,613	760,481		
Power Load	Power for Auxil.	MWh	68,896	67,595	146,752	216,014
	Power for Transmission	MWh	20,357	20,357		
	Auxil. of Generator	MWh		4,628		
	Toral	MWh	89,253	92,581	146,752	216,014
Generated Elec.	Gas Turbine	MWh		92,566		
Demand of Cooling Medium	Steam Absorption	RT	82,000	82,000		
	Gas Absorption	RT			36,000	
	GHP	RT			1,500	
	Electric Chiler	RT			5,000	41,000
	EHP	RT			35,500	37,000
	Total Chilled Medium	RT	82,000	82,000	78,000	78,000
	Gas Boiler	Ton	343	216		
	West Heat Boiler	Ton		126		
	Total Steam	Ton	343	343		
Demand of Electricity	Power demand of Plant	kW	40,266		66,125	97,333
	Total	kW	40,266		66,125	97,333
Electric Charge	Elect. Demand	kVA	50,332		82,656	121,667
	Capacity Charge	Rp/kVA M	4,780		5,180	5,180
	Consumpt.of Elec (peak)	MWh	17,721		30,557	44,979
	Usage Charge(peak)	Rp/kWh	109.50		240.50	240.50
	Consump. of Elec (off peak)	MWh	71,532		116,195	171,035
	Usage Charge(off peak)	Rp/kWh	109.50		178.50	178.50
		@Rp/kWh	177		286	286
		KRp	12,660,288		33,227,626	48,909,968
Gas Charge	Consumption of Gas	Km3	61,098	78,778	28,700	
		@Rp/m³	315	315	330	
		KRp	20,190,730	24,815,225	9,470,910	
Water Charge	Consumption of Water	m3	3,374,180	3,374,178	1,670,049	1,146,501
		@Rp/m³	3,650		3,650	3,650
		KRp	12,315,759	12,315,749	6,095,679	4,184,729
Utility Cost		KRp	45,166,776	37,130,974	48,794,215	53,094,697
Investment Cost	Energy Plant	MMRp	386,579	435,908	414,909	397,590
	District Pipelines	MMRp	57,504	57,504		
	Total	MMRp	444,083	493,412	414,909	397,590
Maintenance	Ratio for Maint. Cost	%	3.0	3.0	4.0	4.0
		KRp	11,597,370	13,077,240	16,596,360	15,903,600
Personnel Cost	Mgr.	Persons	1	1	0	0
	Operator	Persons	24	24	140	140
	Wage(Mgr)	KRp/Man Y	22,000	22,000	22,000	22,000
	Wage(Operator)	KRp/Man Y	14,000	14,000	14,000	14,000
	Total	KRp	358,000	358,000	1,960,000	1,960,000
Rental Fee for Space	Floor Area	m2	22,960	24,600	28,080	28,080
	Rate	Rp/m2 Month	28,000	28,000	28,000	28,000
		KRp	7,714,560	8,265,600	9,434,880	9,434,880
Overhead	Admi. expences	KRp	1,640,000	1,640,000	1,560,000	1,560,000
	Insurance	KRp	773,158	871,816	829,818	795,180
	Total	KRp	2,413,158	2,511,816	2,389,818	2,355,180
Depreciation	Depreciation Rate	%	6.0	6.0	6.0	6.0
		KRp	26,644,980	29,604,720	24,894,540	23,855,400
Energy Cost		KRp	93,891,844	90,918,350	101,069,813	106,603,757
Energy Cost/Mcal					[illegible]	[illegible]

(5) Calculation of Energy Cost

The total energy cost relating to the district cooling operation in each case is calculated based on each step mentioned above. The initial cost is converted into depreciation expenses. Therefore, this energy cost can be the total evaluation of the district cooling operation cost.

(6) Analysis of Total Energy Cost

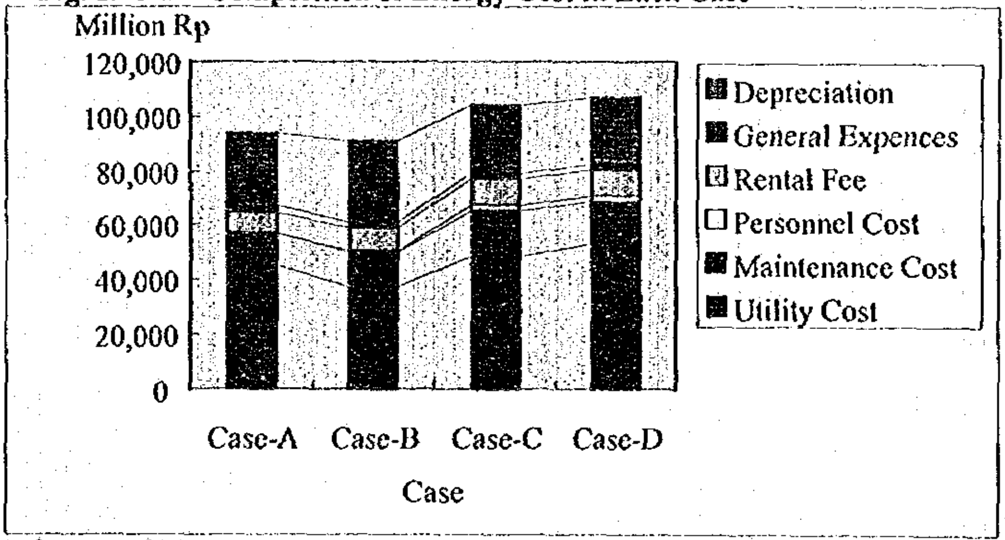
Table 19-3-7 summarizes the costs and expenses for each item from Table 19-3-6 and Fig. 19-3-2 shows them in graph form.

Table 19-3-7 Composition of Energy Cost by Case (Million Rp/Year)

	Case-A	Case-B	Case-C	Case-D
Utility Cost	45,167	37,131	48,794	53,095
Maintenance Cost	11,597	13,077	16,596	15,904
Personel Cost	358	358	1,960	1,960
Rental Fee for Spac	7,715	8,266	9,435	9,435
General Expences	2,413	2,512	2,390	2,355
Depreciation	26,645	29,605	24,895	23,855
Total	93,895	90,948	104,070	106,604

Source: JICA Team

Fig. 19-3-2 Composition of Energy Cost in Each Case



Source: JICA Team

As seen from the above table and figure, independent systems using electricity-gas mix air-conditioning are superior to those using 100 % electric air conditioning. Moreover, district cooling systems are even better. From this, it can be confirmed that the gas air-conditioning system is superior to the electric air conditioning system in the balance of initial cost to running cost, as prescribed in Chapter 9. Of course, it is a disadvantage to the district cooling system that it is subjected to installation of costly chilled water pipelines in the area and, in addition, it results in more radiation loss than independent systems, but the obtained data reveals that the economy of scale by intensification of energy processing overcomes the disadvantage. In other words, the district cooling system enables application of a lower tariff rate of gas and power consumption in a large scale facility, which then leads to broad reduction of running costs. In addition, this system enables energy required for air conditioning capacity in the entire area to be processed in a compact machinery room, in comparison to the total area required for installation of air conditioning machinery space in individual buildings. The evaluation of the floor area which was determined from relevant space rental charges reveals that space saving effect of the district cooling system greatly contributes to its economics. Furthermore, reduction of personnel cost by streamlined equipment control is an advantageous point of the district cooling system though the effect is relatively small.

Of available district cooling systems, those of co-generation type are superior to the conventional type in total energy costs. The effect of energy-saving by co-generation type is reflected to the economics.

19.3.7 Feasibility Evaluation of District Cooling Business

The comparative study of the total energy cost assures the superiority of district cooling systems in the foregoing sections. However, further study must be conducted as to whether the difference in cost is enough to motivate investors for the district cooling business.

In addition, the evaluation of total energy costs shown in the foregoing sections does not take into account the time factor. Usually land development progresses with steady growth of the area over a long period. Investment for the district cooling infrastructures such as construction of related plants and chilled water pipelines in the area takes place in the early stages of land development. Therefore, if a long period is needed for accumulation of thermal demand, the investment may not be recovered, meaning a failure of the business due to burden of interest payment and running costs.

The feasibility of the district cooling business in BSD is evaluated on the basis of the two points mentioned above.

(1) Preconditions and Assumptions for Evaluation of Business Feasibility

a. In Table 19-3-6, the total energy cost of the independent systems are 198.81 Rp/Mcal for a gas-electric mix air conditioning type and 203.65 Rp/Mcal for an electric air conditioning typ. We take 198.81 Rp/Macal as the competitive price for district cooling systems.

b. Regarding the effects of gas market building-up patterns, feasibility of the district cooling business is checked with four patterns: the pattern of 100%-completion of energy using buildings in the initial year and patterns of continuous development at a constant percentage 50%, 20% or 10% each year.

c. Pay back years and IRR are used as the evaluation index. The cash flow is before taxation.

(2) Calculation of the Feasibility of the District Cooling Business

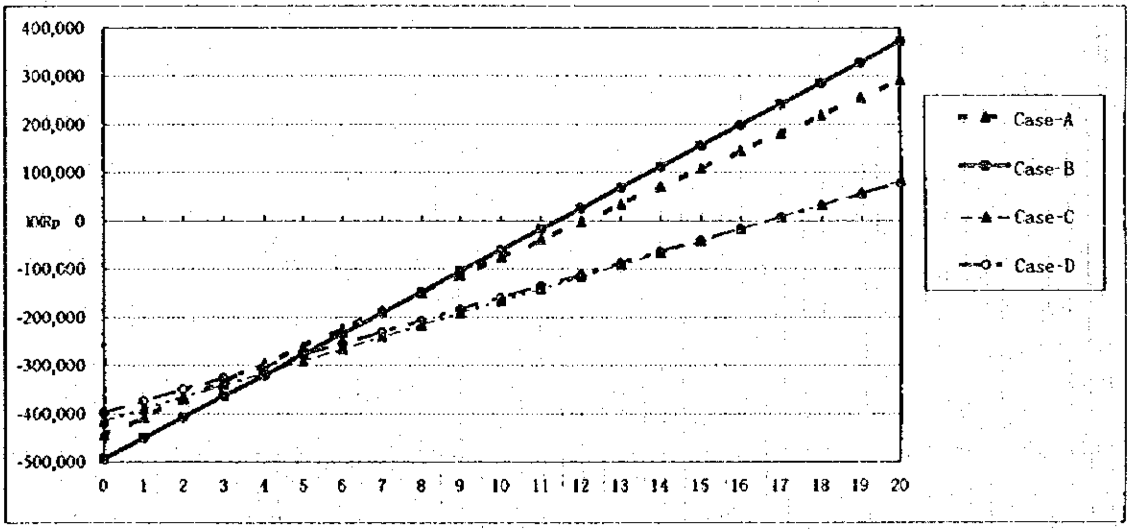
Table 19-3-8 100% Load Completion in the Initial Year

Cumulativ Cash Flow (MMRp)

IRR: 20 years

	IRR	0	1	2	3	4	5	6	7	8	9
Case-A	5.38%	-444,083	-407,289	-370,495	-333,701	-296,907	-260,113	-223,319	-186,525	-149,731	-112,937
Case-B	6.07%	-493,412	-450,153	-406,894	-363,635	-320,376	-277,117	-233,858	-190,599	-147,340	-104,081
Case-C	1.80%	-414,909	-390,016	-365,123	-340,230	-315,337	-290,444	-265,551	-240,658	-215,765	-190,872
Case-D	1.80%	-397,590	-373,737	-349,884	-326,031	-302,178	-278,325	-254,472	-230,619	-206,766	-182,913

	10	11	12	13	14	15	16	17	18	19	20
Case-A	-76,143	-39,349	-2,555	34,239	71,033	107,827	144,621	181,415	218,209	255,003	291,797
Case-B	-60,822	-17,563	25,696	68,955	112,214	155,473	198,732	241,991	285,250	328,509	371,768
Case-C	-165,979	-141,086	-116,193	-91,300	-66,407	-41,514	-16,621	8,272	33,165	58,058	82,951
Case-D	-159,060	-135,207	-111,354	-87,501	-63,648	-39,795	-15,942	7,911	31,764	55,617	79,470



Thermal Charge(Rp/Mcal)

	Thermal charge
Case-A	198.81
Case-B	198.81
Case-C	198.81
Case-D	203.70

Source: JICA Team

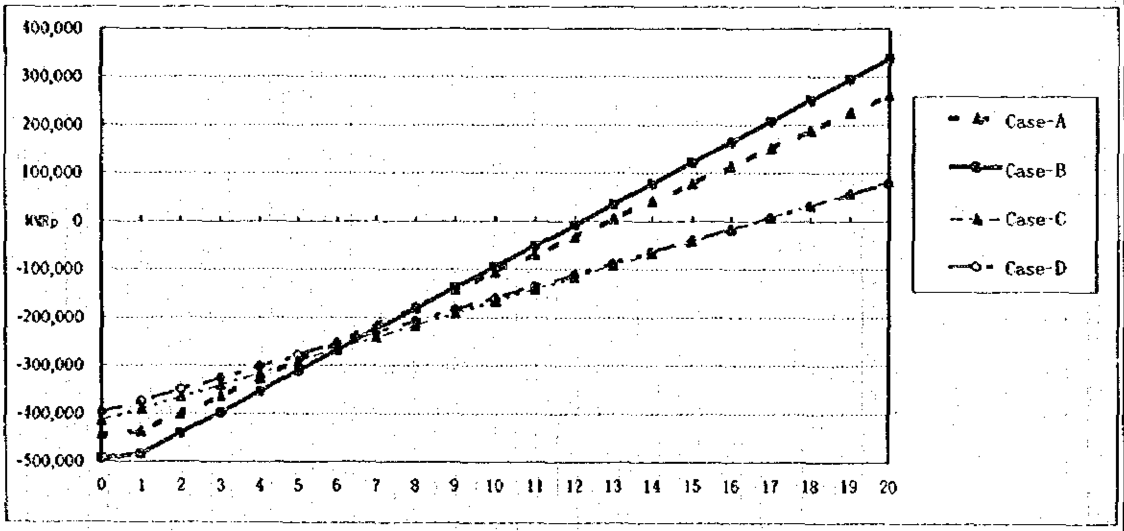
Table 19-3-9 Continuous Development at 50% a Year

Cumulativ Cash Flow (MMRp)

IRR: 20 years

	IRR	0	1	2	3	4	5	6	7	8	9
Case-A	4.66%	-444,083	-436,726	-399,932	-363,138	-326,344	-289,550	-252,756	-215,962	-179,168	-142,374
Case-B	5.30%	-493,412	-483,888	-440,629	-397,370	-354,111	-310,852	-267,593	-224,334	-181,075	-137,816
Case-C	1.80%	-414,909	-390,016	-365,123	-340,230	-315,337	-290,444	-265,551	-240,658	-215,765	-190,872
Case-D	1.80%	-397,590	-373,737	-349,884	-326,031	-302,178	-278,325	-254,472	-230,619	-206,766	-182,913

	10	11	12	13	14	15	16	17	18	19	20
Case-A	-105,580	-68,786	-31,992	4,802	41,596	78,390	115,184	151,978	188,772	225,566	262,360
Case-B	-94,557	-51,298	-8,039	35,220	78,479	121,738	164,997	208,256	251,515	294,774	338,033
Case-C	-165,979	-141,086	-116,193	-91,300	-66,407	-41,514	-16,621	8,272	33,165	58,058	82,951
Case-D	-159,060	-135,207	-111,354	-87,501	-63,648	-39,795	-15,942	7,911	31,764	55,617	79,470



Thermal Charge(Rp/Mcal)

	Thermal charge
Case-A	198.81
Case-B	198.81
Case-C	198.81
Case-D	203.70

Source: JICA Team

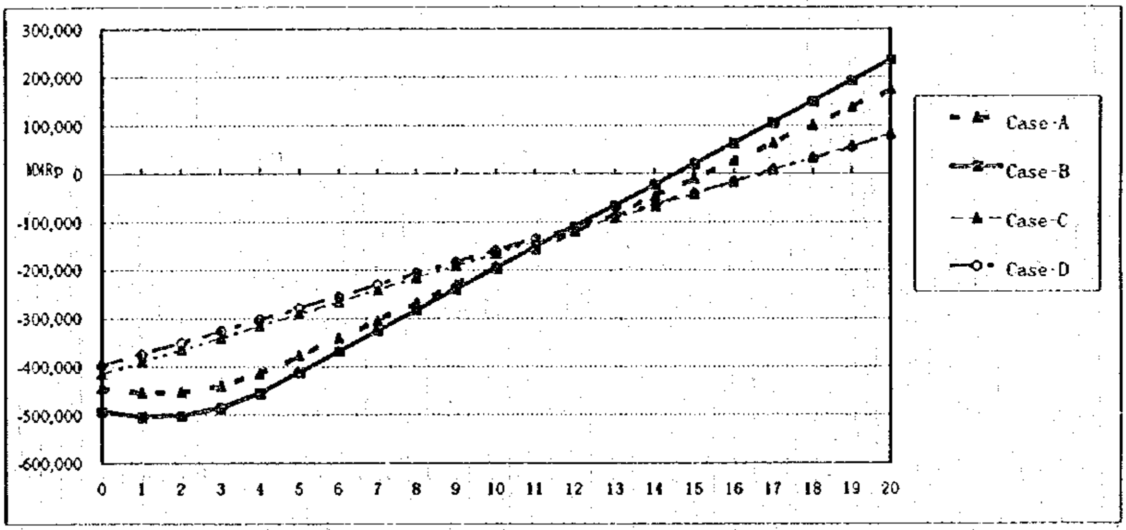
Table 19-3-10 Continuous Development at 20% a Year

Cumulativ Cash Flow (MMRp)

IRR: 20 years

	IRR	0	1	2	3	4	5	6	7	8	9
Case-A	2.84%	[illegible]	[illegible]	-452,951	-439,677	-414,638	-377,864	-341,070	-304,276	-267,482	-230,688
Case-B	3.41%	-492,432	-501,135	-501,354	[illegible]	-455,318	-412,059	-368,800	-325,541	-282,282	-239,023
Case-C	1.80%	-414,909	-390,016	-365,123	-340,230	-315,337	-290,444	-265,551	-240,658	-215,765	-190,872
Case-D	1.80%	-397,590	-373,737	-349,884	-326,031	-302,178	-278,325	-254,472	-230,619	-206,766	-182,913

	10	11	12	13	14	15	16	17	18	19	20
Case-A	[illegible]	-157,100	-120,306	-83,512	-46,718	-9,924	26,870	63,664	100,458	137,252	174,046
Case-B	-195,764	-152,505	-109,246	-65,987	-22,728	20,531	63,790	107,049	150,308	193,567	236,826
Case-C	-165,979	-141,086	-116,193	-91,300	-66,407	-41,514	-16,621	8,272	33,165	58,058	82,951
Case-D	-159,060	-135,207	-111,354	-87,501	-63,648	-39,795	-15,942	7,911	31,764	55,617	79,470



Thermal Charge(Rp/Mcal)

	Thermal charge
Case-A	198.81
Case-B	198.81
Case-C	198.81
Case-D	203.70

Source: JICA Team

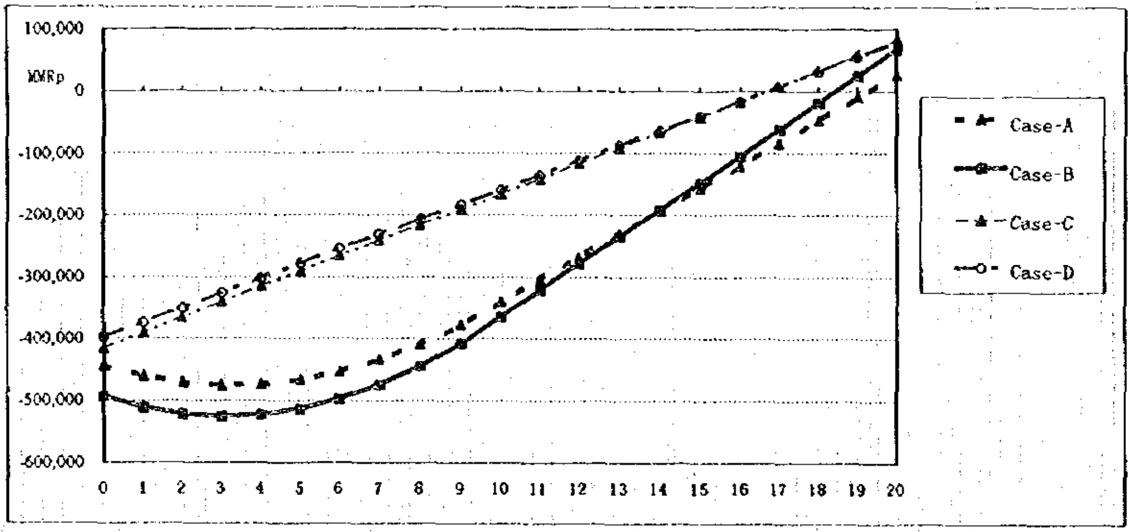
Table 19-3-11 Continuous Development at 10% a Year

Cumulativ Cash Flow (MMRp)

IRR 20 years

	IRR	0	1	2	3	4	5	6	7	8	9
Case-A	0.41%	-444,955	-460,278	-470,555	-475,036	-473,335	-466,118	-452,938	-435,833	-408,784	-377,877
Case-B	0.92%	-493,413	-510,873	-521,296	-525,567	-522,981	-513,267	-496,966	-471,978	-444,215	-402,701
Case-C	1.80%	-414,909	-390,016	-365,123	-340,230	-315,337	-290,444	-265,551	-240,658	-215,765	-190,872
Case-D	1.80%	-397,593	-373,737	-349,884	-326,031	-302,178	-278,325	-254,472	-230,619	-206,766	-182,913

	10	11	12	13	14	15	16	17	18	19	20
Case-A	-341,031	-305,259	-267,495	-230,301	-193,577	-157,113	-123,119	-83,525	-46,231	-9,937	26,857
Case-B	-353,442	-311,103	-277,925	-234,665	-191,605	-148,141	-104,888	-61,639	-18,376	24,889	68,148
Case-C	-165,979	-141,086	-116,193	-91,300	-66,407	-41,514	-16,621	8,272	33,165	58,058	82,951
Case-D	-159,060	-135,207	-111,354	-87,501	-63,648	-39,795	-15,942	7,911	31,764	55,617	79,470



Thermal Charge(Rp/Mcal)

	Thermal charge
Case-A	198.81
Case-B	198.81
Case-C	198.81
Case-D	203.70

Source: JICA Team

(3) Conclusions

As described in Section (2) we calculated the sensitivity in IRR by the difference in the thermal charges, and the results are compared below.

Table 19-3-12 IRR in Conventional District Cooling Business

Coeficient of Thermal Charge	Thermal Charge (Price)	Demand Build-up (year)			
	Rp/Mcal	1	2	5	10
1.00	198.81	5.38	4.66	2.84	0.41
1.10	218.69	8.58	7.63	5.39	2.61
1.20	238.57	11.50	10.31	7.62	4.48

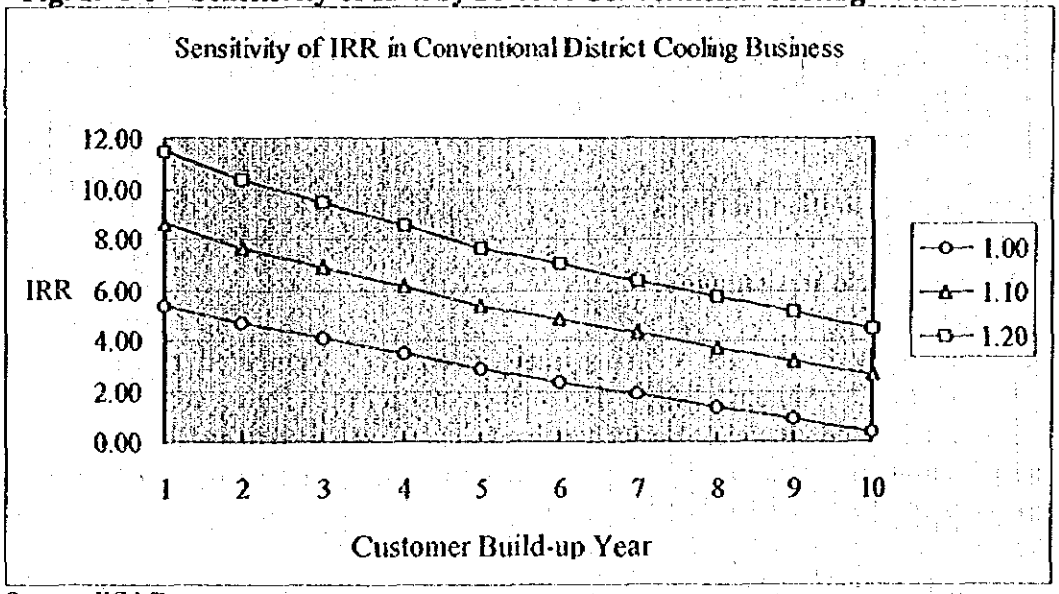
Source: JICA Team

Table 19-3-13 IRR in Co-generation Type District Cooling Business

Coeficient of Thermal Charge	Thermal Charge (Price)	Demand Build-up (year)			
	Rp/Mcal	1	2	5	10
1.00	198.81	6.07	5.30	3.41	0.92
1.10	218.69	8.90	7.93	5.65	2.84
1.20	238.57	11.52	10.33	7.64	4.51

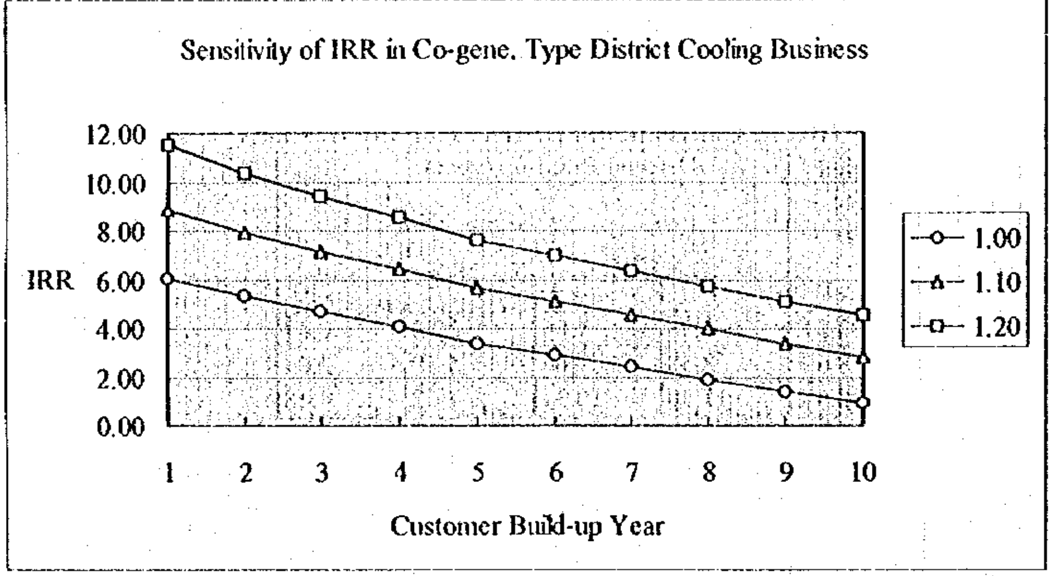
Source: JICA Team

Fig. 19-3-3 Sensitivity of IRR by Price in Conventional Cooling Business



Source: JICA Team

Fig. 19-3-4 Sensitivity of IRR by Price in Co-generation Type District Cooling Business



Source: JICA Team

From the above, district cooling is economically feasible with the IRR higher than 10% only in four cases that the market development is completed in only two years and thermal price of 20% higher level is charged to the customers.

Relatively, co-generation type is superior to conventional type due to the energy conservation effect on the economics. The district cooling business will be feasible with co-generation.

The district cooling business may not be feasible in other cases, but by reducing the construction, operation and personnel costs, and with higher levels of energy conservation, some cases may become feasible.

19.4 Proposed Distribution Network

19.4.1 Method of Grid Designing for BSD

The BSD feasibility study area contains more uncertainty compared to the Bekasi feasibility study area. Although BSD's development master plan shows area zoning such as residential use or commercial use, concrete site plans which indicate the location or structure of buildings are not available yet. Therefore, the Team tried to make a free-hand grid design.

The grid design of pipelines in the area is conducted in the following steps:

(1) Area zoning and load estimation
(2) Selection of roads where pipelines are necessary
(3) Measurement of pipe length and drawing of network diagram
(4) Pipeline load assignment
(5) Network analysis and decision of pipe diameter

We zoned the study area according to BSD's development master plan and obtained 18 commercial plots and 18 residential plots. The gas load of each plot was estimated using the plot area in case of commercial plots and the number of customers in case of residential plots. We confirmed the roads where pipelines are necessary from the map in BSD's development master plan and measured pipeline length. From this information, we drew the network diagram shown in Fig. 19-4-1. The gas demand of each plot was assigned to the nodes in the network diagram using the percentage shown in Table 19-4-1. In the network design, we assumed 80 % of each plot's load as the pipeline load because customers in BSD are in the residential and commercial sectors and the peak times of both sectors are different. While the total load in the area is more than 20,000 m^3/h, a 10 bar distribution system which conveys gas to the heavy demand area near plot C-13 and a 1 bar system which distributes gas to the residential districts are required. Since PGN's Serpong offtake station is located at the northern edge of BSD, a 10 bar pipeline will be extended from the station. We decided to install two regulators which reduce gas pressure from 10 bar to 1 bar at the northern part of the study area and the center of commercial plots. Using the data prepared, we conducted a network analysis in order to determine the most suitable pipe diameters which do not exceed the flow velocity of 20 m/sec. As for the distribution pipe to each customers in residential plots, we estimated the necessary length and diameter of pipeline using the results of Bekasi F/S area.

Fig. 19-4-1 Network Diagram for BSD F/S Area

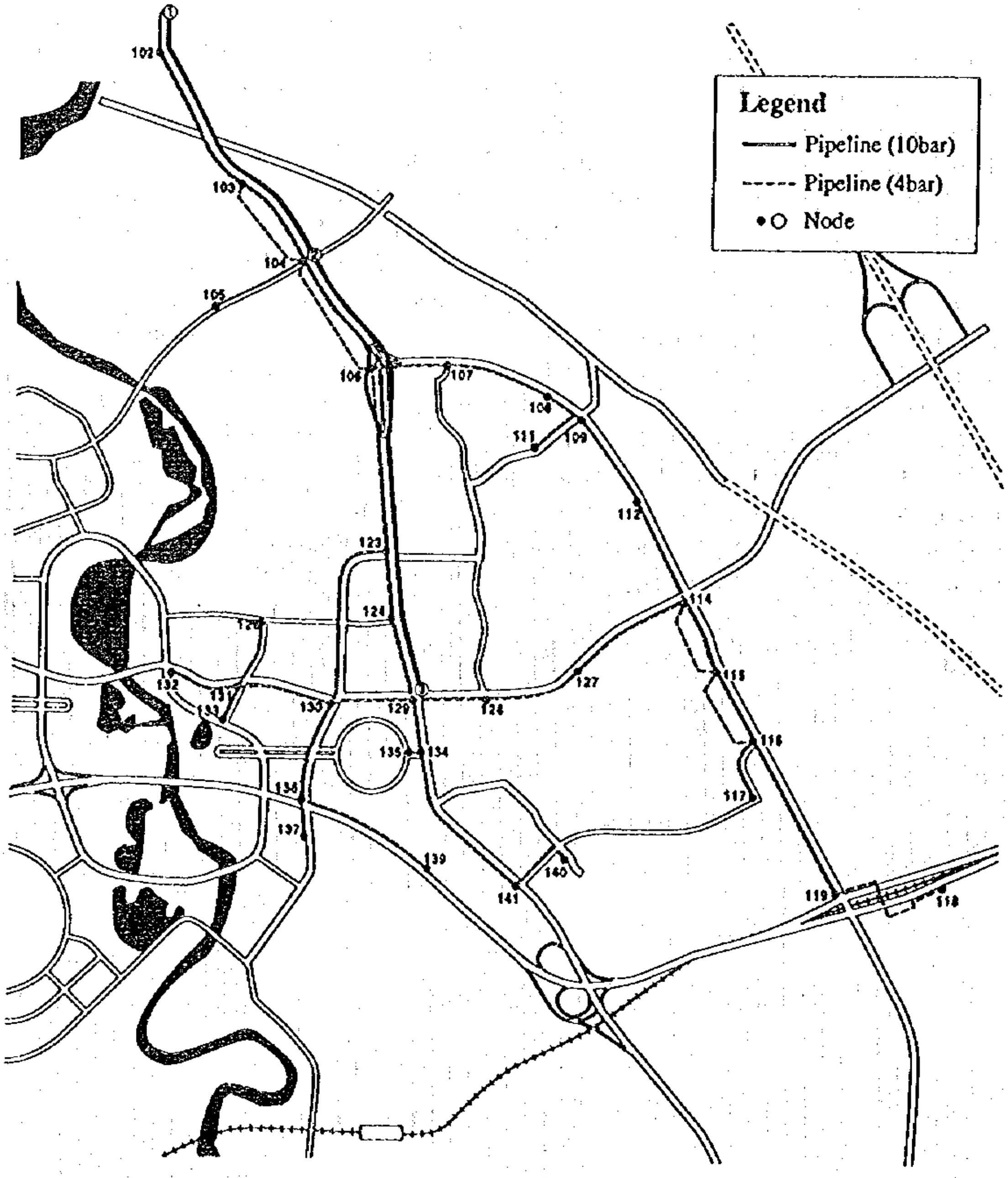


Table 19-4-1 Demand in Each Plot and its Assignment to Nodes

Plot No.	Demand (m^3/h)	Demand Assignment to Nodes									
		Node 1		Node 2		Node 3		Node 4		Node 5	
		No.	%	No.	%	No.	%	No.	%	No.	%
C-1	1,570	103	50%	104	50%						
C-2	2,100	103	50%	104	50%						
C-3	1,800	104	50%	106	50%						
C-4	800	106	33%	107	33%	121	33%				
C-5	1,200	121	100%								
C-6	2,100	114	50%	115	50%						
C-7	1,300	124	33%	129	33%	128	33%				
C-8	1,200	124	25%	129	25%	130	25%	125	25%		
C-9	800	125	25%	130	25%	131	25%	126	25%		
C-10	2,300	126	25%	131	25%	133	25%	132	25%		
C-11	500	128	34%	129	33%	134	33%				
C-12	2,600	130	25%	131	25%	133	25%	136	25%		
C-13	2,700	135	100%								
C-14	2,400	129	20%	130	20%	136	20%	139	20%	134	20%
C-15	1,100	116	70%	117	30%						
C-16	1,700	119	100%								
C-17	1,500	141	100%								
C-18	1,700	137	100%								
R-1	30	102	100%								
R-2	40	106	100%								
R-3	100	107	100%								
R-4	30	108	100%								
R-5	50	112	100%								
R-6	60	111	100%								
R-7	80	112	100%								
R-8	70	127	100%								
R-9	40	122	100%								
R-10	40	128	100%								
R-11	100	115	100%								
R-12	130	116	100%								
R-13	30	140	100%								
R-14	140	140	100%								
R-15	260	117	100%								
R-16	160	116	100%								
R-17	50	118	100%								
R-18	180	118	100%								

Source : JICA Team

19.4.2 Results of Designing

Since the development in BSD proceeding step by step, we made a pipeline extension plan which consists of 4 phases. Table 19-4-2 shows the diameter and length of each pipe and Table 19-4-3 shows the length and cost of pipeline necessary in each phase.

Table 19-4-2 Diameter and Length of Pipeline in F/S Area

No.	Left Node	Right Node	Diam. (mm)	Length (m)	Phase	No.	Left Node	Right Node	Diam. (mm)	Length (m)	Phase
1	1	2	250	1,600	1	25	116	117	150	400	2
2	2	3	200	2,500	2	26	116	119	150	750	2
3	12	104	300	50	1	27	118	119	100	800	2
4	13	129	300	50	2	28	121	122	150	350	3
5	13	129	300	50	4	29	122	123	150	350	1
6	102	103	63	850	1	30	123	124	150	150	2
7	103	104	125	400	1	31	123	125	150	550	2
8	103	104	125	400	1	32	124	129	150	450	4
9	104	106	150	550	1	33	125	130	150	400	2
10	104	105	150	600	1	34	126	131	150	350	4
11	104	106	150	550	1	35	127	128	250	500	4
12	106	121	150	450	1	36	128	129	250	400	2
13	106	107	150	450	1	37	129	130	300	450	2
14	107	108	150	550	3	38	129	134	250	350	4
15	108	109	150	300	3	39	130	131	250	500	2
16	109	111	63	300	3	40	130	136	200	550	4
17	109	112	150	500	3	41	131	132	150	500	4
18	112	114	150	600	3	42	131	133	150	300	4
19	114	127	250	750	2	43	134	135	200	150	4
20	114	115	200	500	2	44	134	141	150	900	2
21	114	115	150	500	2	45	136	137	150	250	4
22	115	116	200	400	2	46	136	139	150	750	4
23	115	116	150	400	2	47	140	141	63	250	4
24	116	119	200	750	2	Total				24,450	

Source : JICA Team

Table 19-4-2 Length and Cost of Pipeline Necessary in BSD F/S Area

(Length [km], Cost [million Rp-])

Classification	Material	Phase	I	II	III	IV	Total
Main Pipes to Plots	Steel	Length	4.6	9.4	2.8	5.6	22.3
		Cost	822	1,710	398	0	2,929
	P.E.	Length	1.7	0.0	0.3	0.3	2.2
		Cost	180	0	25	21	227
	Total	Length	6.3	9.4	3.1	5.8	24.5
		Cost	1,002	1,710	423	21	3,156
Distribution Pipes in Residential Plots	Steel	Length	0	0	0	0	0
		Cost	0	0	0	0	0
	P.E.	Length	22.8	0	128.4	0	151.2
		Cost	1,351	0	7,608	0	8,959
	Total	Length	22.8	0	128.4	0	151.2
		Cost	1,351	0	7,608	0	8,959
Total		Length	29.1	9.4	131.5	5.8	175.7
		Cost	2,353	1,710	8,031	21	12,115

Source : JICA Team

19.5 Gas Supply

The gas consumed in the BSD feasibility study area is directly supplied from PGN's Serpong Offtake Station as the station is located at the edge of the area. The availability of gas is checked in the Master Plan chapters and we assume no problem in the supply of gas to the area.

19.6 Economic and Financial Assessment-BSD

19.6.1 Assumptions

Assumptions in the financial projections of BSD are listed below:

(1) In the financial projections of BSD, we assume 5 pricing & business unit cases; each coinciding with that in the Master Plan (Chapter 14). We also conducted calculations for cases with downside contingency, in-house pipeline installations substantially paid by gas utility, etc.

(2) In Case 5, PGN is supposed to invest in pipelines up to the "A" regulator, whereas a separate utility invests in the portion from the main pipelines after the "A" regulator to service pipes through distribution pipelines and the "B" regulator.

(3) The labor cost of the separate utility is assumed as two thirds the current PGN level (without pension plan). Unlike the Bekasi case, we assume the same labor efficiency in BSD as in the Master Plan.

(4) The gas material price, i.e., the transfer or wholesale price, to the separate utility is set at 315 Rp/m3, which is the K2 price in PGN tariff table and is the same as in the Master Plan.

(5) Gas sales prices to end customers are set at the same level as in the Master Plan in each case.

(6) Commercial air-conditioning demand in BSD is projected assuming that the build-up of the commercial facilities will be 50% in ten years of the whole plan for a sensitivity analysis case.

The next table shows plans for BSD. (Air conditioning demand will be developed 100%. case 1 to 4) Detailed plans for each case are shown in Appendices O.

Table 19-6-1 Plans for BSD

(Gas Demand)

			1997	1998	1999	2000	2005	2010	2015	2020
Residential		(1000m3)	0	126	679	1,800	4,932	5,028	5,028	5,028
Commercial	(cooking)	(1000m3)	0	921	1,286	2,670	4,273	5,561	6,908	6,908
	(AC)	100% (1000m3)	0	6,747	7,672	17,977	32,337	41,833	53,678	59,087
Gas demand Total		(1000m3)	0	7,795	9,636	22,447	41,542	52,421	65,615	71,023
AC demand with 100% contingency		(1000m3)	0	6,747	7,672	17,977	32,337	41,833	53,678	59,087

(Number of Customers)

			1997	1998	1999	2000	2005	2010	2015	2020
Residential		(units)	0	212	1,142	4,017	12,431	12,592	12,592	12,592
Commercial	(cooking)	(units)	0	13	17	46	91	161	240	240
	(AC)	(units)	0	7	8	22	43	73	108	112
Gas demand Total		(units)	0	232	1,166	4,084	12,565	12,826	12,941	12,945

(Sales Volume per Customer)

			1997	1998	1999	2000	2005	2010	2015	2020
Residential		(1000m3)	0	0.59	0.59	0.45	0.40	0.40	0.40	0.40
Commercial	(cooking)	(1000m3)	0	69.62	76.24	57.54	47.06	34.52	28.73	28.73
	(AC)	(1000m3)	0	945.74	976.88	833.41	747.08	573.92	496.58	525.37
Gas demand Total		(1000m3)	0	33.54	8.26	5.50	3.31	4.09	5.07	5.49

(Investment Plan)

		1997	1998	1999	2000	2005	2010	2015	2020
Cumulative main pipeline length (10bar)	(km)	1.6	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Cumulative main pipeline length (1bar)	(km)	4.7	11.6	11.6	11.6	14.7	20.5	20.5	20.5
Cumulative distribution pipeline length	(km)	22.8	22.8	22.8	22.8	151.2	151.2	151.2	151.2
Cumulative offtaker	(units)	0	0	0	0	1	2	2	3
Cumulative A governor	(units)	1	1	1	1	2	2	2	2
Cumulative B governor	(units)	1	2	5	7	13	13	13	13
Total investment (PGN)	(mil Rp)	2,723	2,002	1,120	733	87	165	29	0

(Number of Workers)

		1997	1998	1999	2000	2005	2010	2015	2020
Administrative staff (Except Safety)	(persons)	1	2	4	5	4	2	1	1
Administrative workers (Except Safety)	(persons)	3	5	9	10	6	2	1	1
Administrative staff (for Safety)	(persons)	2	2	1	1	5	2	1	0
Administrative workers (for Safety)	(persons)	4	4	2	1	6	1	0	0
Sales	(persons)	1	4	9	7	1	1	1	0
Meter reading	(persons)		1	1	3	5	4	3	2
Collecting	(persons)		1	2	4	8	6	4	3
High-medium pressure (Safety)	(persons)	0	2	2	1	1	1	1	0
Low pressure (Safety)	(persons)	10	9	8	8	38	27	19	13
Meter administration	(persons)	1	2	7	10	13	9	7	1
Total	(persons)	22	32	45	50	87	55	38	21

Sources:JICA team, Appendices O

19.6.2. Results of Projections-BSD

The next tables are the summary of case 5 of BSD feasibility study. First cash flow is for separate utility, the second is economic analysis, and the third is for PGN. Detailed analyses for each case are in Appendices O.

Table 19-6-2 Financial Analyses and Economic Analyses

(Financial Feasibility Analysis)

		1997	1998	1999	2000	2005	2010	2015	2020
Gas sales	(mil Rp)	0	3,065	4,103	9,509	18,035	22,276	27,263	29,048
Gas material cost	(mil Rp)	0	2,455	3,035	7,071	13,086	16,513	20,669	22,372
Gross profit	(mil Rp)	0	609	1,068	2,438	4,950	5,763	6,594	6,676
Property tax	(mil Rp)	2	3	4	4	7	5	3	2
Labor cost	(mil Rp)	100	229	479	588	528	318	208	120
Administrative expenses	(mil Rp)	30	69	144	177	158	95	62	36
Maintenance & other expenses	(mil Rp)	48	78	101	116	320	355	367	368
Total investment	(mil Rp)	2,381	1,542	1,120	733	87	165	29	0
Before tax cash flow	(mil Rp)	-2,561	-1,313	-779	820	3,850	4,825	5,924	6,150
IRR of before tax cash flow		22.7%							
NPV as of 10%	(mil Rp)	13,786							
NPV as of 15%	(mil Rp)	5,263							

(Social Benefit & Loss Analyses of BSD Project)

		1997	1998	1999	2000	2005	2010	2015	2020
Social benefit for residential customers	(Rp/m3)	800	800	800	800	800	800	800	800
Social benefit for commercial cooking	(Rp/m3)	800	800	800	800	800	800	800	800
Social benefit for commercial AC	(Rp/m3)	528	528	528	528	528	528	528	528
Total social benefit from gas sales	(MMRp)	0	4,400	5,622	13,068	24,438	30,559	37,891	40,747
Social loss for gas supplied	(Rp/m3)	167	167	167	167	186	217	242	267
Total social loss from gas supplied	(mil Rp)	0	1,302	1,609	3,749	7,727	11,375	15,879	18,963
Gross social benefit	(mil Rp)	0	3,099	4,013	9,319	16,711	19,183	22,012	21,784
Total investment	(mil Rp)	2,723	2,002	1,120	733	87	165	29	0
LPG bottle repurchase (residential)	(mil Rp)	42	186	575	483	32	0	0	0
In house pipeline installation (residential)	(mil Rp)	85	372	1,150	966	65	0	0	0
LPG bottle repurchase (commercial)	(mil Rp)	3	1	6	1	1	4	0	0
In house pipeline installation (cooking)	(mil Rp)	47	13	104	23	17	63	0	0
In house pipeline installation (AC)	(mil Rp)	95	10	183	45	32	99	29	0
Turbo chiller	(1000$)	7,216	727	13,874	3,440	2,468	7,494	2,211	0
	(mil Rp)	16,958	1,709	32,605	8,085	5,799	17,610	5,195	0
Absorption chiller	(1000$)	7,735	779	14,872	3,688	2,645	8,033	2,370	0
	(mil Rp)	18,178	1,832	34,950	8,667	6,216	18,877	5,569	0
Imported facilites (included)	(mil Rp)	1,555	320	3,150	1,067	483	1,416	400	0
Imported tax	(mil Rp)	0	0	0	0	0	0	0	0
Net social loss for facilities	(mil Rp)	3,987	2,137	3,564	1,337	519	1,491	403	0
Labor cost	(mil Rp)	495	641	757	834	1,677	956	616	330
Income tax (included)	(mil Rp)	56	73	87	98	186	103	64	34
Administrative expenses	(mil Rp)	148	192	227	250	503	287	185	99
Maintenance & other expenses	(mil Rp)	54	95	117	132	349	395	408	420
Value tax (included)	(mil Rp)	20	29	34	38	85	68	59	52
Net social benefit	(mil Rp)	-4,609	136	-530	6,902	13,934	16,224	20,524	21,020
EIRR		55.9%							
NPV as of 10%	(mil Rp)	75,527							
NPV as of 15%	(mil Rp)	41,634							

(Financial Feasibility of PGN in Separate Utility Case)

		1997	1998	1999	2000	2005	2010	2015	2020
Gas sales price	(Rp/m3)	315	315	315	315	315	315	315	315
Gas purchase price	(Rp/m3)	162	168	174	183	212	230	252	277
Total gas sales	(mil Rp)	0	2,455	3,035	7,071	13,086	16,513	20,669	22,372
Total gas purchased	(mil Rp)	0	1,309	1,681	4,102	8,802	12,082	16,535	19,673
Gross profit	(mil Rp)	0	1,147	1,355	2,969	4,283	4,431	4,134	2,699
Offtaker	(mil Rp)	0	0	0	0	0	0	0	0
A governor	(mil Rp)	119	0	0	0	0	0	0	0
Main pipeline (10bar)	(mil Rp)	223	460	0	0	0	0	0	0
Labor expenses Salaries	(mil Rp)	359	374	253	224	1,045	580	371	192
Pensions	(mil Rp)	36	37	25	22	104	58	37	19
Total	(mil Rp)	395	411	279	245	1,149	638	408	211
Administrative expenses	(mil Rp)	118	123	84	74	345	191	122	63
Maintenance & other expenses	(mil Rp)	2	2	2	2	16	27	27	39
Net cash flow	(mil Rp)	-858	150	990	2,647	2,773	3,574	3,576	2,388
FIRR		94.7%							
NPV as of 10%	(mil Rp)	16,886							
NPV as of 15%	(mil Rp)	10,127							

Sources:JICA team, Appendices O

The next tables shows FIRR, NPV as of 10% discount rate, and NPV as of 15% discount rate for each case. In case 5, results are for the separate utility. Downside contingency when sales volume decreases by 2% and investment costs rise by 10% has been done. Cases when in house pipeline installation cost would be paid by the gas utilities have also been done. Results of economic analyses are shown at the bottom of the table. We conducted the same analyses when air conditioning demand development is 50%.

Consecutively we show financial feasibility of PGN in case 5, and equity return for separate utility when we consider financing of the separate utility.

Table 19-6-3 Results of Financial and Economic Projections-BSD

(%, mil Rp)

	Case 1	Case 2	Case 3	Case 4	Case 5
(100% Air conditioning development demand)					
FIRR	10.3%	17.4%	38.0%	52.5%	22.7%
NPV(10%)	304	10,203	11,701	21,600	13,786
NPV(15%)	-3,611	2,126	5,887	11,623	5,263
(Downside contingency analysis)32%					
FIRR	7.6%	14.7%	32.1%	46.7%	18.8%
NPV(10%)	-2,969	6,733	9,566	19,267	10,110
NPV(15%)	-5,884	-262	4,561	10,183	2,770
(In house pipeline installation)					
FIRR	8.9%	15.8%	28.3%	41.1%	19.7%
NPV(10%)	-1,376	8,524	10,022	19,921	11,765
NPV(15%)	-5,010	727	4,487	10,224	3,613
(Downside contingency with in house pipeline installation)					
FIRR	6.4%	13.3%	24.1%	36.8%	16.4%
NPV(10%)	-4,648	5,053	7,887	17,588	8,088
NPV(15%)	-7,284	-1,661	3,162	8,784	1,120
(Economic Analysis)					
EIRR	52.2%	52.2%	52.2%	52.2%	55.9%
NSB(10%)	72,634	72,634	72,634	72,634	75,527
NSB(15%)	39,538	39,538	39,538	39,538	41,634

Table 19-6-3 (Continued)

(50% Air conditioning development demand)					
FIRR	-------------	8.6%	8.5%	24.1%	21.2%
NPV(10%)	-------------	-1,932	-777	9,122	12,027
NPV(15%)	-------------	-5,640	-2,111	3,626	4,204
(Downside contingency analysis)					
FIRR	-------------	6.7%	5.8%	21.6%	18.0%
NPV(10%)	-------------	-4,594	-2,138	7,563	9,125
NPV(15%)	-------------	-7,539	-2,970	2,652	2,177
(In house pipeline installation)					
FIRR	-------------	7.5%	6.0%	19.7%	18.4%
NPV(10%)	-------------	-3,612	-2,457	7,443	10,006
NPV(15%)	-------------	-7,040	-3,510	2,227	2,555
(Downside contingency with in house pipeline installation)					
FIRR	-------------	5.8%	3.7%	17.6%	15.7%
NPV(10%)	-------------	-6,274	-3,818	5,884	7,103
NPV(15%)	-------------	-8,939	-4,370	1,252	527
(Economic Analysis)					
EIRR	30.1%	30.1%	30.1%	30.1%	32.9%
NSB(10%)	35,207	35,207	35,207	35,207	38,099
NSB(15%)	16,480	16,480	16,480	16,480	18,575

[Financial Feasibility of PGN, in Case 5]

Assumptions:

- PGN will invest in off-take and meter stations, high pressure mainlines, and "A" regulators.
- PGN will whole-sell gas to the separate utility at 315 Rp/m3.
- PGN will be in charge of safety maintenance of pipelines but will not be paid for their labor cost.
- Financial feasibility for PGN can be considered with FIRR. Investment for PGN here is marginal, so that we do not suppose any financing restrictions for PGN in this case.

Results:

	[100% Air Conditioning Demand]	[50% Air Conditioning Demand]
	FIRR=94.7%	FIRR=40.6%
	NPV(10%)=16,886	NPV(10%)=6,509
	NPV(15%)=10,127	NPV(15%)=3,419

[Equity Return of Separate Utility]

[100% Air Conditioning Demand]

Assumptions:

- Total equity invested 3,000 mil Rp
- Total equity invested /Total facility investment=16.3 %
- Interest rate for cash deposits=5.0%
- Interest rate for long term and short term debt=10.0%

Results: IRR of equity=18.4%

[50% Air Conditioning Demand]

Assumptions:

- Total equity invested: 3,000 mil Rp
- Total equity invested /Total facility investment=16.3%
- Interest rate for cash deposit=5.0%
- Interest rate for long term and short term debt=10.0%

Results: IRR of equity=18.0%

(Source: JICA Team, Appendices O, BSD)

19.6.3. Assessment

(1) From the results of the financial projections, we see BSD cases are quite feasible except for Case 1 with 100% air conditioning demand development case. However, when we see its sensitivity analysis case of 50% air conditioning demand development, only Cases 4 and 5 are feasible.

(2) In Case 4, PGN will be too profitable in the 100% air conditioning demand development case. A realistic result will be in either a case in which the Government invests in part of the distribution lines or one in which PGN raises the residential gas price more slowly.

(3) As air conditioning demand increase might significantly fluctuate in the course of development speed in the Jakarta area, we should take the contingency between the 100% development case and the 50% development case.

(4) In Case 5, the viability of the separate utility does not change so much between these

two cases. It is because the margin of gas supply to air conditioning demand of separate utility is the gap between 330 Rp/m3 and 315 Rp/m3 which is quite small and the separate utility is quite vulnerable to the demand fluctuations of air conditioning demand.

(5) In Case 5, the profitability of PGN has large volatility in terms of percentage change of air conditioning demand. It is because PGN is supposed to sell gas at 315 Rp/m3 regardless of demand fluctuations.

(6) In both demand cases, PGN is quite profitable in Case 5, which is reasonable in accordance with the financial rule that high risk should bear high return, and vice versa. But there may be some more room for them to lessen sales price of gas to the separate utility.

(7) Economic feasibility is rather high in both demand cases.

(8) As an example of equity investment in Case 5, we get IRR of 18.4% or 18.0%, for the 100 % AC demand case or 50% AC demand case with 16.3% equity of total investment of this project which is 3,000 mil Rp.