5.4 Renovation Plan of Civil and Building Facilities

5.4.1 General

As a result of the study in Paragraph 5.6 "Personnel Scheme", since a drastic increase in personnel to the total present employee of the Dayeuhkolot Workshop is found unnecessary on all the other the Plan-1,2 and 3, the building facilities which are not related to the machine shops, are reusable and excluded from the study items.

The facilities to be excluded from the study items are referred to the attached drawing "Layout of Workshop for the Plan-D".

5.4.2 Facilities

(1) Facilities excluded from the study

The facilities to be determined by the policy of the Dayeuhkolot Workshop are as listed below:

Facility No.	Name of Facility	Remarks
1	Guard house	Existing
5a	Saw mill	- ditto -
5b	Mosque (worship room)	- ditto -
10	Control office	Establishment
10a	- ditto -	Existing
10b	- ditto -	- ditto -
12a	Repair shop of vehicle	- ditto -
12b	- ditto -	- ditto -
8a	Dinning room	- ditto -
14	- ditto -	Establishment
15	Fire fighting equipment	- ditto -
18	Garden	- ditto -

(2) Facilities to be studied

Facility No.	Name of Facility	Remarks
2	Machine shop for large size components	Existing
3	Casting shop	- ditto -
4	Coil-winding shop	- ditto -
5	Metalwork shop	- ditto -

6	Welding shop	Existing
7	Machine shop for small size components	Establishment
8	Assembly shop for large size components	- ditto -
9	Fuel store	- ditto -
11	Machine shop for medium size components	- ditto -
12	Laboratory	- ditto -
13	Substation	- ditto -
16	Access road	- ditto -
17	- ditto -	Existing

5.4.3 Plan-1 (Refer to the attached drawing "LAYOUT OF WORKSHOP, PLAN-1")

The new machine shop for the additional 10 units of machine tools is constructed adjacently to the existing metal work shop.

(1) Merit

(a) Since the new machine shop is located behind the existing building, no affection is given to the operation of the existing facilities even under the construction.

(b) Construction equipment and materials can be maintained at an open area being adjacent to the existing welding shop.

(c) Construction period of civil and building works is only 3 months considering the small floor area. (19m x 30m = 570 m^2).

(2) Demerit

Since the traffic between the new machine shops and the existing buildings becomes frequent in view of the processes of large size and special shape components, the disadvantageous condition is given to the small transport in the same area.

5.4.4 Plan-2 and Plan-3 (Refer to the attached drawing "PLAN-2 AND PLAN-3 (ARRANGEMENT OF WORKSHOP)")

(1) Working Scheme of Each Machine Shop

The working scheme of each machine shop is as follows:

(Unnecessary shops are excluded from the plan.)

(a) Machine shop for large size components (No.2)

The processes of major components of water turbine runners, shafts and liners are carried out by using the existing machine tools.

(b) Casting shop (No.3)

Since the future increase of casting work in the repair work is not considered, the existing shop is left as it is.

(c) Winding shop (No.4)

This shop is excluded from the renovation plan because the complete modification is needed if the facilities are properly improved.

(d) Metal work and welding shop (No.5)

The processes of water turbine runners, guide vanes, air heaters and other related accessories, and welding and assembly of air heaters are carried out at the metalwork/welding shops.

(e) Assembly shop (No.6)

The assembly shop is newly established for assembling the water turbine runners, liners, shafts and guide vanes.

(f) Machine shop for small size components (No.7)

The processes of small size components and accessories are carried out using the machine tools.

(g) Assembly shop for large size components (No.8)

As the said new assembly shop (No.6) has enough space for assembling, the existing assembly shop for large size components is excluded from the plan. (This shop is recommended to be used as generator repair shop in ANNEX-2).

(h) Machine shop for medium size components (No.11)

The processes of medium size components are carried out using the machine tools.

(i) Laboratory (No.12)

The laboratory is not necessary for the repair works and is excuded from the plan. However, the testing machines such as magnetic-particle testing machine and ultrasonic testing machine are stored in the main office.

(j) Substation for workshop (No.13)

A substation is provided to receive electric power to all the facilities in the workshop.

(2) Merit

(a) Workshop operation

The new machine shops/facilities are constructed in due order, and the existing machine tools to be reused are relocated to the new machine shops in each construction stage. Therefore, no special affection to the workshop operation is expected even if the operation is suspended due to the construction works.

(b) Construction equipment/materials

Since the new machine shops are to be constructed in due order, only small lot of construction equipment/materials can be maintained at the workshop area (South of existing workshop).

(c) Efficient operation of machine tools

With the new construction of various shops, the machine tools can be arranged efficiently and the efficient operation of the machine tools can be carried out.

(d) Plottage

For the construction of machine shop for small size components, the preparation of new plottage is necessary. The total plottage to be prepared is 2/3 of that in the Plan-D.

(3) Demerit

(a) Construction period

The overall construction period becomes longer because the new machine shops are scheduled to be constructed stage by stage.

5.5 Construction Cost

5.5.1 Basis of Cost Estimate

The Construction cost is estimated on the separate items of civil/building works cost, machine tools cost and other necessary expenses referring to the Dayeuhkolot Workshop Renovation Plan.

(1) Civil/Building Works (Unit price is assumed from those in Dayeuhkolot Plan.)

- Preparation of new workshop site

  The preparation of workshop site is not mentioned in Dayeuhkolot Plan, but since the new workshop site is a swampy area, the cost of the same is counted.

- Roads

  The cost of road is estimated separating into two items of new road and repair of the existing road.

- Workshop buildings

  The cost of workshop buildings is estimated separating into two items of new workshop buildings required for the supplemented machine tools and modification of the existing workshop buildings including the renewal of the existing workshop buildings.

(2) Machine Tools/Equipment

The ex-factory prices based on the maker's estimate and cost data book (1987) in Japan are applied to the machine tools/equipment.

(3) Other Expenses (Refer to Paragraph 5.3)

The other expenses are estimated on the following items:

- Packing fee, transportation fee and customs clearance fee based on the unit prices generally applied in Japan and Indonesia.

- Ocean freight/insurance premium based on 0.9% of FOB.

- Installation cost consisting of Yen portion on installation supervisors and Rupiah portion on material cost/personnel expenses.

- Workers training fee applying the JICA base unit price for specialists. (Worker training fee is not included in economic analysis.)

- Engineering fee based on the costs of preparation of tender documents, assistance of contrct award, review of shop drawings, inspection/site supervision, etc.

- Physical contingency based on 10% of construction cost on both Yen and Rupiah Portions.

The total of construction cost for the Plan-D was not calculated eventually with the following reasons:

- It was so difficult to estimate a necessary expense for training purpose in view of various items and many quantities of the workshop facilities to be procured.

- It was self-explanatory that costliness in procurement of the workshop facilities will being a lower IRR (internal rate of return) than those of the other Plans becouse dependence on outside shops of this Plan is so high.

5.5.2 Plan-1

Description	Q'ty	Unit Price (Rp.1,000)	Unit Price (¥1,000)	Amount (Rp.1,000)	Amount (¥1,000)
1) Establishment	m^2			193,000	
a) Preparation of plottage	320	40		13,000	
b) No.6 Extension of workshop	570	316		180,000	
2) Renovation	m^2			59,000	
a) No.17 Access Road	310	119		37,000	
b) No.17 Factory Road	650	34		22,000	

3)	Ex-Factory Price of Machine Tools	unit				289,700
	a) Machine tools		10			289,700
4)	Other Expenses				175,000	160,600
	a) Packing fee	250m^3		20		5,000
	b) Transportation fee					
	Ocean freight	250m^3			8	2,000
	Inland transportation	250m^3	40		10,000	
	c) Customs clearance	250m^3	20		5,000	
	d) Insurance premium					2,600
	e) Installation cost				49,000	6,000
	f) Worker training fee				72,000	88,000
	g) Engineering fee					16,000
	h) Physical contingency				39,000	41,000
	Grand Total				427,000	450,300

5.5.3 Plan-2

	Description	Q'ty	Unit Price (Rp.1,00)	(¥1,000)	Amount (Rp.1,000)	(¥1,000)
1)	Establishment	m^2			778,000	
	a) Preparation of plottage	3,300	40		132,000	
	b) No.6 Assembly shop	570	316		180,000	
	c) No.7 Machine shop for small size components	700	316		221,000	
	d) No.9 Warehouse	900	202		182,000	
	e) No.16 New road	400	158		63,000	
2)	Renovation	m^2			510,000	
	a) No.2 Machine shop for large size components	300	330		99,000	
	b) No.11 Reconstruction of Machine shop for medium size components	750	408		306,000	
	c) No.17 Access road	310	119		37,000	
	d) No.17 Factory road	2,000	34		68,000	

3)	Ex-Factory Price of Machine Tools and Equipment					553,700
	a) Machine tools	105 units				528,700
	b) Power receiving equipment	1 lot				25,000
4)	Other Expenses				355,000	222,600
	a) Packing fee	700m^3		20		14,000
	b) Transportation fee					
	Ocean freight	1,000m^3		8		8,000
	Inland transportation	1,000m^3	40		40,000	
	c) Customs clearance fee	1,000m^3	20		20,000	
	d) Insurance premium					5,000
	e) Installation cost				73,000	9,000
	f) Worker training fee				72,000	88,000
	g) Engineering fee					28,000
	h) Physical contingency				150,000	70,600
	Grand Total				1,643,000	776,300

5.5.4 Plan-3

	Description	Q'ty	Unit Price (Rp.1,000)	Unit Price (¥1,000)	Amount (Rp.1,000)	Amount (¥1,000)
1)	Establishment	m^2			778,000	
	a) Preparation of plottage	3,300	40		132,000	
	b) No.6 Assembly shop	570	316		180,000	
	c) No.7 Machine shop for small size components	700	316		221,000	
	d) No.9 Warehouse	900	202		182,000	
	e) No.16 New road	400	158		63,000	
2)	Renovation	m^2			510,000	
	a) No.2 Machine shop for large size components	300	330		99,000	
	b) No.11 Machine shop for medium size components	750	408		306,000	
	c) No 17 Access road	310	119		37,000	
	d) No 17 Factory road	2,000	34		68,000	

3)	Ex-Factory Price of Machine Tools and Equipment					736,600
	a) Machine tools	110 units				711,600
	b) Power receiving equipment	1 lot				25,000
4)	Other Expenses				407,000	257,000
	a) Packing fee	900m^3		20		18,000
	b) Transportation fee					
	Ocean freight	1,200m^3		8		9,600
	Inland transportation	1,200m^3	40		48,000	
	c) Customs clearance fee				24,000	
	d) Insurance premium					6,600
	e) Installation cost				109,000	13,500
	f) Worker training fee				72,000	88,000
	g) Engineering fee					31,000
	h) Physical contingency				154,000	90,300
	Grand Total				1,695,000	993,600

5.6 Personnel Scheme

5.6.1 Personnel Scheme of Each Plan

	Plan-1 Hydro.-Thermal(Ap.)	Plan-2 Hydro.-Thermal(Ap.)	Plan-3 Hydro.-Thermal(Ap.)
Production/design	5 - 2	8 - 3	8 - 3
Finish/assembly	9 - 4 (2)	8 - 4 (4)	9 - 4 (4)
Inspection	4 - 2 (1)	5 - 2 (2)	5 - 2 (2)
	18 - 8 (3)	22 - 9 (6)	22 - 9 (6)
Lathe for shaft	2 (1)	1 (1)	1 (1)
Face lathe	2	2 (1)	2 (1)
Horizontal boring/ milling machine		1 (1)	1 (1)
Vertical boring/ milling machine		1 (1)	1 (1)
Radial drilling machine	1 (1)	2 (1)	2 (1)
Heavy duty lathe	6 (1)	4 (1)	4 (1)
Lathe	8 - 2	15 - 4 (1)	15 - 4
Milling machine	4	4 - 1	4 - 1
Shaper	4 - 1	4 - 2	4 - 2
Upright drilling machine	2	1 - 1	1 - 1
Key seater		1	1
Screw cutting lathe		1	1
Vertical lathe (gantry type)	1 (1)		1 (1)
Press	1	2	2
Roller		1 - 2	1 - 2
Shearing machine		1 - 2	1 - 2
Bending machine	1	1	1
Hack sawing machine		1	1
Welding/metalwork machines	15 - 4	18 - 4	18 - 4
Grinder	5	5	5
	52 - 7 (4)	66 - 16 (7)	67 - 16 (7)
Sub-Total	70 - 15 (7)	88 - 25 (13)	89 - 25 (13)
Leader	10	18	18
Total	102	144	145

Notes: 1) The above figures show number of personnel.
2) Hydro : Hydropower plant, Thermal : Thermal power plant, AP : Apprentice workers

5.6.2 Personnel Scheme of Each Machine Shop

	Plan-1 Hydro.-Thermal(Ap.)	Plan-2 Hydro.-Thermal(Ap.)	Plan-3 Hydro.-Thermal(Ap.)
Machine shop for large size components	13 (3)	13 (3)	13 (3)
Machine shop for medium size components	10 (1)	14 - 3 (3)	15 - 3 (3)
Machine shop for small size components	7 - 3	12 - 4 (1)	12 - 4 (1)
Welding/metal work shop	22 - 4	27 - 9	27 - 9
Assembly shop	13 - 6 (3)	14 - 6 (6)	14 - 6 (6)
Sub Total	65 -13 (7)	80 - 22(13)	81 -22(13)
Total	78 (7)	102 (13)	103 (13)
Production/design group	5 - 2	8 - 3	8 - 3
Grand Total	92	126	127

5.6.3 Apprentice Workers Training Schedule

The apprentice workers are trained for the future processing personnel engaging in the processing works by heavy and special duty machine tools and the particular works as the supplementary workers.

The assignment for the apprentice workers training is scheduled as follows:

- 3 persons for face lathe, horizontal and vertical boring/milling machines, and heavy duty lathe
- 3 persons for lathe for shaft, radial drilling machine, shaper with copying attachment, and milling machine
- 1 person for screw cutting lathe (3 units/set)
- 6 persons for assembly shop (each 2 persons for finish/assembly/inspection)

5.6.4 Arrangement of Leaders for Each Machine Shop

Necessary number of leaders are arranged to control the design, schedule, storage of materials and products, quality, safety, etc. in each shop.

The leaders are arranged at a rate of a leader for 7-8 workers as follows:

	Plan-1			Plan-2			Plan-3		
	Leader	Worker	Total	Leader	Worker	Total	Leader	Worker	Total
Machine shop for large size components	2	16	18	2	16	18	2	16	18
Machine shop for medium size components	2	11	13	3	20	23	3	21	24
Machine shop for small size components	2	10	12	2	17	19	2	17	19
Welding/metalwork shop	2	26	28	5	36	41	5	36	41
Assembly shop	2	22	24	4	26	30	4	26	30
	10	85	95	16	115	131	16	116	132
Production/design group		7	7	2	11	13	2	11	13
Total	10	92	102	18	126	144	18	127	145

5.6.5 Breakdown for Estimated Personnel of Each Plan

The breakdown of estimated personnel of each plan is prepared for the data of financial review of the Plan as follows:

	Production /design	Leader	Regular staff	Temporary staff	Apprentice worker	Total
Plan-1	7	10	33	45	7	102
Plan-2	11	18	52	50	13	144
Plan-3	11	18	53	50	13	145

5.6.6 Comparison of Estimated Personnel in Each Plan and Present Personnel at the Dayeuhkolot Workshop

	Present personnel at Dayeuhkolot Workshop	Plan-1	Plan-2	Plan-3
	Leader-Worker	Leader-Worker	Leader-Worker	Leader-Worker
Engineering Dept.	13-14	13-14	13-14	13-14
Power Plant Logistic Dept.	6-50	6-50 (Design: 7)	6-50 (Design: 11)	6-50 (Design: 11)
		. Design staffs are belonging to Engineering Dept.		
POWER PLANT PRODUCTION DIVISION				
Power Plant Production Control Section	1-0			
Hydropower Plant	1-13			
Geothermal/ Steam Power Plant	1-6	(10-85)	(18-115)	(18-116)
Gas/ Diesel Power Plant	0-6			
Forging/Casting	1-9			
Material Procurement Section	4-9			
	8-43	10-85	18-115	18-116
Transmission Line Logistic Dept.	4-16	4-26	4-26	4-26
Transmission Line Equipment Production Section	1-3	1-3	1-3	1-3
General Affairs Dept.	18-33	18-33	18-33	18-33
	50-169	52-211	60-241	60-242
Total	219	263	301	302

5.7 Machine Tools and Personnel for Future Work Demand

According to the Peak Load Production and Installed Capacity Plan prepared by PLN, 29 units of hydroelectric power plants are scheduled to be constructed during the period from 1993 to 1994 (for detail of future power plant scheme, refer to Chapter-3 Demand Forecasting). These 29 units are equivalent to 28% of the total demand of 103 units to be constructed.

Therefore, the work demand is to be increased by 28% in the future and if these units are scheduled to be repaired after two (2) times of periodic inspection (40,000 hours cycle), the required number of machine tools and personnel based on 14% work demand (50% increase of machine tools) and 28% work demand (100% increase of machine tools) is estimated incorporating in the repair cycle of the existing plants after twelve (12) years.

Further, since the increase ratio of the work demand on thermal power plants is estimated at 26% considering the future 7 units under planning to the existing 27 units in Java, the required number of machine tools and personnel is estimated based on the same conditions as those for hydroelectric power plants including the repair demand of ancillary equipment of existing thermal power plants.

Estimat of Machine Tools and Personnel for Future Work Demand

	Plan-2		14% increase		28% increase	
	No. of Personnel	No. of machine tool (unit)	No. of Personnel	No. of machine tool (unit)	No. of Personnel	No. of machine tool (unit)
Production Design	11	-	12	-	14	-
Hydro	8	-	9	-	10	-
Thermal	3	-	3	-	4	-
Finish/assembly	13	-	15	-	17	-
Hydro	9	-	10	-	12	-
Thermal	4	-	5	-	5	-
Inspection	7	-	7	-	8	-
Hydro	5	-	5	-	6	-
Thermal	2	-	2	-	2	-
Process	45	45	55	55	59	59
Hydroelectric	37	37	46	46	49	49
Thermal	8	8	9	9	10	10
			Supplemental machine Tools:		Supplemental machine Tools:	
			Lathe for shaft:	1	Lathe:	3
			Face lathe:	1	Shaper:	1
			Lathe:	4		
			shaper:	2		
			Milling machine:	1		
			Drilling machine:	1		
Sheet metal	10	11	11	12	12	13
Hydro	6	7	6	7	7	8
Thermal	4	4	5	5	5	5
			Supplemental machine Tool:		Supplemental machine Tool:	
			Shearing machine:	1	Bending machine:	1
Metal work	27	27	29	29	34	34
Hydro	23	23	25	25	29	29
Thermal	4	4	4	4	5	5
			Supplemental machine Tool:		Supplemental machine Tool:	
			Welding machine:	2	Welding machine:	5
Total	113	83	129	96	144	106

5.8 Workers Training

The business base of the Dayeuhkolot Workshop is not manufacture of new hydraulic turbines, but is partial manufacture of the existing power plant components, and repair and restoration of damaged components.

Based on this base, the repair work training schedule is arranged as follows:

5.8.1 Training Items

(1) Design engineer

Since the structural design is mainly applied, the following are important:

- Type of hydraulic turbine and main body basic structure and parts composition by maker
- Parts composition of hydraulic turbine major components such as turbine shaft, runner, seat liner, protect liner and guide vane
- Standard gap, tolerance and limits in assembling of structures/parts/counter parts
- Essential point in sketch and records of the parts and their counter parts
- Specifications of processing limits/tolerance
- Metalwork design technique - shop drawings of guide vanes, runners, bend pipes, etc., and method of heat treatment

(2) Finishing, Assembly Workers

- Marking-off of actual size in metalwork
- Marking-off for the process of components

(3) Inspectors

- Inspection procedure of runners, guide vanes and turbine shafts
- Technique of magnetic particle and ultrasonic inspection

- Centering check of turbine shaft and static balance check of runner

(4) Production Control Engineers

- Preparation of process chart of each component (type of machine tools and process chart)
- Preparation and promotion of daily and overall schedule
- Preparation and promotion of quality control working schedule

5.8.2 Workers Training Schedule

In order to enable the workers to acquire the production technique, the training is essential. The training is scheduled to be carried out at both an experienced manufacturer and Dayeuhkolot Workshop prior to the start of production operation.

The following are the schedule and cost estimate for the training:

(1) At an Experienced Manufacturer

Contents of training	Number of trainee and schedule		
	1st year	2nd year	Total
(a) Basics of production process and quality control	1	1	2
(b) Basic design for repair of water turbine components	1	1	2
(c) Basics of assembly/inspection technique		1	1
(d) Processing technique of heavy machine tools		1	1
Total (Man/Year)	2	4	6

(2) At Dayeuhkolot Workshop

Contents of instructions	Number of specialist	
	1st year	Total
(a) Production process and quality control	1	1

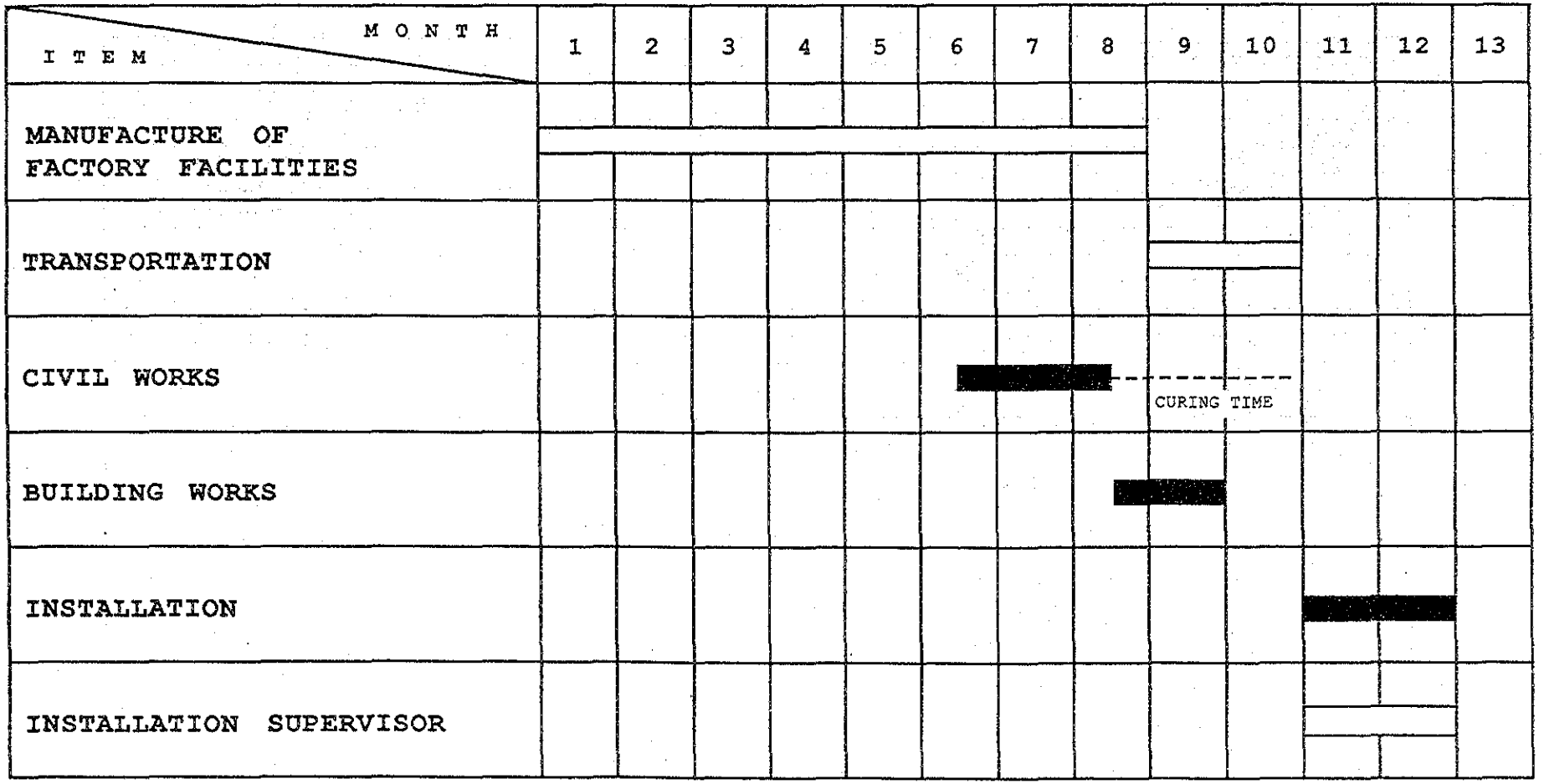
(b)	Basic design of hydraulic turbine components	1	1
	Total (Man/Year)	2	2

(3) Cost Estimate

Description	1st year (x ¥ 1,000)	2nd year (x ¥ 1,000)	Amount (x ¥ 1,000)
(a) Training at an experienced manufacturer	18,000	36,000	54,000
(b) Training at Dayeuhkolot workshop	40,000	-	40,000
Total amount	58,000	36,000	94,000

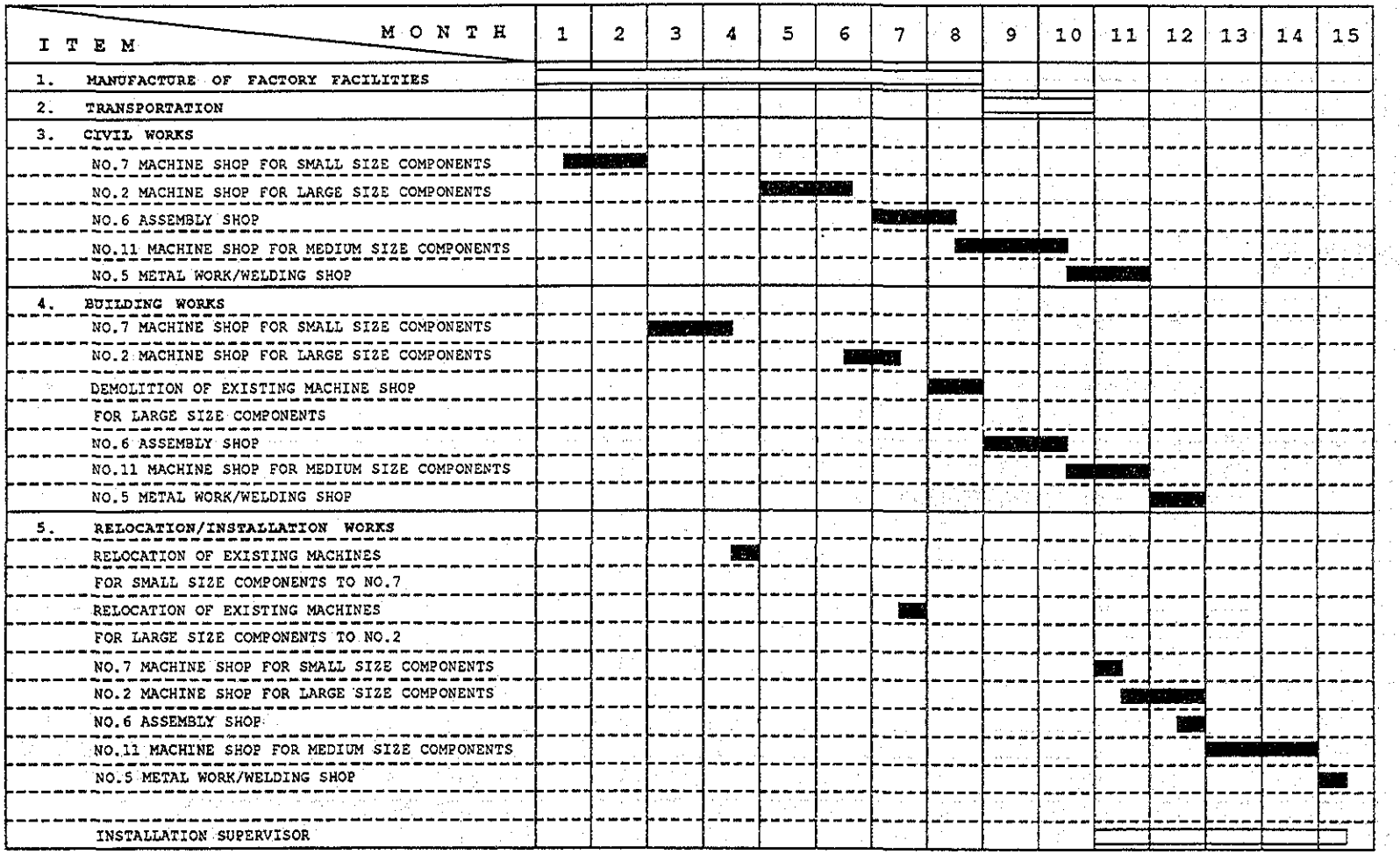
5.9 Construction Schedule

5.9.1 Plan - 1



NOTE : ABOUT SIX (6) MONTHS ARE REQUIRED FOR THE PLANNING, DESIGN, PREPARATION OF TENDER/CONTRACT DOCUMENTS, TENDER PROPOSAL, ETC. BEFORE CONTRACT, AND THE PREPARATION OF PLOTTAGE FOR NEW WORKSHOP SITE IS CARRIED OUT DURING THE SAME PERIOD.

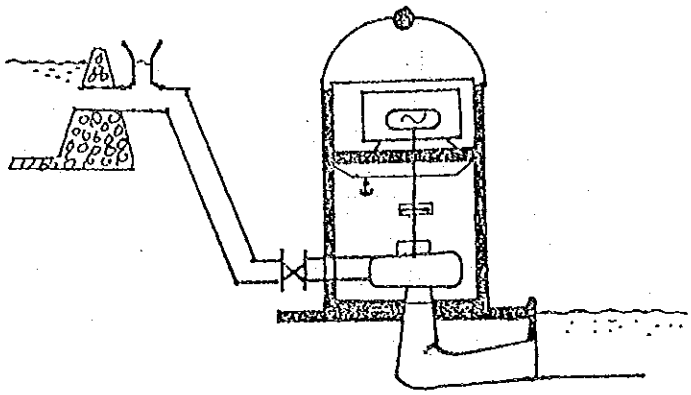
5.9.2 Plan - 2 & 3



NOTE : ABOUT TWELVE (12) MONTHS ARE REQUIRED FOR THE PLANNING, DESIGN, PREPARATION OF TENDER/CONTRACT DOCUMENTS, TENDER PROPOSAL, ETC. BEFORE CONTRACT, AND THE PREPARATION OF PLOTTAGE FOR NEW WORKSHOP SITE IS CARRIED OUT DURING THE SAME PERIOD.

Table 5-1

Inventaris PLTA th. 1986



A. DATA P L T A

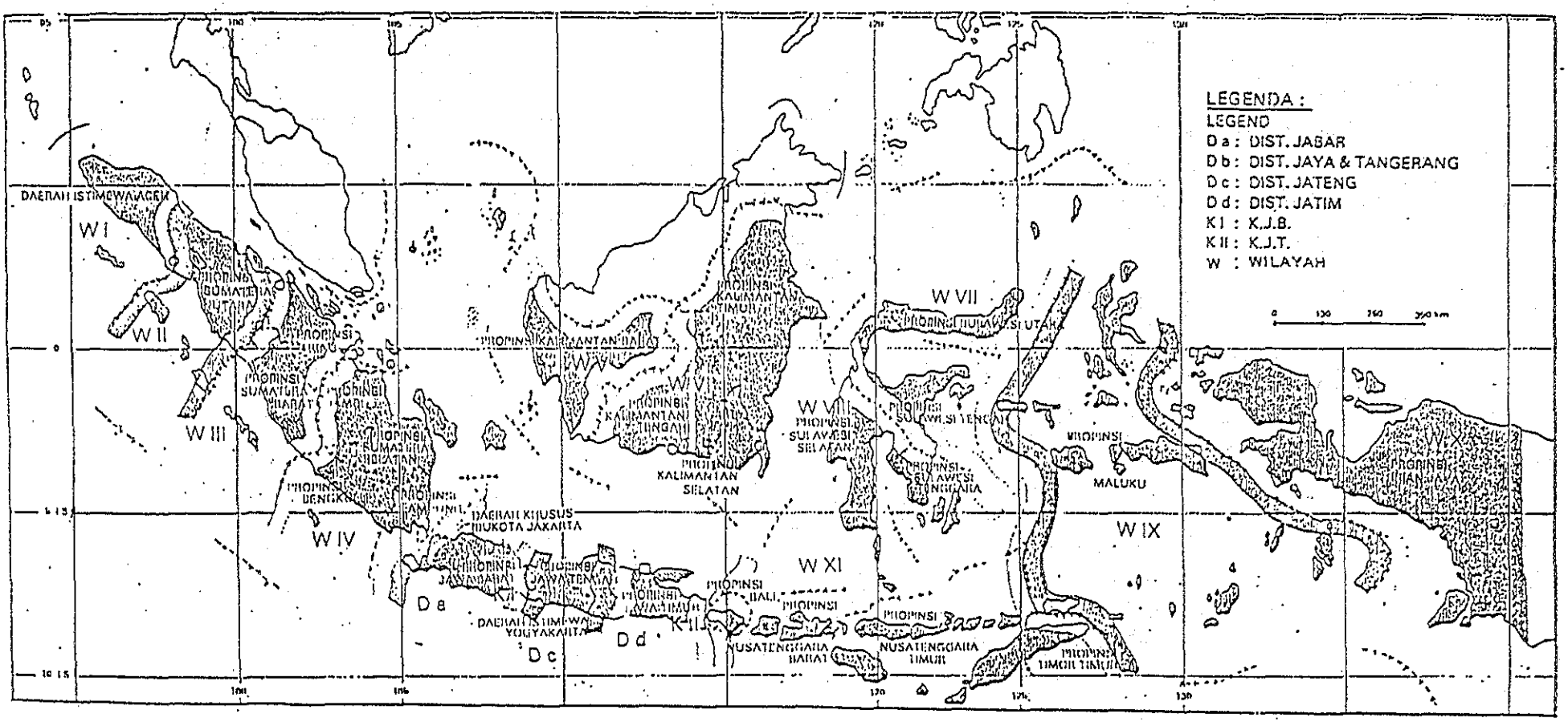
1. Jumlah Unit	:	81
2. Jumlah Type/Model	:	
a. Type Horizontal	:	45
b. Type Vertical	:	36
c. Type Bulb Turbin	:	-
d. Type Cross Flow	:	-
3. Jumlah daya terpasang	:	1230815 KW
4. Jumlah merek turbin	:	13
5. Jumlah merek generator	:	17
6. Jumlah lokasi	:	30

B. DATA P L T M

1. Jumlah Unit	:	40
2. Jumlah Type/Model	:	
a. Type Horizontal	:	31
b. Type Vertical	:	3
c. Type Bulb Turbin	:	5
d. Type Cross Flow	:	1
3. Jumlah daya terpasang	:	8841 KW
4. Jumlah merek turbin	:	11
5. Jumlah merek generator	:	13
6. Jumlah lokasi	:	36

Keterangan :

1.1. PETA WILAYAH KERJA PLN
OPERATING UNITS OF PLN



KESATUAN	DAYA TERPASANG (KW)	JUMLAH UNIT (BH)	JUMLAH SENTRAL (BH)
WILAYAH I	372	1	1
WILAYAH II	200	3	2
WILAYAH III	80.010	11	6
WILAYAH IV	2.420	4	3
WILAYAH V	-	-	-
WILAYAH VI	30.000	3	1
WILAYAH VII	16.340	7	5
WILAYAH VIII	1.710	4	2
WILAYAH IX	-	-	-
WILAYAH X	120	1	1
WILAYAH XI	480	4	4
KITLUR JATIM	209.080	21	9
KITLUR JABAR	870.240	38	14
DIST.JATIM	822	4	4
DIST.JATENG	1.373	6	6
DIST.JABAR	640	6	3
TOTAL	1.211.607	114	50

Jumlah Merk :

Turbin : 21

Generator : 24

Jumlah TypeTurbin :

Francis : Vertical 30

Horizontal 69

Kaplan : Vertical 8

Horizontal 1

Pelton : Vertical -

Horizontal 2

Bulb : Vertical -

Horizontal 3

Cross Flow : 1

Jenis PLTA

Run Of River :

Regulating Pondage :

Reservoir :

Pumped Storage :

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

NO UNIT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	TEN PA-SA-NG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN	
																			H=...M	Q=...M3/dt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	WIL I BANDA ACEH Cabang :																			
1	Lhokseumawe	PLTM Angkup	I	CGEE Alsthom	Bulb Turbine	-	-	659	-	-	-	Unelec	IA.100 G/63/ 40	78143974 -2	0,38	472,5	0,8	372	H = 9	Q = 5,1
			II	CGEE Alsthom	Bulb Turbine	-	-	659	-	-	-	Unelec	IA.100 G/63/ 40	78143974 -2	0,38	472,5	0,8	372	H = 9 (belum beroperasi)	Q = 5,1
	WIL II SUMUT Cabang :																			
2	Binjai	PLTM Namthe	I	Gilkes	Francis.Hor	6156	113	446	1976	Gilkes	-	Macfarlane	TBT700 A	61115	0,22	100	0,8	80	H = 9,45	Q = 1,05
3	Sibolga	PLTM Tarutung	I	Schlipers	Francis.Hor	372	82	1500	1926	K & TH MOLLER	-	Siemens	F.243	1882839N	0,22	75	0,8	60	H = 60	-
			II	Schlipers	Francis.Hor	-	82	1500	1926	K & TH MOLLER	-	Siemens	F.243	189546 N	0,22	75	0,8	60	H = 60	-
																		200		

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

HALAMAN : 2

NO UNIT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	TAHUN PASANG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN H=...M	KETERANGAN Q=...M3/dt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	WIL III																			
	SUMBAR																			
	Sektor : Bukit Tinggi																			
4		PLTA Batang Agam	I	Ebara/ Allis Charmers	Francis.Hor	R.410028-1	6236	750	1976	Allis Ch	—	Meidensha	TL-AF	588738R3	6,3	4.700	0,8	3.500	H = 90,8	Q = 4,49
		Sungai.Agam	II	Ebara/ Allis Charmers	Francis.Hor	R.410028-2	6236	750	1976	Allis Ch	—	Meidensha	TL-AF	588738R4	6,3	4.700	0,8	3,500	H = 90,8	Q = 4,49
			III	Ebara/ Allis Charmers	Francis.Hor	R.810384-3	6236	750	1981	Allis Ch	—	Meidensha	TL-AF	588738R3	6,3	4.700	0,8	3.500	H = 90,8	Q = 4,49
																		10.500		
5		Maninjau	I	Toshiba	Francis.Vert	3601075/A	23800	600	1980	Toshiba	PQTO	Meidensha	VTC-AF	5G9778R1	10	21.500	0,79	17.200	H = 226	Q = 8,73
		Sungai Antokan	II	Toshiba	Francis.Vert	3601075/B	23800	600	1980	Toshiba	PQTO	Meidensha	VTC-AF	5G9778R2	10	21.500	0,79	17.200	H = 226	Q = 8,73
			III	Toshiba	Francis.Vert	3601075/C	23800	600	1980	Toshiba	PQTO	Meidensha	VTC-AF	5G9778R3	10	21.500	0,79	17.200	H = 226	Q = 8,73
			IV	Toshiba	Francis.Vert	3601075/D	23800	600	1980	Toshiba	PQTO	Meidensha	VTC-AF	5G9778R4	10	21.500	0,79	17.200	H = 226	Q = 8,73
																		68.800		

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

NO UNIT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	THN PA-SA-NG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KV	KETERANGAN	
																			H=...M	Q=...M3/dt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	Cabang :	PLTM																		
6	Padang	Lembah D. Lingkat	I	B.B.I.	Francis.Hor	-	122	1000	1979	Jyoti	B	Jyoti	Brush	1798	0,38	110	0,8	80	H = 29	Q = 0,5
7		SungaiPenuh	I	Escher Wyss	Francis.Hor	10800	105	1000	1957	Escher Wyss	-	Oerlikon	616386	30278001	0,23	88	0,8	70	H = 32	Q = 0,3
8	Solok	Koto Anau	I	Barata	Francis.Hor	-	-	1000	1977	Jyoti	D	Dipl.Ing Hitzinger	SGS 60 S/6	52598	0,38	200	0,8	160	H = 27,5	Q = 0,9
9		Muara Labuh S.Bt.Bango Kecil	I	Barata	Francis.Hor	311	430	750	1982	Jyoti	D	A.Van.Kaick	DIDB-120.E/8D	808983	0,38	500	0,8	400	H = 35	Q = 1,87
																		560		
	WIL IV SUMSEL																			
	Cabang :																			
10	Bengkulu	PLTA TES Sungai Ketahuan	I	S.F.A.C.	Francis.Hor	984	900	1000	1959	-	-	Westing.H	SAT.765 3716	9236	6	825	0,8	660	H = 43,5	Q = 1,5
			III	S.F.A.C.	Francis.Hor	985	900	1000	1959	-	-	Westing.H	SAT.765 3716	9235	6	825	0,8	660	H = 43,5	Q = 1,5
																		1320		
11		PLTM T.Kaning Sungai Nokan	I	Gilkes	Francis.Hor	6151	149	660	1977	Gilkes	B	Macfarlane	TBT 100A	61033	0,22	125	0,8	100	H = 14,3	Q = 0,95
12		K.Curup	I	Barata	Francis.Hor	-	-	750	1983	Gilkes	-	Unelec	-	-	-	1000	0,8	1000	H = 63	Q = 2,25

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN :1987/1988

HALAMAN :4

NO URUT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	THN PA-SA-NG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN H=...M	KETERANGAN Q=...M3/dt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	WIL VI KALSEL																			
	Sektor : Barito																			
13		PLTA Ir.PM.Noor / Sungai Riam Kanan	I	Fuji Electric	Francis.Vert	500166A	14080	273	1971	Fuji Electric	Pendu lum	Fuji Electric	SPF 645/261 -22	225031A	11	11.000	0,9	10000	H = 39,8	Q = 30,34
			II	Fuji Electric	Francis.Vert	500167A	14080	273	1971	Fuji Electric	Pendu lum	Fuji Electric	SPF 645/261 -22	225032A	11	11.000	0,9	10000	H = 39.8	Q = 30,34
			III	Fuji Electric	Francis.Vert	KJ 69054E1	14080	273	1980	Fuji Electric	Pendu lum	Fuji Electric	SPF 645/261 -22	KJ.69054 L1	11	11.000	0,9	10000	H = 39,8	Q = 30,34
																		30000		
	Cabang : Banjarmasin																			
14		PLTM Haruyan / Sungai Haruyan	I	CGEE Alsthom	Bulb Turbine	-	234	460	1976	Brake System	-	Unelec	AT.400 MB 50	-	0,38	262	0,8	200		

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

NO URUT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	TAHUN PASANG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN H=...M	KETERANGAN Q=...M3/dt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	WIL VII SULUT																			
	Sektor :																			
15	Minahasa	PLTA Tonsea Lama / Sungai Tondano	I	Escher Wyss	Francis.Ver	6007	6000	500	1950	Escher Wyss	FV-1918	G.E.C	ATB-12	1423814	1,5	5.550	0,8	4.440	H1= 96	Q = 6,4
			II	Charmilles	Francis.Ver	FV.36285	6750	600	1970	Charmilles	026	EBC Swiss	WAV 190 /10	34524	6,3	6.000	0,75	4.500	H2= 89,5	Q = 6,49
			III	Andritz	Francis.Ver	1216	7760	600	1981	Escher Wyss	Model7 P.C.S.	EBC Austria	WAV/ 190/63 /10	AW 588695	6,3	6.800	0,8	5.440	H3= 93,25	Q = 6,77
																		14.380		
	Cabang :																			
16	Manado	PLTM Pontak	I	PT.Tisco	Francis.Ver	-	100	150	1979	-	-	Siemens	AT 250 LB 7	184882/4	0,38	75	0,8	60	H = 5	Q = 2,1
17		Tenga	I	Barata	Francis.Hor	-	242	1000	1977	Jyoti	D	Dipl. Ing Hitzinger	SGS 60M/6	52565	0,38	225	0,8	180	H = 23,5	-
18	Palu	Sawidago	I	Barata	Francis.Hor	311	172	695	1983	Jyoti	D	Jyoti	Brusless	-	0,38	150	0,8	120	H = 15,3	Q = 1,06
		Hanga-Hanga	I	Barata	Francis.Hor	-	-	-	1985	-	-	-	-	-	-	-	-	1600	-	-

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

NO UNIT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	THN PA-SA-NG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN H=...M	KETERANGAN Q=...M3/dt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	WIL VIII SULSEL																			
	Cabang :																			
19	Pinrang	PLTA Sawito / Sungai Sadang	I	Sponjene Brenske BRNC	Kaplan.Vert	KT.336	812	250	1940	JM.Voith	W.Oil Press	Smits.SL	D.G. Suspension	22954	3,15	675	0,8	540	H = 6,8	Q = 10
			II	Sponjene Brenske BRNC/ Baratn	Kaplan.Vert	KT.337	812	250	1940	JM.Voith	W.Oil Press	Smits.SL	D.G. Suspension	22953	3,15	675	0,8	540	H = 6,8	Q = 10
			III	Sponjene Brenske BRNC	Kaplan.Vert	KT.338	812	250	1973	JM.Voith	W.Oil Press	Smits.SL	D.G. Suspension	22952	3,15	675	0,8	540	H = 6,8	Q = 10
																		1.620		
	Cabang :																			
20	Watampone	PLTM Cenae	I	Gilkes	Francis.Hor	6153	134	625	1971	Gilkes	B	Macfarlane	TBT 600C	61034	0,22	112	0,8	90	H = 12,5	
	WIL X IRIANJAYA																			
	Cabang :																			
21	Jayapura	PLTM Wamena / Sungai Wamena	I	Gilkes	Francis.Vert	6173	184	197	1977	Gilkes	C	Mawdsleys	BS.261-3/70	3 CA 6 KB 1058	0,38	150	0,8	120	H = 5	Q = 3,6

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

NO URUT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	THN PASANG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN H=...M	KETERANGAN Q=...M3/dt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	WIL XI DENPASAR																			
	Cabang :																			
22	Denpasar	PLTM Karang Asem / Sungai.Pilah	I	Gilkes	Francis.Hor	6154	115	588	1972	Gilkes	B	Macfarlane	TBT 600 B	61030	0,22	100	0,8	80	H = 11,15	Q = 0,3
23	Ampenan	Narmada / Sungai Narmada	I	Barata	Francis.Hor	-	160	750	1976	Jyoti	D	Jyoti	Brushless Hor. Shaft	-	0,22	150	0,8	120	H = 15,3	Q = 1
24	Ende	Ruteng / Way Carit / S.Way Carit	I	Gilkes	Francis.Hor	6152	179	740	1979	Gilkes	B	Macfarlane	TBT 700A	61031	0,22	150	0,8	120	H = 17,35	-
		Bajawa/Ogi / S.Soa Seso	I	H.B.I	Francis.Hor	77605	233	1327	1981	Jyoti	D	Hitzinger	Brushless	-	0,38	200	0,8	160	H = 54	Q = 0,47
	KIT-TUR JATIM																			
	Sektor :																			
25	Brantas	PLTA Mendalan / Sungai Kalikonto	I	Escher Wyss	Francis.Hor N.37/900	8261	9000	750	1930	Escher Wyss	F25/N 900.Pendulum	Oerlikon	C.OT 4001146	136009	6	7.000	0,8	5.600	H = 152,5	Q = 5,25
			II	Charmilles	Francis.Hor	7703	9450	750	1955	Charmilles	Pendulum	Schorch	W.8140 / 8	126496-1	6	7.250	0,8	5.800	H = 152,5	Q = 5,3
			III	Charmilles	Francis.Hor	7704	9450	750	1955	Charmilles	Pendulum	Schorch	W.8140 / 8	126496-2	6	7.250	0,8	5.800	H = 152,5	Q = 5,3
			IV	Charmilles	Francis.Hor	7705	9450	750	1955	Charmilles	Pendulum	Schorch	W.8140 / 8	126496-3	6	7.250	0,8	5.800	H = 152,5	Q = 5,3
																		23.000		

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT

DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I

UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

NO URUT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	THN PA-SA-NG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN H=...M	KETERANGAN Q=...M3/dt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
26		Siman / Sungai Kalikonto	I	Escher Wyss	Francis.Vert F.37/1300	9565	5000	600	1935	Escher Wyss	-	Oerlikon	SGV400 /130 Suspension	195971	6,3	4.500	0,8	3.600	H = 98	Q = 4,5
			II	Escher Wyss	Francis.Vert F.37/1300	8358	5000	600	1955	Escher Wyss	-	B.B.C	WAV 190 /10 Suspension	34515	6	4.500	0,8	3.600	H = 98	Q = 4,5
			III	Escher Wyss	Francis.Vert	8359	5000	600	1955	Escher Wyss	-	B.B.C	WAV 190 /10Suspension	34512	6	4.500	0,8	3.600	H = 98	Q = 4,5
																		10.800		
27		Selorejo / Sungai Kalikonto	I	Ebara	Kaplan.Vert	R.111019-01	6528	500	1973	Allis Ch	ED6-WR	Meidensha	VEK-AF Suspension	6R77281	6,6	5.600	0,8	4.080	H = 37,1	Q = 14,7
28		Sutami / Sungai Brantas	I	Toshiba	Francis.Vert	3600420-A	50000	250	1973	Toshiba	Cabinet Actuator	Toshiba	TAK/24R Suspension	7110320	11	39.000	0,9	35.000	H = 78	Q = 53,5
			II	Toshiba	Francis.Vert	3600420-B	50000	250	1973	Toshiba	Cabinet Actuator	Toshiba	TAK/24R Suspension	7110322	11	39.000	0,9	35.000	H = 78	Q = 53,5
			III	Toshiba	Francis.Vert	3600420-C	50000	250	1974	Toshiba	Cabinet Actuator	Toshiba	TAK/24R Suspension	7413135	11	39.000	0,9	35.000	H = 78	Q = 53,5
																		105.000		

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

NO URUT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	TEH PA-SA-NG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN	
																			H=...M	Q=...M3/dt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
29		PLTA.Wlingi Sungai Brantas	I	Toshiba	Kaplan.Vert VK - IKS	3600762	27800	143	1978	Toshiba	C.A	Meidensha	VTC-AF	5J8600R1	11	30.000	0,9	27.000	H = 22	Q = 143
			II	Toshiba	Kaplan.Vert VK - IKS	3600986	27800	143	1978	Toshiba	C.A	Meidensha	VTC-AF	5F8200R1	11	30.000	0,9	27.000	H = 22	Q = 143
																		54.000		
)		PLTA.Lodoyo Sungai Brantas	I	Toshiba	Kaplan.Hor HK - IRT	3601219	6385	150	1982	Toshiba	FQTO/4 EL	Meidensha	CKB/AS	IH9216 RI	6,6	5.300	0,85	4.500	H = 8,5	Q = 67,5
	Sektor : Madiun																			
31		PLTA Giringan Sungai Duweh dan Catur	I	Escher Wyss	Francis.Hor F.25/300	N.1000	2000	1000	1937	Escher Wyss	-	Heemaf	DG/156 /6 HR	1501059	6,3	2.000	0,7	1.400	H = 106,5	Q = 1,130
			II	Charmilles	Francis.Hor	2732	1300	1000	1955	Charmilles	-	Smits	D.G	42016	6,3	1.280	0,7	900	H = 106,5	Q = 1,130
			III	Charmilles	Francis.Hor	2788	1300	1000	1955	Charmilles	-	Smits	D.G	42015	6,3	1.280	0,7	900	H = 106,5	Q = 1,170
																		3.200		

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

NO UNIT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	TAHUN PASANG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN H=...M	KETERANGAN Q=...M3/dt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
32		PLTA Golang / Sungai Dueh dan Catur	I	Neyrpic	Francis.Hor	-	1350	1000	1959	Neyrpic	Type50	Alsthom Belfort	HV.125 /51	351235	6,3	1.280	0,7	900	H = 88,5	Q = 1,37
			II	Neyrpic	Francis.Hor	-	1350	1000	1959	Neyrpic	Type50	Alsthom Belfort	HV.125 /51	351236	6,3	1.280	0,7	900	H = 88,5	Q = 1,37
			III	Neyrpic	Francis.Hor	-	1350	1000	1959	Neyrpic	Type50	Alsthom	HV.125	351235	6,3	1.280	0,7	900	H = 88,5	Q = 1,37
																		2.700		
33		Ngebel / Telaga Agung	I	B.Mayer	Francis.Hor	2037	3170	1000	1968	-	Pendu-lum	A.E.G.	S 66796	265/894	6,3	2.750	0,8	2.200	H = 183,5	Q = 1,41
	KIT - JBR JABAR																			
34	Sektor : Tuntang	PLTA Jelok / Sungai Tuntang	I	Escher Wyss	Francis.Hor	9176	7280	600	1937	Escher Wyss	N37/ 900	B.B.C	W.230/ 10	1801023	6,6	6.400	0,8	5.120	H = 144	Q = 4,481
			II	Escher Wyss	Francis.Hor	9177	7280	600	1938	Escher Wyss	N37/ 900	B.B.C	W.230/ 10	B.44961	6,6	6.400	0,8	5.120	H = 144	Q = 4,481
			III	Escher Wyss	Francis.Hor	9178	7280	600	1938	Escher Wyss	N37/ 900	B.B.C.	W.230/ 10	B.44934	6,6	6.400	0,8	5.120	H = 144	Q = 4,481
			IV	Escher Wyss	Francis.Hor	NT.11010	7280	600	1962	Escher Wyss	P37/ 1300	Oerlikon	SGT.420 120-10	933987-M01.1	6,6	6.400	0,8	5.120	H = 144	Q = 4,481
																		20.480		

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PENYELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

NO UNIT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	TH PA-SA-NG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN H=...M	KETERANGAN Q=...M3/dt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
35		PLTA.Timo Sungai Tuntang	I	Skoda-CKD	Francis.Hor	F. 212	6250	750	1963	Skoda	Pendu-lum	Skoda	H 6458/8	33274	6,3	5.000	0,8	4.000	H =103	Q = 4,6
			II	Skoda-CKD	Francis.Hor	F. 213	6250	750	1963	Skoda	Pendu-lum	Skoda	H 6458/8	33273	6,3	5.000	0,8	4.000	H =103	Q =4,6.
			III	Skoda-CKD	Francis.Hor	F. 214	6250	750	1963	Skoda	Pendu-lum	Skoda	H 6458/8	33275	6,3	5.000	0,8	4.000	H =103	Q = 4,6
																		12.000		
36		Wonogiri Sungai Bengawan - Solo	I	Ebara	Kaplan.Vert IRS-KPL	RA.10138-01	8716	273	1981	Ebara	Pendu-lum	Shinko	FENKL 2-AW 3700	A 092360101	6,6	7.750	0,8	6.200	H = 20,4	Q = 36,7
			II	Ebara	Kaplan.Vert IRS-KPL	RA.10138-02	8716	273	1981	Ebara	Pendu-lum	Shinko	FENKL 2-AW 3700	A 092360102	6,6	7.750	0,8	6.200	H = 20,4	Q = 36,7
																		12.400		
37	Sektor : Ketenger	PLTA Ketenger Sungai Banjaran dan Soroba-dag	I	Charmilles	Pelton.Hor	1479	5040	600	1939	Charmilles	-	Oerlikon	SOT. 360134	137901	6,6	4.400	0,8	3.520	H = 272,5	Q = 1,615
			II	Charmilles	Pelton.Hor	1480	5040	600	1939	Charmilles	-	Oerlikon	SOT. 360134	137902	6,6	4.400	0,8	3.520	H = 272,5	Q = 1,615
																		7.040		

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

NO UNIT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	TEN PA-SA-NG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN	
																			E=...M	Q=...M3/dt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
38		PLTA Sempor	I	C.Dumont	Francis.Hor	T.4355	1495	750	1980	Neyrpic	HEUBL 100 L6 - CEM	Uneloc	PA. 100695 -75/6	TD144499 /1	6,3	1.250	0,8	1.000	H = 30	Q = 3,13
39		PLTA Garung Telaga Menjer	I	Ebara	Francis.Ver	R.910126 -01	18600	750	1982	Wood Ward	Bulle-tin 07058	C.E.M	IWEPC 181-80 /8	FN 33920	6	15.000	0,8	13.200	H = 195	Q = 7,92
			II	Ebara	Francis.Ver	R.910126 -02	18600	750	1982	Wood Ward	Bulle-tin 07058	C.E.M	IWEPC 181-80 /8	FN 33921	6	15.000	0,8	13.200	H = 195	Q = 7,92
																		26.400		
40	Sektor : Cirebon	PLTA Parakan Kondang Sungai Cimanuk	I	Escher Wyss	Francis.Hor F.37/550	3861	3600	600	1955	Escher Wyss	F.37/ N 550	Smits SL	D.G.	26453	6,3	3.200	0,78	2.496	H = 52,6	Q = 6
			II	Escher Wyss	Francis.Hor F.37/550	3862	3600	600	1955	Escher Wyss	F.37/ N 550	Smits SL	D.G.	26454	6,3	3.200	0,78	2.496	H = 52,6	Q = 6
			III	James Leffel	Francis.Hor	2759	3500	600	1955	Wood Ward	LHR 269949	G.E.	AT.1	6920306	6,3	3.200	0,77	2.464	H = 52,6	Q = 6
			IV	James Leffel	Francis.Hor	DDW 2760	3500	600	1955	Wood Ward	LHR 269948	G.E.	AT.1	6920305	6,3	3.200	0,77	2.464	H = 52,6	Q = 6
																		9.920		

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

NO UNIT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	THN PA-SA-NG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN H=...M	KETERANGAN Q=...M3/dt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
41	Sektor : Priangan	PLTA Plengan Sungai Cilaki,Cisangkuy,Cisarua.	I	Escher Wyss	Francis.Hor	6355	1500	750	1922	Escher Wyss	F.25	G.E.	ATB.8 1500 M	2238668	6,3	1.500	0,7	1.050	H = 90	Q = 1,66
			II	Escher Wyss	Francis.Hor	6356	1500	750	1922	Escher Wyss	F.25	G.E.	ATB.8 1500 M	2238667	6,3	1.500	0,7	1.050	H = 90	Q = 1,66
			III	Escher Wyss	Francis.Hor	6357	1500	750	1922	Escher Wyss	F.25	G.E.	ATB.8 1500 M	5999967	6,3	1.500	0,7	1.050	H = 90	Q = 1,66
			IV	B. Mayer	Francis.Hor	1799	2900	750	1962	-	-	Siemens	VFL 400/ 35-8	B.1100211	6,3	2.500	0,8	2.000	H = 90	Q = 2,85
																		5.150		
42		Lamajan Sungai Cisangkuy(Cilaki,Cisangkuy,Cisarua.	I	Charmilles	Francis.Vert	2764	9000	600	1924	Charmilles	PIC-PIC	Smits.SL	VDG. 260-110 Suspension.	10233	6,3	8.000	0,8	6.400	H = 216	Q = 3,6
			II	Charmilles	Francis.Vert	2745	9000	600	1925	Charmilles	PIC-PIC	Smits.SL	VDG. 260-110 Suspension.	10231	6,3	8.000	0,8	6.400	H = 216	Q = 3,6
			III	Charmilles	Francis.Vert	3578	9000	600	1934	Charmilles	PIC-PIC	Heemaf	B.230-10 Suspension	1801020	6,3	8.000	0,8	6.400	H = 216	Q = 3,6
																		19.200		

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

NO UNIT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	TEN PA-SA-NG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN H=...M	KETERANGAN Q=...M3/dt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
43		PLTA Cikalong / Sungai Cisangkuy (Cilaki, Cisangkuy, Cisarua)	I	Neyrpic	Francis.Hor	-	9100	750	1960	Neyrpic	Type 570	Alsthom Belfort	RV.220 85	371799	6,3	8.000	0,8	6.400	H = 140	Q = 5,5
			II	Neyrpic	Francis.Hor	-	9100	750	1960	Neyrpic	Type 570	Alsthom Belfort	RV.220 85	371798	6,3	8.000	0,8	6.400	H = 140	Q = 5,5
			III	Neyrpic	Francis.Hor	-	9100	750	1960	Neyrpic	Type 570	Alsthom Belfort	RV.220 85	371797	6,3	8.000	0,8	6.400	H = 140	Q = 5,5
																		19.200		
1		Bengkok/Dago / Sungai Cikapundung	I	Escher Wyss	Francis.Hor	6358	1500	750	1923	Escher Wyss	F.25	G.E.	ATB.8 1500 M.750	3748464	6,3	1.500	0,7	1.050	H = 104	Q = 1,37
			II	Escher Wyss	Francis.Hor	6359	1500	750	1923	Escher Wyss	F.25	G.E	ATB.8 1500 M.750	7940371	6,3	1.500	0,7	1.050	H = 104	Q = 1,37
			III	Escher Wyss	Francis.Hor	6984	1500	750	1923	Escher Wyss	F.25	G.E	ATB.8 1500 M.750	3748463	6,3	1.500	0,7	1.050	H = 104	Q = 1,37
			IV	Charmilles	Francis.Hor	2704	1000	750	1923	Charmilles	PIC-PIC	Smits SL	DG.1505 54/110	9764	6,3	1.000	0,7	700	H = 104	Q = 1,37
																		3.850		

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

NO UNIT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	TEN PA-SA-NG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN	
																			H=...M	Q=...M3/dt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
5	Sektor : Bogor	PLTA Ubrug / Sungai Cicatih	I	Charmilles	Francis.Hor	2708	7600	600	1924	Charmilles	PIC-PIC	Siemens	PFL 520 40/600	1024880	6,3	7.200	0,75	5.400	H = 74	Q = 11,59
			II	Charmilles	Francis.Hor	2709	7600	600	1924	Charmilles	PIC-PIC	Siemens	PFL.520 40/600	1024881	6,3	7.200	0,75	5.400	H = 74	Q = 11,59
			III	Charmilles	Francis.Hor	23750	8900	600	1950	Charmilles	-	Smits SL	D.C.	23750	6,3	8.400	0,75	6.300	H = 74	Q = 11,59
																		17.100		
6		Kracak / Sungai Cianten dan Ciklumung	I	Charmilles	Francis.Vert	3044	8600	750	1927	Charmilles	-	Smits.SL	VDG.215 160 Suspen-sion	21196	6,3	6.500	0,85	5.525	H = 104	Q = 8,9
			II	Charmilles	Francis.Vert	3045	8600	750	1927	Charmilles	-	Smits.SL	VDG.215 160 Suspension	12195	6,3	6.500	0,85	5.525	H = 104	Q = 8,9
			III	Charmilles	Francis.Vert	3046	8600	750	1958	Charmilles	S.267	Smits.SL	VDG.215 160 Suspen-sion	40019	6,3	6.500	0,85	5.525	H = 104	Q = 8,9
																		16.575		

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

NO UNIT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	TEN PA-SA-NG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN H=...M	KETERANGAN Q=...M3/dt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	Distribusi JATIN																			
47	Cabang : Banyuwangi	PLTM Klonoing	I	Escher Wyss	Francis.Hor	7552	74	1000	1927	Escher Wyss	-	A.E.G	SDG. 1001/G	2060559	3	65	0,8	52		
48	Madium	Pakis Baru	I	Barata	Pelton .Hor	-	125	1000	1979	Jyoti	B	Jyoti	Brush Hor	1801	0,38	150	0,8	120		
		Taneggul	I	PT. Tisco	Kaplan.Vert	-	76	500	1978	Gilkes	-	AIM.Larroy	Brush-less synch	-	0,38	75	0,8	60	H = 40	Q = 1,85
49	Madiun Distribusi JATENG	Widas	I	Meidensha	Cross Flow HS-8N-P-3	MH-98866R-1	710	239	1983	Meidensha	HT-4HN	Meidensha	ED-AVR	149509 PA1	0,33	-	0,88	650	H = 21,6	Q = 4,5
50	Cabang : Purwokerto	Wonosobo Sungai Wanganaji	I	Escher Wyss	Francis.Hor	7385	166	750	1943	Escher Wyss	-	A.E.G.	SOD. 750/155	2059723	6	155	0,8	124		
51		Banjarnegara Sungai Serayu	I	JM. Voith	Francis.Hor	14995	360	1000	1949	JM.Voit	-	B.B.C.	W.465	14995	6,3	320	0,8	256	H = 25	Q = 2
52		Ngargoyoso	I	PT. Tisco	Francis.Hor	-	81	750	1971	Jyoti	-	Unelec	.AT 250LB7	-	0,22	75	0,8	60	H = 30 (Pemda)	Q = 0,33

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

NO UNIT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	THN PASANG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN	
																			H=...M	Q=...M3/
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
53		PLTM Nonodadi	I	Neyrpic	Bulb.Turbin	-	-	720	1981	-	-	Unelec	AT.400 MB.5	-	0,38	262,5	0,8	210	H = 3,8	Q = 7,
	Cabang :																			
54	Yogyakarta	Talang-Kromak	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cabang :																			
55	Tegal	Tonjong	I	Barata	Francis.Hor	-	-	600	1978	Jyoti	-	Siemens	IFC 4403	M.199622	0,4	260	0,8	208	-	-
56		Mejagong	I	Neyrpic	Bulb.Turbin	-	782	802	1980	-	-	Unelec	-	-	0,38	-	-	575	H = 14,37	Q = 5
	Distribusi JABAR																			
	Cabang :																			
57	Cirebon	PLTM Maja	I	Barata	Francis.Hor	-	-	750	1977	Jyoti	B	Jyoti	-	4722	0,38	110	0,8	75	H = 11,6	Q = 0
		Sungai Cilangkrang																		
58		Slamanegu	I	Barata	Francis.Hor	-	135	606	1977	Jyoti	-	Jyoti	Brush Hor	SR.17971 S.472	6,3	110	0,7	154	-	-

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN : 1987/1988

NO UNIT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	THN PA-SA-NG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN H=...M	KETERANGAN Q=...M
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
59	Cabang : Cianjur	PLTN Cijedil / Sungai Cianjur	I	JM.Voith	Francis.Hor	7299	200	1000	1923	JM.Voith	Pendu-lum	Siemens Schuckert	VFW 360.g/ 1000	1093503 N	6,3	174	0,7	122	H = 35	Q =0,
			II	JM.Voith	Francis.Hor	7300	200	1000	1923	JM.Voith	Pendu-lum	Siemens Schuckert	VFW 360.g/ 1000	1093502 N	6,3	174	0,7	122	H = 35	Q =0,
			III	JM.Voith	Francis.Hor	7296	250	1000	1921	JM.Voith	Pendu-lum	Siemens Schuckert	VFW 370.h/ 1000	1093501 N	6,3	220	0,7	154	H = 35	Q =0,
			IV	JM.Voith	Francis.Hor	7297	250	1000	1921	JM.Voith	Pendu-lum	Siemens Schuckert	VFW 370.h/ 1000	1093500 N	6,3	220	0,7	154	H = 35	Q =0,
																		552		
60	L.M.K.	Cibinong	I	Dwikn	Francis.Hor	-	-	1000	1962	-	-	Rode.K		880007	0,22	25	0,8	20		
61	L.M.K.	Cipayung	I	Barata	Francis.Hor	-	-	1000	1977	Jyoti	-	-	-	-	0,38	500	0,8	400	H = 40	

PERUSAHAAN UMUM LISTRIK NEGARA PUSAT
DINAS PEMELIHARAAN TENAGA AIR

I N V E N T A R I S A S I
UNIT-UNIT PUSAT LISTRIK TENAGA AIR DAN MICRO HYDRO TAHUN :1987/1988

NO UNIT	LOKASI	PUSAT LISTRIK	NO UNIT	MEREK MESIN	TYPE/ MODEL	NOMOR SERIE	HORSE POWER	RPM	THN PA-SA-NG	MEREK GOVERNOR	TYPE/ MODEL GOV	MEREK GENERATOR	TYPE/ MODEL GEN	NOMOR SERIE	KV	KVA	COS Q	KW	KETERANGAN H=...M	KETERANGAN Q=...
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
	Sektor :	PLTA																		
62	Saguling	Saguling	I	Toshiba	Francis.Vert	-	-	333,3	1984	-	-	Mitsubishi Electric-Corp	Syn - crho - nous	82EN8101	16,5	206100	0,85	175.000	H = 335,7	Q =
			II	Toshiba	Francis.Vert	-	-	-"-	1984	-	-	- " -	-"-	82EN8201	16,5	206100	0,85	175.000	H = 335,7	Q =
			III	Toshiba	Francis.Vert	-	-	-"-	1985	-	-	- " -	-"-	82EN8301	16,5	206100	0,85	175.000	H = 335,7	Q =
			IV	Toshiba	Francis.Vert	-	-	-"-	1985	-	-	- " -	-"-	83EN8401	16,5	206100	0,85	175.000	H = 335,7	Q =
	P.O	PLTA																		
63	Jatiluhur	Ir.H.Juanda	VI	Neyrpic	Francis.Vert	-	35000	272	1982	Neyrpic	RAPID	Alsthom Atlantique	RYV 469107	410983	6,3	40.000	0,62	25.000	H = 66 (pengelolaan uni PLTA Juanda Jatiluhur)	Q = olc

Table 5-2 CLASSIFICATION TABLE OF MAJOR COMPONENTS FOR EXISTING HYDRAULIC GENERATING EQUIPMENT

NAME OF P/S		INSTALLED OPERATED YEAR		SPEED (RPM)	TURBINE OUTPUT (kW)	HEAD (m)	DISCHARGE (cu.m/s)	ESTIMATED DIMENSION AND CLASSIFICATION OF MAJOR COMPORNENT									
								NS (m-kW)	RUNNER		COVER		GUIDE VANE			SHAFT	
									DIA. (mm)	CLASS	DIA. (mm)	CLASS	WID. (mm)	Q'ty	CLASS	DIA. (mm)	CLASS
(1) Francis-Hor																	
1	TARUTUNG	1	1926	61	1,500	60	60.00	70	500	a	1,000	b	50	12	a	50	a
	"	2	1926	61	1,500	60	60.00	70	500	a	1,000	b	50	12	a	50	a
2	MUNTHE	3	1976	11	446	80	9.45	1.050	241	500	a	900	a	190	12	b	75	a
3	BATANG AGAM	4	1976	11	750	3,500	90.80	4.490	158	1,000	b	1,629	b	240	16	b	210	c
	"	5	1976	11	750	3,500	90.80	4.490	158	1,000	b	1,629	b	240	16	b	210	c
	"	6	1981	6	750	3,500	90.80	4.490	158	1,000	b	1,629	b	240	16	b	210	c
4	LEMPUR	7	1979	8	1,000	80	29.00	0.500	133	500	a	900	a	100	12	a	55	a
5	SUNGAI PENUH	8	1959	28	1,000	70	32.00	0.300	110	400	a	800	a	65	12	a	55	a
6	KOTO ANAU	9	1977	10	1,000	160	27.50	0.900	201	500	a	900	a	160	12	b	70	a
7	MUARA LABUH	10	1982	5	750	400	35.00	1.870	176	500	a	1,000	a	135	12	a	105	a
8	TES	11	1959	28	1,000	660	43.50	1.500	230	425	a	838	a	160	12	b	110	b
	"	12	1959	28	1,000	660	43.50	1.500	230	425	a	838	a	160	12	b	110	b
9	T.KANING	13	1977	10	660	100	14.30	0.950	237	500	a	900	a	190	12	b	70	a
10	K.CURUP	14	1983	4	750	1,000	63.00	2.250	134	475	a	864	a	95	12	a	140	b
11	TENGA	15	1977	10	1,000	180	23.50		259	500	a	900	a	210	12	b	75	a
12	SAWIDAGO	16	1983	5	695	120	15.30	1.060	258	500	a	1,000	a	205	12	b	70	a
13	HANGA.-HANGA	17	1985	2	-	1,600	-		-	800	b	1,300	b	-	14	b		b
14	CENAE	18	1971	16	625	90	12.50		252	500	a	900	b	200	12	b	70	a
15	KARANG ASEM	19	1972	15	588	80	11.15	0.300	258	500	a	900	a	205	12	b	70	a
16	NARMADA	20	1976	11	750	120	15.30	1.000	272	500	a	900	a	220	12	b	70	a
17	RUTENG	21	1979	8	740	120	17.35		229	500	a	900	a	180	12	b	70	a
18	BAJAWA/OGI	22	1981	6	1,327	160	54.00	0.470	115	500	a	900	a	85	12	a	65	a
19	MENDALAN	23	1930	57	750	5,600	152.50	5.250	105	1,250	c	1,929	b	190	18	a	250	c
	"	24	1955	32	750	5,800	152.50	5.300	107	1,250	c	1,929	b	195	18	b	250	c
	"	25	1955	32	750	5,800	152.50	5.300	107	1,250	c	1,929	b	195	18	b	250	c
	"	26	1955	32	750	5,800	152.50	5.300	107	1,250	c	1,929	b	195	18	b	250	c
20	GIRINGAN	27	1937	50	1,000	1,400	106.50	1.130	109	600	b	940	a	100	12	a	145	a
	"	28	1955	32	1,000	900	106.50	1.130	88	600	b	941	a	75	12	a	125	b
	"	29	1955	32	1,000	900	106.50	1.170	88	600	b	941	a	75	12	a	125	b
21	GOLANG	30	1959	28	1,000	900	88.50	1.370	111	600	b	943	a	100	12	a	125	b
	"	31	1959	28	1,000	900	88.50	1.370	111	600	b	943	a	100	12	a	125	b
	"	32	1959	28	1,000	900	88.50	1.370	111	600	b	943	a	100	12	a	125	b
22	NGEBEL	33	1968	19	1,000	2,200	183.50	1.410	69	800	b	1,235	b	65	14	a	170	b
23	JELOK	34	1937	50	600	5,120	144.00	4.481	86	950	b	1,646	b	115	16	a	260	c
	"	35	1938	49	600	5,120	144.00	4.481	86	950	b	1,646	b	115	16	a	260	c
	"	36	1938	49	600	5,120	144.00	4.481	86	950	b	1,646	b	115	16	a	260	c
	"	37	1962	25	600	5,120	144.00	4.481	86	1,250	c	1,929	b	150	18	a	260	c
24	TIMO	38	1963	24	750	4,000	103.00	4.600	145	1,060	b	1,667	b	230	16	b	220	c
	"	39	1963	24	750	4,000	103.00	4.600	145	1,060	b	1,667	b	230	16	b	220	c
	"	40	1963	24	750	4,000	103.00	4.600	145	1,060	b	1,667	b	230	16	b	220	c
		40				79,880		88.944									

	NAME OF P/S		INSTALLED OPERATED YEAR		SPEED (RPM)	TURBINE OUTPUT (kW)	HEAD (m)	DISCHARGE (cu.m/s)	ESTIMATED DIMENSION AND CLASSIFICATION OF MAJOR COMPORNENT									
									NS (m-kW)	RUNNER		COVER		GUIDE VANE			SHAFT	
										DIA. (mm)	CLASS	DIA. (mm)	CLASS	WID.(mm)	Q'ty	CLASS	DIA. (mm)	CLASS
25	SEMPOR	41	1980	7	750	1,000	30.00	3.130	338	475	a	1,204	b	265	12	c	140	c
26	PARAKAN	42	1955	32	600	2,496	52.60	6.000	212	800	b	1,579	b	275	14	c	205	c
	"	43	1955	32	600	2,496	52.60	6.000	212	800	b	1,579	b	275	14	c	205	c
	"	44	1955	32	600	2,496	52.60	6.000	212	800	b	1,579	b	275	14	c	205	c
	"	45	1955	32	600	2,496	52.60	6.000	212	800	b	1,579	b	275	14	c	205	c
27	PLENGAN	46	1922	65	750	1,050	90.00	1.660	88	600	b	978	a	75	12	a	145	b
	"	47	1922	65	750	1,050	90.00	1.660	88	600	b	978	a	75	12	a	145	b
	"	48	1922	65	750	1,050	90.00	1.660	88	600	b	978	a	75	12	a	145	b
	"	49	1962	25	750	2,000	90.00	2.850	121	800	b	1,304	b	145	14	a	180	b
28	CIKALONG	50	1960	27	750	6,400	140.00	5.500	125	1,180	c	2,612	c	215	18	b	260	c
	"	51	1960	27	750	6,400	140.00	5.500	125	1,180	c	2,612	c	215	18	b	260	c
	"	52	1960	27	750	6,400	140.00	5.500	125	1,180	c	2,612	c	215	18	b	260	c
29	BENGKOK/DAGO	53	1923	64	750	1,050	104.00	1.370	73	600	b	943	a	60	12	a	145	b
	"	54	1923	64	750	1,050	104.00	1.370	73	600	b	943	a	60	12	a	145	b
	"	55	1923	64	750	1,050	104.00	1.370	73	600	b	943	a	60	12	a	145	b
	"	56	1923	64	750	1,050	104.00	1.370	73	600	b	943	a	60	12	a	145	b
30	UBRUG	57	1924	63	600	5,400	74.00	11.590	203	1,200	c	2,081	b	385	18	d	260	c
	"	58	1924	63	600	5,400	74.00	11.590	203	1,200	c	2,081	b	385	18	d	260	c
	"	59	1950	37	600	6,300	74.00	11.590	219	1,200	c	2,368	c	420	18	d	280	c
31	KLONOING	60	1927	60	1,000	52	-		-	500	a	950	a	-	12	a	50	a
32	WONOSOBO	61	1943	44	750	124	-		-	500	a	1,000	b	-	12	a	75	a
33	BANFARNEGORA	62	1949	38	1,000	256	25.00	2.000	286	600	b	1,200	b	280	12	b	85	a
34	NGARGOYOSA	63	1971	16	750	60	30.00	0.330	83	500	a	900	b	60	12	a	60	a
35	TONJONG	64	1978	9	600	208	-		-	500	a	900	a	-	12	a	90	a
36	MAJA	65	1977	10	750	75	11.60	0.925	303	500	a	900	a	245	12	b	60	a
37	SLAMANGGU	66	1977	10	606	154	-		158	500	a	900	a	120	12	a	80	a
38	CIJEDIL	67	1923	64	1,000	122	35.00	0.300	130	500	a	950	a	100	12	a	65	a
	"	68	1923	64	1,000	122	35.00	0.300	130	500	a	950	a	100	12	a	65	a
	"	69	1921	66	1,000	154	35.00	0.360	146	500	a	950	a	110	12	a	70	a
	"	70	1921	66	1,000	154	35.00	0.360	146	500	a	950	a	110	12	a	70	a
39	CIBINONG	71	1962	25	1,000	20	-		-	400	a	800	a	-	12	a	40	a
40	CIPAYUNG	72	1977	10	1,000	400	40.00		199	500	a	900	a	155	12	b	95	a
		32				58.535		96.285										
		72				138.415		185.229										

NAME OF P/S		INSTALLED OPERATED YEAR		SPEED (RPM)	TURBINE OUTPUT (kW)	HEAD (m)	DISCHARGE (cu.m/s)	ESTIMATED DIMENSION AND CLASSIFICATION OF MAJOR COMPORNENT								
								NS (m-kW)	RUNNER		COVER		GUIDE VANE			SHAFT	
									DIA. (mm)	CLASS	DIA. (mm)	CLASS	WID. (mm)	Q'ty	CLASS	DIA. (mm)	CLASS
(2) Francis-Vert																	
1	MANINJAU	1	1980	7 600.0	17.200	226.00	8.730	90	1,130	c	1,760	b	145	18	a	390	d
	"	2	1980	7 600.0	17.200	226.00	8.730	90	1,130	c	1,760	b	145	18	a	390	d
	"	3	1980	7 600.0	17,200	226.00	8.730	90	1,130	c	1,760	b	145	18	a	390	d
	"	4	1980	7 600.0	17,200	226.00	8.730	90	1,130	c	1,760	b	145	18	a	390	d
2	IR.PM.NOOR	5	1971	16 273.0	10,000	39.80	30.340	273	1,500	c	2.710	c	860	18	f	420	e
	"	6	1971	16 273.0	10,000	39.80	30.340	273	1,500	c	2,710	c	860	18	f	420	e
	"	7	1980	7 273.0	10,000	39.80	30.340	273	1,320	c	2,780	c	580	18	f	420	e
3	TONSEA LAMA	8	1950	37 500.0	4,440	96.00	6.400	111	800	b	1,400	b	130	14	a	260	c
	"	9	1970	17 600.0	4,500	89.50	6.490	146	750	b	1,357	b	165	14	b	250	c
	"	10	1981	6 600.0	5,440	93.25	6.770	153	850	b	1,490	b	200	14	b	270	c
4	PONTAK	11	1979	8 150.0	60	5.00	2.100	155	500	a	900	b	120	12	a	95	a
5	WAMENA	12	1977	10 197.0	120	5.00	3.600	289	500	a	900	b	235	12	b	110	b
6	SIMAN	13	1935	52 600.0	3,600	98.00	4.500	117	850	c	1,368	b	145	14	a	230	c
	"	14	1955	32 600.0	3,600	98.00	4.500	117	850	c	1,368	b	145	14	a	230	c
	"	15	1955	32 600.0	3,600	98.00	4.500	117	850	c	1,368	b	145	14	a	230	c
7	SUTAMI	16	1973	14 250.0	35,000	78.00	53.500	202	2,000	d	3,600	d	640	20	f	650	f
	"	17	1973	14 250.0	35,000	78.00	53.500	202	2,000	d	3,600	d	640	20	f	650	f
	"	18	1974	13 250.0	35,000	78.00	53.500	202	2,000	d	3,600	d	640	20	f	650	f
8	GARUNG	19	1982	5 750.0	13,200	195.00	7.920	118	1,130	c	1,758	b	195	18	b	330	d
	"	20	1982	5 750.0	13,200	195.00	7.920	118	1,130	c	1,758	b	195	18	b	330	d
9	LAMAJAN	21	1924	63 600.0	6,400	216.00	3.600	58	900	b	1,380	b	65	14	a	280	c
	"	22	1925	62 600.0	6,400	216.00	3.600	58	900	b	1,380	b	65	14	a	280	c
	"	23	1934	53 600.0	6,400	216.00	3.600	58	900	b	1,384	b	65	14	a	280	c
10	KRACAK	24	1927	60 750.0	5,525	104.00	8.900	168	1,060	b	1,747	b	280	16	b	250	c
	"	25	1927	60 750.0	5,525	104.00	8.900	168	1,060	b	1,747	b	280	16	b	250	c
	"	26	1927	60 750.0	5,525	104.00	8.900	168	1,060	b	1,747	b	280	16	b	250	c
11	SAGULING	27	1984	3 333.3	175,000	335.70	56.000	97	2,000	d	3,600	d	280	20	b	1,020	g
	"	28	1984	3 333.3	175,000	335.70	56.000	97	2,000	d	3,600	d	280	20	b	1,020	g
	"	29	1985	2 333.3	175,000	335.70	56.000	97	2,000	d	3,600	d	280	20	b	1,020	g
	"	30	1985	2 333.3	175,000	335.70	56.000	97	2,000	d	3,600	d	280	20	b	1,020	g
12	IR.H.JUANDA	31	1982	5 272.0	25,000	66.00	45.000	229	1,760	d	3,490	d	635	20	f	570	f
		31			1,016,335		647.640										
		103			1,154,750		832.869										

NAME OF P/S		INSTALLED OPERATED YEAR		SPEED (RPM)	TURBINE OUTPUT (kW)	HEAD (m)	DISCHARGE (cu.m/s)	ESTIMATED DIMENSION AND CLASSIFICATION OF MAJOR COMPORNENT									
								NS (m-kW)	RUNNER		COVER		GUIDE VANE			SHAFT	
									DIA. (mm)	CLASS	DIA. (mm)	CLASS	WID. (mm)	Q'ty	CLASS	DIA. (mm)	CLASS
(3) Kaplan-Vert																	
1	SAWITO	1	1940	47	250	540	6.80	10.000	529	-		-		-			165	b
	"	2	1940	47	250	540	6.80	10.000	529	-		-		-			165	b
	"	3	1973	14	250	540	6.80	10.000	529	-		-		-			165	b
2	SELOREJO	4	1973	14	500	4.080	37.10	14.700	349	-		-		-			260	c
3	WLINGI	5	1978	9	143	27,000	22.00	143.000	493	-		-		-			720	g
	"	6	1978	9	143	27,000	22.00	143.000	493	-		-		-			720	g
4	WONOGIRI	7	1981	6	273	6.200	20.40	36.700	496	-		-		-			360	d
	"	8	1981	6	273	6.200	20.40	36.700	496	-		-		-			360	d
5	TANGGUL	9	1978	9	500	60	40.00	1.850	39	-		-		-			65	a
		9				72.160		405.950									
(4) Kaplan-Hor																	
1	LODOYO	1	1982	5	150	4,500	8.50	67.500	693	-		-		-			390	d
(5) Pelton-Hor																	
1	KETENGER	1	1939	48	600	3.520	272.50	1.615	32	-		-		-			230	c
	"	2	1939	48	600	3.520	272.50	1.615	32	-		-		-			230	c
2	PAKIS BARU	3	1979	8	1.000	120	-		-	-		-		-			70	a
		3				7.160		3.230									
(6) Bulb Turbine																	
1	ANGKUP	1	-	-	659	372	9.00	5.100	815	-		-		-			110	a
	"	2	-	-	659	372	9.00	5.100	815	-		-		-			110	a
2	HARUYAN	3	1976	11	460	200	-		-	-		-		-			100	a
3	MEJAGONG	4	1980	7	802	575	14.37	5.100	687	-		-		-			120	a
4	WONODADI	5	1981	6	720	210	3.80	7.200	-	-		-		-			100	a
		5				1.729		22.500									
(7) Cross Flow																	
1	WIDAS	1	1983	4	239	650	21.60	4.500	131	-		-		-			180	b
		122				1.240.949											

Table 5-3a CLASSIFICATION TABLE (according to measuring range and Operation period)

Unit: Piece

Measuring Range / Operation period (year)	RUNNER a (A) φcm ~ 50	RUNNER b (A) ~ 100	RUNNER c (B) ~ 150	RUNNER d (C) 150 ~	LINER a (A) φcm ~ 100	LINER b (B) ~ 200	LINER c (C) ~ 300	LINER d (C) 300 ~
~ 5 (11)	3	1	2	5	3	3	0	5
~10 (20)	13	2	5	0	12	7	1	0
~15 (8)	3	2	0	3	3	2	0	3
~20 (6)	2	2	2	0	2	2	2	0
~25 (6)	1	4	1	0	1	5	0	0
~30 (9)	3	3	3	0	6	0	3	0
~35 (11)	0	8	3	0	2	9	0	0
~40 (3)	0	2	1	0	0	2	1	0
~50 (5)	1	4	0	0	2	3	0	0
~60 (7)	1	5	1	0	1	6	0	0
61~ (17)	6	9	2	0	13	4	0	0
Total 103 Units	(A) 33	42	(B) 20	(C) 8	(A) 45	(B) 43	(C) 7	8

to be repaired ⟷ to be newly produced

Table 5-3b CLASSIFICATION TABLE (according to measuring range and Operation period)

Unit: Piece

Measuring Range / Operation period (year)	GUIDE VANE A a	GUIDE VANE B b	GUIDE VANE C c	GUIDE VANE C d	GUIDE VANE D e	GUIDE VANE D f	SHAFT A a	SHAFT B b	SHAFT c	SHAFT d	SHAFT e	SHAFT f	SHAFT g
	a	b	c	d	e	f	a	b	c	d	e	f	g
	cm ~15	~25	~35	~45	~55	60 ~	~ 10	~ 20	~ 30	~ 40	~ 50	~ 60	cm 61 ~
~ 5 (11)	24	62	80	0	0	20	2	2	0	2	0	1	4
~10 (20)	132	114	16	0	18	0	11	2	2	4	1	0	0
~15 (8)	12	56	0	0	0	60	2	1	1	0	2	2	0
~20 (6)	26	26	0	0	0	36	2	1	1	0	2	0	0
~25 (6)	44	48	0	0	0	0	1	1	4	0	0	0	0
~30 (9)	48	78	0	0	0	0	1	5	3	0	0	0	0
~35 (11)	52	54	56	0	0	0	0	2	9	0	0	0	0
~40 (3)	14	0	12	18	0	0	1	0	2	0	0	0	0
~50 (5)	72	0	0	0	0	0	1	1	3	0	0	0	0
~60 (7)	40	18	48	0	0	0	1	0	6	0	0	0	0
61~ (17)	196	0	0	36	0	0	6	7	4	0	0	0	0
Total	(A) a	(B) b	(C) c	(C) d	(D) e	(D) f	(A) a	(B) b	c	d	(C) e	f	g
103 Units 1,516 pcs.	660	456	212	54	18	116	28	22	35	6	5	3	4

← to be newly produced

→ to be repaired

Table 5-4a MEAN MACHINING TIME (RUNNER)

UNIT: Hour

Q'ty / Item	A – 75 pcs. New 51 Repair 24	B – 20 pcs. New 13 Repair 7	C – 8 pcs. New 0 Repair 8	Mean machining time New 64 / Repair 39 } 103 pcs.
Preparation	15 - 1,125	16 - 320	16 - 128	1,573/103 = 15.0H
Design	150 -11,250	150 - 3,000	150 - 1,200	15,450/103 = 150.0
Marking	15 - 1,125	24 - 480	32 - 256	1,861/103 = 18.0
Finishing	150 -11,250	210 - 4,200	232 - 1,856	17,306/103 = 168.0
Inspection	130 - 9,750	140 - 2,800	150 - 1,200	13,750/103 = 133.0
1 Sub-total	460 -34,500	540 -10,800	580 - 4,640	49,940/103 = 484 H
Face lathe	84H - 6,300H	90H - 1,800	100H - 800	8,900H /103 = 86.0H
Lathe	55H - 4,125	57 - 1,140	63 - 504	5,769H / 103 = 56.0
Hor.B.Mach.	27H - 2,025	33 - 660	33 - 264	2,949 / 103 = 29.0
Ver.B.Mach.	20H - 1,500	20 - 400	20 - 160	2,060 / 103 = 20.0
Radial.D.Mach.	1.7H- 127	2 - 40	3.5- 28	195 / 103 = 2.0
2 Sub-total	187.7H-14,077	202H - 4,040	219.5H-1,756	19,873H /103 = 193 H
Press	55H - 4,125	57 - 1,140	62 - 496	5,761 / 103 = 56.0
Metalwork	495 -37,125	580 -11,600	615 - 4,920	53,645 /103 = 520.0
Grinding	190 -14,250	220 - 4,400	235 - 1,880	20,530 /103 = 200
3 Sub-total	740 -55,500	857H -17,140	912H - 7,296	79,936 /103 = 776.0H
Total (2 + 3)	927.7H-69,577	1,059H-21,180	1131.5- 9,052	99,809 /103 = 969 H
Grand total (1 + 2 + 3)	1387.7-104,077	1,599H-31,980	1,712 -13,696	149,749 /103 = 1,453 H

Ratios of repair working-hour to new production working hour of machine tools are assumed as follows:

Face lathe	85 - 90 %	Press	10 - 20 %
Lathe	80 - 85 %		
Horizontal boring machine	70 - 75 %	Metalwork	45 - 55 %
Vertical boring machine	45 - 50 %	Grinding	65 - 75 %

Table 5-4b MEAN MACHINING TIME (LINER)

Unit: Hour

Q'ty / Item	A−45 × 4 = 180 pcs.	B−43 × 4 = 172 pcs.	C−15 × 4 = 60 pcs.	Mean Machining Time (412 pcs.)
Preparation	2H - 360	2 - 344	4 - 240	944/412 = 3.0H
Design	11H - 1,980	11 - 1,892	13 - 780	4,652/412 = 11.0
Marking	2H - 360	2 - 344	3 - 180	884/412 = 3.0
Finishing	12 - 2,160	15 - 2,580	22 - 1,320	6,060/412 = 14.0
Inspection	12 - 2,160	13 - 2,236	17 - 1,020	5,416/412 = 13.0
1 Sub-total	39H - 7,020	43H - 7,396	59 - 3,540	17,956/412 = 44.0
Face lathe	23H - 4,140	32 - 5,504	45 - 2,700	12,344/412 = 30.0H
Milling Mach.	13 - 2,340	17 - 2,924	27 - 1,620	6,884/412 = 17.0
Radial.B.Mach.	22 - 3,960	28 - 4,816	41 - 2,460	11,236/412 = 28.0
2 Sub-total	58 -10,440	77 -13,244	113 - 6,780	30,464/412 = 75.0
3 Metalwork	23 - 4,140	32 - 5,504	45 - 2,700	12,344/412 = 30.0H
Total (2 + 3)	81H -14,580	109H -18,748	158H - 9,480	42,808/412 = 105.0
Grand total (1 + 2 + 3)	120H	152H	217H	149 H

Table 5-4c MEAN MACHINING TIME (GUIDE VANE)

Unit: Hour

Item \ Q'ty (Piece)	A－660 New 492 Repair 168	B－456 New 224 Repair 232	C－266 New 170 Repair 96	D－134 New 36 Repair 98	Mean Machining Time New 922 Repair 594 1,516 pcs.
Preparation	1 - 660	1 - 456	1 - 266	1 - 134	1,516／1,516 =1
Design	6 - 3,960	6 - 2,736	6 - 1,596	6 - 804	9,096／1,516 =6
Finishing	2 - 1,320	3 - 1,368	4 - 1,064	8 - 1,072	4,824／1,516 =3
Inspection	1 - 660	1 - 456	1 - 266	1 - 134	1,516／1,516 =1
1 Sub-total	10H - 6,600	11 - 5,016	12 - 3,192	16 - 2,144	16,952／1,516=11 H
Lathe	17H -11,220	20H - 9,120	23H - 6,118	28H - 3,752	30210/1516 = 20.0
Milling mach.	6 - 3,960	7 - 3,192	12 - 3,192	13 - 1,742	12,086/1,516 = 8.0
Shaper	10 - 6,600	13 - 5,928	20 - 5,320	25 - 3,350	21,198/1,516 =14.0
2 Sub-total	33 -21,780	40 -18,240	55 -14,630	66 - 8,844	63,494/1,516 =42.0H
Press	5H - 3,300	6.5- 2,960	10 - 2,660	13 - 1,742	10,662/1,516 ≒ 7.0
Metalwork	25 -16,1500	30 -13,680	35 - 9,310	43 - 5,762	45,252/1,516 ≒ 30.0
Grinding	21 -13,860	25 -11,400	29 - 7,714	36 - 4,824	37,798/1,516 ≒ 25.0
3 Sub-total	51 -33,660	61.5-28,044	74 -19,684	92 -12,328	93,716/1,516 = 62.0
Total (2 + 3)	84H	101	129	158	104H
Grand total (1 + 2 + 3)	94H	112	141	174	115H

Ratios of repair working-hour to new production working hour of machine tools are assumed as follows:

Lathe	75 - 80 %
Milling machine	70 - 75 %
Shaper	65 - 70 %
Press	60 - 70 %
Metalwork	50 - 60 %
Grinding	50 - 60 %

Table 5-4d MEAN MACHINING TIME (SHAFT)

Unit: Hour

Item \ Q'ty (Piece)	A −28 pcs. New 13 Repair 15	B −22 pcs. New 17 Repair 5	C −53 pcs. New 34 Repair 19	Mean Machining Time Repair 39 103 pcs.
Preparation	10 - 280	12 - 264	13 - 689	1,233/103 = 12.0
Design	90 - 2,520	103 - 2,266	124 - 6,572	11,358/103 = 110.0
Marking	18 - 504	25 - 550	35 - 1,855	2,909/103 = 28.0
Finishing	110 - 3,080	174 - 3,828	238 -12,614	19,522/103 = 190.0
Inspection	42 - 1,176	66 - 1,452	70 - 3,710	6,338/103 = 62.0
1 Sub-total	270 - 7,560	380 - 8.360	480 -25,440	41,360/103 = 402.0
Lathe for shaft	135H - 3,780	148H - 3,256	167H - 8.851	15,887/103 = 155.0H
Hor.B.Mach.	13H - 364	15H - 330	16H - 848	1,542/103 = 15.0
Ver.B.Mach.	17H - 476	18H - 396	22H - 1,166	2,038/103 = 20.0
Radial.D.Mach.	1.5H - 42	2H - 44	2H - 106	192/103 = 2.0
2 Sub-total	166.5H -4,662	183H - 4,026	207H -10,971	19,659/103 = 192.0H
Grand total (1 + 2)	436.5 - 12,222	563 - 12,386	687 - 36,411	594.0

Ratios of repair working-hour to new production working-hour of machine tools are assumed as follows:

Lathe for shaft	30 - 35 %
Horizontal boring machine	35 - 40 %
Vertical boring machine	45 - 50 %
Radial drilling machine	45 - 50 %

Table 5-4e MEAN WORKING TIME (LARGE AND SMALL SIZE COMPONENTS)

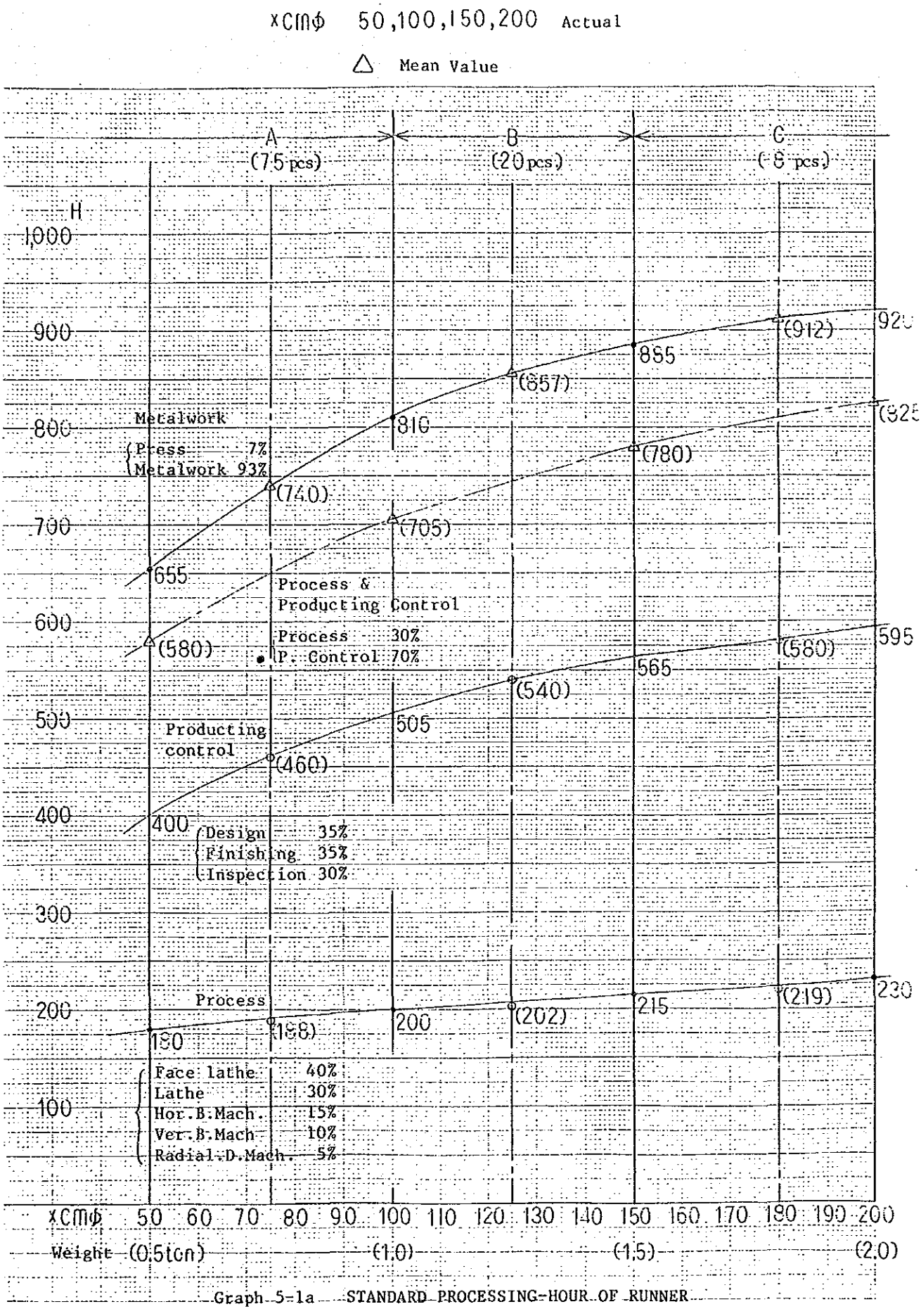
Q'ty (Piece) / Item	RUNNER	LINER	GUIDE VANE	SHAFT	Mean Working Time	
	103	412	1,516	103	Large Size components A	Small size components (A x 90 %)
	a					
Preparation	15H- 1,545	3H- 1,236	1H - 1,516	12- 1,236	5,500	4,900
Design	150-15,450	11 - 4,532	6 - 9,096	110-11,330	40,400	36,300
Marking	18- 1,854	3 - 1,236		28- 2,884	5,900	5,300
Finishing	168-17,304	14 - 5,768	3 - 4,548	190-19,570	47,200	42,400
Inspection	133-13,699	13 - 5,356	1 - 1,516	62- 6,386	26,900	24,200
Total	484H -49,852	44H-18,128	11H - 16,676	402H -41,406	125,900	113,100

Table 5-5a BASIC QUANTITY BY MACHINE FOR LARGE SIZE COMPONENTS

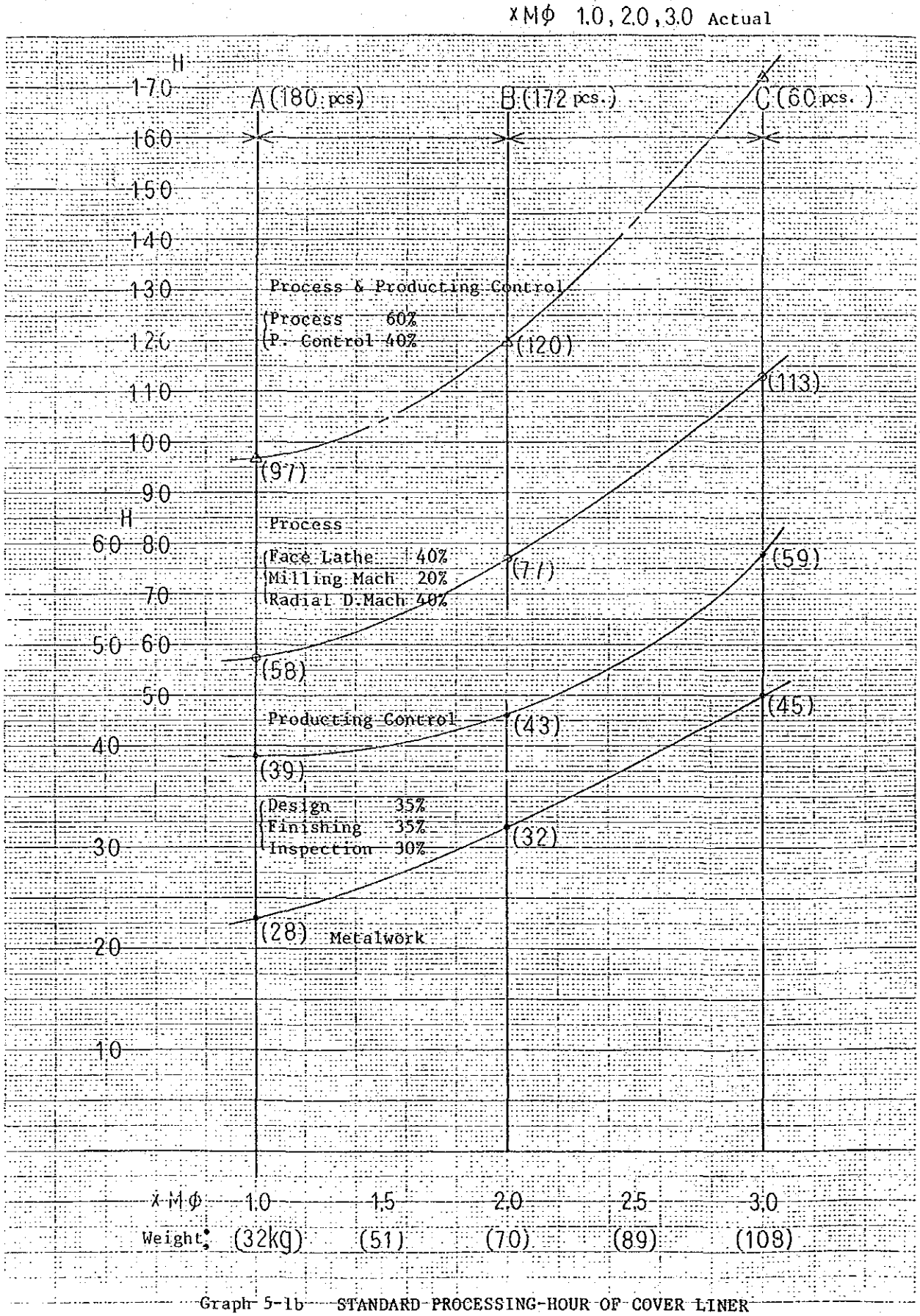
	NAME OF COMPONENT / NAME OF MACHINE	64 UNITS TO BE NEWLY PRODUCED (OPERATION PERIOD ..... OVER 20 YEARS)						39 UNITS TO BE REPARED (OPERATION PERIOD ..... UNTIL 20 YEARS)					A	BASIC QUANTITY			
		RUNNER 64	LINER 103X 4 412	GUIDE VANE 64X n 922	SHAFT 64	ACCESSORY 64	SUB-TOTAL (hour)	RUNNER 39	GUIDE VANE 39 x n 594	SHAFT 39	ACCESSORY 39	SUB-TOTAL (hour)	GRAND TOTAL (hour)	B Day A/7-hour	C Year B/260-day	D QUANTITY/CYCLE C/6-year	BASIC QUANTITY
1	Lathe for Shaft	---	---	---	9,920	---	9,920	---	---	2,106	---	2,106	12,000	1,710	6.5	1.0	1
	(hour/ pc.)				155H					54H							
2	Face & Vertical Lathe	5,504	12,360	---	---	832	18,696	2,964	---	---	234	3,198	21,800	3,110	11.9	1.9	2
	(hour/ pc.)	86H	30H			13H		76H			6H						
3	Horizontal B. Mach.	1,856	---	---	960	192	3,008	858	---	234	39	1,131	4,140	590	2.2	0.4	1
	(hour/ pc.)	29H			15H	3H		22H		6H	1H						
4	Vertical B.Mach.	1,280	---	---	1,280	640	3,200	390	---	390	117	897	4,100	580	2.2	0.4	1
	(hour/ pc.)	20H			20H	10H		10H		10H	3H						
5	Radial D.Mach.	128	11,536	---	128	2,048	13,840	---	---	39	585	624	14,400	2,060	7.9	1.3	2
	(hour/ pc.)	2H	28H		2H	32H				1H	15H						
6	Lathe	3,584	---	18,440	---	11,840	33,864	1,872	9,504	---	3,900	15,276	49,000	7,000	26.9	4.4	1
	(hour/ pc.)	56H		20H		185H		48H	16H		100H						3
7	Milling Mach.	---	7,004	7,376	---	1,216	15,596	---	3,564	---	156	3,720	19,300	2,750	10.5	1.7	2
	(hour/ pc.)		17H	8H		19H			6H		4H						
8	Shaper	---	---	12,908	---	384	13,292	---	5,940	---	78	6,018	19,300	2,750	10.5	1.7	2
	(hour/ pc.)			14H		6H			10H		2H						
9	Press	3,584	---	6,454	---	256	10,294	468	2,970	---	78	3,516	13,800	1,970	7.5	1.3	2
	(hour/ pc.)	56H		7H		4H		12H	5H		2H						
10	Metal Work	33,280	12,360	27,660	---	960	74,260	11,310	10,692	---	390	22,392	96,600	13,800	53.0	8.8	8
	(hour/ pc.)	520H	30H	30H		15H		290H	18H		10H						
11	Air Grinder	12,800	---	23,050	---	1,920	37,770	5,850	8,910	---	780	15,540	53,300	7,610	29.2	4.8	5
	(hour/ pc.)	200H		25H		30H		150H	15H		20H						
	Sub-total (1-8)	12,352	30,900	38,724	12,288	17,152	111,416	6,084	19,008	2,769	5,109	32,970	144,040	20,550	79.0		15
	Sub-total(9-11)	49,664	12,360	57,164	0	3,136	122,324	17,628	22,572	0	1,248	41,448	163,700	23,380	89.9		15
	Grand total	62,016	43,260	95,888	12,288	20,288	233,740	23,712	41,580	2,769	6,357	74,418	307,740	43,930	169.0		30

Table 5-5b BASIC QUANTITY BY MACHINE FOR SMALL SIZE COMPONENTS

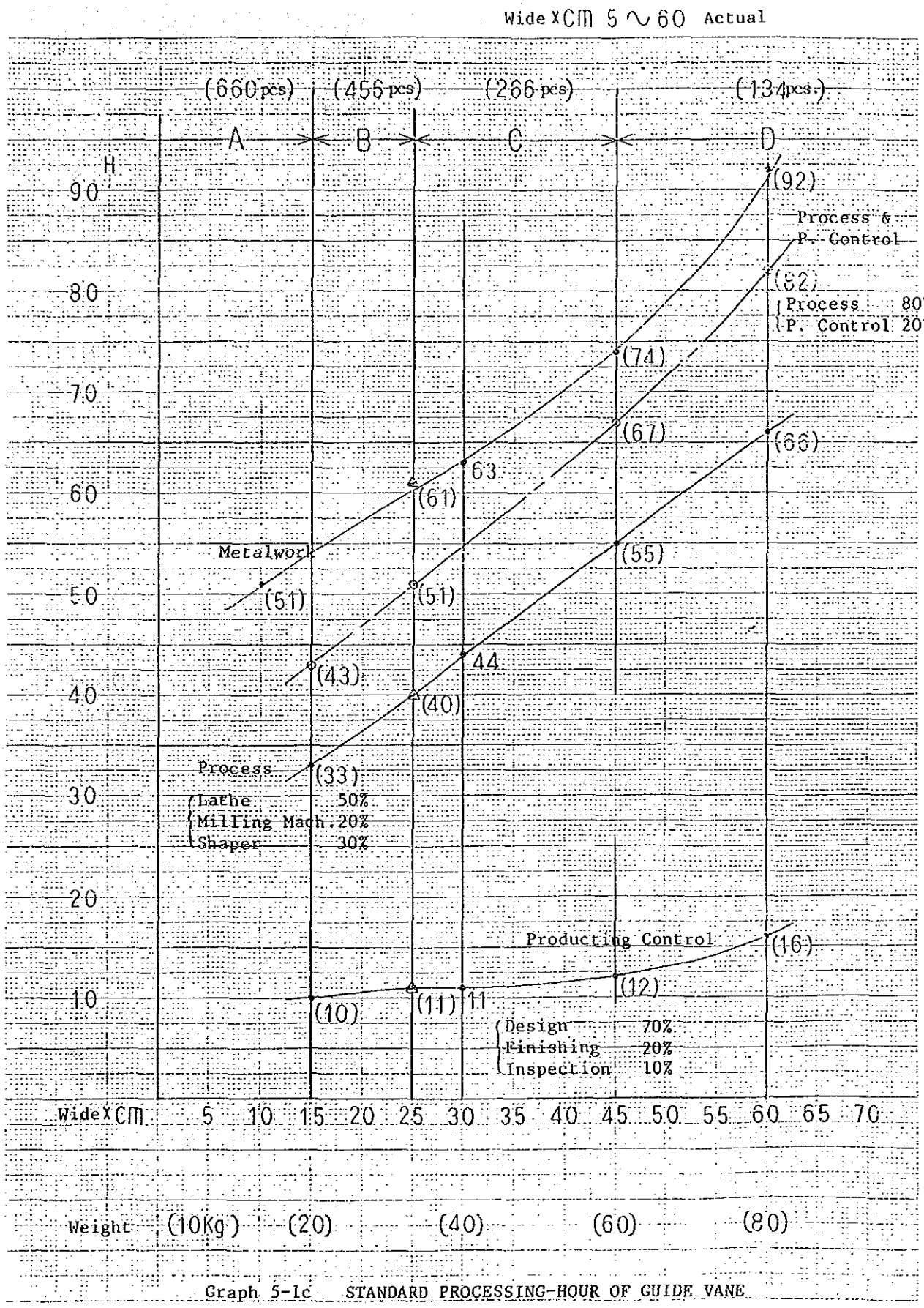
	NAME OF COMPONENT / NAME OF MACHINE	(103 RUNNER . KEY . LINER . REAMER . BOLT	(103) COVER . BUSHING . LINER . BOLT	(1516) GUIDE VANE . PIN . BUSHING . SPINDLE . KEY	(103) SHAFT . KEY . REAMER . LINER . BOLT	(103) BEARING	(103) INLET VALVE	(:50) PRESSURE REGULATOR	(103) OIL PRESS SYSTEM	(103) ACCESSORY	(103) PIPING SYSTEM	A GRAND TOTAL	BASIC QUANTITY B DAY A/7-hour	C YEAR B/260-day	D Q'TY/CYCLE C/6-year	BASIC QUANTITY
1	Lathe (Midium)	5,150	5,665	48,512	3,090	3,605	2,575	750	2,575	3,090	---	75,000	10,700	41.1	6.8	6
	(hour/pc.)	50H	55H	32H	30H	35H	25H	15H	25H	30H						
2	Lathe (Small)	5,150	8,240	68,220	2,060	6,180	4,635	1,500	4,635	5,665	1,030	107,000	15,280	58.7	9.7	9
	(hour/pc.)	50H	80H	45H	20H	60H	45H	30H	45H	55H	10H					
3	Milling Machine	1,030	3,090	---	2,575	3,090	2,575	1,250	4,120	4,120	1,545	23,300	3,320	12.8	2.1	2
	(hour/pc.)	10H	30H		25H	30H	25H	25H	40H	40H	15H					
4	Shaper	824	1,545	7,580	515	2,575	2,575	1,000	1,545	3,090	2,575	23,800	3,400	13.0	2.1	2
	(hour/pc.)	8H	15H	5H	5H	25H	25H	20H	15H	30H	25H					
5	Upright D.Mach.	515	1,545	---	515	2,060	2,060	1,250	2,060	1,545	1,030	12,500	1,790	6.8	1.1	1
	(hour/pc.)	5H	15H	---	5H	20H	20H	25H	20H	15H	10H					
6	Screw Cutting Lathe	515	1,030	---	515	2,060	1,545	750	2,060	2,575	2,060	13,100	1,870	7.1	1.1	1
	(hour/pc.)	5H	10H	---	5H	20H	15H	15H	20H	25H	20H					
7	Key Seater	---	---	---	---	2,060	515	250	1,030	2,060	515	6,400	910	3.5	0.6	1
	(hour/pc.)					20H	5H	5H	10H	20H	5H					
8	Bending Roller	---	---	---	---	---	---	---	1,545	1,030	515	3,100	440	1.7	0.3	1
	(hour/pc.)								15H	10H	5H					
9	Shearing Machine	---	---	---	---	---	---	---	1,545	1,545	2,060	5,100	730	2.8	0.5	1
	(hour/pc.)								15H	15H	20H					
10	Bending Machine	1,030	1,030	7,580	---	---	---	---	515	515	---	10,600	1,520	5.8	0.9	1
	(hour/pc.)	10H	10H	5H					5H	5H						
11	Hack Sawing Mach.	---	---	---	---	---	---	---	8,240	6,695	5,150	20,000	2,850	10.9	1.8	2
									80H	65H	50H					
12	Welding, Metal Work	12,360	12,360	15,160	12,360	14,420	14,420	7,000	13,390	13,390	11,330	126,000	18,000	69.0	11.0	10
	(hour/pc.)	120H	120H	10H	120H	140H	140H	140H	130H	130H	110H					
	Sub-total (1-9)	13,184	21,115	124,312	9,270	21,630	16,480	6,750	18,025	22,145	8,755	261,100	37,300	143.4		22
	Sub-total (10-12)	13,390	13,390	22,740	12,360	14,420	14,420	7,000	25,235	23,175	19,055	164,800	23,540	90.5		15
	Grand total	26,574	34,505	147,052	21,630	36,050	30,900	13,750	43,260	45,320	27,810	425,900	60,840	233.9		37



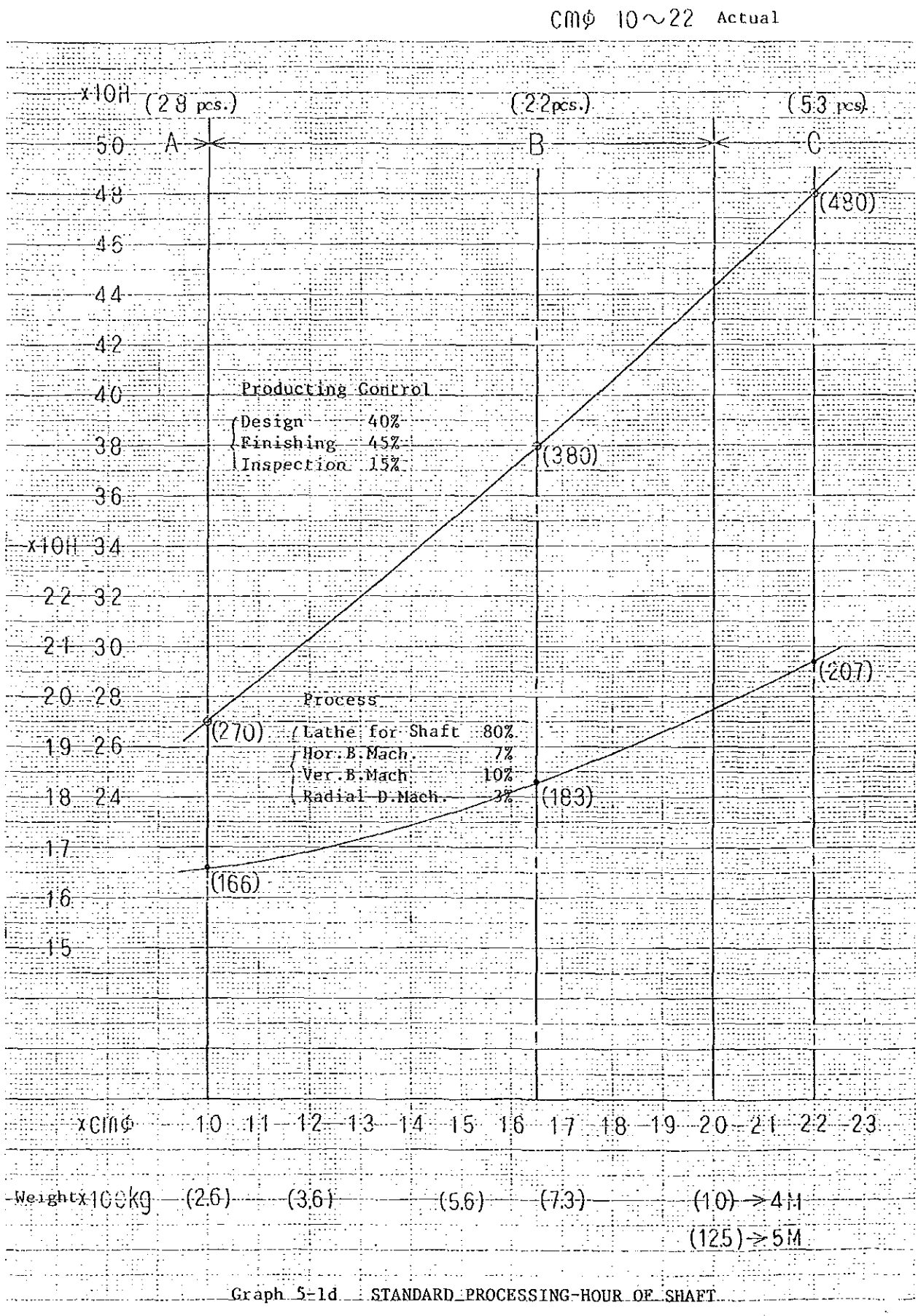
Graph 5-1a STANDARD PROCESSING-HOUR OF RUNNER



Graph 5-1b STANDARD PROCESSING-HOUR OF COVER LINER



Graph 5-1c STANDARD PROCESSING-HOUR OF GUIDE VANE



Graph 5-1d STANDARD PROCESSING-HOUR OF SHAFT

CHAPTER - 6

ECONOMIC EVALUATION

CHAPTER-6
ECONOMIC EVALUATION

6.1 Economic Analysis

In general, economic analysis bases its cost and benefit prices on international market prices. Furthermore non-traded goods prices are adjusted by removing market distortions especially of foreign exchange market. The Dayeuhkolot Mechanical Section which is to be renovated repairs and reproduces the spare parts for power generating equipment. Due to non-homogeneity of the products, the spare parts cannot be counted equally. The complexity of treating non-homogeneous goods as a group can be avoided by using machining hours of services provided by the Workshop. By adopting machining hours, the economic analysis can be dispensed from estimating material costs which constitute the largest proportion in the Workshop operation costs* . Therefore, the product prices of the Project contain much less intermediate goods than in usual cases. As the benefit price for the Project, the average fee charged at private workshops is applied since it is the social opportunity cost saved by the Project. Three cost components which constitute service charge at private workshops are deemed to require the above-mentioned adjustment particular to economic analysis. These three cost items are depreciation, tax, and wage for unskilled labor. Both depreciation and tax comprise only negligible portion of a total cost. Shadow wages are applied for unskilled labor in ordinary economic analysis. However, since unskilled labor is expected to have a similar share in proportion to both total benefit and cost, it will not require the adjustment due to its offsetting effect.

The capital requirement for the Project is calculated on CIF bases with addition of installation cost in Bandung. Tax is not included in the capital cost. Another major adjustment carried in economic analysis is with foreign exchange rate. At present Yen/Dollar rate is fluctuating violently and it is difficult to estimate the real rate. Thus in this analysis the most up-to-date rate on October 30, 1987 is employed as the appropriate estimate for the future rate wihtout applying a conversion factor Rupiah/Yen rate on October 30, 1987 is 11,94 Rupiah/Yen.

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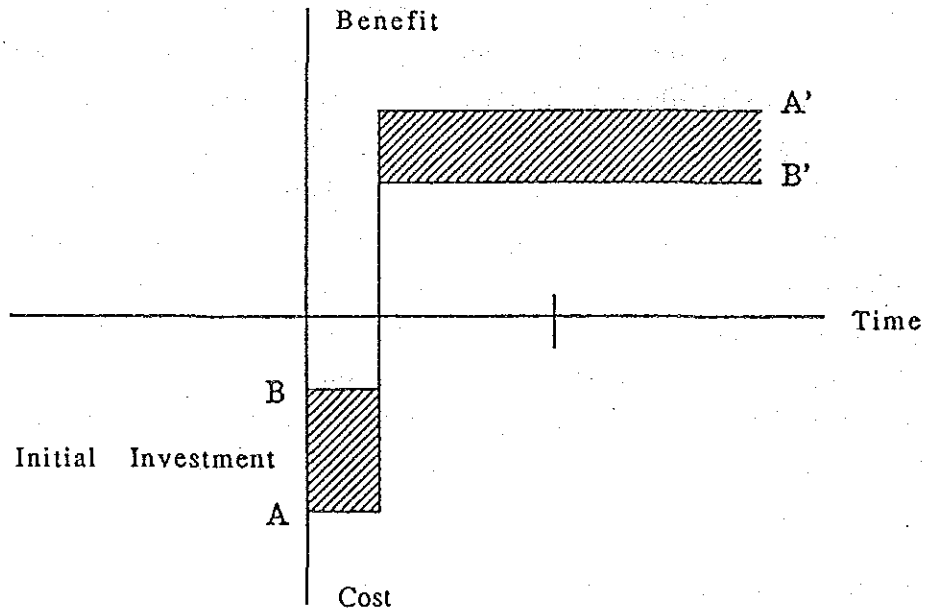
* In cash flow tables estimated material costs are added both to benefit and cost streams for the sake of exposition.

6.2 Evaluation Method for Renovation

The Project in question is renovation, thus the investment is addition to the present configuration of capital to affect the future cash flow of the Dayeuhkolot Workshop. The justification of the investment must be based upon the net cash flow created by the additional investment, but not upon the total cash flow of the Workshop. Fig. 6-1 represents cash flows of the Dayeuhkolot Workshop. The Line B-B' indicates the present capital and its expected future cash flow without renovation while A-A' shows the total asset and cash flow after the renovation. As is obvious from this illustration, the difference between A and B is the additional investment required for renovation and that between A' and B' represents the net cash flow solely generated by the renovation. This net cash flow is shown in shadow in the figure.



As the first step to arrive at the net cash flow, the expected cash flow without any renovation has to be established. This "do-nothing" plan will be termed as the Plan 0.

From each of the total cash flows after the renovation the cash flow of the Plan 0 should be subtracted to derive the net cash flow from which the return on investment will be calculated.

6.3 Benefit

Financial Analysis is usually carried out based upon actual cash transactions associated with the Project in question. However, the Dayeuhkolot Workshop only receives the budget from the PLN Pusat to pay for the material and service purchased from outside for the repair and reproduction work because it is only a section of the PLN. Therefore an ordinary financial analysis cannot be carried out, and only Economic Analysis can be applied to the Project.

In economic analysis, the social opportunity costs without the implementation of the Project becomes social benefit for the Project. The social opportunity costs without the Renovation Project are the amount to be paid to private workshops, whether foreign or domestic, to repair or reproduce the spare parts for power generating equipment. First the prices for the spare parts have to be clearly defined to be applied to the production quantity for the measurement of total revenue i.e. total benefit. However, it is impossible or even meaningless to attach prices to individual machining work which the Dayeuhkolot Workshop handles. None of the spare parts which the Dayeuhkolot Workshop produces is identical to each other. So-called non-homogeneity of the products makes it unable to count the products as a whole. For demand forecast, machining hour is adopted to measure the level of output, so as to avoid the problem of non-countability of the products. The social benefit must conform to the same unit as used in the demand forecast by setting hourly machining service charge.

The hourly machining charge was estimated from two different approaches. First approach is to interview a few workshops directly for the quotation of the prices. The second approach is to calculate the prices from the past data on specifications and prices of subcontracted jobs. The renovation plans aims at expanding the capacity of the Workshop to become fully capable of producing the spare parts for the power generating equipment, including large-size equipment. At moment the large-sized work which the Dayeuhkolot Workshop cannot handle is sent to abroad, generally to a workshop in Switzerland. The amount of work reaches nearly 2 billion Rupiah in 1986/87 alone. For these imported spare parts, international price has to be calculated.

(1) Domestic Machining Charge

The machining hourly charge data collected from interviews from Indonesian workshops range from Rp.13,000 to 29,000/hr. From the actual subcontract data it was estimated to be Rp.15,400/hr.

Considering fairly good consistency of the estimates and assuming rather conservative side, Rp.15,400/hr has been adopted for the project analysis.

(2) Foreign Machining Charge

From the evaluation of the past data the machining hour charge is estimated to be Rp.106,000/hr. The price is considered to be rather high for international standard price. Therefore, CIF machining charge of Rp.49,000/hour has been adopted, based upon the standard hourly charge in Japan.

6.4 Productivity

Total output expected from the operation at the Dayeuhkolot Workshop is measured by machining hour as is shown in demand forecast. This forecast work volume has been calculated to derive the requirement of machinery. One of the underlining assumptions is that the work volume itself is based upon a standard productivity level.

The work volume estimate for the Dayeuhkolot Workshop will be affected by the degree of deviation of the productivity from the standard level.

Sample works have been chosen to compare with standard works volumes. The samples of the work for runner, guide vane, and runner shaft have been taken from "the Dayeuhkolot Annual Report" according to its sizes.

The limited number of the samples poses a lower confidence, but at least the general tendency can be captured. Table 6-1 shows the results of the comparison of the productivities. Regardless of the types of the spare parts, the productivity at the Dayeuhkolot Workshop declines for the machining of the large-sized spare parts. The lowest productivity was achieved for the fabrication of runner shafts. Although the repair of the spare parts requires varying degrees of work volume depending on the level and type of damage, the comparison in Table 6-1 shows roughly the same result as in the case of

the reproduction. The only exception is the repair work for the runner of size-A, but it is deemed to be a deviated sample from a normal case where the damage was light.

From the above observation it is concluded that the productivity levels at the Dayeuhkolot Workshop are set regardless of the types of the spare parts as follows, according to the size;

Large size work	0.3
Small size work (including welding Work)	0.8

The renovation plans include the introduction of large size machinery which enhances the efficiency of the Workshop to a large extent and also technology transfer programs. Therefore the productivity levels will rise smoothly. The rise in the productivity levels are assumed to change as follows;

	1st Year	2nd Year	3rd Year
Large size	0.3	0.6	1
Small Size (including welding work)	0.8	0.9	1

Under the above-mentioned assumptions and work volume forecast made in the Chapter 3, the work loads are estimated for each renovation plan and plan 0 as shown in Table 6-2.

6.5 Investment and Existing Asset

Investment costs are divided into foreign currency portion and local currency portion as shown in Table 6-3. The machinery costs are based upon the quotations made in Japan and also includes various costs up to the factory site in Bandung such as Freight, Insurance, installation fees, etc.

The existing asset value termed as "asset carried forward" in cash flow tables is the book value of the total assets of the Dayeuhkolot Workshop as of March 31, 1987, which includes machinery, building and also circulating assets. It is questionable that the book value correctly reflects the economic value of the existing assets. However, the difference cash flows between Plan 0 and renovation Plans should exclude the existing assets since the additional investment alone should be separated for the evaluation.

The operation of the Workshop cannot dispense with a turn-over capital, but the existing assets already have the turn-over capital as its component. The addition to the capital for the sake of operation is assumed not to be necessary. The residual value of the investment after the project life is small due to wear and tear during 20 years of operation and is considered to be offset by the costs of dismantling the equipment and the building.

6.6 Material Costs

As mentioned earlier, the economic benefits of the Project is based upon the machining service charge, thus the material costs can be omitted from both cash inflows and cash outflows. However, the material costs of the same amount are added to both cash in and outflows to confirm to the normal practice of the economic analysis. The ratio between material costs and service charge is set at 1:1 in accordance to the prevailing circumstances in Indonesia.

6.7 Other Manufacturing Costs

The other manufacturing costs besides the material costs include utilities, maintenance and tools. The maintenance cost is assumed to be 1% of the equipment investment while the other costs are to be 10% of the material costs.

6.8 Other Administration Costs

The administration costs other than the administration salary include stationary, office maintenance, transportation and communication costs, which are assumed to be 50% of the material costs.

6.9 Project Life

Under ordinary accounting practice the depreciation period for the machinery is 10 years, but in reality the machine tool can withstand the operation for 20 years. Thus the project life period is set as 20 years.

6.10 Personnel and Wage

The personnel required for the renovation plans is envisaged to follow what is planned at the Clause 5.6 "Personnel Scheme".

As is analysed at Personnel Management, the present indirect workforce at the Dayeuhkolot Workshop has the size far greater than the appropriate level. Thus the renovation plans 2 and 3 which envisage expansion of the capacity can be operated without accompanying increase in employment for indirect services, but with only additional direct laborers. Table 6-4 presents the expected allocation of the personnel for each renovation plan.

The wages levels follow basically the present levels at the Dayeuhkolot Workshop. The administrative hierarchy is divided in 6 layers of manager, deputy manager, section chief, foreman, general worker and daily worker, whose wage levels are set as shown in Table 6-5. The wage levels in Table 6-5 are inflated by 25% from those in 1986 after taking into account the effect of devaluation of the currency in 1986. The consequent wage payment is shown at the last three lines of each table of Table 6-4.

6.11 Return to Investment

Under the assumptions mentioned above, the cash flows for the Plan 0 through Plan 3 are calculated as shown in Table 6-6 through 6-8.

According to the evaluation method, the cash flow for Plan 0 must be subtracted from that for each renovation plan to arrive at a incremental difference cash flow for the additional investment. The difference cash flows for respecttive plans are shown in Table 6-10. The Internal Rate of Return (IRR) is derived for this difference cash flow of each renovation plan as follows:

Plan 1	10.3%
Plan 2	10.9%
Plan 3	7.6%

The renovation Plan 2 ranks higher than Plan 1 or Plan 3. The Opportunity Cost of Capital in Indonesia is said to be 10% which Plan 2 and Plan 1 both exceed.

6.12 Sensitivity Analysis

The future plan always has some risks. The gap between the realized and planned operation outcome is caused by various factors.

The sensitivity analysis is conducted upon the Plan 2 in accordance to each factor.

Investment Cost

20% overrun	8.6%
10% overrun	9.7%
Base case	10.9%
10% reduction	12.3%
20% reduction	14.1%

Work Volume

20% increase	13.8%
10% increase	12.4%
Base case	10.9%
10% reduction	9.4%
20% reduction	7.9%

Machining Service Charge

20% higher	13.9%
10% higher	12.5%
Base case	10.9%
10% lower	9.2%
20% lower	7.5%

If productivity level does fail to reach targeted level of 1 for Large-Sided Maching Job

Base case (1)	10.9%
0.3	6.3%
0.4	7.1%
0.5	7.7%
0.6	8.4%
0.8	9.7%

IPR is the most affected if the technology transfer fails to raize the present level of productivity. Therefore the traning program should be regarded as most important factor in the case of the implementation.

The results of overall sensitivity analysis show that the Project is still viable ever in the worst cases if a low interest finance is aquired.

6.13 Repayment Period

We can see from the economic analysis carried out in 6.11 renovation Plan 2 is economically most feasible. We can now compute the repayment period assuming the following loan conditions.

REPAYMENT PERIOD for renovation Plan 2 is calculated under the assumptions as follows:

Loan to be repaid	:	Foreign portion only
Grace period	:	5 years
Interest	:	3%
Interest generated by accumulated surplus during grace period	:	5%

If net surplus created solely by renovation is used to repay the debt, it will take 10 years to nullify the debt outstanding. If the net surplus generated by total operation, the repayment period reduces to 9 years.

TABLE 6-1 PRODUCTIVITY LEVEL/DAYEUHKOLOT

UNIT MAN.HOUR

	MANUFACTURE			REPAIR		
	A DAYUEHKOLO	B STANDARD	B/A	A DAYUEHKOLO	B STANDARD	B/A
SIZE A	960	928	0.97	192	537	2.80
RUNNER SIZE B	2880	1059	0.37	777	612	0.79
SIZE C	N.A.	1132	-	3360	654	0.19
RUNNER SIZE A	308	167	0.54	96	58	0.60
SHAFT SIZE B	720	183	0.25	227.2	63	0.28
SIZE C	N.A.	207	-	528	72	0.14
SIZE A	96	84	0.88	N.A.	53	-
GUIDE SIZE B	N.A.	101	-	N.A.	64	-
VANE SIZE C	N.A.	129	-	160	82	0.51
SIZE A			0.79			0.80
GENERALSIZE B			0.31			0.53
SIZE C						0.28

TABLE6-2 PRODUCTION VOLUME FOR EACH RENOVATION PLAN UNIT MACHING HOUR

		1	2	3	4	5	6	7	8	9
PLAN 0	WORK VOLUME									
	LARGE SIZE MACHING (DOMESTIC)	3,802	3,802	3,802	3,802	3,802	3,802	3,802	3,802	
	LARGE SIZE MACHING (IMPORT)	0	0	0	0	0	0	0	0	
	SMALL SIZE MACHING WORK	15,480	15,480	15,480	15,480	15,480	15,480	15,480	15,480	
	WELDING WORK	37,400	37,400	37,400	37,400	37,400	37,400	37,400	37,400	
PLAN 1	WORK VOLUME									
	LARGE SIZE MACHING (DOMESTIC)	3,802	7,604	12,673	12,673	12,673	12,673	12,673	12,673	
	LARGE SIZE MACHING (IMPORT)	2,300	4,600	7,667	7,667	7,667	7,667	7,667	7,667	
	SMALL SIZE MACHING WORK	20,413	22,965	25,517	25,517	25,517	25,517	25,517	25,517	
	WELDING WORK	37,400	42,075	46,750	46,750	46,750	46,750	46,750	46,750	
PLAN 2	WORK VOLUME									
	LARGE SIZE MACHING (DOMESTIC)	3,802	7,604	12,673	12,673	12,673	12,673	12,673	12,673	
	LARGE SIZE MACHING (IMPORT)	3,200	6,400	10,667	10,667	10,667	10,667	10,667	10,667	
	SMALL SIZE MACHING WORK	45,213	50,865	56,517	56,517	56,517	56,517	56,517	56,517	
	WELDING WORK	53,800	60,525	67,250	67,250	67,250	67,250	67,250	67,250	
PLAN 3	WORK VOLUME									
	LARGE SIZE MACHING (DOMESTIC)	3,802	7,604	12,673	12,673	12,673	12,673	12,673	12,673	
	LARGE SIZE MACHING (IMPORT)	3,400	6,800	11,333	11,333	11,333	11,333	11,333	11,333	
	SMALL SIZE MACHING WORK	45,213	50,865	56,517	56,517	56,517	56,517	56,517	56,517	
	WELDING WORK	53,800	60,525	67,250	67,250	67,250	67,250	67,250	67,250	

UNIT MACHING HOUR											
10	11	12	13	14	15	16	17	18	19	20	21
3,802	3,802	3,802	3,802	3,802	3,802	3,802	3,802	3,802	3,802	3,802	3,802
0	0	0	0	0	0	0	0	0	0	0	0
15,480	15,480	15,480	15,480	15,480	15,480	15,480	15,480	15,480	15,480	15,480	15,480
37,400	37,400	37,400	37,400	37,400	37,400	37,400	37,400	37,400	37,400	37,400	37,400
12,673	12,673	12,673	14,448	14,448	14,448	14,448	14,448	14,448	16,222	16,222	16,222
7,667	7,667	7,667	8,740	8,740	8,740	8,740	8,740	8,740	9,813	9,813	9,813
25,517	25,517	25,517	29,089	29,089	29,089	29,089	29,089	29,089	32,661	32,661	32,661
46,750	46,750	46,750	53,295	53,295	53,295	53,295	53,295	53,295	59,840	59,840	59,840
12,673	12,673	12,673	14,448	14,448	14,448	14,448	14,448	14,448	16,222	16,222	16,222
10,667	10,667	10,667	12,160	12,160	12,160	12,160	12,160	12,160	13,653	13,653	13,653
56,517	56,517	56,517	64,429	64,429	64,429	64,429	64,429	64,429	72,341	72,341	72,341
67,250	67,250	67,250	76,665	76,665	76,665	76,665	76,665	76,665	86,080	86,080	86,080
12,673	12,673	12,673	14,448	14,448	14,448	14,448	14,448	14,448	16,222	16,222	16,222
11,333	11,333	11,333	12,920	12,920	12,920	12,920	12,920	12,920	14,507	14,507	14,507
56,517	56,517	56,517	64,429	64,429	64,429	64,429	64,429	64,429	72,341	72,341	72,341
67,250	67,250	67,250	76,665	76,665	76,665	76,665	76,665	76,665	86,080	86,080	86,080

TABLE 6-3 DAYUEHKOLOT INVESTMENT PLAN

	PLAN1		PLAN2		PLAN3	
	F. C. ¥ '000	L. C Rp '000	F. C. ¥ '000	L. C Rp '000	F. C. ¥ '000	L. C Rp '000
MACHINERY	289,700		553,700		736,600	
(MACHINERY VOLUME m3)		(250)		(700)		(900)
PACKAGING	5,000	0	14,000	0	18,000	0
TRANSPORTATION	2,000	0	8,000	0	9,600	0
INSURANCE	2,600	0	5,000	0	6,600	0
PORT HANDLING CHARGE		5,000		20,000		24,000
INLAND TRANSPORTATION		10,000		40,000		48,000
INSTALLATION COST	6,000	49,000	9,000	73,000	13,500	109,000
SUB TOTAL	305,300	64,000	589,700	133,000	784,300	181,000
LAND RECLAMATION	0	13,000	0	132,000		132,000
BUILDING	0	239,000	0	1,156,000		1,156,000
ENGINEERING FEE	16,000		28,000		31,000	
CONTINGENCY 10%	32,130	31,600	61,770	142,100	81,530	146,900
TOTAL	353,430	347,600	679,470	1,563,100	896,830	1,615,900
RP EQUIVALENT TOTAL	4,568,000		9,677,000		12,326,000	

*INVESTMENT DOES NOT INCLUDE TRAINING.

TABLE6-4 DAYEUHKOLOT RENOVATION PERSONNED ALLOCATION

PLAN 1	MANAGER	DEPUTY	SECTION	FOREMAN	GENERAL	DAILY WORK	TOTAL
MANAGEMENT							
TECHNOLOGY		1	5	13	56	8	83
ADMINISTRATION	1	1	4	12	26	7	51
PRODUCTION							0
MACHINERY			2	10	33	50	95
TRANSMISSION			1	4	19	10	34
TOTAL	1	2	12	39	134	75	263
PAYMENT Rp'000	6698	10201	48479	138756	340193	93674	637999
INDIRECT LABOR	137	52%			380748.71		
DIRECT LABOR	126	48%			257250.54		

PLAN2	MANAGER	DEPUTY	SECTION	FOREMAN	GENERAL	DAILY WORK	TOTAL
MANAGEMENT							
TECHNOLOGY		1	5	13	56	8	83
ADMINISTRATION	1	1	4	12	26	7	51
PRODUCTION							0
MACHINERY			2	18	52	61	133
TRANSMISSION			1	4	19	10	34
TOTAL	1	2	12	47	153	86	301
PAYMENT Rp'000	6698	10201	48479	167218	388429	107056	728080
INDIRECT LABOR	137	45%			380748.71		
DIRECT LABOR	164	55%			347331.50		

PLAN3	MANAGER	DEPUTY	SECTION	FOREMAN	GENERAL	DAILY WORK	TOTAL
MANAGEMENT							
TECHNOLOGY		1	5	13	56	8	83
ADMINISTRATION	1	1	4	12	26	7	51
PRODUCTION							0
MACHINERY			2	18	54	60	134
TRANSMISSION			1	4	19	10	34
TOTAL	1	2	12	47	155	85	302
PAYMENT Rp'000	6698	10201	48479	167218	393506	107056	733158
INDIRECT LABOR	137	45%			380748.71		
DIRECT LABOR	165	55%			352409.00		

TABLE6-5 WAGE & SALARY AT DAYEUHKOLOT '000 Rp / YEAR

	PER PERSON SALARY
MANAGER	6698
DEPUTY MANAGER	5100
SECTION CHIEF	4040
FOREMAN	3558
GENERAL WORKER	2539
DAILY WORKER	1217

TABLE 6-6 ECONOMIC ANALYSIS PLAN 0 UNIT Rp Million

YEAR	1	2	3	4	5	6	7	8	9	10
CASH INFLOW										
LARGE SIZE MACHING WORK										
DOMESTIC		117	117	117	117	117	117	117	117	117
IMPORT		0	0	0	0	0	0	0	0	0
SMALL SIZE MACHING WORK		477	477	477	477	477	477	477	477	477
WELDING WORK		1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152
TOTAL INFLOW		1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746
CASH OUTFLOW										
INVESTMENT										
ASSET CARRIED FORWARD	2,030									
OPERATION COST		1,590	1,590	1,590	1,590	1,590	1,590	1,590	1,590	1,590
MATERIAL		873	873	873	873	873	873	873	873	873
DIRECT LABOR		165	165	165	165	165	165	165	165	165
OTHER MANUFACTURING COST		128	128	128	128	128	128	128	128	128
ADMINISTRATION SALARY		381	381	381	381	381	381	381	381	381
OTHER INDIRECT EXPENCES		44	44	44	44	44	44	44	44	44
NET CASH FLOW	-2,030	155	155	155	155	155	155	155	155	155

UNIT Rp Miilion PLANO

11	12	13	14	15	16	17	18	19	20	21
117	117	117	117	117	117	117	117	117	117	117
0	0	0	0	0	0	0	0	0	0	0
477	477	477	477	477	477	477	477	477	477	477
1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152
1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746	1,746
1,590	1,590	1,590	1,590	1,590	1,590	1,590	1,590	1,590	1,590	1,590
873	873	873	873	873	873	873	873	873	873	873
165	165	165	165	165	165	165	165	165	165	165
128	128	128	128	128	128	128	128	128	128	128
381	381	381	381	381	381	381	381	381	381	381
44	44	44	44	44	44	44	44	44	44	44
155	155	155	155	155	155	155	155	155	155	155

TABLE 6 - 7 ECONOMIC ANALYSIS PLAN 1 UNIT Rp Million

YEAR	1	2	3	4	5	6	7	8	9	10
CASH INFLOW										
LARGE SIZE MACHING WORK										
DOMESTIC		117	234	390	390	390	390	390	390	390
IMPORT		225	451	751	751	751	751	751	751	751
SMALL SIZE MACHING WORK		629	707	786	786	786	786	786	786	786
WELDING WORK		1,152	1,296	1,440	1,440	1,440	1,440	1,440	1,440	1,440
TOTAL INFLOW		2,123	2,688	3,367	3,367	3,367	3,367	3,367	3,367	3,367
CASH OUTFLOW										
INVESTMENT	4,568	0	0							
ASSET CARRIED FORWARD	2,030									
OPERATION COST		1,896	2,221	2,611	2,611	2,611	2,611	2,611	2,611	2,611
MATERIAL		1,062	1,344	1,684	1,684	1,684	1,684	1,684	1,684	1,684
DIRECT LABOR		257	257	257	257	257	257	257	257	257
OTHER MANUFACTURING COST		143	172	205	205	205	205	205	205	205
ADMINISTRATION SALARY		381	381	381	381	381	381	381	381	381
OTHER INDIRECT EXPENCES		53	67	84	84	84	84	84	84	84
NET CASH FLOW	-6,598	227	467	756	756	756	756	756	756	756

UNIT Rp Miilion PLAN1

11	12	13	14	15	16	17	18	19	20	21
390	390	445	445	445	445	445	445	500	500	500
751	751	857	857	857	857	857	857	962	962	962
786	786	896	896	896	896	896	896	1,006	1,006	1,006
1,440	1,440	1,641	1,641	1,641	1,641	1,641	1,641	1,843	1,843	1,843
3,367	3,367	3,839	3,839	3,839	3,839	3,839	3,839	4,310	4,310	4,310
2,611	2,611	2,972	2,972	2,972	2,972	2,972	2,972	3,332	3,332	3,332
1,684	1,684	1,919	1,919	1,919	1,919	1,919	1,919	2,155	2,155	2,155
257	257	293	293	293	293	293	293	329	329	329
205	205	229	229	229	229	229	229	253	253	253
381	381	434	434	434	434	434	434	488	488	488
84	84	96	96	96	96	96	96	108	108	108
756	756	867	867	867	867	867	867	978	978	978

TABLE 6-8 ECONOMIC ANALYSIS PLAN 2

Unit Rp Million

YEAR	1	2	3	4	5	6	7	8	9	10
CASH INFLOW										
LARGE SIZE MACHINING WORK										
DOMESTIC		117	234	390	390	390	390	390	390	390
IMPORT		314	627	1,045	1,045	1,045	1,045	1,045	1,045	1,045
SMALL SIZE MACHINING WORK		1,393	1,567	1,741	1,741	1,741	1,741	1,741	1,741	1,741
WELDING WORK		1,657	1,864	2,071	2,071	2,071	2,071	2,071	2,071	2,071
TOTAL INFLOW		3,480	4,292	5,248	5,248	5,248	5,248	5,248	5,248	5,248
CASH OUTFLOW										
INVESTMENT	9,677									
ASSET CARRIED FORWARD	2,030									
OPERATION COST		2,801	3,268	3,817	3,817	3,817	3,817	3,817	3,817	3,817
MATERIAL		1,740	2,146	2,624	2,624	2,624	2,624	2,624	2,624	2,624
DIRECT LABOR		347	347	347	347	347	347	347	347	347
OTHER MANUFACTURING COST		246	286	334	334	334	334	334	334	334
ADMINISTRATION SALARY		381	381	381	381	381	381	381	381	381
OTHER INDIRECT EXPENCES		87	107	131	131	131	131	131	131	131
NET CASH FLOW	-11,707	679	1,024	1,431	1,431	1,431	1,431	1,431	1,431	1,431

Unit Rp Million

11	12	13	14	15	16	17	18	19	20	21
390	390	445	445	445	445	445	445	500	500	500
1,045	1,045	1,192	1,192	1,192	1,192	1,192	1,192	1,338	1,338	1,338
1,741	1,741	1,984	1,984	1,984	1,984	1,984	1,984	2,228	2,228	2,228
2,071	2,071	2,361	2,361	2,361	2,361	2,361	2,361	2,651	2,651	2,651
5,248	5,248	5,982	5,982	5,982	5,982	5,982	5,982	6,717	6,717	6,717
3,817	3,817	4,345	4,345	4,345	4,345	4,345	4,345	4,866	4,866	4,866
2,624	2,624	2,991	2,991	2,991	2,991	2,991	2,991	3,359	3,359	3,359
347	347	396	396	396	396	396	396	444	444	444
334	334	371	371	371	371	371	371	408	408	408
381	381	438	438	438	438	438	438	488	488	488
131	131	150	150	150	150	150	150	168	168	168
1,431	1,431	1,637	1,637	1,637	1,637	1,637	1,637	1,851	1,851	1,851

TABLE 6-9 ECONOMIC ANALYSIS PLAN 3

Unit Rp Million

YEAR	1	2	3	4	5	6	7	8	9	10
CASH INFLOW										
LARGE SIZE MACHING WORK										
DOMESTIC		117	234	390	390	390	390	390	390	390
IMPORT		333		1,111	1,111	1,111	1,111	1,111	1,111	1,111
SMALL SIZE MACHING WORK		1,393	1,567	1,741	1,741	1,741	1,741	1,741	1,741	1,741
WELDING WORK		1,657	1,864	2,071	2,071	2,071	2,071	2,071	2,071	2,071
TOTAL INFLOW		3,500	3,665	5,313	5,313	5,313	5,313	5,313	5,313	5,313
CASH OUTFLOW										
INVESTMENT	12,326									
ASSET CARRIED FORWARD	2,030									
OPERATION COST		2,841	2,936	3,883	3,883	3,883	3,883	3,883	3,883	3,883
MATERIAL		1,750	1,833	2,657	2,657	2,657	2,657	2,657	2,657	2,657
DIRECT LABOR		352	352	352	352	352	352	352	352	352
OTHER MANUFACTURING COST		270	279	361	361	361	361	361	361	361
ADMINISTRATION SALARY		381	381	381	381	381	381	381	381	381
OTHER INDIRECT EXPENCES		87	92	133	133	133	133	133	133	133
NET CASH FLOW	-14,356	659	729	1,430	1,430	1,430	1,430	1,430	1,430	1,430

Unit Rp Million

11	12	13	14	15	16	17	18	19	20	21
390	390	445	445	445	445	445	445	500	500	500
1,111	1,111	1,266	1,266	1,266	1,266	1,266	1,266	1,422	1,422	1,422
1,741	1,741	1,984	1,984	1,984	1,984	1,984	1,984	2,228	2,228	2,228
2,071	2,071	2,361	2,361	2,361	2,361	2,361	2,361	2,651	2,651	2,651
5,313	5,313	6,057	6,057	6,057	6,057	6,057	6,057	6,801	6,801	6,801
3,883	3,883	4,418	4,418	4,418	4,418	4,418	4,418	4,952	4,952	4,952
2,657	2,657	3,028	3,028	3,028	3,028	3,028	3,028	3,400	3,400	3,400
352	352	401	401	401	401	401	401	451	451	451
361	361	398	398	398	398	398	398	436	436	436
381	381	438	438	438	438	438	438	495	495	495
133	133	151	151	151	151	151	151	170	170	170
1,430	1,430	1,639	1,639	1,639	1,639	1,639	1,639	1,849	1,849	1,849

TABLE 6-10 DIFFERENCE CASH FLOW

Unit Rp Million

YEAR		1	2	3	4	5	6	7	8	9	10
PLAN 1	10.282%	-4,568	72	312	601	601	601	601	601	601	601
PLAN 2	10.893%	-9,677	524	869	1,275	1,275	1,275	1,275	1,275	1,275	1,275
PLAN 3	7.596%	-12,326	504	574	1,274	1,274	1,274	1,274	1,274	1,274	1,274
ACCUMULATED CASHFLOW			524	1,419	2,765	4,179					
			26	71	138	209					
DEBT OUTSTANDING		679,470	699,854	720,850	742,475	764,749	420,274	326,105	229,112	129,208	26,307
INTEREST		20,384	20,996	21,625	22,274	22,942	12,608	9,783	6,873	3,876	789

Unit Rp Million

11	12	13	14	15	16	17	18	19	20	21
601	601	712	712	712	712	712	712	823	823	823
1,275	1,275	1,482	1,482	1,482	1,482	1,482	1,482	1,696	1,696	1,696
1,274	1,274	1,484	1,484	1,484	1,484	1,484	1,484	1,694	1,694	1,694
-79,681	-188,848	-301,291								
-2,390	-5,665	-9,039	0	0						

TABLE 6-11 SUMMARY OF ASSUMPTIONS

		PLAN 0	PLAN 1	PLAN 2	PLAN 3
	FOREIGN EXCHANGE RATE	11.94 Rp 1987.10.30			
	MACHINING CHARGE(DOMESTIC)	Rp 15400 / Hr			
	MACHINING CHARGE (IMPORT)	Rp 49000 / Hr			
BENEFIT	PRODUCTIVITY LEVEL LARGE MACHINE				
	YEAR 1	0.3	0.3	0.3	0.3
	YEAR 2	0.3	0.6	0.6	0.6
	YEAR 3	0.3	1	1	1
	PRODUCTIVITY LEVEL SMALL MACHINE				
	YEAR 1	0.8	0.8	0.8	0.8
	YEAR 2	0.8	0.9	0.9	0.9
	YEAR 3	0.8	1	1	1
COST	INVESTMENT Rp Million		4568	9463	12376
	MATERIAL COST	SERVICE CHARGE : MATERIAL COST=1:1			
	MANPOWER				
	DIRECT LABOR	82	128	166	168
	DIRECT LABOR WAGE Rp Million	165	257	347	352
	INDIRECT LABOR	137	137	137	137
	INDIRECT LABOR WAGE Rp Million	381	381	381	381
	OTHER MANUFACTURING EXPENSES	1 % OF M/C VALUE AND 10 % OF MATRIAL COST			
	OTHER ADMINISTRATION EXPENSES	5 % OF MATERIAL COST			
PROJECT LIFE		20 YEARS			

CHAPTER - 7

CONCLUSIONS AND RECOMMENDATION

CHAPTER - 7

CONCLUSIONS AND RECOMMENDATION

7.1 Conclusion

In economic analysis of renovation plan, return on investment is calculated from the net incremental cash flow created by renovation by deducting the cash flow without investment from the cash flow with investment.

Internal Rate of Return is calculated as an indicator of return on investment.

The study compares three alternative plans of the renovation for the machining section of the Dayeuhkolot Workshop.

The Plan 3 is envisaged with a full capacity to meet the spare parts repair and reproduction demands. The Plan 2 is a reduced plan from the Plan 3 by eliminating two large costly machines with low operation. The Plan 1, on the other hand, is a minimum investment in addition to the present production equipment in order to equable the Dayeuhkolot Workshop to undertake large size parts machining jobs.

Cost saving on outside jobbing expenditure is taken as benefit for the Dayeuhkolot Workshop operation. The benefit is measured by machining hour charge.

IRR is calculated from a cash flow for each alternative plan as follows;

Plan 1	10.3%
Plan 2	10.9%
Plan 3	7.6%

In comparison the Plan 2 has the highest return by the slight margin to the Plan 1. Both the Plans 2 and 1 exceed the generally assumed level of opportunity cost of capital of 10% in Indonesia.

7.2 Recommendation

It is recommendable to adopt the Plan-2 which is technically and economically justifiable as concluded above.

For the purpose of achievement of the Plan-2, the following funds are needed:

- Foreign currency portion:	¥776,300,000	=	Rp. 9,269,022,000
- Local currency portion:			Rp. 1,643,000,000
	Total		Rp. 10,912,022,000

A net construction stage for the Plan-2 is 15.5 months by count from placing orders suppliers/vendors of machine tools. Moreover, the engineering services on the following items will have to be executed taking about tone year:

- Detailed design
- Preparation of tender documents
- Tender call
- Tender evaluation
- Contract negotiation and award
- Review of manufacturers' drawings for approval
- Attendance of shop tests

While the beginning part of the construction stage can be overlapped with the latter part of the pre-construction stage when the engineering services will be executed, the total period for achievement of the Plan-2 would be two (2) years.

In view of arrival of overhaul of several water turbines in due time, it is beneficial to take formalities and procedures necessary for realization of the Plan-2 as soon as possible aiming at immediate elevation of repairing technique of the personnel concerned in the Dayeuhkolot Workshop.

APPENDIX

APPENDIX COMPARISON TABLE OF MACHINERY AND EQUIPMENT

CODE	DESCRIPTION		QUANTITY OF EQUIPMENT								UNIT PRICE (1,000 YEN)	PRICE (1,000 YEN)				SIZE per unit (mm)			WEIGHT per unit (kg)	MOTOR (kW)	TYPE AND MAKER
			PLAN - 0		RENOVATION PLAN							PLAN - 0	RENOVATION PLAN								
					PLAN - 1		PLAN - 2		PLAN - 3				PLAN - 1	PLAN - 2	PLAN - 3	WIDTH	LENGTH	HEIGHT			
			EX	PR	EX	PR	EX	PR	EX	PR											
	[LATHE]																				
B1	Lathe for shaft	(1,000 x 10,000)		1							34,200	34,200	0	0	0	2,500	14,000	1,800	18,000		
B1	Lathe for shaft	810 x 7,000				1		1		1	19,800	0	19,800	19,800	19,800	2,000	10,000	1,400	10,600	11	TE 810 x 7,000 TAKISAWA
B2	Lathe for shaft	(1,000 x 8,000)		2							31,200	62,400	0	0	0	2,500	12,000	1,800	15,000		
B3	Heavy duty lathe	(700 x 4,000)	1	4	1		1		1		13,400	53,600	0	0	0	1,600	6,600	1,400	7,000	11	
B4	Heavy duty lathe	(1,000 x 2,000)		3							20,000	60,000	0	0	0	2,500	4,000	1,600	20,000		
B4	Heavy duty lathe	810 x 4,000				1					16,700	0	16,700	0	0	2,000	6,600	1,400	8,200	11	TE 810 x 4,000 TAKISAWA
B5	Heavy duty lathe	(600 x 3,000)		9				1		1	9,300	83,700	0	9,300	9,300	1,300	5,000	1,400	4,300	7.5	
B6	Face lathe	(2,000 x 2,000)	2	1	2		2		2		50,000	50,000	0	0	0	3,400	7,000	1,400	30,000	42 x 2 = 84	
B7	Face lathe	(3,000 x 2,000)		1							80,000	80,000	0	0	0	4,500	7,000	2,000	35,000		
B8	Face lathe	(1,000 x 3,000)		1							20,000	20,000	0	0	0	2,500	5,000	1,600	25,000		
B9	Heavy duty lathe	(600 x 2,000)	2	13	2	3	2	3	2	3	8,200	106,600	24,600	24,600	24,600	1,300	3,900	1,400	3,600	7.5 x 5 = 37.5	TAL 600 x 2,000 TAKISAWA
B10	Lathe	(500 x 2,000)	2	3	2		2		2		7,000	21,000	0	0	0	1,200	3,900	1,300	3,000	5.5 x 2 = 11	
B10	Lathe	510 x 1,500						2		2	5,600	0	0	11,200	11,200	1,200	3,200	1,300	2,600	5.5 x 2 = 11	TAL 510 x 1,500 TAKISAWA
B11	Lathe	(400 x 2,000)		5							5,000	25,000	0	0	0	1,000	3,900	1,200	2,500		
B12	Lathe	(700 x 1,200)	3	5	3		3		3		9,000	45,000	0	0	0	1,600	3,000	1,400	3,000	11 x 3 = 33	
B12	Lathe	510 x 1,000						5		5	5,400	0	0	27,000	27,000	1,200	2,700	1,300	2,300	5.5 x 5 = 27.5	TAL 510 x 1,000 TAKISAWA
B13	Lathe	(400 x 1,000)	3	2	3		3		3		4,500	9,000	0	0	0	1,000	2,500	1,200	2,000	3.7 x 3 = 11.1	
B13	Numerically controlled lathe	460 x 800						1		1	18,000	0	0	18,000	15,000	1,200	2,500	1,300	2,000	3.7	TAL 460 x 800 TAKISAWA
B14	Lathe	(200 x 500)		5							3,000	15,000	0	0	0	1,200	1,500	1,200	1,500		
B15	Screw cutting lathe	(1/4 " ~ 2")		6				3		3	6,900	41,400	0	20,700	20,700	1,000	2,500	1,300	2,000	3.7 x 3 = 11.1	
B16	Face lathe	(2,000 x 3,000)		1							70,000	70,000	0	0	0	3,400	5,000	1,800			
B17	Horizontal boring & milling machine	1,830						1		1	33,000	0	0	33,000	33,000	6,000	5,500	4,000	24,000	20	KBT-1101P KURAKI
B18	Vertical boring & milling machine	2,800						1		1	50,900	0	0	50,900	50,900	5,400	8,200	4,500	22,000	65	RB-2N SHIN NIPPON KOKI
B19	Vertical lathe (gantry type)	3,000				1				1	173,000	0	173,000	0	173,000	5,000	7,000	6,500	60,000	45	TMD-3,000 O-M
	Sub-total		13	62	13	6	13	18	13	19		776,900	234,100	214,500	387,500						
	[SHAPER]																				
S1	Shaper	(630 x 1,400)	2	3	2		2		2		2,500	7,500	0	0	0	1,600	2,400	1,600		5.5 x 2 = 11	
S2	Shaper	(500 x 850)	1	9	1		1	2	1	2	2,000	18,000	0	4,000	4,000	1,000	2,000	1,400	1,600	5.5 x 3 = 16.5	SUD-550 UCHIDA
S3	Shaper with copying attachment	700 x 1,000				1		1		1	6,300	0	6,300	6,300	6,300	2,600	2,900	1,800	3,500	9	SUD-700C UCHIDA
	Sub-total		3	12	3	1	3	3	3	3		25,500	6,300	10,300	10,300						
	[MILLING MACHINE]																				
F1	Milling machine	(300 x 1,300)	3	7	3		3		3		7,600	53,200	0	0	0	1,800	2,600	2,000		10 x 3 = 30	
F1	Milling machine	400 x 1,600				1		2		2	11,300	0	11,300	22,600	22,600	2,100	2,100	2,800	5,000	12 x 2 = 24	TK-VS3 TAKEDA
F2	Milling machine	(200 x 1,000)		4							3,000	12,000	0	0	0						
F3	Key seater	450						1		1	8,300	0	0	8,300	8,300	1,600	11,600	1,500	2,000	5	TS-500 TAIKO
	Sub-total		3	11	3	1	3	3	3	3		65,200	11,300	30,900	30,900						

Notes:

(1) Figures in parentheses show specifications of equipment in the plan of Dayeuhkoit workshop.

(2) "EX" and "PR" mean "Existing" and "Procurement" respectively.

CODE	DESCRIPTION		QUANTITY OF EQUIPMENT								UNIT PRICE (1,000 YEN)	PRICE (1,000 YEN)				SIZE per unit (mm)			WEIGHT per unit (kg)	MOTOR (kW)	TYPE AND MAKER
			PLAN - D		RENOVATION PLAN - 1		PLAN - 2		PLAN - 3			PLAN - D	RENOVATION PLAN - 1	PLAN - 2	PLAN - 3	WIDTH	LENGTH	HEIGHT			
			EX	PR	EX	PR	EX	PR	EX	PR											
	[GRINDER]																				
GR1	Bench grinder	(10")	1	20	1		1	7	1	7	600	16,000	0	5,600	5,600	400	600			1.5 x 8 = 12	
GR2	Cutting grinder	(10")	1	6	1		1	2	1	2	200	1,200	0	400	400	600	800			1.5 x 3 = 4.5	
GR3	Universal tool & cutter grinder (For bit)							1		1	5,100	0	0	5,100	5,100	1,300	1,600	1,500	1,000	4	C-40 MAKINO
												0	0	0	0						
GR4	Bench tool & cutter grinder (For bit)							1		1	800	0	0	800	800	800	1,000	1,200	200	1.5	DW-31S WAIDA
												0	0	0	0						
GR5	Pedestal grinder with dust collector (For bit)							4		4	400	0	0	1,600	1,600	400	800			1.5 x 4 = 6	SGF-CFX4 SHOWA
												0	0	0	0						
GR6	Air grinder	(180)						6		6	50	0	0	300	300						
GR7	Electric handy grinder	(180)		15				10		10	50	750	0	500	500						
	Sub-total		2	41	2	0	2	31	2	31		17,950	0	14,300	14,300						
	[DRILLING MACHINE]																				
BR1	Upright drilling machine	(500 x 1,000)		7						2	2,000	14,000	0	0	4,000	500	900	2,300	700	5.5 x 2 = 11	AUD-550 ASHINA
BR2	Upright drilling machine	(300 x 650)	2	2	2		2	1		1	1,300	2,600	0	1,300	1,300	440	700	2,000	400	2.2 x 3 = 6.6	AUD-500 ASHINA
BR3	Bench drilling machine							3		3	200	0	0	600	600	600	400			2.2 x 3 = 6.6	ASD-360 ASHINA
BR4	Radial drilling machine	3,000			0	1		2		2	23,000	0	23,000	46,000	46,000	2,400	2,600	1,000	5,100	8 x 2 = 16	HOR-D3,000 OGAWA
	Sub-total		2	9	2	1	2	6	0	8		16,600	23,000	47,900	51,900						
	[MECHANICAL PERSS]																				
PM1	Mechanical press	(100 t)		1							20,000	20,000	0	0	0						
PM1	Mechanical press	10 ~ 30 t						1		1	4,200	0	0	4,200	4,200	1,200	1,700	1,800	2,000	2.2	
PM2	Mechanical press	(125 kg)	1	0	1		1		1			0	0	0	0	1,000	1,000	1,500		1.5	
	Sub-total		1	1	1	0	1	1	1	1		20,000	0	4,200	4,200						
	[BENDING MACHINE]																				
LP1	Bending machine	(15 x 2,500)		1							8,500	8,500	0	0	0						
LP1	Bending machine	5 ~ 6 x 2,500								1	5,900	0	0	0	5,900	1,200	3,000	1,500	1,500	5.5	
LP2	Bending machine	(3 x 1,000)	1	0	1		1				2,000	0	0	0	0	800	1,400	1,500		5.5	
	Sub-total		1	1	1	0	1	0	0	1		8,500	0	0	5,900						
	[AIR COMPRESSOR]																				
C1	Air compressor	(12 kg/cm2)	2	3	2		2	3	2	3	1,500	4,500	0	4,500	4,500	1,000	2,000	1,200	700	11 x 5 = 110	
C2	Air compressor	(7 kg/cm2)	2	3	2		2	3	2	3	1,100	3,300	0	3,300	3,300	1,000	2,000	1,200	700	11 x 5 = 110	
	Sub-total		4	6	4	0	4	6	4	6		7,800	0	7,800	7,800						
	[CRUCIBLE FURNACE]																				
CR	Crucible furnace	(700 ~ 800 kg)	1	1	1		1		1		5,000	5,000	0	0	0						
	Sub-total		1	1	1	0	1	0	1	0		5,000	0	0	0						
	[ANNEALING FURNACE]																				
A	Annealing furnace	3,000 x 3,000						1		1	50,000	0	0	50,000	50,000	3,500	4,500	1,800	5,000	2.2	
	Sub-total		0	0	0	0	0	1	0	1		0	0	50,000	50,000						
	[SURFACE PLATE TABLE]																				
KM1	Surface table	1,200 x 2,400						1		1	1,800	0	0	1,800	1,800	1,200	2,400	300	1,000		
KM2	Assembling table	3,000 x 3,000						1		1	5,000	0	0	5,000	5,000	3,000	3,000	400	2,500		
	Sub-total		0	0	0	0	0	2	0	2		0	0	6,800	6,800						

Notes:
(1) Figures in parentheses show specifications of equipment in the plan of Dayeuhkolt workshop.
(2) "EX" and "PR" mean "Existing" and "Procurement" respectively.

CODE	DESCRIPTION	QUANTITY OF EQUIPMENT								UNIT PRICE (1,000 YEN)	PRICE (1,000 YEN)				SIZE per unit (mm)			WEIGHT per unit (kg)	MOTOR (kW)	TYPE AND MAKER
		PLAN - D		RENOVATION PLAN							PLAN - D	RENOVATION PLAN								
				PLAN - 1		PLAN - 2		PLAN - 3				PLAN - 1	PLAN - 2	PLAN - 3	WIDTH	LENGTH	HEIGHT			
		EX	PR	EX	PR	EX	PR	EX	PR											
	[WELDING MACHINE]																			
L1	Arc welding machine (250 ~ 400 A)										0	0	0	0						
	400 A	4	2	4		4	1	4	1	500	1,000	0	500	500						
	250 A	1	1	1		1	4	1	4	400	400	0	1,600	1,600						
L2	DC welding machine with generator (295 ~ 470 A)										0	0	0	0						
	DC 10 ~ 295 A	1	3	1		1		1		800	2,400	0	0	0						
	DC 40 ~ 350 A	1	2	1		1		1		900	1,800	0	0	0						
	DC 20 ~ 470 A	1	2	1		1		1		1,000	2,000	0	0	0						
	DC 20 ~ 450 A									1,000	0	0	0	0						
L4	TIG Argon arc welding machine (57 A)	1	4	1		1		1		800	3,200	0	0	0					13 x 22 = 286	
	25 ~ 57 A						1		1	800	0	0	800	800						
L5	TIG welding machine (300 A)	2	4	2		2		2		1,000	4,000	0	0	0						
	20 ~ 300 A						1		1	1,000	0	0	1,000	1,000						
L6	Plazuma spraying welding machine (120 A)	1	0	1		1		1		2,000	0	0	0	0						
L7	Varioming welding machine (94 A)	1	4	1		1		1		1,500	6,000	0	0	0						
	51 ~ 94 A									1,300	0	0	0	0						
L8	Metal spraying machine	1	0	1		1		1		5,000	0	0	0	0						
L9	Selectron (10 ~ 20 A)	1	1	1		1		1		1,000	1,000	0	0	0						
	Sub-total	15	23	15	0	15	7	15	7		21,800	0	3,900	3,900						
	[BENDING ROLLER]																			
RP1	Bending roller machine (25 x 2,500)		1							10,000	10,000	0	0	0						
RP2	Bending roller machine (13 x 1,270)		1							7,000	7,000	0	0	0						
RP3	Bending roller machine 5 ~ 6 x 1,200					1	2	1	2	5,000	0	0	10,000	10,000	1,000	2,000	1,600	3,000	5.5 x 2 = 11	
	Sub-total	0	2	0	0	1	2	1	2		17,000	0	10,000	10,000						
	[SHEARING MACHINE]																			
G1	Shearing machine (12)		1							6,000	6,000	0	0	0						
G2	Shearing machine (5)		1							3,500	3,500	0	0	0						
G3	Shearing machine 3 x 1,200					1	2	1	2	2,000	0	0	4,000	4,000	1,000	2,000	1,800	2,000	7.5 x 2 = 15	
	Sub-total	0	2	0	0	1	2	1	2		9,500	0	4,000	4,000						
	[PUNCHING MACHINE]																			
P1	Punching machine (1 ~ 2)		1				1		1	3,000	3,000	0	3,000	3,000	1,000	2,000	1,600	2,000	2.2	
	Sub-total	0	1	0	0	0	1	0	1		3,000	0	3,000	3,000						
	[SAW MACHINE]																			
GG1	Band saw machine (150)	1	2	1		1		1		2,000	4,000	0	0	0					2.2	
GG2	Band saw machine (500)		1							4,000	4,000	0	0	0						
GG3	Chain saw machine (2,600)		1							3,000	3,000	0	0	0						
GG4	Circular saw machine (16")	1	0	1		1		1			0	0	0	0					3.7	
K	Planing machine (300)		1							2,500	2,500	0	0	0						
GG5	Hack sawing machine 200						2		2	800	0	0	1,600	1,600	1,000	500	800	1,900	8 x 2 = 16	KILSER-200 MURAHASHI
	Sub-total	2	5	2	0	2	2	2	2		13,500	0	1,600	1,600						

Notes:
(1) Figures in parentheses show specifications of equipment in the plan of Dayeuhkolt workshop.
(2) "EX" and "PR" mean "Existing" and "Procurement" respectively.

CODE	DESCRIPTION		QUANTITY OF EQUIPMENT								UNIT PRICE (1,000 YEN)	PRICE (1,000 YEN)				SIZE per unit (mm)			WEIGHT per unit (kg)	MOTOR (kW)	TYPE AND MAKER
			PLAN - D		RENOVATION PLAN							PLAN - D	RENOVATION PLAN								
					PLAN - 1		PLAN - 2		PLAN - 3				PLAN - 1	PLAN - 2	PLAN - 3	WIDTH	LENGTH	HEIGHT			
			EX	PR	EX	PR	EX	PR	EX	PR											
	[CRANE]																				
T1	Electric hoist	(1 t)	1	2	1		1		1		1,000	2,000	0	0	0						
T2	Jib crane	(5 t)		3							3,000	9,000	0	0	0						
T2	Gantry crane	30 m x 15 m x 5 t						2		2	7,000	0	0	14,000	14,000					16 x 2 = 32	
T3	Gantry crane	(10 t)		2							15,000	30,000	0	0	0						
T3	Gantry crane	30 m x 15 m x 10 t				1		3		3	15,000	0	15,000	45,000	45,000					18 x 3 = 54	
T4	Gantry crane	(25 t)		1							30,000	30,000	0	0	0						
T5	Gantry crane	(50 t)		1							50,000	50,000	0	0	0						
	Sub-total		1	9	1	1	1	5	1	5		121,000	15,000	59,000	59,000						
	[TESTING APPARATUS]																				
ST	*Shearing testing machine*			1							8,000	8,000	0	0	0						
SST	Stress testing machine			1							15,000	15,000	0	0	0						
MB	Balancing machine			1							15,000	15,000	0	0	0						
MG1	Magnetic-particle testing machine							1		1	1,500	0	0	1,500	1,500						
MG2	Ultrasonic testing machine							1		1	2,500	0	0	2,500	2,500						
MT	Measuring tools			2				2		2	4,000	8,000	0	8,000	8,000						
	Sub-total		0	5	0	0	0	4	0	4		46,000	0	12,000	12,000						
	[COIL-WINDING MACHINE]																				
LK1	Coil-winding machine	(light duty)		1							4,000	4,000	0	0	0						
LK2	Coil-winding machine	(middle duty)		1							5,000	5,000	0	0	0						
LK3	Coil-winding machine	(heavy duty)		1							6,000	6,000	0	0	0						
	Sub-total		0	3	0	0	0	0	0	0		15,000	0	0	0						
	[TRANSPORTATION EQUIPMENT]																				
M1	Ordinaly truck	(5 t)		3				2		2	5,000	15,000	0	10,000	10,000						
M2	Ordinaly truck	(10 t)		3				1		1	12,000	36,000	0	12,000	12,000						
M3	Trailer	(50 t)		1							100,000	100,000	0	0	0						
M4	Trailer	(100 t)		1							200,000	200,000	0	0	0						
M5	Jeep			5				2		2	2,500	12,500	0	5,000	5,000						
M6	Pick-up			3				1		1	2,000	6,000	0	2,000	2,000						
M7	Mini-bus			2				1		1	3,000	6,000	0	3,000	3,000						
M8	Sedan			1				1		1	3,000	3,000	0	3,000	3,000						
M9	Dolly with rail	(300 m)		1				1		1	3,500	3,500	0	3,500	3,500						
M10	Forklift	(5 t)		2				1		1	7,000	14,000	0	7,000	7,000						
M11	Forklift	(10 t)		1							13,000	13,000	0	0	0						
M12	Forklift	(3 t)						1		1	3,000	0	0	3,000	3,000						
	Sub-total		0	23	0	0	0	11	0	11		409,000	0	48,500	48,500						
	Grand total		48	217	48	10	50	105	47	109		1,599,250	289,700	528,700	711,600						

Notes:
(1) Figures in parentheses show specifications of equipment in the plan of Dayeuhkolt workshop.
(2) "EX" and "PR" mean "Existing" and "Procurement" respectively.