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**THE FEASIBILITY STUDY REPORT
ON
THE RENOVATION OF DAYEUKOLOLOT WORKSHOP
IN
THE REPUBLIC OF INDONESIA
(SUMMARY)**

MARCH 1988

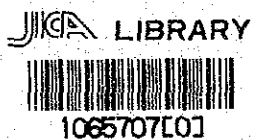
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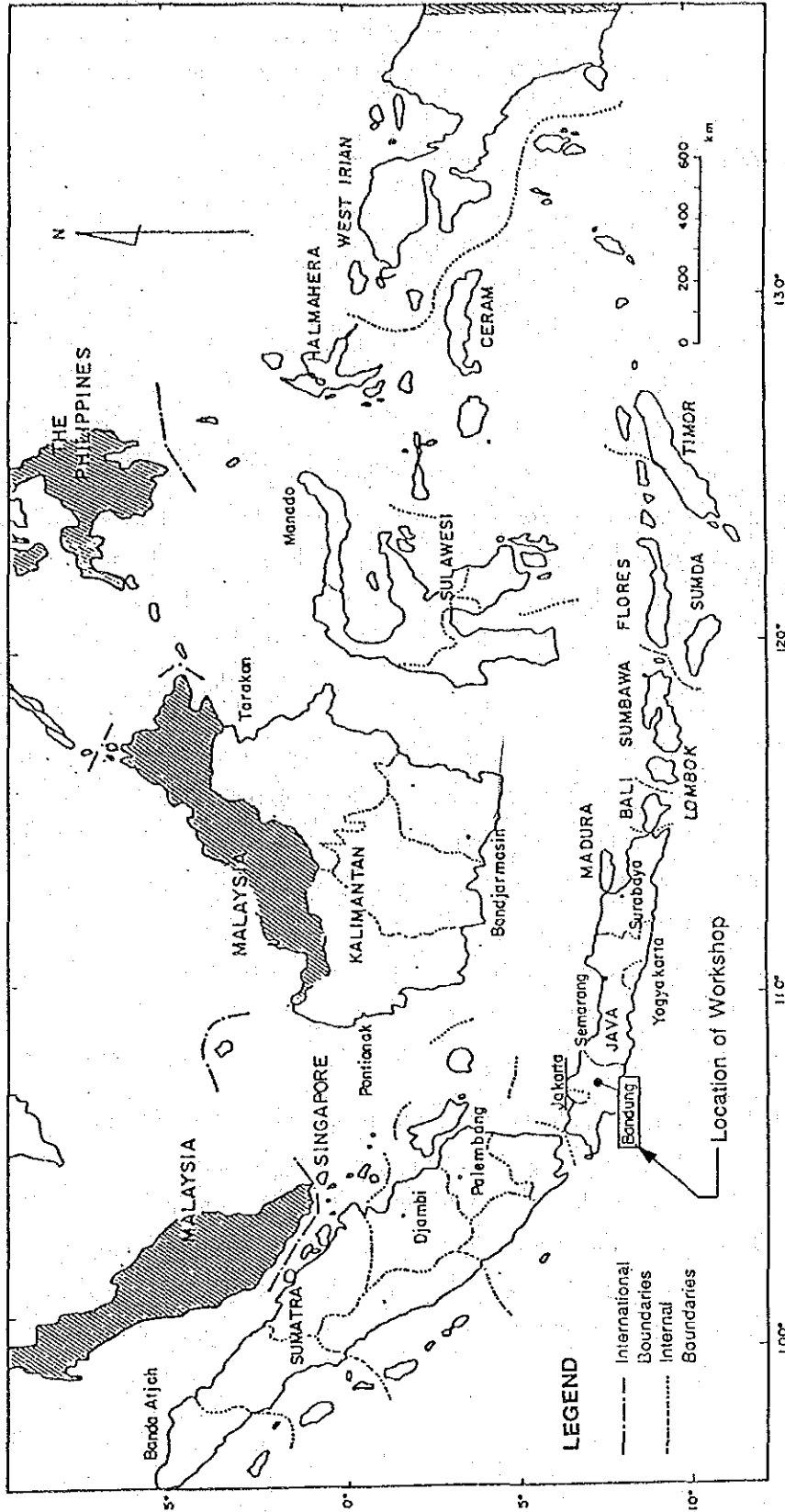
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LOCATION MAP



THE FEASIBILITY STUDY REPORT
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OF DAYEUKOLOI WORKSHOP
IN
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BACKGROUND

1. BENGKEL MESIN DAYEUKOLOI (hereinafter called as Dayeuhkolot Workshop) had been organized before the Independence Day of The Republic of Indonesia. Since the establishment, the minor extension had been carried out. But, the large-scale renovation and/or improvement have not been enforced.
2. The Dayeuhkolot Workshop belongs to PLN and is controlled by the PLN Regional Office for Generating and Transmission of West-Central Area of Jawa (PLN KJB). The Workshop is mainly repairing water-turbine and manufacturing replacement parts of auxiliary equipment for hydro-power station of PLN at West-Central areas, and also repairing auxiliary equipment for thermal, gas and geo-thermal power stations, and power transformer, and manufacturing hardware for transmission and distribution systems as well.
3. The total capability for power generation being 10,900 MW was observed in 1986/87 in the whole Indonesia, and PLN had solely the capacity of 6,200 MW at that time. PLN has generated 18,189 GWh, and the total generated energy including the external energy was 19,442 GWh in 1986/87. As a remarkable point, it is noted that 73.4% of the total generating capacity and 75.2% of the total generated energy were in Jawa Island.
4. In 5 years future, PLN has a plan to install generating facilities of 3,802 MW in total by 1992/93.

5. The items and the volume of works of the Dayeuhkolot Workshop are increasing gradually and steadily. However, the existing machine tools and almost all factory facilities become obsolete because almost all had been installed before 1979. For solving the above problem, the Government of Japan had been officially requested from the Government of the Republic of Indonesia to execute the feasibility study of renovation plan for the improvement of repair technic and the expansion of the Workshop. In response to the request, the Government of Japan had decided to investigate the present condition of the Dayeuhkolot Workshop to make plan, and entrusted the Japan International Cooperation Agency (JICA) with execution of the investigation and planning of the renovation of the Workshop, and the pre-investigation had been executed in February 1987.

Based on the results of the pre-investigation, JICA sent a field investigation team from July 13, 1987 to August 11, 1987 for executing the feasibility study.

The following is a summary of the above investigation.

DIAGNOSES FOR THE DAYEUEHKOLOT WORKSHOP

6. The Dayeuhkolot Workshop is located in the South-East suburbs of Bandung, and has a plottage of about 12,300 m² and building of about 4,570 m² in total. The large machine shop, small machine shop, welding shop, casting shop and storehouse, etc. are arranged in the premises. There is an enough open space in the front of office building, however, the space among the buildings is very narrow. Many machine tools and auxiliaries, repaired goods, goods under repair, raw materials, disused articles, waste materials, etc. are placed in the disorder in each building and the narrow space becomes narrower accordingly.
7. The kind and the size of machine tools in the large machine shop are not enough for machining water turbine of 5,000 kW class. It is doubtful whether the large machines working over eight and half years and frequently used has a high machining accuracy or not. One arm-crane with 5-meter radius arm and one small gantry crane are provided, and these are used by a half ton and 2-ton chain-blocks.

In the small size machine shop, there are enough quantities and kinds of machine tools. A small gantry crane of 0.5-ton is provided for transporting raw materials and processed goods, and a 5-ton hand operated winch on 5 m fixed type gantry crane is used for many purposes. It is judged by the register book that the machining accuracy of machines over 8 years will be down.

In the welding shop, press, punching machines, cutting machines, rollers, electric welders, etc. for repairing runners and guide vanes of water turbine and manufacturing of air heater for boiler of thermal plant are provided. But no lifting facility is arranged. Draft tube and Spiral casing of water-turbine are manufactured at the open workshop.

Furnaces for casting bearing metal for turbine, hardware for transmission and distribution line systems such as clamp, terminal, etc. are installed and sand pits are also provided in the casting shop.

In the transformer shop, hand-operated winding machines are arranged. But any facilities for insulation could not be found and no crane is provided.

8. 219 persons of workers and staff including a manager of the Workshop were working at the time of the field investigation, and about 60 persons of temporary workers were also employed. Although the team had no chance to refer to the regulations of the workshop, it is judged by their organization chart and sections that the personal arrangement are not so poor. But, a quality control section is not arranged.
9. It seems that any systematic training for workers is not executed. There are no spaces and no facilities for training in the premises.
10. There is no special hazardous work, and general safety measures are provided. It is required to rearrange and clean the premises for providing walk way. Safety measures for electrical facilities are provided in good conditions. However, fire fighting and preventing facilities are poor.
11. The Workshop does not make industrial noises, vibrations, smoke, poisonous gas, stench because of its work substance. It is reported that any claim by surrounding inhabitants relating preservation of a good environment did not happen.

12. The work volume of the Workshop is remarkably increasing in recent years. In case of 6 average working hours per day, the average ratio of operation of main facilities was approximately 123% in December 1986. In fact, the workshop was operated in full swing.

It is judged, however, that the present management system for the manufacturing process has to be improved.

13. It is a weak point that there is no quality control section. It is also concerned that, as for the quality control, there is a delicate shade of meaning between PLN staff and the managing staff of the factory.
14. The Dayeuhkolot Workshop submitted annually the accounting report formed with balance sheet, statement of profit and loss and fund flow table to PLN head office (PLN PUSAT), and the accounting data indicate only the financial statement of indirect cost. Transferred items corresponded to the capital from PLN is taken as major liabilities. It would be meaningless to review the assets of the Dayeuhkolot Workshop because of one section of PLN.
15. There is a close mutual relation between the material cost and the output of production in the direct cost. The output made a rapid progress as large as 60% per year, and the material cost also increased accordingly.

The administration cost indicates a high ratio. Indirect manpower is larger than direct manpower and it shows a possibility of cost reduction.

16. The turn-over ratio for material consumption and stocks is calculated as 2 from 1984/85 to 1986/87, and this value should be reduced. More cost down will be considered, when such high value should be suppressed.

DEMAND FORECAST

17. The most important point to be taken for the renovation of the Dayeuhkolot Workshop is to make realistic forecast of "Volume of Work". The total numbers of Francis type water turbine in the whole Indonesia which are being operated at present are 103 units. After operation of every 40,000 hours, the major overhaul will be carried out and the repair work will be done at the same time, if any.

18. With increase of power demand in future, generating facilities will be expanded accordingly. The workshop capacity such as quantity and type of machine tools, and manpower in the Dayeuhkolot Workshop are to be reviewed.

FRAMING OF RENOVATION PLAN

19. When the renovation plan will be formulated, selection of type and quantity of the workshop facilities are based on the method, route and kinds of process machining of repair and manufacture.

Standard operation hours of machine tools selected by kinds of material to be processed will be set by the size and weight of the materials. If kinds and volume of materials/parts for repair and manufacture are estimated, the kinds and quantity of machine tools will be derived accordingly.

Before calculation of units machine tools needed, the load/operation hours of the machine should be decided, and the date per one machine tool will be calculated by the standard operation hours. And, then, the necessary quantity of machines will be decided by 40,000 hours of repair cycle (corresponding to about 6 years due to conditions of operation of hydro-power station).

20. The renovation plan is reviewed comparatively by both technical and economical matters as for the following basic four (4) plans.

Plan-1: Several items special facilities which are indispensable for machining main parts of water turbine are added to the existing facilities of the Dayeuhkolot Workshop.

Plan-2: In accordance with the forecast of main parts items and volume of repair works of water turbine to be repaired, the workshop facilities, kind, type and quantity of machine tools will be decided, and the existing facilities and machine tools shall be used as many as possible. However, special parts will be ordered to outside workshops, while almost all repair works will be executed at the Dayeuhkolot Workshop.

Plan-3: Several special machine tools for special parts are supplemented to arrangement in the Plan-2 in order to make orders to outside workshops zero.

Plan-D: Plan prepared by the Dayeuhkolot Workshop itself.

It is noted that specific machine tools are unnecessary for repairing thermal power generating facilities (steam, gas and geo-thermal), and hardware of transmission and distribution line systems.

It is also noted that civil and building works associated directly with the workshop facilities only to be renovated are considered.

21. The newly introduced machine tools and equipment for the respective plans are as follows:

Plan-1

<u>Description</u>	<u>Q'ty (unit)</u>
Lathe for shaft (810 x 7,000 mm)	1
Vertical lathe (3,000 mm dia.)	1
Heavy duty lathe (810 x 4,000 mm)	1
- ditto- (600 x 2,000 mm)	3
Radial drilling machine (3,000 mm)	1
Milling machine (1,600 mm)	1
Shaper with copying attachment (700 mm)	1
Gantry crane (10 ton)	1
<hr/>	
Total of Items to be introduced	(7)10 units
Total of Existing Machine Tools which will be used as they are.	(31)48 units

Plan-2

(A) Machine tools for large size components

<u>Description</u>	<u>Q'ty (unit)</u>
Horizontal boring machine (1,830 mm)	1
Vertical boring machine (2,800 mm)	1
Lathe for shaft (810 x 7,000 mm)	1
Heavy duty lathe (600 x 2,000 mm)	2
- ditto - (600 x 3,000 mm)	1

Radial drilling machine (3,000 mm)	2
Milling machine (1,600 mm)	1
Shaper with copying attachment (700 mm stroke)	1
Press (10 ~ 30 ton)	1
Arc welding machine	3
Universal tool and cutter grinder	1
Pedestal grinder with dust collector	2
<hr/>	
Total of Items to be introduced	(12) 17 units
Total of Existing Machines which will be used as they are.	(3) 4 units

(B) Machine tools for small size components

<u>Description</u>	<u>Q'ty (unit)</u>
Lathe (600 x 2,000 mm)	1
Lathe (510 x 1,500 mm)	2
Lathe (510 x 1,000 mm)	1
Numerically controlled lathe (460 x 800 mm)	1
Screw cutting lathe	3
Key seater (450 mm)	1
Bending roller machine (5 ~ 6 mm t)	1
Shearing machine (1 ~ 3 mm t)	1
Hack sawing machine	2
Radial drilling machine	3
Tool and cutter grinder	1
Pedestal grinder with dust collector	2
Bench grinder (10")	7
Air grinder	6
Electric hand grinder	10
Punching machine (1 ~ 2 mm t)	1
Cutting grinder (10")	2
<hr/>	
Total of Items to be introduced	(17) 45 units
Total of Existing Machine Tools which will be used as they are.	(8) 36 units

(C) Machine tools for thermal power plant, etc.

<u>Description</u>	<u>Q'ty (unit)</u>
Lathe (510 x 1,000 mm)	4

Shaper (500 x 850 mm)	2
Milling machine (1,600 mm)	1
Bending rollers (5 ~ 6 t x 1,200 mm)	1
Shearing machine (3 t x 1,200 mm)	1
Upright drilling machine (300 x 650 mm)	1
Arc welding machine (250 A)	4
<hr/>	
Total of Items to be introduced	(7) 14 units
Total of Existing Machine Tools which will be used as they are.	(2) 2 units

(D) Testing apparatus and others

<u>Description</u>	<u>Q'ty (unit)</u>
Air compressor (12 kgf/cm ²)	3
- ditto - (7 kgf/cm ²)	3
Magnetic particle testing machine (AC 200 V, DC 2,000 A)	1
Ultrasonic testing machine (100 ds 1 ~ 5 MHz)	1
Surface plate for stage direction (1,200 x 2,400 mm)	1
Assembling table (3,000 x 3,000 mm)	1
Annealing furnace (3,000 x 3,000 mm) (Heavy oil, Automatic control type)	1 set
Measuring apparatus	2 sets
<hr/>	
Total of Items to be introduced	(8) 13 units
Total of Existing Items which will be used as they are.	(5) 7 units

(E) Transportation/handling equipment.

<u>Description</u>	<u>Q'ty (unit)</u>
10-ton Gantry crane	3
5-ton Gantry crane	2
Wagon	1
Steel rail with turn table (300 m)	1
Ordinary truck (5-ton)	2
- ditto - (10-ton)	1
Jeep	2

Pick-up	1
Mini-bus	1
Sedan	1
Fork lift (3-ton)	1
- ditto - (5-ton)	1
<hr/>	
Total of Items to be introduced	(12) 16 units
Total of Existing Item which will be as it is.	(1) 1 unit

Plan-3 The following machine tools are supplemented to those in the Plan-2:

<u>Description</u>	<u>Q'ty (unit)</u>
Gantry type vertical lathe (3,000 m/mø - 20 ton)	1
Upright drilling machine (550 m/m) (replace with existing ones)	2
Bending machine (5 ~ 6 t x 2,500 m/m) (replace with existing one)	1
<hr/>	
Total	4 units

Plan-D

<u>Description</u>	<u>Q'ty (unit)</u>
Lathe (heavy 42/light 20)	62
Shaper (heavy 3/light 9)	12
Milling machine (heavy 7/light 4)	11
Welding machine	23
Roller (heavy)	2
Shearing machine (heavy)	2
Punching machine	1
Sawing machine (each type)	5
Drilling machine (heavy 7/light 2)	9
Press (heavy), 100-ton	1
Bench grinder	35
Cutting grinder	6
Bending machine, 15 t x 2,500 mm	1
Air compressor	6
Crucible furnace	1

Testing/measuring apparatus	5
Coil-winding machine	3
Total	185 units

22. The special features for the respective Plans considering quantity, size, type of main machine tools and machining hours estimated for outside orders are as follows:

	<u>Plan-1</u>	<u>Plan-2</u>	<u>Plan-3</u>	<u>Plan-D</u>
- Processing limit in length (mm)	7,000	7,000	7,000	10,000
- Processing limit in outside diameter (mm)	3,000	2,000	3,000	2,000
- Processing limit in weight (ton)	20	1.2	20	2
- Horizontal boring machine	Nil	Exist	Exist	Nil
- Vertical boring machine	Nil	Exist	Exist	Nil
- Radial drilling machine	One unit shortage	Exist	Exist	Nil
- Machining hours for outside order (hour)	15,210	4,000	0	23,870

23. The estimated costs for the respective Plans are as follows:

	(x ¥ 1,000, x Rp. 1,000)			
	<u>Plan-1</u>	<u>Plan-2</u>	<u>Plan-3</u>	<u>Plan-D</u>
- New Building & Land Creation	Rp193,000	Rp778,000	Rp778,000	Rp2,300,000
- Improvement of Building	Rp59,000	Rp510,000	Rp510,000	Rp746,000
- Machinery facilities	¥289,700	¥553,700	¥736,600	¥1,599,250
- Others	Rp175,000	Rp355,000	Rp407,000	
	¥160,600	¥222,600	¥257,000	
Total	Rp427,000	Rp1,643,000	Rp1,695,000	
	¥450,300	¥776,300	¥993,600	

24. Manpower schedule for the respective Plans is planned considering the following.

a) Operators to operate machine tools installed.

- b) Manpower for assembling parts processed and for inspecting the complete goods.
- c) Probational workers for operating large machines and special facilities.
- d) Administrative staffs for repair and manufacture works.
- e) Group leaders arranged at each section.
- f) Engineering staffs for designing of repair and manufacture.

PROCUREMENT OF MATERIALS

25. Raw materials for repair and manufacture at the Dayeuhkolot Workshop are mainly various steel, stainless steel, cooper, brass, white-metal, etc. All standard materials can be procured at local market at any time.

CONCLUSION

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

Internal Rates of Return (IRR) are calculated from a cash flow for the respective Plans as follows;

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

The Plan 2 has the highest IRR with the slight margin to the Plan 1. Both the Plan 2 and 1 exceed the generally assumed level of opportunity cost of capital of 10% in Indonesia.

RECOMMENDATION

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

In order to achieve this Plan-2, funds consisting of the foreign currency portion being ¥776,300,000 and the local currency portion being Rp.1,643,000,000 (An equivalent total by Rp/¥ rate being 11.94 is Rp.10,912,022,000.) are needed.

A period of 15.5 months is to be considered for a net construction time schedules for this Plan-2. As the pre-construction stage, the engineering services such as detailed design, preparation of tender documents, tender call, contract award, review of shop drawings, shop inspection, etc. will have to be done taking a period of one year, the total period required for completion of the Plan-2 would reach as long as about two years, while the beginning part of the construction stage can be over-lapped with the latter part of the pre-construction stage. On the other hand, some of water turbines would have to be overhauled soon. In this sense, formality and procedure for realization of the Plan-2 are to be taken as soon as possible.

REMOVAL OF ELECTRICAL SECTION TO KLENDER WORKSHOP

28. At the Dayeuhkolot Workshop, homemade hand-operated winding machines are working as repairing facilities of power transformer, and the temporary repair work only can be made. For repairing power transformer permanently, it is required to provide vacuum drying facilities, drying room, insulation oil purifier, etc.

In addition to the above facilities, wide access road, wide space for turning trailers, space for outside oil tanks, and open work space shall be required for a repair shop of power transformer. The Klender Workshop has a wide space not used now, and it is enough for providing necessary facilities for repairing power transformer. Therefore, to prevent double investment, the facilities for repairing transformer are not included in this renovation plan because it is recommendable to these facilities for repairing power transformers from the Dayeuhkolot Workshop to the Klender Workshop.

The repair works of 20 to 25 kV class distribution transformers and of power transformers at power stations and substations with the primary voltage up to 77 kV will be considered. But repair works of 150 kV class transformer are not included.

For providing full-scale repair facilities for power transformers, it is required to arrange the cost of approximate Yen 580 million and Rp 1,250 million. And, the space of about 2,100 m² is needed for working area.

GENERATOR REPAIR SHOP

29. Generator winding has generally a life of 30 years, and the windings insulation over 30 years may be broken down by an weak lightning surge or switching surge.

In accordance with the recent development of resin insulation materials, process of insulation and simple facilities, high reliability insulation can be applied to the winding insulation easily. Therefore, it is recommended to provide new coil repair facilities at the Dayeuhkolot Workshop, and to repair the existing old coils in order for getting high reliability.

Special materials such as resin will be imported. And, joint materials and consumables are arranged locally.

Approximate Yen 300 million and Rp 420 million will be needed for providing the generator winding repair facilities. And, the space of about 600 m² is required.

COMPARISON TABLE OF FOUR (4) PLANS

ITEM	PLAN	PLAN - D	PLAN - I	PLAN - 2	PLAN - 3
Features and Characteristics		<ul style="list-style-type: none"> ◦ Medium, small size machines ◦ No large, special equipment ◦ Many hours of outside order ◦ Many machines and high cost but not effective for turbine repair 	<ul style="list-style-type: none"> ◦ 20% of cost of Plan - D ◦ Included group leaders, design engineers, probational workers. 	<ul style="list-style-type: none"> ◦ Reasonable quantity of machines and equipment ◦ Some outside order because of limitation of large and special machines ◦ Included effective man power as same as Plan - 1 	<ul style="list-style-type: none"> ◦ Add special equipment to Plan - 2 aiming at no outside order ◦ Low operation rate and high cost in machines
	Machine Quantity and Cost (× ₹ 1,000)	Existing: 48 New: 217 Total (unit) (*): 265 (171%) Cost (× ₹ 1,000) (*): 1,599,250 (302%)	48 10 58 (37%) 289,700 (55%)	50 105 155 (100%) 528,700 (100%)	47 109 156 (101%) 711,600 (135%)
Total Employee	549	263	301	302	
Outside order hours for repairing main turbine parts (**)		23,870 (17%) (597%)	15,210 (10%) (380%)	4,000 (3%) (100%)	0
	Land Creation, Expansion and Improvement of Building (× Rp1,000)	New: 7,934 m ² 2,300,000 Improvement: 3,824 m ² 746,000 Total: 11,758 m ² 3,046,000	890 m ² 193,000 960 m ² 59,000 1,850 m ² 252,000	5,870 m ² 778,000 3,360 m ² 510,000 9,230 m ² 1,288,000	5,870 m ² 778,000 3,360 m ² 510,000 9,230 m ² 1,288,000
Ex-Factory cost of machines and equipment (× ₹ 1,000)		1,599,250	289,700	528,700 25,000 (***)	711,600 25,000 (***)
	Others (× Rp1,000)	-	175,000 160,600	355,000 222,600	407,000 257,000
Total (× Rp1,000)	-	427,000 450,300	1,643,000 776,300	1,695,000 993,600	
Internal Rate of Return	-	10.3 %	10.9 %	7.6 %	
Remarks	See Note (****)				

Note (*) Ratio compared with Plan - 2
 (**) Ratio compared with total machining hours
 (***) Necessary money for extension of power receiving facility.
 (****) Expense in column for "Others" of the PLAN - D was not shown because "Others" include the training fee, a realistic figure of which is so difficult to estimate in view of various items and many quantities in the workshop facilities to be procured.

DRAWINGS

PLAN - 1

(ARRANGEMENT OF WORKSHOP)

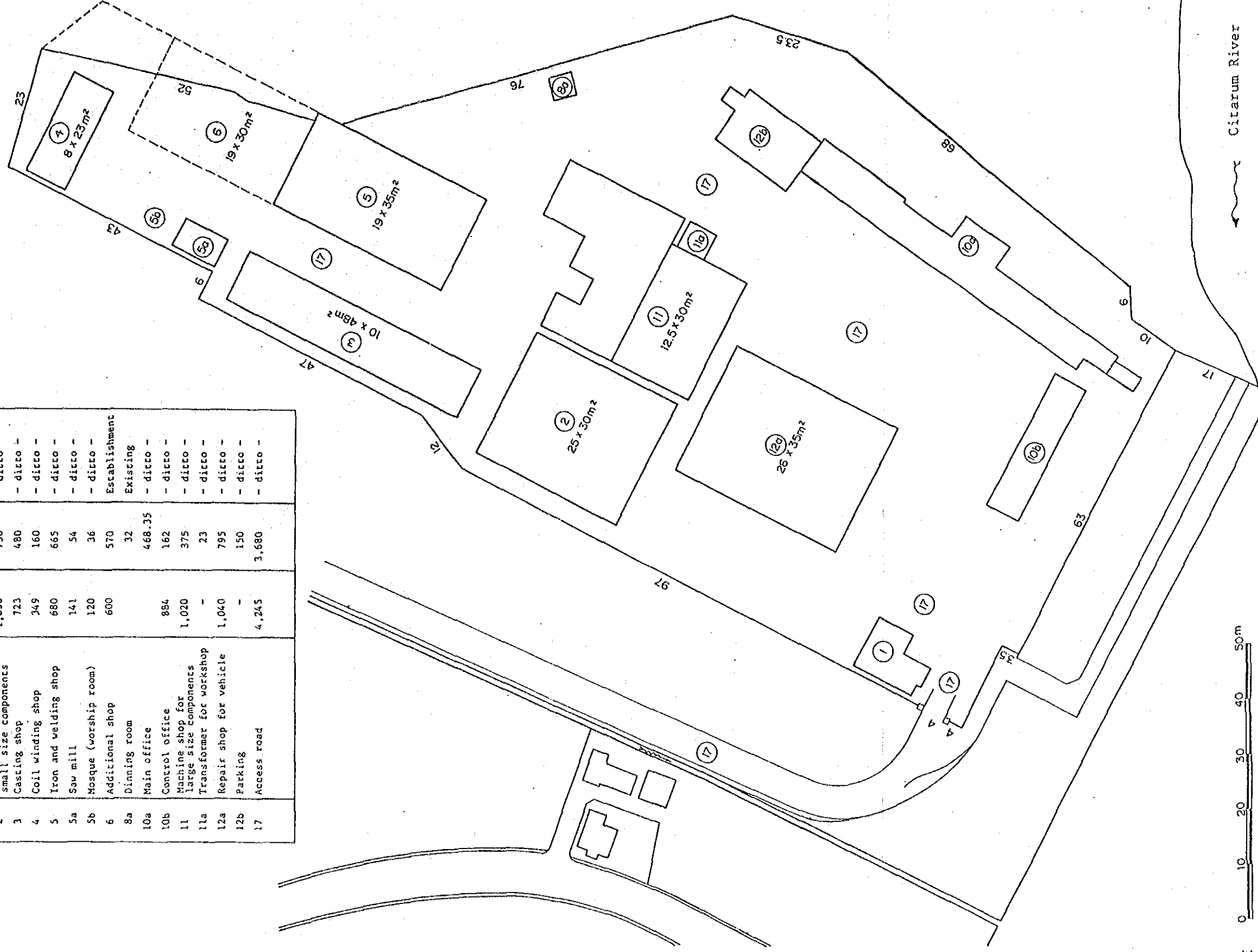
DRAWING LIST

PLAN-1 (ARRANGEMENT OF WORKSHOP)

<u>Serial No.</u>	<u>Drawing No.</u>	<u>Description</u>
1.	R-100	General Arrangement of Workshops PLAN-1
2.	R-101	Arrangement of Machine Shop No. 2 for Small Size Components
3.	R-102	Arrangement of Casting Shop No. 3
4.	R-103	Arrangement of Iron and Welding Shop No. 5
5.	R-104	Arrangement of Machine Shop No. 11 for Large Size Components

Drawing No. R-100 General Arrangement of Workshops PLAN-1

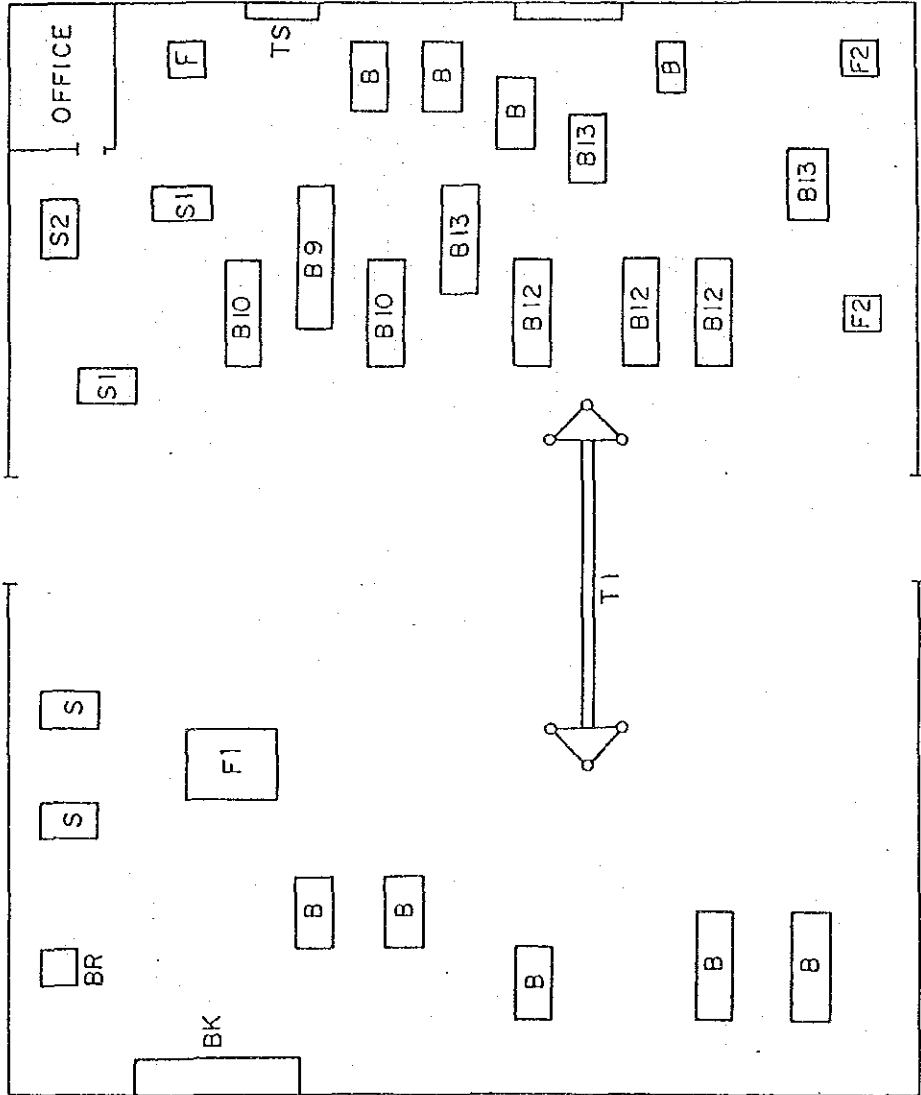
Shop No.	Description	Area m ²		Remarks
		Plottage	Floor	
1	Guard house	326	103.25	Existing
2	Machine shop for small size components	1,050	750	- ditto -
3	Casting shop	723	480	- ditto -
4	Coil winding shop	349	160	- ditto -
5	Iron and welding shop	680	665	- ditto -
5a	Saw mill	141	54	- ditto -
5b	Mosque (worship room)	120	36	- ditto -
6	Additional shop	600	570	Establishment
8a	Dinning room		32	Existing
10a	Main office		468.35	- ditto -
10b	Control office	884	162	- ditto -
11	Machine shop for large size components	1,020	375	- ditto -
11a	Transformer for workshop	-	23	- ditto -
12a	Repair shop for vehicle	1,040	795	- ditto -
12b	Parking	-	150	- ditto -
17	Access road	4,245	3,680	- ditto -



Drawing No. R-101

Arrangement of Machine Shop No.2 for Small Size Components

Scale: 1/200 Area: 25 x 30 m = 750 m²



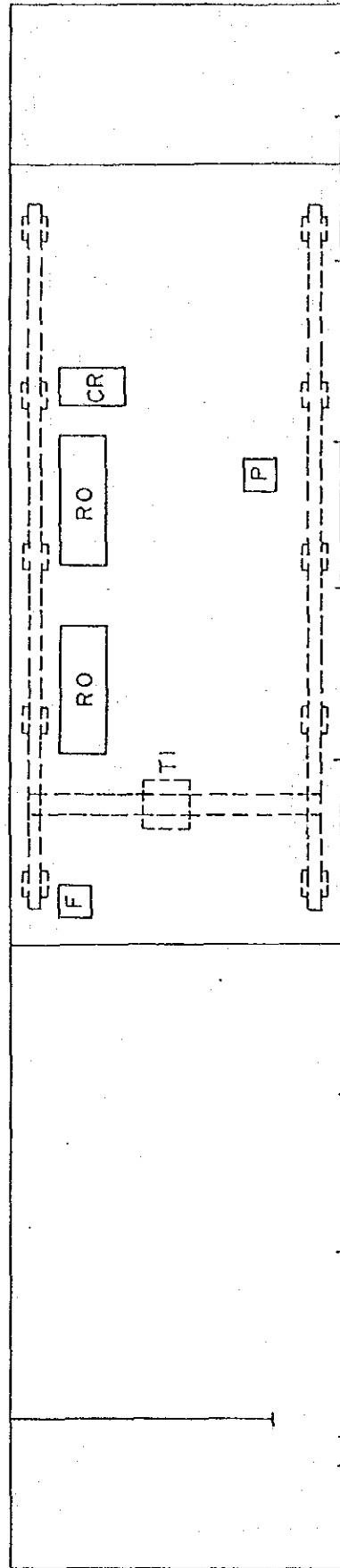
Code	Description	Specifications	Q'ty
B9	Heavy lache	600 x 2,000 mm	1
B10	Lathe	500 x 2,000 mm	2
B12	- ditto -	700 x 1,200 mm	3
B13	- ditto -	400 x 1,000 mm	3
S1	Shaper	630 x 1,400 mm	2
S2	- ditto -	500 x 850 mm	1
F1	Milling machine	300 x 1,300 mm	1
F2	- ditto -	380 x 1,650 mm	2
TL	Gantry crane	5 tons	1

Drawing No. R-102

Arrangement of Casting Shop No.3

Scale: 1/200 Area: 48 x 10 m = 480 m²

Code	Description	Specifications	Qty
CR	Crucible furnace	700 - 800 kg	1
TI	Electric hoist	1 ton	1
F	Electric fan		1
RO	Coke furnace		2
P	Cupola		1



Drawing No. R-103

Arrangement of Iron and Welding Shop No.5

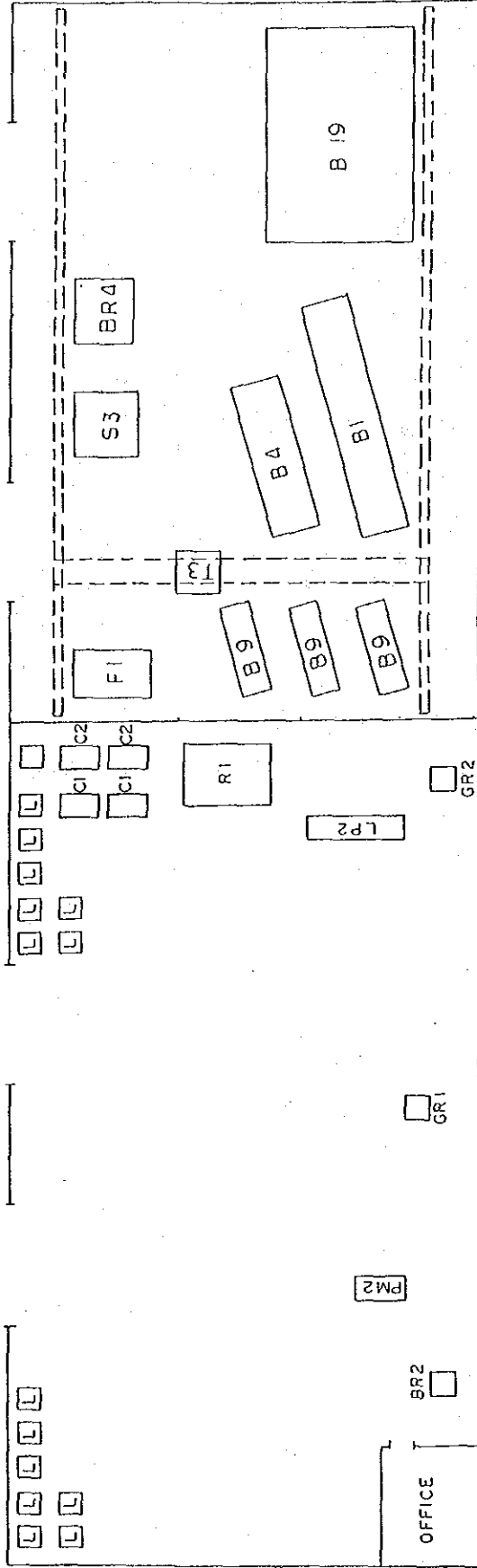
Area: 19 x 35 m = 665 m²

Code	Description	Specifications	Q'ty
L1	Arc welding machine	AC 400 A	4
	- ditto -	AC 250 A	1
L2	DC welding machine with generator	DC 10 - 295 A	1
	- ditto -	DC 40 - 350 A	1
	- ditto -	DC 20 - 470 A	1
L4	TIG Argon welding machine	57 A	1
L5	TIG Welding machine	300 A	1
L6	Plasma xpraying welding machine	170 A	2
L7	Vacuuming welding machine	94 A	1
L8	Metal xpraying machine		1
L9	Selectron	10 - 20 A	1

Code	Description	Specifications	Q'ty
BR2	Upright drilling machine	300 x 650 mm	1
GR2	Cutting grinder	10"	1
GR1	Bench grinder	10"	1
PM2	Mechanical press	125 kg	1
L22	Bending roller	3 t x 1,000 mm	1
C1	Air compressor	12 kg/cm ²	2
C2	- ditto -	7 kg/cm ²	2
RI	Waving roller		1

Code	Description	Specifications	Q'ty
RI	Lathe for shaft	810 x 7,000 mm	1
BR4	Heavy lathe	810 x 4,000 mm	1
BR	- ditto -	600 x 2,000 mm	3
BR9	Vertical lathe (Gantry type)	3,000 mm	1
S3	Shaper with copying attachment	700 mm	1
PI	Milling machine	380 x 1,650 mm	1
BR4	Radial drilling machine	3,000 mm	1
T3	Gantry crane	20 m x 15 m, 10 tons	1

Arrangement of Additional Workshop No.6
Area: 19 x 30 m = 570 m²



NO. 5

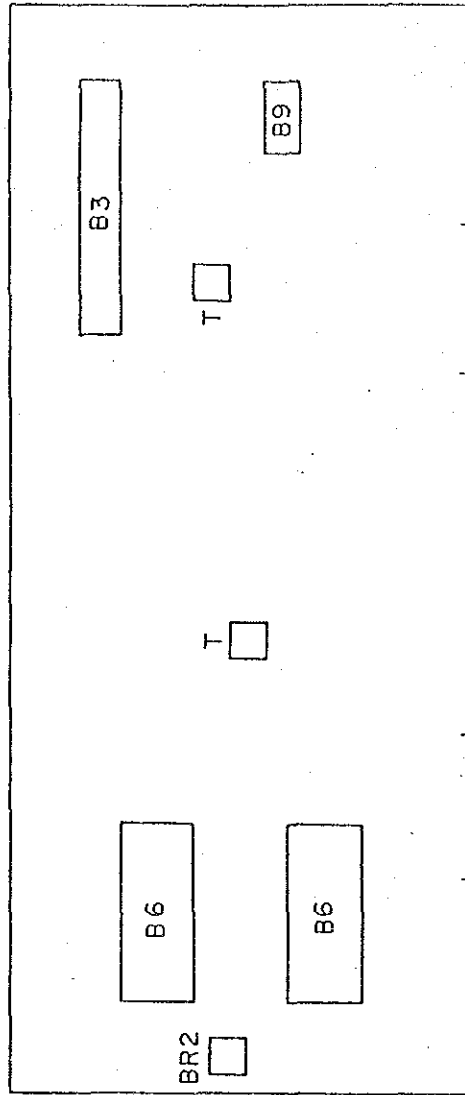
NO. 6

Drawing No. R-104

Arrangement of Machine Shop No.11 for Large Size Components

Scale: 1/200 Area: 30 x 125 m = 375 m²

Code	Description	Specifications	Qty
B3	Lathe for shaft	700 x 4,000 mm	1
B6	Face lathe	2,000 x 2,000 mm	2
B9	Lathe	600 x 2,000 mm	1
BR2	Upright drilling machine	300 x 650 mm	1
T	Derrick crane		2



PLAN - 2 AND PLAN - 3
(ARRANGEMENT OF WORKSHOP)

DRAWING LIST

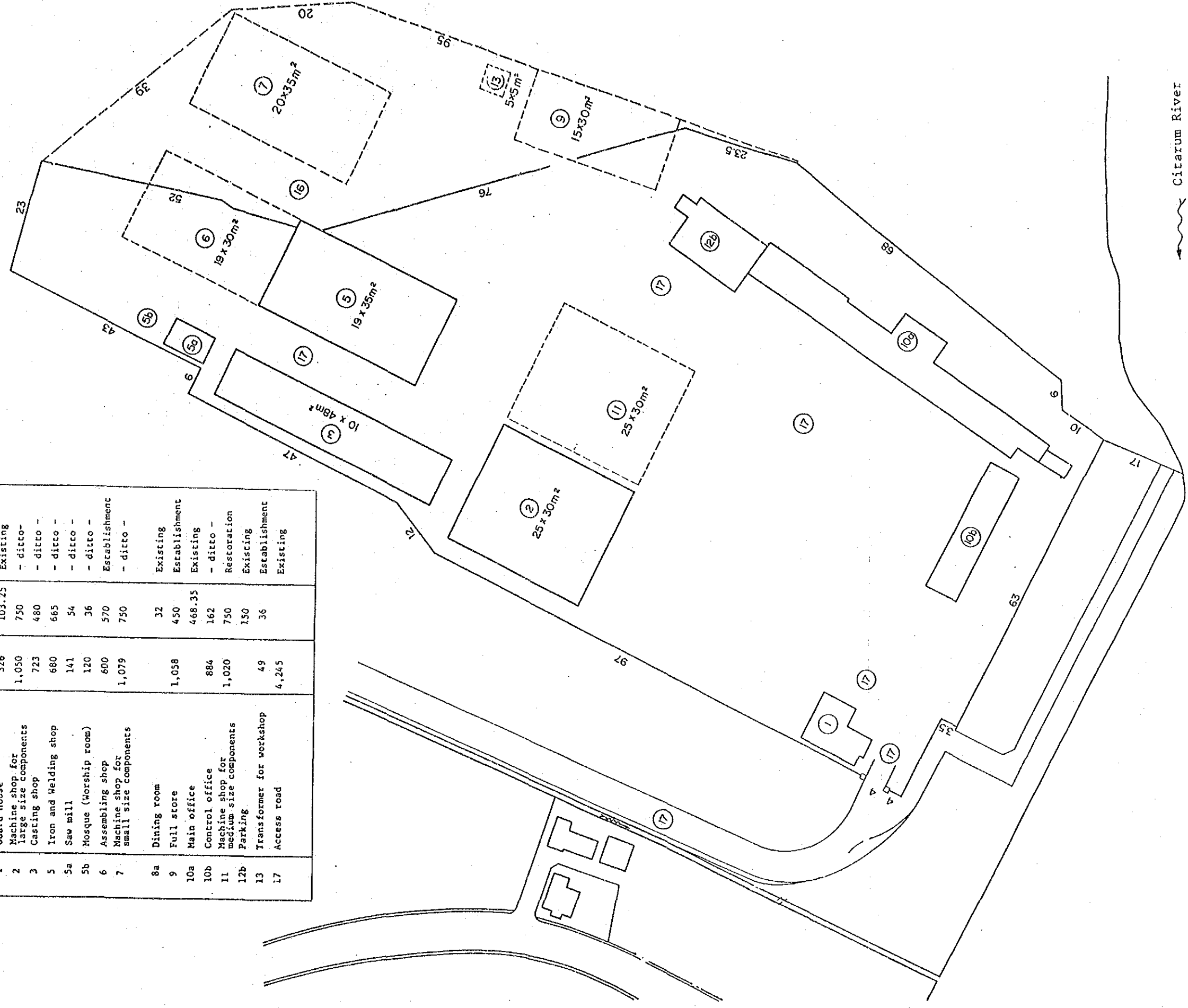
PLAN-2 and PLAN-3

(ARRANGEMENT OF WORKSHOP)

<u>Serial No.</u>	<u>Drawing No.</u>	<u>Description</u>
1.	R-200	General Arrangement of Workshop PLAN-2 and PLAN-3
2.	R-201	Arrangement of Machine Shop No. 2 for Large Size Components
3.	R-202	Arrangement of Welding Shop No. 5 and Assembling Shop No. 6
4.	R-203	Arrangement of Machine Shop No. 7 for Small Size Components
5.	R-204	Arrangement of Machine Shop No. 11 for Medium Size Components

Drawing No. R-200 General Arrangement of Workshop PLAN-2 and PLAN-3

Shop No.	Description	Area m ²		Remarks
		Plottage	Floor	
1	Guard house	326	103.25	Existing
2	Machine shop for large size components	1,050	750	- ditto -
3	Casting shop	723	480	- ditto -
5	Iron and welding shop	680	665	- ditto -
5a	Saw mill	141	54	- ditto -
5b	Mosque (Worship room)	120	36	- ditto -
6	Assembling shop	600	570	Establishment
7	Machine shop for small size components	1,079	750	- ditto -
8a	Dining room		32	Existing
9	Full store	1,058	450	Establishment
10a	Main office		468.35	Existing
10b	Control office	884	162	- ditto -
11	Machine shop for medium size components	1,020	750	Restoration
12b	Parking		150	Existing
13	Transformer for workshop	49	36	Establishment
17	Access road	4,245		Existing



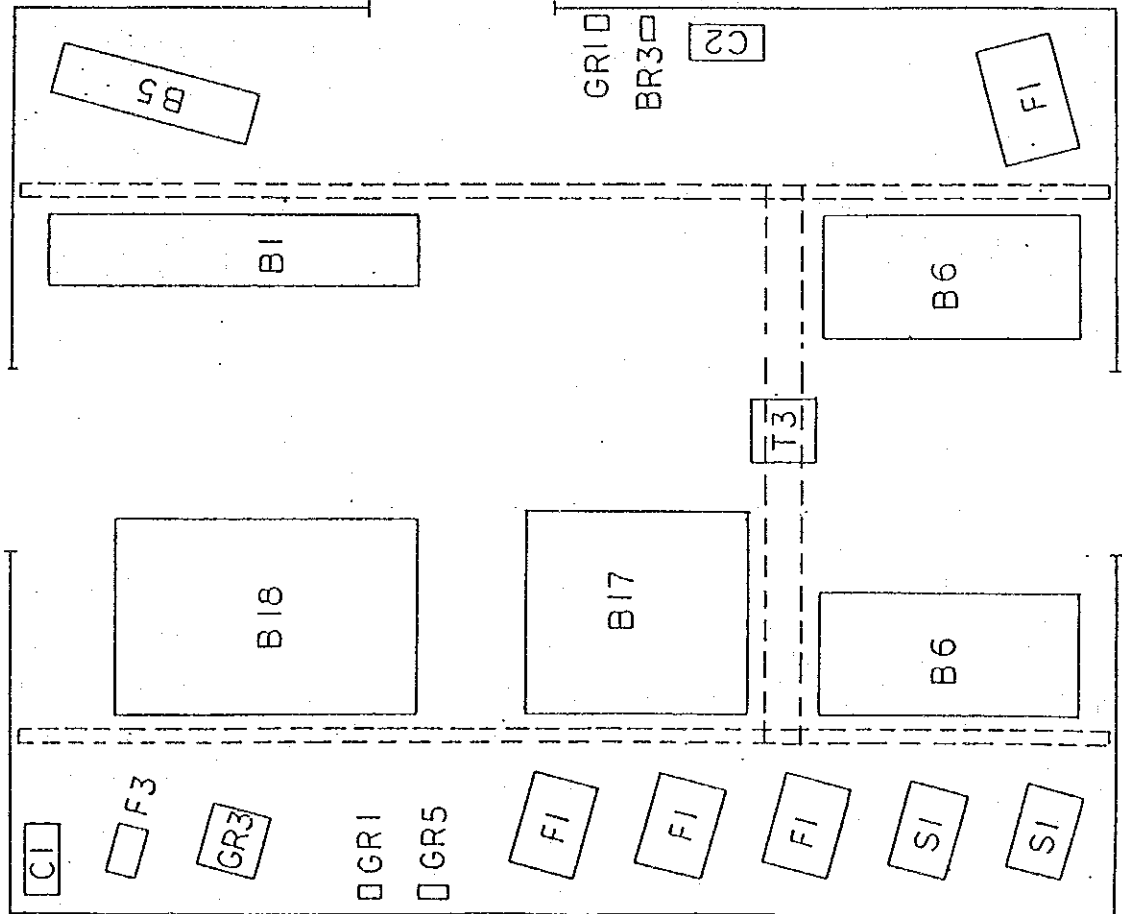
SCALE 0 10 20 30 40 50m

Citarum River

Drawing No. R-201

Arrangement of Machine Shop No.2 for Large Size Components

Scale: 1/200 Area: 25 x 30 m = 750 m²



Code	Description	Specifications	Qty	Existing	Providing
B1	Lathe for shaft	810 x 7,000 mm	1	-	1
B5	Heavy lathe	600 x 3,000 mm	1	-	1
B6	Face lathe	2,000 x 2,000 mm	2	2	-
B7	Horizontal boring and milling machine	1,830 mm	1	-	1
B8	Vertical boring and milling machine	2,800 mm	1	-	1
S1	Shaper	630 x 1,400 mm	2	2	-
F1	Milling machine	300 x 1,300 mm	3	3	-
F1	- ditto -	380 x 1,650 mm	1	-	1
F3	Key searer	450 mm	1	-	1
L1	Arc welding machine	AC 250 A	1	1	-
L2	DC welding machine with generator	DC 10 - 295 A	1	-	1
GR1	Bench grinder	10"	2	-	2
GR3	Universal tool and cutter grinder		1	-	1
GR5	Pedestal grinder with dust collector		1	-	1
GR7	Electric handy grinder	180 mm	2	-	2
WC	Hand drilling machine		1	-	1
C1	Air compressor	12 kgf/cm ²	1	-	1
C2	- ditto -	7 kgf/cm ²	1	-	1
T3	Gantry crane	30 m x 15 m x 10 tons	1	-	1

Drawing No. R-202

Arrangement of Welding Shop No.5

Area: 19 x 35 m = 665 m²

Code	Description	Specifications	Q'ty	Existing	Providing
L1	Arc welding machine	AC 400 A	2	2	-
	- ditto -	AC 250 A	5	-	5
L2	DC welding machine with generator	DC 40 - 300 A	2	1	1
	- ditto -	DC 30 - 400 A	1	1	-
L4	TIG Argon welding machine	57 A	1	1	-
L5	TIG welding machine	300 A	2	2	-
L6	Plasma spraying welding machine	20 - 300 A	1	-	1
L7	Vacuuming welding machine	120 A	2	1	1
L8	Vertical spraying machine	9 A	1	1	-
L9	Selectron	10 - 20 A	1	1	-
R3	Bending roller machine	5 - 6 t x 1,270 mm	2	-	2
G3	Shearing machine	3 t x 1,270 mm	2	-	2
P1	Punching machine	1 - 2 t	1	-	1
GR1	Bench grinder	10" dia.	2	1	1

Arrangement of Assembling Shop No.6

Area: 19 x 30 m = 570 m²

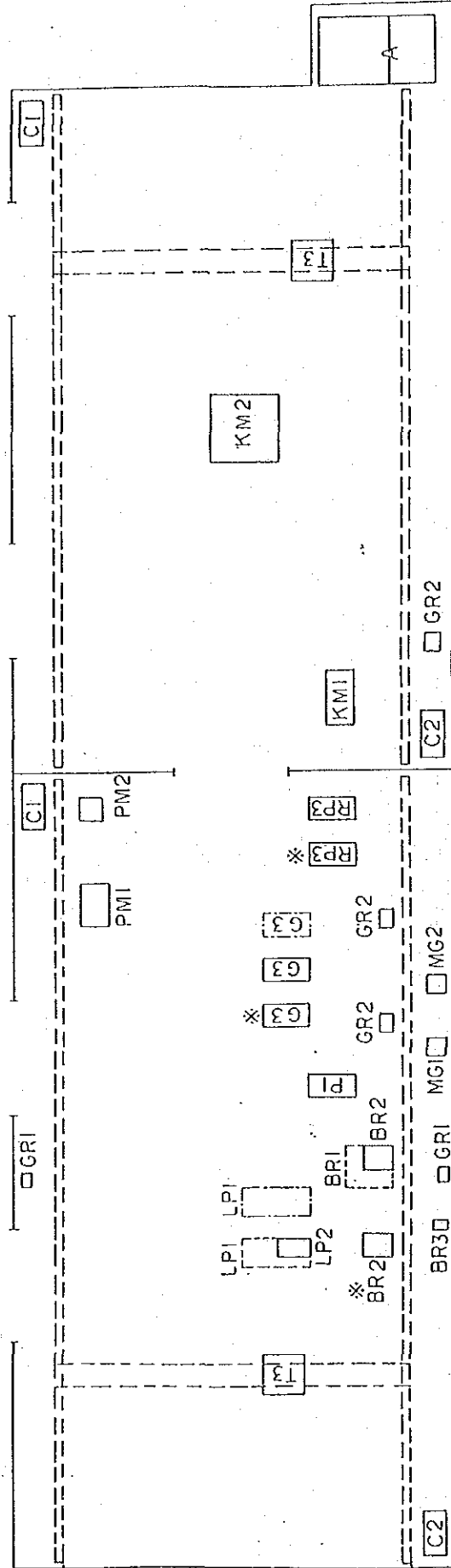
Code	Description	Specifications	Q'ty	Existing	Providing
GR2	Cutting grinder	10"	1	-	1
GR6	Air grinder	180 mm	2	-	2
GR7	Electric handy grinder	180 mm	2	-	2
XR1	Surface table	1,200 x 2,400 mm	1	-	1
XR2	Assembling table	3,000 x 3,000 mm	1	-	1
T3	Crane crane	30 m x 15 m - 10 tons	1	1	-
CI	Air compressor	12 kg/cm ²	1	1	-
C2	- ditto -	7 kg/cm ²	1	1	-
A	Annealing furnace	3,000 x 3,000 mm	1	-	1

Note-1: In case of PLAN-3 adopted, BR1 shall be replaced by BR2.

Note-2: [] shows PLAN-3.

* marked machines will be used for the processing parts of thermal power plant and others.

[] shows the spaces for the future machines.



NO.5

NO.6

Drawing No. R-203

Arrangement of Machine Shop No.7 for Small Size Components

Scale: 1/200

Area: 20 x 35 m = 700 m²

Code	Description	Specifications	Q'ty	Existing	Providing
B12	Lathe	700 x 1,200 mm	3	3	-
	- ditto -	510 x 1,000 mm	5	-	5
B13	- ditto -	400 x 1,200 mm	3	3	-
B15	Numerically controlled lathe	460 x 800 mm	1	-	1
L1	Screw cutting lathe	1/4" - 2"	3	-	3
L4	Argon welding machine	400 A	1	-	1
L9	TIG Argon welding machine	25 - 57 A	1	-	1
OCS	Selectron	10 - 20 A	2	-	2
GR1	Back sawing machine	10"	2	-	2
GR5	Bench grinder	10"	1	-	1
GR6	Pedestal grinder with dust collector	180 mm	2	-	2
GR7	Air grinder	180 mm	2	-	2

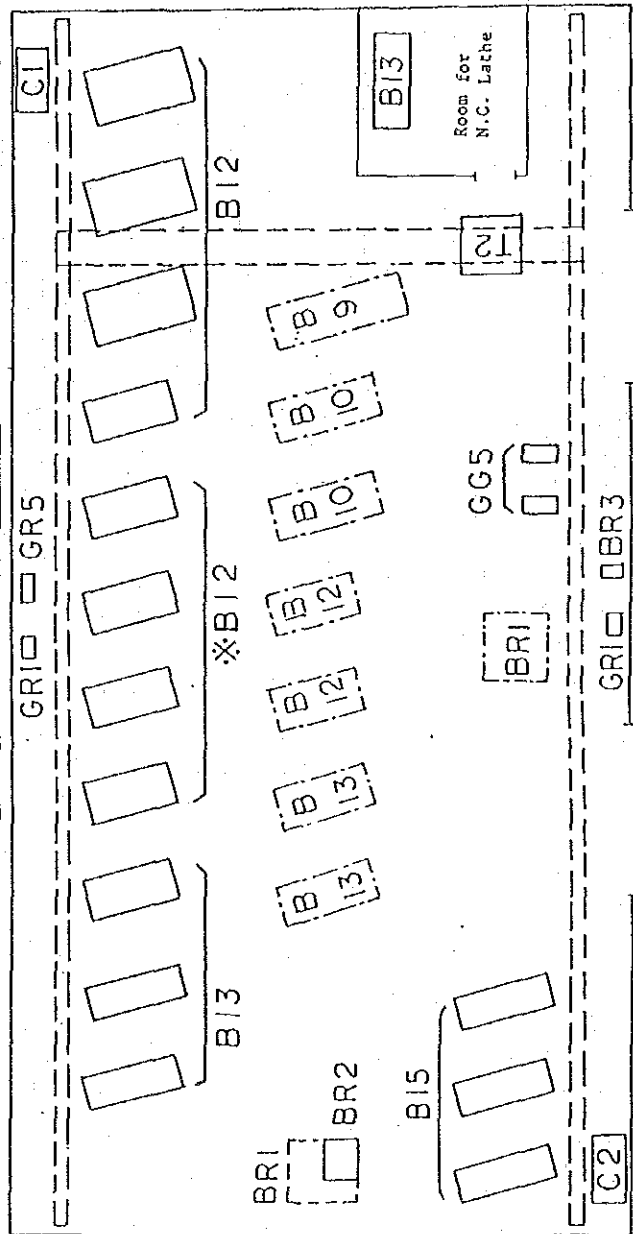
Code	Description	Specifications	Q'ty	Existing	Providing
BRI	Upright drilling machine	500 x 1,000 mm	1	-	1
BR2	- ditto -	300 x 650 mm	1	1	-
BR3	Bench drilling machine	12 kgf/cm ²	1	-	1
C1	Air compressor	7 kgf/cm ²	1	-	1
C2	- ditto -	30 m x 15 m - 5 tons	1	-	1
T2	Gantry crane		1	-	1

Note-1: In case of PLAN-3 adopted, BRI shall be replaced by BR2.

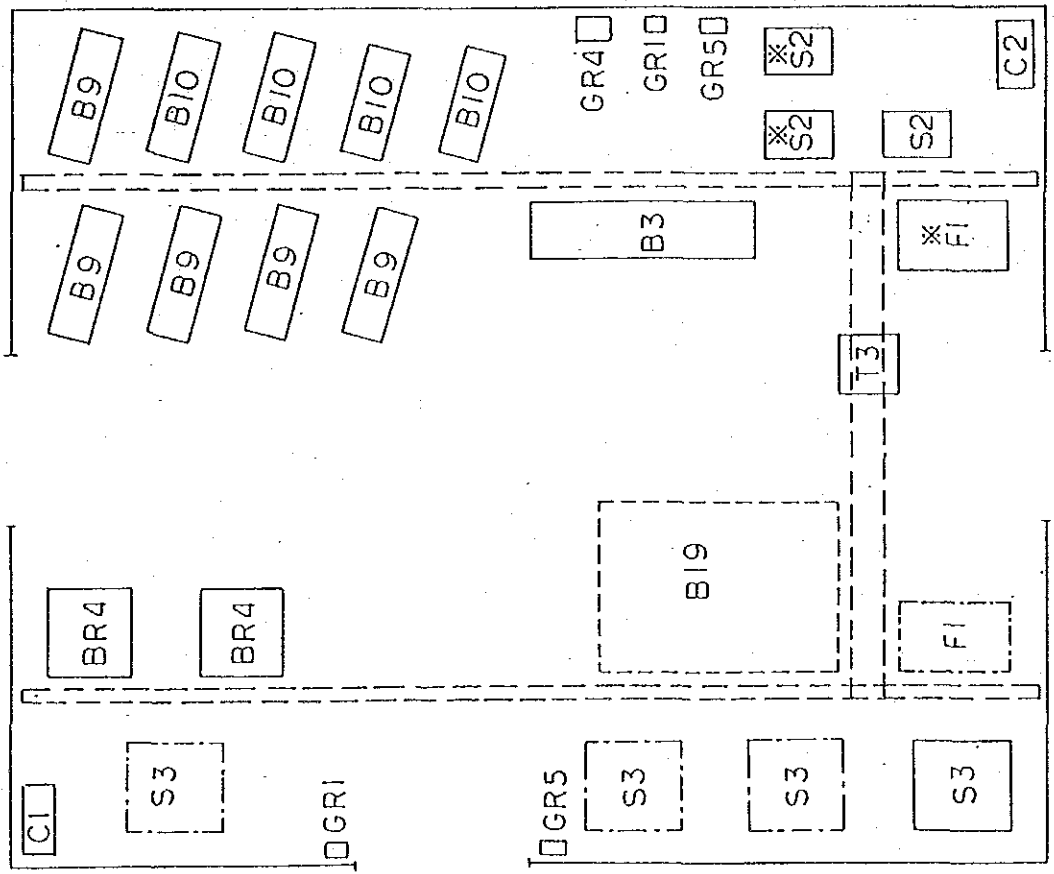
Note-2: [---] shows PLAN-3.

* marked machines will be used for the processing parts of the main power plant and others.

[] shows the spaces for the future machines.



Drawing No. R-204 Arrangement of Machine Shop No. 11 for Medium Size Components
 Scale: 1/200 Area: 25 x 30 = 750 m²



Code	Description	Specifications	Qty	Existing	Providing
B3	Lathe for shaft	700 x 4,000 mm	1	1	-
B9	Heavy lathe	600 x 2,000 mm	5	2	3
B10	Lathe	500 x 2,000 mm	2	2	-
	- ditto -	510 x 1,500 mm	2	-	2
B19	Vertical lathe (Gantry type)	3,000 mm	1	-	1
S2	Shaper	500 x 850 mm	3	1	2
S3	Shaper with copying attachment	700 x 1,000 mm	1	-	1
F1	Milling machine	300 x 1,300 mm	1	-	1
L1	Arc welding machine	AC 250 A	1	-	1
L2	DC welding machine with generator	DC 10 - 295 A	1	1	-
GR1	Bench grinder	10"	2	-	2
GR4	Bench tool and cutter grinder		1	-	1
GR5	Pedestal grinder with dust collector		2	-	2
GR7	Electric handy grinder	180 mm	2	-	2
BR4	Radial drilling machine	3,000 mm	2	-	2
C1	Air compressor	12 kgf/cm ²	1	-	1
C2	- ditto -	7 kgf/cm ²	1	-	1
T3	Gantry crane	30 m x 15 m - 10 tons	1	-	1

Note: shows for PLAN-3.
 * marked machines will be used for the processing, parts of thermal power plants and others.
 shows the spaces for the future machines.

PLAN - D

(ARRANGEMENT OF WORKSHOP)

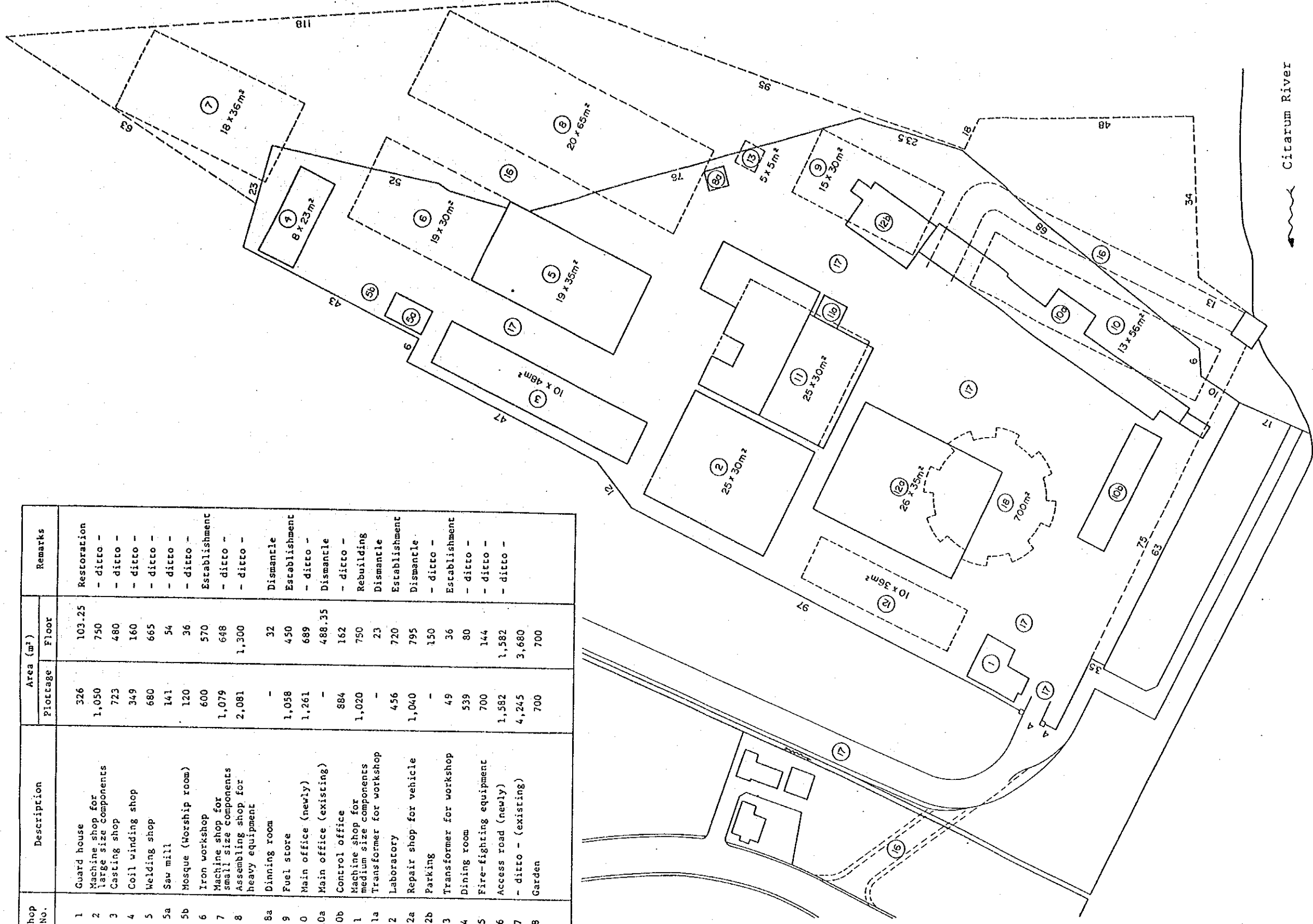
DRAWING LIST

PLAN-D (ARRANGEMENT OF WORKSHOP)

<u>Serial No.</u>	<u>Drawing No.</u>	<u>Description</u>
1.	R-300	General Arrangement of Workshop PLAN-D
2.	R-301	Arrangement of Machine Shop No. 2 for Large Size Component
3.	R-302	Arrangement of Casting Shop No. 3
4.	R-303	Arrangement of Coil Winding Shop No. 4
5.	R-304	Arrangement of Welding Shop No. 5
6.	R-305	Arrangement of Machine Shop No. 7 for Small Size Components
7.	R-306	Arrangement of Assembling Shop No. 8 for Large Size Components
8.	R-307	Arrangement of Machine Shop No. 11 for Medium Size Components
9.	R-308	Arrangement of Laboratory No. 12

Drawing No. R-300 General Arrangement of Workshop PLAN-D

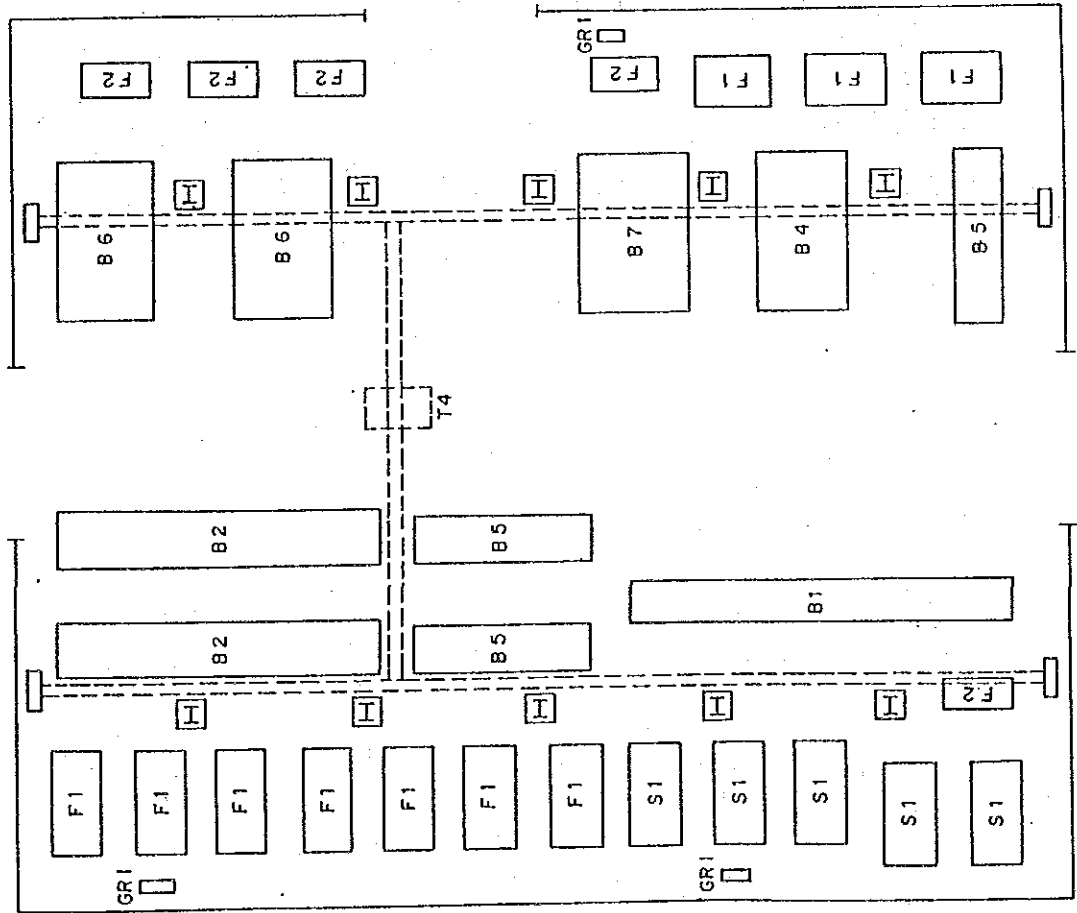
Shop No.	Description	Area (m ²)		Remarks
		Plottage	Floor	
1	Guard house	326	103.25	Restoration
2	Machine shop for large size components	1,050	750	- ditto -
3	Casting shop	723	480	- ditto -
4	Coil winding shop	349	160	- ditto -
5	Welding shop	680	665	- ditto -
5a	Sew mill	141	54	- ditto -
5b	Mosque (Worship room)	120	36	- ditto -
6	Iron workshop	600	570	Establishment
7	Machine shop for small size components	1,079	648	- ditto -
8	Assembling shop for heavy equipment	2,081	1,300	- ditto -
8a	Dinning room	-	32	Dismantle
9	Fuel store	1,058	450	Establishment
10	Main office (newly)	1,261	689	- ditto -
10a	Main office (existing)	-	488.35	Dismantle
10b	Control office	884	162	- ditto -
11	Machine shop for medium size components	1,020	750	Rebuilding
11a	Transformer for workshop	-	23	Dismantle
12	Laboratory	456	720	Establishment
12a	Repair shop for vehicle	1,040	795	Dismantle
12b	Parking	-	150	- ditto -
13	Transformer for workshop	49	36	Establishment
14	Dining room	539	80	- ditto -
15	Fire-fighting equipment	700	144	- ditto -
16	Access road (newly)	1,582	1,582	- ditto -
17	- ditto - (existing)	4,245	3,680	- ditto -
18	Garden	700	700	



SCALE 0 10 20 30 40 50m

Drawing No. R-301 Arrangement of Machine Shop No.2 for Large Size Components

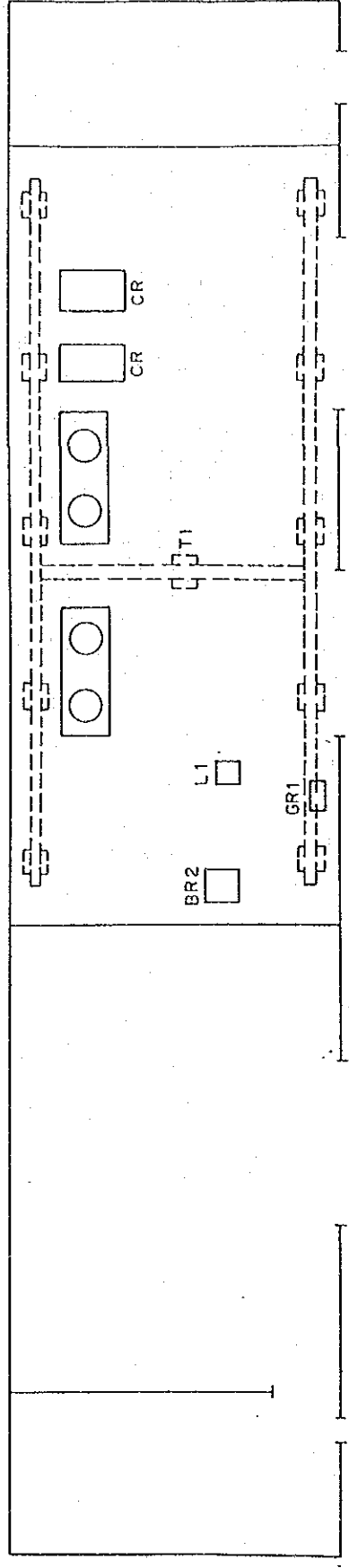
Scale: 1/200 Area: 30 x 25 = 750 m²



Code	Description	Specifications	Qty	Existing	Procurement
B1	Lathe for shaft	1,000 x 10,000 mm	1	-	1
B2	- ditto -	1,000 x 8,000 mm	2	-	2
B4	Heavy lathe	1,000 x 2,000 mm	1	-	1
B5	- ditto -	600 x 3,000 mm	3	-	3
B6	Face lathe	2,000 x 2,000 mm	2	2	-
B7	- ditto -	3,000 x 2,000 mm	1	-	1
S1	Shaper	630 x 1,400 mm	5	2	3
F1	Milling machine	300 x 1,300 mm	10	3	7
F2	- ditto -	200 x 1,000 mm	4	-	4
GR1	Bench grinder	10"	3	-	3
GR7	Electric handy grinder	180 mm	2	-	2
T4	Overhead crane	25 t	1	-	1

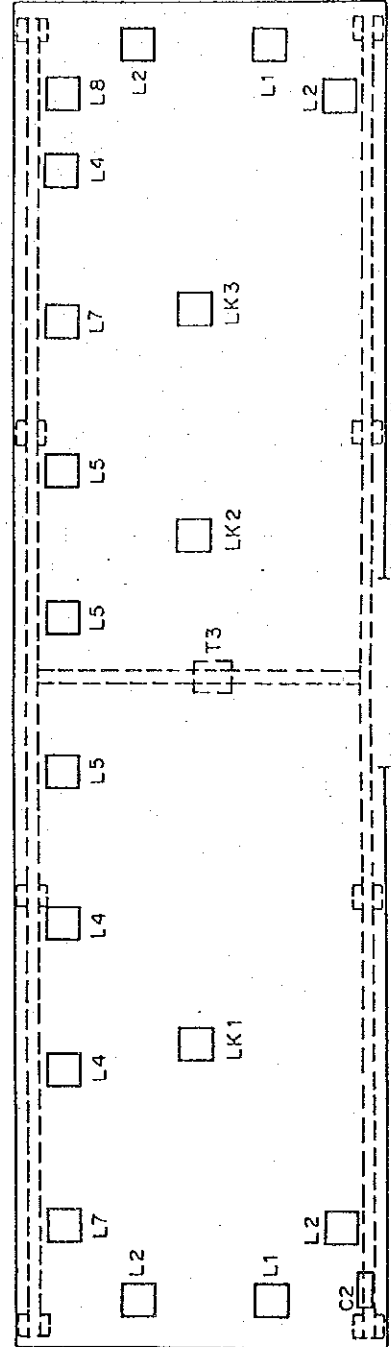
Drawing No. R-302 Arrangement of Casting Shop No.3
 Scale: 1/200 Area: 10 x 36 = 360 m²

Code	Description	Specifications	Q'ty	Existing	Procurement
L1	Arc welding machine	250 A	1	1	-
GR1	Bench grinder	10"	1	1	-
GR7	Electric handy grinder	180 mm	1	-	1
BR2	Upright drilling machine	300 x 650 mm	1	-	1
CR	Crocodile furmance	700 x 800 kg	2	1	1
T1	Electric hoist	1 ton	1	1	-



Drawing No. R-303 Arrangement of Coil Winding Shop No. 4
 Scale: 1/200 Area: 8 x 23 = 184 m²

Code	Description	Specifications	Q'ty	Existing	Procurement
L1	Arc welding machine	AC 400 A	1	1	-
	- ditto -	AC 250 A	1	-	1
L2	DC welding machine with generator	DC 10 - 295 A	2	1	1
	- ditto -	DC 40 - 350 A	1	1	-
	- ditto -	DC 20 - 470 A	1	1	-
L4	TIG Argon arc welding machine	57 A	3	1	2
L5	TIG welding machine	300 A	3	2	1
L7	Variation welding machine	94 A	2	-	2
L8	Metall spraying machine	180 mm	1	1	-
CR7	Electric hand grinder	7 kgf/cm ²	1	-	1
C2	Air compressor	10 tons	1	1	-
T3	Overhead crane		1	-	1
LK1	Coil winding machine (Small sized)		1	-	1
LK2	- ditto - (Medium sized)		1	-	1
LK3	- ditto - (Large sized)		1	-	1



Drawing No. R-304 Arrangement of Welding Shop No.5

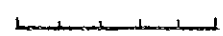
Area: 19 x 35 = 665 m²

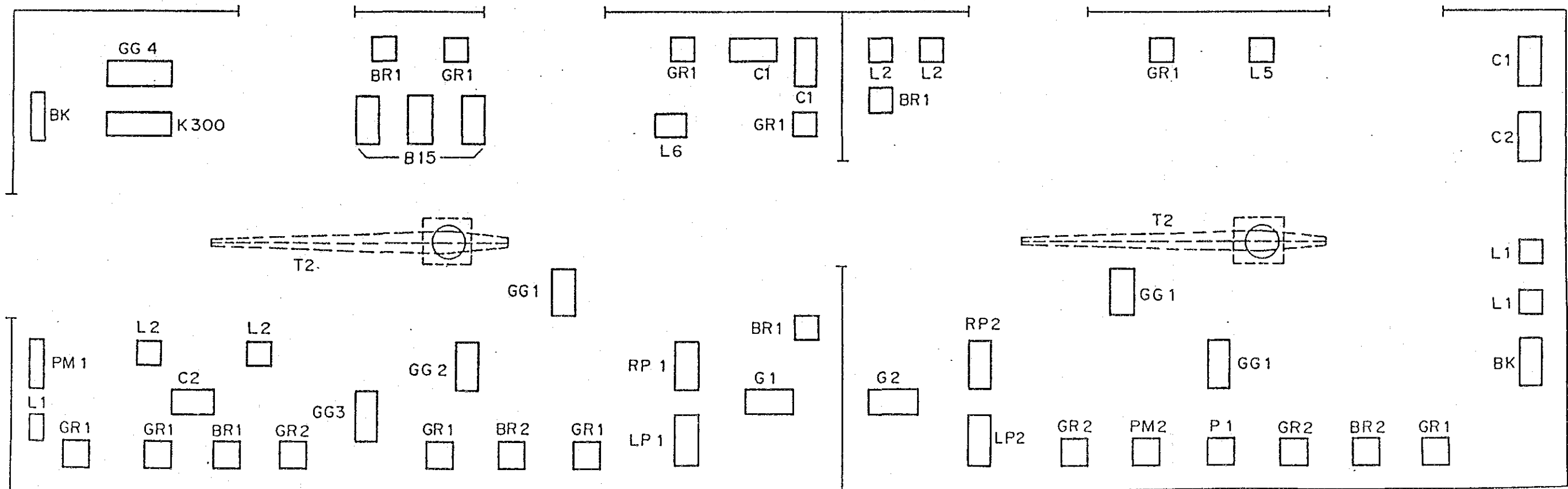
Code	Description	Specifications	Q'ty	Existing	Procurement
L1	Arc welding machine	AC 400 A	1	-	1
L2	DC welding machine with generator	DC 10 - 295 A	1	-	1
	- ditto -	DC 40 - 350 A	1	-	1
L6	Plazuma spraying welding machine	120 A	1	1	-
RP1	Bending roller machine	25 x 2,500	1	-	1
G1	Shearing machine	12	1	-	1
GG1	Band saw machine	150 mm	1	1	-
GG2	- ditto -	500 mm	1	1	-
GG3	Chain saw machine	2,800 mm	1	-	1
GG4	Circular saw machine	16 " dia.	1	1	-
GR1	Bench grinder	10 " dia.	7	-	7
GR2	Cutting grinder	10 " dia.	1	-	1
GR7	Electric handy grinder	180 mm	4	-	4
BR1	Upright drilling machine	500 x 1,000 mm	3	-	3
BR2	- ditto -	300 x 650 mm	1	1	-
PM1	Mechanical press	100 tons	1	-	1
LP1	Bending roller machine	15 t x 2,500 mm	1	-	1
C1	Air compressor	12 kgf/cm ²	2	-	2
C2	- ditto -	7 kgf/cm ²	1	-	1
T2	Jib crane	5 tons	1	-	1
BK	Working table		1	-	1
B15	Screw cutting latho	1/4 " - 2 "	3	-	3
K	Planing machine	300 mm	1	-	1

Arrangement of Iron Workshop No.6

Area: 19 x 30 = 570 m²

Code	Description	Specifications	Q'ty	Existing	Procurement
L1	Arc welding machine	AC 400 A	2	-	2
L2	DC welding machine with generator	DC 40 - 350 A	1	-	1
	- ditto -	DC 20 - 470 A	1	-	1
L5	TIG welding machine	300 A	1	-	1
G2	Shearing machine	5 mm	1	-	1
P1	Punching machine	1 - 2 mm	1	-	1
GG1	Band saw machine	150 mm	2	-	2
GR1	Bench grinder	10 " dia.	2	-	2
GR2	Cutting grinder	10 " dia.	2	-	2
GR7	Electric handy grinder	180 mm	4	-	4
BR1	Upright drilling machine	500 x 1,000 mm	1	-	1
BR2	- ditto -	300 x 650 mm	1	-	1
C1	Air compressor	12 kgf/cm ²	1	-	1
C2	- ditto -	7 kgf/cm ²	1	-	1
T2	Jib crane	5 tons	1	-	1
BK	Working table		1	-	1
RP2	Bending roller machine	13 t x 1,270 mm	1	-	1
PM2	Mechanical press	125 kg	1	1	-
LP2	Bending roller machine	3 t x 1,000 mm	1	1	-

Scale  5m



No 5

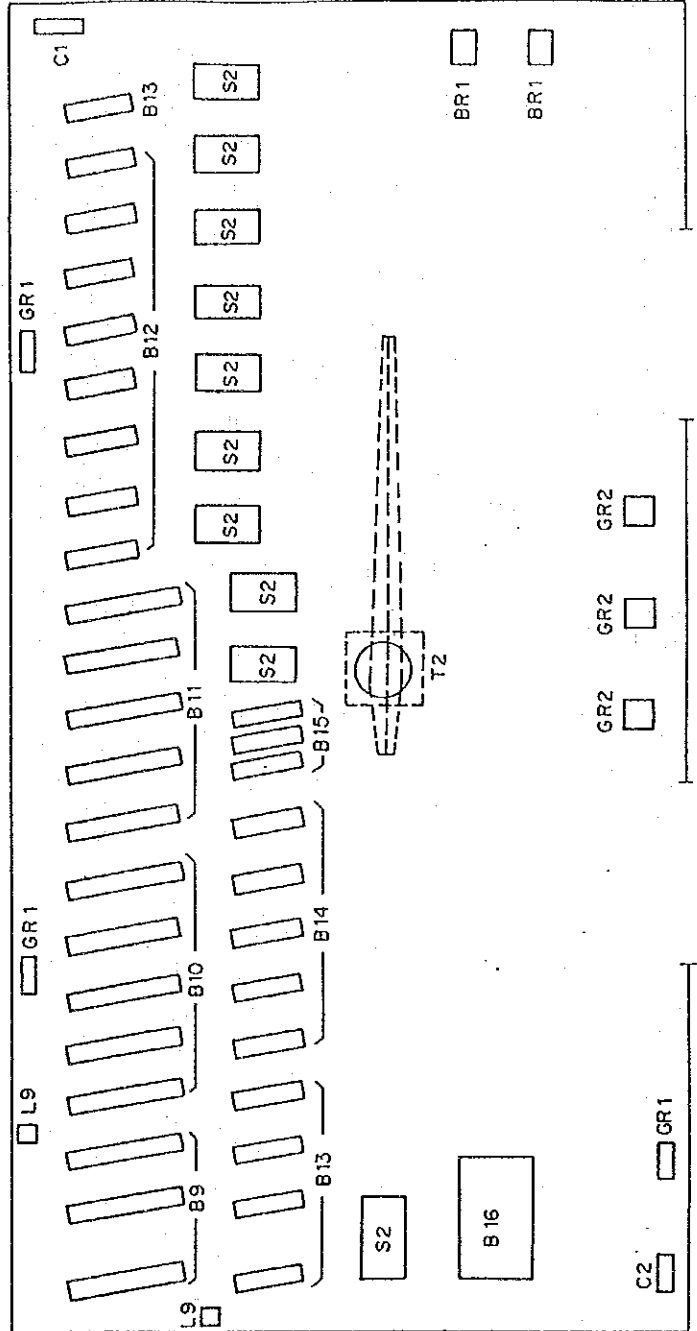
No 6

Drawing No. R-305 Arrangement of Machine Shop No.7 for Small Size Components

Scale: 1/250 Area: 18 x 36 = 648 m²

Code	Description	Specifications	Q'ty	Existing	Procurement
L9	Selectron welding machine	10 - 20 A	2	1	1
GR1	Bench grinder	10"	3	-	3
GR2	Cutting grinder	10"	3	-	3
GR7	Electric handy grinder	180 mm	1	-	1
BR1	Upright drilling machine	500 x 1,000 mm	2	-	2
C1	Air compressure	12 kgf/cm ²	1	1	-
C2	- ditto -	7 kgf/cm ²	1	-	1
T2	Jib crane	5 tons	1	-	1

Code	Description	Specifications	Q'ty	Existing	Procurement
B9	Lathe	600 x 2,000 mm	3	2	1
B10	- ditto -	500 x 2,000 mm	5	2	3
B11	- ditto -	400 x 2,000 mm	5	-	5
B12	- ditto -	700 x 1,200 mm	8	3	5
B13	- ditto -	400 x 1,000 mm	5	3	2
B14	- ditto -	200 x 500 mm	5	-	5
B15	Screw cutting lathe	1/4" - 2"	3	-	3
B16	Face lathe	2,000 x 3,000 mm	1	-	1
S2	Shaper	500 x 850 mm	10	1	9

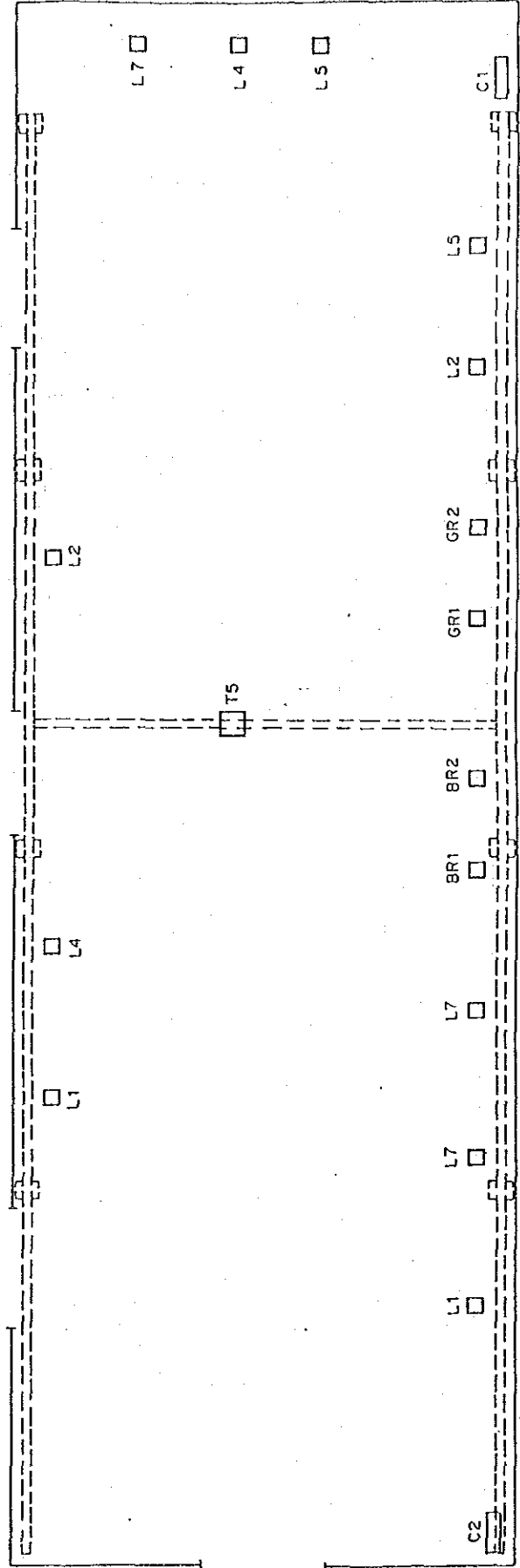


Drawing No. R-306 Arrangement of Assembling Shop No.8 for Large Size Components

Scale: 1/250 Area: 20 x 65 = 1,300 m²

Code	Description	Specification	Qty	Existing	Procurement
L1	Arc welding machine	AC 400 A	2	2	-
L2	DC welding machine with generator	DC 10 - 295 A	1	1	-
	- ditto -	DC 3 - 470 A	1	1	-
L4	TIG Argon welding machine	57 A	2	-	2
L5	TIG welding machine	300 A	2	-	2
L7	Varioung welding machine	94 A	3	1	2
GR1	Bench grinder	10" dia.	1	-	1

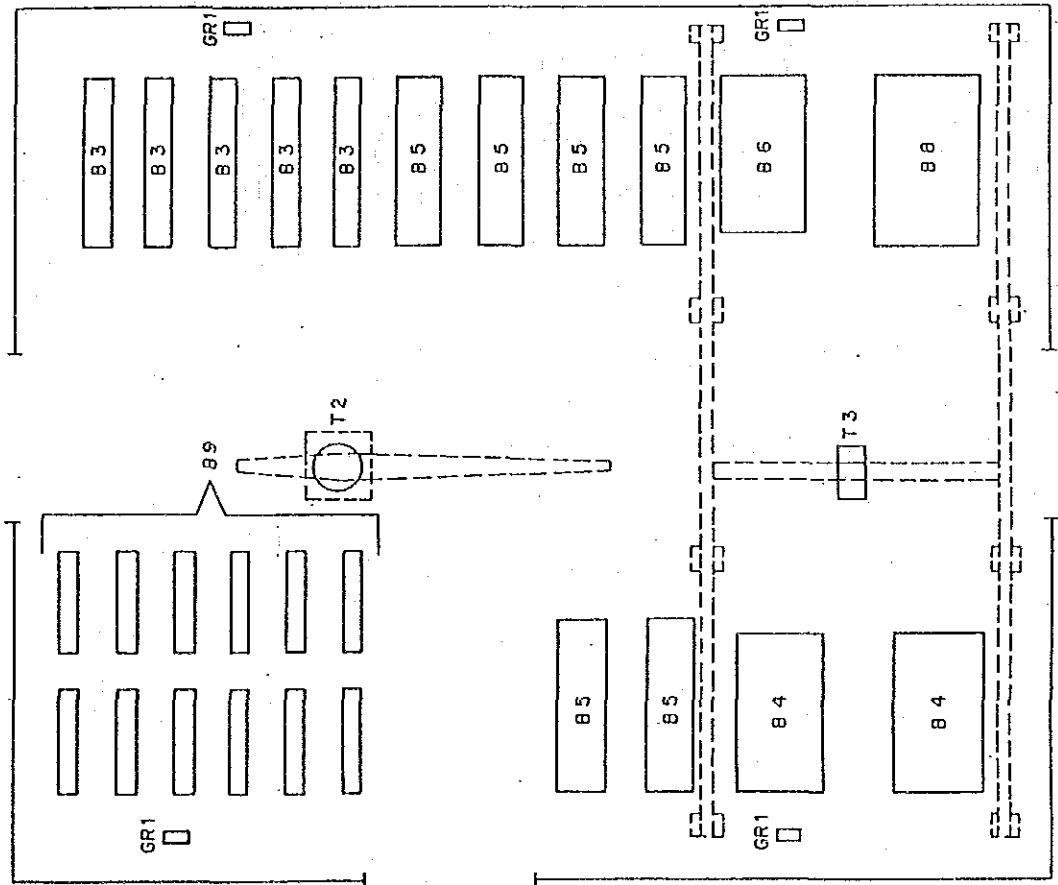
Code	Description	Specification	Qty	Existing	Procurement
GR2	Cutting grinder	10" dia.	1	1	-
GR7	Electric handy grinder	180 mm	1	-	1
BR1	Upright drilling machine	500 x 1,000 mm	1	-	1
BR2	- ditto -	300 x 650 mm	1	1	-
C1	Air compressor	12 kgf/cm ²	1	1	-
C2	- ditto -	7 kgf/cm ²	1	1	-
T5	Overhead crane	50 tons	1	-	1



Drawing No. R-307

Arrangement of Machine Shop No.11 for Medium Size Components

Scale: 1/200 Area: 25 x 30 = 750 m²

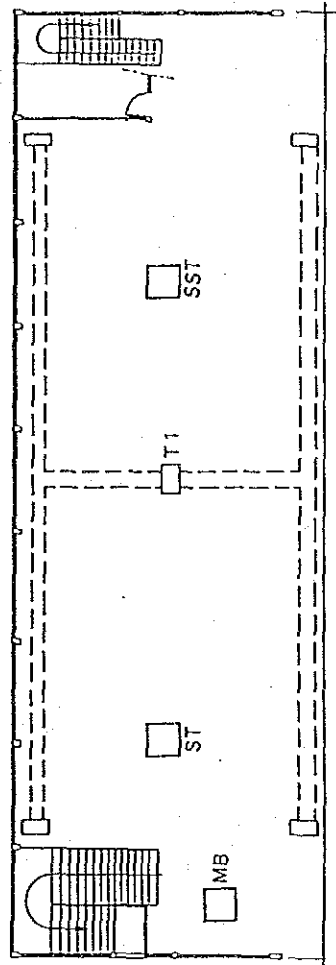
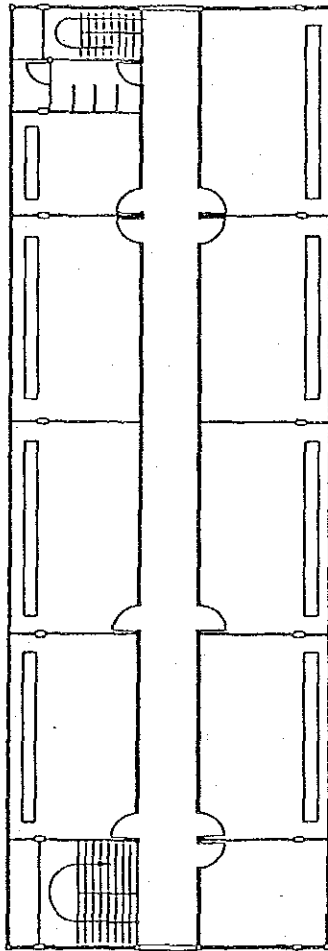


Code	Description	Specifications	Q'ty	Existing	Procurement
B3	Lathe for shaft	700 x 4,000 mm	5	1	4
B4	heavy lathe	1,000 x 2,000 mm	2	-	2
B5	- ditto -	600 x 3,000 mm	6	-	6
B6	Face lathe	2,000 x 2,000 mm	1	-	1
B8	- ditto -	1,000 x 3,000 mm	1	-	1
B9	heavy lathe	600 x 2,000 mm	12	-	12
GR1	Bench grinder	10" dia.	4	-	4
CR7	Electric handy grinder	180 mm	1	-	1
T3	Overhead crane	10 tons	1	-	1
T2	Jib crane	5 tons	1	-	1

Drawing No. R-308 Arrangement of Laboratory No.12

Scale: 1/100 Area: 10 x 36 = 360 m²

Code	Description	Specifications	Q'ty	Existing	Procurement
T1	Electric hoist	1 ton	1	-	1
ST	Shearing testing machine		1	-	1
SST	Stress testing machine		1	-	1
MB	Balancing machine		1	-	1
MT	Measuring tools		2	-	2



JICA

