THE STUDY ON HMT RESTRUCTURING AND DEVELOPMENT PROGRAM IN INDIA

Volume II

Action Program

MAIN REPORT

MARCH 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of India, the Government of Japan decided to conduct the Study on HMT Restructuring and Development Program in India and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to India a study team headed by Mr. Takashi Nobehara of The Sumitomo Business Consulting Co.,Ltd. four times from March, 1991 to March, 1992.

The team held discussions with the officials concerned of the Government of India and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the program and to the enhancement of friendly relationship between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of India for their close cooperation extended to the team.

March, 1992

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

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INTRODUCTION

A. Outline of the Study

This is the Final Report (Main Report - Volume II) of the HMT Restructuring and Development Program. The study has been donducted based on the Scope of Work agreed between the Government of India and the Japan International Cooperation Agency (JICA) on November 22, 1990.

The report consists of the following three volumes:

Executive Summary

Main Report
- Volume I : Diagnostic Overview and Corporate Plan
- Volume II : Action Programs

B. Objective of the Study

The objective of the study is to propose a comprehensive corporate strategic plan for physical and organizational restructuring and development of HMT's operations covering product mix, organization, management systems and prospective investment areas in order to improve its competitive position, profitability, export performance, and domestic market shares and coverage, and based on the plan, to formulate investment plans and action programs for physical and organizational restructuring and improvement.

As a result, the restructuring of HMT would contribute to the development of the capital goods sector in India.

I. PROPOSAL FOR ACTION PROGRAM

I-1. Bangalore Machine Tool Factory (MTB)

A. Outline of the Factory

1. Background

In 1948, the War Disposal Utilization Committee (WDUC) advised the Government of India to set up a machine tool factory to make use of Rs. 4,000 million worth of surplus war machinery. It was for that reason that machine tool factories were established, ushering in much needed industrial growth to the country. This resulted in the signing of a MOU between the DGS&D and M/s. Oerlikon Buhle Ltd., Switzerland.

In 1953, Hindustan Machine Tools started as a single factory to produce 400 Tool Room Precision lathes per year at Bangalore. The actual production was started in the year 1955. This was the beginning of not only HMT Ltd. but Machine Tool Unit I & II at Bangalore.

Thereafter, the company broadened its product range of General Purpose Machines beyond the H22 lathe by entering into technical collaboration with other international leaders in machine tools, such as Fritz Werner, Herman Kolb, Olivetti, Ernault Somua, etc.

There was a ready market for the increased range of products. By 1960, the company was manufacturing 1,000 machines in four different designs as against its original plan of manufacturing 400 machines of a single type by 1962.

The second unit of HMT was set up in Bangalore in 1960 out of its own resources, thereby doubling its manufacturing capacity to 2,000 units per year.

The recession in 1966 adversely affected the engineering industry. For the first time, in 1967, the company encountered a loss. Hence, gaps in the machine tool

range had to be bridged and new sophisticated product lines were included.

As a result, the company embarked on further diversification to include more sophisticated machine tools. These machines ranged from drum-turret lathes and high speed multi-spindle automatics to transfer lines.

So far, HMT I & II has adopted itself to changing situations through organization set-up changes. To cite an example, the plant layout of MTB has undergone changes 3 times to meet the specific needs of the time.

1) 1955 Process Layout

   To specifically develop operator and supervisory skills.

2) 1960 Group Technology based Product Layout

   To meet the higher volume of market demand for diverse products.

3) 1980 Component-centers on flow-line principle

   To meet the diverse demand of the market of small batch production.

2. Products

The production program for 1991/92 at MTB (Machine Tools, Bangalore) is as follows.

MTB Projected Production Program
for 1991/92 at 1990/91 Prices

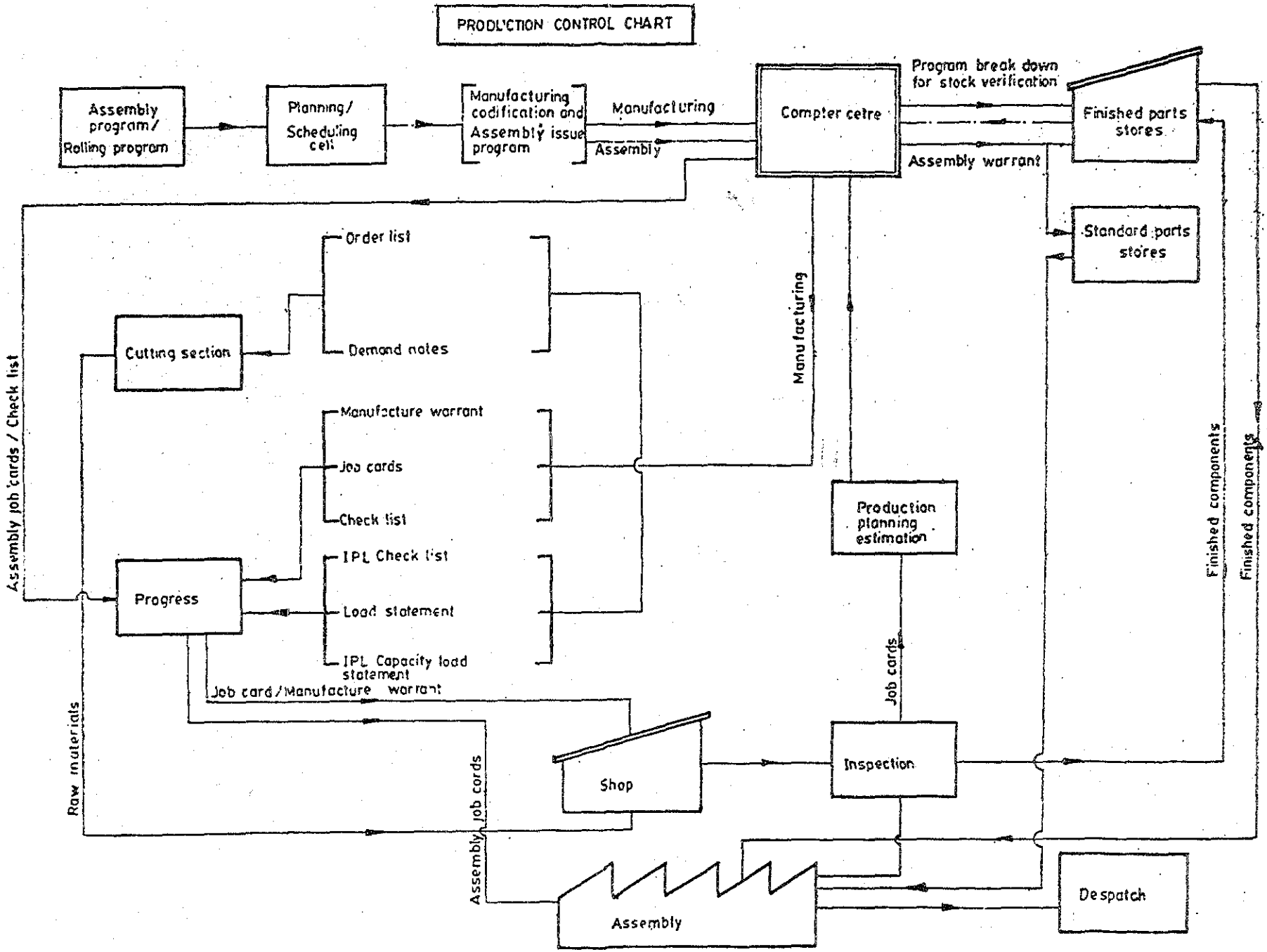
Value in Rs. Lakhs

Category	1990/91(Budget Estimate) No.	Value	1991/92 Plan No.	Value
GPMs	520	2,626	422	2,054
GPMs Tooled-up	128	2,114	138	2,208
SPMs	19	307	20	320
CNC	27	940	35	1,315
Acc/Tools	-	1,337	-	1,506
CCM	-	150	-	200
Reconditioning	-	170	-	200
Spares	-	160	-	200

4. Outline of Production Process

The outline of the production process adopted at MTB is as shown in Fig. I-1-1.

Fig. 1-1-1 Production Process at MTB



B. Basic Concept of Action Program

1. Existing Problems

The following are pointed out as major problems existing in MTB.

1. Too many product varieties (25) and variants
2. Various batch sizes (from 1 to 40)
3. Large number of manufacturing components (approx. 40,000)
4. Large number of bought-out parts (approx. 25,000)
5. Old plant machinery

   Approx. 80% of the 430 plant machines are at least 25 - 30 years old.
6. Depletion in manpower in the areas of critical machines and assembly
7. High average age of employees (approx. 50 years)
8. Few CNC machines in the product line
9. Fifty percent of the existing product mix is non-yielding
10. Long cycle time required for production

With the above problems and with the complex dynamic environment, the scheduling and rescheduling process for the PPC department is found to be difficult. Hence, there is a definite need to introduce CNC machines, FMS & FMC in steps with computerized production control, planning & a Monitoring System in MTB.

2. Objectives

The following are pointed out as the objectives of the Action Program.

- To maintain its position as the leader in the machine tool industry in India by supplying high technology products and enhancing its market share.

- To increase the production share of CNC machines to 60% by 1999/2000 by steps, in accordance with the shift of the market.

- To integrate and reduce the number of GPM models in line with the introduction of new CNC models.

- To strengthen the competitiveness both in price & quality through the modernization of production facilities and processes.

- To acquire high level technologies especially in such high tech products such as CNC machines, FMC or FMS through technical collaborations.

- To establish a strategic Management Information System (MIS) with the introduction of computerized production planning, monitoring and control systems.

- To develop ancillary and other related industries .

3. Approach

The Action Program for MTB can be divided into three steps. The production facilities of MTB will be modernized through the following three steps.

Step 1: Modernization of Small Parts Machine Shops

The aged general purpose machines (GPMs) are to be replaced with CNC lathes and machining centers, with one CNC machine replacing several GPMs.

Step 2: Modernization of Medium Small Parts Machine Shops

The manufacturing systems where eight or twelve GPMs are to be replaced with one machining center with a pallet changer or one FMC will be established.

Step 3: Modernization of all the Machine Shops

The following three manufacturing systems will be established.

FMS 1 - Large size cast iron parts
FMS 2 - Medium size cast iron parts
FMS 3 - All round shaped parts

C. Marketing Plan

1. Product Mix and Sales Forecast

(a) Analysis of current product mix

The machine tools in the product mix are almost all non-CNC machines except for a few CNC machines.

At present, non-CNC machines, i.e. GPMs, are classified under the following 4 categories according to kind and volume of work to be machined. (Ref. Fig. I-1-2)

Category I	Low variety and high volume. (large volume parts such as those for cars are typical, with only a few kinds of work to be machined)
Category II	Automatic machines for batch production of large volume (a little bit smaller volume and more kinds than those in category I, many located in the job shops)
Category III	Semi-Automatic machines for batch production (provided with pre-setting and program control functions, multi-cutter and multi-spindle machining are available.
Category IV	Machines for high variety, low volume (general GPM)

HMT products are classified according to these 4 categories as shown in Table I-1-1 (products are from catalogue 1500/1-90).

As shown in Table 1, HMT products cover almost all categories of non-CNC machines. Such a machine tool manufacturer may be unique in the world.

This fact means a great advantage as well as a great disadvantage. The advantage is that HMT maintains technologies and facilities to cover all kinds of demand

Fig. I-1-2 Categories of Non-CNC Machine Tools

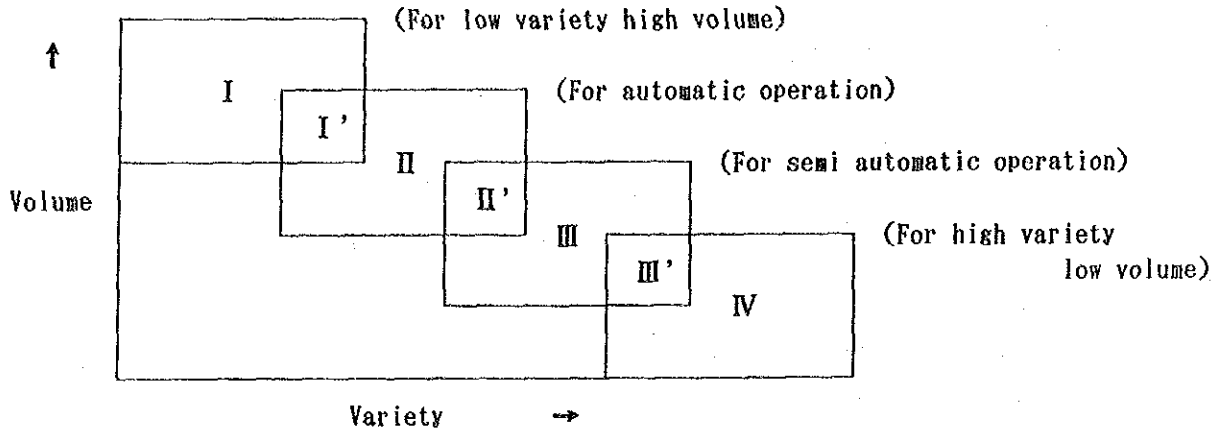


Table I-1-1 HMT Product Analysis

Category		Product in HMT
I		GS/GF, AS, ASH; LTM54 & OTHER SPMS
	I'	P3, P7/P7R; TR42B, TR60B; FC25/FC40
II		C20, HMT Fay, Two Way Multi SP. Drill, Multi SP. Drill
	II'	PTL30, L22TP
III		SBC35, Transpilate, S-Pilate, RTV; L200
	III'	DSE, BT3~8V, Rotary Mill, Facing & Center M/c, EM3, EM4; SJ331~391, GCS, GRC55, GDS22; L2000; FB
IV		L45, B32, NH22/26, Vikram, LB, TL20, LTM20; Floor Mill, FNR, FN2, FN3, M1TR, FN1, FN1P; RM61~65, Column Drill; G18, HG18, GCP55, K1308G17/22, G9, IGE90, GIF80/1258GIM100, SFW, GVS30, GCS500, GCL00/100/100T/140/140T, GTC28/28T, CTL174; H250, W92, WS1, S150; AZ9~11, UTA, UTX, RAS, RISZ, RW

in the market based on the production record of all categories of machines.

The disadvantage stems from having too wide a range of products. The technologies and production capacity can not be concentrated and cost efficiencies resulting from mass-production can not be expected.

The marketing strategy from now on should be studied in the light of the above mentioned status quo.

(b) Demand Trends

In planning the operation strategy of the Company, the demand forecast will be the most difficult issue. Further, it may be nearly impossible to forecast the demand by surveying in a short time the domestic and overseas markets around HMT as a public sector in India.

Therefore, in viewing the fact that the machine tool industry in India is more than 10 years behind that in leading countries, the development process of the machine tool industry in India will follow the process which has been seen so far in the leading countries. With this premise in mind, the demand forecast is studied.

Tracing the development of machine tool industries in leading countries shows nearly uniform steps as far as observation of international exhibitions of machine tools in the leading countries is concerned. These show the trend of machines, new orders reported by governments and committees, and statistics of production and shipment.

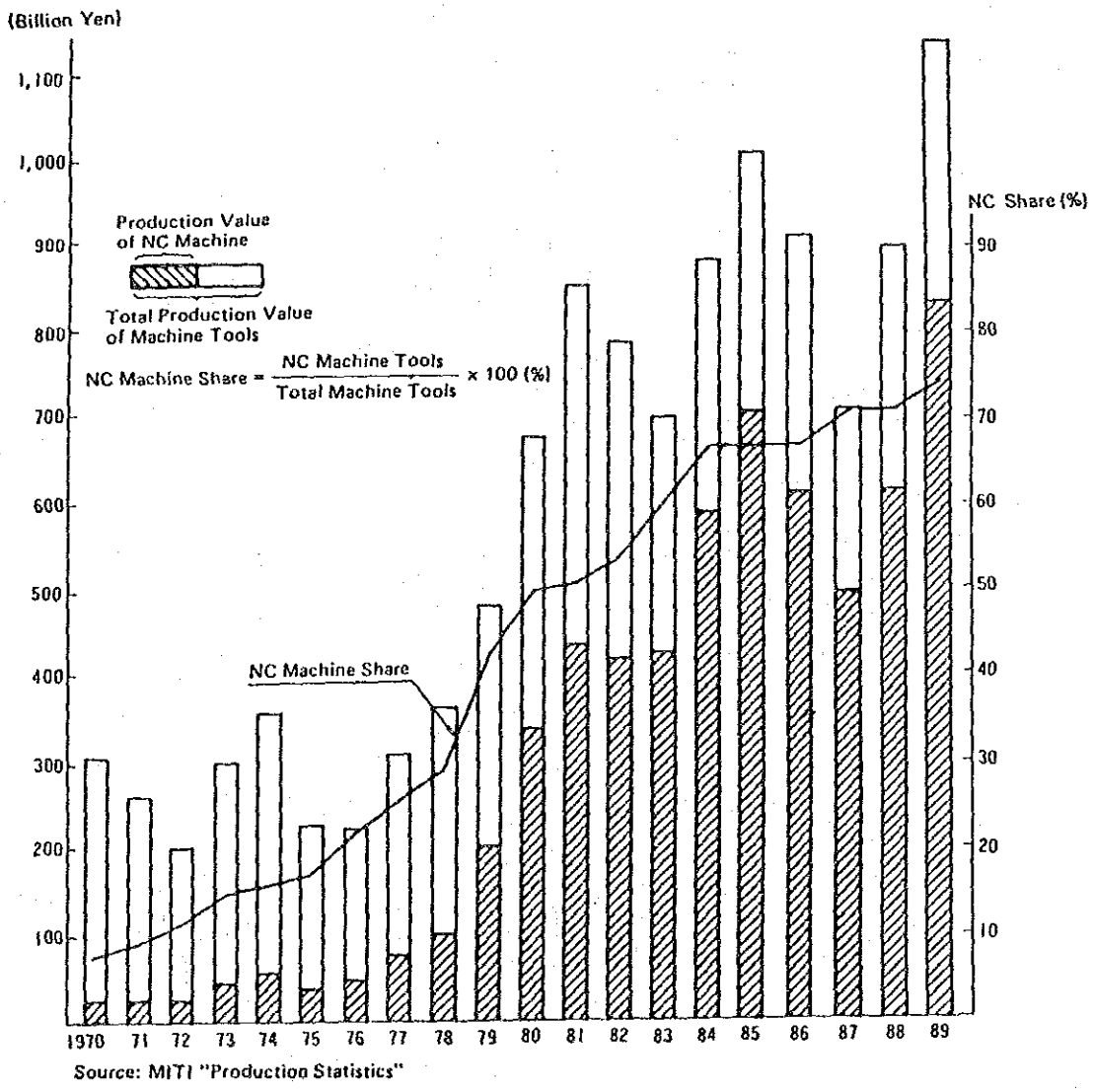
Therefore, Japan is selected as a representative of leading countries, and the process of machine tool development is traced as follows.

Table I-1-2 shows the transition of the production of CNC machine tools in Japan during the 20 years from 1970 to 1989.

Table I-1-2 NUMBERS OF NC MACHINE TOOLS PRODUCED IN JAPAN

Year	NC lathe	Machining Centers	Other NC Machines	NC Machines Total Units
1970	589	333	529	1,451
1971	595	295	451	1,379
1972	581	328	441	1,350
1973	1,459	564	742	2,765
1974	1,670	577	793	3,040
1975	1,355	401	432	2,188
1976	2,073	526	713	3,312
1977	3,677	926	833	5,436
1978	4,986	1,377	979	7,342
1979	8,203	2,927	3,187	14,317
1980	12,007	5,231	4,814	22,052
1981	12,133	7,394	6,399	25,926
1982	10,344	6,942	6,852	24,138
1983	10,020	7,791	8,597	26,408
1984	16,555	10,252	11,229	38,036
1985	19,084	13,345	12,540	44,969
1986	15,976	10,857	11,943	38,776
1987	15,241	9,027	11,192	35,460
1988	20,942	11,474	15,234	47,650
1989	24,491	14,828	18,723	58,042

Fig. I-1-3 NC Machine Share in Japan (1970-1989)



Source: MITI "Production Statistics"

Compared with 1970, the production in 1989 shows approx. 42 times as many CNC-Lathes, 45 times as many machining centers and 35 times as many other CNC machines. In total, 40 times as many CNC machines were produced in 1989.

Fig. I-1-3 shows the transition of the production amount in the same period. The progress of total production amount during the 20 years shows an increase of 3.7 times. The CNC ratio progressed from 7% in 1970 to 74% in 1989, or a progress rate of more than 10 times.

Therefore, the transition of machine tools in Japan during the 20 years can be said to be the progress of CNC machine tools.

This process in other leading countries in the world during the 20 years has been similar to that in Japan.

Acknowledging the premise mentioned in the beginning that the development process of the machine tool industry in India will follow the process so far in the leading countries, the trend of demand forecast of HMT will be that the variety and production of GPM should be gradually reduced and the CNC ratio of HMT in the future should reach the same level as that in the leading countries.

Innovation of Machine Tool Technology by CNC Technology

The meaning of the introduction of CNC technology in the field of machine tools is not limited to the area of mere engineering development, but also it can be said to represent large scale innovation.

In other words, CNC technology has, as can be explained in the following three figures, changed widely the concept, category and function of machine tools.

Table I-1-3 shows the transition in the production amount of CNC and non-CNC machine tools in Japan from the years 1977 to 1989.

Fig. I-1-4 Concept of Machine Tool

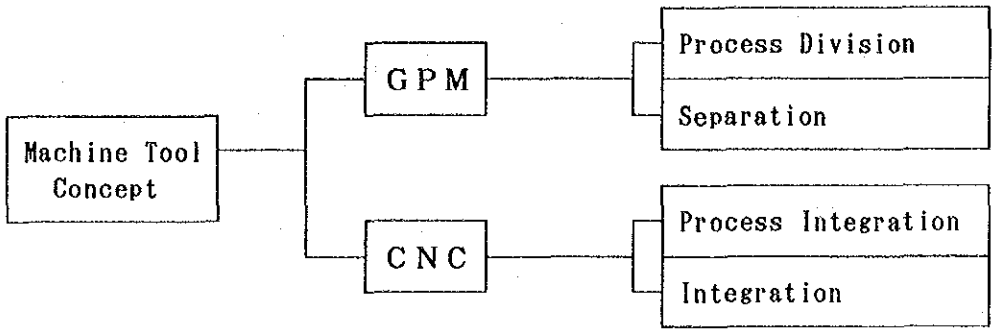


Fig. I-1-5 Categories of Machine Tool (Lathe)

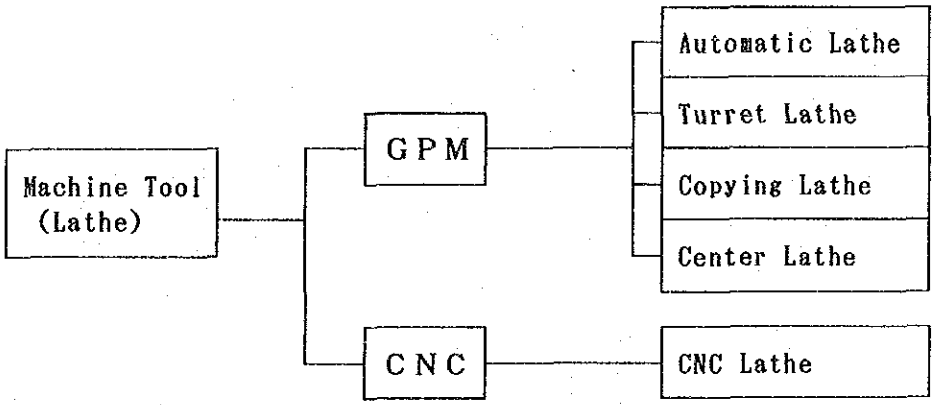
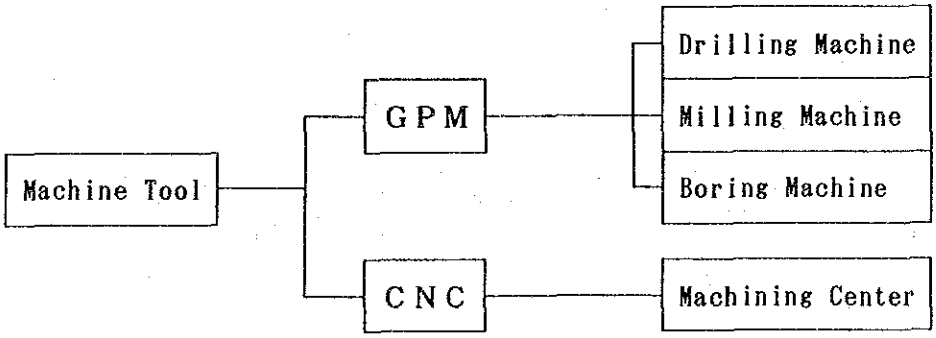


Fig. I-1-6 Classification of Machine Tool by Function



In the non-CNC machines (74.2%) in 1977, a majority of the figure is occupied by machines classified in the process division of the concept of GPM: Center Lathe, Automatics, Knee-type Vertical Milling M/C, Horizontal Boring M/C, Shaping M/C, Slotting M/C, Gear Cutting M/C, Grinding M/C, etc.

In the non-CNC machines (27%) in 1989, CNC-Lathes and Machining Centers took the place of many GPMs, and Gear Cutting Machines, Grinding Machines and others are the majority.

The general trend in 1989 shows CNC-Lathes (22.1%) and Machining Centers (25.1%) which are nearly same ratios as the other CNC Machines and non-CNC Machines (GPM) occupying about 1/4 each of the total.

In the other CNC machines, CNC Gear Cutting M/C and CNC Grinding M/C are included. They were virtually nonexistent in the years 1977 - 1981. Further, CNC EDM (Electric Discharge Machine) and CNC Wire Cut EDM came to occupy much of the ratio.

Hence, the machine tools in the year 1989 can be classified in (1) CNC-Lathe, (2) Machining Center, (3) Other CNC machine, (4) GPM.

Further, along with the trend toward FA (Factory Automation) in manufacturers, the number of enterprises who introduce FMC and/or FMS is rapidly increasing.

Machining Centers occupy the majority of Module Machines in these systems, the others are CNC-Lathes and other CNC machines.

Table I-1-4 shows a view of FMC installation, and Table I-1-5 shows a view of FMS installation, both sets of data come from a recent JMTBA (Japan Machine Tool Builder's Association) report.

Thus, the introduction of CNC technology has brought large scale innovation in machine tools, and the machine tools have greatly developed along with the recent trend of Manpower Saving and Factory Automation,

Table I-1-3 Machine Tools Production Share in Japan
by NC Type and Non-NC Machines

(Value: Billion Yen)

	1977		1981		1985		1989	
CNC lathes	42.7	13.7%	161.3	19.0%	221.0	21.0%	251.7	22.1%
Machining Centers	23.1	7.4	165.4	19.4	267.3	25.5	286.2	25.1
Other CNC Machines	14.7	4.7	107.4	12.6	215.5	20.5	293.9	25.8
Non-CNC Machines	232.3	74.2	417.2	49.0	347.3	33.0	307.4	27.0
T O T A L	312.8	100	851.3	100	1051.1	100	1139.2	100

Table I-1-4 Installation of FMC in Japan

Base of FMC	Nos. of Companies	Nos. of FMC	Average work-hour per month
Machining Center	50	297	351 hours
CNC Lathe	17	51	211 hours
Other CNC	7	15	267 hours
TOTAL	51	363	328 hours

Table I-1-5 Installation of FMS in Japan

Base of FMS	Nos. of Companies	Nos. of System	Nos. of Machines
Round	8	12	44
Non-Round	23	35	193
TOTAL	25	47	237

and in connection with the systematization which FMC and FMS have delivered.

In this stage, the category of machine tools classified as GPMs (Fig. I-1-2) has changed as shown in Fig. I-1-7.

(c) Product Mix to be directed

i. Principle for selection of Product Mix.

The current product mix is shown in Table 1 as described in item (a) of this section, and covers all of the GPM category.

The premise is based on the idea that the current product mix should gradually be shifted to cover all the categories shown in Fig. I-1-7.

This philosophy comes from the desire of HMT to maintain its current status as a manufacturer of machine Tools to cover all GPMs.

In settling on the product mix as of the year 2000, the following two important principles must be confirmed.

(1) Product mix is established through a series of developments. New products must always be introduced to the market.

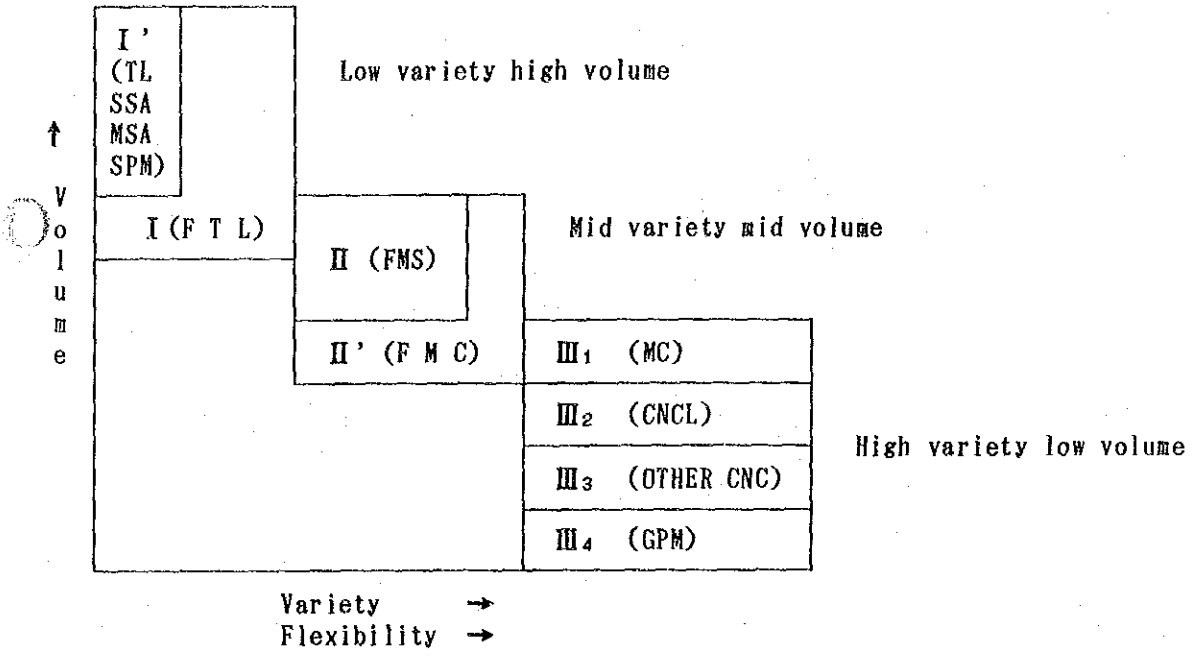
(2) Each Unit of HMT should avoid manufacturing the same kind of machines as others, and should undertake to manufacture the machines of individual character considering the following three factors:

. Avoiding the wide spread of technology potential, an organization to handle exclusive products should be established.

. Production facilities and systems should be simplified.

. Contribution to cost performance should be aimed

Fig. I-1-7 Category of Machine Tools



Note: Category III (1, 2, 3, 4) have same level of volume.

Category I : FTL (Flexible Transfer Lines), machining lines for small variety and large volume of parts such as those for cars in typical, module machines are machining centers and head index

Category I' : Transfer Lines (TL), Single Sp. Automatics, Multi-Sp. Automatics, Special Purpose Machines (All Non-CNC)

Category II : FMS (Flexible Manufacturing Systems)

Category II' : FMC (Flexible Manufacturing Cells)

Category III_1 : CNC Machining Centers

Category III_2 : CNC Lathes

Category III_3 : Other CNC Machines

Category III_4 : GPMs, many Grinding Machines and Gear Cutting Machines will remain as GPMs

at by concentrating production on similar machines.

ii. Product Categories of each Unit in 1999/2000

The product categories of each unit are set up as shown in Table I-1-6.

Categories of product duplication among Units are shown in Table I-1-6 as follows;

(1) III_1 (MC) : MTB, large MC (Table size 800 x 800 and above)
MTP, MC general (Table size less than 800 x 800)
MTH, plano-miller type MC (Multi-Face)

(2) III_2 (CNCL) : MTB, Post-MSA (for mass-pr.) Post-HL (large)
MTK, CNC-L general (Medium, small)

(3) III_3 (other CNC) : MTB, CNC-H-400
MTA, CNC Grinding Machine

(4) III_4 (GPM) : MTB, Special turning, Gear Cutting, Radial Drill, etc.
MTP, FN series, etc.
MTK, NH series, etc.
MTH, AZ series, etc.
MTA, Grinding Machines, etc.

iii. Product Mix in MTB

MTB-Product mix is classified in the following four groups.

(1) System
(2) CNC
(3) GPM
(4) Tool

The product mix of each group to be achieved by 1999/2000 will be as follows;

System : FMC, FMS, CNC H400 with Auto-loader or Robot

CNC : GDM, WEDM; Large MC, Turning Center, Post-MSA, Post-HL, CNC H-400

GPM : RM H400, GS2M, MSA, WS1, L200

Tool : System Tooling (Pre-setting) for MC and current Tool Room Products

(d) Sales Forecast (quantity) and Sales Price

The sales forecast up to 1999/2000 is as shown in Table I-1-7, where sales prices (Ex-works basis) are shown based on 1992/93 prices.

Table I-1-6 Product Mix in Each Unit

Unit	Product Categories
MTB *	II(FMS), II'(FMC), III(MC), III_2 (CNCL), III_3 (OTHER CNC), III_4(GPM)
MTP	III_1 (MC), III_4 (GPM)
MTK	III_2 (CNCL), III_4 (GPM)
MTH	I(FTL), I'(TL, SPM), III(MC), III_4 (GPM)
MTA	III_3 (OTHER CNC), III_4 (GPM)

* MTB will become a technology center of for HMT.

Table I-1-7 Sales Forecast
(Sales Numbers: Top - Domestic, Bottom - Export)

PRODUCT	GROUP	PRICE Rs. L	1992 /1993	1993 /1994	1994 /1995	1995 /1996	1996 /1997	1997 /1998	1998 /1999	1999 /2000
HL	GPM	14.98	10 5	20	20	20	15	15	TO MTK	
post-HL *-1	CNC	80.00			2	5	5	5 2	5 2	5 2
C20/MC2	GPM	5.41	20	25 5	25 5	20	TO MTK			
MSA	GPM	42.12	21 4	19 6	12 8	12 8	10	10	5	5
post-MSA *-2	CNC	65.00			2	5	7 3	7 3	10 3	10 3
GDM	CNC	40.00	8	20	20	25	25	25	30	30
L-200	GPM	54.03	10	2	5	5	5	10	10	10
H-400	GPM	16.95	23 2	25 5	25 5	30	20	20	20	20
CNC H-400 *-3	CNC	45.00				1	2	4 2	4 2	4 2
GS2M	GPM	6.80	20	20	20	20	20	20	20	20
WS1	GPM	41.47	20	16 4	16 4	16 4	20	20	20	20
RM	GPM	3.65	250 50	265 85	350 100	430 120	390 110	390 110	310 90	310 90
SPM			5	6	4	4	TO MTH			
LARGE SIZE MC *-4	CNC	98.00				1	3	5	5 1	5 1
TURNING CENTER *-5	CNC	82.00					1	3	3 1	3 1
WEDM	CNC	15.00	3	5	5	10	10	15	20	20
HG18	GPM	17.47	10	5	10	10	TO MTA			
SFW	GPM	6.94	8 12	8 17	8 17	8 17	10 15	8 12	TO MTA	
GNC18	CNC	71.28	4	5	10	10	15	10	TO MTA	
FMC *-6	SYSTEM					1	3	2	3	3
FMS *-6	SYSTEM								1	2
TOOL	TOOL									
TOTAL			485	563	673	771 sys. 1	686 sys. 3	696 sys. 4	567 sys. 4	567 sys. 5

Note:

*-1 Specification is the same as that for HL, but an entirely different design slant type bed is preferable, for heavy machining of large work pieces.

*-2 Post-MSA

CNC Lathes for high volume production of machining the same work pieces as those for MSA.
Both front and rear sides of work pieces can be machined using a turn over device built into the machine.
Double Spindle type or Single Spindle of two machines is required; six (6) axis are not required.

*-3 CNC H-400

H-400 revamped to be converted to a CNC machine; the basic design of H-400 is not required to be modified so much.

*-4 Large MC

Two series Table Size: 800 x 800 and 1,000 x 1,000 mm
Design : flexible for both Fixed type and Pallet Shuttle system
Number of Tools for ATC : more than 40 in principle.

*-5 Turning Center

CNC Lathes provided with ATC on the tool post, multifunctioned machine of Drilling and Milling, etc., as well as Turning.

*-6 FMC, FMS

FMCs of 1 set in 95/96, 3 sets in 96/97, and 2 sets in 97/98 and FMSs of 1 set in 98/99 and 2 sets in 99/00 are assigned for implementation of Equipment Improvement Plan Step II and Step III.

2. Sales and Service System

(a) Reinforcement of Sales System

The Marketing Section of the Machine Tool Business Group will be in charge of marketing and sales activities of all the machine tools including products of MTB.

The following measures will be taken for the reinforcement of the Marketing Section of the Machine Tool Business Group.

- To increase the sales force by transferring surplus workers at factory units including MTB to the Marketing Section.

  This mainly aims at the improvement of the after-sales service system and closer contact with customers.

- To improve the after-sales service system.

- To realize closer relationships with smaller-scale users.

  Large-size businesses, such as "projects", make up sixty to seventy percent of the total machine tool business. It is necessary to avoid failing small scale business opportunities.

- To allow flexible pricing.

  At negotiations, price flexibility must be allowed to sales personnel.

- To achieve close contacts with customers and collect more useful information on customers.

  It is, above all, necessary to collect information concerning the needs for FMC and FMS systems.

(b) Measures to Enter the International Market

i. The First Step (Up to 1995/96)

a. To build up an agent network in important regions.

- To evaluate overseas markets by region and determine the important regions.

- To evaluate existing agents in the important regions.

- To set up at least two non-exclusive agents in an important region.

b. To visit the agents regularly, once a month or once every two months, and extend joint sales promotion with them.

HMT sales persons will regularly visit important end users accompanying a man from the agent.

c. To increase sales commission to the agents.

The increase in sales commission to the agents will be considered. The following standard can be suggested for the increase.

Turnover	Commission
Up to Rs. 10 lakhs	10.0%
10 to 20 lakhs	7.5%
More than 20 lakhs	5.0%

ii. The Second Step (1996/97 - 1999/2000)

a. To introduce the following measures for the important regions.

- Direct contact with customers

This aims at the grasp of customer needs, quicker response to them, and the establishment of stable customer relationships.

- Participation in projects
- Joint work with another company

The establishment of a representative office will be considered according to the market situation. Candidate location of representative offices is as follows.

Location	Area of Responsibility
London	EC, Middle Europe, West Africa
Athens	Middle East, North/East Africa East Europe
Singapore	ACEAN, Vietnam, Australia/New Zealand
New York	USA, Middle America

A successful representative office will be promoted to being a sales company.

b. To strengthen the agent network in the non-important regions.

D. Production Plan

Volume of Production and the Production Cycle are referred to in the above mentioned Table I-1-7. These are decided according to the Sales Forecast. However, Table I-1-7 shows volumes in each year and monthly production and cycle should be determined in detail in the 6th month of the previous year.

E. Equipment, Technology Improvement Plan

1. Equipment Improvement Plan

(a) Plant Layout

Fig. I-1-8 : Existing Plant Layout as of 1991
Fig. I-1-9 : Proposed Plant Layout for Step 1 of Action Program
Fig. I-1-10: Plant Layout Plan for Radial Drilling Division
Fig. I-1-11 : Plant Layout for Step II FMCs and Step III FMS-103.
Fig. I-1-12 : Plant Layout for Step III FMS-101
Fig. I-1-13 : Plant Layout for Step III FMS-102

(b) Buildings and Structures

No construction or expansion of buildings and structures will be implemented under the Action Program.

(c) Equipment

i. Outline

The Action Program will be implemented in three steps as follows;

Step I : CNC stand alone machine - renovation and new installation
Step II : 6 sets FMC - new installation
Step III : 3 sets FMS - new installation

ii. Equipment List and Prices

Step I .... Table I-1-8
Step II .... Table I-1-9
Step III .... Table I-1-10

iii. Investment Plan

As shown in Table I-1-11 - 13.

Table I-1-8 List of Equipment (Step I)

M/C DESCRIPTION	NO.	TOTAL VALUE (FOB) Rs.L	IMPORT CONTENT Rs.L	INDIGENOUS CONTENT Rs.L	REF.
SBCNC 35/800 CNC LATHE	2	122	—	—	by HMT
SBCNC 35/2000 CNC LATHE	1	62	—	—	by HMT
STC 15 CNC LATHE	3	94	—	—	by HMT
STC 25/1000 CNC LATHE	5	208	—	—	by HMT
STC 25/1500 CNC LATHE	1	44	—	—	by HMT
GAS CARBURISING PLANT		20	—		Import
VTC 1200 x 635 MACHINING CENTER	4	250	—	—	by HMT
VTC 800 860 x 460 MACHINING CENTER	4	198	—	—	by HMT
HTC 600 1220 x 635 MACHINING CENTER	3	296	—	—	by HMT
CNC HOR. BORING MACHINE	1	169	—	—	by HMT
CNC PREC. INT. GRIND MACHINE	1	105	—		Import
CNC PREC. VERT. INT. GRIND MACHINE	1	169	—		Import
CNC PREC. SURF. GRIND MACHINE	1	130	—		Import
CNC PREC. CYL. GRIND MACHINE	1	221	—		Import
CNC JIG BORING/GRIND MACHINE	1	215	—		Import
AIR CONDITIONING OF SMALL PARTS		60		60	
OTHERS *		152	152		Import
TOTAL	29	2,515	1,806	709	

* Includes tool presetting devices, special tools, material handling devices, material cutting, and etc.

additional value for (1) Custom's duty & (2) CIF value (6% for indigenous & 10% for imported) to be included.

Table I-1-9 List of Equipment (Step II)

M/C DESCRIPTION	NO.	TOTAL VALUE (FOB) Rs.L	IMPORT CONTENT Rs.L	INDIGENOUS CONTENT Rs.L	REF.
FMC (TURNING)	3	450	270	180	by HMT
FMC (MACHINING)	3	525	315	210	by HMT
Assembly and Tool Shop Equipment and Store Modernization and material handling Equipment	-	150	75	75	by HMT
TOTAL	6	1,125	660	465	

Table I-1-10 List of Equipment (Step III)

M/C DESCRIPTION	NO.	TOTAL VALUE (FOB) Rs.L	IMPORT CONTENT Rs.L	INDIGENOUS CONTENT Rs.L	REF.
FMS-101	1	1,455	—	—	by HMT
FMS-102	1	1,832	1,832		Import
FMS-103	1	1,208	—	—	by HMT
TOTAL	3	4,495	2,962	1,533	

Table I-1-11 Investment Plan (Step I)

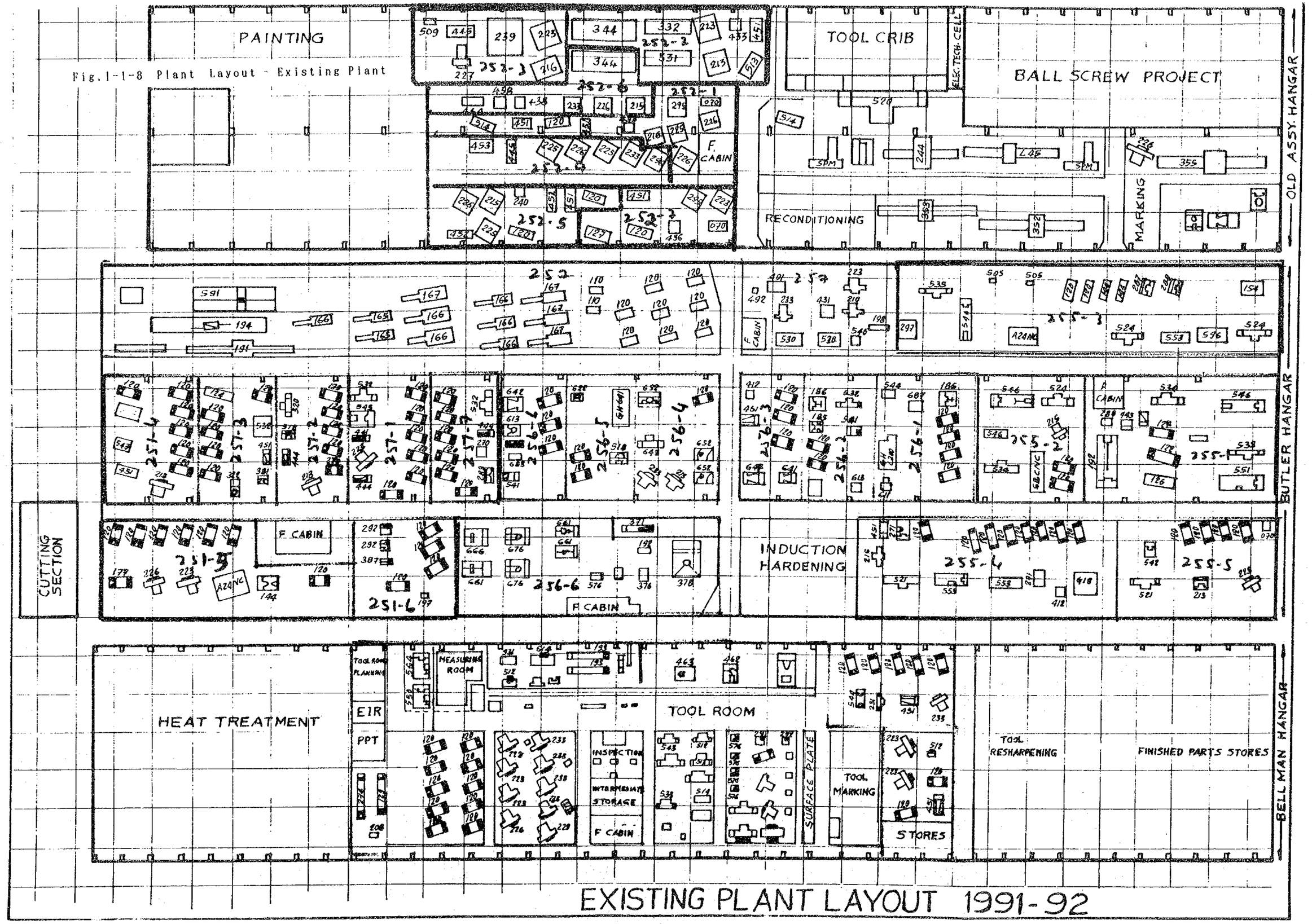
M/C DESCRIPTION	STEP I					
	1992 - 1993		1993 - 1994		1994 - 1995	
	NO.	FOB RS.L	NO.	FOB RS.L	NO.	FOB RS.L
SBCNC 35/800 CNC LATHE	2	122				
SBCNC 35/2000 CNC LATHE	1	62				
STC 15 CNC LATHE	3	94				
STC 25/1000 CNC LATHE	5	208				
STC 25/1500 CNC LATHE	1	44		20		
GAS CARBURISING PLANT *						
VTC 1200 x 635 MACHINING CENTER	2	125	2	125		
VTC 800 860 x 460 MACHINING CENTER	2	99	2	99		
HTC 600 1220 x 635 MACHINING CENTER	1	99	2	197		
CNC HOR. BORING MACHINE					1	169
CNC PREC. INT. GRINDING *			1	105		
CNC PREC. VERT. INT. GRINDING *			1	169		
CNC PREC. SURF. GRINDING *			1	130		
CNC PREC. CYL. GRINDING *					1	221
CNC JIG BORING/GRINDING *					1	215
AIR CONDITIONING OF SMALL PARTS				60		
OTHERS **		60		57		35
TOTAL (STEP I)	17	913	9	962	3	640
CUMULATIVE TOTAL			26	1,875	29	2,515

* Imported machine

** Includes tool presetting device, system tooling, special tool, material handling device, material cutting and etc.

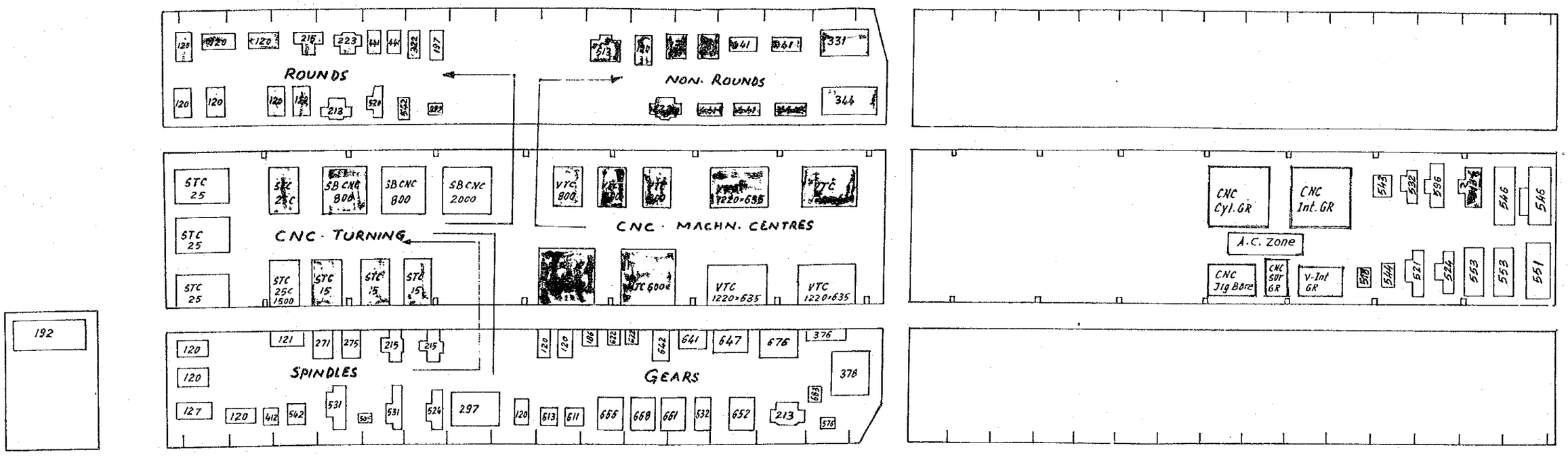
Additional value for i) custom's duty, & ii) CIF value (6% for indigenous & 10% for imported) to be included.

Fig.1-1-8 Plant Layout - Existing Plant



EXISTING PLANT LAYOUT 1991-92

Fig. I-1-9 Proposed Plant Layout for Step 1



PROPOSED PLANT LAYOUT
FOR JICA CONSIDERATION 1991-92

Scale :- 20mm = 5 metres

Fig. I-1-10 Plant Layout for Radial Drilling Division

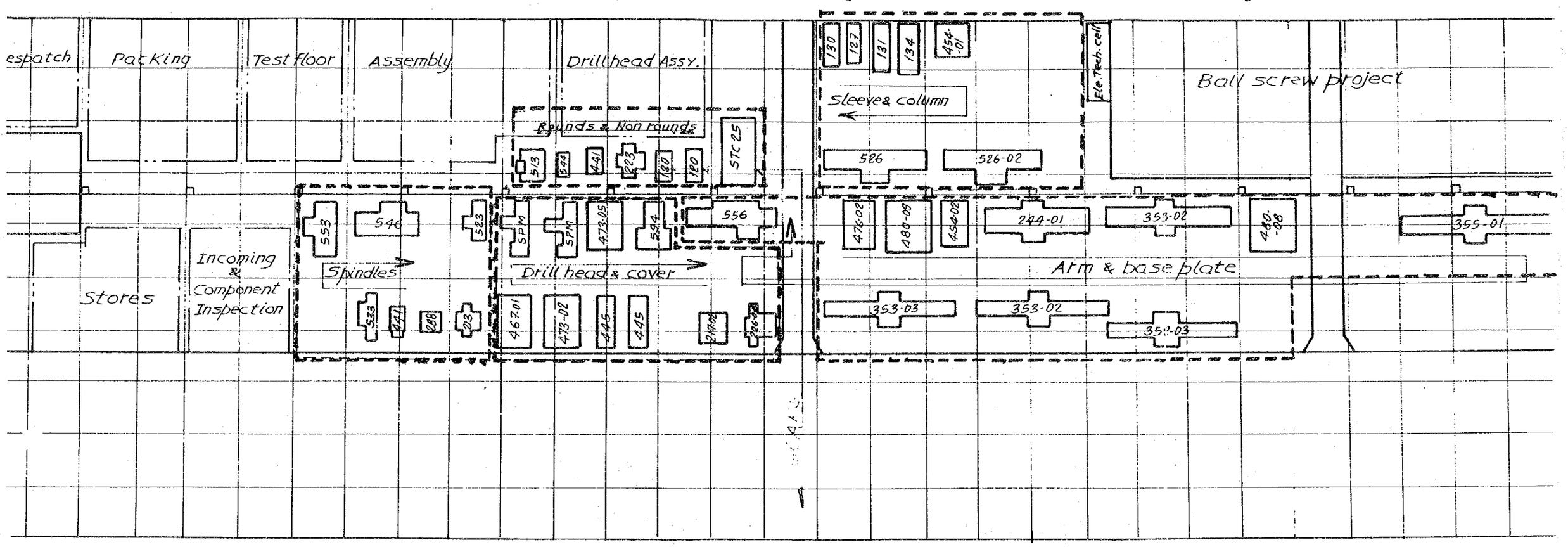
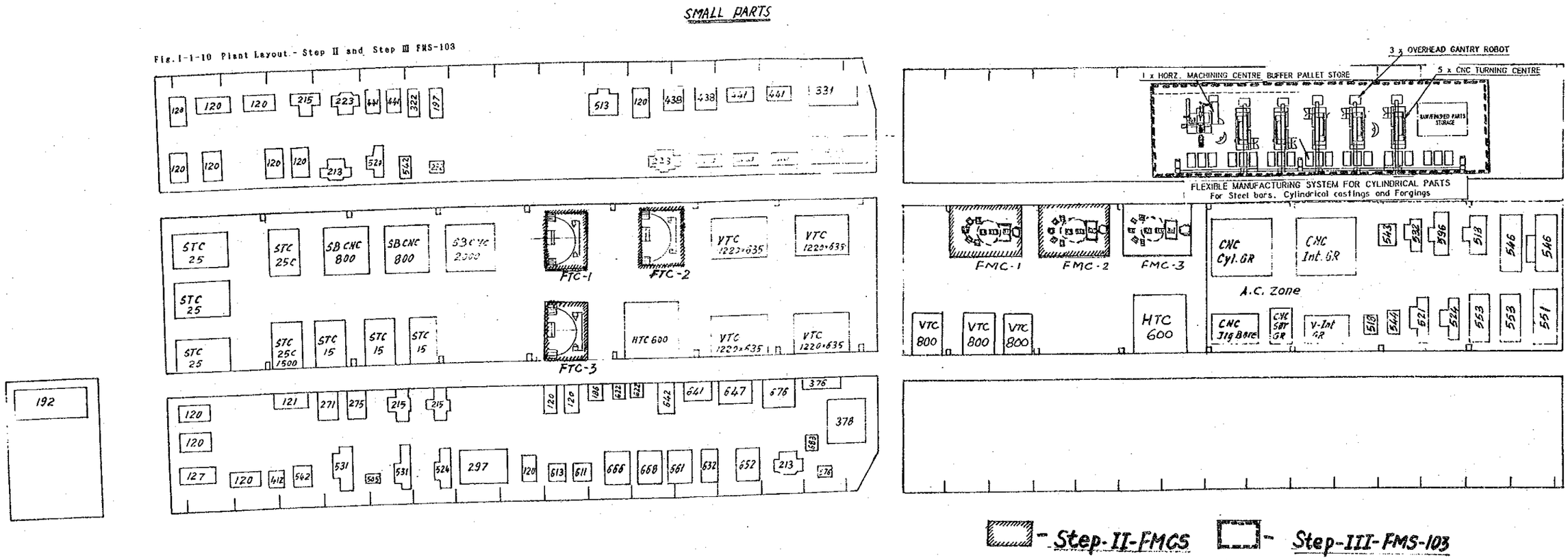


Fig. I-1-11 Plant Layout for Step II (FMC) and Step III: FMS-103



PROPOSED PLANT LAYOUT

Scale :- 20mm = 5 metres

Fig. I-1-12 Plant Layout for Step III: FMS-101

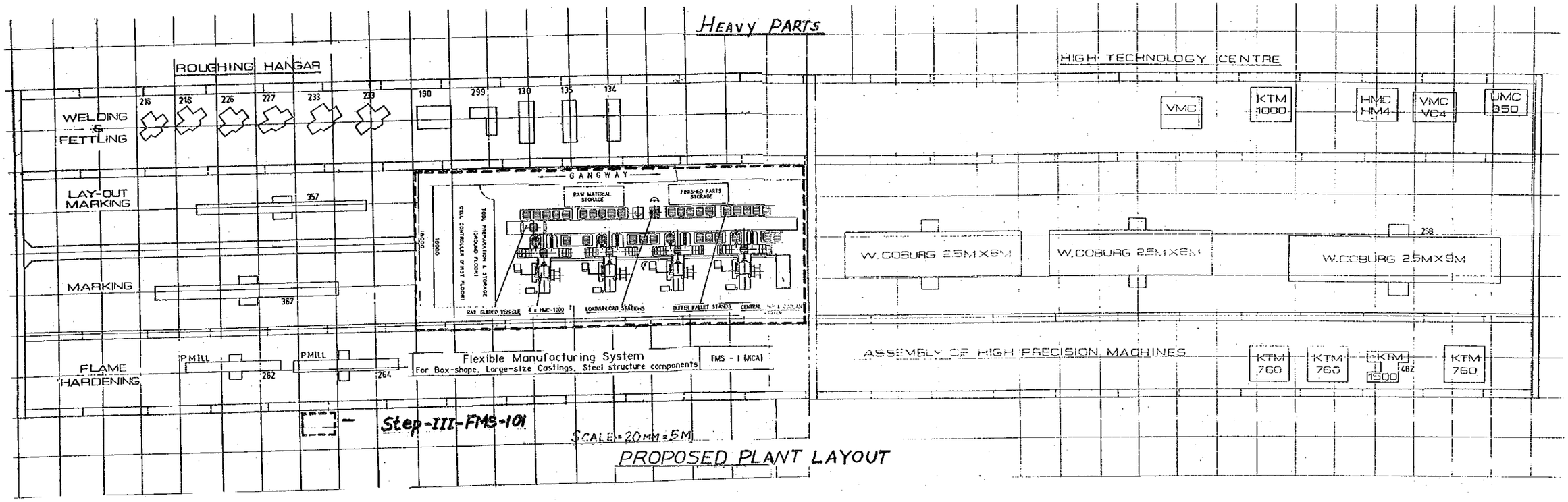


Fig. I-1-13 Plant Layout for Step III: FMS-102

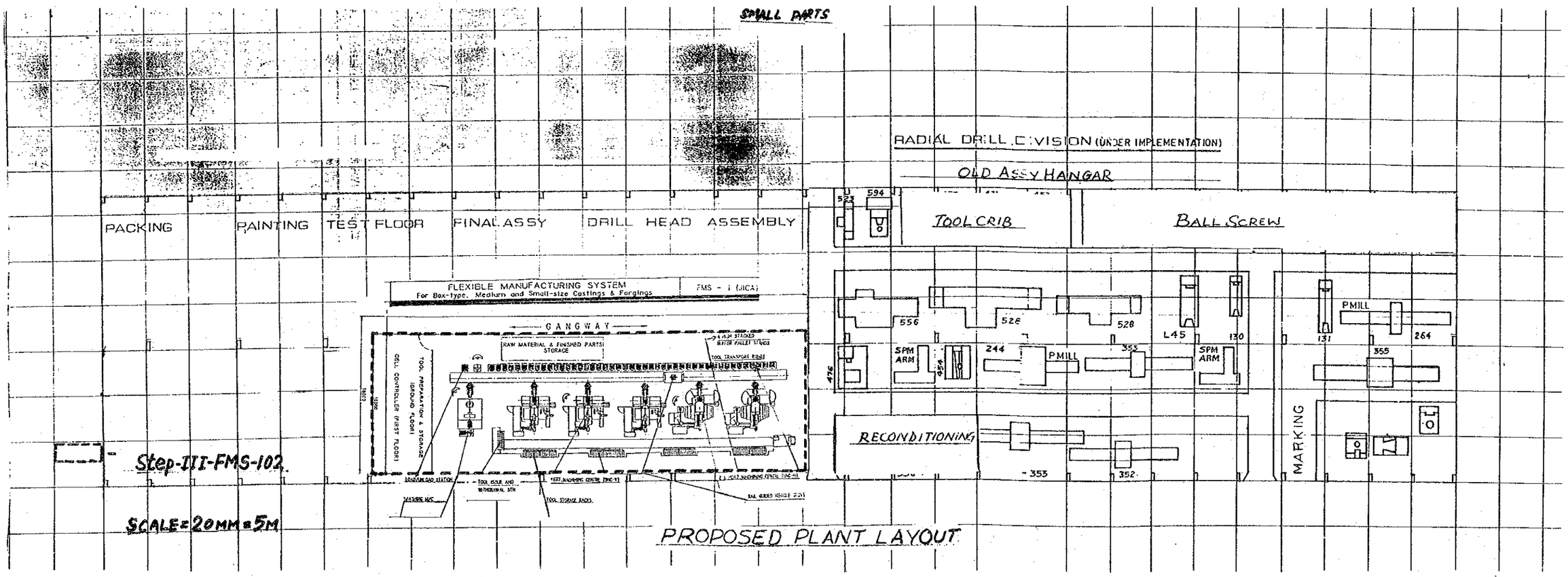


Table I-1-12 Investment Plan (Step II)

M/C DESCRIPTION	STEP II					
	1995 - 1996		1996 - 1997		1997 - 1998	
	NO.	FOB RS.L	NO.	FOB RS.L	NO.	FOB RS.L
FMC (TURNING)	1	150	2	300		
FMC (MACHINING)	1		1	175	2	350
TOTAL	1	150	3	475	2	350
CUMULATIVE TOTAL		2,665		3,140		3,490

Additional value for i) custom's duty, & ii) CIF value (6% for indigenous & 10% for imported) to be included.

Table I-1-13 Investment Plan (Step III)

M/C DESCRIPTION	STEP III			
	1998 - 1999		1999 - 2000	
	NO.	FOB RS.L	NO.	FOB RS.L
FMS-101			1	1,455
FMS-102	1	1,832		
FMS-103			1	1,208
TOTAL		1,832	2	2,663
CUMULATIVE TOTAL		5,322		7,985

Additional value for i) custom's duty, & ii) CIF value (6% for indigenous & 10% for imported) to be included.

2. Production Technology Improvement Plan

(a) Production Technology Improvement

i. Modernization of factory equipment

The current equipment consisting almost entirely of GPMs are very aged, and these will be renovated to modern ones.

The basic philosophy of the renovation is to forward (1) CNC - conversion, and (2) Systematization (FMC, FMS).

ii. Cost reduction

The purpose of this renovation is to achieve cost reductions of production in a general sense, and actually the following three items will be carried out in the production process of MTB.

(i) To minimize works-in-process inventory
(ii) To improve inventory turnover ratio
(iii) To minimize machining cost

iii. Production system (Cost reduction by production concentration)

GT (Group Technology) will be employed in the machine shop which has been modernized by renovation.

The work pieces in the Small Parts Buttlar Hanger are classified in 4-Groups, (1) Rounds, (2) Non-Rounds, (3) Spindles, and (4) Gears, and the machines are arranged according to the material flow.

CNC machines, FMC and FMS will have surplus machine hours in their capacity, and these surplus hours will have to be assigned to machine the same kind of parts for other units. (For example, spindles for MTK or MTP are machined by the Spindle Group.)

iv. Shift of surplus workers from machine shop to the shops of mechanical/electrical assembly.

A fair number of workers and machines will become surplus as a result of productivity improvement by employing CNC machines, FMC and FMS.

These surplus man-hours will have to be assigned to the mechanical/electrical assembly shop.

The man-hour capacity of the assembly shop will increase with this assignment.

In other words, the investment in the machine shop for equipment modernization turns out surplus workers due to productivity improvement, and the capacity of the assembly shop will increase by employing them, and further this leads to expansion of production in MTB.

Hence, the investment in the machine ship definitely means the development of the production capacity in MTB, and this relates to the plan of increasing production.

v. Implementation Schedule

The implementation schedule by steps is as follows.

- Step I ... 29 sets CNC stand alone M/C (Table I-1-14)
- Step II ... 6 sets FMC (Table I-1-15)
- Step III .. 3 sets FMS (Table I-1-15)

(b) Product Technology Improvement

Product Technology Improvement is focused on the development of system and new CNC products.

The following four items will be developed by the year 2000, and put in a series of products.

i. Development of FMC and FMS (1995/96 - 1999/2000)

Six (6) sets of FMC in Step II and FMS-101, 102, 103 in Step III described in section 1 Equipment Improvement will be developed.
This means that MTB will develop and manufacture them

Table I-1-14 Numbers of Equipment in Each Shop

M/C DESCRIPTION	ROUNDS	NON ROUNDS	SPINDLES	GEARS	TOOL ROOM	HEAVY PARTS
SB CNC 35/800	1			1		
SB CNC 35/2000			1			
STC 15	3					
STC 25/1000	1		1	2	1	
STC 25/1500			1			
VTC 1220 x 635	1	1	2			
VTC 800 860 x 460	1	2			1	
HTC 600 1220 x 635		2			1	
CNC HOR. BORING						1
CNC INT. GRINDING					1	
CNC VERT. INT. GRINDING					1	
CNC SURF. GRINDING					1	
CNC CYL. GRINDING					1	
CNC JIG BORING/GRINDING					1	
TOTAL	7	5	5	3	8	1
GRAND TOTAL	29					

Table I-1-15 Numbers of FMC and FMS

DESCRIPTION	SMALL PARTS	RADIAL DRILL DIVISIONO	HEAVY PARTS	REFERENCE
FMC (TURING)	3			CNC LATHE WITH ROBOT
FMC (MACHINING)	3			CNC M/C WITH PALLET CHANGER
FMS-101			1	FOR LARGE SIZED CUBICAL COMPONENTS
FMS-102		1		FOR MEDIUM TO SMALL SIZED CUBICAL COMPONENTS
FMS-103	1			FOR TURNED COMPONENTS
TOTAL	7	1	1	

by itself for its own use.

ii. Development of Special Turning Machines (1994/95)

General Turning Machines i.e. lathes, are the products of MTK. In MTB the following two kinds of turning machines will be developed.

(1)Post-HL
(2)Post-MSA

"Post" means not only CNC-conversion, but also large modification of the basic design.

These will be developed aiming at the same user group of HL and MSA.

Post-HL will have the same specification as that for HL for machining large work pieces.

The machine bed will be a slant type as far as possible.

Post-MSA will be for machining large volume of parts such as materials for cars and bearings, etc.

A six (6) axis spindle will not be required.

With a single spindle or double spindle mechanism, the arrangement of several machines connected by a work piece loader will be preferable.

iii. Development of CNC-H-400 (1995/96)

Without large modification of the current H-400 basic engineering, the outlook will be modernized.

FMC will be constructed by including an Auto-loader or Robot.

iv. Development of a High-Grade CNC Machine (1995/96 - 1996/97)

(1) Large Machining Center

The table will be designed to have two series, 800 x 800 and 1,000 x 1,000 mm, enabling both the fixed type and pallet shuttle type systems.

This machining center will have such functions as being a Module Machine for FMC with pallet change and full scale FMS, and more than 40 tools will be provided on the ATC.

(2) Turning Center

This machine will be designed for the purpose of multi-machining, and will be CNC Lathe equipped with a turret type tool post with ATC. Also Drilling Attachments and Milling Attachments, etc., will be supplemented.

(3) Auxiliary Accessories (Automated Functions)

The following accessories will be developed to supplement the functions as Module Machines for FMS and FMC.

. Cutting Monitoring Device
. Automatic Gauging and Compensation
. Auto-detection of Tool Breakout
. Tool-life Calculation/Cumulative
. Automatic Loading and unloading
. Automatic Chip Removal

(c) Acquiring of Technology

The aforementioned four improvement items should be developed by MTB (or HMT) itself.

However, to the degree that time and capacity are limited, technology will be introduced through collaboration.

A License Agreement would be better for acquiring technology.

i. Technology Resource

(i)	FMS, FMC,	Fritz Warner (Germany), KTM (U.K.)
(ii)	Post-MSA	Gildemeister (Germany)
(iii)	CNC-H-400	Liebherr (Germany)
(iv)	Large MC	KTM (U.K.), OERLIKON (Switzerland)

The above are recommended suppliers as partners in License Agreements. However, there could be many other suitable suppliers, such as major Japanese machine tool manufacturers.

ii. Cost of acquiring technology

The following are the required costs for a single License Agreement

(1) Initial Payment (Lump Sum) : 400 - 800 Rs.L
(2) Royalty : 3% (not for investment)
(3) Dispatch of Engineer(s)for training : Rs 4,000 x $5^{persons}$ x 120^{days} = 24 Rs.L
(4) Invitation of Engineer(s) : Rs 10,000 x $2^{persons}$ x 100^{days} = 20 Rs.L
(5) Travel expenses : Actual cost
(6) Absence fee : compensation to be included in initial payment

3. Environmental Condition

This plan is to introduce CNC-Machines, FMCs and FMSs for the renovation of aged equipment in the factory.

This equipment is to be inspected in accordance with various rules stipulated in the standard, and levels of noise and vibration are regulated within the limit. Further, as these are metal machining devices, no gas or oils will be discharged.,

Therefore, there will not be any adverse effect on environmental conditions.

F. Unit Operation Improvement Plan

1. Factory Organization

The divisionalization of the MTB organization is to be examined. The content of MTB divisionalization is as follows:

Proposed Divisionalization at MTB

(a) Need of divisionalization

The following are the existing problems at MTB.

1) Too many products/variants
2) Large No. of Manufacturing components
3) Long cycle time required for production
4) Few CNC Machines in the product line
5) Old plant and machinery

With these major problems and with the complex dynamic environment, the following strategies are immediately to be adopted.

i) There should be an emphasis on changing of technology flow from low technology to medium and high technology in the years to come.

ii) Since the additional products/variants tend to increase the no. of components manufactured (especially in small parts), off-loading of simple components should be started immediately.

iii) The concept of 'Divisionalization' as a strategy to enhance responsibility/accountability through small cohesive divisions should be introduced.

(b) Concept of divisionalization

i) Divisions as cost-centers are identified considering

- Balanced turnover
- Similar technology
- Resource requirement/utilization

ii) The divisions shall manufacture only A/B Class components. All 'C' Class components are to be off-loaded by 1992-93. Operation off-loading is to be considered in the second plan.

iii) Each division shall be self-contained with minimum interdependency for facilities. The product variety within the division shall be small and manageable.

iv) Divestment of product/variety reduction

(c) Main divisions

i) Automatics Division
ii) Gearing Division
iii) Drilling Division
iv) Heavy duty Lathes/SPM division

(d) Strategies/Action plan

i) Small parts

- Off-loading plans to be executed as per schedule
- Rearrangement of operators with training/retraining
- Old machines should be removed
- Reorganize the plant machines in line with the needs of the division with provision for modernization
- Each division will need to lesson the component flow to assembly. With improved flow, assembly utilization will improve leading to uniform production activity.
- Heat treatment remains a common facility.

ii) Heavy parts:

- As physical reallocation of heavy machines is difficult only identification of each machine for each division shall be done.
- Reallocation of direct workmen is to be done.
- Remove unused/not required machines.

iii) High tech center and Tool room remain common manufacturing facilities.

iv) Assembly - reallocation of assembly filters/electrical fitters to be done depending on requirements of each division.

- Recruitment of assembly filters/electrical fitters in view of retirements.

- To provide/utilize a washing station for components before assembly. This will result in improved quality and hence customer satisfaction.

(e) Advantages of Divisionalization

- Small groups with manageable product variety.
- Sharing of responsibility of division chiefs.
- Better scope for implementation of 'online' computerization of the production control system due to reduced complexities.
- Tread forward sub-contracting.
- Product viability/profitability can be better assessed.
- Concept of belonging among the employees of the Division.

2. Manpower Plan

(a) Manpower Reduction by Step I

With the introduction of CNC stand alone machines, the numbers of machines and workers in the Small Parts Buttler Hanger and Tool Room will be cut down as shown in Table I-1-16.

Table I-1-16 Manpower Plan at Step I

Unit: person

DESCRIPTION		ROUNDS	NON ROUNDS	SPINDLES	GEARS	TOOL ROOM	TOTAL
CNC'S TO BE PLANNED	M/CS	7	5	5	3	8	28
	MEN	14	10	10	6	16	56
GPM'S TO BE RETAINED	M/CS	20	13	25	25	34	117
	MEN	40	26	50	50	48	214
HAND LABOUR		6	9	3	8	15	41
TOTAL	M/CS	27	18	30	28	42	145
	MEN	60	45	63	64	79	311
EXISTING	M/CS	65	55	60	57	56	293
	MEN	93	96	81	77	98	445
CUT DOWN	M/CS	38	37	30	29	14	148
	MEN	33	51	18	13	19	134

Table I-1-17 Manpower Plan at Step II & III

SYSTEM	NO.	SMALL PARTS		RADIAL DRILL		HEAVY PARTS		GRAND TOTAL	
		M/CS	MEN	M/CS	MEN	M/CS	MEN	M/CS	MEN
FMC (T)	3	24	21					24	21
FMC (M)	3	36	33					36	33
FMS-101	1					48	44	48	44
FMS-102	1			60	55			60	55
FMS-103	1	40	35					40	35
TOTAL	9	100	89	60	55	48	44	208	188

Table I-1-18 Surplus Worker Reallocation Plan

STEP	CNC OPER	CNC PROG	CNC MAINT	ASSEM FITTER	ELECT FITTER	SERV ENG	GRAND TOTAL
I	14	3	3	90	24	0	134
II	6	2	2	30	12	2	54
III	6	2	0	80	40	6	134
TOTAL	26	7	5	200	76	8	322

(b) Reduction of numbers of machines and workers by introduction of FMC and FMS (Step II, III).

With the introduction of the three (3) sets of FMC (Turning) and FMC (Machining) in Step II, and the FMS-101, 102 and 103 sets in Step III, the number of current GPMs and the workers for them will be reduced as shown in Table 1-1-17.

(c) Shifting of Workers

The surplus workers caused by the implementation of steps I, II and III will be shifted to other jobs after taking part in the necessary training courses.

(1) CNC - Operators .... shift in machine shop (reinforcement of workers)

(2) CNC - Programmers ... Ditto (Ditto)

(3) CNC - Maintenance Engineers Ditto (Ditto)

(4) Assembly Fitters .... shift to assembly shop (reinforcement of assembly man-hours)

(5) Electrical Fitters .. shift to electrical assembly shop (reinforcement of man-hours)

(6) Service Engineers ... shift to Marketing (CNC - after delivery service)

G. Education, Training Plan

1. Curriculum

(a) Education and Training Course

The Education and Training course will be divided into (1) CNC Course and (2) ASS Course.

CNC Course Trainees : CNC-Operators, CNC-Programmers, CNC-Maintenance Engineers, Service Engineers.

ASS Course Trainees : Assembly Fitters, Electrical Fitters

Each training period would have eight (8) weeks of training which would include:
First 3 weeks : Lectures
Remaining 5 weeks : Training in shops

Contents of Lectures:

CNC Course : CNC Theory & Programming
ASS " : Mechanism & Electric Engineering

These are elementary lectures only.

(b) Education and Training Program

All Education and Training will start at the completion of the planned step I, II & III as shown in Fig. I-1-14.

The number of trainees for each class will be around 20, and a concrete allocation of them is shown in Table I-1-19.

Fig. I-1-15 shows details of the program in (a), (b) and (c) in the years 1995, 1998 and 2000 respectively.

Table I-1-19 Numbers of Trainees by Type of Courses

Step	CNC Course	ASS Course
I	20 persons - 1 class	23 persons - 4 classes, 22 persons - 1 class
II	12 persons - 1 class	21 persons - 2 classes
III	14 persons - 1 class	20 persons - 6 classes

Fig. I-1-14 Training Program

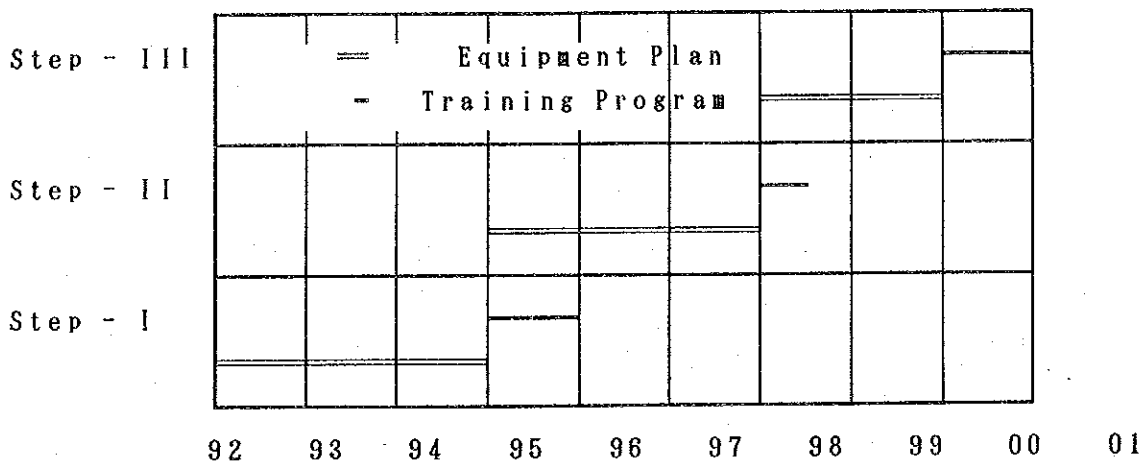
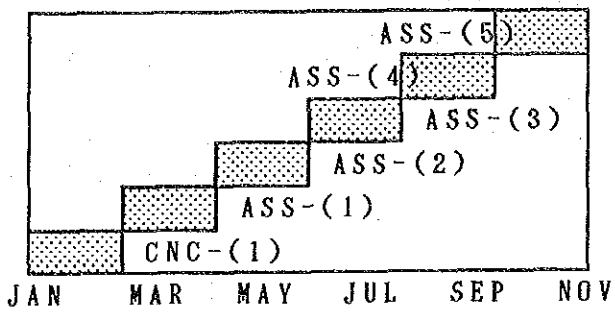


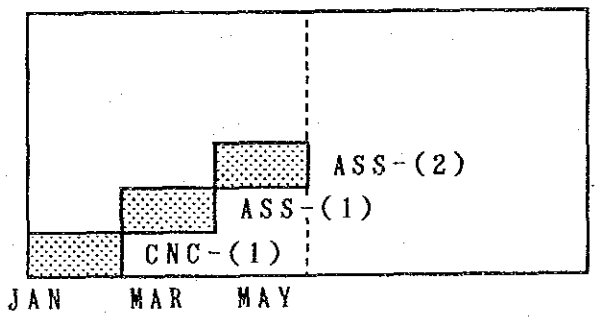
Fig. I-1-15 Training Implementation Schedule by Course

(a)



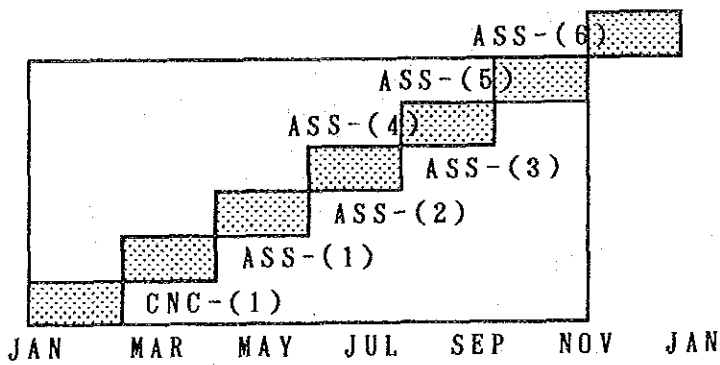
1995

(b)



1998

(c)



2000

I-2. Press Factory

A. Direction of Factory Renovation

A high productive capacity of engineering, fabricating, machining and assembly of products is necessary in order to manufacture presses competitively in terms of engineering level, price quality and delivery time.

The following two points are proposed as the direction of factory renovation.

(a) Integration and modernization of fabrication shop

The present fabrication shop of the press division should be integrated with the fabrication plant of the machine tool division.

The renovation of facilities and introduction of new facilities should be implemented aiming at high productivity and quality with low cost, and further aiming at diversification of fabricated products.

(b) Reinforcement of machining/assembly shops

The reinforcement of machining/assembly shops is required. This is because the existing large machine tools are even now the bottleneck of the production and the present assembly shop area is not large enough.

Existing machine tools should be converted to NC machines. New, highly efficient, machine tools should also be introduced there. Small machine tools should be released to sub-contractors, thus, the machining shop will be reinforced.

In future steps, cranes should be updated with the reinforcement of building structures, and assembly shops should be expanded.

Along with the plant renovation, technology collaboration with leading overseas companies and reinforcement of the engineering department should be promoted.

After the completion of plant renovation, securing a high operation ratio of the productive capacity of the plant will be an important issue. Diversification of products and sub-contract manufacture of heavy parts should be pursed.

The renovation of the press factory should be examined carefully in order to maintain a good balance between engineering power and plant facilities.

B. Modernization and Expansion of Press Factory

1. Background

For the manufacturing of presses which have enough competitiveness in engineering design, price, quality and delivery time, the installation of high-levels of manufacturing facilities, as well as high engineering capabilities, is essential.

The renovation of the press factory in HMT is needed taking the following factors into consideration.

(a) To achieve a balance between production facilities and engineering capabilities;

(b) To strengthen marketing capabilities in order to maintain a constant operation ratio of production facilities; and

(c) To establish a long-term technical collaboration for both the promotion of product diversification and the strengthening of sub-contracting or joint working activities.

2. Objective

The press machine plant would be expanded and modernized in order to (i) increase the range of products to be handled, and (ii) integrate the steel fabrication shop.

3. Contents

(a) Installation of such new machines as high efficiency horizontal boring machines, or CNC-five surface machining-planomillers with approx. 10m table length.

(b) Installation of several positioners for welding work, large automated plate cutting machines, a bending roller, a press brake and a large stress relieving furnace in the steel fabrication shop.

C. Outline of the Factory

1. Background

The development of indigenous industry in the area of Metal Forming machines during the 60s did not keep pace with the overall industrial development of the country. Even the licensed capacity in this particular industry has not been fully installed and the utilization of installed capacity has been very poor. The type of machines produced also were the simpler ones with rather outdated design and construction features. Consequently imports of metal forming equipment have been proportionately higher compared to imports of metal cutting machines in previous years.

With a view to offer better and modern equipment in the metal forming field also to machine tool users in the country, HMT decided as part of its diversification program to enter into this area of production also.

The market for metal forming presses is mainly from the Defense and Automobile industries. In order to, at least, partially fill the gap between Production and Demand of metal forming machine tools, HMT entered into a technical collaboration with M/s. Verson Allsteel Press Company. The agreement was finalized on 2nd May, 1969.

The collaboration agreement provides for the supply of the standard design of mechanical/hydraulic presses and engineering for special presses for manufacturing of, (i) Mechanical Presses, (ii) Hydraulic Presses, (iii) Transmat Presses, (iv) Impact Extrusion Presses, (v) Press Brakes and Shears, (vi) Special Presses, and (vii) Auxiliary and Accessory Equipment for such presses.

The collaboration lasted between the years 1969 and 1979.

After that period, Verson Allsteel Press Co., Chicago, U.S.A. was taken over by Allied Corporation, and Verson International Ltd. (U.S.A.) did all the international dealings.

Later this company was shifted to England, with a subsidiary company, Verson Europe in Belgium, and Verson International Ltd., Birmingham, U.K. was established.

New collaboration with Verson International Ltd., provided for technology transfer for presses up to 500 tons, and a joint working arrangement was concluded for the presses above 500 ton capacity. This collaboration lasted between the years 1982 and 1989.

Through this collaboration, HMT bought the drawings of 40 presses in total.

At present, HMT does not have effective collaboration, however on a case to case basis, Versons works with HMT on quotations for joint work for onward submission to customers.

2. Geometrical Condition

The HMT-Hyderabad Unit is located in a part of an industrial area in the northern suburbs of Hyderabad City, Capital of Andhra Pradesh State. The location is approx. 15km from the center of the city and it takes about 30 min. by car.

In relation to main ports, Hyderabad is about halfway between the two ports, Bombay and Madras.

Electric power supply for the industries in Hyderabad is not sufficient. In fact, the industrial areas there share holidays on different days to compensate for the shortage of the power supply.

3. Land and Building

The total area of HMT, Hyderabad is 3,593,616 m^2
PRH occupies the following area and buildings:

Details of PRH		
Land Area		30,350 m^2
Plinth Area	Workshop	5,508 m^2
	Service Building	786 m^2
	Elec. Substation	144 m^2
	Works Office	882 m^2
	Compressor Room	125 m^2
	Security Gate II	194 m^2
	Fire Tender Shed	60 m^2
	TOTAL	7,699 m^2

4. Production Items

Major products and their specifications are as follows:

Products	Specifications
i) Press Brakes	
Mechanical Press Brakes	110, 140, 180, 225 Ton
Hydraulic Press Brakes	200, 315, 400, 500, 630, 800, 1,000 Ton
ii) Profit master open back Inclinable Presses	100, 160, 200, 250 Ton
iii) Mechanical Presses	100, 160, 200, 250, 315, 400, 500, 630, 800, 1,000, 1,250, 1,600 Ton
iv) Hydraulic Presses	200, 250, 315, 400, 500, 630, 800, 1,000, 1,250, 1,600, 2,000, 2,500 Ton
v) Four Point Clipping and Setting Presses	200 Ton
vi) Refractory Brick Presses	200, 300, 400, 600, 630 Ton
vii) Precision Press PP6	2 Ton - 120 str/min
viii) Flow Forming Lathe FTL-40	LT 650 mm, CH 410 mm
ix) CNC-Turret Punch Press	(Under Development)
x) Coal Mining Equipment	
xi) Knuckle Joint Press	
xii) Special Machineries	
- CRV Press	Capping, Ringing, Gauging, Vanishing
- Hydraulic Shear	(Under Development)
- Friction Screw Press	

- Cap Pressing Press
- Extrusion Press 215 Ton
- Forging Press (Under Development)

5. Production Facilities

Production facilities operating at PRH are listed in Table 1-2-1.

Table I-2-1 List of Existing Production Facilities

Sl. No.	Name of M/c.	No.	Type	Size	Make	Year Installed
I.	SMALL PARTS:					
1.	Center Lathe	120-P1	H22	Swing over Bed: 450mm Dist. between Center: 1,000mm	HMT	1970
2.	Center Lathe	121-P1	LB25	Swing: 500/1,500 lg.	HMT	1970
3.	Center Lathe	127-P1	H26	Swing: 530/1,500 lg.	HMT	1971
4.	Center Lathe	127-P2	H26	Swing: 530/1,500 lg.	HMT	1971
5.	Center Lathe	130-P1	B32	Swing: 640/1,500 lg.	HMT	1979
6.	V. Milling	223-P1	M2V	Table: 1,100 x 310	HMT	1971
7.	V. Milling	226-P2	FN3V	Table: 1,350 x 310	HMT	1983
8.	Slotting	322-P1	CH40	Max. Stroke: 400mm/Max. Wt. 2.5T Table Dia: 800mm	COOPER	1982
9.	Surface Grinding	515-P1	SFW2	Working Surface: 250 x 1,500	HMT	1971
10.	Cyl. Grinding	531-P1	G17	Max. Dia: 450/Length: 1,260	HMT	1970
11.	Honing	594-P1	--	Max. Dia Bore: 900mm Max. Stroke: 2,300mm	HMT	1980

II. MEDIUM HEAVY PARTS:

1.	H.D. Center Lathe	134-P1	L45	Swing Over Bed: 900mm Between Center: 3,000mm	HMT	1971
2.	H.D. Center Lathe with CNC Retrofit	134-P2	L45	- do -	HMT	1984
3.	H.D. Center Lathe	135-P1	L45	Swing Over Bed: 900mm Between Centers: 5,000mm	HMT	1972
4.	V.T. Turning	190-P1	1L532	Max. Dia: 2,800mm Working Ht.: 1,100mm	STANKOIMPORT	1974
5.	V. Milling	226-P3	FN3V	Table: 1,350 x 310 mm	HMT	1985
6.	Plano Milling	249-P1	FP8P1	Table: 4,000L x 1,600W x 2,000H	FRITZWERNER	1974
7.	Planing (BECO)	333-P1	P2500	Table: 2,500 x 620 mm	FERRERTTO BECO	1971
8.	Planing	338-P1	6E3836	Table: 6,000 x 1,500	WALDRICH COBURG	1974
9.	R. Drilling	453-P2	RM63	Max. Drill: 90mm Max. Tapping: M56	HMT	1970
10.	Gear Shaping	629-P1	5E	Blank Dia 1,600/Face Wd. Spur 254/Helical 254/Double Helical 457mm	WE SYKES	1974

III. HEAVY PARTS:

1.	R. Drilling	454-P2	RM65	Max. Drilling: Dia 90/Tap M70	HMT	1990
2.	H. Boring	470-P1	AF7	Table: 920 x 920/Max. Facing 0750	HMT	1974

3.	H. Boring	474-P1	AZ11	Table: 1,200 x 1,200/Max. Facing 0850	HMT	1979
4.	Floor Type H. Boring & Milling	478-P1	WD130	Spindle Travel: 1,100/ Floor Bed 3,770 x 5230 mm	TOS	1974
5.	Floor Type H. Boring & Milling	478-P2	WD130A	Spindle Travel: 1,100/ Floor Bed 3,770 x 4,000 mm	TOS	1974
6.	Floor Type H. Boring & Milling	479-P1	WD160B	Spindle Travel: 1,600/ Floor Bed 3,770 x 6,440 mm	SKODA	1974
7.	Plano Miller	258-P1	6625Y	Table Size: 8,500L x 2,000W x 2,500H Max. Wt. of Job: 65,000kgs.	STANKOIMPORT	1988
8.	Gear Hobber	645-P1	5343P	Table Dia 2,800/Vert. Travel of Hob: 1,200, Module: 40, Wt. 45T	STANKOIMPORT	1991

IV. FABRICATION:

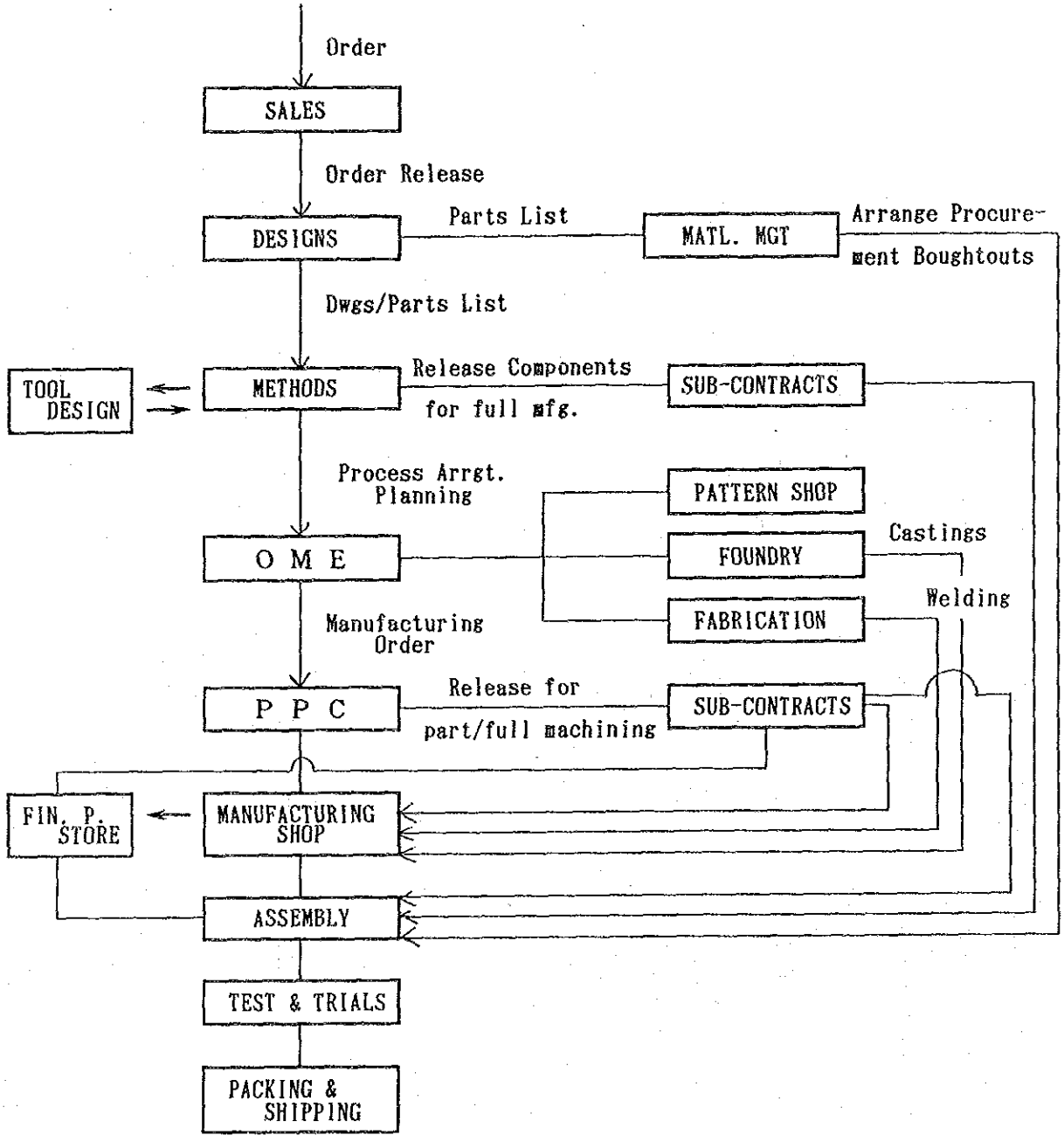
1.	Hacksaw Cutting	208-P1	HH16	Max. Cutting Dia: 400	M/C. KING	1974
2.	Hacksaw Cutting	208-P2	HS20	Max. Cutting Dia: 200mm	TANSI	1979
3.	Hacksaw Cutting	208-P3	HS20	Max. Cutting Dia: 200mm	TANSI	1980
4.	Hacksaw Cutting	208-P4	HS30	Max. Cutting Dia: 300mm	TANSI	1981
5.	R. Drilling	453-P1	RM63	Max. Drill 90mm/Tap: M56	HMT	1970
6.	Profile Flame Cutting	759-P1	120-C	Max. Th. to be cut: 320mm Table: 2,500 x 6,000 mm	HANCO	1974
7.	Flame Cutting M/c.	758-P1	PUG	Max. Th. to be cut: 50mm	IOL	1990
8.	Flame Cutting	758-P2	MARK IV	Max. Th. to be cut: 150mm	BOC	1974

V.	ASSEMBLY:					
1.	R. Drilling	454-P1	RM65	Max. Drill 90mm/Tap: M70	HMT	1971
VI.	MISCELLANEOUS & HANDLING EQUIPMENT:					
1.	Air Compressors (2)		EH200	200 CFM	KIRLOSKAR	1972
2.	Air Compressors (1)		ESH14"x11"	500 CFM	INGERSOLL RAND	1978
3.	Air Compressors (2)		EH200M	200 CFM	KIRLOSKER	1991
4.	Welding Transformers & Rectifiers (9)					
5.	Welding Manipulators (3)			5 Ton Capacity		
6.	E.O.T. Crace			50/10T	GARLICK	1975
7.	E.O.T. Crane			50/10T	GARLICK	1976
8.	E.O.T. Crane			20T	VOLTAS	1972
9.	E.O.T. Crane			20T	VOLTAS	1972
10.	E.O.T. Crane			35/10T	ACC	1973
11.	E.O.T. Crane			10T	NSE	1980
12.	Goliath Crane		STEEL YARD	10T		

6. Outline of Production Process

The production process of a standard product at PRH is depicted as follows:

Fig. I-2-1 Production Process



D. Concept of the Action Program

1. Current problems

HMT manufactured and sold mechanical/hydraulic presses in collaboration with Verson Allsteel Press Co. (U.S.A.) and Verson International for 20 years, from 1969 to 1989.

However, the operation of the Press Division has been deteriorating due to unstable operation caused by the fluctuations in the narrow press market in India and weakened competitiveness caused by outdated technology.

The following are major problems.

(a) No availability to introduce new technology due to no effective collaboration, and limited development capacity of own engineers.

(b) No possibility to respond to various requirements of customers on equipment and technology due to no collaboration back-up.

(c) Current technology is limited for manufacturing sheet metal forming presses and does not allow response to the wide demand of metal forming machineries.

(d) No exposure for engineers to acquire the trends of new technologies in the international market, and thus they are far behind the trends of new technologies.

(e) Delay in the introduction of office automation facilities in the engineering department, and productivity and high quality engineering are limited.

(f) Products are limited by press machinery, and operation of the division is unstable directly affected by fluctuations of the market.

(g) Passive sales activity; lack of aggressive sales activity.

(h) Quality of products is comparable to competitors, however, price and delivery time are inferior.

(i) Steel fabrication shop integrated with machine shop is still small and restricts the renovation of the machine shop.

(j) Lack of mechanization and automation in steel fabrication shop, and productivity is low. Heavy steel plates being stocked in the shop due to shortage of handling capacity in outdoor storage yard makes the welding shop space small.

(k) Lack of a large annealing furnace for stress relief of fabricated steel structures; annealing jobs are sub-contracted.

(l) Steel fabrication shops in the Unit are split into two divisions of press and machine tool. There is no systematic activity of productivity and quality improvement due to lack of consistent management system.

(m) Many aged machine tools in the machine shop are not digitalized and NC-converted, and productivity is low.

(n) Large machine tools are a bottleneck in machining jobs due to a shortage of capacity.

(o) The 50 ton capacity overhead crane restricts the manufacturing of large Presses. The productivity of assembly jobs is limited by sub-assembled weight.

(p) Nine aged small machine tools in the machine shop make it costly to produce small parts.

(q) Small assembly area restricts shipping capacity.

(r) Low working productivity due to low morale of workers.

(s) Heavy steel plate above 60 mm in thickness is imported, and it takes 10 months. Such plates must

be prepared by forecasting jobs to meet the delivery time, which causes increase in the stock amount.

(t) Quality of steel material is unstable, this causes confusion of manufacturing process and delay of delivery.

2. Purpose

The purpose of the renovation is to aim at stable operation of the division, and acquiring international level technology. HMT would contribute to obtaining foreign currency through exportating products by doing business in the international market as well as in India and expanding the business to assure profit.

(a) Acquiring international level technology will improve competitiveness.

(b) Diversifying the products will evade fluctuations in the market.

(c) Doing business in the international market through a collaborator under technology collaboration will also reduce vulnerability to fluctuations.

(d) Business opportunities will be expanded by increasing the amount of joint efforts and by modernizing the factory.

(e) The status as manufacturing base in the international market will be assured by improved productivity and quality through modernization of the factory.

3. Approach

(a) Phase I

Step 1: An independent steel fabrication shop will be constructed, and high productivity and quality of welding jobs will be achieved.

Step 2: Modern large machine tools will be introduced in the machine shop, and high efficiency and quality of machining jobs will be realized.

The small machine tools will be repositioned with ancillary companies. Machine tools in the machine shop will be re-arranged and partial group technology will be introduced for productivity improvement.

The aged machine tools will be revamped to be converted to NC-machines.

(b) Phase 2

Step 3: Bending roller and press brake, etc., will be introduced in the steel fabrication shop, and the manufacture of cylindrical shaped products will be made possible to diversify the products.

Step 4: The steel fabrication shop will be expanded, and material stock, marketing and cutting jobs will become highly efficient.

A 100 Ton overhead crane will be installed to ease the handling of large pieces.

A new large machining/assembly shop will be constructed and large machine tools will be introduced to enable the manufacturing of large presses and machinery required in the international market. However, facilities will be limited to a minimum at this stage.

(c) Phase 3

Step 5: As an expansion after the year 2000, further large machine tools will be introduced in the new machine shop to increase machining capacity, and the arrangement will be set up to make possible the manufacturing of the first class presses required in the international market.

E. Marketing Plan

1. Product Mix and Sales Forecast

Table I-2-2 shows representative products only.

The amount of Joint work is not shown as it is uncertain at this stage of planning. HMT inter-Unit shift work and Joint work through JWA by aggressive sales activity will be extra.

The purpose of sub-contract work of welding and machining is to keep operations at a required level during the recession for major products. This target will vary according to the magnitude of the recession.

The amount of the New Products is an assumption of the target of diversification through collaboration. Aggressive sales activity will be required to hit the target.

2. Sales Prices

Current Prices in the year 1991 are shown in table I-2-2.

Typical prices are shown though prices vary in products of the same capacity due to differences in functions and construction.

3. Sales Organization, Sales Routine

(a) The sales department should reinforce the sale personnel to enable aggressive activity and locate them in major industrial areas in India.

(b) The engineering department should organize proposals for sales activity and do sales activity in participation with the sales department.

(c) In the background of sales activity of the collaborator in the international market, sales activity should be carried out to enable the under-

take manufacturing of equipment.

(d) As a manufacturing base, sales activity should be carried out to undertake manufacturing of equipment keeping contact with leading suppliers of heavy machinery in the international market.

(e) Attention should be paid to major projects in India. HMT should investigate the possibility of participation to undertake manufacturing of equipment as a part of sales activity.

(f) Approaching successful contractors of projects in India, HMT should do sales activity to obtain business as a sub-contractor to undertake manufacturing of equipment.

(g) Pamphlets showing manufacturing capacity of the factory should be prepared for advertizement to a trade association.

Table I-2-2 Product Mix and Sales Forecast

(Rs:Lks)

Product Mix	1992/93			1993/94			1994/95			1995/96			1996/97			1997/98			1998/99			1999/2000		
		Unit	Amount		Unit	Amount		Unit	Amount		Unit	Amount		Unit	Amount		Unit	Amount		Unit	Amount		Unit	Amount
Mechanical Press																								
1,000T	2	250	500	2	250	500	2	250	500	3	250	750	4	250	1,000	4	250	1,000	4	250	1,000	4	250	1,000
500T	7	70	490	7	70	490	7	70	490	7	70	490	7	70	490	8	70	560	10	70	700	10	70	700
300T	6	50	300	6	50	300	6	50	300	6	50	300	6	50	300	8	50	400	9	50	450	10	50	500
200T	10	30	300	10	30	300	10	30	300	10	30	300	10	30	300	11	30	330	13	30	390	15	30	450
Hydr. Press																								
1,000T	2	160	320	2	160	320	2	160	320	3	160	480	3	160	480	3	160	480	3	160	480	3	160	480
630T	4	70	280	4	70	280	4	70	280	4	70	280	4	70	280	5	70	350	5	70	350	5	70	350
250T	-	-	-	-	-	-	5	60	300	6	60	360	6	60	360	7	60	420	9	60	540	9	60	540
Special Press	-	-	-	-	-	-	-	-	-	-	-	-	3	100	300	5	100	500	5	100	500	5	100	500
Others																								
New Product	-	-	-	4	50	200	4	50	200	4	50	200	6	50	300	10	50	500	15	50	750	20	50	1,000
Steel Fabrication	-	-	-	-	-	100	-	-	100	-	-	100	-	-	200	-	-	300	-	-	300	-	-	580
	-	-	-	-	-	200	-	-	200	-	-	200	-	-	200	-	-	200	-	-	200	-	-	400
JOINT WORK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	31		2,190	35		2,690	40		2,990	43		3,460	49		4,210	61		5,040	73		5,660	81		6,500

F. Production Plan

1. Production Volume

Table I-2-3, 4 and 5 shows the production schedule in 1992/93, 1995/96, and 1999/2000.

2. Production Cycle Time

The average cycle time of each production process is as follows:

i) Design:	Standard:	3	months
	Non-Standard:	6	months
ii) Material Procurement:	Cast Steel:	3	months
	Forged Steel:	4	months
	Steel Plate (Ind.):	1	month
	Steel Plate (Import):	10	months
iii) Boughtouts:	Hydraulic Units (Import):	8	months
iv) Welding:		4	months
v) Machining:		4	months
vi) Assembly and Trial Test:		2	months

The average cycle time of the whole production process from designing to trial test is approximately 9 months for standard items and 15 months for non-standard ones.

Figure I-2-2 shows the cycle time for production of non-standard items.

Table I-2-3 Production Schedule (1992/93)

(Rs. Lks)

Product Mix	No. of Units	Material (Production Weight: Ton)							
		Steel Plate		Cast Steel	Forged Steel	Non-Fer.	Boughtout		Total
		Import	Indig.				Import	Indig.	
Mechanical Press									
1,000T	2	(160)	(89)	(30)	(34)	(2)	-	-	(315)
Material		40	16	7	25	4	59	33	184
Duty		26	-	-	-	-	34	-	60
Sub Total		66	16	7	25	4	93	33	244
500T	7	(327)	(249)	(62)	(15)	(5)	-	-	(658)
Material		83	44	15	30	12	35	37	256
Duty		53	-	-	-	-	20	-	74
Sub Total		136	44	15	30	12	55	37	330
300T	6	(159)	(87)	(47)	(28)	(3)	-	-	(324)
Material		40	15	9	11	8	24	48	155
Duty		26	-	-	-	-	14	-	40
Sub Total		66	15	9	11	8	38	48	194
200T	10	(144)	(57)	(78)	(17)	(3)	-	-	(299)
Material		36	10	8	25	7	13	39	138
Duty		23	-	-	-	-	8	-	31
Sub Total		59	10	8	25	7	21	39	169
Hydr. Press									
1,000T	2	(101)	(22)	(21)	-	-	-	-	(144)
Material		26	4	8	-	1	31	49	119
Duty		16	-	-	-	-	18	-	34
Sub Total		42	4	8	-	1	49	49	153
630T	4	(50)	(121)	(12)	(25)	-	-	-	(208)
Material		13	21	6	10	-	11	45	106
Duty		8	-	-	-	-	6	-	14
Sub Total		21	21	6	10	-	17	45	121
Grand Total	31	(941)	(625)	(250)	(119)	(13)	-	-	(1,948)
Material		238	110	53	101	31	173	251	958
Duty		152	-	-	-	-	101	-	253
Sub Total		390	110	53	101	31	274	251	1,211

Table I-2-4 Production Schedule (1995/96)

(Rs. Lks)

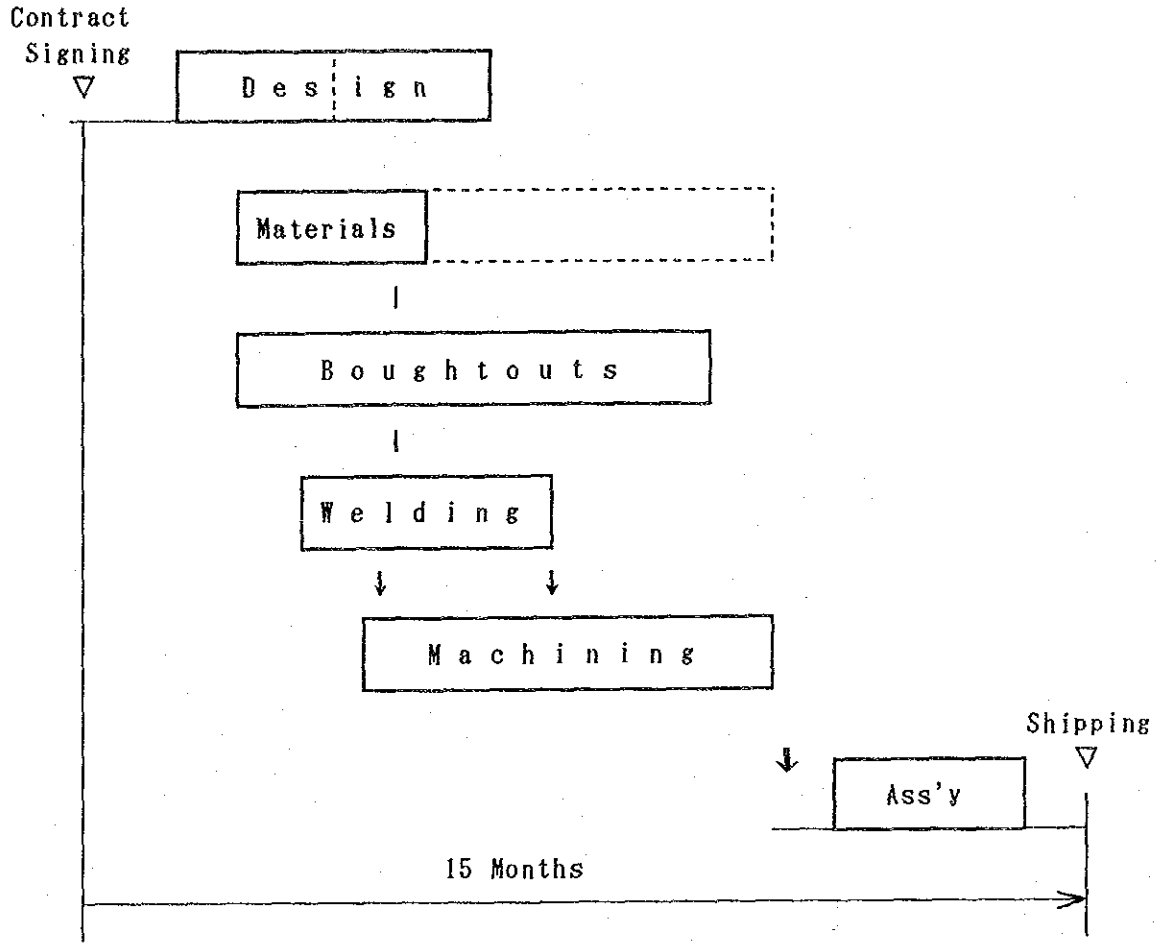
Product Mix	No. of Units	Material (Production Weight: Ton)							
		Steel Plate		Cast Steel	Forged Steel	Non-Fer.	Boughtout		Total
		Import	Indig.				Import	Indig.	
Mechanical Press 1,000T	3	(240)	(133)	(45)	(52)	(3)	-	-	(473)
Material		60	24	11	38	6	89	50	276
Duty		39	-	-	-	-	51	-	90
Sub Total		99	24	11	38	6	140	50	366
500T	7	(327)	(249)	(62)	(15)	(5)	-	-	(658)
Material		83	44	15	30	12	35	37	256
Duty		53	-	-	-	-	20	-	74
Sub Total		136	44	15	30	12	55	37	330
300T	6	(159)	(87)	(47)	(28)	(3)	-	-	(324)
Material		40	15	9	11	8	24	48	155
Duty		26	-	-	-	-	14	-	40
Sub Total		66	15	9	11	8	38	48	194
200T	10	(144)	(57)	(78)	(17)	(3)	-	-	(299)
Material		36	10	8	25	7	13	39	138
Duty		23	-	-	-	-	8	-	31
Sub Total		59	10	8	25	7	21	39	169
Hydr. Press 1,000T	3	(152)	(33)	(32)	-	-	-	-	(217)
Material		39	6	12	-	1	47	74	178
Duty		24	-	-	-	-	27	-	51
Sub Total		63	6	12	-	1	74	74	229
630T	4	(50)	(121)	(12)	(25)	-	-	-	(208)
Material		13	21	6	10	-	11	45	106
Duty		8	-	-	-	-	6	-	14
Sub Total		21	21	6	10	-	17	45	121
250T	6	(41)	(174)	(4)	(14)	-	-	-	(233)
Material		10	31	1	4	-	39	71	157
Duty		7	-	-	-	-	23	-	31
Sub Total		17	31	1	4	-	62	71	188
New Product	4	(106)	(58)	(31)	(19)	(2)	-	-	(216)
Material		18	7	4	5	4	11	21	69
Duty		12	-	-	-	-	6	-	18
Sub Total		30	7	4	5	4	17	21	87
Steel Fabrication	-	(50)	(70)	-	-	-	-	-	(120)
Material		13	12	-	-	-	-	-	25
Duty		8	-	-	-	-	-	-	8
Sub Total		21	12	-	-	-	-	-	33
Grand Total	43	(1,269)	(982)	(279)	(202)	(16)	-	-	(2,748)
Material		313	170	66	123	37	268	385	1,361
Duty		200	-	-	-	-	156	-	356
Sub Total.		513	170	66	123	37	424	385	1,716

Table I-2-5 Production Schedule (1999/2000)

(Rs. Lks)

Product Mix	No. of Units	Material (Production Weight: Ton)							
		Steel Plate		Cast Steel	Forged Steel	Non-Fer.	Boughtout		Total
		Import	Indig.				Import	Indig.	
Mechanical Press									
1,000T	4	320	178	60	68	4	-	-	630
Material		80	32	14	50	8	118	66	368
Duty		52	-	-	-	-	68	-	120
Sub Total		132	32	14	50	8	186	66	488
500T	10	467	356	89	21	7	-	-	940
Material		119	63	21	43	17	50	53	366
Duty		76	-	-	-	-	29	-	105
Sub Total		195	63	21	43	17	79	53	471
300T	10	265	145	78	47	5	-	-	540
Material		67	25	15	18	13	40	80	258
Duty		43	-	-	-	-	23	-	66
Sub Total		110	25	15	18	13	63	80	324
200T	15	216	86	117	26	5	-	-	450
Material		54	15	12	38	11	20	59	207
Duty		35	-	-	-	-	12	-	47
Sub Total		89	15	12	38	11	32	59	254
Hydr. Press									
1,000T	3	152	33	-	32	-	-	-	217
Material		39	6	12	-	1	47	74	178
Duty		24	-	-	-	-	27	-	51
Sub Total		63	6	12	-	1	74	74	229
630T	5	63	151	15	31	-	-	-	260
Material		16	26	8	13	-	14	56	133
Duty		10	-	-	-	-	8	-	18
Sub Total		26	26	8	13	-	22	56	151
250T	9	62	261	6	21	-	-	-	350
Material		15	47	2	6	-	59	107	236
Duty		11	-	-	-	-	35	-	46
Sub Total		26	47	2	6	-	94	107	282
Special Purpose Press	5	327	249	62	15	5	-	-	658
Material		83	44	15	30	12	35	37	256
Duty		53	-	-	-	-	20	-	73
Sub Total		136	44	15	30	12	55	37	329
New Product	20	318	174	94	56	6	-	-	648
Material		90	34	20	24	18	54	106	346
Duty		58	-	-	-	-	30	-	88
Sub Total		148	34	20	24	18	84	106	434
Steel Fabrication	-	290	406	-	-	-	-	-	696
Material		75	70	-	-	-	-	-	145
Duty		46	-	-	-	-	-	-	46
Sub Total		121	70	-	-	-	-	-	191
Grand Total	81	2,480	2,039	521	317	32	-	-	5,389
Material		639	361	119	222	79	436	637	2,493
Duty		408	-	-	-	-	252	-	600
Sub Total		1,047	361	119	222	79	688	637	3,153

Fig. I-2-2 Production Cycle of Non-Standard Products



G. Plant Rehabilitation and Technology Improvement

1. Plant Rehabilitation

(a) Plant Layout

The following plant layout drawings are attached to this report.

Drawing No.	Name of Drawing
F-001	FACTORY LAYOUT
F-001R	FACTORY LAYOUT (RENOVATION PLAN)
PL-012b	PLANT LAYOUT
PL-013	PLANT LAYOUT
PL-014	PLANT LAYOUT (PROPOSED)
PL-015	PLANT LAYOUT (PROPOSED)

(b) Civil & Building Construction

The cost breakdown of civil and building construction is as follows:

i) Phase 1

Step 1

Construction		Specification		Cost (Rs.Lks)
Steel Fabrication Shop (incl. Civil Work)	Bay 1	Width	21,000mm	162.0
		Length	150,000mm	
		Column Space	7,500mm	
		E.O.T.Crane	100Ton	
		Crane Hook	FL+8,000mm	
	Bay 2	Width	18,000mm	138.0
		Length	150,000mm	
		Column Space	7,500mm	
		E.O.T.Crane	50Ton	
		Crane Hook	FL+8,000mm	
Annealing Furnace Yard		Width	10,000mm	5.0
		Length	15,000mm	
		Height	10,000mm	
Shot Blasting Yard		Width	10,000mm	5.0
		Length	15,000mm	
		Height	10,000mm	

Construction	Specification		Cost (Rs.Lks)
Painting Yard	Width	10,000mm	3.0
	Length	10,000mm	
	Height	10,000mm	
Air Compressor Room	Width	15,000mm	5.0
	Length	10,000mm	
	Height	8,000mm	
Civil Construction	Earth Moving	5,850m^2	90.0
	Aux. Office	900m^2	32.0
	Pipework	-	10.0
	Road, Parking Area	-	50.0
	Equipment Foundation	-	16.0
Step 2			
Civil Construction	Equipment Foundation	-	10.0
ii) Phase 2			
Step 3			
Civil Construction	Equipment Foundation		3.0
Step 4			
Steel Fabrication Shop	Bay 3 Width	18,000mm	125.0
	Length	150,000mm	
	Column Space	7,500mm	
	E.O.T Crane	20Ton	
	Crane Hook	FL+8,000mm	
Machining Shop	Width	25,000mm	245.0
	Length	150,000mm	
	Column Space	10,000mm	
	E.O.T.Crane	150Ton	
	Crane Hook	FL+11,000mm	
Civil Construction	Equipment Foundation		8.0
	Road		6.0
	Aux. Office (2F-10x60m)		50.0
	Pipework		15.0
iii) Phase 3			
Step 5			
Civil Construction	Equipment Foundation		13.0

(c) Equipment

Cost of equipment at each investment step is as follows:

i) Phase I

Step 1

Equipment	Specification	Country of Origin	Cost (Rs.Lks)	Import Tax
E.O.T.Crane	35T/35T x 2	India	296.0	
	50T/10T x 1	India	50.0	
	25T/5T x 1	India	20.0	
JIB Crane	5T x 5m x 4	India	21.0	
	2T x 5m x 4	India	17.0	
Transfer Car	100T x 2	India	20.0	
Manipulator	20T x 2	Import	32.0	26.0
	15T x 2	Import	24.0	20.0
Cutting Machine	Comb. Gas/Plasma x1 4,00w x 20,000 Rail	Import	200.0	200.0
Portable Cutting Machine	Plate Thick x 4	Import	3.0	3.0
Drilling Machine	Stational x 1	India	6.0	
CO_2 Gas Welder	- x 15	India	20.0	
Welder Transformer	33KVA x 3	India	2.0	
Annealing Furnace	Electric x 1 6 x 6 x 10m	India	83.0	
Shot Blasting Machine	6 x 6 x 10m x 1	India	38.0	
Painting Equipment	x 1	India	10.0	
Fettling	x 6	India	1.0	
Welding Rod Dryer	- x 6	India	2.0	
Pre-Heating Torch	Gas x 6	India	1.0	
Potable Drilling Machine	x 4	Import	38.0	32.0
Air Compressors	$7kg/m^2 x 1,000Nm^3/Hr x 3$	India	15.0	
Hydraulic Press	500T x 1	India	42.0	
Inspection Equipment	X-Ray Inspection x1	Import	4.0	6.0
	r-Ray Inspection x1	Import	3.0	4.0
Power Supply	400KVA x 1	India	75.0	
Aux. Facilities	Office Equipment 1set	India	5.0	
Air Piping	Yard Piping 1 set	India	5.0	
	Step 1 Total		1,033.0	291.0
			1,324.0	

Step 2

Equipment	Specification	Country of Origin	Cost (Rs.Lks)	Import Tax
Machining Shop				
Planomiller	CNC-5 surface Machining 3,000Wx2,500Hx8,500x1	Import	450.0	380.0
Vertical Lathe	Max. Dia 3,200mm x 1 Work Height 1,600mm	India	152.0	
Teeth Hardening Machine	Electric 45KVA x 1 Work Dia. 3,000mm Module 30mm	Import	28.0	23.0
Layout Machine	Marking 3,000mm x 1	Import	27.0	23.0
Horizontal Boring Machine	Table Main spindle 116 x1 Table 1,200x1,200mm	India	38.0	
Power Supplies	1 set	India	25.0	
Horizontal Boring Machine				
(479-1)	Retrofit-NC	India	75.0	
(478-2)	Retrofit-NC	India	70.0	
(478-1)	Retrofit-NC	India	20.0	
Vertical Lathe (190-1)	Retrofit-NC	India	3.0	
Ancillary Parts	for Machine Tools x 1	Import	54.0	46.0
Inspection Equipment	for Machine Tools x 1	Import	27.0	23.0
Measuring Equipment	for Machine Tools	Import	14.0	11.0
	Step 2 Total		1,033.0	506.0
			1,539.0	

ii) Phase 2

Step 3

Steel Fabrication Shop				
Bending Roller	Max.plate thick 60mmx1 Max.plate width 2,500mm Bend Dia. (60m/m) 2,000mm	India	140.0	
Press Brake	Capacity 2,000Ton x 1 Machine Width 2,500mm	India	150.0	
Turning Roller	4 pair	India	60.0	
Machining Shop				
Vertical Boring Machine	Table 1,500x1,500mmx1 Spindle Dia. 90mm Vertical Travel 1,500mm	Import	180.0	153.0
	Step 3 Total		530.0	153.0
			683.0	

Step 4

Equipment	Specification	Country of Origin	Cost (Rs.Lks)	Import Tax
Steel Fabrication Shop				
E.O.T.Cranes	100T/25T x 1	India	205.0	
	20T/5T x 1	India	19.0	
	10T/5T x 1	India	14.0	
JIB Cranes	2Tx5m x 4	India	17.0	
Cutting Machine	Plasma x 1	Import	190.0	160.0
	2,500Wx20,000Rail			
Machining Shop				
Horizontal Boring Machine	CNC Floor type x 1	Import	1,450.0	1,235.0
	Main spindle 250 ϕ			
	Bed 5,000Wx12,000mm			
	Spindle Travel 1,750/1,500mm			
	Spindle Up/Down 5,000mm			
Drilling Machine	Portable	India	1	
E.O.T.Cranes	150T/30T x 1	India	276.0	
Power Supply	200KVA x 1	India	25.0	
	Step 4 Total		2,197.0	1,395.0
			3,592.0	

iii) Phase 3

Step 5

Machining Shop				
Horizontal Boring Machine	CNC-Floor type	Import	1,180.0	1,000.0
	Main spindle 180 ϕmmx1			
	Bed 4,000Wc9,000Lmm			
	Spindle Travel 1,400/1,200mm			
	Spindle Up/Down 4,500mm			
Planomiller	CNC-5 surface Machiningx1			
	3,500Wx2,500Hx12,000mm	Import	630.0	535.0
E.O.T.Cranes	75T/20T x 1	India	108.0	
	50T/10T x 1	India	65.0	
Wall Cranes	5T x 4	India	21.0	
	Step 5 Total		2,004.0	1,535.0
			3,539.0	

2. Technology Improvement

(a) Product Technology Improvement

Through long term technology collaboration, the introduction of new technology to the current products, diversification of press machinery and diversification of general industrial machinery should be achieved.

i) Introduction of new technology to the current products
- Double action Mechanical Press
- Transfer Press - Dual/Tri-axis
- Link Drive Press
- CNC-Control
- Die spotting/Tryout Press
- Press automation/Feeding
- Cushion Lock + Stroke adjustment
- Material Handling Equipment for Presses

ii) Diversification of Press Machinery
- Forging Press
- Small Ammunition Making Press
- Tube Extrusion Press
- High speed/Low tonnage Press with Feeding Equipment
- Presses for various types of bricks
- Punching Press
- U/O Press
- Tool Design

iii) Industrial Machinery
- Bending Roller
- Beam/Pipe Bender
- Shearing Machine
- Straightening Machine
- Auxiliary Equipment for rolling mill plant - Roller Table, Pusher/Puller, various steel Beds, Transfer Machine, etc.
- Large steel structures
- Fabricated round products - Reactor Vessels, Heat Exchanger, Pressure Vessel, etc.
- Transfer cards and Buggies, etc.

(b) Acquisition of Technology

i) Necessary Technology

Technology necessary for product improvement is broadly divided into three categories.

- New technology to the current products
- Diversification of Press Machinery
- Diversification of general industrial machinery

ii) Technology resource, Acquiring method

- Technology resource
  Selection of collaborater(s) from leading companies in developed countries, including Verson (U.S.A.) as last collaborater.
- Acquiring method
  Long term, more than 10 years, technology collaboration: Engineering support, Supply of drawings, Supply of Basic engineering, Market and Market development co-operation, Utilization of HMT as manufacturing base, Supply of technical information and resident engineer(s) are to be included in the Agreement.

iii) Cost of acquiring technology

Initial payment should be as low as possible and royalty would be 2 - 3 % of sales amount limited to own sales.

Cooperate sales and manufacturing sub-contract should be exempted from royalty payments.

(c) Production Technology Improvement

i) Design

- Micro-filming of drawings
- Dry-quick copying (expansion/reduction) machine to handle original size transparencies.
- Preparation of A-3 size reduced drawing books
- Introduction of high function Xerox machines and word processors

ii) Production Process

- Steel fabrication shop will be separated from the machine shop and will have the layout in which

high productive welding jobs are carried out.
- New high-tech NC machine tools will be introduced in the machine shop, and aged machine tools will be revamped to be converted to NC-machines.
- Group technology will be introduced in the gear manufacturing shop.

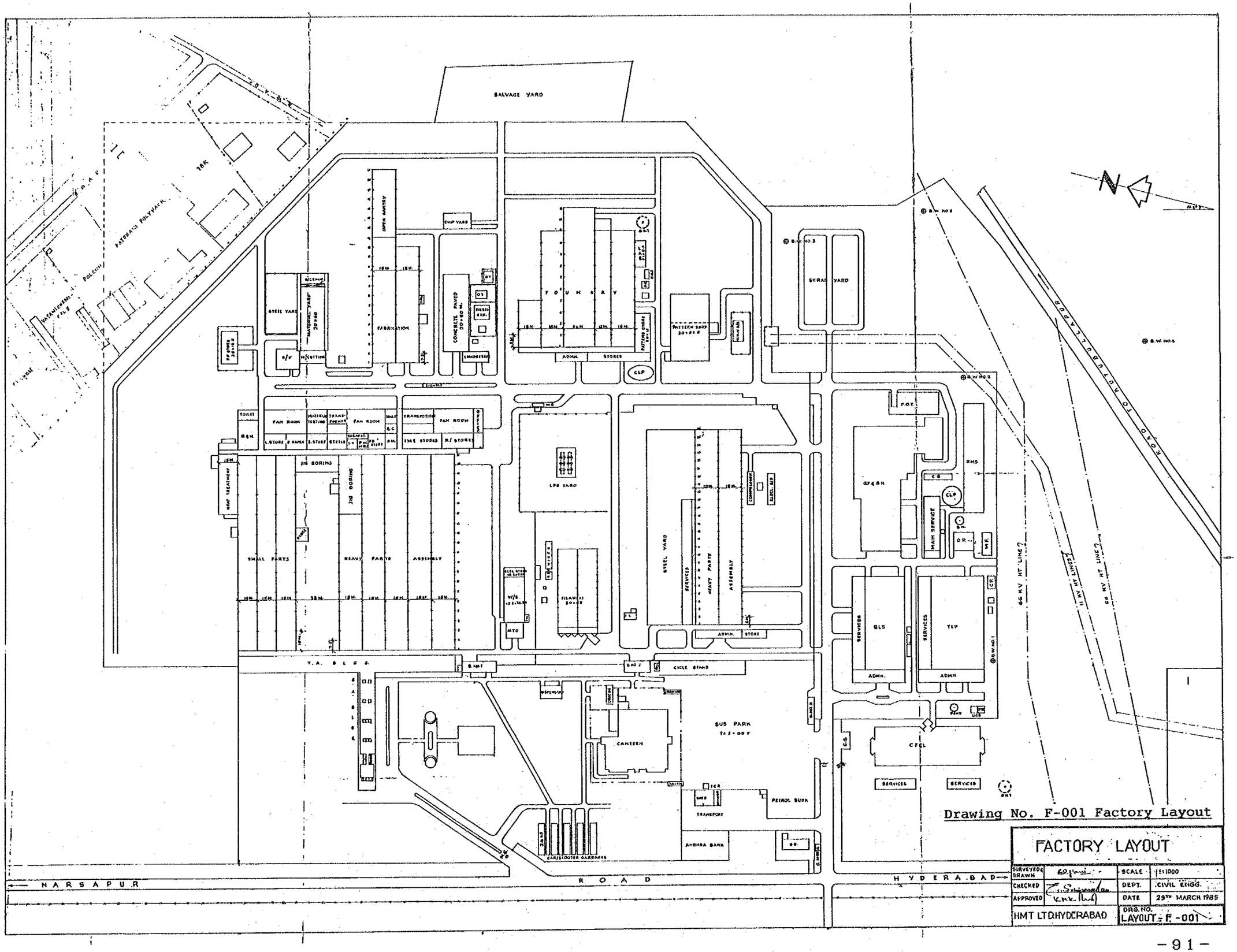
iii) Production Control

Control roles will be clarified and group assignment will be classified.

Production Planning & Control
Sub-Contracting (In/Out House)
Procurement (Materials, Boughtouts)
Material Control (Stock Control)
Product Control (Goods, Packing, Shipment)

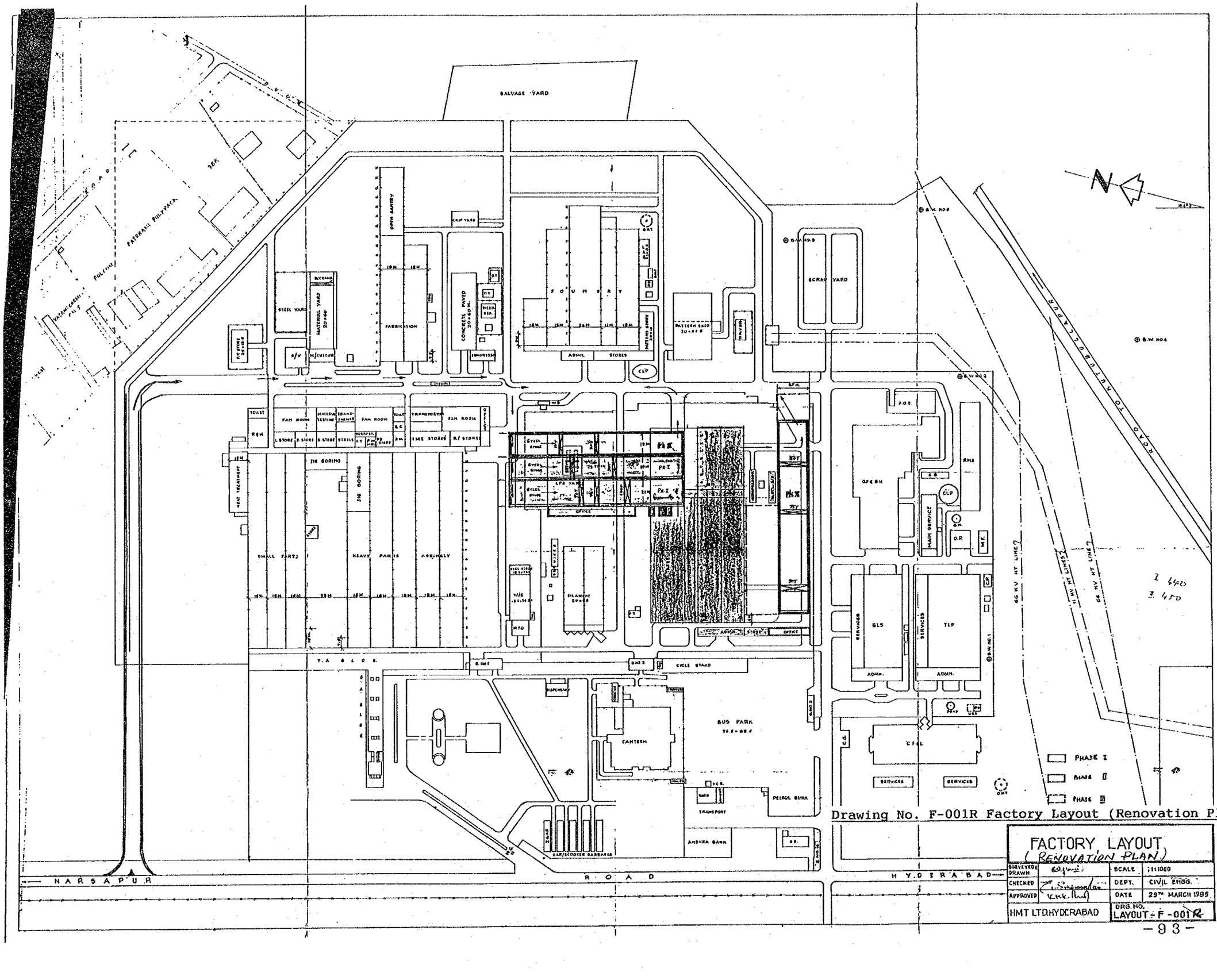
iv) Quality Control

- Quality control will be thoroughly achieved for in-house products, sub-contracted products and boughtouts, and will be stressed in approaches to outside suppliers.
- Leadership and management of Q/C circle activity.
- Management of analysis of defects and establishment of countermeasures to avoid repetitions.
- Collection of information of quality control through joint activity with public organizations, and training personnel concerned.
- DRB (Design Review Board) will be carried out to assure quality of products at the completion of basic engineering.



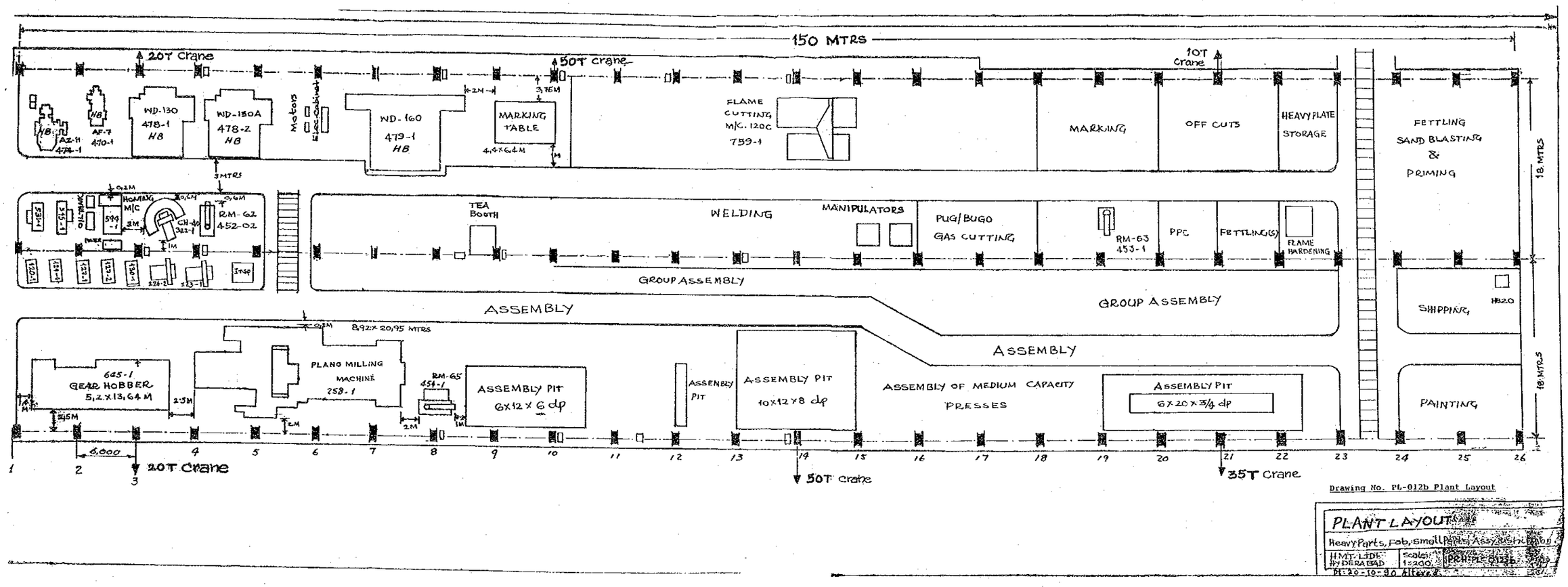
Drawing No. F-001 Factory Layout

FACTORY LAYOUT			
SURVEYED & DRAWN		SCALE	1:1000
CHECKED		DEPT.	CIVIL ENGG.
APPROVED		DATE	29TH MARCH 1985
HMT LTD.HYDERABAD		DRG.NO.	LAYOUT-F-001



Drawing No. F-001R Factory Layout (Renovation Plan)

FACTORY LAYOUT (RENOVATION PLAN)			
SURVEYED DRAWN		SCALE	1:1000
CHECKED		DEPT.	CIVIL ENGG.
APPROVED		DATE	29TH MARCH 1985
HMT LTD.HYDERABAD		DRG. NO.	LAYOUT - F - 001R



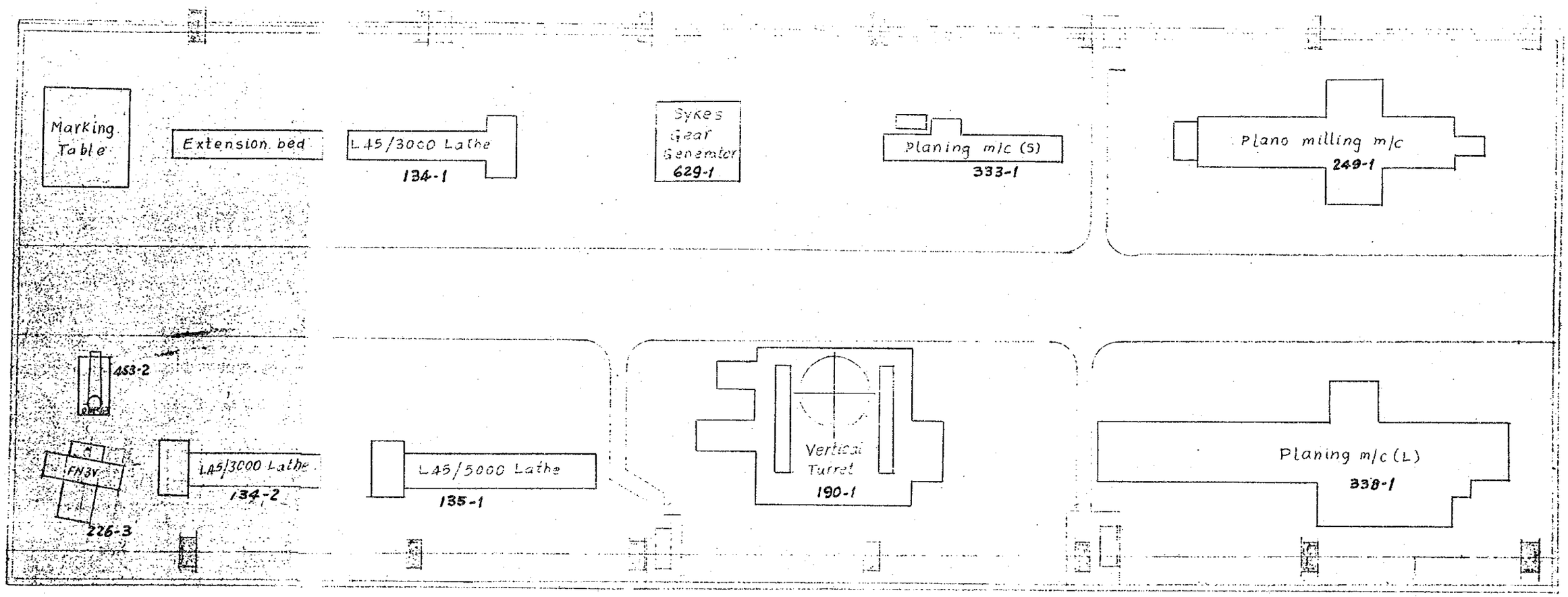
Drawing No. PL-012b Plant Layout

PLANT LAYOUT

Heavy Parts, Fab, Small Parts, Ass'y & Shipping

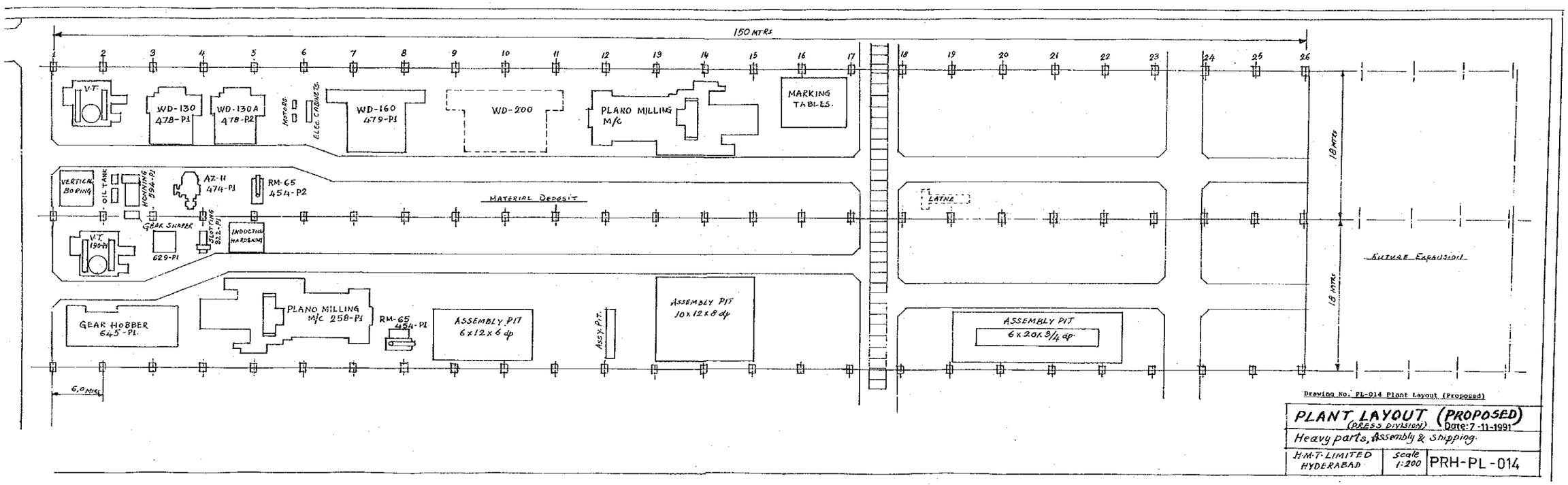
HMT LTD'S HYDERABAD	Scale: 1:200	PRN: PL-012b

PL-20-10-80 Altered



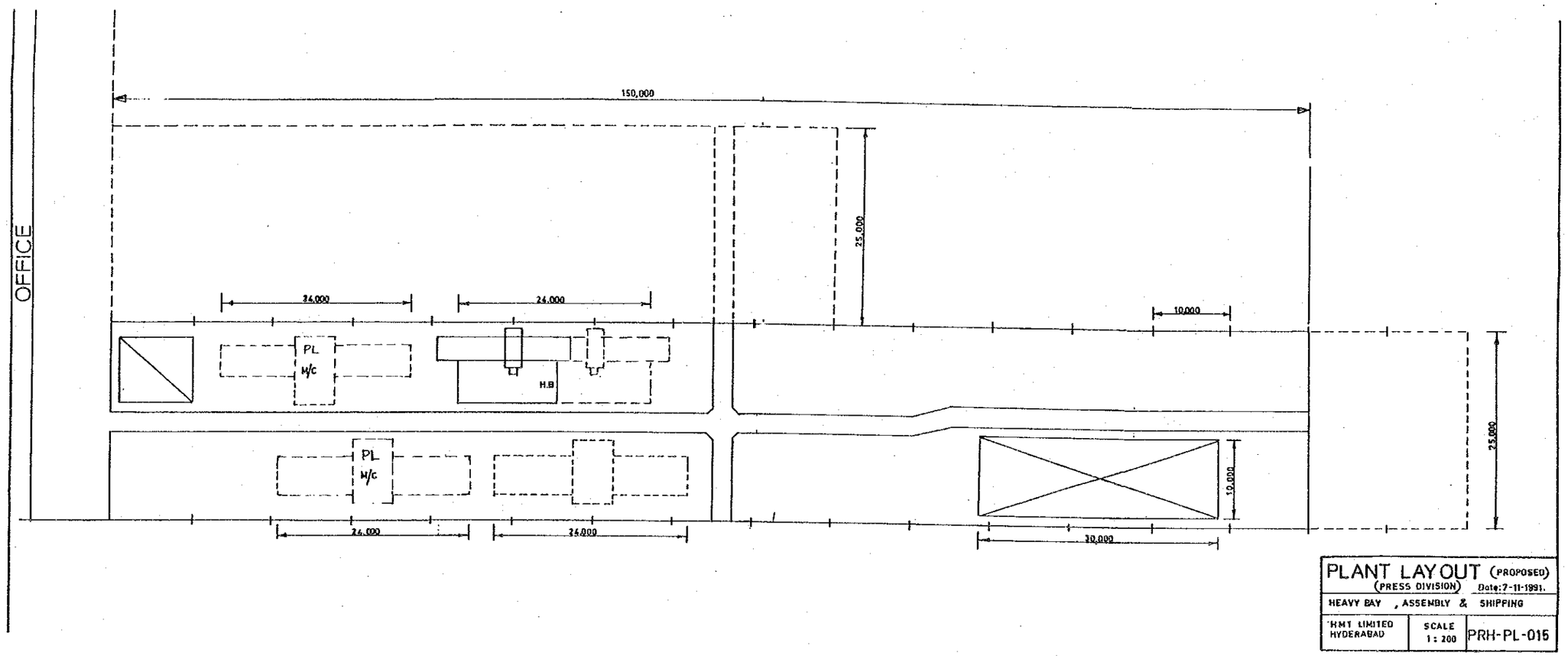
Drawing No. PL-013 Plant Layout

Plant Layout
Medium heavy parts
PRH-PL-013



Drawing No. PL-014 Plant Layout (Proposed)

PLANT LAYOUT (PROPOSED) (PRESS DIVISION) Date: 7-11-1991		
Heavy parts, Assembly & Shipping.		
H.M.T. LIMITED HYDERABAD	scale 1:200	PRH-PL-014



Drawing No. PL-015 Plant Layout (Proposed)

H. Unit Operation Improvement Plan

1. Management Information System (MIS)

MIS is not investigated for the Press Div., as it may not be effective due to the variety of orders of industrial machinery as well as Press Machinery.

2. Factory organization and Manpower Plan

The following tables shows the personnel plan and the manpower schedule of RPH.

Table I-2-6 Personnel Plan

(No. of persons)

Department	Personnel Plan		
	1991	1995	2000
GENERAL MANAGER	1	1	1
PERSONNEL	2	9	10
SALES MARKETING	4	15	20
FINANCE & ACCOUNTING	27	17	20
ADMINISTRATION	-	15	15
QUALITY ASSURANCE	1	5	5
MAINTENANCE	48	30	30
CONSTRUCTION & SERVICE	19	20	25
ENGINEERING	56	(86)	(95)
DESIGN	-	56	65
PROPOSAL	-	15	15
DEVELOPMENT	-	15	15
FACTORY GENERAL MANAGER	2	1	1
PRODUCTION CONTROL	32	30	29
QUALITY CONTROL	20	16	16
PRODUCTION TECHNOLOGY	25	15	15
MACHINE SHOP	(170)	(167)	(170)
PROCESS DESIGN		10	10
MACHINING CONTROL	50	14	15
ASSEMBLY CONTROL		16	20
ELECTRICALS, INSTR'MENT		14	15
SHOP WORKERS	120	113	110
STORAGE, MATERIAL HANDLING	46	36	40
FABRICATION SHOP	(40)	(82)	(99)
PRODUCTION CONTROL		4	10
MARKING, CUTTING	10	5	5
WELDING TECHNOLOGY		6	6
MATERIAL CONTROL		4	5
SHOP WORKERS	30	63	73
UTILITY CONTROL	-	5	5
T O T A L	493	550	596

Table I-2-7 Manpower Schedule and Costs

Description	1991/ 92	1992/ 93	1993/ 94	1994/ 95	1995/ 96	1996/ 97	1997/ 98	1998/ 99	1999/ 2000	2000/ 01	2001/ 02	Average Earnings per year
P S	219	219	258	256	276	281	286	291	296	296	296	82,400
WG	274	274	274	274	274	281	287	294	300	300	300	58,200
T O T A L	493	493	512	530	550	562	573	585	596	596	596	
* Earnings	Rs. Lakhs											
P S	181	181	196	211	227	232	236	240	244	244	244	
WG	159	159	159	159	159	164	167	171	175	175	175	
T O T A L	340	340	356	370	387	395	403	411	419	419	419	

Note: 1) Above costs do not include promotions and increases which amount to 8% (approx.)
2) Figures in the table are rounded.

I. Education and Training

Education and training at RPH will be focused on acquisition of basic operation skills of NC machines, corresponding to introduction of NC machines. The number of workers to receive the education and training would be as follows:

Table I-2-8 Education and Training

Job	Education and Training				
	1993/94	1994/95	1995/96	1996/97	1997/98
Welding	15	15	10	5	5
Machining	30	30	30	10	10
Assembly	10	10	10	10	10

I-3 Tractor Factory

A. General Description of the Tractor Division

1. Background

Tractor production was introduced at HMT in 1971, through a technical collaboration with Motokov, Czechoslovakia, as one of the steps toward diversification to expand beyond the machine tool production business.

Knock-down assembly with imported components started on the 25 HP range tractor; its domestic production scheme was completed in 1976/1977. Gradually enlarging the product range and the inhouse design, currently 4 types of tractors, 25, 35, 45 and 59 HP, are being produced and 75 HP range is now under testing. At the same time, other smaller and larger versions are being studied.

The annual turn over and profit are subsequently increasing. Today the tractor division is one of the most important core businesses in HMT.

2. Premises

The tractor factory was established in Pinjore, Haryana in northern India, surrounded by rich farm land. The higher utilization of tractors in that area means that it is a favorable location for tractor production. However, being far away from the south of the country, sales promotion in the southern region needs to be activated. To compensate for this situation, an assembly unit in Hyderabad in the mid-south region has been under construction, and is likely to be operative from April 1992 onwards.

There is an industrial area near the Pinjore factory, which is also convenient for subcontracted work. Pinjore HMT estate is located in the urban area, and the township complex is operated by HMT for their employees.

3. Building and Site

A vast land area is owned by HMT, a part of which is used for the factory and there are facilities like township for the employees, schools, hospitals, monasteries and other public service installations like post office, banks, transport etc.

The tractor division, adjacent to the machine tool factory, occupies about half of the factory area. There is an administration building and a technical administration building which are operated jointly with the machine tool division. In addition to the above, there is a tractor R&D center, and a spare parts storage building for the marketing department.

Details of the configuration are shown as follows.

i) Area

Total	3,400,000 m^2
Factory Space	290,000 m^2
Township	1,540,000 m^2
Future Expansion (including the machine tool operation)	1,570,000 m^2

ii) Building

Factory	39,800 m^2
R&D Center	3,270 m^2
Spare Part Building (tractor space only)	900 m^2

4. Product Line

The factory mainly produces tractors and diesel engines. Hydrodozers, front loaders and other industrial products besides tractors are also produced on a subcontract basis.
The production of diesel engines for various applications is carried out to help increase the diesel engine production volume.

Currently, 4 types of tractors, 25, 35, 45, and 59 HP, are produced and there are various other models in

addition to the standard types. Corresponding to the recent market demands for larger size tractors, a 75 HP range will enter into production in the near future.

Besides assembly of tractors and engines, principal inhouse activities cover production of castings, machining of critical parts, heat treatment, painting, testing and trials. A considerable number of forgings and castings, seatmetal work, crank shafts, hydraulic equipment and other boughtouts, depend on subcontractors.

5. Facilities and Equipment

Though well maintained, many of the facilities are superannuated; there is not much highly sophisticated and highly efficient equipment. The foundry capacity is exceptionally small, as compared with the current production volume thereby depending on subcontractors.

The shop has a wide variety of machine tools, lots of medium-size, and small size components are produced along with the continuous production of the important components.

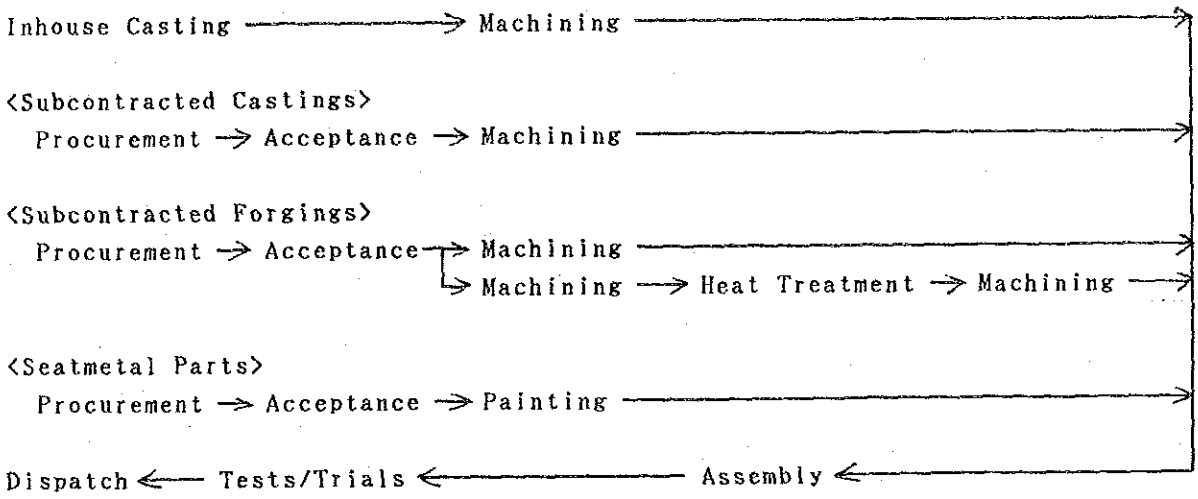
Almost all of the machines are conventional, mono-functional types with one man/one machine operation.

The principal manufacturing line is of simple SPM-configuration, and is inflexible to design changes. Thus, it becomes difficult to respond to immediate market trends.

The layout of the machine tools has many problems. The layout of the machine tools is mainly process based except for few product lines and component centers thereby making a considerable room for improvement in material handling.

6. Production Flow Concept

The diagrammatic concept of the production is indicated as follows.



B. Basic Concepts of the Action Program

1. Current Problems

HMT's tractor problems are summarized as follows.

(a) Despite the rapid growth in the Indian domestic market, HMT failed to keep up with the emerging trend, thus reducing its share of the market.

(b) The international tractor market is shrinking except in a few specific countries. Since HMT lacks experience in international competition, it would be difficult for them to be competitive in the future.

(c) Marketing efforts need to be strengthened.

(d) Product quality is still based upon the Zetor-original of 20 years ago. Also the design improvement has not kept up with current rapid international developments.

Frequent problems have been reported in areas such as gear box assembly, the hydraulic system. Hood construction also indicates weaknesses in the both design and production engineering capability of the vendors.

(e) There are problems like working environment which has a negative effect on quality. There are problems in cleanliness control, assembly line environment, and so on.

(f) Excessive inventory and manpower, manual transportation of the materials from stores to assembly lines add to the operating costs.

2. Purpose

The prime purpose of the action program is for HMT to rebound from its reduced market share of tractors through rehabilitation of outdated machinery and installation of new production facilities. The targeted market share will be 20% in the year 2000. In addition to the rehabilitation and the new investments, rein-

forcement of R&D activities, review of the present production system and increase of marketing infrastructure would constitute the integral parts of the program.

3. Approach

The integral master plan of the approach is described as follows.

(a) R&D

i) Increase R&D manpower.
ii) Reinforcement of testing and R&D facilities.
iii) Specialized training for R&D personnels to increase design capability.
iv) Extensive analysis of competitor's products.
v) Marketing research to determine business prospects other than tractors.

(b) Production

i) Facility renovation and augmentation to increase production capacity.
ii) Productivity improvement, quality management with a systematic approach.
iii) Cost reduction actions.

(c) Implementation Schedule

1991/1992 - 1992/1993	-	Planning of a new plant
	-	Planning of the rehabilitation of the existing plant
1993/1994 - 1996/1997		Investment (Step 1)
1997/1998 - 1999/2000		Investment (Step 2)

The additional investment (Step 2) shall be taken up, after the appraisal of the initial investment (Step 1) and sales performance, especially from the financial analysis viewpoint like profitability and return of investments.