One of the main dangers associated with the working environment is the method of storing inflammables. In some cases, large volumes of heavy oil, lubricating oil and machining oil are stored in one place or even near fires; and unclear standards regarding the handling of dangerous substances are responsible for this. It is also very noticeable that treatment facilities for waste oil and effluents of the plating shops containing chemicals for plating are not satisfactory with inadequate maintenance.

The painting shops are inadequately ventilated. In such places as foundries and forging shops where a lot of dust is generated, very few dust collecting devices are provided. Even when devices are provided, they are not functioning properly, causing problems of safety and health. In fact, some workers take time off work because of illnesses associated with the working environment, affecting the operation. The storage and control of toxic chemicals are also found to be inappropriate. Many plating tanks are corroded and the leakage pan capacity is generally small.

(2) Direction of Improvement Relating to Safety Control and Environment Control

Safety and health control should be implemented as part of the supervisors ordinary work under the guidance and control of the staff in charge of safety and health control and the managers of the shops.

It is recommended to organize the sections responsible for safety and health control at each level of the organization and prepare the standards for the safety and health control under assistance of outside experts, then conduct the diffusion of the standards to all employees so that they will personally recognize the importance of safety and health.

Chapter 4 Renovation Plan

4-1 Major Tasks of the Four Industrial Projects

There are several tasks which the Four Industrial Projects should achieve in order to cope with the social and economic conditions of Burma as discussed in Chapter 1 and more specifically to meet the market requirements for their products as analyzed in Chapter 2. At the same time, the Projects, as described in Chapter 3, face various technical difficulties or problems on which remedial measures or improvement are needed. This section summarizes these tasks and technical problems thus analyzed or identified.

1) The tasks which the social and economic conditions bring about are as follows:

1. Imports of raw materials and component parts have been restrained because of constrained foreign exchange. This causes difficulties for the continuation and expansion of production not only of HIC but of all sectors and results in the current stagnation of the economy. This requires measures which stimulate the economic activities. In this context it is vital not only to sustain the production of HIC at the present level and possibly realize expansion in future. The continuation and expansion of HIC's production would in turn gear the activities of agricultural, traffic and transportation, and social services sectors which could contribute to stabilization of rising consumer prices as well as economic growth.

2. However, with the present reliance on the imports of numerous component parts and raw materials, the continuation and expansion of the production are accompanied by an inevitable continuing and expanding outlay of foreign exchange. The efficient utilization of scarce materials, whether locally supplied or imported, could contribute to the savings of foreign exchange. To this end, it is necessary to take appropriate measures for increasing the effective use of resources which are squandered.

3. Another means of ensuring the efficient utilization of domestic human and material resources and conservation of foreign exchange

is to expand the domestic production of component parts to substitute for those presently supplied by imports, although not all domestic production of component parts realize this particular aim.

4. In Burma, as already pointed out, the development of principal industries has progressed to some extent, but without the harmonious development of the peripheral industries which could support the principal industries. This is a fundamental weakness of the Burmese industry. The development of the peripheral industries is an important task, since it leads to increases in domestic demands which in turn stimulate the expansion of industrial production. In the field of machinery and engineering industry, HIC's role should be to formulate nuclei which will eventually grow into the peripheral industries supporting the main industries in this field.

5. In order to encourage the improvement of the balance of payments, not only measures aimed simply at the saving of foreign exchange but also to the extent possible measures to assure the earning of foreign exchange must be undertaken.

2) The following measures should be taken to meet the domestic market requirements already analyzed in Chapter 2.

1. Primary importance is to establish a set of measures to ensure the continuation and expansion of production for the products presently manufactured by the Four Industrial Projects. As there is a chronic shortage of industrial products in the market, these tend to result in a rise in the consumer prices and so causes social uncertainties.

2. In addition, it is necessary to facilitate the production of spare parts which are to be supplied to outside users. There is a noticeable shortage not only of the spare parts for the vehicles, agricultural machinery, and electrical appliances supplied by HIC, but also of machine tools, jigs, and dies needed by other industrial entities. The demand for the latter is great.

3. There are some HIC's products which are at present competing with imports. It is necessary to consider model changes for these pro-

ducts as a strategic response. As HIC has been producing the products without model changes for a long time, most of the products are outmoded.

3) Summarized below are the main issues of technical difficulties or problems currently faced by HIC, as analyzed in Chapter 3, on which remedial measures are needed for improving the production of the Four Industrial Projects.

1. Scarcity of component parts and raw materials required is the primary obstacle for HIC to sustain a stable production. Measures for ensuring an adequate supply of required raw materials and component parts are absolutely essential.

2. A large number of the equipment installed in HIC's factories currently suffer from severe wear and tear, while some equipment of deteriorated precision are used. This causes losses in production and increases in rejects which result in a waste of scarce resources. In order to sustain the production with improvement of efficiency and product quality, the repair or replacement of those equipment is an urgent task.

3. The above conditions of equipment is attributable to the lack of spare parts and inadequate maintenance. Improvement of the maintenance system including the measure for securing the supply of required spare parts is essential.

4. There are a number of worn-out equipment which are used for the measurement of precision or inspection of quality of the manufactured component parts. It is necessary to repair or replace these equipment. Also the system for checking and calibrating accuracy of the measuring instruments is inadequate, so that instruments with deteriorated accuracy are left in use. The checking and calibration system for measuring instruments must be improved.

5. There have arisen bottlenecks in the common parts of the machining line by the insertion of machining for new parts on that line. Among those bottlenecks, there are some caused by excessive work loads or by inept operation. Improvement of these bottlenecks is needed.

6. There are some production lines which form disorderly flows, those duplicated with other lines, and those having idle equipment, of which rationalization is needed for improving productivity. There are also some equipment of which repair or replacement is needed in order to ensure the precision of machining and safety of operation.

7. HIC has used heavy oil as the energy source in the furnaces of their production processes. There is a shortage of heavy oil in recent years, to the extent that operation of the production facilities may be obstructed. Methanol and LPG are used in some furnaces, but methanol is insecure in its long range stability of supply, while LPG is a fairly costly energy. It is an urgent task to establish an energy source which promises economy and stable supply on a long range.

8. Although a considerable number of component parts have already been localized, there are still many items of raw materials and component parts of which domestic production can be considered for import substitution. Nevertheless, there are some items of component parts for which domestic production can not assure required quality and stable supply and are also subject to substantially increased production costs due to the small scale production. It is necessary to scrutinize the items for domestic production by taking these factors into consideration.

9. For some component parts, minor modifications could make localization feasible or enable to adopt simplified processes to reduce production costs. To this end, it is necessary for HIC to build up its capability of performing minor model changes and developing simple products so that HIC can undertake such minor model changes or product development to meet the versatile demand and also to respond to the procurement conditions of component parts.

10. There are many problems found with the quality control. Among the component parts manufactured at the HIC factories, there are some which would fall short of the designed durability although passing the present inspections. In some cases, off-grade parts have been used in the assembly of the finished products. Further, there are

other problems found with the progress control of production. In order to assure the efficiency of production and improvement of quality especially with a view to expanding the production for exports, it is necessary to correct the defects in the present system for production control.

11. With respect to personnel management, there are numerous points to be improved in order to enhance efficiency and discipline of the workers. However, in this regard it is important to examine as to what system is best suited under the Burmese conditions.

4-2 Targets of the Renovation Plan

(1) Contribution to Burmese Economic Activities

As already mentioned in Chapter 1, the production activities of HIC have contributed in a wide range of fields to the Burmese economy. Among these are the promotion of the expansion of transportation means and agriculture through the supply of vehicles and agricultural machinery. Besides these HIC supplies fluorescent lamps and electric fans which are essential for factories and offices to maintain their activities, while supplying incandescent lamps, watt-hour meters, dry cell batteries, engines, etc. which serve to improve living standards. In light of the importance of HIC's activities, the primary target to be pursued should be set on the continuation of HIC's production in order to ensure the supply of the products and the enhancement of the facilities and operation systems to respond to the increase in demands in the future.

Most of the industries in Burma suffer from a chronic lack of spare parts for repair and tools, hindering their production activities. Since HIC is the mainstay of the machinery industry in Burma, another task of HIC is to supply spare parts for repair and tools to other industries. On the other hand, it would be necessary to give consideration to avoid the monopolization by HIC of the supply of machinery and spare parts in order to leave some opportunities for the private sector to grow in the machinery and light engineering industry in the future.

From the above viewpoints, the renovation plan is investigated by paying special regards to the enhancement and expansion of the following areas:

1. Such sections as the modern casting facilities, large-scale pressing facilities, high quality machining facilities and other large-scale production lines which HIC should have to possess in order to function as the mainstay of the machinery industry in Burma and which the private sector may be unable to possess even in the future.

2. Given that the private sector may gradually undertake light engineering industry such as the manufacture of simple parts and the

repair of machinery, such areas as the manufacture of precision parts which require built-up high technology and which the private sector may be unable to undertake even in the future.

3. The manufacture of the products and parts which are required for the production activities of other industries or the improvement of living standards, but presently being in a short supply.

(2) Correction of the Essential External Dependence

Many of the raw materials and component parts required for the HIC's production are dependent on imports. The spare parts and tools also are situated in similar conditions. Hence, under the stringent foreign exchange situations, the industries currently face difficulties in sustaining their production activities particularly due to the curtailment of imports. Further, since spare parts for repair are not available, machines are used without adequate repairs and this in turn leads to the acceleration of wear on machines. In order to improve this state of affairs, the renovation plan will give attention to the following points which may facilitate the establishment of self-sustaining production.

1. Expand the local production of component parts and spare parts.

2. Establish the system which is capable of undertaking the repair and maintenance of machinery, equipment and facilities without reliance on outer supports.

3. Build up product development capability, so as to enable HIC to perform the design of products which can reduce the use of imported raw materials and component parts.

4. Endeavour for the development of human resources.

(3) Establishment of Production System Capable of Development

Since HIC was engaged in the production of products for the supply to the small-scale domestic market, the production had less competitiveness when compared to export-oriented industries established abroad. Hence, it was difficult for HIC to increase the production by the promotion of exports, even if the production facilities had

surplus capacity. Under this situation, as the production was performed in a volume fairly below the production capacity, the recovery of invested capital took a long period of time, preventing the replacement with new types of machines or new jigs, dies and molds. As a consequence, the models of the products produced were left out of date, limiting possibilities for exports. This resulted in a vicious circle. In the future, it is necessary for HIC to form the operational bases that enable the renewal of machinery, facilities and tools to meet the market needs in its own capacity and establish the production capability which can produce competitive products for exports. To this end it is important to take appropriate measures not only for the enhancement and expansion of the production facilities but also for the accumulation of appropriate technology and the establishment of production control system which enables efficient utilization of the facilities.

The present plan is to take measures to meet the above requirements for the establishment of the production system which is capable of development.

4-3 Framework for the Renovation Plan

4-3-1 General

In order to achieve the targets of the renovation plan as mentioned in the previous section, the plan places emphases on the following points:

1. Renovation and modernization of the production facilities.
2. Establishment of auxiliary sections which support the renovation and modernization of the facilities.
3. Enhancement and improvement of the systems for product development and production control for HIC's self-sustaining operation.

The primary activities for the renovation and modernization of the production facilities comprise the repair or replacement of worn-out machines and facilities to recover the capacity of the existing facilities, the improvement of bottlenecks in the facilities, and the rationalization of production lines for responding to the expansion of the production in the future. The next activities are to prepare the expansion of the production both in a variety of products and volume based on the thus enhanced production bases so as to satisfy the market needs. In this connection, the type and capacity of new machinery and equipment to be introduced in the plan are investigated by taking consideration not only the requirements for maintaining the present production but also the relationship with the machinery and equipment which may be additionally required in expanding the production in the future.

The existing machinery, equipment and facilities which have been thus renovated and modernized, together with the installation of new ones to some extent, may face difficulties in maintaining their performance capacities if inadequate measures are taken for maintenance. Hence, the establishment of adequate maintenance system is indispensable.

Some of the machinery and facilities may have certain excess capacity to cater to the increase in production in the future. In order to achieve the maximum utilization of their capacity, the establishment of the systems supporting efficient operation together with the acquirement of production technology are essential. Thus it is planned to establish the service sec-

tions which can well function to support the efficient operation of the main production lines.

In the meanwhile, as the basis for establishing the self-sustaining operation in future, it is planned to form the base for product development activities and also to introduce a presently applicable system for production control.

The framework of the renovation to be pursued on the specific subjects as stated above is described in more details in Sections 4-3-2 to 4-3-4.

4-3-2 Renovation and Modernization of Production Facilities

(1) Renovation of Existing Production Facilities and Enhancement of Production Bases for Future Development

1) Repair or Replacement of Worn-out Machinery and Facilities, and Improvement of Bottlenecks

As has been already discussed in Chapter 3, since most of the machinery and facilities have been constructed more than 20 years ago, there is a large number of machinery and equipment which are badly worn or deteriorated and which have reduced precision. Further, some manufacturing processes have bottlenecks in a certain part of the respective process, causing unbalance of the line and hindering the operation efficiency. Since spare parts are lacking for some equipment, these have been obtained by disassembly of other machines, and this has resulted in disturbances of the line system as a consequence. Further, in some manufacturing processes, because of changes in the plans for the supplementary equipment initially planned, the supplementary equipment has remained in an insufficient state or not been installed to date.

The renovation to be pursued under this subject aims at the enhancement of the existing production facilities through the repair or replacement of the existing machinery and facilities and the installation of additional machinery.

The wear and tear of machinery and equipment are attributable to the age and use of machinery and facilities for a long period of time.

However, in view of the actual quantity of products manufactured by these machinery and equipment, it appears that the wear and deterioration of the machinery and facilities are more serious than the usual conditions even considering the age of machinery and equipment used for a long period of time. It is attributable to the fact that inadequate measures have been taken for the maintenance. In order to prevent further deterioration and maintain the efficient production, it is planned to establish the maintenance system as described in the subsequent section.

2) Rationalization of Production Lines for Future Expansion of Production

There are some production lines in which the work efficiency has been depressed because of modifications occurring to the originally installed lines, and also some shops in which the layout of machines has been disturbed or spaces have been cramped because of the installation of additional machines. It is planned to make rearrangements of those lines for rationalization by taking consideration of the future production plan.

3) Measures for Ensuring Stable Supply of Economical Fuel

In each of the factories the various types of furnaces, such as the heat furnaces, melting furnaces, heat treatment furnaces, drying furnaces, etc. are used. The fuel for these furnaces is heavy oil, except No.2 HI in which natural gas is used. As the supply of heavy oil is currently in short, methanol is temporarily used as a substitute fuel for a number of the furnaces. However, since the methanol is produced for the use of blending with light fuel for three-wheel motor cars, the supply to factories will be stopped along with the increase of its demand for the blended fuel in the near future. Hence, it is required to take measures for securing a stable supply of the fuel. Therefore LPG, electricity, and natural gas are the possible substitutes. Each of these has its particular advantages and disadvantages but considering fuel cost, adaptation of furnace devices, fuel supply system, and reliability of future supply, the employment of natural gas seems most appropriate. It is planned to use natural gas as a substitute fuel.

4) Recovery of Waste Materials for Utilization

There are a large number of resources used by HIC which are not easily obtained in Burma and which are extremely important.

A large amount of iron and non-ferrous materials are employed as materials in the parts of the products manufactured at HIC. Scrap in the form of trimmings, cuttings and processed rejects occurs during the processing of the above parts and this is thrown away. The machining oil on the cuttings and trimmings is also left unrecovered.

Sea sand is used for the shell molds. Although the sea sand is costly because of a long distance transportation, it is thrown away after use, since there is no existing facilities for the reclamation of the used sand.

The present plan aims at the effective use of these materials thrown away through recovery and re-use.

(2) Realization of Production Facilities Capable of Responding to the Tasks Imposed on the Four Industrial Projects

1) Enhancement of Capabilities for Product Supply

The production plan projected for the renovation plan is shown in Tables 4.3-1 (1) to 4.3-1 (4).

1-1) Enhancement and Expansion of Production Facilities and System for Agricultural Machinery to Meet Expansion of Mechanized Agriculture

As has already been mentioned in Chapters 1 and 2, a vital condition for the expansion of agricultural production is the supply of the various types of agricultural machinery. However, as HIC produces only a few types of agricultural machinery in a comparatively small quantity, the production of HIC is not sufficient to meet the demand for most types of agricultural machinery. Further most of the machinery currently being produced follow the models originally introduced from Japan, which require modifications to adapt these to the farming practices of Burma. There are other types of the machinery which are not used yet but will be required for the expansion of agriculture in Burma in the future.

Table 4.3-1(1) PLANNED PRODUCTION OF AGRICULTURAL MACHINERY AND EQUIPMENT

Type of Product	Actual			Planned					
	1984	1985	1986	1988	1989	1990	1992	1995	1998
Pumping Set	4,200	4,627	4,920	5,475	5,530	5,920	7,340	9,520	9,670
4" Pump	3,700	4,000	4,260	4,500	4,500	4,500	4,500	4,500	4,500
4" Pump w M SC4C	0	1	10	250	250	350	500	850	1,000
4" Pump H H	500	625	600	600	600	700	900	1,000	1,000
4" Pump w M SV0-102	0	1	30	40	40	50	70	100	100
6" Pump	0	0	1	50	50	50	50	50	50
8" Pump	0	0	19	20	20	20	20	20	20
2" Self Priming	0	0	0	10	50	150	800	2,000	2,000
3" Self Priming	0	0	0	5	20	100	500	1,000	1,000
Light A M	551	357	845	1,000	1,000	1,100	1,200	1,350	3,000
P Tiller	393	190	270	500	500	550	600	600	0
P Thresher	108	117	505	500	500	550	600	750	1,000
Reaper	0	0	0	0	0	0	0	0	1,000
Power Tiller	0	0	0	0	0	0	0	0	1,000
Di Generating Set	234	170	331	300	300	350	450	600	600
2 KVA Generator	34	50	150	100	100	100	100	100	100
4 KVA Generator	200	120	181	200	200	250	350	500	500
Pesticide Eq	1,225	1,145	2,400	2,800	2,800	3,000	3,000	3,000	3,000
H P Sprayer	400	0	400	800	800	800	800	800	800
A K Sprayer	825	945	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Hand Push Duster	0	200	0	0	0	100	100	100	100
Power Mist	0	0	0	0	0	100	100	100	100
Implement	0	0	0	50	50	50	50	50	50
Rotary Device	0	0	0	50	50	50	50	50	50
Tools	549,180	534,235	499,642	621,000	621,000	630,000	654,000	684,000	685,000
Hand Tools	79,922	84,617	112,869	78,000	78,000	80,000	90,000	100,000	100,000
Mamooties	443,230	439,277	357,650	500,000	500,000	500,000	500,000	500,000	500,000
Shovel	10,355	6,064	20,383	20,000	20,000	25,000	35,000	50,000	50,000
Pick Axe	13,573	3,277	8,600	5,000	5,000	5,000	5,000	5,000	5,000
Axe	2,100	1,000	140	3,000	3,000	4,000	6,000	9,000	10,000
Cross Cut Saw	0	0	0	5,000	5,000	5,000	5,000	5,000	5,000
Hand Saw	0	0	0	10,000	10,000	11,000	13,000	15,000	15,000

Source: HIC

Table 4.3-1(2) PLANNED PRODUCTION OF VEHICLES AND PARTS

Type of Product	Actual			Planned					
	1984	1985	1986	1988	1989	1990	1992	1995	1998
Vehicles									
Light Vehicles	733	930	1,009	1,330	1,330	1,370	1,490	2,070	2,300
B-600 Pick Up	335	400	433	600	600	600	700	800	800
X-2000 C Country	200	233	236	430	430	450	450	700	800
T-2000 L Truck	198	297	340	300	300	300	300	500	600
Amb Car for H & C	0	0	0	0	0	20	40	70	100
Heavy Vehicles	775	1,040	912	930	980	1,275	1,310	2,050	2,200
6.5T Truck	615	755	552	670	670	915	930	940	950
5T 4WD Truck	0	47	52	50	50	50	50	50	50
3.5T Truck	91	164	219	100	150	150	150	150	150
25 Bus	69	74	75	60	60	100	100	100	100
33 Bus	0	0	14	50	50	60	80	110	150
FM Series Truck	0	0	0	0	0	0	0	300	300
H07 Engine	0	0	0	0	0	0	0	400	500
Engines	1,541	1,781	2,066	2,360	2,460	2,700	2,900	4,000	4,500
For HV	704	848	894	900	1,000	1,100	1,300	1,700	1,900
DS-70 Engine	704	848	894	900	1,000	1,100	1,200	1,300	1,400
Marine Appl. Engine	0	0	0	0	0	0	100	400	500
For LV	837	933	1,172	1,460	1,460	1,600	1,600	2,300	2,600
B-600 Engine	422	373	520	630	630	650	650	900	1,000
X-2000&T-2000 Engine	415	560	652	830	830	950	950	1,400	1,600
Parts									
Piston & P Ring/Pin	428,623	322,807	256,127	410,000	410,000	502,000	730,000	1,230,000	1,550,000
Piston	39,813	46,881	36,702	60,000	60,000	72,000	100,000	160,000	160,000
P Ring	388,810	275,926	219,425	350,000	350,000	420,000	600,000	1,000,000	1,300,000
Piston Pin	0	0	0	0	0	10,000	30,000	70,000	90,000
Cylinder liner	0	0	0	0	0	5,000	50,000	70,000	70,000
In & Ex Valve	0	0	0	0	0	0	0	20,000	100,000
Inlet Valve	0	0	0	0	0	0	0	10,000	50,000
Exhaust Valve	0	0	0	0	0	0	0	10,000	50,000
Rear Axle Shaft	0	0	0	0	0	0	0	3,000	9,000
Met & Oil Bearing	0	0	0	0	0	0	0	0	70,000
Metal Bearing	0	0	0	0	0	0	0	0	50,000
Oiless Bearing	0	0	0	0	0	0	0	0	20,000
Disc Wheel	0	0	0	0	0	0	0	15,000	25,000
Spring	0	0	0	110,000	110,000	120,000	145,000	194,000	200,000

Source: HIC

Table 4.3-1(3) PLANNED PRODUCTION OF ELECTRIC PRODUCTS

Type of Product	HI No.	Actual			Planned					
		1984	1985	1986	1988	1989	1990	1992	1995	1998
El Home Appliances *1		19,110	26,438	25,495	27,910	27,710	29,720	33,740	49,170	67,200
Air Conditioner	No.1	0	600	816	500	300	300	300	500	500
Refrigerator	No.1	200	200	327	200	200	300	300	500	500
Electric Iron	No.1	9,224	11,633	10,000	10,000	10,000	10,000	10,000	14,000	20,000
Electric Hot Plate	No.1	5,720	6,320	6,500	6,000	6,000	7,000	9,000	14,000	20,000
Rice Cooker	No.1	154	5,685	4,825	8,000	8,000	8,000	9,000	14,000	20,000
Electric Fan	No.3	3,812	2,000	3,027	3,100	3,100	4,000	5,000	6,000	6,000
Lighting Eq & Acc		5,181,766	5,163,104	4,606,246	4,623,200	4,642,200	5,469,000	5,840,000	7,541,500	10,133,000
Lamps		3,899,794	3,823,136	3,373,196	3,485,500	3,485,500	4,205,500	4,505,500	5,806,500	8,008,000
I Lamps	No.1	3,464,796	3,366,100	2,944,700	3,000,000	3,000,000	3,300,000	3,300,000	4,000,000	6,000,000
F Lamps	No.1	431,198	454,260	421,720	480,000	480,000	900,000	1,200,000	1,800,000	2,000,000
M Lamps	No.1	3,800	2,776	6,776	5,500	5,500	5,500	5,500	6,500	8,000
Fixtures		74,167	79,372	74,500	68,700	75,700	82,500	93,500	94,000	84,000
M Lamps Fix	No.1	1,278	822	1,700	1,700	1,700	2,500	3,500	4,000	4,000
L Lamps Fix		72,889	78,550	72,800	67,000	74,000	80,000	90,000	90,000	80,000
	No.1	33,889	44,950	39,795						
	No.3	39,000	33,600	33,005						
Ballast		76,649	91,528	73,200	80,000	80,000	86,000	96,000	96,000	96,000
Ballast	No.1	39,149	49,028	47,200						
M Lamps Bal	No.1	3,277	4,200	4,600						
F Lamps Bal	No.1	35,872	44,828	42,600						
Ballast	No.3	37,500	42,500	26,000						
Lamp Socket		160,800	175,700	135,500	138,000	150,000	165,000	185,000	185,000	185,000
	No.1	80,800	93,700	75,500						
	No.3	80,000	82,000	60,000						
Glow Starter Socket		82,300	74,700	76,000	75,000	75,000	90,000	100,000	100,000	100,000
	No.1	43,300	33,700	46,000						
	No.3	39,000	41,000	30,000						
S-Down Transfer	No.3	40,000	31,420	33,230	30,000	30,000	40,000	60,000	60,000	60,000
El Accessories	No.1	848,056	887,248	840,620	746,000	746,000	800,000	800,000	1,200,000	1,600,000

Table 4.3-1(4) PLANNED PRODUCTION OF ELECTRIC PRODUCTS

Type of Product	HI No.	Actual			Planned					
		1984	1985	1986	1988	1989	1990	1992	1995	1998
Radio & TV		1,897	4,100	2,314	8,000	8,000	9,000	11,000	15,000	15,000
Radio	No.1	760	451	28	5,000	5,000	5,000	7,000	10,000	10,000
C TV	No.1	1,137	3,649	2,286	3,000	3,000	4,000	4,000	5,000	5,000
Calculator	No.1	0	3,500	750	1,000	1,000	1,000	1,000	1,000	1,000
El Power Dist Eq		28,849	24,925	26,000	26,850	26,850	27,350	30,350	36,350	40,300
Power Dist Trans	No.5	60	193	340	350	350	350	350	350	300
Watt-Hour Meter	No.3	28,849	24,925	26,000	26,500	26,500	27,000	30,000	36,000	40,000
T Lamp & D Lamp		68,374	76,050	50,850	70,000	70,000	75,000	87,000	110,000	140,000
T Lamp	No.3	48,074	56,050	40,350	50,000	50,000	55,000	65,000	80,000	100,000
D Lamp	No.3	20,300	20,000	10,500	20,000	20,000	20,000	22,000	30,000	40,000
El Motor	No.3	1,074	750	1,475	1,250	1,350	1,600	2,500	4,000	5,000
Storage Battery	No.4	22,870	12,585	14,137	29,000	29,000	30,000	30,000	32,000	35,000
Dry Cell Battery		18,913,768	19,641,449	14,221,704	41,500,000	41,500,000	42,000,000	46,000,000	56,000,000	64,000,000
	No.1	13,832,964	13,449,504	12,199,646	20,750,000	20,750,000	21,000,000	23,000,000	28,000,000	32,000,000
	No.2	5,080,804	6,191,945	2,022,058	20,750,000	20,750,000	21,000,000	23,000,000	28,000,000	32,000,000

Note: *1 1988 through 1998: Including planned production of Water Cooler and Deep Freezer.
Source: HIC

It is planned to undertake the enhancement and expansion of production facilities and systems for agricultural machinery in the following directions, along with the promotion of the mechanization of agriculture now in progress chiefly through the efforts of the Agricultural Mechanization Department.

1. Enhance and expand the facilities in order to establish the capability of producing a wide variety of agricultural machinery required to promote mechanized agriculture.

2. Proceed with the testing and development research of agricultural machinery which is suited to the Burmese agriculture, in a view to building up HIC's capabilities of performing model changes and the development of new types of the machinery by themselves.

3. Expand the local production of component parts of the machinery which do not require model changes in the near future.

In line with the above, one of the important tasks is the development and model changes of agricultural machinery which meet the farming practices of Burma. To this end a prompt start of experiments and tests is required. Based on the result of these research and development, decision should be made on model changes and standardization of component parts, and after that the expansion of the local production of component parts should be undertaken on the basis of the thus changed models and standardized specifications and also at the time of renewing dies. As to the types of agricultural machinery for which the market demand is still unclear because of new introduction to Burma, a trial production based on the CKD should have to be initiated and when the market requirements become clear then activities for model change and local production should be undertaken.

The various plans involved under this subject are indicated in Table 4.3-2.

Table 4.3-2 RENOVATION PROJECTS FOR AGRICULTURAL MACHINERY AND EQUIPMENT PRODUCTION AND DEVELOPMENT

		1. Introduction of new AME 2. Securing supply capacity of AME to the agricultural sector	- Research & development of models suitable to Burmese agricultural practice through field application	- Increase in rate of parts production in Burma
- Improve/establishment of system		1. AME plants rehabilitation (#1-14) 2. Improvement of AME shop system (#1-15) 3. Reorganization of material handling ME for AME plants (#1-16)	- Establishment of product development system (#10-1)	- Establishment of product development system (#10-1)
1. As a part of AME production development	1. Diesel engine production 2. Spare parts production	<Completed> - Production of SP 1. Cylinder liner (#4-12) 2. Piston pin (#4-17)	<Completed>	- Production of disel engine CP (#4-24)
2. For development of small scale irrigation system	Water pumping set	<Completed>		
3. For mechanization of agriculture				
a) Field preparation	Power tiller	<Completed>	- Model change of power tiller (#9-4) 1. Simplification 2. Development of economical type	- Production of CP of power tiller (#4-23) - Production of power tiller blade (#4-25)
b) Transplanting	Transplanter	<Further study is needed on applicable model>		
c) Pesticide/insecticide control	Sprayer	<Completed>	<Further study is needed on requirement>	
d) Harvesting	Reaper	- Production of reaper (#9-99) 1. CKD	- Production of reaper (#9-99) 1. CKD	- Production of reaper (#9-99) 2. Production
e) Post-harvesting	Thresher	<Completed>	<Completed>	- Production of CP of thresher (#4-22)
4. For development of fish cultivation	High-head water pumping set	- Self priming pump production (#9-5)		

1-2) Expansion of Production of Vehicles and Spare Parts for Vehicles Responding to Expansion of Transportation Means

The most pressing obstacle to development of the transportation sector in Burma is the absolute insufficiency of transportation means. The main cause for this is the production of vehicles by HIC far smaller than the requirement and also the lack of spare parts for the vehicles which cause to leave many of vehicles out of services. Further, the models of vehicles presently being produced have been continued for a long period without model changes and thus require improvements in many aspects relating to use.

In order to cope with these situations, it is planned to undertake the following measures.

1. Aiming at the enhancement of facilities and systems for the production of the main models of vehicles such as the B-600 pick-up trucks and vans, X-2000 cross country, T-2000 light trucks, TE 6.5 ton truck series and BX 33-passenger buses so as to meet future demands, the following measures will be undertaken. (These measures should be undertaken in close conjunction with the plans for the expansion of the local production of component parts as described later.)

   a) Provision of Engine Production System

      - Provision for increases in production of the DS-70 Engine for TE and BX (#4-19)
      - Local production of the engine for T-2000 and increased production of the engine for X-2000 (#4-21)

   b) Provision of Bus Production System (#1-4)

   c) Provision of the Assembly Lines

      - No.1 HI: HV Assembly Shop (#1-5)
      - No.4 HI: . LV Assembly Shop (#1-8)
                 . LV Body Assembly Shop (#1-9)

d) Provision of Component Parts Processing Facilities

- No.1 HI: . Leaf Spring Shop (#1-6)
  . Press Shop No.2 (#4-1)
  . Machine and Heat Treatment Shop (#4-6)

- No.4 HI: . Light Alloy Foundry/Piston Manufacturing Shop (#4-5)
  . Machine Shop (#4-7)

e) Improvements of the Metal Processing Department

The plan comprises the improvements of the foundry shop, forging shop and press shop (#4-1, #4-2, #4-3, #4-4). Details are described later in the subject of the local production of metal parts.

2. Establishment of the supply system for spare parts is made to serve mainly the vehicles already supplied by HIC (#4-1 to #4-20). Details are described later in the subject of the local production of component parts for vehicles.

3. It is planned to proceed with testing and development research required for necessary improvements. The direction of the testing and development research should be as follows:

a) Put the emphasis on improvements in the existing model instead of introduction of new models in the case of products which already have a high proportion of locally produced parts (B-600 - #9-2).

b) Undertake the unification of the engines mounted as far as possible (X-2000, T-2000 - #9-1, Marine Engine - #9-3).

c) Arrange schedules to proceed with the experiment and development work so that model changes are undertaken at the time of changing the dies (2000 cc Engine - #9-1).

To this end it is planned to establish the system for the experiment and development of products. (#10-1)

1-3) Provision of the Production Facilities and Systems for Electric Products

With the exception of the part of the watt-hour meter, incandescent lamps, dry cell batteries, and electric accessories, electric products produced by HIC are used at factories and offices, and these products therefore are essential to production activities of industries. However, the production of HIC is insufficient to satisfy the demand. The present plan is for provision of production facilities and system for the production of electric products so that the production can meet the future increase in demands.

In general, it is judged that the production lines for electric products of HIC have surplus capability to some extent in view of the initial capacity at the time of installation. The production currently tending to be on the low side is due to other factors than the limit of the production capacities. The first step of the present plan is the removal of these factors and the increases of production by adopting two shift operation and other measures for maximum utilization of the existing lines. After that an expansion of the facilities will be undertaken in order to meet the increasing demands.

The number of product items is large for the electric accessories, lighting fixtures and motors. The production system can be strengthened by a concentration of those product items.

There are some products for which the production has been continued according to the old models unchanged since the time of initial production. Inconveniences have arisen in the usage of these. Model changes or partial changes of specifications are required. Nevertheless, this should be realized at the best time for replacing equipment and dies in order to minimize cost increases incurred in the changes of models or specifications. The products concerned are as follows:

1. Dry cell batteries: in order to match the specifications of those competing with the HIC product in the

market, change to a type which accords with international quality standards.

2. Fluorescent lamps: in order to meet with international standards, change the present 38 mm diameter lamps to 28 mm diameter lamps.

3. Watt-hour Meter: since the three-phase three-wire type allows illegal use of electricity, promote the development of a three-phase four wire-type which is suitable for domestic use.

1-4) Provision of the Production System for Producing Electric Products Required for the Improvement of Living Standards

For the following products manufactured by HIC and required for the improvements of living standards, it is planned to enhance the production facilities and systems so as to meet the increase in demands in the future.

1. Improvements of living standards due to the extension of electrification; incandescent lamps, fluorescent lamps, electric accessories, dry cell batteries, watt-hour meters.

2. Improvements in the living standards of rural or remote areas; portable diesel electric generators.

3. Provision of fire engines and ambulances; modification of TE (Fire Engine), modification of X-2000 (Ambulance).

Further, the provision of TV, radio and other electronic products is essential to improvements in the information and cultural aspects of the future. Nevertheless, as these are areas of extremely rapid technical advances, there is a danger that parts supply will rapidly become impossible, although the production of those products destined for a relatively small market like Burma is unadaptable to model changes. Therefore, it is advisable to manufacture these products based on the CKD or SKD, until the required production quantity becomes sufficiently large.

1-5) Provision for the Production Facilities and System for the Production of Spare Parts and Tools to be Supplied

In many of Burma's state corporations the scarcity of spare parts and tools is a grave problem. This results in not only a lowering of production activities but even total stoppage of operations. HIC has supplied spare parts and tools to some state corporations on an order basis. However, the present supply capacity is limited both in terms of production capacity and product items. It is planned to ameliorate the following points.

1. Strengthen the facilities for the production of the various spare parts and tools.

2. Develop the capability of designing of the various spare parts and tools.

This plan will be implemented together with the provision for the production facilities and systems for spare parts and tools to be used by HIC (Refer to the description of the projects in Category 3).

2) Strengthening of the Self-Sustaining Production

2-1) Renovation and Expansion of the Metal Processing Sections

a) Renovation and Expansion of Foundry Shop

The foundry produces cast products which are processed for component parts to be assembled into final products. Hence, the importance of the foundry is to supply the cast products in quality and quantity as required and at the right time. The current production has been achieved fairly below the production plan. Further, problems of both belated delivery and defective quality of the cast products have arisen. Hence, it is planned to improve the foundry.

Along with the increase in the production of the products in the future, the enhancement and expansion of the production facilities for cast products are essentially required. In general, the production of some products involves the imports of component

parts to a fairly large extent, and even if some of the parts are localized, most of the raw materials required for the local production of component parts are still dependent on imports. For the products of cast iron, however, most of the raw materials including pig iron are locally available and the production of cast products greatly contributes to the foreign exchange savings. The products of cast iron may have possibility of supply to other state corporations and also great possibility of exports.

As shown in Table 4.3-3 and Figure 4.3-1, the required production of cast iron products will increase from the present production plan of 3,600 tons per annum to about 7,800 tons per annum in 10 years.

In order to provide the system for production increase, it is planned to perform the renovation and expansion of the foundry as a comprehensive renovation plan covering all facilities of the foundry shop.

b) Renovation and Expansion of the Press Section

In order to respond to the increases in vehicle production and the local production of currently imported component parts, the plan aims at a substantial expansion of the existing press section.

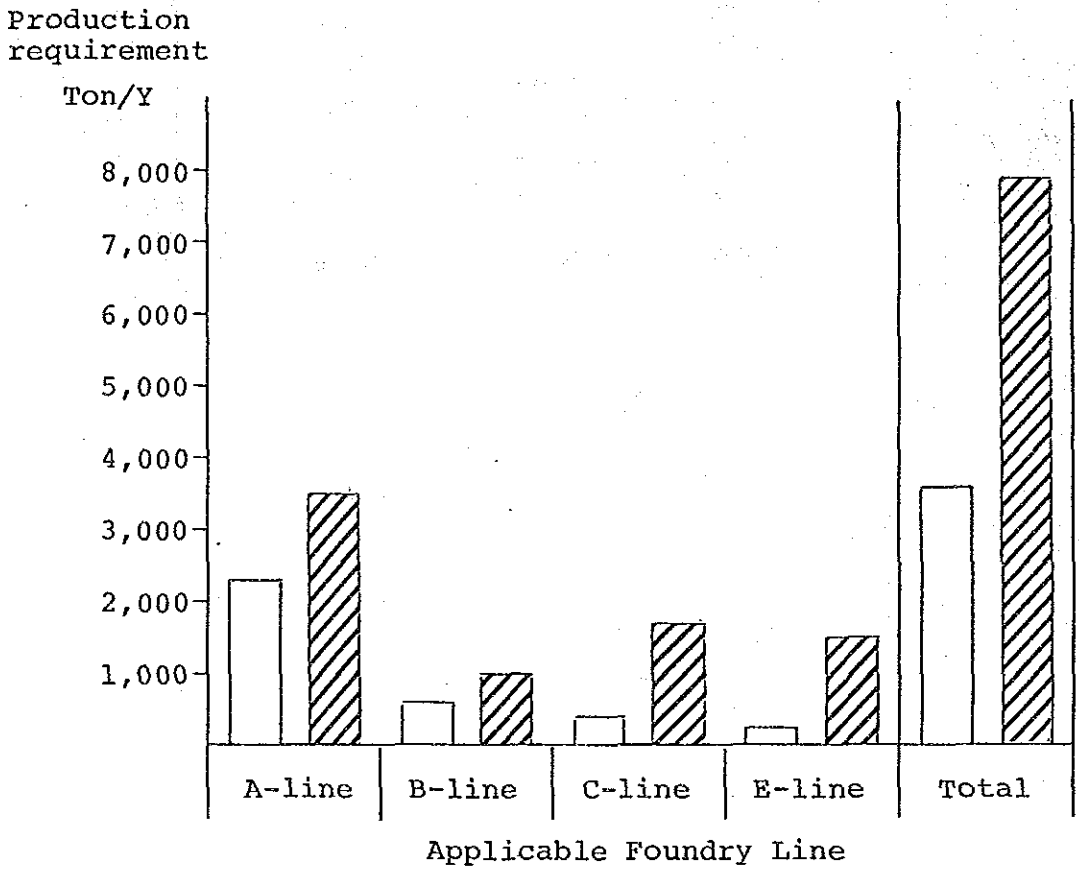
Machines of the Press Shop No.2 of No.1 HI which is the main press shop has been considerably worn out. The wear of the press machines causes the deterioration of mechanical performance, depressing the production capacity. This section is one of the main bottlenecks in vehicle manufacturing process. The present plan envisages the repair and replacement of deteriorated machines together with the introduction of die changer and trimming machines in order to solve the bottlenecks and ensure the full activation of the existing facilities.

However, for the local production of the thick plate parts and large panel parts such as the disk wheel, main frame, and rear axle housing, etc., the introduction of large-scale press machi-

Table 4.3-3 PRODUCTION REQUIREMENT OF CASTING MATERIALS

Description	Present Production (t/y)	Increase by 1998 (t/y)	Total Requirement in 1998 (t/y)	Applicable Foundry Line
Truck	786	700	1,486	A & B
Agricultural machinery	1,480	20	1,500	A & E
Light vehicle	590	1,180	1,770	C
Machine tool	250	200	450	A & B
General Eng. products	150	50	200	E
Export parts	300	2,000	2,300	A
Electric motor	44	40	84	A & E
Total	3,600	4,190	7,790	

Figure 4.3-1 PRODUCTION REQUIREMENT OF CASTING MATERIALS BY FOUNDRY LINE NO.3 HI



nes considerably surpassing in capacity the existing machines is required, so that the existing press shop cannot accommodate such large press machines. Therefore, it is necessary to construct a new press shop having production lines which perform the processing of the above-mentioned parts for completion. The machines of the new press shop would have a production capacity considerably exceeding that required for the production of vehicles to be supplied to the domestic market. However they would serve to strengthen the production capacity so as to cater to the supply of various spare parts for domestic use and vehicle parts for export.

c) Enhancement and Expansion of Forging Sections

The existing forging shop was designed originally for manufacturing forged products for the component parts of the light vehicles. At present, it also produces those for the component parts of the heavy vehicles and agricultural machinery. However, it does not have forging machines which are capable of manufacturing large-sized forged products.

The required production of forged products, as shown in Table 4.3-4, will increase to about 660 tons per annum in 1998, twofold against the present requirements, only for the increase in the production of the items of which the local production has already been undertaken. To realize this, the renovation of the existing facilities and the removing of bottlenecks are planned.

Further, a forging capacity of 1,030 tons per annum will be required for expanding the local production of component parts. Most of those component parts are comparatively larger sized ones, requiring large-scale forging machines. In this event, it is necessary to construct a new forging shop, because the present forging shop is too small to accommodate the new machines and also unable to provide the necessary extra space for expansion.

The new forging machines would be of excessive capacity if they are used only for the vehicle production. However, this planning is to permit the production of forged products to meet the demand

Table 4.3-4 PRODUCTION REQUIREMENT OF FORGED PARTS

Description		Present Production (t/y)	Increase by 1998 (t/y)	Total requirement in 1998 (t/y)
Present Products	Light Vehicle	75.72	140.85	216.56
	Heavy Vehicle	217.30	132.77	350.07
	Agri. M/E	75.37	18.86	94.23
	Sub-total (I)	368.39	292.47	660.86
Expected Products	Light Vehicle	-	175.00	175.00
	Heavy Vehicle		835.00	835.00
	Spare parts	-	20.00	20.00
	Sub-total (II)	-	1,030.00	1,030.00
	Total	368.39	1,322.47	1,690.86

Notes: Sub-total (I) can be handled by the existing forging facility, while sub-total (II) requires additional forging facilities.

of other state corporations and furthermore possible exports of the forged products in the future. The present plan does not take into account the production of the larger-sized forged products such as the crankshaft to be used for the engines of heavy vehicles, and component parts of tractors and rail buses because of much larger-scale forging machines being required.

2-2) Enhancement of Machining Sections Responding to Expansion of Local Production of Metal Parts

About 50% of the component parts which HIC annually imports are those for the heavy vehicles, including the parts for the engines. The local production of the component parts for the light vehicles is quite advanced, except T-2000 for which the local production of the component parts is still nil due to deficient capacity. Therefore, the percentage of the value of component parts imported for these vehicles accounts for about 70% of the total value of imports for HIC. The local production must be advanced in the interests of saving on foreign exchange.

The imports of metal parts account for a majority of the imports of component parts for vehicles. Hence, in order to expand the local production of the component parts for vehicles, the enhancement and expansion of the facilities are required for the metal processing sections as mentioned in the previous section, but also for the machining sections. Most of the items to be taken up for the local production require the setup of exclusive machining lines. Hence the local production of small quantity items would be costly and thus uneconomical.

Nevertheless, among the uneconomical items for the local production, there are some having possibilities of the supply to the domestic market for vehicle spare parts and also possibility of exports. For the future development, it would be worthwhile to undertake the local production of the component parts having such possibilities of increasing the production in the future, even if the production should have to pay some extent of cost penalty at the initial stage. In this context, the plan includes the enhancement of machining sections by taking into account the local production of some components selected from the above viewpoints.

2-3) Component Parts and Raw Materials Required Besides Metal Parts

There are several items other than metal parts of which the localization could be considered. Among these, however, some items might create constraints that affect the main production lines due to several causes despite the fact that the local production would probably ensure the use of domestic resources. The items to be localized must be selected with deliberate examinations. On the other hand, there are some items having potential of supplying to other consumers. The production plan gives priority to such items having high potential for future development. Nevertheless, even in this event consideration would be given to appropriate measures to be taken for protecting the stable operation of the main production lines.

The present conditions of main component parts and raw materials which may be the subject of localization are summalized below:

1. The bulbs for the incandescent lamps: This is already locally produced by the Ceramic Industry Corporation. However, the quality of the local-made bulbs is poor, causing a considerable number of rejects on the manufactured lamps. This leads to a loss of production efficiency. In order to improve the quality of the bulbs, it is important to provide technical assistance to the Ceramic Industry Corporation, although such assistance is excluded from the scope of the Renovation Plan.

2. Plastic parts: Molding using phenolic resins already takes place in the production processes for electric accessories. The present plan is to manufacture plastic parts for electric fans by molding. In future there is a possibility to extend the manufacture of plastic parts to be used for other products. The layout of the molding shop is investigated by taking such future development into consideration.

3. Manganese dioxide: This is a raw material for dry cell batteries. HIC intends to manufacture the manganese dioxide by using locally available manganeseores. However, no conclusion has been reached yet as to whether the local manganeseores are

definitely usable or not. Further tests and research are advised.

4. Rubber parts: HIC intends to manufacture rubber parts in a view to the utilization of locally available rubber. It is planned to manufacture rubber parts for vehicles, but there is a possibility to manufacture rubber parts to be used for other products. However, as the manufacture of some items require sophisticated technology and large investments, product items are selected for manufacturing.

4-3-3 Establishment of the Auxiliary Departments to Support the Renovated Facilities

(1) Establishment of Maintenance System

Even after the renovation of the existing facilities have been completed together with the installation of new machinery and equipment, another deterioration of the performance of machines may progress unless appropriate maintenance measures are taken.

Also, in order to promote exports of the HIC's products in future, the assurance of product quality, observance of delivery schedules, reduction of costs, etc. are essential, and to this end important measures should be to prevent the facilities from deterioration of machining efficiency and any stoppages of operation due to mechanical troubles. For these reasons the establishment of a maintenance system is essential for export promotion.

It is necessary to set up the maintenance system in line with the actual conditions of the production of HIC. Generally speaking the scale and range of the maintenance operations would be determined by taking into account the two factors; one is the costs incurred for the maintenance operations and the other is opportunity costs to be paid for the losses caused by the deterioration of the machinery and facilities and the stoppage of operation which may accrue if no maintenance measures is taken.

Nevertheless, the maintenance activities of HIC are inadequate and substantial improvement of the present maintenance system is

necessary. The initial step is planned to undertake the provision of the machinery and equipment urgently needed for the enhancement of maintenance system and also to commence necessary preparation for the establishment of preventive maintenance system. After that further expansion of the facilities and the system development is to be undertaken.

(2) Acquirement and Accumulation of Production and Engineerig Technology

The production facilities for heavy and light vehicles and agricultural machinery, after the renovation of the existing machinery and equipment supplemented with new ones as planned in the renovation plan, will have tje ɨrpdictopm capacities exceeding those required for the achievement of the planned production. In order to effectively utilize these facilities, the acquirement of appropriate technology is important. Further, the future thrust of HIC should be directed to the development of new products and the improvement of the present products together with commercialization to be performed by its own efforts and subsequently the expansion of production and sales to be strived through the production of those new or improved products for the domestic markets and exports. To this end it is important for HIC to acquire and accumulate engineering technology including the technology for the followings:

1. Designing of processes required for manufacturing new products.

2. Design of machine layout for new production facilities and modification of the layout adopted for the existing facilities.

3. Design and production of jigs and dies.

4. Modification of procured machines to meet particular operating conditions.

The above is only possible once the following technology has been acquired and accumulated:

1. Technology for the repair and improvement of jigs and dies.

2. Technology for drafting necessary drawings.

3. Expertise and know-how concerning the mechanism, quality and component parts of the products to be manufactured.

In view of the above requirement, it is planned that the primary acquirement and accumulation of technology be made at the maintenance shops, and after that the production engineering center be established to perform engineering required for the development and improvement of products and also for commercialization of the developed or modified products.

On the other hand, the establishment of a die manufacturing shop which can support the commercialization work at HIC's own efforts will be promoted. This shop undertakes the manufacturing of dies but also the repair of those which cannot be handled in the auxiliary machine shops.

(3) Enhancement of Calibration System for Measuring Equipment and Instruments

The HIC's quality inspections are inadequate because of the use of the measuring equipment and instruments of less accuracy. Many of these are used without any check on measurement accuracy and some of these are out of service due to wear. Therefore, it is urgent that checks and calibration of the measuring equipment, instruments and tools for inspection be carried out. Since the equipment for the check and calibration is not currently available at HIC, it is planned to install those equipment. At the same time, the system for a periodic check and calibration of the measuring equipment and instruments will be established so as to ensure that the measuring equipment, instruments, gauges and tools for inspection are kept at the required accuracy level at all times.

4-3-4 Preparations for Self-sustaining Operation in Future

(1) Establishment of Capability for Improvement and Development of Products

Specifications of the present products, for the most part, follow those originally introduced from Japan. Although the requirements of Burma were sufficiently considered at the time of introduction, there have been changes in the requirements since then so that some products cannot satisfy the market needs. Further, there are some products on which modifications may be effective for simplification of mechanical structure or utilization of domestic resources which result in cost reduction and foreign exchange savings. The steps for the improvement and development of products to be undertaken by HIC's own efforts should be firstly to get understanding of the characteristics of component parts through quality analysis of the materials of the component parts, and then proceed with trial manufacture of some component parts and with field tests of the machine assembled by the use of the above-mentioned component parts to check the performance of the machines. To this end it is planned to install the equipment to be used for various types of tests and also for trial manufacture of component parts. At the same time, it is proposed to establish an organization responsible to perform the planning and implementation of improvement and development of products in a systematic manner.

(2) Improvements and Modernization of Production Control

In order to enter the export market in future, it is necessary that efforts should be made to raise the competitiveness of the products of HIC in terms of quality and prices and also to establish other conditions which ensure reliable production. In order to realize these conditions it is planned to pursue the improvement and enhancement of production control placing emphasis on quality control, delivery control, and equipment maintenance. These measures are important for forming the basis for pursuing self-sustaining operation in the future. With future increases in the volume of required production production control will also be important as equipment capacity becomes strained. The present plan is to proceed with the improvement and enhancement of quality control, schedule and delivery control and

facility control as an urgent task. At the same time, the first step for the introduction of a comprehensive production control system in line with future needs is commenced.

4-4 Details of the Renovation Plan

Outline of the individual projects to be implemented for the renovation which have been investigated within the frameworks as stated in the previous section is summarized in the subsequent sections, details of which are described in ANNEX 3. The list of projects by category is shown in Tables 4.4-1 (1) to 4.4-1 (3).

4-4-1 Renovation and Modernization of Production Facilities

(1) Renovation of Existing Production Facilities and Enhancement of Production Bases for Future Development

1) Repair and Replacement of Worn-out Machinery, Equipment and Facilities and Improvement of Bottlenecks

The projects to be implemented for this objective are listed in Table 4.4-2.

2) Rationalization of Production Lines for Future Expansion of the Production

The projects to be implemented for this objective are listed in Table 4.4-3.

a) No.3 HI AME Project Plants (#1~14) (System improvement of AME shops)

The AME shops of the No.3 HI have been operated for a long period of time. During that time various changes have taken place, and space has been taken for production machines and for the repair work of jigs and dies. This has resulted in crowding of the space originally assigned to the production line. It is planned to make modifications of the layout as described below along with the provisions for the production system in consideration given to increases in production of the products and expansion of the local production of component parts.

The basic concept for the modifications of layout is as follows:

1. AME Shop No.2: Set up the specialized line for processing rough forged products and steel parts to manufacture the com-

Table 4.4-1 (1) PROJECT LIST OF RENOVATION PLAN OF THE FOUR INDUSTRIAL PROJECT

No.	Project	HI	Shop/plant
1. Repair/replacement of deteriorated M/E, debottlenecking, and line plan/layout improvement			
1- 1	Shop rehabilitation	No.2	Dry Cell Battery Shop
1- 2	Lighting fixture line rehabilitation	No.1	Coating Shop, etc.
1- 3	Lighting fixture line rehabilitation	No.3	Lighting Fixture Shop, etc.
1- 4	Improvement of shop/line system	No.1	Bus Assy Plant (Htauk Kyant)
1- 5	Rehabilitation of worn-out ME	No.1	HV Assy Shop
1- 6	Rehabilitation of worn-out ME	No.1	Leaf Spring Shop
1- 7	Matel handling equipment rehabilitation	No.1	HV project plants
1- 8	Rehabilitation of worn-out ME	No.4	LV Assy Shop
1- 9	Rehabilitation & shop improvement	No.4	LV Body Assy Shop
1-10	Improvement of shop system	No.4	Plating shop
1-11	Rehabilitation of worn-out ME	No.4	Compressor Room
1-12	Rehabilitation of worn-out ME	No.4	Chemical Analysis Room
1-13	Rehabilitation of worn-out ME	No.4	LV project plants
1-14	AME plants rehabilitation	No.3	AME project plants
1-15	Improvement of AME shop system	No.3	Plating Shop No.1, etc.
1-16	Reorganization of matal handling	No.3	AME Project Plants
1-17	Rehabilitation of worn-out ME	No.3	Chemical Analysis Room
1-18	Water intake/treat rehabilitation	No.3	Water Treatment Plant
1-19	Water intake/treat rehabilitation	No.4	Water Treatment Plant
1-20	Improvement of inter-HI transportation system		
2. Improvement of instrument calibration system			
2- 1	Establishment of calibration system	No.5	#Calibration center
3. Improvement and strengthening of maintenance system and supporting jigs/tools/dies production			
3- 1	Construction of auxiliary MC shop	No.1	#Auxiliary machine shop
3- 2	Gauge manufacturing	No.5	#Gauge mfg shop
3- 3	Die repair & making	No.5	#Die repair/making shop
3- 4	Cutting tool manufacturing	No.5	#Cutting tool mfg shop
3- 5	Establishment of production engineering system	No.5	#Production engineering center

Note: # -- Planned shop/plant

Table 4.4-1 (2) PROJECT LIST OF RENOVATION PLAN OF THE FOUR INDUSTRIAL PROJECTS

No.	Project	HI	Shop/plant
4. Buildup of metal processing capacity and changeover metal parts import to domestic production			
4- 1	Buildup of press capacity	No.1	Press Shop No.2
4- 2	Construction of new press shop	No.1	#Press shop
4- 3	Buildup of casting capacity	No.3	Foundry
4- 4	Buildup of forging capacity	No.3	Forging Shop
4- 5	Improvement of piston & ring line	No.4	Light alloy foundry, etc.
4- 6	Improvement of shop/line system	No.1	M/C & H/Tr shop
4- 7	Improvement of shop/line system	No.4	Machine Shop
4- 8	Improvement of shop/line system	No.4	H/Tr Shop
4- 9	Improvement of shop/line system	No.4	Diesel Engine Shop
4-10	Cylinder liner production	No.3	#foundry (Centrifugal), etc.
4-11	Bolt & nut production	No.1	Bolt & Nut Shop
4-12	U-bolt production	No.1	Leaf Spring Shop
4-13	Rear axle housing production	No.1	#Rear axle housing mfg shop
4-14	Radiator production	No.1	Press Shop No.2
4-15	Bevel gear production	No.1	M/C & H/Tr shop
4-16	Diff carrier production	No.1	M/C & H/Tr shop
4-17	Piston pin production	No.4	Machine shop, etc.
4-18	T2000 parts production	No.4	Machine Shop
4-19	DS parts production	No.4	Diesel Engine Shop
4-20	Exhaust & inlet valve production	No.3	#Exhaust & inlet valve line
4-21	Increase of 2000cc engine production	No.4	Machine Shop
4-22	Production of CP of thresher	No.3	Press & Welding Shop
4-23	Production of CP of power-tiller	No.3	Press & Welding Shop, etc.
4-24	Production of diesel engine CP	No.3	AME Component Shop No.1
4-25	Electrician tool production	No.3	Hand tool shops
4-26	Construction of alloy steel foundry	No.3	#Alloy steel foundry

Note: # -- Planned shop/plant

Table 4.4-1 (3) PROJECT LIST OF RENOVATION PLAN OF THE FOUR INDUSTRIAL PROJECTS

No.	Project	HI	Shop/plant
5. Changeover parts/materials import to domestic production			
5- 1	Rubber parts production	No.6	#Rubber parts production plant
5- 2	Plastic parts production	No.3	AME Component Shop No.1
5- 3	Enamel coated wire production	No.5	#Enamel coated wire shop
5- 4	Manganese dioxide production		
6. Conversion of furnace fuel to ensure the fuel supply			
6- 1	Conversion of furnace fuel		
7. Recycling and reclamation of wasted materials			
7- 1	Coated sand reclaiming/recycling	No.3	Foundry
7- 2	Cutting tips/oil recovery		
7- 3	Reclamation of aluminum chip	No.4	Piston Mfg Shop
8. Production increase to meet the market needs			
8- 1	Increase of F/L production	No.1	Lamp Manufacturing Plant
8- 2	Increase of I/L production	No.1	Lamp Manufacturing Plant
8- 3	Increase of dry cell production	No.1	Dry Battery Plant
8- 4	Increase of electric accessories production	No.1	Bakelite Molding Shop
8- 5	Increase of watt-hour meter production	No.3	Watt Hour Meter Shop
8- 6	Increase of electric motor production	No.3	AME Shop No.1
9. Model change and new product mix introduction to meet the market needs			
9- 1	2000cc engine model change	No.4	Machine Shop, etc.
9- 2	B600 pick-up model change	No.4	LV Assy Shop, etc.
9- 3	Conversion of DS for marine use	No.4	Diesel Engine Shop
9- 4	Model change of power tiller	No.3	AME project plants
9- 5	Self-priming pump production	No.3	AME project plants
9- 6	Low-tension panel production	No.1	
10.Establishment of production development system			
11.Establishment of production control system			

Note: # -- Planned shop/plant

Table 4.4-2 LIST OF PROJCTS FOR REPAIR/REPLACEMENT OF DETERIORATED M/E AND DEBOTTLENECKING

No.	Project	HI	Shop/plant	Description
1- 1	Shop rehabilitation	No.2	Dry Cell Battery Shop	
1- 2	Lighting fixture line rehabilitation	No.1	Coating Shop	Repl:Winding MC for light'g f
			Elec Home Appliances Plant	Repl:T/L & D/L Inspect'n table
			Press Shop No.1	Repl:Iron core blanking dies
			Bakelite Molding Shop	Repl:Dies for light'g f socket
1- 3	Lighting fixture line rehabilitation	No.3	Lighting Fixture Shop	1 Repl:Winding MC for light'g f
				2 Repl:Inspect'n tables L/F etc
				3 Repl:Dies for light'g f socket
		No.3	Plating Shop No.2	Repl:Apparatus for Ni plat'g
1- 5	Rehabilitation of worn-out ME	No.1	HV Assy Shop	1 Repr/Repl:Welder
				2 Repr/Repl:DME (Rear Body Shop)
				3 Repr/Repl:Measrg.Eq
				4 Repl:Paint drying
1- 6	Rehabilitation of worn-out ME	No.1	Leaf Spring Shop	
1- 8	Rehabilitation of worn-out ME	No.4	LV Assy Shop	
1- 9	Rehabilitation & shop improvement	No.4	LV Body Assy Shop	1 Repr/repl:Deteriorated M/E
				2 Supplement:work/measur'g tools
1-11	Rehabilitation of worn-out ME	No.4	Compressor Room	
1-12	Rehabilitation of worn-out ME	No.4	Chem Analysis Room	
1-14	AME plants rehabilitation	No.3	@AME project plants	
1-17	Rehabilitation of worn-out ME	No.3	Chem Analysis Room	Repl:Deteriorated M/E
4- 1	Buildup of press capacity	No.1	Press Shop No.2	Repr:Deteriorated M/E
4- 3	Buildup of casting capacity	No.3	Foundry	Repr/repl:Deteriorated ME
4- 4	Buildup of forging capacity	No.3	Forging Shop	Repr/repl:Deteriorated ME
4- 6	Improvement of shop/line system	No.1	M/C & H/Tr shop	Repr/repl:Deteriorated M/E
4- 7	Improvement of shop/line system	No.4	Machine Shop	Repr/repl:Deteriorated M/E
4- 8	Improvement of shop/line system	No.4	H/Tr Shop	Repr/repl:deteriorated M/E
4- 9	Improvement of shop/line system	No.4	Diesel Engine Shop	Repair:Induction hardening M/E
4-11	Bolt & nut production	No.1	Bolt & Nut Shop	Repr/Repl:Plating facil
4-24	Production of diesel engine CP	No.3	AME Component Shop No.1	Repl:DME & debottlenecking
8- 1	Increase of F/L production	No.1	Lamp Manufacturing Plant	RR:DME & Conversion of 38/28
				Repl:ME for quality control
8- 3	Increase of dry cell production	No.1	Dry Battery Plant	Repr:Deteriorated ME
8- 5	Increase of watt-hour meter production	No.3	Watt Hour Meter Shop	Repl:Deteriorated ME

Notes: 1.Repr--Repair 2.Repl--Replace 3.DME--Deteriorated machine and equipments

Table 4.4-3 LIST OF PROJECTS FOR DEBOTTLENECKING AND SHOP/LINE IMPROVEMENT

No.	Project	HI	Shop/plant	Description
1- 5	Rehabilitation of worn-out ME	No.1	HV Assy Shop	Debottlenecking
1- 7	Material handling equipment rehabilitation	No.1	@HV project plants	
1- 8	Rehabilitation of worn-out ME	No.4	LV Assy Shop	1 Debottlenecking
			LV Assy Shop (painting)	2 Introduce:Sedimentation tank
				3 Introduce:Paint spray'g device
1- 9	Rehabilitation & shop improvement	No.4	LV Body Assy Shop	Debottlenecking
1-10	Improvement of shop system	No.4	Plating shop	1 Introduce:Deironing device
				2 Introduce:Water supply system
				3 Introduce:Zinc plating facil
1-11	Rehabilitation of worn-out ME	No.4	Compressor Room	Introduce:Dehumidifica'n facil
1-13		No.4	@LV project plants	Repl:Transp & matl handling eq
1-14	AME plants rehabilitation	No.3	@AME project plants	1 Debottlenecking
				2 ME:Ensuring product quality
1-16	Reorganization of material handling	No.3	@AME project plants	Improve:Matl handl'g facil
4- 1	Buildup of press capacity	No.1	Press Shop No.2	Debottlenecking
4- 5	Improvement of piston & piston ring line	No.4	Light alloy foundry	
		No.4	Piston mfg. Shop	
4- 6	Improvement of shop/line system	No.1	M/C & H/Tr shop	Debottlenecking
4- 9	Improvement of shop/line system	No.4	Diesel Engine Shop	1 Debottlenecking:cyl block line
				2 Debottlenecking:Cyl head line
				3 Debottlenecking:Crk shaft line
				4 Debottlenecking:T/g case line
				5 Debottlenecking:Cam shaft line
4-11	Bolt & nut production	No.1	Bolt & Nut Shop	Debottlenecking
8- 1	Increase of F/L production	No.1	Lamp Manufacturing Plant	Introduce:ME for auxil mainten
				Introduce:ME for water treat't
8- 5	Increase of watt-hour meter production	No.3	Watt Hour Meter Shop	Add:Checking eq

ponent parts of the engines and pumps, and transfer the workshop located on the west side of the shop to set up a new workshop.

2. AME Shop No.3: Set up the specialized line for processing rough cast products to manufacture the component parts of the engines and pumps, and also processing case parts. Transfer the existing die repair shop to the new workshop.

3. AME Shop No.4: Set up the specialized processing line for the manufacture of the component parts for the transmission of the power tillers.

4. AME Shops No.2, 3 and 4: Set up the lines for processing small items in the respective shops.

Based on the above concept the following system is to be provided for the shops:

Press and Welding Shop

This shop is small and situated in unfavorable conditions for both productivity and safety. The extension of the existing shop building is planned particularly for the storage area for jigs and tools, for space required for undertaking the expanded local production of the threshers and for space required for the local production of the economic type of power tillers. Along with the extension of the shop building, the working place in the shop is divided into the following four sections:

1. Press section
2. Spot welding, and assembling
3. Welding section mainly for arc welding
4. Cutting and drilling section

AME Shop No.1

The yoke for the portable diesel power generators is a heavy item of large diameter pipe form. The present confusion of machining processes in the shop requires line planification of material flow in the shop putting emphasis on efficiency of material handling,

and forming process lines into a direct straight line type, using roller conveyors and palettes. The production system for motors is described later.

Plating Shop No.1

Space is extremely cramped in this shop. Deterioration of the plating equipment is severe and replacement of all the equipment necessary. The shop should be extended in order to install the new plating equipment.

AME Assembly Shop

The layout of this shop has to be entirely reconsidered so as to specialize the AME Assembly Shop No.1 for assembling the engines and pumps to set up straight-line type assembly conveyor lines including the painting and washing section in the line, while transferring the engine running test section to the indoor. The assembly lines for the sprayers, power tillers and threshers are set up in AME Assembly Shop No.2.

The following points are considered for the layout of the individual shops.

1. Most of the parts are completed through a few steps of machining. The layout of machining section is designed to form a flow-line.

2. In the future, U line is to be applied instead of a straight line of machining so that one operator can handle several steps of processing. This type of operation would contribute to the improvement of productivity and enable the efficient response to changes in production.

3. The lines for machining simple items which can be completed on one machine are separated from the above lines.

4. Movement of parts inside the shop is to take place with roller conveyor and other conveyance equipment or with push carts and only operators to handle these. This will also save operators from excess work.

5. Mode of storage of the jigs and dies in the work area is improved for orderly storage.

b) No.4 HI Machine Shop (#4-7)

This shop using the Job Shop method produces some 1,200 units of component parts for vehicles. Further, in the future it is to produce not only the component parts for the light vehicles but also for heavy vehicles and agricultural machinery. To this end it is necessary to establish the production systems that can assure efficient operation and quality of the parts manufactured. However, since the line planification for all the parts would involve a massive investment, this is not the best policy. The shop should be organized so as to make the most of the advantages of the job shop method in processing of the large number of small parts, while establishing specialized lines for efficient processing of the main parts.

The present machine shop is divided into seven sub-shops. The layout is designed so as to undertake a complete processing of the individual items of parts in each of the particular sub-shops, in which the improvements of line balancing are made to recover the initial installed capacity.

Then as the second step (#4-18), for the local production of the main parts including important functional parts, parts involving several processes and large-sized parts, the specialized lines for individually processing these parts are set up. To this end the extension of a shop building with an area of 2,000 square meters is to take place. Also, it is planned to extend a building of about 5,670 square meters on the north of the existing machine shop in order to respond to the local production of the engine for T-2000 and the increase of the production of the engine for X-2000 (#4-21).

c) No.3 HI Water Treatment Plant (#1-18)

The river water intake facilities installed for the intake of water from the Irrawaddy River, the water treatment facilities and connecting pipeline at No.3 HI have been corroded and deteriorated. Since almost no spare parts have been obtained, the facilities are operated in its worn state. The present plan is for the repair and replacement of these corroded or deteriorated equipment and pipes.

d) No.4 HI Water Treatment Plant (#1-19)

The river water intake facilities installed for the intake of water from the Irrawaddy River is unable to function when the water level is lowered during the dry season, adversely affecting the operation of the factory. Further the equipment of the water intake and water treatment facilities and the connecting piping have severe corrosion and deterioration. Since almost no spare parts have been obtained, the facilities are operated in its worn state. The present plan is for the repair and replacement of corroded or deteriorated equipment and pipes and also for an extension of the water piping to relocate the water intake point to the deeper place in the river.

e) Inter-HI Transportation System (#1-20)

Movements of raw materials, rough products and manufactured component parts between Rangoon and the respective factory use boats, trucks, and rail. The volume of the inter-factory movements recorded in 1981/82 is as follows:

Record of HIC's Inter-Factory Movements

Mode of Transportation	Movement Volume in 1981/82 (Tons)
1. Boats	
1) Boats chartered from IWTC and others (300 ton load)	16,600
2) HIC's own boats (100 ton load)	2,700
2. Trucks (5 ton load)	2,000
3. Railway (30 ton load)	6,000
Total	27,300

Seventy percent of the inter-factory movement is by boat, of which 85% depends on the boats chartered from Inland Water Transport Corporation (IWTC) and others and HIC's own boats handle only 15%. There are five boats owned by HIC; the 50 ton boat which is exclusively used for ferrying between Prome and Sinde, and the four 100 ton Z-craft boats used for conveyance between Rangoon and No.2, No.3 and No.4 HIs. The annual transportation capacity of HIC's boats is estimated to be 6,000 tons.

Assuming that the volume of inter-factory movements changes in proportion to the changes in production volume, the volume of inter-factory movements is predicted to be twice its present volume in 10 years.

It is uncertain to what extent the charter boats of IWTC and others can keep pace with the increased demand. Given that the charter boats can be made available to some extent, it is obvious that HIC should have to use its four Z-craft boats more than the present. In view of possible annual operation of these Z-craft boats considering the time

required for the repair and maintenance, it is desirable to have one more boat available. Therefore it is planned to have another 110 ton Z-craft for moving increased cargo from Rangoon to Malun, Sinde, and Htonbo in the Irrawaddy River in order to meet the increase of inter-factory movements volume.

There are several plans for enhancing the production facilities other than mentioned above. Outline of those is described later in the individual subjects of the renovation pertaining to the relevant shops or lines.

3) Measures for Ensuring Stable Supply of Economical Fuel (#6-1)

The furnaces which require the examination of fuel supply system are listed in Table 4.4-4. The existing natural gas distribution pipelines do not connect to the vicinity of the HIC's factories at present. However, the Myanma Oil Corporation has a plan to extend the gas pipeline to each of the factories by 1990. Assuming that this plan is implemented as per schedule, it is planned to use natural gas for fuel. The renovation plan includes the pipeline within the factory site and modification of furnaces to adapt to the natural gas.

As combustion devices based on heavy oil are not adaptable, the modification includes changes in combusion devices, auxiliary equipment and combustors of the furnaces for using gas.

4) Recovery of Waste Materials for Utilization

The areas for the recovery are shown in Table 4.4-5.

a) Re-use of the coated sand used for shell molding (#7-1)

The Foundry of No.3 HI consumes 1,000 tons per annum of sand for coated sand to be used for shell molding. As the coated sand requires round and fine particles of sand containing high quality silica, sea sand is used. The sea sand is transported to No.3 HI over long distance by boat and then washed with water, dried and graded for use. The sand is therefore extremely costly. The plan proposes to undertake the following measures:

1. Recover and re-use the coated sand currently discarded.

Table 4.4-4 LIST OF FURNACE FOR FUEL CONVERSION PROJECT (#6-1)

HI	Shop/plant
No.1	Leaf spring Shop
No.1	M/C & H/Tr Shop
No.3	Coated Sand yard
No.3	Combined H/Tr Shop
No.3	Forging Shop
No.3	Forging for hand tools
No.3	Forging for mamootie
No.3	Foundry
No.3	Sand Drying Shop
No.4	H/Tr Shop
No.4	Light alloy foundry
No.4	Machine Shop
No.4	Painting Shop

Table 4.4-5 LIST OF PROJECTS FOR RECLAIMING/RECYCLING PROJECTS

No.	Project	HI	Shop/plant
7- 1	Coated sand reclaiming/recycling	No.3	Foundry
7- 2	Cutting tips/oil recovery	No.1	
		No.3	
		No.4	
		No.5	
7- 3	Reclamation of aluminum tip	No.4	Piston Mfg Shop

2. By milling the coarse sand currently discarded in the course of the sieving process increase the yield of the sea sand to be used for the coated sand.

3. Reduce the occurrence of defective parts caused by the sand condition of the river sand used as raw material sand for the green sand mold and self hardening molding lines by means of the improvement of the inferior grain form of river sand which can be made by removing powdery sand and the iron content and also by shaping the sand particle round.

4. Proceed with research and tests to confirm as to whether the improved quality river sand can be used as coated sand. If this is possible the volume of sea sand employed could be reduced. This possible development is kept in mind for designing the equipment of the recovery system.

b) Recovery and Re-use of Machining Oil and Chips (#7-2)

In the machining shops each of the individual machine tools employs large amounts of machining oil. The machining oil is discarded together with the chips. In Burma the machining oil is imported. If recovery and re-use could be effected, this would contribute to the saving of foreign exchange. Further, effective use can be made of the chips as part of raw material after removal of the oil.

One unit of the recovery equipment is installed in No.1, No.3, No.4 and No.5 HI respectively.

Long chips produced from machining should be cut into smaller pieces using a chipper, and the machining oil on the chips separated using a centrifugal separator. After this step of separation, the iron powder and water contained in the oil should be separated out.

c) Recovery and Re-use of Aluminum Chips (#7-3)

At present there is no attempt at recovery or re-use of the aluminum chips which are produced in the piston manufacturing process. Recovery activities are limited to such items as riser, sprue, casting fin and residual molten metal.

The No.4 HI Piston Manufacturing Shop is the specialized processing shop for aluminum pistons. Since there is no danger of other materials getting mixed in with the aluminum this provides very favourable conditions for recovery.

The recoverable quantity is estimated at 60% of the chips produced during piston processing or on average 0.107 kg for one piston, the annual estimated recovery volume is as follows:

Estimated Recovery Volume
(Unit: tons)

	1990	1991	1992	1993	1994	1995	1996
Estimated Recovery Volume	4.5	8	9.2	11	13	15.5	17.2

Note: After 1996 amount remains same.

(2) Realization of Production Facilities Capable of Responding to the Tasks Imposed on the Four Industrial Projects

1) Enhancement of Capabilities for Product Supply

1-1) Enhancement and Expansion of Production Facilities and Systems for Agricultural Machinery to Meet Expansion of Mechanized Agriculture

a) Enhancement of Production Facilities for Threshers (#4-22)

Most of the component parts of the threshers which are not localized yet are large-sized pressed parts, requiring a large investment in acquiring necessary dies. In order to reduce this, it is necessary to change the design to a simple one. However, this will require time for necessary research and development. Therefore, the local production should first be undertaken for those parts which are not subject to design changes and require no substantial investments, and then when the modifications in design have been completed further changeover to the local production should be pursued.

The production of pressed parts requires blanking dies, but by introducing a NC punch press the cost of dies can be substantially

reduced. Further, since processing can be shared over a large range of similar parts the present plan includes the installation of a NC punch press.

b) Enhancement of Production Facilities of the Power Tillers

The power tillers manufactured at present employ the model introduced from Japan. The users of the power tillers have strong demand for the application of simplified model. Moreover, there is a need for expanding the local production of the component parts. In order to meet these requirements, the following steps of development are planned.

1. It is planned to proceed with a model change in two phases. The first phase will involve simplification of the rotary tiller parts. This model change can be relatively easily accomplished and a reduction in production costs anticipated. At the same time, one of the simplified models used in Thailand should be obtained to conduct field testings for checking its adaptability to Burma, and a model suited to Burma be developed using that as the base model.

2. The local production of the main handle cover which can be easily accomplished should first be undertaken. Next, the local production of the rotary tiller parts is to be undertaken for which the local production can be expected to have substantial effects. The local production of other comonent parts is to be undertaken at the time of commercial production of the above-mentioned simplified model of power tiller (#4-23).

c) Enhancement of Production Facilities of the Diesel Engine for Agricultural Machinery (#4-24)

1. The repair and replacement of worn-out machines, and the installation of additional boring machines so as to remove bottlenecks.

2. Expansion of the local production of component parts. As a first step the local production of the air cleaner and fuel tank which can be locally produced with a supply of dies is to

be undertaken. After this, the local production of the remaining parts is to be undertaken.

d) Enhancement of Production Facilities for Water Pumps (#9-5)

The water pumps manufactured by HIC are the priming type. The users desire self-priming type pumps, and there are enquiries for export of this type of pumps. Development for local production is already advanced through the copying of a sample of this type of pump and the design of 3" diameter self-priming type pump is nearly completed. It is planned to set up a specialized processing line for the self-priming pump at the place left vacant in the AME Shop of No.3 HI after the transfer of the die repair shop elsewhere.

1-2) Expansion of Production of Vehicles and Spare Parts for Vehicles Responding to Expansion of Transportation Means

a) Provision of Vehicle Production system

a-1) Provision of Engine Production System

Among the engines for heavy vehicles, the domestically produced engine is the DS-70 diesel engine which is mounted on the TE (6.5 ton truck) and the BX (bus). Other engines for heavy vehicles are still not locally produced but the requirements for those are small. For light vehicles the engines for the B-600 and X-2000 are already domestically produced but that for T-2000 is not locally produced yet. The present plan is for an increase in production of the DS-70 engine. Further, for light vehicles the T-2000 engine is to be locally produced and at the same time measures taken for increasing the production of the X-2000 engine.

a-1)-1 Provision for Increase in Production of the DS Engine (#4-9)

The present production line for the DS-70 diesel engine employs the flow-line production system, but this line comprises universal machines, as a majority, and also involves some machines shared for the processing of other component parts. This results in imbalances in processing time among the indi-

vidual machining processes, impairing the efficiency of overall production. The present plan aims at the removal of these hinderings causes through the repair, replacement and supplement of machines.

When these hindering causes are removed and if the operation is performed as per the work standard after the production control system is improved, this section would be capable of producing 1,200 units of the DS-70 diesel engines per annum. Therefore, the further increase in production of the DS Engine can be realized by applying a two-shift operation but without the installation of additional machines.

a-1)-2 Local Production of the Engine for T-2000, and Expansion of the Production of the Engine for X-2000 (#4-21)

There are a number of component parts for the engine for T-2000 in common with those for the engine for X-2000, but since the capacity of the No.4 HI Machine Shop is insufficient to produce the component parts for the engine for T-2000, at present these are relied on imports.

The present plan is for the reorganization and expansion of the machines for the local production of the component parts of the engine for T-2000 and for the increase of the production of component parts of the engine and transmission for the X-2000 and B-600. To this end the present plan is to extend an area of approximately 5,670 square meters in the present machine shop on the north side and to redesign the layout on a flow-line system for the production lines manufacturing the main component parts and for other parts on a job shop system. By these measures this section could be capable of producing component parts which meet the production of 1,000 units of the engine for T-2000 per annum.

Since there are a large number of the component parts which are used both for the emgome fpr T-2000 and the engine for X-2000, as mentioned earlier, these can be dealt with by an increase in the production capacity of the No.4 HI machine

Shop. Most of the machines are designed to be common machines processing the component parts for these two engines, but some machines are specialized for processing certain items of the component parts particular for the respective engine.

In these conditions the production schedules of 1,000 units per annum for the engine for B-600 and 1,600 units for the engine for X-2000 can be met by overtime or a two-shift operation.

a-2) Provision for Bus Production System (#1-4)

The assembly of buses is performed on the knock down method at the Htauk Kyant branch factory of No.1 HI. This branch factory has the building constructed with an excessively sufficient space, because HIC plans to use this factory as a complete bus production plant in future. However, since provision for equipment has not been undertaken, there are a number of problems not only with production efficiency but also with the product quality.

The aim of the present plan is the acquisition of jigs and dies and the expansion of the assembling capacity of the Htauk Kyant branch factory in order to meet the requirements for undertaking the local production of the component parts of the bus body which currently rely on imports. At the Htauk Kyant branch factory, it is planned to set up integrated production line for bus production, including the processing and welding of the pressed parts, painting equipment, and vehicle inspection equipment. The pressed parts to be used for the bus body is to be produced at the Press Shop No.2 of No.1 HI. Further, the production equipment for the upper parts of the dump car, wrecker, tanker, etc. which is located in the No.1 HI Heavy Vehicle Assembly Shop is to be transferred to the Htauk Kyant branch factory. The pressed parts to be used for the bus body is to be produced at the Press Shop No.2 of No.1 HI.

The past production and production plan for the future for buses are as follows:

VEHICLE TYPE	1986	1998
	(Unit:	Vehicle)
33-passenger Bus (BX)	14*	150
25-Passenger Bus (BM)	75*	100*

Note: These figures with (*) mark are for the knockdown assembly only. When the new press shop (#4-2) is constructed, the local production of component parts will be undertaken also for the BM 25-passenger bus.

a-3) Provision for Vehicle Assembly Facilities

a-3)-1 No.1 HI HV Assembly Shop (#1-5)

The present plan aims at the improvement of the following problems:

1. Welding machines and vehicle testing equipment installed in that shop is beyond repair because of severe deterioration.

2. There are balancing problems in the frame assembly line which result in production bottlenecks.

3. The space is cramped by disorderly layout of some machines. (The space for handling the semi-processed parts and also the additional space required for the expansion of the local production of component parts are to be secured.)

a-3)-2 No.4 HI LV Asembly Shop (#1-8)

This shop is for the assembly and painting of the B-600, X-2000 and T-2000. This section suffers from the problems of the deterioration of machinery and equipment, scarcity and deterioration of tools and testing equipment, bottlenecks in the processes, and deterioration of painting equipment, and

these problems are adversely affecting the production and product quality. The present plan is to undertake the amelioration of these problems to improve the production efficiency and product quality.

a-3)-3 No.4 HI LV Body Assembly Shop (#1-9)

Deteriorated machines are left to the side unused in this shop. Moreover due to additions of machines for the assembly of the Path Finder which is a locally modified model of the X-2000, complications in all assembly processes and in material handling have led to a reduction in the performance of machines. In the future, with the increase in the production of the component parts for B-600 and X-2000 and the undertaking of the production of component parts for T-2000, more problems may be induced. It is planned to undertake the following provisions and improvements in order to respond to the above problems.

1. Transfer the B-600 and X-2000 frame assembly areas to the north side of the shop and reorganize the assembly equipment on a flow-line.

2. Make use of the currently idle Gantry for minibus use, in order to increase productivity.

3. Provide jigs for body assembly and welding machines for the Path Finder and T-2000 in order to increase the productivity of the assembly of the Path Finder and also to facilitate the local production of the T-2000.

The past production and the production plan for the future for these vehicles are as follows:

Model of Vehicle	1986	1998
	(Unit: Vehicle)	
B-600	433	800
X-2000	236	900
T-2000	340*	600

Note:

* Knockdown production. Local production of T-2000 is based on the implementation of the projects for local production specified as Category 4 (#4-18, etc.)

b) Improvement of Metal Processing Sections

The production scale of Burma for vehicles is comparatively small. Hence the local production of the component parts which require specialized processing lines for the most part is not economical because of a heavy cost burden to be assumed by one unit of the parts. Nevertheless, if there are any possibilities other than economic factors, such as (i) forming the ground of technology and facilities which serve the future development of metal and machinery industry in Burma and (ii) establishing the bases for promoting the exports of various component parts of vehicles to the South-East Asian countries or other Asian countries, such items are considered for the local production even though the production of these items may be less economical. The plan for the casting, forging and press sections includes such types of projects.

b-1) Specific projects for the enhancement of casting sections

The plan for strengthening the foundry consists of the followings:

1. Enhancement of the No.3 HI Foundry
2. Improvement of No.4 HI Light Alloy Foundry
3. Introduction of a new casting system for manufacturing the cylinder liner
4. Installation of an alloy steel foundry

Of these the enhancement of the No.3 HI Foundry will be the most important project in order to form the basis for expanding the

local production of component parts and also for promoting exports in future.

b-1)-1 Enhancement of the No.3 HI Foundry (#4-3)

The typical items of cast products to be produced by the respective casting lines of the No.3 HI Foundry are summarized below:

Line	Characteristics of Line	Items of Products (Including Local Production in Future)
"A"	Mass Production of Small- and Medium-sized Castings by Green Sand Molding	1) Parts for Heavy Vehicle 2) Parts for Agricultural Machinery 3) Small-sized Parts for Machine Tools 4) Castings for Exports 5) Local Production Items; e.g. - Differential case - Exhaust manifold - Electric generator parts
"B"	Production of Small Quantity by Self Hardening Mold	1) Parts for Heavy Vehicle (engine block) 2) Parts for Machine Tool 3) Parts for Motors 4) General Castings 5) Local Production Items; e.g. - Differential carrier

"C"	Precision Castings by Shell Molding	1) Parts for Heavy Vehicle 2) Parts for Agricultural Machinery 3) Local Production Items; e.g. - Exhaust manifold - Crank shaft - Differential case 4) Parts for Small Agricultural Machinery 5) Parts for Pumps
"E"	Mass Producted Small-Castings by Green Sand Molding and Large-Sized Castings by CO_2 Sand Molding	1) Parts for Motors 2) Parts for Large Machine Tools 3) Local Production Items; e.g. - Water pump (for vehicle) - Pulley (for vehicle) - Small motor case

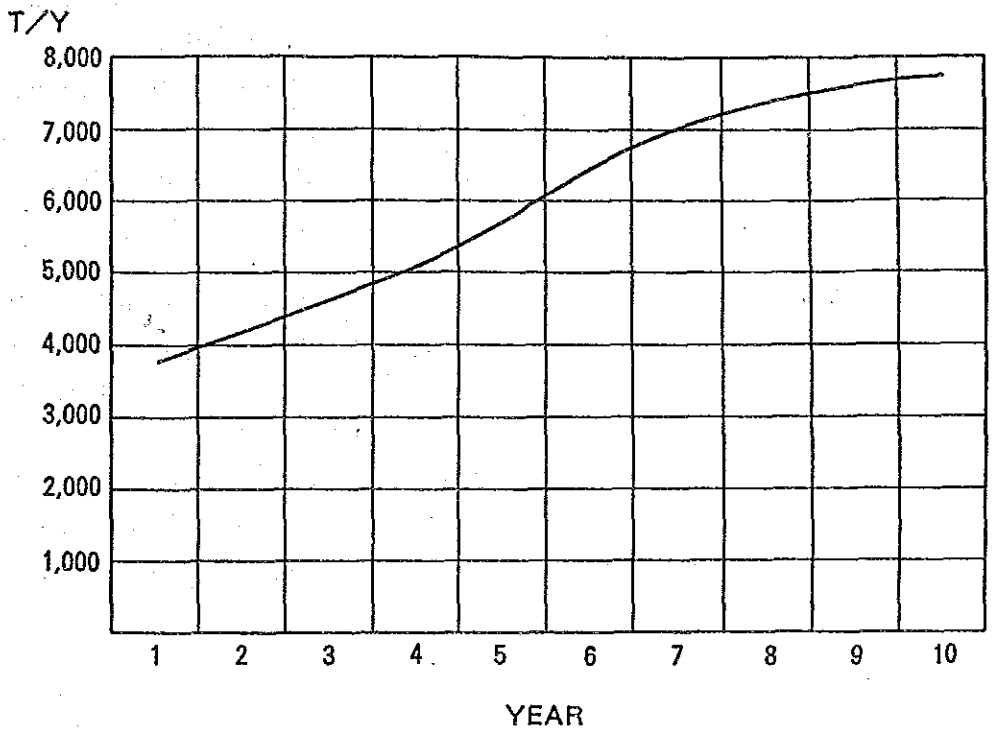
As the production requirements may substantially increase in 1992 onward, as shown in Figure 4.4-1, it is necessary to prepare the production system before that time.

In order to respond to the increased production requirements it will be necessary to enhance not only the facilities of each production line but also auxiliary facilities of the foundry to ensure provision for the entire foundry, including the expansion of the raw materials yard, the expansion of melting facilities and the rationalization of the treatment facilities for castings.

The projects should be implemented with continuation of the production. Summarized below are outline of the projects involved and the manner of the implementation for those projects:

1. As a first step the enhancement of the existing facilities is to take place. Movements of heavy articles are involved in the Foundry, but no conveyance equipment is available at present. It is planned to introduce the

Figure 4.4-1 Trend of Casting Parts Production



conveyance equipment which can help production efficiency increase. Another plan is to supplement compressors so as to increase the capacity of compressors presently being inadequate so that the existing foundry can be operated at normal conditions.

2. The present raw materials yard is on a small scale and should be newly installed between the generators and motors manufacturing shop and the foundry. The new yard should include a scrap yard, an equipment for raw material charging to the charging bucket and the sizing equipment for scrap. The present raw materials yard can be used as an area for placing castings. This is a component of the rationalization plan for the finishing section as described later. As the charging system for raw materials and the conveyance system to the melting furnace have mutually close relationship, the expansion of the melting facilities should also be implemented at the same time.

3. An overall renovation of the old casting facility (E line) is to take place. Since this casting facility is obsolete and seriously deteriorated, it is planned to replace the E line with a complete set of new casting line together with sand treatment equipment and other ancillary equipment. During the renovation of the E line the production should be undertaken by both lines of A and B.

4. Provision for the finishing section for castings including inspection equipment for products, and the introduction of anti-rust treatment facilities for casting, etc.

5. Expansion of shell molding machines of the casting line C.

6. Improvement of the casting line A. In chief the improvement is to be done by the introduction of cope roll over

device and change of the metal blashes in order to increase the production capacity. Small-sized castings are to be dealt with by the E line as far as possible and other castings transferred to the B line during the time when the A line is undergoing improvement.

7. Improvement of the B line and change of the molding processes. Change of the processes in the B line should be undertaken only for the molds. As the core making section of the B line is conditioned under unfavorable working environment, this section should be transferred to a part of the facilities constructed with the replacement of the existing E line. Effective use of the space vacated by the movement of the core making section is included in the plan for the rationalization of the finishing facility for castings.

b-1)-2 Improvements of the No.4 HI Light Alloy Fouricry (#4-5)

It is planned to increase the production of the pistons and piston rings in order to meet increased vehicle production and also the supply to the outside market. To this end the improvement of the light alloy foundry is to take place. Details of the plan is described in the plan of the expansion of pistons and piston rings production.

b-1)-3 Introduction of the casting equipment for manufacturing the cylinder liner (#4-10)

Only the cylinder liners for light vehicles are produced based on the shell molding at the C line of the No.3 HI foundry. It is planned to establish a new casting equipment to manufacture castings for cylinder liners in order to meet the production of cylinder liners for heavy vehicles and agricultural machinery, and also those to be supplied to the outside market. Details of this plan is described later in the subject of the local production of cylinder liner.

b-1)-4 Establishment of Alloy Steel Foundry (#4-26)

The present plan is for the introduction of production equipment for alloy steel and steel castings which is currently lacking.

HIC requires the various types of dies to be used for pressing and forging which are currently supplied by imports. The design, repair and manufacture of dies are to be carried out in due order as part of the renovation plan. However, if the blocks for the dies continue to be imported, there is a danger that problems will arise concerning design or production of dies, supply of blocks or production control. The production of the blocks is vital to establishing a comprehensive capacity for manufacturing the dies.

Moreover, steel castings are vital cast products needed for manufacturing high strength intensity components to be used for industrial machinery and various plant equipment. Demand can be expected in Burma from cement factories, mines and other industries. The HIC's existing foundry is for the mass production of small-sized iron castings but not for the non-mass production of large-sized iron castings.

In the future, it is anticipated that there will be a demand for large-sized cast iron products to be used for industrial machinery and so casting equipment for large cast items will be needed. It is possible to use much of this equipment also for the manufacture of steel alloy castings.

It is planned to set up a steel alloy foundry which is capable of producing 1,900 tons per annum of (i) blocks for dies and ingots, (ii) alloy steel castings and (iii) large-sized iron castings.

The steel alloy foundry is to utilize the maintenance shop, pattern repair shop and laboratory of No.3 HI/ Patterns, core boxes, and metal flasks are excluded from the present plan.

b-2) Expansion of the Press Section

The plan consists of (i) the enhancement of the existing Press Shop No.2 of No.1 HI responding to an increased production of the pressed parts currently manufactured, and (ii) the establishment of a new press shop for the local production of large-sized pressed parts.

Figure 4.4-2 illustrates the new items of component parts for local production which require pressed parts and the type of press machines needed for manufacturing these pressed parts.

b-2)-1 Enhancement of Press Shop No.2 of No.1 HI (#4-1)

Expansion plan for the existing Press Shop No.2 of No.1 HI is as follows:

1. Repair and replacement of deteriorated equipment

2. Improvement of the following bottlenecks occurring in processes

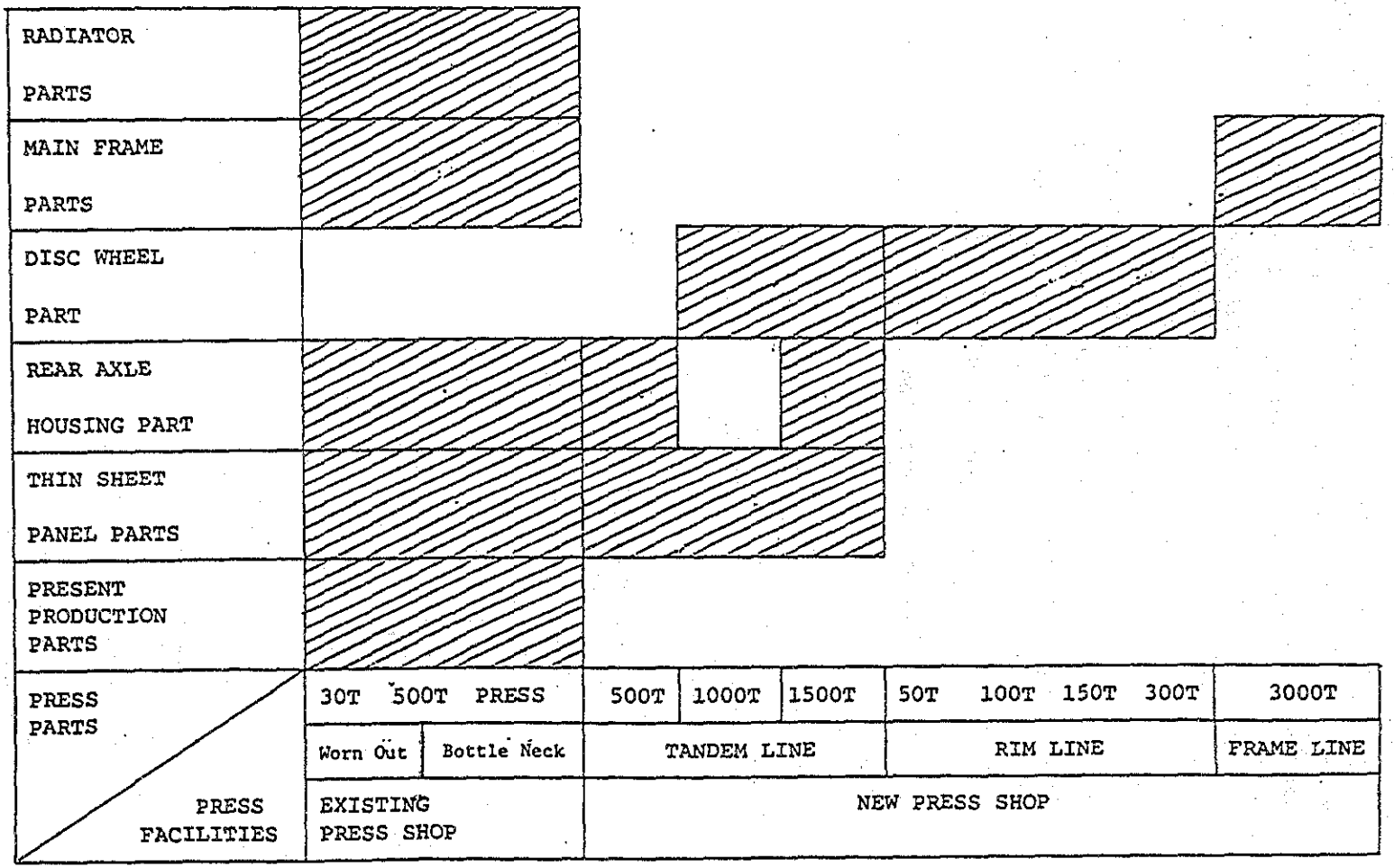
a) Reduction of time for changing dies

At present, the die changing is a time-consuming work. In order to reduce this time, it is planned to adopt a quick die changing system. By using the quick die changer, the change of one die can be accomplished in less than 20 minutes per change. In the future, as the number of pressed parts locally produced greatly increases so will the number of die changing operations. The press section is really the bottleneck in the total processes. Improvement of this section is urgently required.

b) Mechanization of trimming process

The trimming of pressed plates is currently done using manual cutters. As a result, not only do a large number of dimensional defectives occur, but reprocessing involves much wasted time and bottlenecks in

Figure 4.4-2 PRESS FACILITIES EXPANSION PLAN



processing occur. The introduction of a three dimensional cutting device using plasma is planned.

3. As part of an integrated maintenance system, it is planned to establish a die repair shop. At present, hardly any small repairs of dies are carried out and this leads to inferiority in the precision of component parts manufactured.

4. Introduction of equipment for the local production of pressed parts

   Of the pressed parts scheduled for local production in the future, the small- and medium-size items which can be manufactured by using the existing press machines are to be produced at the Press Shop No.2 of No.1 HI by strengthening these machines.

b-2)-2 Construction of New Press Shop (#4-2)

There will be many large-sized pressed parts such as the main frame among the items of pressed parts for vehicles to be locally produced in the future, and the existing press machines will be small to handle these large-sized parts. For this reason, the construction of a new press shop has been planned. The new press shop will include a pressed panel production line for vehicles, disk wheel production line, main frame (chassis) production and assembly line, and a rear axle housing production line. Outline of the new press shop is described below:

1. Construction of the building

2. Acquisition of the dies for use in Press Shop No.2

   The pressing of the small parts to be attached to the large-sized parts is to be done in the existing Press Shop No.2. To this end it will be necessary to purchase the dies to be used at the Press Shop No.2 for that purpose.

3. Panel making for vehicles

For making the panels the following are to be installed:

1,500 ton oil hydraulic press	1 unit
1,000 ton mechanical press	1 unit

Production arrangements will be made for an efficient utilization of the benefits of the large-size press machines. The above-listed press machines can also be used for the production of disk wheel.

4. Disk wheel production line

The disk wheel line consists of the following individual lines:

. Rim production line
. Disk parts production line
. Rim and disk assembly line
. Side ring line
. Bleaching line
. Painting line
. Wheel inspection

5. Production and assembly line for main frame (chassis)

Thick steel plate is cut using a gas cutter or a plasma cutter, and after bending by a press it is rectified with a different press and then painted.

The painted frame is welded together and after drilling, rivetting and re-welding, it is painted again (re-touching).

6. Rear axle housing production line

Component sheets are made from thick alloy steel sheets using a shearing machine, and after bleaching these are cut and bended with a press, followed by trimming, weld assembly and weld drilling.

b-3) Expansion of Forging Section (#4-4)

The expansion plan for the forging shop consists of the following:

1. Provisions and expansion for the existing forging shop

2. Construction of a new forging shop

b-3)-1 Provisions and expansion of the existing forging shop

1. Repair and replacement of existing machines

The present plan is designed to increase the production by the efficient utilization of the existing forging machines. As the drop hammers and trimming presses, the main machines of the shop, have been deteriorated, the repair of these machines is planned. At the same time other relevant facilities are also repaired so as to ensure a stable operation.

2. Improvement of production lines

There are one old 3 ton hammer and another 3 ton hammer recently installed. However, as the 3 ton hammer recently installed can not be operated because the trimming press with which it is to be combined for use has not been installed, only the old 3 ton hammer is used in a three-shift operation. Further, there is a lack of necessary compressed air. It is planned to urgently take measures for undertaking the normal operation of these machines. Besides the above, provision for magna flux flaw detector and shot blasting machines are to be made. Further there are no conveyance equipment, though this is needed for the movement of materials and products in progress, and for the shipment of the manufactured products. Provision of this conveyance equipment is to be undertaken.

b-3)-2 Construction of a new forging shop

The main purpose of the new forging shop is to be the forging of large items scheduled for the local production. Excepting the crank shaft for the heavy vehicles, the items concerned are the rear axle shaft, big gear, knuckle arm and front axle. The local production of the crank shaft for the heavy vehicles is not advisable, because it requires a large amount of investment and high-level technology, and also it seems to be costly due to a small scale production estimated as about 10,000 items per annum. Even in the industrialized countries this sort of crankshaft is not produced by the usual forging manufacturers but production is done by specialized manufacturers who receive the orders for crank shaft production from vehicle manufacturers.

The present plan has been devised so that demand for large size forged items received from other state corporations in the future could be met and handled.

c) Enhancement of Machine Sections Responding to Expansion of Local Production of Metal Parts

The present status of the local production of main component parts for vehicles, and the main processes to be involved for the local production of new items are shown in Tables 4.4-6 (1) to 4.4-6 (10). As has been mentioned in the description of the Metal Processing Sections, in order to form the base for the development of machinery industry together with possible exports of component parts in future, the component parts which can be manufactured by using machines widely adaptable to common uses or using specialized machines usable also for other purposes have been considered for the local production to be undertaken in the renovation plan, even if they are negative from the viewpoint of production economics. Other items have been examined mainly from the viewpoint of economic effects on investment and production economics.

Table 4.4-6(1) MAIN PROCESSES OF PARTS FOR VEHICLES

Vehicles	Parts:	Inlet Manifold					Exhaust Manifold					Water Pump					Gear for Engine				
		B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX
Raw Material	Import																				
	Local	A	A	P	P	P	A	A	P	P	P	A	A	P	P	P	A	A	P	P	P
Forging	Hammer																			P	P
	Press																			P	P
	Others																				
Casting	Iron						A	A	P	P	P	A	A	P	P	P	A	A	P		
	Steel																				
	Alloy	A	A	P	P	P															
Heat Treatment	Refinign																			P	P
	Carburige																				
	Induction																				
	Others																			P	P
Pressing	< 500																				
	500 - 1,000																				
	> 1,000																				
	Special																				
	Roll																				
	Others																				
Welding	Arc Spot																				
	Flash-butt																				
	Friction																				
	Others																				
Machining	Cutting	A	A	P	P	P	A	A	P	P	P	A	A	P	P	P	A	A	P	P	P
	Grinding																				
	Gear Cutting																A	A	P	P	P
	Others																				
Ass'y Line Sub	Engine	4G	4G	4G	4D	4D	4G	4G	4G	4D	4D	4G	4G	4G	4D	4D	4G	4G	4G	4D	4D
	Chassis																				
	Body																				
	Final	4L	4L	4L	1T	1B	4L	4L	4L	1T	1B	4L	4L	4L	1T	1B	4L	4L	4L	1T	1B

Note: A (Actual): Present process
P (Plan): Applicable process in case of domestic production
Ass'y Lines: 1 - No.1 HI G - Gasoline engine line L - Light vehicle line
4 - No.4 HI D - Diesel engine line B - Bus line
T - Truck line

Table 4.4-6(2) MAIN PROCESSES OF PARTS FOR VEHICLES

Parts:		Pulley					Crank Shaft					Gear Blank (d.410 x 57t)					Cylinder Liner				
Vehicles		B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX
Raw Material	Import									P	P						-				
	Local	A	A	P	P	P	A	A	P									A	P	P	P
Forging	Hammer																				
	Press									P	P										
	Others																				
Casting	Iron																				
	Steel	A	A	P	P	P	A	A	P									A	P	P	P
	Alloy																				
Heat Treatment	Refinign									P	P										
	Carburige																				
	Induction									P	P										
	Others						A	A	P											P	P
Pressing	< 500																				
	500 - 1,000																				
	> 1,000																				
	Special																				
	Roll																				
	Others																				
Welding	Arc Spot																				
	Flash-butt																				
	Friction																				
	Others																				
Machining	Cutting	A	A	P	P	P	A	A	P	A	A							A	P	P	P
	Grinding						A	A	P	A	A										
	Gear Cutting																				
	Others																				
Ass'y Line	Sub Engine	4G	4G	4G	4D	4B	4G	4G	4G	4D	4D							4G	4G	4D	4D
	Sub Chassis																				
	Sub Body																				
	Final	4L	4L	4L	1T	1B	4L	4L	4L	1T	1B						-	4L	4L	1T	1B

Note: A (Actual): Present process
P (Plan): Applicable process in case of domestic production

Table 4.4-6(3) MAIN PROCESSES OF PARTS FOR VEHICLES

Vehicles	Parts:	Piston Pin					Radiator					Inlet/Exhaust Valve					New Size Piston & Piston Ring				
		B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX
Raw Material	Import	A	A	P	P	P	-	P	P	P	P	P	P	P	P	P					
	Local																P	P	P	P	P
Forging	Hammer																				
	Press											P	P	P	P	P					
	Others																				
Casting	Iron																P	P	P	P	P
	Steel																P	P	P	P	P
	Alloy																				
Heat Treatment	Refinign	A	A	P	P	P						P	P	P	P	P					
	Carburige	A	A	P	P	P															
	Induction														P	P					
	Others																				
Pressing	< 500						-	P	P	P	P										
	500 - 1,000																				
	> 1,000																				
	Special																				
	Roll																				
	Others																				
Welding	Arc Spot																				
	Flash-butt																				
	Friction											P	P	P	P	P					
	Others						-	P	P	P	P										
Machining	Cutting	A	A	P	P	P						P	P	P	P	P	P	P	P	P	P
	Grinding	A	A	P	P	P						P	P	P	P	P					
	Gear Cutting																				
	Others																				
Ass'y Line Sub	Engine	4G	4G	4G	4D	4D						4G	4G	4G	4D	4D					
	Chassis						-	1	1	1	1										
	Body																				
	Final	4L	4L	4L	1T	1B	-	4L	4L	1T	1B	4L	4L	4L	1T	1B					

Note: A (Actual): Present process
P (Plan): Applicable process in case of domestic production

Table 4.4-6(4) MAIN PROCESSES OF PARTS FOR VEHICLES

Vehicles	Parts:	2000cc Engine & T/M					2000cc Engine VA					DS 70 Engine & Marine Engine					Wheel Hub				
		B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX
Raw Material	Import	-	A	A	-	-	-	P	P	-	-	-	-	-	A	A					
	Local		A	A				P	P						A	A	A	A	P	P	P
Forging	Hammer		A	A				P	P						A	A					
	Press														A	A					
	Others																				
Casting	Iron		A	A				P	P						A	A	A	A	P	P	P
	Steel																				
	Alloy		A	A				P	P						A	A					
Heat Treatment	Refinign		A	A				P	P						A	A					
	Carburige		A	A				P	P						A	A					
	Induction		A	A				P	P						A	A					
	Others														P	P	A	A	P	P	P
Pressing	< 500		A	A				P	P						A	A					
	500 - 1,000																				
	> 1,000																				
	Special																				
	Roll																				
	Others																				
Welding	Arc Spot		A	A				P	P						A	A					
	Flash-butt																				
	Friction																				
	Others																				
Machining	Cutting		A	A				P	P						A	A	A	A	P	P	P
	Grinding		A	A				P	P						A	A					
	Gear Cutting		A	A				P	P						A	A					
	Others																				
Ass'y Line Sub	Engine		4G	4G				4G	4G						4D	4D					
	Chassis																4	4	4	1	1
	Body																				
	Final	-	4L	4L	-	-	-	4L	4L	-	-	-	-	-	1T	1B	4L	4L	4L	1T	1B

Note: A (Actual): Present process
P (Plan): Applicable process in case of domestic production

Table 4.4-6(5) MAIN PROCESSES OF PARTS FOR VEHICLES

Vehicles	Parts:	Disc Wheel					Knucle Arm					Front Axle					Differential Carrier				
		B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX
Raw Material	Import	A	P	P	P	P	A	A	P	P	P	-	-	P	P	P					
	Local																A	A	P	P	P
Forging	Hammer						A	A	P	P	P										
	Press													P	P	P					
	Others																				
Casting	Iron																				
	Steel																A	A	P	P	P
	Alloy																				
Heat Treatment	Refinign						A	A	P	P	P										
	Carburige													P	P	P					
	Induction									P	P										
	Others																			P	P
Pressing	< 500	A	P	P																	
	500 - 1,000																				
	> 1,000				P	P															
	Special																				
	Roll		P	P	P	P															
	Others		P	P	P	P															
Welding	Arc Spot		P	P	P	P															
	Flash-butt		P	P	P	P															
	Friction																				
	Others																				
Machining	Cutting	A	P	P	P	P	A	A	P	P	P			P	P	P	A	A	P	P	P
	Grinding																				
	Gear Cutting																				
	Others																				
Ass'y Line	Sub: Engine																				
	Sub: Chassis	4	4	4	1	1	4	4	4	1	1			4	1	1	4	4	4	1	1
	Sub: Body																				
	Final	4L	4L	4L	1T	1B	4L	4L	4L	1T	1B	-	-	4L	1T	1B	4L	4L	4L	1T	1B

Note: A (Actual): Present process
P (Plan): Applicable process in case of domestic production

Table 4.4-6(6) MAIN PROCESSES OF PARTS FOR VEHICLES

Parts:		Differential Case					Rear Axle Housing, Parts					Drive Pinion, Ring Gear					Differential Gear, Pinion				
Vehicles		B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX
Raw Material	Import						P	P	P	P	P	A	A	P	P	P	A	A	P	P	P
	Local	A	P	P	P	P															
Forging	Hammer						P	P	P	P	P	A	A	P	P	P	A	A	P	P	P
	Press																				
	Others																				
Casting	Iron	A	P	P	P	P															
	Steel									P	P										
	Alloy																				
Heat Treatment	Refinign						P	P	P	P	P	A	A	P	P	P	A	A	P	P	P
	Carburige											A	A	P	P	P	A	A	P	P	P
	Induction																				
	Others	A	P	P	P	P															
Pressing	< 500						P	P	P	P	P										
	500 - 1,000																				
	> 1,000									P	P										
	Special																				
	Roll																				
	Others																				
Welding	Arc Spot						P	P	P	P	P										
	Flash-butt																				
	Friction																				
	Others																				
Machining	Cutting	A	P	P	P	P	P	P	P	P	P	A	A	P	P	P	A	A	P	P	P
	Grinding											A	A	P	P	P	A	A	P	P	P
	Gear Cutting											A	A	P	P	P	A	A	P	P	P
	Others																				
Ass'y Line Sub	Engine																				
	Chassis	4	4	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Body																				
	Final	4L	4L	4L	1T	1B	4L	4L	4L	1T	1B	4L	4L	4L	1T	1B	4L	4L	4L	1T	1B

Note: A (Actual): Present process
P (Plan): Applicable process in case of domestic production

Table 4.4-6(7) MAIN PROCESSES OF PARTS FOR VEHICLES

Vehicles		Parts:	Rear Axle Shaft					Bus Production					Press Parts Reef Cabin					Press Parts F/R Cover Cabin				
			B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX
Raw Material		Import Local	A	P	P	P	P	-	-	-	-	P	A	-	P	P	-	A	A	P	P	P
Forging		Hammer Press Others	A	P	P	P	P															
Casting		Iron Steel Alloy																				
Heat Treatment		Refinign Carburige Induction Others	A	P P	P P	P P	P P															
Pressing		< 500 500 - 1,000 > 1,000 Special Roll Others										P P P P	A		 P	 P 		A	A	P	P	P
Welding		Arc Spot Flash-butt Friction Others										P	A		P	P		A	A	P	P	P
Machining		Cutting Grinding Gear Cutting Others	A A	P P	P P	P P	P P					P										
Ass'y Line	Sub	Engine Chassis Body	4	4	4	1	1					1B 1B	4		4	1T		4	4	4	1T	1B
		Final	4L	4L	4L	1T	1B	-	-	-	-	1B	4L	-	4L	1T	-	4L	4L	4L	1T	1B

Note: A (Actual): Present process
P (Plan): Applicable process in case of domestic production

Table 4.4-6(8) MAIN PROCESSES OF PARTS FOR VEHICLES

Parts:		Press Parts Door Panel					Press Parts Floor Board for Rear Body					Press Parts Panel Side for Rear Body					Press Par ts Bonnet				
Vehicles		B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX
Raw Material	Import Local	A	A	P	P	P	A	A	A/P	-	-	A	A	P	-	-	A	A	-	A	-
Forging	Hammer Press Others																				
Casting	Iron Steel Alloy																				
Heat Treatment	Refinign Carburige Induction Others																				
Pressing	< 500 500 - 1,000 > 1,000 Special Roll Others	A	A	P	P	P	A	A	A P			A	A	P			A	A		A	
Welding	Arc Spot Flash-butt Friction Others	A	A	P	P	P	A	A	A			A	A	A							
Machining	Cutting Grinding Gear Cutting Others																				
Ass'y Line	Sub Engine Sub Chassis Sub Body	4	4	4	1T	1B	4	4	4			4	4	4			4	4		1T	
	Final	4L	4L	4L	1T	1B	4L	4L	4L	-	-	4L	4L	4L	-	-	4L	4L	-	1T	-

Note: A (Actual): Present process
P (Plan): Applicable process in case of domestic production

Table 4.4-6(9) MAIN PROCESSES OF PARTS FOR VEHICLES

Vehicles	Parts:	Press Parts Fender					Main Frame					Knucle					King Pin				
		B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX
Raw Material	Import	A	A	-	A	-	A	A	P	P	P	A	A	P	P	P	-	A	P	P	P
	Local																				
Forging	Hammer											A		P	P	P		A			
	Press																				
	Others																				
Casting	Iron																				
	Steel																				
	Alloy																				
Heat Treatment	Refinign											A		P	P	P		A	P	P	P
	Carburige																		P		
	Induction														P	P				P	P
	Others																				
Pressing	< 500	A	A		A		A	A													
	500 - 1,000																				
	> 1,000								P	P	P										
	Special								P	P	P										
	Roll																				
	Others							A													
Welding	Arc Spot				A		A	A	P	P	P										
	Flash-butt																				
	Friction																				
	Others																				
Machining	Cutting						A	A	P	P	P	A		P	P	P		A	P	P	P
	Grinding																		P		
	Gear Cutting																				
	Others																				
Ass'y Line	Sub: Engine																				
	Sub: Chassis						4	4	4	1T	1B	4		4	1T	1T		4	4	1T	1T
	Sub: Body	4	4		1T																
	Final	4L	4L	-	1T	-	4L	4L	4L	1T	1B	4L	-	4L	1T	1B	-	4L	4L	1T	1B

Note: A (Actual): Present process
P (Plan): Applicable process in case of domestic production

Table 4.4-6(10) MAIN PROCESSES OR PARTS FOR VEHICLES

Vehicles	Parts:	Ball Joint					Cap, Centor Bearing					Cam Shaft				
		B6	X2	T2	TE	BX	B6	X2	T2	TE	BX	B6	X2	T2	TE	BX
Raw Material	Import Local	A	A	P	P	P	-	-	-	P	P	A	A	P	P	P
Forging	Hammer Press Others	A	A	P	P P	P P				P	P	A	A	P	P	P
Casting	Iron Steel Alloy															
Heat Treatment	Refinign Carburige Induction Others	A	A	P	P P	P P				P	P	A A	A A	P P	P P	P P
Pressing	< 500 500 - 1,000 > 1,000 Special Roll Others															
Welding	Arc Spot Flash-butt Friction Others															
Machining	Cutting Grinding Gear Cutting Others	A	A	P	P	P				P	P	A A	A A	P P	P P P	P P P
Ass'y Line	Sub: Engine Chassis Body	4	4	4	1T	1T				4D	4D	4G	4G	4G	4D	4D
	Final	4L	4L	4L	1T	1B	-	-	-	1T	1B	4L	4L	4L	1T	1B

Note: A (Actual): Present process
P (Plan): Applicable process in case of domestic production

c-1) Local Production of Cylinder Liner (#4-10)

The cylinder liners for the light vehicles are produced in the C line of the No.3 HI Foundry using a shell molding method. The cylinder liners for the agricultural machinery are manufactured by the machining of imported castings which is taken place in No.3 HI. The cylinder liners for the heavy vehicles are imported. It is planned to produce all of the cylinder liners which are currently imported in the form of castings or completed parts.

As the existing foundry has no surplus capacity, the local production of cylinder liners require the expansion of foundry. The present plan is to undertake the installation of a complete set of production lines starting from casting, onto machining down to the product for all of these cylinder liners. To realize this a building is constructed in No.3 HI, in which a centrifugal mold casting equipment is installed. The castings thus manufactured, after rough machining, are to be supplied to the shops for machining.

The cylinder liners for the agricultural machinery will be processed and assembled at the AME shop of No.3 HI. The cylinder liners for the heavy and light vehicles will be processed at the specialized lines to be established in the No.4 HI Machine Shop. The manufactured cylinder liners are supplied for assembly to the No.4 HI Diesel Engine Shop in the case of the cylinder liners for heavy vehicle engines and to the engine assembly line located in the LV Machine Shop of No.4 HI in the case of the cylinder liners for light vehicle engines.

The production including service parts is planned to be 70,000 pieces per annum.

Therefore the present plan includes:

1. Casting lines based on the centrifugal mold casting process and equipment for rough machining

2. Establishment of the cylinder liner machining line in the No.4 HI Machine Shop

The machining of cylinder liners for the agricultural machinery and also assembly of all the cylinder liners will be carried out by using the existing machinery and equipment.

Along with the setup of the machining line for the cylinder liners in the No.4 HI machine shop, the existing lines of the machine shop will be reorganized (#4-7).

c-2) Increased Production of Pistons and Piston Rings (#4-5)

At present the production of the pistons and piston rings for the heavy and light vehicles, including the casting and machining, are performed in the No.4 HI.

In order to increase the production of pistons and piston rings consequent to a future increase in production of vehicles and also to supply service parts for HIC produced vehicles and other vehicles to the market which are the new undertakings, it is planned to enhance the production system for the pistons and piston rings.

To this end a new casting equipment will be installed in the light alloy foundry, in which consideration is made to the reduction of riser volume and the simplification of die setting for piston casting.

Further in order to improve the safety conditions and work efficiency of the pouring shop and piston casting shop, the modification of the layout of the pouring shop is to be made.

At the same time, the recovery and re-use of aluminum chips are also to be undertaken.

Layout of the machining processes in the Piston Manufacturing Shop is to be modified so as to adapt to a flow-line operation. Additional jigs and dies required for producing service parts for the general market is to be acquired.

The production capacity of pistons and piston rings including service parts is as follows:

Pistons:	approx.	160,000 pieces per annum
Piston rings:	approx.	1,300,000 pieces per annum

c-3) Local Production of Inlet/Exhaust Valves of Engines (#4-20)

At present the inlet and exhaust valves used for the engines of the heavy and light vehicles are all imported, while those for agricultural machinery are manufactured by the machining of imported forged products in the No.3 HI.

The present plan is to undertake the production of all of the inlet and exhaust valves required for the heavy and light vehicle engines and agricultural machinery engines.

To this end it is planned to construct a shop building with an area of 1,080 square meters and another building for ancillary equipment having an area of about 120 square meters in No.3 HI in which an integrated production line, including the forging and machining, for the manufacturing of inlet/exhaust valves of engines for light and heav y vehicles and agriculture machinery.

The production capacity of the inlet and exhaust valves including service parts is as follows:

Inlet valve:	50,000 pieces per annum
Exhaust valve:	50,000 pieces per annum

c-4) Machining Facilities for Other Metal Parts of Vehicles

c-4)-1 Machining facilities for rear axle housing (#4-13)

At present the rear axle housing for light vehicles is imported as a component part while that for heavy vehicles is imported as a complete set of assembled rear axle. The plan is to undertake the local production of the rear axle housing.

The present plan consists of the removal of the warehouse located on the north side of the HV Assembly Shop of No.1 HI,

the construction of a new building with an area of some 4,050 square meters at the place vacated after the removal of the warehouse, and the installation of a series of production equipment so as to produce all of the rear axle housing for heavy and light vehicles. The production capacity of the rear axle housing including that for service parts is about 4,700 units per annum.

c-4)-2 Radiator production equipment (#4-14)

At present the radiators for both heavy and light vehicles are imported as completed units.

The present plan is to set up the production line for the production of radiator for both heavy and light vehicles. The line is to be installed in the Press Shop No.2 of No.1 HI. The production capacity of the radiators including those for service parts is about 4,000 units per annum.

c-4)-3 Production facilities for bevel gear (#4-15)

The bevel gears for the B-600 and X-2000 are locally produced, while these parts for the heavy vehicles and agricultural machinery are imported. The present plan is to set up a production line for bevel gears to produce locally all of the bevel gears for the heavy and light vehicles and agricultural machinery. The production equipment including those for machining and heat treatment, is to be installed in the Machine and Heat Treatment Shop of No.1 HI. The forged products required are to be supplied from No.3 HI.

The production capacity including service parts is as follows:

Drive pinion, ring gear:	6,200 sets per annum
Differential side gear:	12,400 pieces per annum
Differential pinion:	19,600 pieces per annum

c-4)-4 Machining equipment for rear axle of heavy vehicle (#4-16)

At present the rear axle for the heavy vehicles is imported as an assembled unit which consists of the differencial carrier and other component parts.

The present plan consists of the local production of various component parts of the rear axle for the heavy vehicles and the assembly of the rear axle made of the manufactured component parts.

The component parts to be produced are as follows:

1. Differential carrier
2. Differential cage, retainer, nut, differential cap, collar, flange
3. Differential case
4. Wheel hub

To realize the above, the old Painting Shop for light vehicles at No.1 HI is to be reorganized with the installation of the machines for the production of above items. However, since unevenness of the flooring would result in bad levelling of the equipment and would thus have a detrimental effect on the product quality, it is planned to lay a concrete floor of at least 250 mm thickness. Castings and forged products to be used for processing are to be supplied from No.3 HI. The production capacity of rear axle including service parts is about 1,800 units per annum, and the production of the above-listed parts in equivalents of the production of rear axle.

The present plan is composed of the following lines:

1. Machining line for the differential carrier
2. Machining line for the differential cage and other five items
3. Machining line for the differential case
4. Assembly line for the differential carrier
5. Machining line for the wheel hub

c-4)-5 Equipment for machining and heat treatment of piston pins (#4-17)

At present the piston pins for light vehicles are manufactured by the machining and heat treatment in No.4 HI, while all piston pins for the heavy vehicles and agricultural machinery are imported.

The present plan is for the local production of all of the piston pins to be used in the various engines and also to be supplied as service parts to the market. To this end, specialized machining lines for the integrated production of the various types of piston pins are to be installed in the No.4 HI Machine Shop. Further, in order to respond to the increased requirements for heat treatment, the No.4 HI Heat Treatment Shop is to be extended by an area of approximately 156 square meters and addition of a simple gas carburizer. The production capacity is 90,000 pieces per annum.

c-4)-6 Machining line for component parts of T-2000 (#4-18)

At present the main parts of light vehicles are locally produced only for the B-600 and X-2000. Most of the component parts for the T-2000 rely on imports. The present plan aims at locally producing the following component parts of the T-2000:

1. Rear axle shaft
2. Front axle
3. Steering knuckle
4. Knuckle arm
5. Differential carrier
6. Differential case

In order to install the various machines needed for the production of each of the above parts, a building with an area of about 2,000 square meters will be constructed. Castings or forged products are supplied from No.3 HI. The production capacity is about 1,000 units per annum.

All of the production lines for various parts listed above are to be established as the specialized lines for the individual items.

c-4)-7 Machining equipment for the component parts of the DS engine parts (#4-19)

At present, the following parts among the component parts of the DS-70 Engine for heavy vehicles rely on imports:

1. Engine gear
2. Pulley
3. Inlet manifold
4. Exhaust manifold
5. Water pump

The present plan aims at the local production of the above listed parts. To realize this, the warehouse located on the south side of the present No.4 HI Diesel Engine Shop is to be redesigned so as to install the production lines for these parts. However, since unevenness of the flooring would result in bad levelling of the equipment and would thus have a detrimental effect on the product quality, it is planned to lay a concrete floor of at least 250 mm thickness. The inlet manifold is made from light alloy castings which are supplied from the No.4 HI Light Alloy Foundry. Castings or forged products to be used for other items of the parts are supplied from No.3 HI. The production capacity including service parts is equivalents of 1,900 vehicles per annum.

d) Strengthening of Vehicle Spare Parts Supply System

The present plan aims at providing a system for the supply of spare parts to meet the shortage of these vehicle spare parts in other state corporations and on the market. This plan is a part of the plans for the enhancement of production facilities for component parts, including the Metal Processing Sections, as described in the previous section.

e) Model Changes in Response to Market Demands

e-1) Model Change of the 2000 cc Engine (#9-1)

In recent years there has been an inflow of second hand vehicles which exceeds the domestic production of vehicles in Burma. Most apparent is the inflow of general passenger cars and light trucks, and though these are second hand they are considerably newer in design than the models produced by HIC. Since further economic expansion and increase in the passenger movements are inevitable in the years to come, it will soon be impossible to meet market demands for vehicles only with the X-2000 model designed as the rough road passenger vehicle.

Moreover, HIC in a trial export of the Path Finder, a locally modified model of the X-2000, dispatched two samples each of the 4 door and 2 door model in September, 1987. However, in order to expand the exports, it will be necessary to ensure that the model can compete with other models in the export markets and also pass the various legal requirements of the destination market.

In order to respond to these necessary conditions of the market, it is required to change the specification of the engine for X-2000. The present plan is designed to meet the following targets:

1. If the wide export markets are set as a target, development of new specifications over a wide range of features will be necessary. Therefore the target should be restricted to those markets which can be entered by the modifications of the X-2000 specifications and mounting engines that will clear the emission control regulations.

2. At the same time a system which is capable of responding to a future diversification of the needs of the domestic market should be established.

With these targets in view, the following plan is to be implemented:

1. The basic concept is the replacement of the currently mounted VA engine by the FE engine which can pass the emission control. Together with this, in order to adapt the transmission to the performance of the FE engine, the 4 drive transmission used for the VA engine will have to be replaced by the 5 drive transmission which has proved performance with the FE engine. Technical investigation regarding the mounting of the FE engine and new transmission is to be undertaken by HIC. Development, design and trial manufacturing should be carried out with consideration of the modification of bonnet design and also possible utilization of mass produced parts, and then based on the result of these activities the jigs and dies needed for the commercial production should be developed. As these steps of work require a long period of time equivalent to the development of a new model vehicle, it would be necessary for HIC to start these development activities as early as possible.

2. Based on the result of the above investigation, the local production should be launched. In order to produce the FE engine and the 5 drive transmission, some 100 extra items of component parts will have to be produced. For this production all of the existing machines for the VA engine installed in No.4 HI can be used although the manufacturing of component parts of the FE engine requires the modification of 6 units of the existing machines together with the installation of additional 30 units of new machines. Hence, the production of the FE engine can be undertaken with a comparatively small amount of additional investment for machines, although the jigs and dies should be purchased.

By these measure, the following market needs are to be met:

1. Increase the commercial value of the X-2000 through shift operating efficiency and reduction of gear noise by modifications of the transmission.

2. Increase the exportability of the X-2000 through mounting of an engine which can clear the emission regulations. However, other design features will limit the export markets.

3. In contrast to the VA engine and the 4 drive transmission which are specially adapted only to Burmese conditions, the FE engine and the 5 drive transmission can be used abroad widely with a large number of models. Therefore there are possibilities for HIC to supply the engine and transmission or component parts to vehicle manufacturers abroad, under the so-called OEM (Original Equipment Manufacturing) arrangement or other form of subcontract system, as required by them for the vehicles which they manufacture on a CKD basis. Another possibility for HIC is to export the spare parts to be used for repair of vehicles running abroad.

4. In addition to the possibilities of export for the engine and transmission as completed units, there are possibilities for exporting either component parts or castings and forged products, to be used for manufacturing those parts.

5. Further, since the FE engine and the transmission have shown positive results in use with various models, they could function as the foundation for a response to the diversification of vehicles in the future in the domestic market.

e-2) Model Change of the B-600 Pick Up Truck (#9-2)

The B-600 pick up truck is highly valued in urban areas for taxi and personal use, but the model has remained unchanged since its first introduction. As there is a recent increase in the inflow

of second hand pick up trucks of the 0.5 to 1 ton class, there is a strong demand for increasing the loading capacity. The present plan aims at meeting these market needs by a model change.

Since the B-600 is an old model with a small engine capacity there is hardly any possibility of export. Nevertheless, the localization of the B-600 has progressed, and HIC has gained proficiency in the design of this model. Hence HIC should be well capable of performing trial manufacture and preparation of commercial production of a modified B-600. Aiming at proceeding with the model change of the B-600 to meet the needs of the domestic market in Burma, it is planned that HIC carry out necessary development activities with technical advices provided by outside experts.

The model change should be performed in the following steps divided into two:

1. Extension of the length of the vehicle

2. Widening of the width of the vehicle

This plan is to be implemented as part of the project for establishing the product development system (#10-1).

e-3) Possibility of Converting DS-70 Diesel Engine for Marine Use, and Local Production of Marine Engine (#9-3)

There may be a fair demand for marine-use diesel engine in Burma and neighboring countries. If the DS-70 Diesel Engine mounted on the HIC's heavy vehicles can be used for marine-use, it could enable HIC to undertake the production of marine engines by using the existing facilities.

However, the investigation of this possibility indicates a conclusion that the conversion of the DS-70 Diesel Engine for marine use is technically impossible from the following reasons:

1. The structure of the DS-70 Diesel Engine is unfit to be equipped with various accessories for marine use.

2. The capacity of the DS-70 Diesel Engine is inadequate for marine use. Hence the commercial value of the engine will be substantially lowered if it is mounted on boats.

Hence the plan alternatively envisages the introduction of the H diesel engine which has been commercially proven for both heavy vehicle and marine use.

The adoption of the H diesel engine will bring about the following effects:

1. Satisfy the demand for marine engine.

2. Use the engine for both heavy vehicles and marine use.

3. Improve the performance of the engine for heavy vehicles because of the superiority of the H diesel engine compared to the DS diesel engine.

However, there are the following problems:

1. The level of demand for a marine engine is not yet clear.

2. When the DS engine parts production line is used for the H engine parts, it will be necessary to make changes in arrangements and undertake modifications in the jigs and dies and this will produce complications in assuring quality of products and result in a lowering of productivity. Hence the local production of the H engine would requiree the installation of specialized production line.

Therefore the present plan envisages the import of component parts of the H engine for the CKD assembly which will be supplied to the market in order to evaluate market response including market trends and demand tendency.

If a large demand for the marine use H engine can be anticipated, then investigation of the replacement of the DS Engine by

the H engine should take place. In this event since the machining section for the DS engine comprises universal type machines for the most parts it is expected to be possible to use most of them for processing of the H engine. But as such a conversion requires technical investigations of numerous aspects, the local production of the H engine is to be undertaken after such investigations are completed.

1-3) Provision for Production Facilities and System for Electrical Products

a) Realization of Increased Production Responding to Market Demand

a-1) Provision for Production Facilities in Responding to Industrial Demand

a-1)-1 Increased production of fluorescent lamps (#8-1)

At present there is one production line for the fluorescent lamp. HIC has set the production capacity of the existing line at 400,000 pieces per annum, so that in order to respond to a future increase in production it will be necessary to expand the production capacity. The plan aims at the setup of additional line.

The fluorescent lamps currently manufactured at HIC have a 38 mm diameter whereas other countries already employ the 28 mm diameter type. If production of the 38 mm type is continued it will be necessary for the foreign suppliers of component parts to produce those parts at their production lines maintained solely for producing only the parts to be supplied to Burma, and therefore it is likely that their supply prices should have a significant rise. To avoid this, a 28 mm diameter line should be set up and when an opportunity arises for conversion from the 38 mm to the 28 mm diameter type this should be taken.

The present plan aims at provision for a production increase as outlined above and also for a product conversion to the 28 mm diameter type.

An expansion of production facilities is to take place to realize this plan.

The production plan for 1998 is 2,000,000 pieces per annum, so that it would be necessary to have 5 lines with a capacity equal to the existing line's production capacity of 400,000 pieces per annum. However, the existing line is judged capable of achieving a production capacity of 800,000 pieces per line per annum on the condition that necessary parts are supplied on time, and production is not interrupted. Therefore, in order to minimize required investments, together with the expansion by one line similar to the existing one, an increase in the production efficiency of the existing line will be endeavoured and at the same time a two shift operation for each line introduced. These measures will permit the realization of a production system with a schedule of 2,000,000 pieces per annum. That is, by raising production of one shift on one of the lines from 400,000 to 500,000 pieces, the target can be reached as follows:

500,000 pieces per line per shift x 2 lines x 2 shifts = 2,000,000 pieces per annum.

Thus the present plan consists of the repair and replacement of machine in the existing line and the installation of additional production line.

a-1)-2 Production increase of electric accessories (#8-4)

There are 32 electric accessories such as holders, plugs, sockets, switches, circuit breakers, etc. which are produced at HIC. Shedding of those with low demand should take place to concentrate the production of high demanded 14 items.

The repair and replacement of deteriorated machinery, and the replacement of dies will be necessary for the realization of this plan.

a-1)-3 Production increase of electric motors (#8-6)

In order to improve the present short supply of electric motors, it is planned to increase the production of these by 1998 to a level of 5,000 units per annum.

Production of the electric motors takes place in the AME Shop No.1 of No.3 HI. This shop was originally set up with the technical assistance of West Germany, in which the shops for production of the electric fans, diesel engine electric generators and electric motors were added. As all of the component parts for these three products are processed on the same line, assembly takes place after the manufacture of component parts has reached a certain quantity. This operating condition is inefficient.

Furthermore, there are a number of deteriorated and broken down machines which account for 20% of the total machines, and most of these machines are unrecoverable with any repair.

To realize the planned increase in production, the following measures are planned:

1. A model change from the present three-phase type to a single-phase type, unifecation of the type to be produced, and standardization of component parts so that these can be common by applicable to the various models to a possible maximum extent.

2. Reorganization of the entire layout of the AME Shop No.1 of No.3 HI to establish the specialized shops for specific products.

3. Introduction of equivalent for mechanization of the assembly which is presently done by manual work.

a-1)-4 Provision of production facilities for low tension panel (#9-6)

There is a large demand for the low tension panels which are attached to the distribution transformers, for the use in small factories or in rural areas. This panel is currently

produced in the Engineering Factory of No.1 HI in Rangoon. It is produced on the basis of order placed by the Electric Power Corporation and other state corporations. These panels are designed individually in response to the orders received and based on the design the panels are produced and then equipped with imported switches and meters.

The Engineering Factory No.1 annually produces several hundred steel stacks for administrative use, but equipment is badly deteriorated. There are many problems with product quality.

The present plan aims at the installation of equipment for production of the low tension panel at No.5 HI.

It is planned to set up equipment which can produce cabinets, the panels without housing parts, panel frames and supports.

a-2) Provision for Production System for Producing Electrical Products Required for Improvement of Living Standard

a-2)-1 Production increase of incandescent lamp

In order to meet the increasing demand for the incandescent lamp, it is planned to produce the incandescent lamps at 6,000,000 lamps per annum in 1998.

The existing production facilities of incandescent lamps at the lamp Manufacturing Shop of No.1 HI consists of two lines having the production capacity rated by HIC to be 2,400,000 lamps per annum in two lines. However this rated capacity seems a slight underestimation. It is assessed that the existing facility may be capable of producing 3,600,000 lamps per annum which is the highest production actually recorded in the past. The present plan is to undertake the repair and replacement of the existing equipment which is badly deteriorated, and also enhance the system for minor repair work in the shop and the system for quality control and quality inspection. Further it is planned to install additional production line in the latter half of the 1990's.

a-2)-2 Production increase of dry cell battery (#8-3)

In order to meet the domestic demand for dry cell batteries, an annual production of 42,000,000 batteries must be reached by 1990. The production of the dry cell batteries is carried out in No.1 HI and No.2 HI and the total production was 14,000,000 batteries in 1986/87.

In order to reach the above level of increased production, it will be necessary to provide for increased production of both lines of No.1 HI and No.2 HI. Nevertheless, the present plan is for the establishment of an increased production system for No.1 HI only.

The present plan aims at the improvement of processing yield and operating efficiency by the replacement of the UM-IH line which shows serious deterioration with an ABI system (automatic-bobbin inserting system).

However, in order to operate the ABI system most effectively, it will also be necessary to strengthen the production facilities for components, particularly the zinc can and zinc pellets. These measures will ensure the almost complete automation of the entire assembly line and can be expected as a result to realize an improvement in the production control including quality control in each process.

The present plan consists of the re-organizaiton of the existing production line and introduction of the ABI system in accordance with the following steps:

Step 1: Reinforcement and renovation of the zinc pellet process in order to ensure production of superior quality zinc cans.

Step 2: Reinforcement and renovation of the zinc can process line prior to introduction of the ABI equipment, in order to adapt the shape and dimensions of the zinc can to the ABI equipment which will be eventually introduced.

Step 3: Stabilization of product quality and automation of the entire line through the introduction of ABI equipment and reinforcement and renovation of the existing line.

In future it is planned to install additional production line so as to meet the increasing demand.

a-2)-3 Model change and production increase of watt-hour meter (#8-5)

At present, HIC produces two types of watt-hour meter, a single-phase two-wire type (TE1) and a three-phase three-wire type (TW1). The single phase two-wire type is for domestic use. Since Burma adopts a three-phase four-wire distribution system, the three-phase three-wire type (TW1) helps illegally consume electricity without metering by means of wiring the neutral wire with one of the other wires.

The single phase two-wire type (TE1) was designed about 20 years ago and so outside of Burma this type is rarely produced so that parts supply is very difficult. Moreover, the dies for the TE1 are badly deteriorated and it will be necessary to replace these in the near future.

The production plan for the watt-hour meter is as follows:

1986 (Actual)	26,000 units
1998	40,000 units

In response to the above conditions the present plan is to undertake the following:

1. Model change of the TE1 which is produced at present to the TE5 type which is produced in many countries outside of Burma. This will ensure the stable supplyof component parts.

2. Development of a three-phase four-wire type which meet the electricity distribution system in Burma, and conversion to this from the present three-phase three-wire system.

3. Renovation of the existing equipment, and preparation for the expansion of the production facilities are to be undertaken in conjunction with the above.

a-2)-4 Provision for production system of portable diesel generators

Refer to (2) 1-1) of 4-4-1 - "Enhancement and Expansion of Production Facilities and System for Agricultural Machinery to Meet Expansion of Mechanized Agriculture".

a-2)-5 Enhancement of supply system for fire engine and ambulance

The fire engines and ambulances are special users of the TE 6.5 ton trucks and X-2000 jeeps respectively. As to the enhancement of the production facilities for the TE trucks and the X-2000 jeeps, refer to (2) 1-2), 4-4-1 - "Expansion of Production of Vehicles and Spare Parts for Vehicles Responding to Expansion of Transportation Means".

In particular refer to #4-9, #4-21, #1-5, #1-8 and #1-9.

1-4) Provision for Production Facilities and System for Production of Spare Parts to be Supplied to the Market

a) Production of Gauges and Cutting Tools (#3-2, #3-4)

The present plan aims at the establishment of production facilities for the gauges and cutting tools to be used internally and also to be supplied to the outside users. Refer to (1)-3, 4-4-2 - "Production of Gauges and Cutting Tools".

b) Local Production of Electrician Tools (#4-25)

At present, the production of hand tools such as spanners, pliers, drivers and hammers takes place in the hand tool forging and finishing shop of No.3 HI. By utilizing the technology for manufacturing those hand tools, the local production of electricians' tools such as pliers and screwdrivers for electricians is to be undertaken.

As far as possible the machinery, equipment and dies of the hand tool forging and finishing shops of the No.3 HI are to be used and any special machinery, equipment and dies needed for the production of electricians' tools are supplemented.

c) Development of Capability for Designing Various Spare Parts and Tools

The present plan is to be implemented in conjunction with the plan for enhancing the production facilities for spare parts and tools to be used internally. Refer to (1) 1), 4-4-2 - "Establishment of Auxiliary Machine Shop (#3-1)" and (2), 4-4-2 - "Acquirement and Accumulation of Production and Engineering Technology."

2) Strengthening of the Self-Sustaining Production

2-1) Renovation and Expansion of the Metal Working Sections

As the present plan is closely connected with the increase of the production of the metal parts being presently produced for vehicles and the local production of new metal parts for vehicles, details are described in (2).1-2), 4-4-1 - "Enhancement of Production

Facilities for Production of Vehicles and Spare Parts for Vehicles Responding to Expansion of Transportation Means".

2-2) Enhancement of Machining Sections Responding to Expansion of Local Production of Metal Parts

Details regarding the local production of the metal parts for vehicles have been given in (2) 1-2), 4-4-1 - "Enhancement of Production Facilities for Production of Vehicles and Spare Parts for Vehicles Responding to Expansion of Transportation Means." As provision for the production facilities which can produce exportable metal parts for vehicles is one of the measures to be taken for strengthening the base for self-sustaining production, the enhancement of machining sections is indispensable.

a) Local Production of Bolts and Nuts (#4-11)

At present a part of the bolts and nuts used by HIC are internally produced, but by and large, these are imported.

The machine shop of the respective factories produce the bolts and nuts which each factory specifically requires for the production of specific products. While No.1 HI employs special machines for mainly producing the bolts and nuts for vehicles, the other factories produce these by machining with turret lathes and it is situated in very low productivity.

The present plan is to collectively produce bolts and nuts which are used for the products produced at HIC. It aims at expanding the range of items produced by including those not yet produced and also improving the quality and economic efficiency of the bolts and nuts produced.

It is planned to extend an area of about 1,600 square meters to the west side of the present bolt and nut shop of No.1 HI, in which the following production lines are to be set up:

1. Bolt and nut production line
2. Hub bolt, hub nut inner production line
3. Nut production line for use of hub nut, drum nut and U bolt nut

4. Spring washer production line
5. Plating parts production line

The presently operating bolt and nut shop of No.1 HI will remain centered on the machines working in relatively good order, in which wood screw, tapping screw and machine screw production lines together with one thread rolling machine will be installed, while the old wood screw production line is scrapped.

b) Local Production of U Bolts (#4-12)

All of the U bolts used for the heavy vehicles and for the T-2000 depend on imports. The present plan aims at the local production of the U bolts used for the heavy vehicles and T-2000. The production plan for 1998 including the service parts is about 25,000 pieces per annum. In order to realize this plan, a new U Bolt line shall be installed in the No.1 HI Leaf Spring Shop.

2-3) Local Production of Raw Materials and Component Parts Required Beside Metal Parts

a) Domestic Production of Rubber Parts (#5-1)

At present rubber parts for vehicles and agricultural machinery are entirely dependent on imports. There are about 340 items of rubber parts to be used for the light and heavy vehicles. The present plan aims at the local production of rubber parts for vehicles by shared use of a part of the currently operating tire manufacturing plant of No.6 HI, promoting effective utilization of domestic resources.

As the rubber parts for vehicles comprise a wide variety of items which are produced in a small scale, the operating efficiency is relatively low. Further the production requires various technical factors such as characteristics and formulations of raw materials, operating conditions, and other conditions for assuring required quality. For this reason immediate transfer of technology will be difficult. It is necessary to gradually expand the items of products for production in consideration of manufacturing methods and characteristics of products to be manufactured.

Generally rubber parts for vehicles and agricultural machinery are required to be heat resistant, oil proof and weather proof to meet environmental conditions of their use, and the know-how for manufacturing differs with each items of the parts to be manufactured. Therefore development should proceed from those parts which are of a relatively simple technical nature. Since the oil seal, brake hose and fuel hose are vital safety parts, for the time being their production should not be undertaken.

The initial production is limited to the parts for vehicles. But utilizing the technical thus accumulated and equipment installed the production of rubber parts can be undertaken for other uses in future.

b) Local Production of Plastic Parts (#5-2)

The use of plastic components is a world-wide tendency, since it makes the production of colorful products in a variety of shapes. There is a high possibility for the HIC's products such as electrical products and vehicles to change to the use of plastic components.

The present plan concerns the change to the use of plastic components for the electric fan which are less preferred by users in comparison with other competing similar products which use plastic component because the HIC's electric fan uses no plastic components.

As a result of the planned change to plastic components the following results can be anticipated:

1. Saving of foreign exchange
2. Reduction in materials costs
3. Increase in productivity
4. Assurance of market competitiveness

Moreover, the injection molding machines introduced for this plan can be used for the manufacture of plastic components to be applied to other variety of electrical appliances and vehicles. In order to utilize the injection molding machines for the production of

plastic components to be used for other products, the layout of AME Shop No.1 will be reorganized to set up a section for the manufacturing of various plastic components.

c) Local Production of Enamel Coated Wires (#5-3)

The enamel coated wires used in Burma is partly locally produced, but majority is imported. The present capacity of the local production is approximately 50 tons per annum which is far below the requirements. The production of electrical appliances at HIC annually requires some 120 tons of the enamel coated wires, of which only about 20 tons is the locally produced wires because of limited supply quantity and inferior quality of these wires.

Domestic demand for the enamel coated wires is anticipated to increase not only in HIC but among other state corporations, and the present plan is for installation of the production facilities capable of responding to these demands. The facilities are to be located at No.5 HI. The enamel coated wires currently produced in Burma have quality problems such as instability in thickness of coated enamel, and also less strength and adhesion. Those wires are not usable at high voltages, though usable at low voltages. The present plan is to adopt the vertical type process due to its superiority in enamel coating.

d) Use of Local Manganese Dioxide (#5-4)

The manganese dioxide used as the de-polarizer in the dry cell batteries produced by HIC is all imported at present.

The presence of manganese deposits in Burma has been confirmed and HIC intends to undertake the production of manganese dioxide.

In this connection HIC has requested the Survey Team to conduct an analysis of two samples of domestic manganese ores. However, the analysis results for these samples alone have not provided sufficient information to make the detailed evaluation of the possibility for commercial production. However, it is recommended that further survey be conducted by HIC of the following points in view of assuring the effective use of the domestic manganese:

1. Undertake a sample analysis survey of an adequate number of samples collected from each of the manganese deposits.

2. Confirm the recoverable reserves of the deposits and other technical conditions including the analysis of composition which can be the basis for designing the production facilities.

3. Implement on-site surveys by qualified specialists.

4-4-2 Establishment of Auxiliary Sections Capable of Supporting Renovated Facilities

(1) Establishment of Maintenance System

The present plan consists of the enhancement of workshops and maintenance facilities and of the strengthening of a system for continuous maintenance activities. Further, the process of implementation is divided into the step for implementation of urgent matters and introduction of systems, and the step for subsequent enhancement of systems introduced.

1) Establishment of Auxiliary Machine Shop (#3-1)

The Auxiliary Machine Shops (A/M Shop) are to be set up in the No.1 HI, No.3 HI and No.4 HI respectively. The basic aim of the A/M Shops is to carry out small repairs on the machinery, jigs and dies of the individual shops as these are required.

As these facilities are not available now, when urgent repairs are needed, the machines of the main production lines are used for small repairs. If there is no urgency for the repairs the machines broken down were left unrepaired. Further, parts of these machines left to the side were disassembled for use for other machines so that in fact those machines were scrapped.

The A/M Shops should be managed under the control of each factory in order to assure the mobility of the shop. They are also to be in charge of the production of small spare parts for machines. The techniques for repair acquired through such small repair work on the jigs, dies and tools will be accumulated in the A/M Shops to form the basis of technology which supports the pursuit of self-sustaining operation.

In No.1 HI the existing buildings should be used and new machines installed. In No.3 HI since the existing building facilities can not be used, a new building will be constructed. In No.4 HI the existing buildings can be used. In the A/M Shops the broken machines are to be disassembled and the malfunctioning part newly made or repaired, then the machine to be re-assembled and inspections and adjustments to be carried out. The A/M Shops cannot handle the large items such as the bed, column, or gear box of machine tools. The main items to be handled by the A/M Shops are shafts, cases, plates, collars, metal parts and drill bushes, etc. together with jigs and dies.

2) Improvement of Maintenance System (#11-1)

The basic points for improvement of the maintenance system are as follows:

The shift from the present system which is engaged mainly in breakdown repairs to a preventive maintenance system. Maintenance functions can be divided into the following three, namely, daily checks, scheduled maintenance and repairs after breakdown.

1. The basis of daily check is the correct operation and handling of machinery by the operators in the individual sections or lines. Further, this includes discovery of equipment irregularities or abnormalities by operators following the maintenance manual and routine maintenance activities such as lubrication and cleaning to be performed by the operators.

2. Scheduled maintenance is to be carried out by specialist maintenance specialists. It is to periodically disassemble and check the machinery and equipment in accordance with the maintenance schedule prepared on the basis of maintenance programs and maintenance manuals. Periodic replacement of spare parts and preventative repairs are to take place as necessary. At the same time repairs of any minor troubles which have occurred in the preceding period is to be done. In order to implement the scheduled maintenance it is important to prepare a maintenance program on the basis of the various records relating to maintenance and to proceed with the necessary preparation for the procurement or

manufacturing of parts required for maintenance prior to the execution of the scheduled maintenance.

3. Breakdown maintenance is to be carried out by a staff of maintenance specialists to make repair of breakdowns and replacement of parts.

The present plan is for the establishment of a maintenance system emphasizing on 1 and 2 above. To this end the important measures are to compile detailed maintenance records including records of equipment details and statistics of breakdowns prepare maintenance manuals, and formulate a maintenance program based on the maintenance records and maintenance manuals. Further, when preparing the maintenance program it is essential to appropriate adequate budget for securing the arrangements of necessary parts and materials and also necessary workers.

As the initial phase of the establishment of this system, it is planned to undertake the drawing-up of daily check lists, implementation of daily inspections, drawing-up of statistics for breakdowns and machine records. Then on the basis of this data the maintenance manuals and maintenance programs should be drawn up and the maintenance system further improved.

3) Domestic Production of Gauges and Cutting Tools (#3-2, #3-4)

Since the gauge manufacturing shop is closely related to the calibration equipment for measuring equipment and instruments, it should be set up in No.5 HI near to the Calibration Center discussed later.

Production of the cutting tools is to be done in the cutting tool shop to be set up in No.5 HI. Since the production of cutting tools requires a high level of technology, production is scheduled to be divided into a drill group production and tap group production.

4) Establishment of Dies Repair Shops (#3-3)

General repairs of the dies require special machines for these, requiring a large amount of investments. Hence it is planned to establish dies repair shops which are engaged in temporary repairs

which can be taken place without special machines. Repairs for No.1 HI are to be carried out in the new workshop to be set up in the New Press Shop, and the repairs for No.3 HI and No.4 HI are in the A/M Shop of No.3 HI.

(2) Acquirement and Accumulation of Production and Engineering Technology

There are several alternative concepts concerning the process and preparedness to be taken for development and institutional build-up of these technology from the stage of the acquirement of production technology through to the realization of the Production Engineering Center (for details, refer to ANNEX 3). The present plan is based on the following concept (Refer to Figures 4.4-3).

As mentioned above, the A/M Shops which are in charge of small repairs are to be located, respectively, in No.1 HI, No.3 HI and No.4 HI. These A/M Shops are managed under the control of the respective factories. At the same time a production engineering team is to be attached to each A/M Shop to make them accumulate the technology and expertise for repairing work.

Also, the Calibration Center and the Manufacturing Shop for Gauges and Cutting Tools will be set up in No.5 HI. Technology for manufacturing gauges and cutting tools is to be centralized and accumulated in the Calibration Center.

After these technologies have been accumulated, the Production Engineering Center and the Dies Manufacturing Shop should be set up in No.5 HI. The Production Engineering Center is to centralize the production engineering technology accumulated in the A/M Shops and the technology for manufacturing the gauges and cutting tools which have been accumulated in the Calibration Center. Further, members of the Production Engineering Center are to be stationed in each of the individual A/M Shops to make them give technical guidances to the individual shops. Of the machines installed in the A/M Shop of No.3 HI, those required for the manufacture of large-sized dies will be transferred to the Dies Manufacturing Shop of No.5 HI.

Figure 4.4-3(1) Organization Plan of Maintenance System, Production Engineering Center and Calibration Center (Phase I)

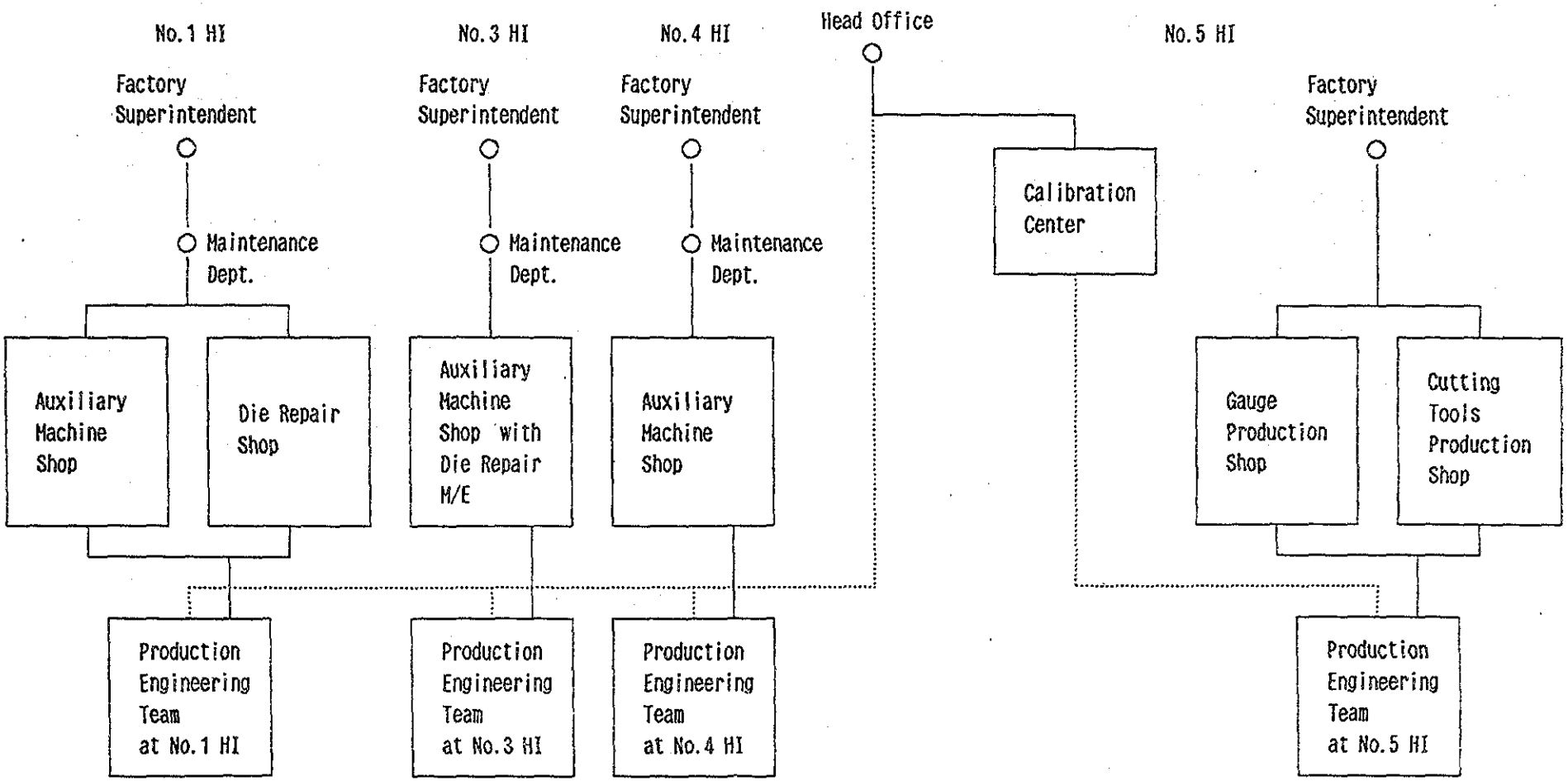
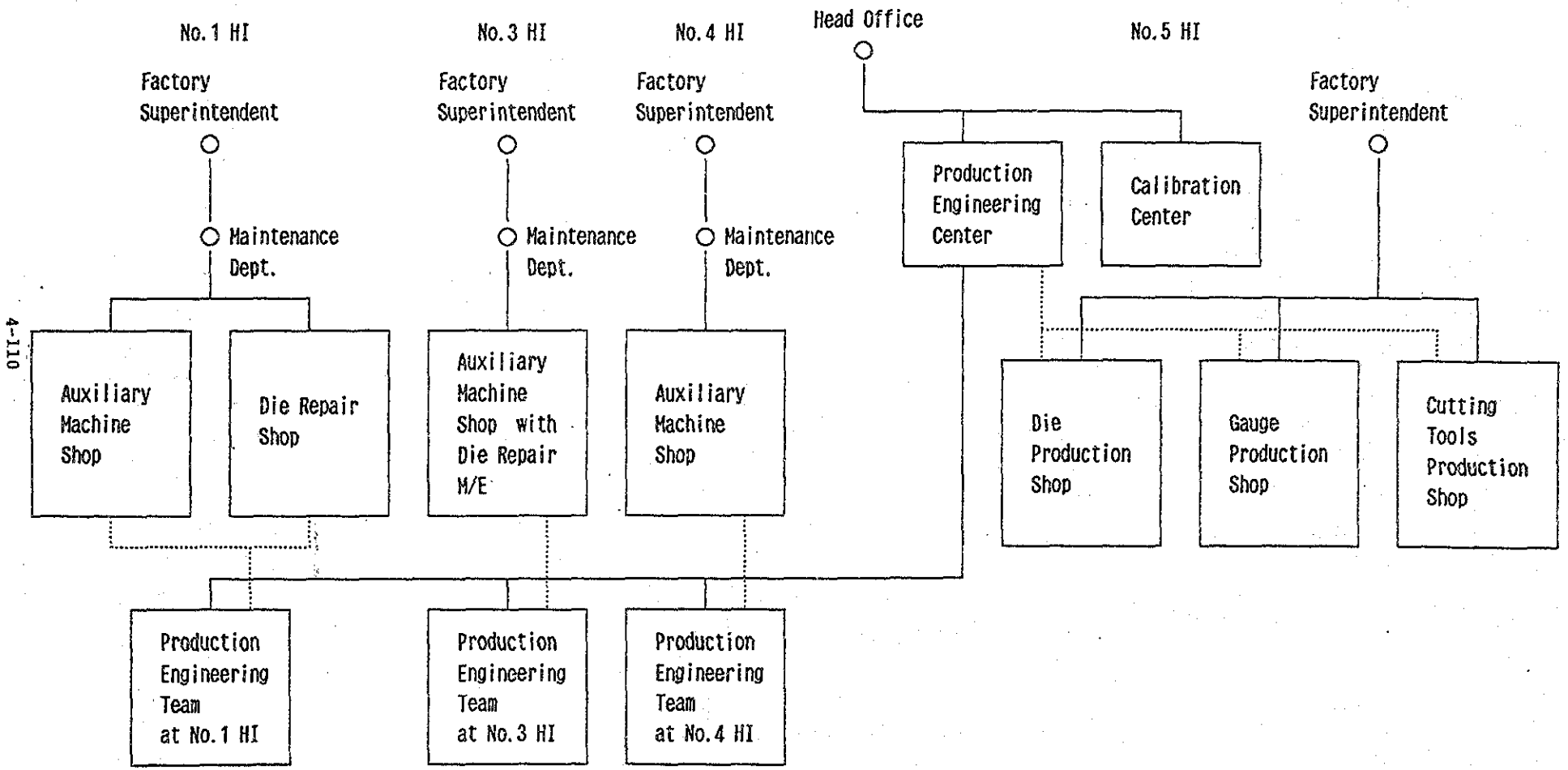


Figure 4.4-3(2) Organization Plan of Maintenance System, Production Engineering Center and Calibration Center (Phase Ⅱ)



(3) Enhancement of Calibration System for Measuring Equipment and Instruments

1) Provision of Equipment

The Calibration Center is established and equipment required for the calibration of measuring equipment and instruments are centralized there. This center will be equipped with a full set of equipment for conducting periodical check and calibration of measuring equipment and instruments installed in the shops. Since this sort of facility does not exist yet in Burma, the Calibration Center should provide its service not only for HIC but offer this to other industries and state corporations.

This facility is to be located in No.5 HI.

The introduction of necessary equipment is to be divided in two phases by grouping them on the degree of urgency involved.

Phase 1 - Primary Urgency Group: The instruments which are most frequently used for periodical check; those usually installed in factories and having a level of accuracy classified as "Tertiary Standard" in foreign countries.

Phase 2 - Secondary Urgency Group: The instruments having high accuracy classified as "Secondary Standard" which can be used as the Mother Instrument for checking the accuracy of the instruments classified as "Tertiary Standard", together with others than those included in Phase 1.

2) Establishment of Calibration System

1. Undertake the training of personnel to be engaged in the calibration activities.

2. Establish comprehensive HIC standards defining checking system, organization, personnel, required technical expertise, and the rule of regular inspections.

3. Carry out guidance for the measurement control of each of the individual shops.

4-4-3 Preparation for Self-Sustaining Operation in Future

(1) Establishment of Capability for Improvement and Development of Products

This plan is to be implemented in three stages as follows:

First Stage: Preparation and initial system setup stage.

Second Stage: Initial development and technology acquirement stage.

Third Stage: Technology development stage, including the development of new products.

Outline of the activities to be performed in each stage is described below:

1) First Stage: Preparation and Initial System Setup Stage

Main activities to be performed at this stage consists of (i) the compilation of data and information concerning specifications and characteristics of the component parts of the HIC's products and applied standards, (ii) the enhancement of a system for conducting the tests and analyses to grasp the quality and performance of the products manufactured and also of the quality of the raw materials and component parts, and (iii) the establishment of a system for feeding collected information and the results of conducted tests and analyses to the production departments concerned.

To this end the provision will be made for the equipment, organization and information system as follows:

a) Provision of Equipment

Provision of equipment necessary for measuring basic points, such as the tension and bending test machine, hardness test machine, metallurgical microscope, instruments, etc.

b) Organizational Setup

1. By the time when the installation of the equipment for tests and research are completed, list-up and classification of testing equipment and instruments which have been installed in the shops are to take place so that these equipment can be used as required.

2. The staff assigned to the research and development have to prepare detailed programs for the research and development including the definition of the objective, methodology, subjects and contents with reference to relevant literature, and other information.

3. Identification of the subjects for research and development have to be performed in consideration of the research activities which can possibly be worked out by utilizing the available equipment.

   (Examples)

   . Research on the relationship between the analysis result of the composition of molten metal for casting, and the result of the test and analysis of microscopic structure and intensity made on test pieces.

   . Research on the relationship between the result of the material test of heat treatment agents and the hardness, structure and intensity caused by treatment conditions.

   . Research on the relationship between the materials for surface treatment of paintings or platings and the strength and weatherproofness of coated surface caused by treatment conditions.

c) Provision of Data and Information

1. Filing and classification for reference concerning all records relating to the research and development activities, tests, analyses and measurements performed.

2. Classification for reference of standards, codes literature and other relevant data and information collected or to be made available.

3. Collection and classification for reference of information concerning tendencies of relevant products, technology and demands in Burma and abroad.

4. Collection and classification for reference of drawings, bill of materials, and other technical and design documents of the products manufactured by foreign manufacturers, together with the design standards, drawings and specifications, the standards of raw materials, preparation standards for bill of materials, standards of component parts, and other standards to be applied to the HIC's products.

2) Second Step: Initial Development and Technology Acquirement Stage

Design for modification, trial manufacture, performance test and further improvement are to take place for the HIC's products which require partial modification. In the course of these activities, technology for (i) defining the specifications of component parts and (ii) drafting the drawings of those parts shall be acquired.

To this end the provision will be made for the equipment, organization and information system as follows:

a) Provision of Equipment

The definition of specifications and design of component parts have to be performed with the expertise based on actual conditions and characteristics of the products. In order to grasp these it is necessary to perform the tests and analyses of the raw materials, component parts and the products. Therefore the equipment and instruments needed for these tests and analyses are to be installed.

b) Organizational Setup

1. Organize a system for producing HIC's shop drawings based on the original drawings of foreign products which HIC possesses, and starting the production according to the thus prepared drawings.

2. Organize a system for conducting the strength test, durability test and performance test of the products as required for the research activities. These tests and research shall be performed, respectively, by the teams organized for the specific fields and in accordance with the objective, methodology and contents of the research prepared on the individual subjects.

3. Conduct research for clarifying the causes of defective component parts which have been used for the defective products sold, by means of repeating the manufacturing processes under the same conditions.

Cooperation and assistance of the technical advisory teams from relevant Japanese companies to the Four Industrial Projects is required to perform the above.

c) Provision of Data and Information

1. Collect test and analysis data with realization of actual conditions by participating in the tests and analyses conducted. Since the collected data is indispensable in determing the specifications of parts, all the data should be filed regardless of success or unsuccess of the tests.

2. Scrutinize the test and analysis data compiled in the file to select those useful for the research.

3. Collect and compile relevant data and information available from outside of HIC.