③ All managers should thoroughly understand the purpose of and their role in restructing and modernization. Each department and section manager should be given the responsibility and authority to perform his part in the modernization plan and he should provide the implementation plan for his part.

Taking this chance, Leko ko can change the organization (See Figure 11-10) to rationalize the control and management sections and also study the possibility of separating the energy department as an independent firm. A planning and promotion section should be newly established to support the manager in restructuring and modernizing.

④ The plant manager should receive reports monthly from each manager about the progress of the implementation plan. The plant manager should check the progress and show a strong intention to execute the plan on schedule.

For efficient implementation, Leko ko should use a QC method such as PDCA: P (Plan), D (Do), C (Check) and A (Action).
Personnel problems are not reported in this section but are described in Section 11.4.1 1) A lack of engineers and skilled workers.

11.6 Overall Schedule for Modernization

Figure 11-11 shows the schedule of the modernization plan up to 2005. The purpose of the plan is the implementation of the sales and production plan with the same number of employees as at present, modernization of the organization and management, enhancement of the ability of employees by education and training and improvement of the vitality of the whole organization. Leko ko should be careful not to make useless investments, paying attention to the profit to be realized by the investment, when they install machining equipment and introduce the system for improvement.
Although not shown in the figure, the technical and work standards should also be revised based on updated technology when Leko ko educates engineers using the standards. The standards have not been revised since 1983.

Table 11-1 World Major Forgemasters and Foundries

Company	*1 EAF	LF	Max. Ingot	*1 Press	Characterized Technology	Competitive Product
SdF/Italy	180EAF 100EAF	180LF 140AOD 70AOD	280	12,600 5,000	TREST(Terni refractory efetroslag topping)	Turbine rotor
VSG/Germany	110EAF 20EAF		210	8,000 6,000	Krupp, Thyssen, Klockner PESR(Pressurized ESR)	Retainer ring Crankshaft
Saarschmiede /Germany	125EAF	125LF	150	6,000	160ESR VIM VAR	Turbine rotor
CLI/France	95EAF	95VAR 95VOD	240	11,300 7,500	Hollow ingot	Shell Retainer ring Nuclear parts
Fortech /France	40EAF			65,000 20,000 2,500	30ESR	Gas turbine disk
FSL/UK	90EAF	90VOD 75VAD			12VIM 7VAR 13ESR TSV(Sliding gate tophole gate) VIDP(Vacuum induction degassing and pouring)	Turbine rotor Off shore parts
FEL/UK			300	10,000 1,500	GFM SPX65	
Bethforge /US	150EAF	150LF 150LF	300	9,070 2,270	DC/EBT	Turbine rotor Nuclear parts
Erie Forge /US	68EAF	118LF 113VOD	130	3,630 1,815	UHP	Medium size product
KSL/Japan	100EAF 25EAF 20EAF	100LF 100LF 100LF 50LF 20LF	500	13,000 3,000	72ESR 18VOD RR-PRESS RR forging process Steel cast crank	Crank shaft USC Rotor Monoblock rotor Super clean rotor Nuclear parts
JSW/Japan	120EAF 25EAF	150LF 140LF 130LF 100LF 30LF	600	10,000 3,000	100ESR 8000Press Giantic ingot of 600ton Super clean steel	Super clean rotor Monoblock rotor Shell Nuclear parts
JCFS /Japan	100EAF 50EAF	150LF 140LF 100LF 80LF	500	8,000 3,000	Electroslag hot top Program control forging	Monoblock rotor Super clean rotor Nuclear parts

*1: Figures mean max. capacity in tons.

Table 11-2 Future Production Plan to 2005 and Productivity per Head

	Design Capacity	Max. production Record in 1987	Production in 1995	Production in 1996	Production in 1998	Production in 2000	Production in 2005	Production of *3 Advanced shop, 1994
Steel melting No. of personnel*1 Production/Head	150,000 ton/y	60,000 ton/y 450~ 500 133~ 120 ton/H	16,783 ton/y 200~210 84~80 ton/H	27,437 ton/y 200 137 ton/H	54,278 ton/y 200 271 ton/H	70,000 ton/y 200 350 ton/H	80,000 ton/y 200 400 ton/H	161,220 ton/y 166 971 ton/H
Ingot for sale		NA	2,821 ton/y	5,642 ton/y	11,284 ton/y	14,552 ton/y	16,630 ton/y	20,000 ton/y
Forging(As Forged) No. of personnel*1 Production/Head *2	45,000 ton/y	NA 380 NA	8,524 ton/y 180 47 ton/H	12,524 ton/y 180 70 ton/H	24,580 ton/y 180 137 ton/H	31,700 ton/y 180 176 ton/H	36,228 ton/y 180 203 ton/H	75,200 ton/y 200 376 ton/H
Casting No. of personnel*1 Production/Head *2	43,000 ton/y	NA 500 NA	985 ton/y 150 6.6 ton/H	1970 ton/y 150 13.1 ton/H	3,940 ton/y 150 26.3 ton/H	5,081 ton/y 150 34.0 ton/H	5,806 ton/y 150 38.7 ton/H	16,800ton/y 100 168 ton/H
Export Ratio			68 %	74 %	86 %	89 %	90 %	

*1; No. of workers directly in charge of each process

*2; Leko ko should keep no. of worker as same as 1995 by improving productivity

*3; Japanese major shop

NA:Not applicable

*4; Yields are estimated below

Casting/Molten Steel:50% Ingot/Molten Steel:100% Asforged/Ingot:70% Machined Forging/Asforged:70%

Table 11-3 Sales and Production Plan of Leko ko

Production Sales		1993	1994	1995 1~ 6	1995	1996	1998
Ingots	tons	9,466	617	872	2,821	5,642	11,284
	kLv.	33,130	27,788	23,285	70,000	140,000	280,000
Casting	tons	322	501	280	985	1,970	3,940
	kLv.	22,765	36,307	28,930	100,000	200,000	400,000
As Forged Product	tons	928	1,474	1,115	2,029	4,040	6,000
	kLv.	17,636	38,287	39,480	87,436	160,000	240,000
Machined Forging	tons	2,173	4,173	2,108	4,547	5,939	13,006
	kLv.	87,678	239,258	195,689	518,987	630,000	1150,000
Rolls	tons		2,387	974	3,181	3,695	5,400
	kLv.		174,214	128,566	419,890	487,740	712,800
Shafts	tons		245	608	764	836	1,857
	kLv.		16,916	46,219	70,635	77,220	171,600
Others	tons		1,541	526	602	1,408	5,749
	kLv.		48,128	10,904	28,472	65,040	265,600
Total Amount	tons	12.889	6,765	4,375	10,382	17,591	34,230
	kLv.	161,209	321,640	287,384	776,423	1130,000	2070,000
Export share				68 %		74 %	86 %

Table 11-4 Product Mix in 1998

Production / Sales		1995	1998	1998/1995	Present(1995)product /present market	Future(1998 ~2005)product /Future market
Ingots	tons	2,821	11,284	4.0	Domestic mill	Domestic mill Forgemasters/EC
	kLv.	70,000	280,000	4.0		
Casting	tons	985	3,940	4.0	Stern frame, Stern tube /Domestic, EC Valve body/Domestic	Stern frame, Stern tube /Domestic, EC, Asia Mining part, Roll stand/CIS Valve body/Domestic Casing, Runner/EC, Asia, US
	kLv.	100,000	400,000	4.0		
As Forged Product	tons	2,029	6,000	2.9	Roll/EC Round bar/EC, Domestic	Roll/EC, Asia Round bar/EC, Domestic
	kLv.	87,436	240,000	2.7		
Machined Forging	tons	4,547	13,006	2.8	———	———
	kLv.	518,987	1150,000	2.2		
Rolls	tons	3,181	5,400	1.7	Finished roll/Domestic Rough machined roll/EC	Finished roll/Domestic, EC Asia Back up roll/Domesrtic, EC
	kLv.	419,890	712,800	1.7		
Shafts	tons	764	1,857	2.4	Rough machined shaft /EC, Domestic	Finished shaft/EC, Domestic Asia
	kLv.	70,635	171,600	2.4		
Others	tons	602	5,749	9.5	Die plate for plastic mould/Taiwan, EC Axle/Domestic	Die plate for plastic mould/Asia, EC Coupling shaft/Domestic, EC Turbine shaft/EC Mining part/Domestic, CIS
	kLv.	28,472	265,600	9.3		

Table 11-5 Productivity and Yield of Leko ko and Advanced Shop

	Leko ko		Japanese major manufacture	
Steel Making	60ton EAF	25ton EAF	100ton EAF	25ton EAF
Annual Production / head	100 ton/head In 1995 with 60, 25, 15 ton EAF's		971 ton/head In 1994 with 100, 25, 25 ton EAF's	
Power consumption	712 kwh/t	694 kwh/t	500 kwh/t	465 kwh/t
Charge/month	34	13	70	60
Electrode consumption	6.13 kg/t	5.54 kg/t	3.70 kg/t	4.50 kg/t
Tap to tap	260 min	150 min	180 min	70 min

Forging	1600 ton & 3600 ton Press	3000 ton & 13000 ton Press
Annual Production / head	64 ton / head in 1995	376 ton / head in 1994
Lead time from pla -ning to shipment	19 weeks;Finished roll 9 weeks;Rough machined propeller shaft	17 weeks;Finished roll 12 weeks;Finish machined propeller shaft
Energy consumption for heating	Not applicable	2.3 ~3.0 x 10^5 kcal/ ton for 6000 ~10000ton press 1.1 ~1.8 x 10^5 kcal/ ton for 2000 ~5000ton press
Machinig tolelance of square section plate *1	10~15 mm for 130mm thick 15~20 mm for 370mm thick 20~25 mm for 750mm thick	4 ~ 6 mm for 130mm thick 6 ~10 mm for 370mm thick 8 ~12 mm for 750mm thick

*1 ; Figures of leko ko are roughly estimated for comparison

Casting	Stern frame, Stern tube Valve body	Crank throw of assembled crankshaft Stern frame, Stern tube
Annual Production / head	6.6 ton/head in 1995	168 ton/head in 1994
Lead time from pla -ning to shipment	24 weeks;Stern frame 29 weeks;Cone shell of crusher	16 weeks;Stern frame 19 weeks;Cone shell of crusher

Heat Treatment		
Energy consumption for heat treatment	Not applicable	4.2 x 10^5 kcal/ ton for normalizing or quenching 1.7 x 10^5 kcal/ ton for tempering

Table 11-6 Competitiveness of Leko ko

Major Items	*1 Level	Competitiveness to competitor
Facilities	=	Even as producer of medium size product except machining capacity Facilities are 12 years old
Technology	×	Even or weak a little for present products, but weak to expand new product mix. and to solve technical problem
Workmanship	×	Weak. Number of qualified workers significantly decreased since 1989.
Productivity	××	Weak. Ex. molten steel/a shop worker x year = 37 ton/man x year. (competitor= 210) See Table 13-5 in detail
Sales force	××	Weak. Too small(few personnel) to keep sales plan and to expand new product mix.
Cost Energy cost	○	Strong in both electricity(0.76Lv./kwh) and gas(1812 Lv./10^3Nm^3)
Cost Material cost	○	Strong in scrap cost(1/3 of international price) Even in other raw material and refractory etc
Cost Labour cost	◎	Strong. About 7000lv./m
Cost Financial expences	××	Weak. Too much interest.(40% in state bank)

*1 ◎ ; Much stronger
○ ; Stronger
= ; Even
× : Weaker
×× ; Much weaker

Table 11-7 Cost Estimation of Investment for Improvement

Machine and Equipment	Max. size of work Dia.	Length	Weight		Cost k US$
1. Installation (NC equipped)					
1) Engine Lathe x 1set	2000mm	16000mm	30t		6000
2) Engine Lathe x 2sets	500mm	4000mm	3t		1000
3) Grinding machine x 1set	2000mm	8000mm	30t		6000
				Sub. total	13000
2. Retro-fit (NC equipped)					
1) Engine Lathe x 2sets	500mm	4000mm	3t		400
2) Engine Lathe x 2sets	1500mm	10000mm	20t		2000
3) Engine Lathe x 1set	2000mm	16000mm	30t		1500
4) Grinding machine x 1set	1500mm	4000mm	20t		1000
				Subtotal	4900
3. Installation					
1) Ejector	Same as installed				221

4. Introduction of production system	Hardware CPU	P-CPU	WS	Software	Cost / k US$ Hardware	Software
1) Steel making support system	1set	——	20sets	100k steps	500	1000
2) Press schedule support system	——	3sets	——	15ksteps	20	1500
3) Machining plan support system	——	3sets	——	15ksteps	20	1500
				Subtotal	540	4000
4) Total production system	3sets	——	125sets	1900k steps	5730	16630

Figure 11-1 Gross Tonnage of World Shipbuilding

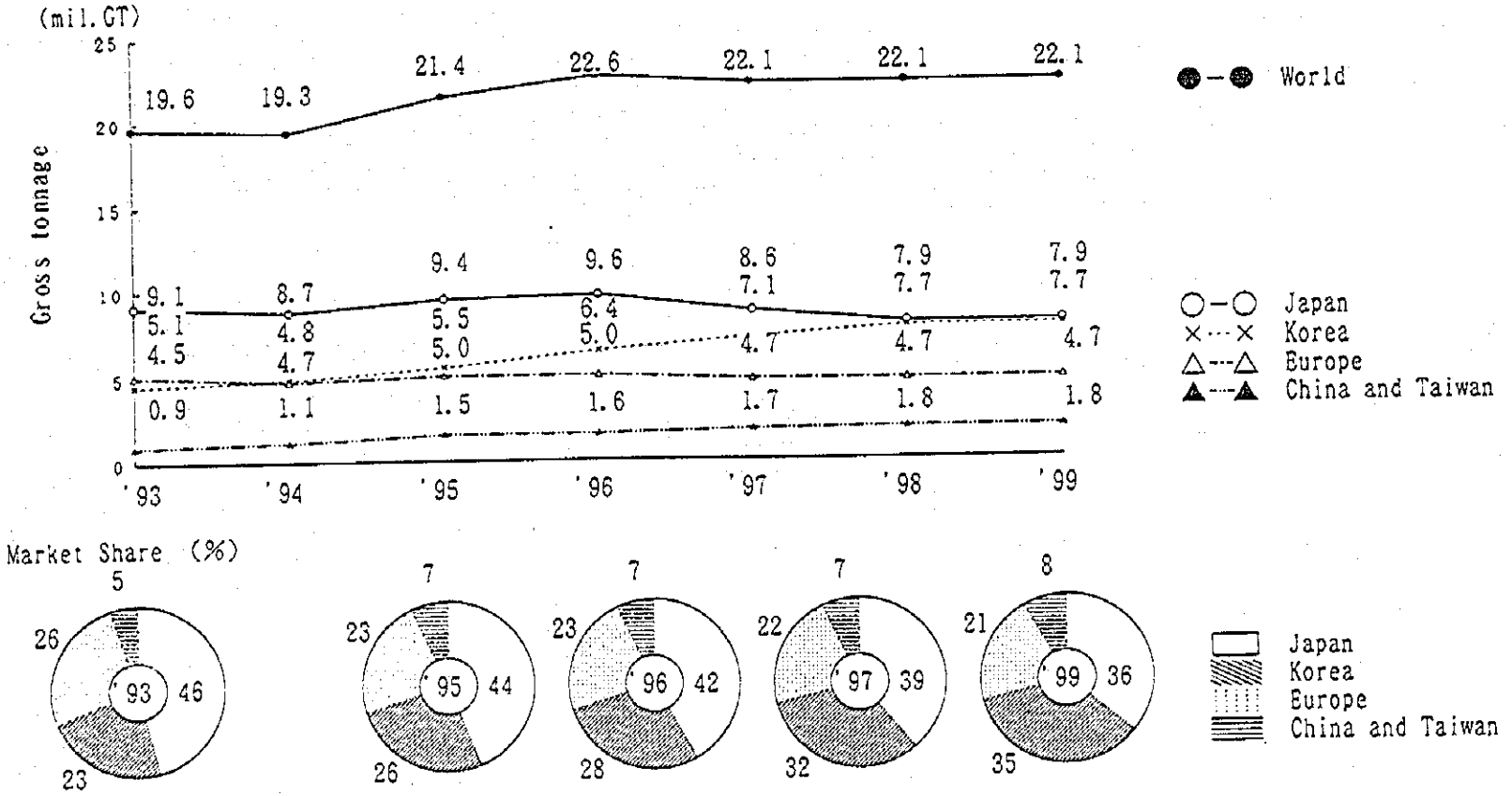


Figure 11-2 World Consumption of Steel Product

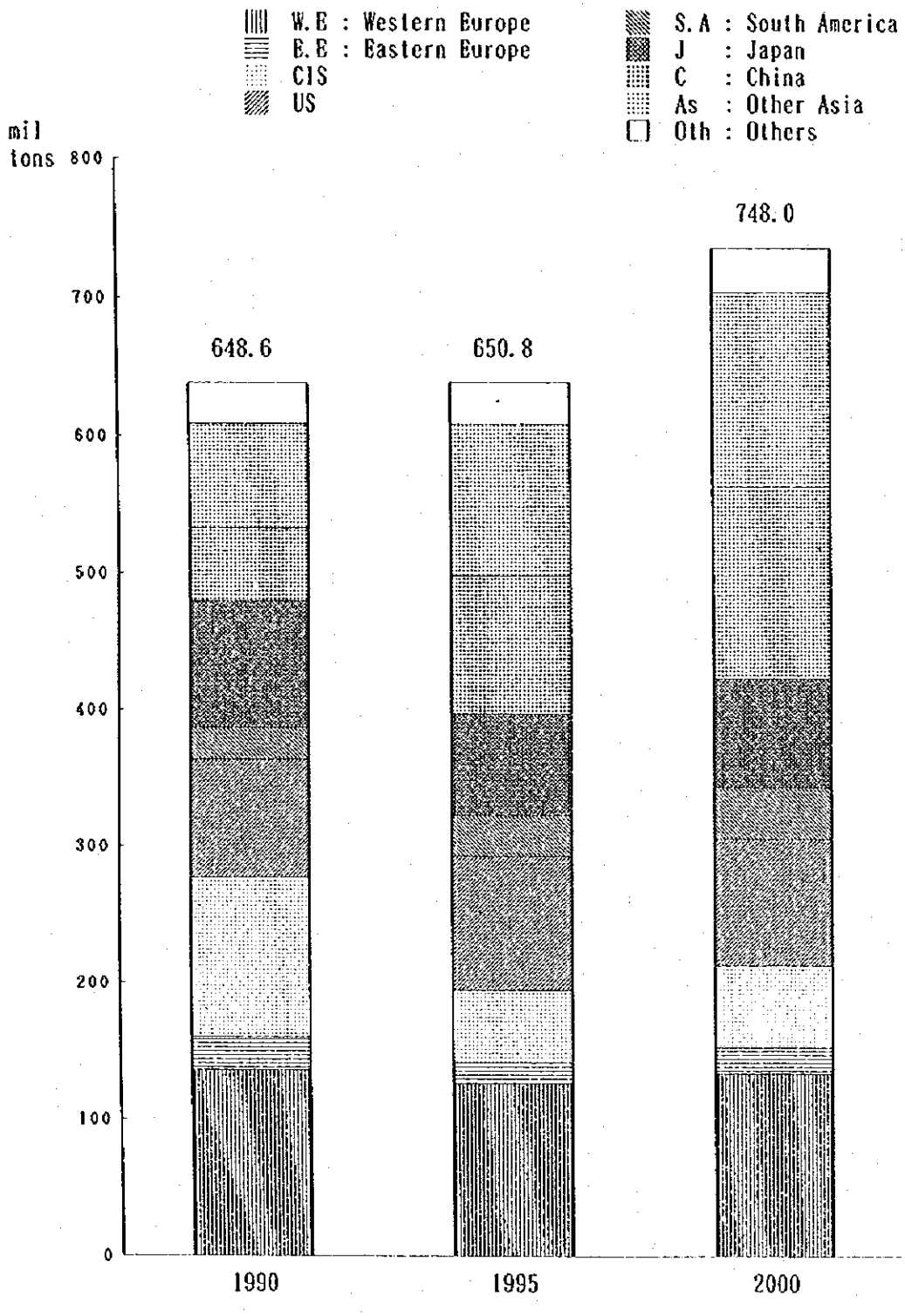


Figure 11-3 Electricity Consumption in Asia

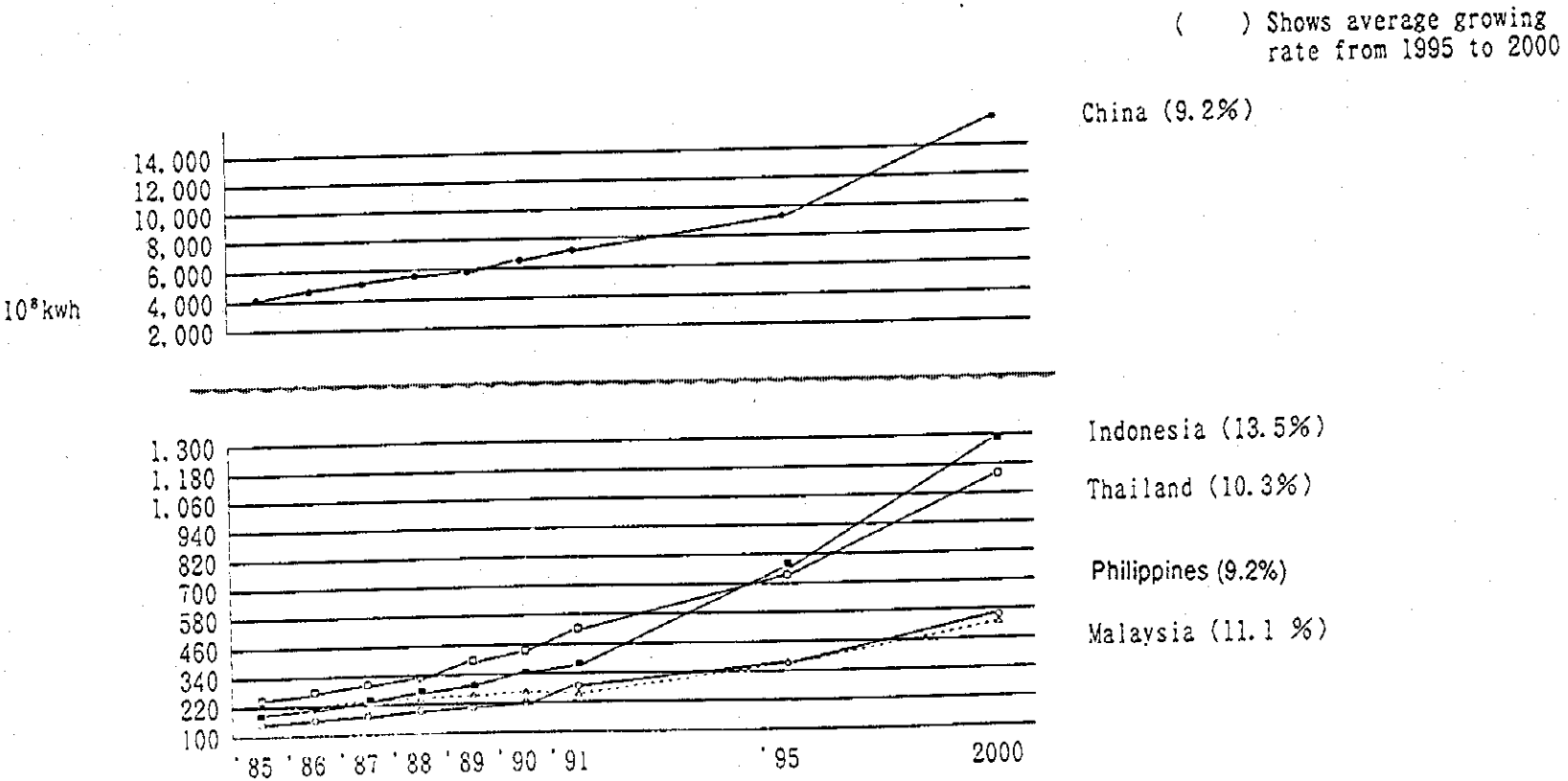


Figure 11-4 Forging Production of World

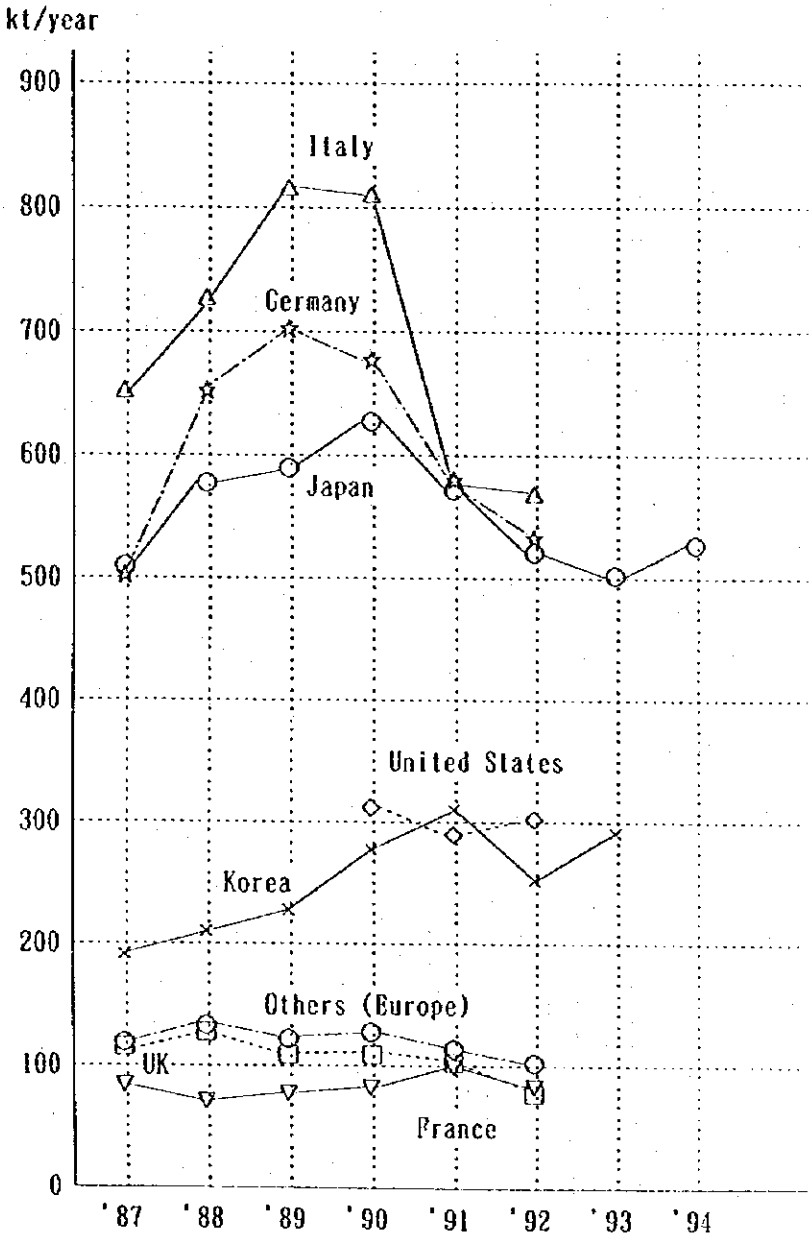


Figure 11-5 Steel Casting Production of World

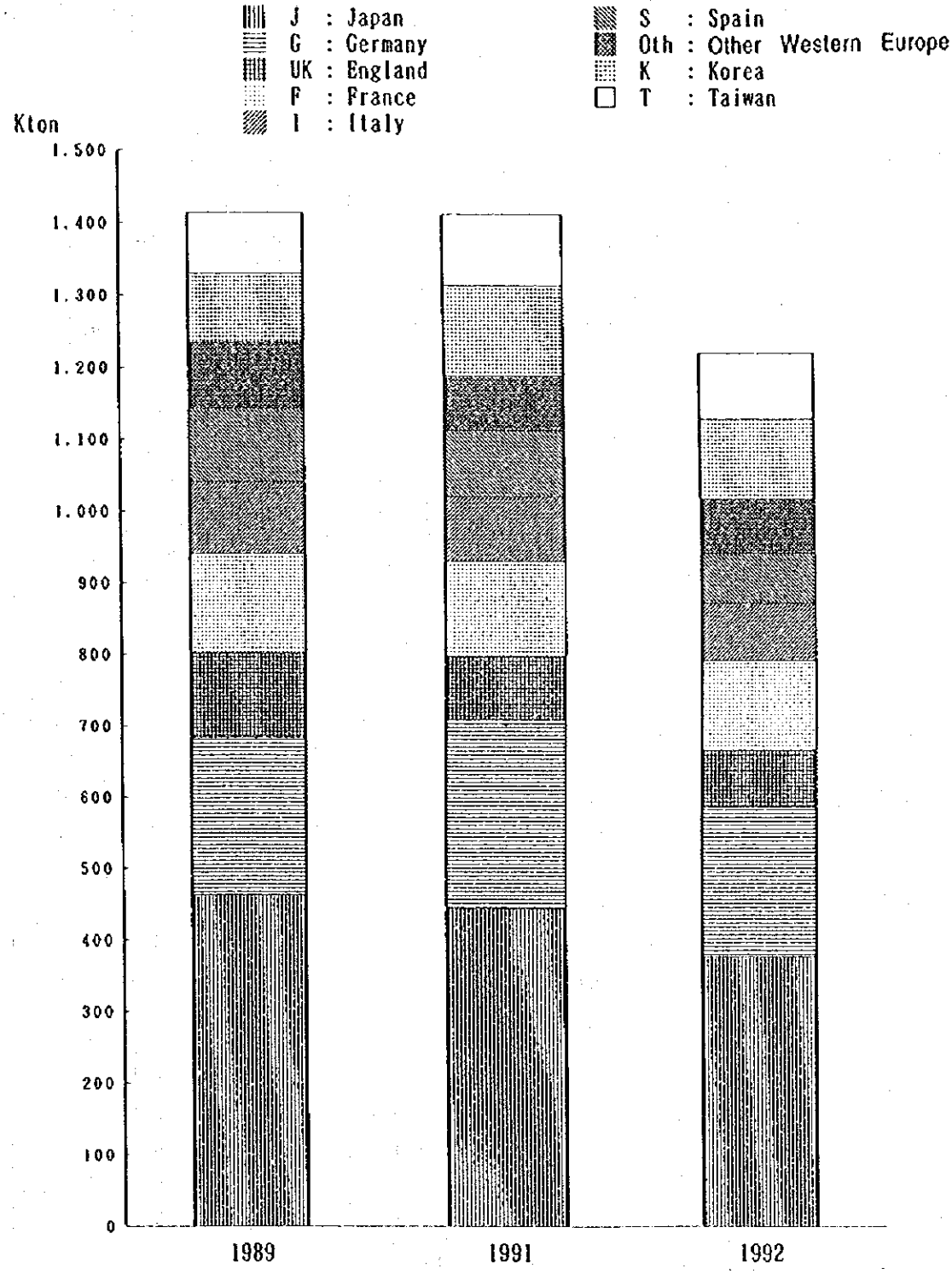


Figure 11-6 Material Balance in 1994 and First Half of 1995

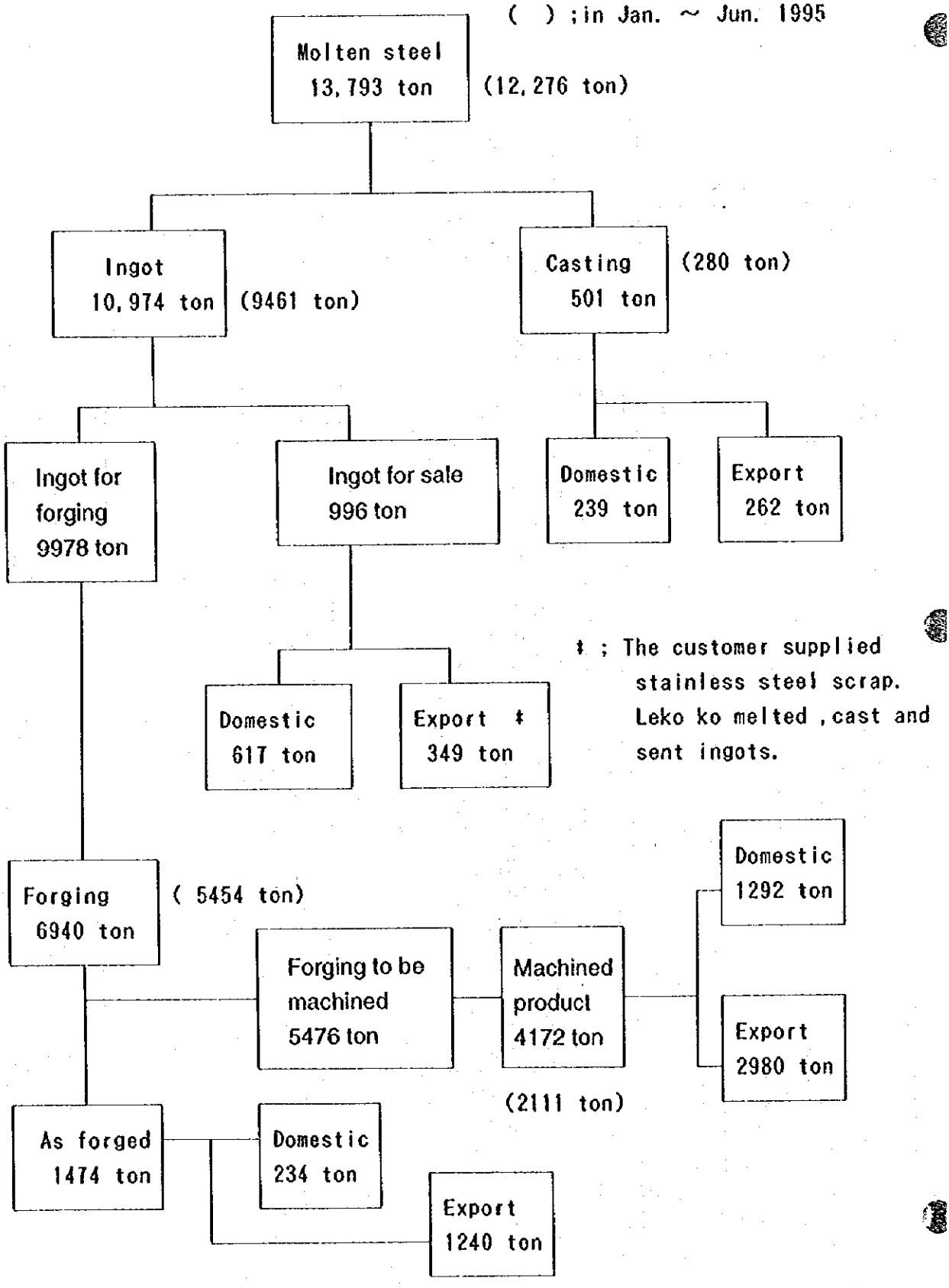


Figure 11-7 Steel Making Support System

Steel making support system

(1) Object

① Improvement of production efficiency
- Decreasing down time in all shops
- Quick reschedule of melting sequence to sudden change of production schedule

② Cost reduction and stabilization of quality
- Standardization of steel making technique and training fresh man
- Optimizing operating condition in case of disturbance
- On time control of quality and yield
- Speedy development and improvement of steel making technology supported by data acquisition system

(2) Feature of system

① Optimum raw material arrangement by use of LP calculation can achieve cost minimum operation
- Preliminary calculation of raw material arrangement (for rough preparation to transportation by bogie)
- Final calculation of raw material arrangement
- Final calculation of alloy addition

② Easy guidance for operator
A guidance using computer simulation model of operation formulated by analysing actual operation data
(Temperature estimation, estimation of oxygen blow time)
Clear work instruction on CRT illustrating Japanese, drawings and graphes

③ On time display of chemical analysis results on operator's CRT
Chemical lab. sends the results just after analysis
Automatic judgement of analysis results to the specification

④ Data acquisition of steel making practice
Automatic data acquisition system with providing sensors and improving equipment
BCD signal from scrap weighing machines and alloy hoppers
Analog signal from thermometers and flow meters
Point contact signals showing furnce location and inclination of furnace
Total 360 signals are acquisited
Automatic preparation of steel making records

⑤ Control of production status
Monitoring production status by comparing actual status data, originally planned data and the signals
Modification of production schedule

⑥ Statistical analysis of operation data
On time processing of statistical analysis
50 kinds of graphes and table usefull for QC activities and technical analysis

⑦ Suitable computer for steel shop application
Quick response time for steel making operation
Flexible system for various requests
Free from environmental disturbance such as noise , magnetic field etc

(3) System functions and their out line

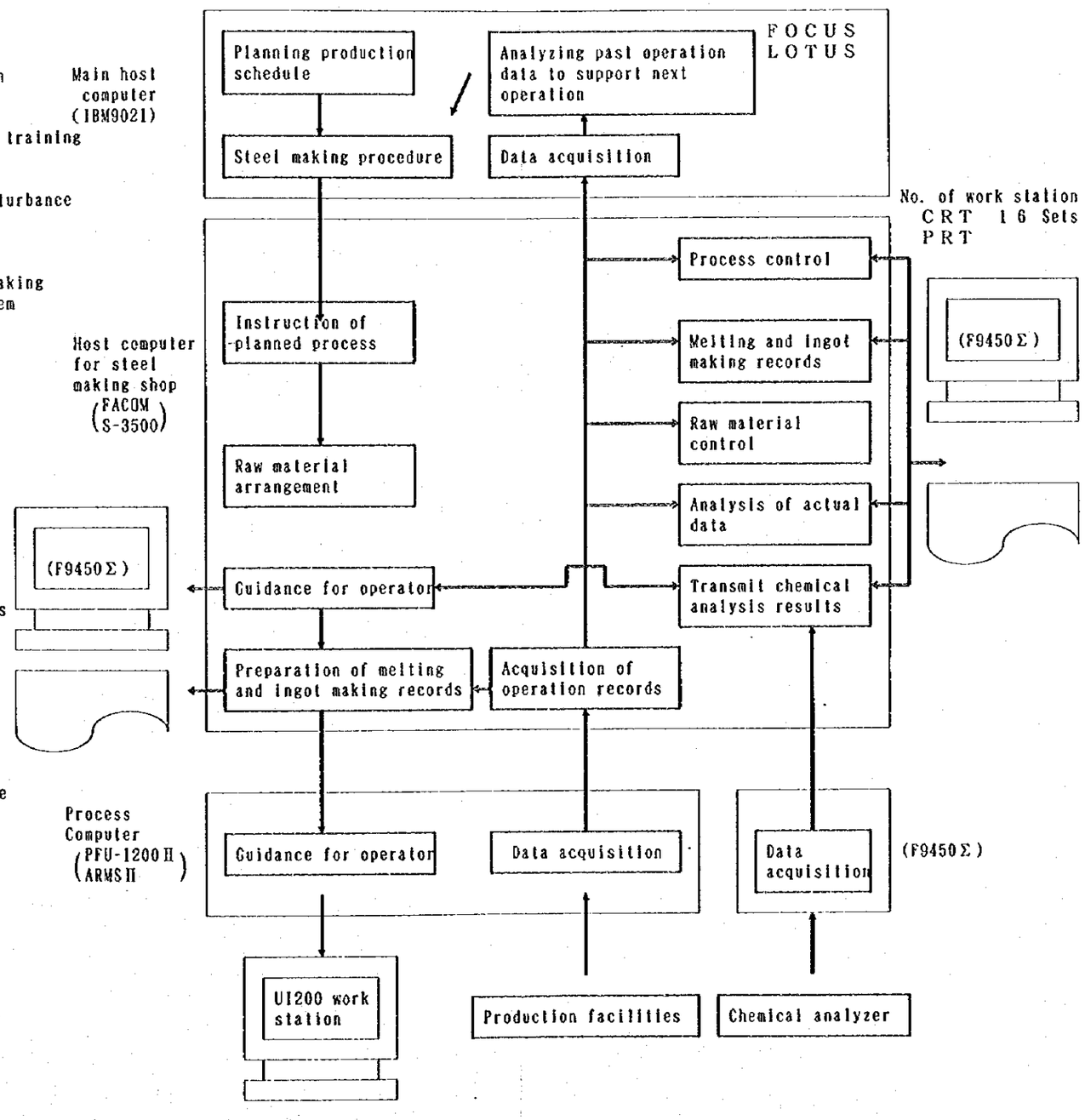


Figure 11-8 Manufacturing Procedure Control System (Fee Forging Process)

Manufacturing procedure control system (Free forging process)

1. Objects

(1) Uniform format and preparation of work instruction
(2) Standardization of manufacturing design
(3) Effective preparation of manufacturing procedure

2. Feature of the system

(1) Strict standardization of manufacturing procedure

- Procedures are prepared based on 30 technical standards covering excess material, ingot application , heat treatment, etc

(2) Drawing can be in-put by minimum data input

- Forging drawing and heat treatment pattern are shown on CRT and hard copy

(3) Automatic preparation of procedure from order specifications

- Procedures are automatically prepared for repeat order. Computer can pick up customer, steel grade, material spec. forging dimension and necessary data and out put procedures. About 40% of products are covered by this automatic preparation .
- In case of similar order , procedures can be automatically prepared with small modification using CRT and key board.

(4) Preparation of forging procedure

- Detail forging procedures are provided for rotors, shells and others which need individual special forging sequences

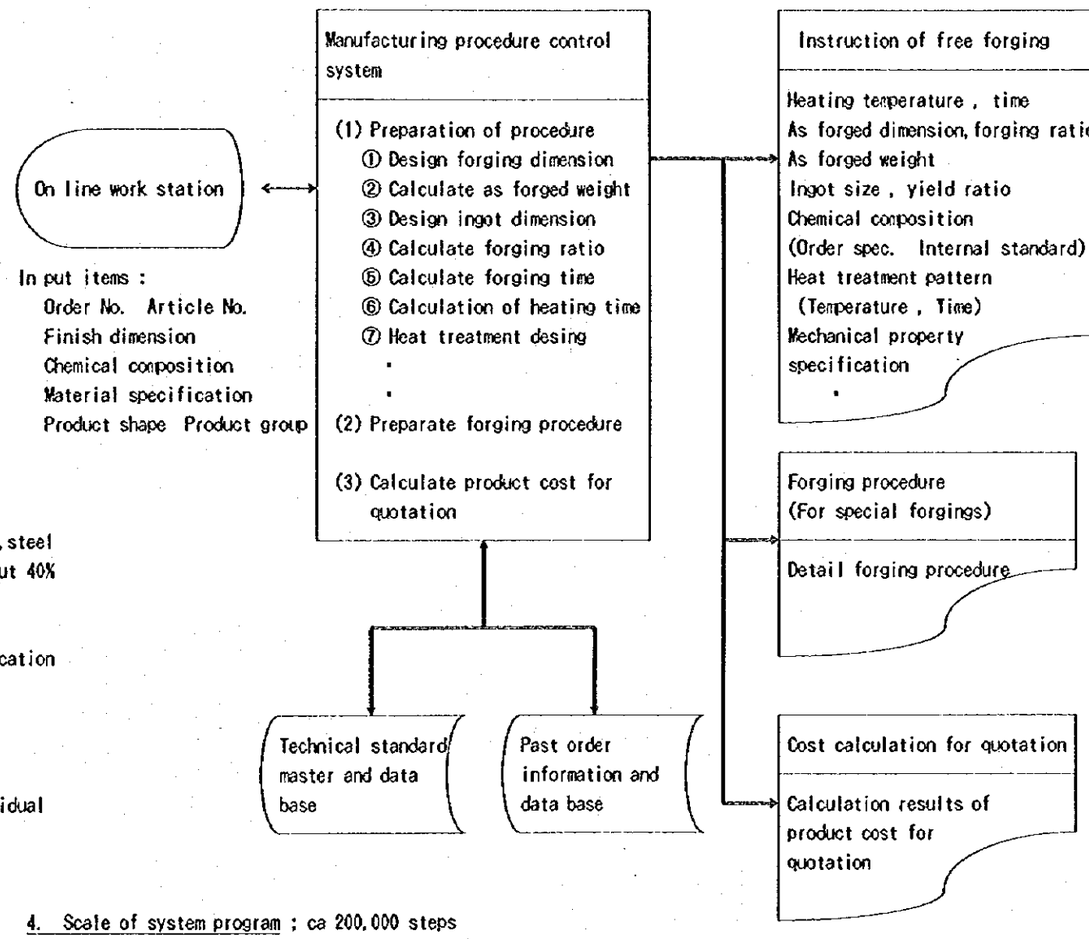
(5) Cost estimation

- Cost for quotation can be calculated and estimated costs are printed out.

(6) On line processing

- By use of work stations prepared procedures can be simultaneously accessed

3. System function



4. Scale of system program ; ca 200,000 steps

5. Future subjects ; Automatic generation of machining drawing by CAD linking with manufacturing procedure control system

Figure 11-9 Production and Operation Control System

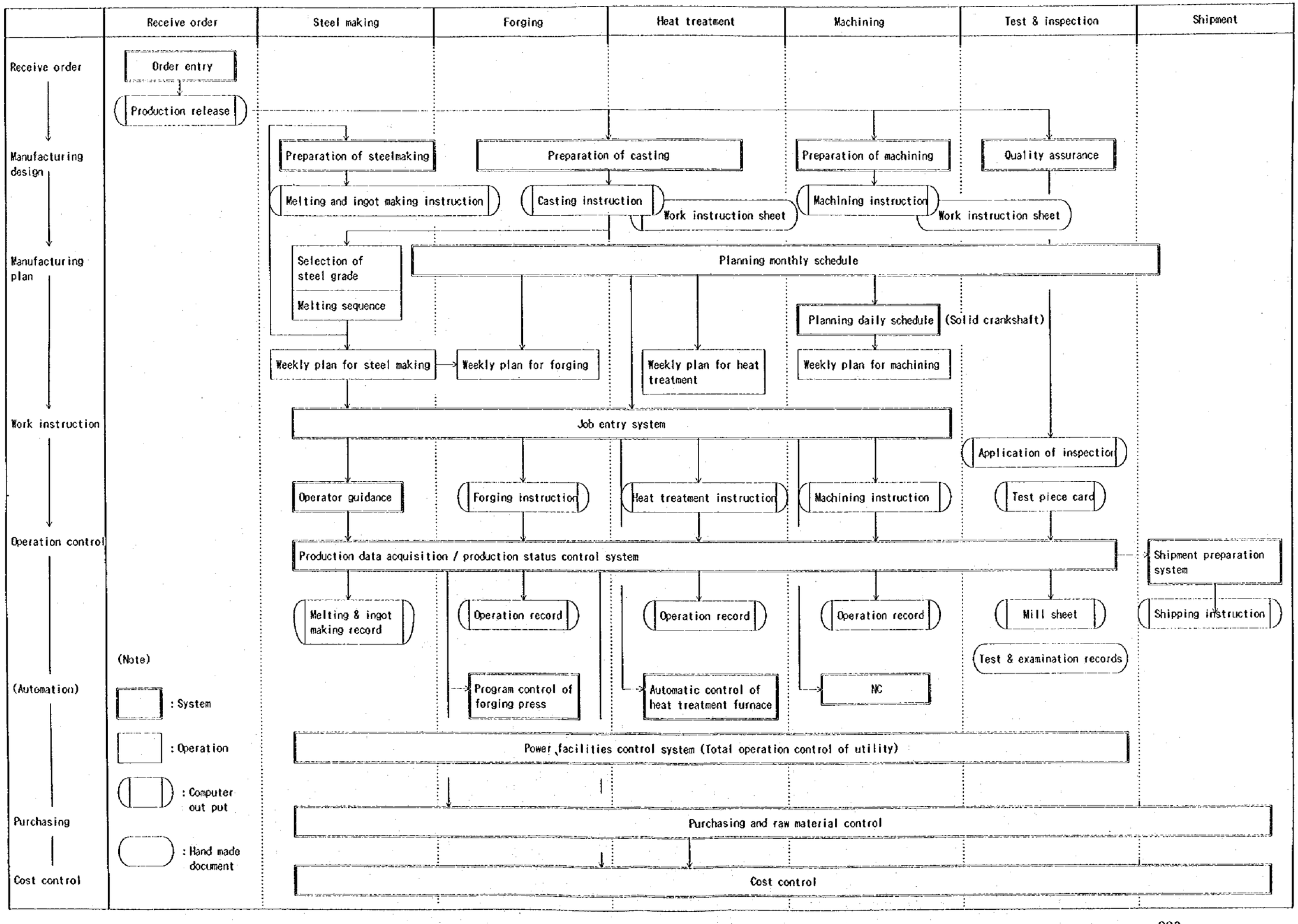
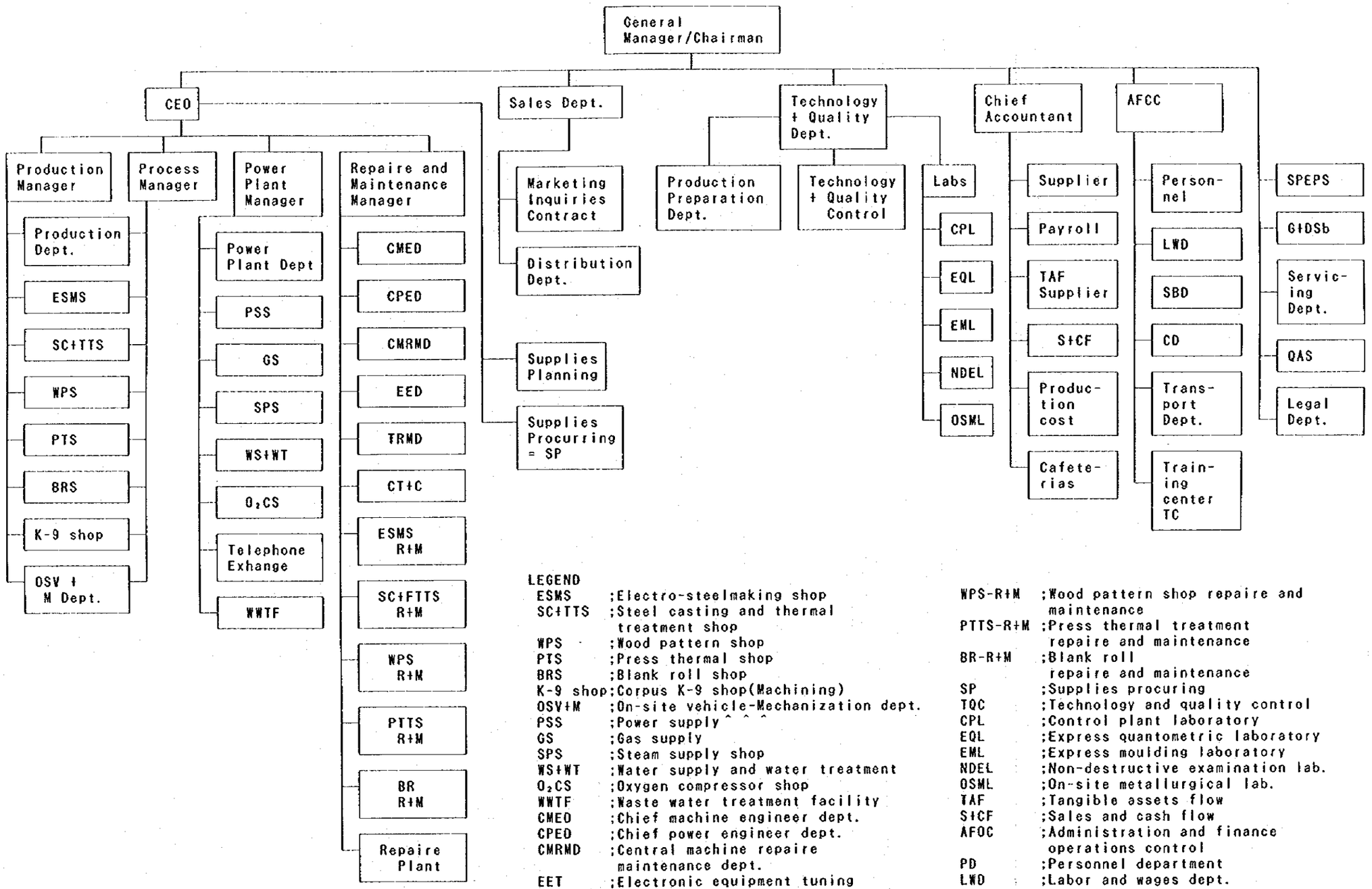


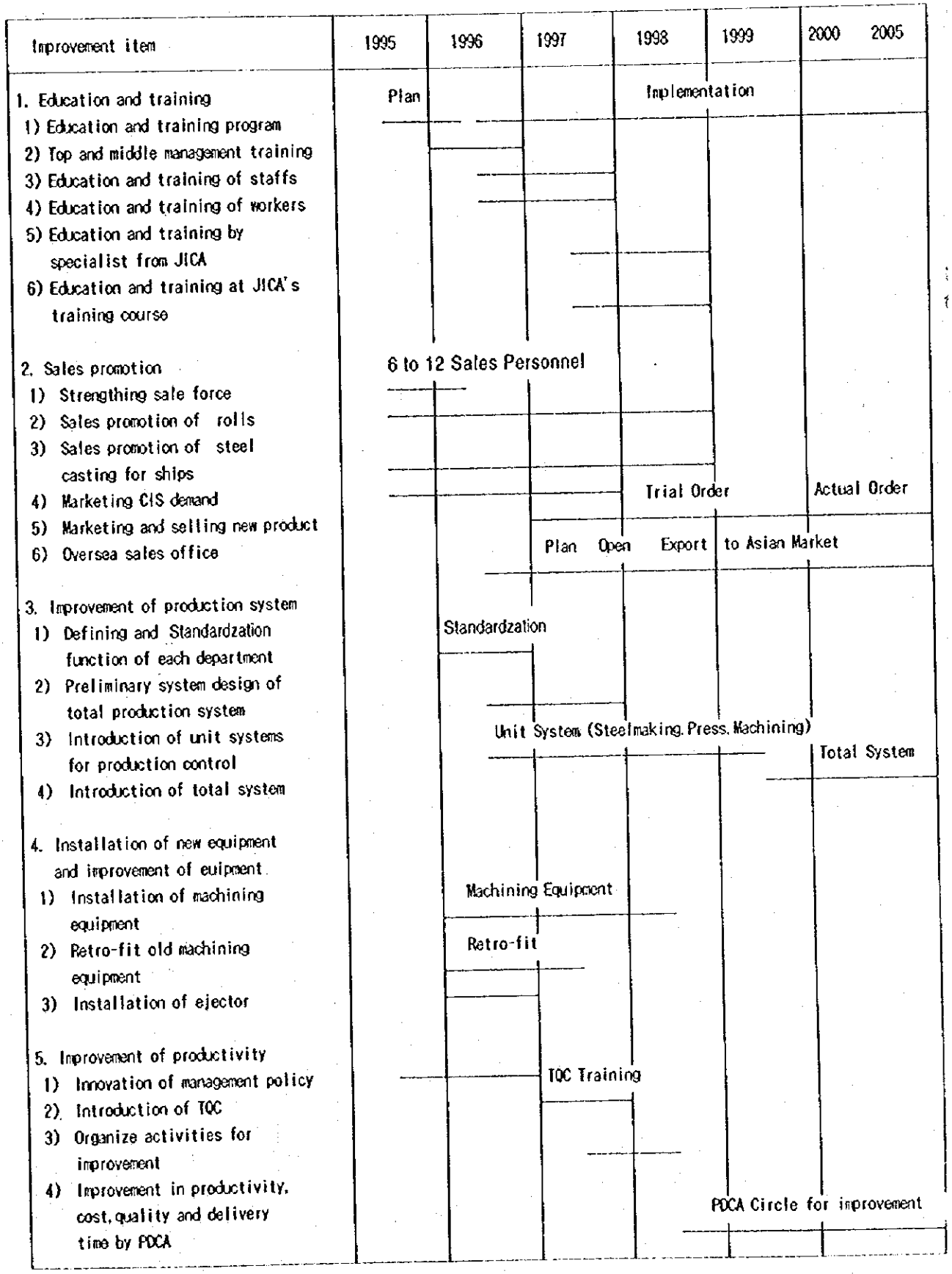
Figure 11-10 Organization Chart of Leko ko



LEGEND

ESMS	;Electro-steelmaking shop
SC+TTS	;Steel casting and thermal treatment shop
WPS	;Wood pattern shop
PTS	;Press thermal shop
BRS	;Blank roll shop
K-9 shop	;Corpus K-9 shop(Machining)
OSV+M	;On-site vehicle-Mechanization dept.
PSS	;Power supply ^ ^ ^
GS	;Gas supply
SPS	;Steam supply shop
WS+WT	;Water supply and water treatment
O_2CS	;Oxygen compressor shop
WWTF	;Waste water treatment facility
CMED	;Chief machine engineer dept.
CPED	;Chief power engineer dept.
CMRMD	;Central machine repaire maintenance dept.
EET	;Electronic equipment tuning
TRMD	;Technical repaire and maintenance dept.
CI+C	;Capital investment and construction
ESMS-R+M	;Electro-steelmaking shop - Repaire and maintenance
SC+FTTS -R+M	;Steel casting fettling-thermal treatment shop -repaire and maintenance
WPS-R+M	;Wood pattern shop repaire and maintenance
PTTS-R+M	;Press thermal treatment repaire and maintenance
BR-R+M	;Blank roll repaire and maintenance
SP	;Supplies procuring
TQC	;Technology and quality control
CPL	;Control plant laboratory
EQL	;Express quantometric laboratory
EML	;Express moulding laboratory
NDEL	;Non-destructive examination lab.
OSML	;On-site metallurgical lab.
TAF	;Tangible assets flow
S+CF	;Sales and cash flow
AFOC	;Administration and finance operations control
PD	;Personnel department
LWD	;Labor and wages dept.
SBD	;Social benefits dept.
CD	;Catering dept.
TC	;Training center
SPEPS	;Safety procedures environmental and process supervision
G-DSb	;Guards and disaster stand-by
QAS	;Quality assurance system

Figure 11-11 Overall Schedule for Modernization of Leko ko



Chapter 12 Conclusion and Recommendation

12. Conclusion and Recommendation

12.1 Kremikovtzi, Stomana, Kamet and Promet Steelworks

12.1.1 Assumptions used in evaluation of scenarios

With regard to each scenario, the production cost and profit of loss result, which are expected to be improved through the planned investment at each steelworks, are calculated based on the following assumptions in 2004.

(1) Production and sales volume;
1.76 million tons as a total of four steelworks in 2004.
The details of each steelworks are mentioned in Table 9-4.

(2) Sales price

	Domestic	Export
Bloom, slab, billet	235 US$/t	193 US$/t
Rebar	286	234
Hot Coil	295	243

(3) Labor cost; Reduction by 30% in US$ terms from the actual level in 1993

(4) Fixed expenses; Reduction by 30% in US$ terms from the actual level in 1993

(5) Depreciation
① Equipment in operation ; Depreciation amount in US$ terms in 1993 straight line method over approximately 18 years
② Equipment to be operated in the future;
Straight line method over 10 years

(6) Interest rate
① Existing loans ; 25% p.a. on average of both leva and foreign currency
② New loans ; 10% p.a. in US$ for the first five-year investment plan

(7) Others
① Investment amount ; Please refer to Section 10.2.
② Improved technical specifications; Please refer to Appendix 10-7.
③ Price of major materials ; Please refer to Table 9-6.
④ Price of energy ; Natural gas, US$ 0.12/Nm^3; Electricity, US$ 0.05/Kwh.

12.1.2 Conclusion on Kremikovtzi, Stomana and Promet

Based on the conditions mentioned in Section 12.1.1, the production cost and profit or loss of each steelworks in 2004 were calculated. Table 12-1 shows such financial results, investment amount and the amount of governmental support, etc. as criteria for evaluating scenarios.

Six (6) scenarios of Nos. A, A-2, B-2, C, C-2 and D-3 are objectively selected from nine (9) scenarios according to the criteria assuming steelworks in Bulgaria are companies in a

Table 12-1 Comparison of Nine Scenarios

Criteria	Standards of Evaluation ◎ ○ ●	Scenario A	A-2	B-1	B-2	C	C-2	D-1	D-2	D-3
1. Characteristics of Scenarios		-Promet will be closed. -Kremikovtzi and Stomana will continue to exist separately.	-Promet will be closed. -Kremikovtzi and Stomana will continue to exist separately. -Imported scrap will not be needed because of increase of hot metal from Kremikovtzi.	-Promet will be incorporated into Stomana to produce shapes and bars. -All blast furnaces of Kremikovtzi will be closed to prevent environmental pollution. -Middle shape and bar mill of Stomana will be closed.	-Promet will be incorporated into Stomana to produce wire rods. -Kremikovtzi will produce only steel sheets and coils. Rod mill of Kremikovtzi will be closed. -Stomana will produce only plate. Middle shape and bar mill of Stomana will be closed.	-Promet will be incorporated into Stomana to produce shapes and bars. -Kremikovtzi will produce existing steel products. -Stomana will produce only plate. Middle shape and bar mill of Stomana will be closed.	-Promet will be incorporated into Stomana to produce shapes and bars. -Kremikovtzi will produce existing steel products. -Stomana will produce only plate. Middle shape and bar mill of Stomana will be closed. -Hot metal production from Kremikovtzi will be increased so as not to consume imported scrap in the Bulgarian steel industry.	-Promet will be incorporated into Stomana to produce shapes and bars. -All blast furnaces of Kremikovtzi will be closed to prevent environmental pollution. -Middle shape and bar mill of Stomana will be closed.	-Promet will be incorporated into Stomana to produce shapes and bars. -All blast furnaces of Kremikovtzi will be closed to prevent environmental pollution. -Middle shape and bar mill of Stomana will be closed.	-Promet will be incorporated into Stomana to produce shapes and bars. -All blast furnaces of Kremikovtzi will be closed to prevent environmental pollution. -Middle shape and bar mill of Stomana will be closed.
2. Production Plan of Products (1,000 tons/year)										
Kremikovtzi		1,313	1,313	871	871	1,313	1,313	1,081	871	871
Stomana		448	448	652	504	210	210	442	652	504
Promet		0 Closed	0 Closed	238	386	238	238	238	238	386
Kamet		0 Closed	0 Closed	0 Closed	0 Closed	0 Closed	0 Closed	0 Closed	0 Closed	0 Closed
3. Production Costs	Low - High	○	◎	●	○	○	◎	●	●	●
4. Investment (million US$)	Low - High	●	●	●	●	●	●	○	○	○
Total (Including Environmental Pollution Prevention)		274.6 (145.6)	266.6 (133.0)	268.2 (133.7)	267.3 (133.6)	277.0 (145.6)	269.0 (133.0)	167.0 (45.3)	146.3 (41.1)	145.5 (41.2)
5. Grant of Government Relief /Profit (million US$/y)	Profit Relief	○ 1.3	◎ -31.1	● 12.5	○ 5.0	○ 8.2	◎ -24.3	● 38.0	● 32.1	● 24.1
6. Decrease in the Regular Number of Workers (Relocation/Retirement)	Small Large	● Promet closed.	● Promet closed.	○	○	○	○	● BFs and Converters in Kremikovtzi closed.	● BFs and Converters in Kremikovtzi closed.	● BFs and Converters in Kremikovtzi closed.

1. The Bulgarian side and JICA study team selected scenarios A, B-2, C and D-3 as the conclusion to the study of the sixth site investigation.
2. The JICA study team added scenarios A-2 and C-2.

market economy. However, although D-3 Scenario is the most unprofitable in six (6) scenarios, it is selected because of the lowest investment scenario for environment pollution prevention. Based on the JICA study, the Ministry of Industry of Bulgaria should prepare implementation plans of restructuring of the steel industry and of modernization of steelworks meeting present states of Bulgaria in consideration of labor problems, political problems, etc.

12.1.3 Recommendations on a scenario executed

The JICA study team recommends the MOI to select Scenario A-2 or C-2 from six (6) scenarios in consideration of reforming as a vigorous and the most profitable steel company in a market economy.

Because volume of domestic steel scrap in Bulgaria is estimated at 700,000 t/y, and increase of the volume will not be expected in the future, the steel industry will be forced to purchase imported scrap at high prices. According to the above, it is considered that Scenarios B-2 and D-3 reducing or discontinuing production of hot metal from blast furnaces at Kremikovtzi Steelworks should not be selected.

The following points can be found out in Tables 12-1 and 12-2.

① Grant of Government relief is unnecessary for the steel industry in scenarios reducing consumption of imported scrap by increase of hot metal produced from blast furnaces at Kremikovtzi Steelworks as shown in Table 12-2. (Scenarios A-2 and C-2)

② Kremikovtzi Steelworks can be profitable in scenarios in which blast furnaces are operated.

Table 12-2 Grant of Government Relief

Scenario	A	A-2	B-2	C	C-2	D-3
Production capacity of blast furnaces (1000t/y)	1,000	1,330	1,000	1,000	1,328	0
Hot metal produced from Blast furnaces (1000t/y)	991	1,330	879	991	1,328	0
Scrap consumption in the steel industry (1000t/y)						
Domestic scrap	600	600	600	600	600	600
Import scrap	335	0	443	334	0	1,295
Total	935	600	1,043	934	600	1,895
Grant of government relief to: (million US$/y)						
Kremikovtzi	-8.7	-32.3	-7.0	-8.7	-32.3	0.9
Stomana	10.0	1.3	-0.6	7.5	-1.5	12.4
Promet	-	-	12.6	9.4	9.5	10.8
Total	1.3	-31.1	5.0	8.2	-24.3	24.1

12.1.4 Absolutely necessary conditions to execute the recommendations

(1) Merger of Kremikovtzi, Stomana and Promet Steelworks

If Scenario A-2 or C-2 is selected, and three steelworks will be merged into a steel company being led by Kremikovtzi Steelworks, it is possible to further reduce the production costs in addition to improvement proposed by the JICA study.

At present, three steelworks are separately operated but the following merits will be expected by merging three steelworks into one steelworks.

① The optional way to purchase raw materials including imported scrap, iron ore, and coking coal, and to produce competitive steel products responding to changes of raw material, and domestic and world steel market conditions can be planned.

② By putting into one organization, the management, steelworks, and human resources including directors and employees can be effectively utilized.

③ It is difficult for Stomana and Promet Steelworks to separately realize a profit by themselves. However, if they are merged with Kremikovtzi Steelworks, a profit can be expected by rationalization.

④ Greater cost reductions can also be realized by improvements within a framework larger than that described here for the individual steelworks.

⑤ It is easy to implement modernization of the steelworks.

If three steelworks separately implement the restructuring and modernization, the coordination function is required to the Ministry of Industry. Because it is impossible for only three staff members now in charge of the steel industry in the Ministry of Industry to coordinate, manpower should be increased. However, by the merger, restructuring and modernization of the steel industry can be effectively implemented by talented staff members in steelworks.

(2) Reduction of production costs

Operation should be improved to improve steel product yield and energy consumption. The improvement is shown in detail in Appendix 10-7.

(3) Completion of environmental pollution prevention measures

The neighboring area is impacted by environmental pollution from the steelworks. Environmental pollution prevention measures in Section 10.2.5 should be executed.

(4) Decrease of interest rate of loan

The Bulgarian Government should make an effort that interest rate of loan will be lowered.

(5) Training for personnel

The management at steelworks should be trained for corporate management and production control according to Section 10.3.3.

(6) Implementation plan for restructuring and modernization of the steel industry

Persons responsible for the implementation plan, including those in the Ministry of Industry should understand contents recommended in the JICA study.

Base on the scenarios recommended in the JICA study, the Ministry of Industry should prepare implementation plan of restructuring and modernization of the Bulgarian steel industry, and promote finalization of the plan. The implementation plan should at least include the following.

- Production plan
- Improvement plan for modernization of steelworks and forecast of production costs
- Organization, management and training
- Implementation schedule
- Organization of implementation

The target level of production technology and management proposed in the JICA study should be indicated in the implementation plan.

After finalization of the implementation plan, an implementation team should be organized in a steelworks. The team should totally control the modernization plan, including improvement of operation and facilities, and performance tests. In case that three steelworks are merged into a steel company, only one implementation team is required for three steelworks.

12.1.5 Necessary conditions to execute the recommendations

(1) Amendment of regulations and laws concerned

Problems in and improvement methods for the Ministry of Industry, the management, and steelworks were already described in Section 10.3. An idea to modify the organization of the above three parties is shown for your reference as follows. Regulations and lows concerned should be amended to implement the modification.

A board of directors is established in a steel company to prepare and implement business plan. Also, each member of the board is in charge of management of some departments. The Ministry of Industry representing shareholders establishes a shareholders' meeting. The meeting assigns an executive director and directors of the board, and approve business plan to receive a profit from steel company as shareholders. Purposes of this idea are to establish clear cut-lines of responsibilities and roles by separation of functions to protects a profit of shareholders, and to manage steel company.

(2) Ministries and Agencies concerned

Ministries and Agencies responsible for the preparation of implementation plan, promotion of finalization of restructuring, and modernization of the steel industry are shown as follows.

① Ministries and Agencies

- Advisor of Prime Minister
- Ministry of Finance
- Ministry of Trade
- Ministry of Labor
- Ministry of Environment
- Ministry of Economic Development
- Bulgarian National Bank
- Energy Committee
- Privatization Agency
- Sofia University of Technology

② Steelworks

- Kremikovtzi Steelworks
- Stomana Steelworks
- Promet Steelworks
- Branch Chamber of Ferrous and Non-ferrous Metallurgy
- Trade Union Metalicy

(3) Recommendations to each sections

a) Ministry of Finance and other concerned governmental institute

(a) As a result of the study at the steelworks, it was found that the interest rate on a borrowings in US dollar was as high as 19% to 21% p.a. as of the end of December, 1994. It was explained by the Ministry of Industry that the LIBOR + 2% to 2.5% p.a., and the lending rate to Bulgarian companies is 10% to 15% p.a.(as of July 1995) after a bank spread is added. Although the business result of the steelworks were so poor that they were required to pay a large spread, the present spread or risk fee makes normal business activities almost impossible.

The concerned governmental institutes, including but not limited to the Ministry of Finance, should establish concrete measures for modernizing the Bulgarian financial market.

b) Production Division at the steelworks

(a) Some of the countermeasures in this report are already investigated by each steelworks, and all of these items are very effective to prevent pollution, reduce production cost and improve product quality. They should immediately be implemented in careful consideration of priority.

(b) The above main items are pointed out from macro view point. It should be noted that there are many other items to be done. Accumulation of simple countermeasures are also effective. The following procedure should be implemented with the recognition that the Bulgarian steelworks can also achieve the same results as those of the Japanese steelworks which are shown in this report.

① Set the target values considering the actual results of Japanese steelworks.

② Show the target and the results clearly so that persons concerned can understand.

③ Consider the reason and countermeasures when a difference between the target and results is large.

④ Carry out the countermeasures

⑤ Follow the results of the countermeasures, and take further countermeasures, if necessary

⑥ Standardize the optimal operational methods.

⑦ Plan and implement the necessary training.

(c) Sales promotion both in the domestic and overseas markets requires cost reduction and the improvement of intangible competitiveness such as quality control, delivery control, and after-care, as well as development of the products which meet the customers requirement. It is necessary to implement these in cooperation with the sales division, considering the options of customers and subsequent manufacturing process.

(d) The operating division has final responsibility for environmental control. Full awareness should be ensured for the following items among all concerned.

① Considering the ISO environmental control system, the environmental control should be performed by all the members especially workers of operating division.

② Maintenance of the environmental control equipment such as dust collectors, should be adequately conducted.

③ Operating division should cope with accidental troubles such as inflow of oil into water treatment equipment .

④ Grasping the relations between the operational conditions and emitted volume of pollutant, operate in the optimal operational conditions.

c) Sales division at steelworks

(a) The organization for sales is not adequate. If the products are manufactured in consideration of necessary information obtained on customer re-

quirements, it will be possible to accept more orders at reasonable prices.

d) Environmental division at steelworks

(a) Recognizing that the pollution prevention is the necessary condition for the steel production, implement the measures described in this report.

(b) Grasping the actual conditions, conduct the cause analysis and measures if necessary.

e) Material preparation division in steelworks

Long-term contracts, construction of vessels for private use, interchange of technical experts between steelworks and mining companies, investment in new mines and other measures can contribute to a stable supply of iron ore and coking coal in both volume and quality.

The price of steel scrap in the international market fluctuates constantly. A grasp of the trend in steel product prices in the market, the supply and demand of steel scrap, and the price of scrap in each country is required.

(a) Iron ore

The Bulgarian steel industry should increase iron ore yield by purchasing imported iron ore as a substitute for low grade domestic ore (Indian iron ore has ample supply capacity), and lower the average purchase priced by increasing the blending ratio of low priced iron ore, in consideration of the trend in market prices.

(b) Coal

Multiple shippers should be used and the blending ratio of coal should be changed. The average price can be lowered by purchasing low grade (semi-soft coking coal) and low priced South African coal ($28/MT for Japan).

A stable supply and price of coal should be secured by making long term agreements with coal producers in U.S.A., South Africa or Australia, which have ample supplies, for about 70% for purchased coal. Pulverized coal injection (PCI) should be installed.

(c) Steel scrap

Imports of steel scrap from the U.S.A., Germany and Britain, which have ample supplies, should be investigated. Control of the quality and volume of market scrap and the steel scrap generated at the steelworks should be tightened.

12.2 Leko ko Steelworks

12.2.1 Conclusion

1) Major market of heavy steel casting and forging

The major markets for heavy steel castings and the forgings are shipbuilding, energy, steelmaking, and industrial machinery industries. Although some heavy steel casting and forging manufacturers have been restructured, closed, or merged mainly in Western Europe, the price level is still low in the steel casting and forging markets due to overcapacity and an oversupply of steel castings and forgings. Furthermore, the demand for heavy steel castings and forgings changes significantly and quickly with business conditions. The low price and quick change in demand makes it difficult for the heavy steel casting and forging manufacturers to manage their casting and forging businesses. In the present situation, Leko ko Steelworks has no other way to increase its sales revenues than selling at a cheap price because the Bulgarian steel casting and forging market is too small and the customers put priority on quality and the actual operation record of products when placing orders.

For the restructuring and modernization, Leko ko Steelworks should attempt to promote sales, increase production, and reduce the costs of products without increasing the number of employees. As a future final target, Leko ko Steelworks should improve its competitiveness in quality and cycle time and reduce the cost of its products, making it possible to sell in the international market.

2) Sales and production plan

Heavy steel casting and forging manufacturers will not be profitable without decreasing the fixed cost of their products by increasing capacity utilization by growth in production because their fixed manufacturing cost, including tangible fixed assets and labor, is very large compared with their total sales amount. Leko ko's fixed cost accounted for 70% of its total production cost in 1993 and was much higher than the 45~ 50% of other heavy steel casting and forging manufacturers. In order to make a profit, Leko ko Steelworks has made the sales and production plan shown in Table 12-3 and will produce 80,000 tons of molten steel in 2005, which is achievable by Leko ko, as this site produced 60,000 tons of molten steel in 1987.

To promote sales, Leko ko will develop a new product mix such as casings, runners and rotors in addition to its present product mix of steel castings and forgings used in steel plants (including rolls), ships, and mining.

Table 12-3 Sales and Production Plan

	1995	1996	1998	2000	2005
Steel melting	16,783 ton	27,437 ton	54,274 ton	70,000 ton	80,000 ton
Ingot for sale	2,821 ton	5,642 ton	11,284 ton	14,552 ton	20,000 ton
Forging	8,524 ton	12,524 ton	24,580 ton	31,700 ton	36,228 ton
Casting	985 ton	1,970 ton	3,940 ton	5, 081 ton	5,806 ton
Export ratio	68%	74%	86%	89%	90%
Market	Domestic →				
	EC →				
	CIS →				
	Middle East →				
	→				

Leko ko should install machining equipment in order to receive orders for high grade products by increased its machining capacity for shipment of finished products.

12.2.2 Recommendations

Leko ko should improve the productivity of management and production in order to achieve the sales and production plan shown in Table 12-3 without increasing the number of employees. In the other words, Leko ko should improve its competitiveness in terms of the quality, cycle time, and cost of products which can be sold in international market. Heavy casting and forging facilities are generally difficult to automate and mechanize. Therefore, the technology and skill of personnel greatly affect product the quality, cost, and delivery. The competitiveness of forgemasters and foundries depends not only on facilities and their capacity but also on the ability, technology, and skill of managers, staff, and workers. The present subjects for Leko ko are the following five items shown in Section 11.4 and Figure 11-11.

- Improvement of technology and skill by training and eduction (improve ability of managers, salesmen, engineers, and workers)
- Growth of production by sales promotion and cost reduction (to be achieved by improved productivity and not by increased number of employees)
- Improvement of production control system
  (EDPS of office work and production control)
- Increase machining capacity (new installation and retro-fit)
  Improvement of productivity (improvement by PDCA and introduction of TQC)

In addition to the above items, additional recommendations are made below.

1) Stop selling cheap (sell at reasonable price)

Leko ko is now increasing its production by receiving large orders at low prices from western customers. The total production amount from January to October exceeds the estimated annual production amount for 1995.

Futhermore, Leko ko's order book of 1996 is now 60% filled with firm orders.

Leko ko should make efforts to improve the quality of its product, maintain short delivery times, and generally become a reliable supplier. At the same time, Leko Ko should change its sales policy and maintain a reasonable sales price level which will make Leko ko profitable in a shorter time than selling cheap.

2) Transfer of roll technology

Rolls are one main product of Leko ko, which has suitable manufacturing equipment for finish-machined rolls. It is beneficial for Leko ko to study the transfer of roll technology to improve the present quality of its cold rolling rolls and back up rolls and to develop new rolls such as hot rolling rolls and steel cast rolls.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF INDUSTRY
THE REPUBLIC OF BULGARIA

STUDY ON RESTRUCTURING AND MODERNIZATION OF THE STEEL INDUSTRY IN THE REPUBLIC OF BULGARIA

- APPENDIX -

MARCH 1996

KAWASAKI STEEL CORPORATION
SUMITOMO METAL INDUSTRIES, LTD.
KOBE STEEL, LTD.

Appendix 2-1 Share of Net Material Products (NMP) and Gross Domestic Products (GDP) in Each Sector

(Unit: %)

	50	60	70	80	85	88	89	90	91	92
Agriculture, Forest	31.5	32.3	18.0	19.0	13.3	11.5	10.9	17.8	15.3	9.6
Mining, Industry	33.8	47.3	55.0	51.0	59.9	53.2	51.5	44.3	43.4	39.3
Construction	6.8	7.0	9.0	9.0	9.9	7.9	7.8	7.0	4.5	3.9
Commerce	21.4	9.0	9.0	10.0	6.9	6.8	7.6	8.1	7.7	6.9
Transport, Telecommunication	3.1	4.2	7.0	8.0	7.6	7.6	8.6	7.5	8.1	6.9
Other, Services	3.4	0.2	2.0	3.0	2.4	13.0	13.6	15.3	21.0	33.4

Note: From 1989, NMP are replaced by GDP

Source: Statistical Year Book of Member Countries of CMEA, Bulgaria N.S.I.

Appendix 2-2 Evolution of Major Economic Indexes

(Unit: %, growth over the previous year)

	76-80	81-85	86	87	88	89	90	91	92	93
GDP	(8.2)	(3.7)	(4.0)	(5.7)	(6.1)	(6.2)	(-)	(-)	(-)	(-)
(NMP)	6.1	3.7	5.3	5.4	2.4	-3.3	-9.1	-11.7	-5.7	-4.0
Gross Products	(-)	(5.1)	(4.5)	(4.9)	(5.0)	(5.0)	(-)	(-)	(-)	(-)
of Industry	6.0	4.3	4.0	4.2	5.2	1.0	-12.5	-18.6	-7.0	-4.5
Gross Products	(3.7)	(3.4)	(7.4)	(N.A)	(5.5)	(8.9)	(-)	(-)	(-)	(-)
of Agriculture	0.9	-0.6	11.7	-5.1	-0.1	-5.0	-3.7	-9.8	-7.7	-5.0

Note: Figures in parentheses indicate planned figures; from 1989, NMP are relaced by GDP.

Source: Government, National Bank of Bulgaria

Appendix 2-3 Evolution of Total Investment

(Unit: %)

	61-70	71-75	76-80	81-85	86	87	88	89	90	91	92
Total Investment	(-)	(6.4)	(7.5)	(1.9)	(5.8)	(8.9)	(4.1)	(-)	(-)	(-)	(-)
	10.2	8.7	4.0	4.5	7.8	7.3	2.4	0.4	-25.1	-15.6	-10.0

Note: Figures in parentheses indicate planned figures; after 1989, there have been no planned figures.

Source: Statistical Year Book of Member Countries of CMEA, Government statistics.

Appendix 2-4 Investment in Each Sector

(Unit: %)

	80	85	88	89	90	91	92
Productive Sector	71.4	72.3	74.1	76.1	77.7	80.9	81.7
Agriculture, Forestry	12.4	8.1	8.5	8.4	9.8	7.4	2.9
Mining, Industry	41.9	46.7	49.9	49.8	48.4	56.1	48.7
Construction	2.5	3.8	3.6	4.8	4.5	2.6	17.1
Transport, Telecommunication	11.1	9.8	7.4	5.9	8.0	2.6	6.3
Commerce	3.0	3.3	2.7	4.3	3.8	4.8	3.8
Others	0.5	0.6	2.1	2.9	3.2	7.4	2.9
Non Productive Sector	28.6	27.7	25.9	23.9	22.3	19.1	18.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Statistical Year Book of Member Countries of CMEA, Government statistics.

Appendix 2-5 Revenue of National Budget

(Unit: Million Leva)

	88	89	90	91	92	93*	94*
Total Revenue	22,064	22,912	23,972	54,782	77,014	126,746	99,887
Tax Revenue, including:	18,462	19,809	19,476	51,042	69,682	115,801	80,154
Profit Tax	8,110	9,185	8,126	22,401	16,769	23,455	9,920
Income and Consumer Tax	4,443	4,450	4,082	9,686	12,337	23,388	39,677
Social Security	3,628	3,906	4,364	11,392	21,514	36,185	N.A
Others	2,281	2,368	2,804	7,653	19,061	32,774	N.A
Non-Tax Revenue**	3,602	3,103	4,496	3,740	7,333	10,945	19,733

Appendix 2-6 Percentage of Revenue in GDP

(Unit: %)

	88	89	90	91	92	93*
Total Revenue	57.7	58.0	53.3	41.8	36.7	36.7
Tax Revenue, including:	48.3	50.2	43.3	38.9	33.2	33.6
Profit Tax	21.2	23.2	17.9	17.1	8.0	6.8
Income and Consumer Tax	11.6	11.2	9.0	7.4	5.9	6.8
Social Security	9.5	9.9	9.6	8.6	10.2	10.5
Others	6.1	6.1	6.6	5.8	9.1	9.5
Non-Tax Revenue**	9.4	7.8	9.9	2.9	3.5	3.2

Note * : Budget Plan

** : Non Tax Revenue includes tax revenue for the previous year, revenues from fees for service revenue by National Bank.

Source: Ministry of Finance, Government statistics

Appendix 2-7 Expenditure of National Budget

(Unit: Million Lava)

	88	89	90	91	92	93*	94*
Current Expenditure	22,393	23,137	28,124	75,091	107,237	154,330	133,567
Wages & Salaries	1,778	1,850	2,496	6,544	12,203	19,129	9,875
Maintenance & Operation	5,167	5,748	5,517	12,195	16,685	28,578	21,379
Defense & Security	1,929	1,944	2,190	5,333	8,375	12,795	18,859
Subsidies	6,767	6,119	6,753	5,471	3,653	6,550	6,550
Interest	795	1,208	4,296	24,261	32,020	32,838	42,735
Social Security	3,895	4,104	5,465	18,629	28,666	47,806	3,454
Capital Expenditure	2,062	2,164	1,407	2,658	5,634	6,633	3,896

Appendix 2-8 Percentage of Current Expenditure in GDP

(Unit: %)

	88	89	90	91	92	93*
Current Expenditure	63.7	61.4	64.3	57.4	51.1	44.7
Wages & Salaries	4.6	4.7	5.5	5.0	5.8	5.5
Maintenance & Operation	13.5	14.5	12.2	9.3	7.9	8.3
Defense & Security	5.0	4.9	4.8	4.1	4.0	3.7
Subsidies	17.6	15.5	14.9	4.2	1.7	1.9
Interest	2.1	3.1	9.5	18.5	15.2	9.5
Social Security	10.2	10.4	12.0	14.2	13.7	13.9
Capital Expenditure	5.4	5.5	3.1	2.0	2.7	1.9

* Budget Plan

Source: Ministry of Finance, Government statistics

Appendix 2-9 Balance of Payments (in Hard Currency)

(Unit: Billion $)

	70	75	80	85	86	87	88	89
Current Balance	-	-0.7	0.9	-0.1	-0.7	-0.8	-0.8	-1.3
Trade Balance	-0.1	-0.6	0.8	-0.4	-0.8	-1.0	-1.0	-1.2
(Export)	0.4	1.0	3.3	3.3	2.7	3.2	3.5	3.1
(Import)	0.5	1.6	2.5	3.7	3.5	4.2	4.5	4.3
Services	-	-0.1	0.0	0.2	0.0	0.1	0.1	-0.2
Unrequited Transfer	-	0.0	0.1	0.1	0.1	0.1	0.1	0.1
Foreign Reserve	N.A	N.A	N.A	2.1	1.5	1.2	1.8	1.4

(Unit: Million $)

	90	91	92	93
Current Balance	-860	-96.0	-520.5	-900.4
Trade Balance	-757	-32.0	-484.5	-695.1
(Export)	2,615	3,737.0	4,608.5	3,635.3
(Import)	3,372	3,769.0	5,093.0	4,330.4
Services, net	-211	-114.0	-75.8	-242.2
Transport	51	-13.8	-31.7	-83.9
Tourism	78	-84.2	31.9	69.5
Interest	-396	-28.1	-76.0	-192.3
Private transfer, net	108	50.0	39.8	36.9
Capital Balance	-135	115.0	-31.5	148.4
Errors & Omissions	127	45.2	225.9	263.2
Overall Balance	-868	64.2	-326.1	- 488.8

Source: Bulgaria N.S.I.

Appendix 2-10 Regional Share of Foreign Trade by Bulgaria

(Unit: %)

		85	86	87	88	89	90	91	92	93
Former CMEA	Ex.	75.7	81.6	81.4	82.4	83.8	80.2	57.7	39.2	35.4
	Im.	75.4	75.7	78.8	75.1	73.4	75.9	48.5	36.3	42.9
Western Industrial Countries										
	EX.	9.6	7.2	6.9	6.5	8.2	9.0	26.3	42.2	43.1
	IM.	15.3	15.5	15.4	15.6	17.3	15.0	32.8	43.8	42.6
Developing Countries										
	Ex.	14.7	11.2	11.7	11.1	8.0	6.1	8.3	8.6	7.0
	Im.	9.3	8.8	5.8	9.3	9.3	4.3	4.5	8.6	4.9
Total	Ex.	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
with Other	Im.	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Foreign Trade Annual Statistics of Bulgaria
Bulgaria N.S.I.

Appendix 2-11 Share of Major Trading Partner

(Unit: %)

	Export					Import				
	85	89	90	91	92	85	89	90	91	92
Former USSR	56.6	65.2	64.0	49.8	25.2	56.1	52.9	56.5	43.2	28.6
Former East Germany	5.1	5.5	2.9	-	-	5.1	5.8	6.7	-	-
West Germany*	1.4	1.3	1.3	4.8	10.0	3.9	4.9	3.7	7.0	12.8
Czekoslovakia	4.6	4.3	4.4	0.9	0.7	4.1	4.9	4.6	1.2	1.9
Poland	3.5	3.8	2.6	2.1	2.3	4.6	4.8	5.0	1.1	0.8
Libya	4.3	1.3	4.0	2.1	0.5	2.9	1.4	1.7	2.5	0.4
Iraq	3.1	1.0	0.2	0.0	0.1	0.6	2.9	2.0	0.0	0.0
USA	0.2	0.6	1.7	3.4	1.7	1.2	1.5	0.6	2.9	3.0
Japan	0.2	0.2	0.3	0.7	0.4	0.6	1.3	1.0	0.5	2.3
Total with others	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note *: from 1991, West Germany includes East Germany
Source: Foreign Trade Annual Statistics of Bulgaria

Appendix 2-12 Composition of Export Commodities

(Unit: %)

	60	70	80	85	88	89	90	91	92
Machine, Equipment, Transport equipment	12.9	29.0	44.4	53.5	60.5	59.4	59.1	30.6	15.6
Energy, Metal, Mineral resources	9.2	8.1	15.0	10.0	7.0	7.7	7.7	10.5	19.9
Foods & Beverages, Raw materials for foods	56.4	43.4	24.4	18.4	15.8	15.7	14.7	20.8	22.3
General consumables Fuels	17.9	14.7	8.8	9.7	10.7	11.1	10.3	22.3	8.3
Chemicals, Rubber, Construction materials	3.6	4.8	7.4	8.4	6.0	5.5	7.4	15.1	28.0
Others	0	0	0	0	0.7	0.6	0.9	0.6	5.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Appendix 2-13 Composition of Import Commodities

(Unit: %)

	60	70	80	85	88	89	90	91	92
Machine, Equipment, Transport equipment	43.9	40.6	35.4	33.2	41.6	42.7	46.2	15.8	23.0
Energy, Metal, Mineral resources	24.3	29.1	42.9	46.9	36.7	35.1	33.6	58.7	42.0
Foods & Beverages, Raw materials for foods	16.7	15.9	9.7	9.5	9.6	10.6	3.4	7.9	6.9
General consumables Fuels	7.6	5.7	4.4	3.8	5.1	5.2	6.4	4.4	5.4
Chemicals, Rubber, Construction materials	7.5	8.7	7.6	6.6	6.2	5.8	9.6	13.0	18.2
Others	-	-	-	-	0.8	0.6	0.8	0.2	4.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Statiscal Year Book of Member Countries of CMEA, Bulgaria N.S.I.

Appendix 2-14 Evolution of Rank of Trade Partner

	Export				Import			
No	1980	(share %)	1991	(share %)	1980	(share %)	1991	(share %)
1	USSR	(49.9)	USSR	(49.8)	USSR	(57.3)	USSR	(43.2)
2	East Germany	(5.5)	Germany	(4.8)	East Germany	(6.6)	Germany	(7.0)
3	Poland	(3.9)	USA	(3.4)	West Germany	(4.8)	Austria	(4.7)
4	Greece	(3.8)	Italy	(2.7)	Poland	(4.0)	Italy	(4.2)
5	Libya	(3.6)	Greece	(2.2)	Czech Rep	(3.7)	Poland	(3.7)
6	West Germany	(2.5)	Libya	(2.1)	Rumania	(1.9)	U.K.	(3.6)
7	Switzerland	(2.2)	Poland	(2.1)	Hungary	(1.9)	USA	(2.9)
8	Rumania	(2.2)	U.K.	(1.9)	France	(1.8)	Libya	(2.5)
9	Czech Rep	(2.0)	Rumania	(1.8)	Switzerland	(1.8)	France	(2.1)
	Hungary	(1.9)	Switzerland	(1.2)	Austria	(1.7)	Switzerland	(2.1)
Rank of Japan	31	(0.2)	26	(0.2)	21	(0.5)	21	(0.2)

Source: Foreign Trade Annual Statistics of Bulgaria.

Appendix 2-15 Composition of Labour by Sector

(Unit: %)

	50	60	70	80	85	88	89	90	91	92	93
Productive Sector	95.0	90.8	86.9	83.1	82.3	81.7	81.5	80.4	78.6	78.1	77.5
Mining Industry, Construction	11.4	27.1	38.8	43.2	45.6	46.7	46.3	44.8	42.3	38.9	36.9
Agriculture & Forestry	79.5	55.5	35.8	24.6	21.1	19.2	19.3	18.5	19.0	21.2	23.0
Transport, Telecommunication	1.8	4.1	6.0	6.8	6.7	6.6	6.7	7.0	7.5	7.2	7.2
Commerce	2.3	4.0	6.2	8.1	8.5	8.8	8.8	9.1	8.9	10.0	9.6
Others	-	0.1	0.1	0.4	0.4	0.4	0.4	1.0	0.9	0.8	0.8
Non Productive Sector	5.0	9.2	13.1	16.9	17.7	18.3	18.5	19.6	21.4	21.9	22.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total (number, thousand)								4,097	3,564	3,274	3,076

Source: Statistical Year Book of Member Countries of CMEA, Bulgaria N.S.I.

Appendix 2-16 Unemployment Number and Ratio Estimation

	end of 1991	1992	1993	May of 1993
Number (thousand)	72	430	577	592
Ratio (%)	-	11.5	15.6	16.0

NB: Unemployment number and ratio were not published by N.S.I., these figures are estimated ones.

Appendix 5-1 Forecast of Steel Consumption by Demand Categories and Product Type (Optimistic Case)

(Optimistic case) (1000MT)

Usage of each product (1995)

	Gen	Mine	Non fe	Mach	Elec	Chem	Food	Cons	Agr	Trans	Other	Total
Ingots & semis	1	1	1	32	2	1	1	81	1	1	10	132
Railway	0	0	0	0	0	0	0	1	0	2	0	3
Sections	0	0	1	6	0	1	0	7	0	0	3	17
Bars	1	1	1	26	2	1	0	66	1	1	8	107
Wire rods	0	0	0	71	0	0	0	27	0	0	3	101
Special steel	0	17	1	33	3	1	0	1	0	0	2	57
Hot 3mm more	1	1	1	42	2	2	0	6	0	0	2	57
Hot 3mm less	0	0	0	19	6	2	0	3	1	0	3	33
Cold rolled s.s.	0	0	0	49	15	6	0	7	2	0	9	87
Electrical s.s.	0	0	0	0	11	0	0	0	0	0	0	11
Stainless steel	0	0	0	4	0	1	0	0	0	0	2	7
Steel for tool	0	0	0	4	0	0	0	0	0	0	2	6
Tinplate	0	0	0	24	0	3	4	9	0	0	2	42
Galvanized s.s.	0	0	0	8	0	0	0	6	0	0	1	15
Cold tapes	0	0	0	3	2	0	0	0	0	0	1	7
Sections	0	1	0	2	0	0	0	1	0	0	1	5
Balls	0	0	0	5	0	0	0	0	0	0	0	5
Seamless tubes	3	1	1	22	2	3	1	10	1	0	5	49
Welded tubes	1	0	0	33	0	0	0	12	0	0	4	50
Drawn wires	0	1	0	21	8	3	0	9	0	4	6	51
Total	6	24	6	493	61	23	7	236	5	7	63	940
	0.7%	2.8%	0.7%	48.0%	7.3%	2.7%	0.8%	28.1%	0.6%	0.8%	7.5%	

Long	478	56.9%
Flat	264	31.4%
Tube	99	11.7%

Usage of each product (1999)

	Gen	Mine	Non fe	Mach	Elec	Chem	Food	Cons	Agr	Trans	Other	Total
Ingots & semis	1	2	1	36	3	1	1	105	1	1	12	164
Railway	0	0	0	0	0	0	0	1	0	2	0	4
Sections	0	0	1	6	0	1	0	9	0	0	3	21
Bars	1	1	1	29	2	1	1	85	1	1	10	133
Wire rods	0	0	0	81	0	0	0	34	0	0	4	120
Special steel	0	20	2	37	3	1	0	1	0	0	2	66
Hot 3mm more	1	1	1	49	3	2	0	7	0	0	2	66
Hot 3mm less	0	0	0	21	6	3	0	3	1	0	4	39
Cold rolled s.s.	0	0	0	55	17	7	0	9	2	0	10	101
Electrical s.s.	0	0	0	0	12	0	0	0	0	0	0	12
Stainless steel	0	0	0	5	0	1	0	0	0	0	2	8
Steel for tool	0	0	0	5	0	0	0	0	0	0	2	7
Tinplate	0	0	0	28	9	3	6	0	0	0	2	48
Galvanized s.s.	0	0	0	9	0	0	0	7	0	0	2	18
Cold tapes	0	0	0	4	2	0	0	0	0	0	1	7
Sections	0	1	0	2	0	0	0	1	0	0	1	6
Balls	0	0	0	5	0	0	0	0	0	0	0	5
Seamless tubes	4	1	1	26	2	4	1	13	1	0	6	59
Welded tubes	1	0	1	37	0	0	0	16	0	0	4	59
Drawn wires	0	1	0	24	9	3	0	12	0	4	7	60
Total	8	27	8	461	68	27	9	305	6	8	75	1002
	0.8%	2.7%	0.8%	46.0%	6.8%	2.7%	0.9%	30.4%	0.6%	0.8%	7.5%	

Long	578	57.7%
Flat	306	30.5%
Tube	118	11.8%

Usage of each product (2004)

	Gen	Mine	Non fe	Mach	Elec	Chem	Food	Cons	Agr	Trans	Other	Total
Ingots & semis	1	2	1	46	4	2	1	117	2	1	15	192
Railway	0	0	0	0	0	0	0	2	0	3	0	5
Sections	0	0	1	8	0	1	0	10	0	0	4	25
Bars	1	2	1	38	3	1	1	95	1	1	12	156
Wire rods	0	0	0	104	0	0	0	38	0	0	5	148
Special steel	0	23	2	48	4	1	0	1	0	0	3	82
Hot 3mm more	1	1	2	62	4	2	0	8	0	0	3	84
Hot 3mm less	0	0	0	27	9	3	0	4	1	0	5	49
Cold rolled s.s.	0	0	0	71	24	8	0	10	3	0	13	129
Electrical s.s.	0	0	0	0	17	0	0	0	0	0	0	17
Stainless steel	0	0	0	6	0	1	0	0	0	0	3	10
Steel for tool	0	0	0	6	0	0	0	0	0	0	3	8
Tinplate	0	0	0	36	13	4	8	0	0	0	3	83
Galvanized s.s.	0	0	0	12	0	0	0	8	0	0	2	22
Cold tapes	0	0	0	5	3	0	0	0	0	0	1	10
Sections	0	1	0	3	0	0	0	1	0	0	2	7
Balls	0	0	0	7	0	0	0	0	0	0	0	7
Seamless tubes	4	1	2	33	2	5	2	14	1	0	8	72
Welded tubes	1	0	1	48	0	0	0	17	0	0	5	72
Drawn wires	0	1	0	31	13	4	0	13	0	5	8	75
Total	7	31	10	591	98	33	12	341	7	10	92	1231
	0.6%	2.5%	0.8%	48.0%	7.9%	2.7%	1.0%	27.7%	0.6%	0.8%	7.5%	

Sources: National statistical Institute & Ministry of Industry of Bulgaria

(Forecast : JICA Consultant)

Long	695	56.5%
Flat	392	31.8%
Tube	144	11.7%

Appendix 5-2 Forecast of Steel Consumption by Demand Categories and Product Type (Pessimistic Case)

(Pessimistic case) (1000MT)

Usage of each product (1995)

	Gen	Mine	Non fe	Mach	Elec	Chem	Food	Cons	Agr	Trans	Other	Total
Ingots & semis	1	1	1	30	2	1	1	81	1	1	10	129
Railway	0	0	0	0	0	0	0	1	0	2	0	3
Sections	0	0	1	5	0	1	0	7	0	0	3	16
Bars	1	1	1	24	2	1	0	66	1	1	8	105
Wire rods	0	0	0	67	0	0	0	26	0	0	3	97
Special steel	0	17	1	31	3	1	0	1	0	0	2	54
Hot 3mm more	1	1	1	40	2	2	0	6	0	0	2	54
Hot 3mm less	0	0	0	18	6	2	0	3	1	0	3	32
Cold rolled s.s.	0	0	0	46	14	5	0	7	2	0	8	83
Electrical s.s.	0	0	0	0	10	0	0	0	0	0	0	11
Stainless steel	0	0	0	4	0	1	0	0	0	0	2	6
Steel for tool	0	0	0	4	0	0	0	0	0	0	2	5
Tinplate	0	0	0	23	8	3	4	0	0	0	2	39
Galvanized s.s.	0	0	0	7	0	0	0	6	0	0	1	14
Cold tapes	0	0	0	3	2	0	0	0	0	0	1	6
Sections	0	1	0	2	0	0	0	1	0	0	1	5
Balls	0	0	0	4	0	0	0	0	0	0	0	4
Seamless tubes	3	1	1	21	1	3	1	10	1	0	5	47
Welded tubes	1	0	0	31	0	0	0	12	0	0	4	47
Drawn wires	0	1	0	20	0	3	0	9	0	3	5	49
Total	6	23	6	379	59	22	6	235	5	6	61	807
	0.7%	2.8%	0.7%	47.0%	7.3%	2.7%	0.8%	29.1%	0.6%	0.8%	7.5%	

Long	462	57.2%
Flat	251	31.1%
Tube	94	11.7%

Usage of each product (1999)

	Gen	Mine	Non fe	Mach	Elec	Chem	Food	Cons	Agr	Trans	Other	Total
Ingots & semis	1	1	1	32	2	1	1	97	1	1	11	148
Railway	0	0	0	0	0	0	0	1	0	2	0	4
Sections	0	0	1	6	0	1	0	9	0	0	3	19
Bars	1	1	1	26	2	1	1	79	1	1	9	121
Wire rods	0	0	0	71	0	0	0	32	0	0	3	106
Special steel	0	18	2	33	3	1	0	1	0	0	2	58
Hot 3mm more	1	1	1	42	2	2	0	7	0	0	2	59
Hot 3mm less	0	0	0	19	6	2	0	3	1	0	4	34
Cold rolled s.s.	0	0	0	48	15	5	0	8	2	0	9	89
Electrical s.s.	0	0	0	0	11	0	0	0	0	0	0	11
Stainless steel	0	0	0	4	0	1	0	0	0	0	2	7
Steel for tool	0	0	0	4	0	0	0	0	0	0	2	6
Tinplate	0	0	0	24	8	3	5	0	0	0	2	43
Galvanized s.s.	0	0	0	8	0	0	0	7	0	0	1	16
Cold tapes	0	0	0	3	2	0	0	0	0	0	1	7
Sections	0	1	0	2	0	0	0	1	0	0	1	5
Balls	0	0	0	5	0	0	0	0	0	0	0	5
Seamless tubes	4	1	1	22	2	4	1	12	1	0	6	53
Welded tubes	1	0	0	33	0	0	0	14	0	0	4	52
Drawn wires	0	1	0	21	0	3	0	11	0	4	6	53
Total	7	24	7	403	61	24	8	281	5	7	67	895
	0.8%	2.7%	0.8%	45.0%	6.8%	2.7%	0.9%	31.4%	0.6%	0.8%	7.5%	

Long	519	58.0%
Flat	271	30.3%
Tube	105	11.7%

Usage of each product (2004)

	Gen	Mine	Non fe	Mach	Elec	Chem	Food	Cons	Agr	Trans	Other	Total
Ingots & semis	1	2	1	40	3	1	1	105	1	1	13	169
Railway	0	0	0	0	0	0	0	1	0	2	0	4
Sections	0	0	1	7	0	1	0	9	0	0	3	22
Bars	1	1	1	33	3	1	1	85	1	1	10	137
Wire rods	0	0	0	90	0	0	0	34	0	0	4	129
Special steel	0	28	2	42	4	1	0	1	0	0	2	71
Hot 3mm more	1	1	1	54	3	2	0	7	0	0	2	73
Hot 3mm less	0	0	0	24	8	3	0	3	1	0	4	43
Cold rolled s.s.	0	0	0	62	21	7	0	9	2	0	11	112
Electrical s.s.	0	0	0	0	15	0	0	0	0	0	0	15
Stainless steel	0	0	0	5	0	1	0	0	0	0	2	9
Steel for tool	0	0	0	5	0	0	0	0	0	0	2	7
Tinplate	0	0	0	31	12	3	7	0	0	0	2	55
Galvanized s.s.	0	0	0	10	0	0	0	7	0	0	2	19
Cold tapes	0	0	0	4	3	0	0	0	0	0	1	9
Sections	0	1	0	3	0	0	0	1	0	0	1	6
Balls	0	0	0	0	0	0	0	0	0	0	0	6
Seamless tubes	3	1	1	28	2	4	2	13	1	0	7	63
Welded tubes	1	0	1	41	0	0	0	16	0	0	5	63
Drawn wires	0	1	0	27	11	3	0	12	0	5	7	66
Total	6	27	9	512	84	28	11	304	6	9	81	1078
	0.6%	2.5%	0.8%	47.5%	7.9%	2.7%	1.0%	28.2%	0.6%	0.8%	7.5%	

Long	611	56.7%
Flat	342	31.7%
Tube	126	11.7%

Sources: National statistical Institute & Ministry of Industry of Bulgaria

(Forecast : JICA Consultant)

Appendix 6-1 World-wide Crude Steel Production and Iron Ore Output/Trade Volume for Period 1984-1993

(Unit: One Million MT)

Item \ Jan.-Dec.	1984	1985	1986	1987	1988
Crude steel production	711	719	714	737	780
Pig iron production	491	499	496	509	538
Iron ore production	882	910	921	946	964
Breakdown: Free countries	493	511	508	522	541
Breakdown: Former U.S.S.R.	247	248	250	251	250
Breakdown: China	142	151	163	168	173
Internationally traded iron ore	372	376	370	368	401
Seaborne iron ore trade	306	321	311	319	348

Item \ Jan.-Dec.	1989	1990	1991	1992	1993:(P)
Crude steel production	786	710	737	723	726
Pig iron production	545	532	509	500	503
Iron ore production	991	980	951	921	935
Breakdown: Free countries	569	558	562	537	547
Breakdown: Former U.S.S.R.	241	236	199	175	153
Breakdown: China	181	186	175	196	225
Internationally traded iron ore	424	397	399	367	398
Seaborne iron ore trade	362	347	358	334	352

(P) Provisional

Source: TEX Report

Appendix 6-2 Iron Ore Exported by Each Country for Period 1990-1993

(Unit : One Million MT)

Country \ Jan.-Dec.	1990	1991	1992	1993:P
Sweden	16.4	15.5	15.5	16.4
France	3.3	3.1	2.9	2.8
Spain	1.7	2.2	1.9	1.4
Norway	2.1	2.1	2.3	2.5
Others	0.1	--	0	0.2
Western Europe Total	23.6	22.9	22.6	23.3
Former U.S.S.R.	38.6	27.4	27.0	29.3
South Africa	17.0	15.5	14.9	19.6
Mauritania	11.4	10.5	8.1	9.7
Liberia	3.9	1.1	1.5	0.3
Angola	—	—	—	—
Sierra Leone	—	—	—	—
Algeria	—	—	—	—
Others	0.1	0.1	0.1	0.1
Africa Total	32.4	27.2	24.6	29.7
Canada	27.0	29.7	25.1	26.1
U.S.A.	3.2	4.0	5.1	5.1
Northern America Total	30.2	33.7	30.2	31.2
Brazil	114.3	114.7	106.0	111.9
Venezuela	14.8	13.4	10.2	10.4
Chile	6.5	7.4	6.0	6.3
Peru	3.5	2.7	3.2	5.0
South America Total	139.1	138.2	125.4	133.6
India	31.6	31.5	28.5	31.5
North Korea	0.8	0.8	0.8	0.8
Others	—	0.1	0.2	0.3
Asia Total	32.4	32.4	29.5	32.6
Australia	100.0	115.9	106.6	116.5
New Zealand	1.0	1.2	1.4	1.3
Oceania Total	101.0	117.1	108.0	117.8
World Trading	397.3	398.9	367.3	397.5

Source: TEX Report

Appendix 6-3 Iron Ore Price in Europe (Main Brands) for Period 1992-1994

FOB US¢/Fe 1% - DMT

① Lumpy ore	1992	1993	1994	Remarks
ISCOR (S. Africa)	¢32.29 (-7%)	¢29.38 (-9%)	¢28.00 (-4.7%)	
Mt. Newman (Aus) Hamersley (Aus)	¢48.28 (-3.9%)	¢42.06 (-12.9%)	¢40.28 (-4.2%)	(CIF Rotterdam)
Carajas (Brazil)	¢37.10 (-11.16%)	¢33.09 (-10.8%)	¢30.47 (-7.92%)	

② Pellets	1992	1993	1994	Remarks
LKAB (Sweden)	¢53.475 (-7.5%)	¢45.70 (-14.5%)	¢45.60 (-0.22%)	
QCM (Canada) Carol Lake (Canada)	¢49.35 (-6.9%)	¢44.25 (-10.3%)	¢44.00 (-0.56%)	
CVRD (Brazil)	¢48.47 (-7.05%)	¢43.64 (-9.96%)	¢43.64 (--)	

③ Powdery	1992	1993	1994	Remarks
LKAB (Sweden)	¢37.00 (-1.6%)	¢31.00 (-2.3%)	¢29.10 (-6.1%)	
Mt. Newman (Aus) Hamersley (Aus)	¢41.40 (-1.2%)	¢35.18 (-15.0%)	¢32.80 (-6.77%)	(CIF Rotterdam)
Carajas (Brazil)	¢33.10 (-4.8%)	¢29.09 (-12.1%)	¢26.47 (-9%)	

Source: TEX Report

Appendix 6-4 Production of Coke Oven Coke (Mt)

	1984	1985	1986	1987	1988	1989	1990	1991	1992 *
Australia	3.6	3.6	3.8	3.6	4.1	4.4	4.5	4.2	4.4
Austria	1.8	1.8	1.7	1.7	1.7	1.8	1.7	1.5	1.5
Belgium	5.9	6.0	5.1	5.2	5.6	5.5	5.4	4.9	4.6
Canada	4.9	4.7	4.5	4.6	4.7	4.4	3.7	3.6	3.7
Denmark	—	—	—	—	—	—	—	—	—
Finland	—	—	—	0.1	0.5	0.4	0.5	0.5	0.5
France	9.0	8.7	8.3	7.5	7.4	7.3	7.2	6.9	6.8
Germany	28.4	30.2	30.0	26.7	25.5	25.2	21.9	16.5	n.a.
Greece	—	—	—	—	—	—	—	—	—
Iceland	—	—	—	—	—	—	—	—	—
Ireland	—	—	—	—	—	—	—	—	—
Italy	6.9	7.4	7.2	6.8	6.7	6.7	6.4	6.1	5.4
Japan	48.2	48.6	45.1	43.7	47.7	46.9	45.9	45.5	43.7
Luxembourg	—	—	—	—	—	—	—	—	—
Netherlands	2.7	3.0	2.9	2.8	2.9	2.9	2.7	2.9	2.9
New Zealand	—	—	—	—	—	—	—	—	—
Norway	0.3	0.3	0.3	0.3	0.2	—	—	—	—
Portugal	—	—	—	—	—	—	—	—	—
Spain	3.3	3.4	3.1	2.9	3.0	3.1	3.2	3.2	3.0
Sweden	1.2	1.2	1.2	1.1	0.9	1.0	1.1	1.1	1.1
Switzerland	—	—	—	—	—	—	—	—	—
Turkey	2.6	2.7	3.0	3.2	3.4	2.8	3.2	3.3	3.2
United Kingdom	7.0	9.3	8.9	8.7	8.6	8.4	8.4	7.8	6.5
United States	27.7	26.0	23.2	25.4	29.4	30.0	25.1	21.8	n.a.
OECD Total	153.7	156.8	148.3	144.3	152.3	150.9	140.8	129.9	124.3

Note : The solid product obtained from the carbonization of coal, principally coking coal, that is used mainly in the iron and steel industry; also includes coke and semi-coke made from lignite.

* : Estimated

Source: IEA/OECD Energy Balances and IEA Country Submissions (1992)

Appendix 6-5 Consumption of Coke Oven Coke (Mt)

	1984	1985	1986	1987	1988	1989	1990	1991	1992 *
Australia	3.5	3.5	3.3	3.2	3.1	3.2	4.2	4.2	3.7
Austria	2.9	3.0	2.6	2.6	2.6	2.6	2.5	2.5	2.2
Belgium	5.9	5.8	5.1	5.0	5.4	5.3	5.3	5.0	4.3
Canada	5.3	5.2	4.9	4.9	5.1	4.9	3.8	4.1	3.9
Denmark	0.1	0.1	0.1	—	0.1	—	—	—	—
Finland	1.2	1.2	1.1	1.1	1.2	1.3	1.3	1.2	1.2
France	10.3	10.4	9.1	8.4	8.4	8.5	7.7	7.2	6.9
Germany	28.6	29.7	26.4	24.7	25.8	25.7	21.1	16.3	n.a.
Greece	0.1	0.1	—	—	—	—	—	—	—
Iceland	—	—	—	—	—	—	—	—	—
Ireland	—	—	—	—	—	—	—	—	—
Italy	6.9	7.3	7.0	6.9	6.4	6.7	6.4	6.4	5.2
Japan	46.0	46.6	42.2	41.1	44.8	44.3	43.8	42.9	42.2
Luxembourg	1.9	1.8	1.7	1.3	1.4	1.5	1.5	1.3	1.2
Netherlands	2.5	2.5	2.4	2.2	2.5	2.5	2.3	2.2	2.1
New Zealand	—	—	—	—	—	—	—	—	—
Norway	0.8	0.9	0.7	0.7	0.7	0.6	0.5	0.5	0.5
Portugal	0.3	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.3
Spain	3.7	3.8	3.2	3.0	3.0	3.2	3.4	3.2	3.0
Sweden	1.4	1.5	1.5	1.4	1.4	1.4	1.4	1.3	1.4
Switzerland	0.1	0.1	0.1	0.1	—	—	—	—	—
Turkey	2.7	2.8	3.0	3.5	3.4	2.8	3.3	3.5	3.3
United Kingdom	8.5	9.2	8.1	8.8	9.1	8.5	8.2	7.8	6.8
United States	27.1	26.6	22.2	26.7	30.8	30.8	25.2	22.0	n.a.
OECD Total	159.9	162.4	145.2	146.0	155.9	154.1	142.3	131.8	125.2

Note : The solid product obtained from the carbonization of coal, principally coking coal, that is used mainly in the iron and steel industry; also includes coke and semi-coke made from lignite.

* : Estimated

Source: IEA/OECD Energy Balances and IEA Country Submissions (1992)

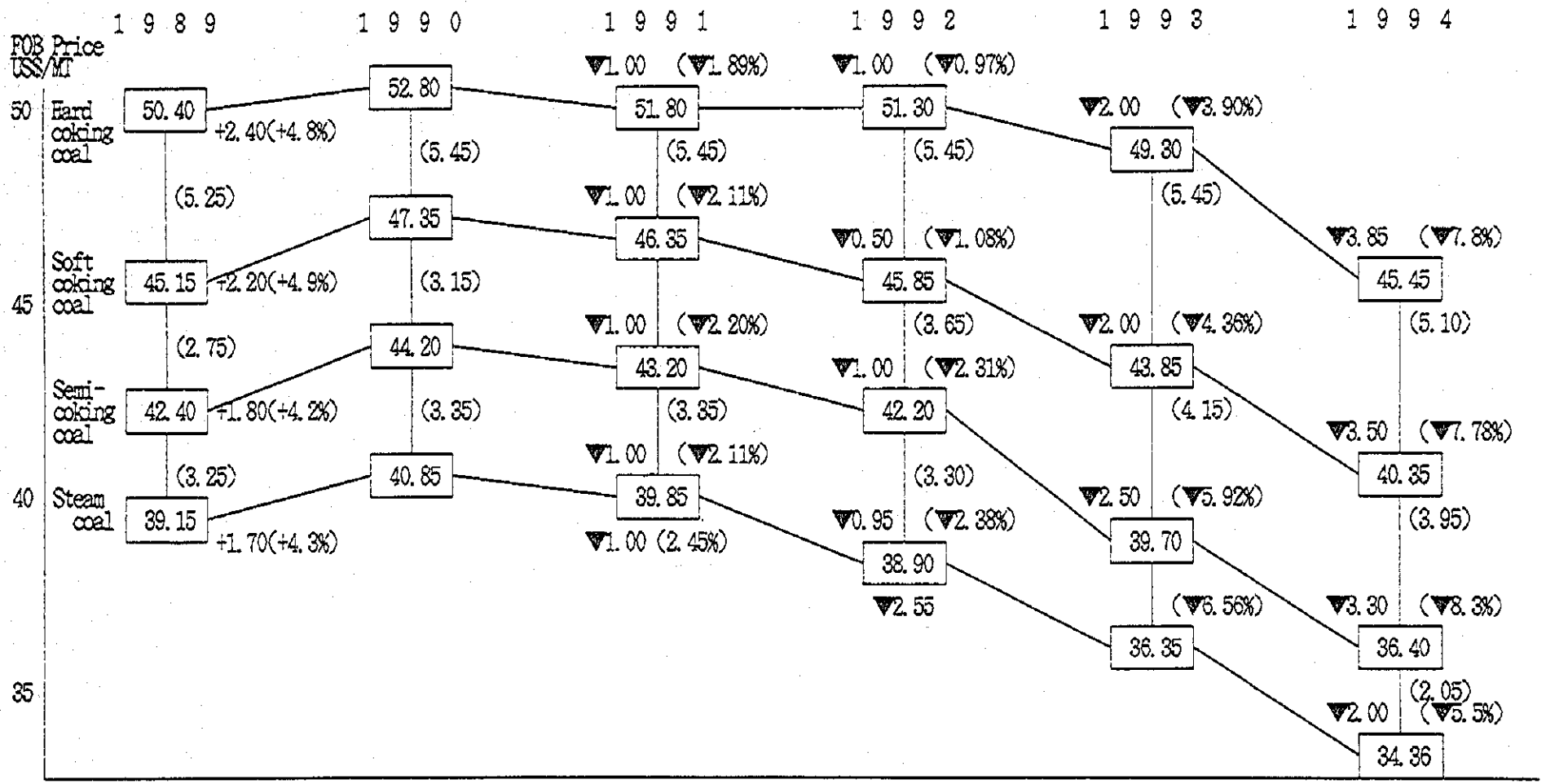
Appendix 6-6 Average CIF Prices for Coking Coal Imported into European Community from Non-EC Countries

	Average of all contracts	
	$/t	$/tce
1977	62.13	58.50
1978	61.90	58.40
1979	65.30	61.50
1980	69.20	65.10
1981	81.70	76.90
1982	81.40	76.60
1983	69.60	65.50
1984	65.00	61.20
1985	62.40	58.80
1986	58.50	55.10
1987	54.00	50.85
1988	56.45	53.15
1989	60.04	56.53
1990	59.95	56.69
1991	59.55	56.07
1992	57.92	54.54
Q189	58.25	54.85
Q289	60.15	56.64
Q389	60.65	57.11
Q489	61.10	57.53
Q190	61.45	58.97
Q290	59.00	55.55
Q390	59.40	55.93
Q490	59.80	56.31
Q191	60.40	56.87
Q291	59.70	56.22
Q391	58.90	55.46
Q491	59.20	55.74
Q192	58.90	55.46
Q292	58.00	54.60
Q392	57.50	54.14
Q492	57.30	53.95
Q193	57.50	54.14

Note : Coking coal refers to coal standardized to the following characteristics: ash 6.0%, sulphur 1.0%, volatile matter 24.0% (all measured on a dry sample basis), moisture 5%, screen size 0 ~30mm.

Source: Commission of the European Communities, Community Imports of Hard Coal from Non-Member Countries for use in Coking Plants (various years).

Appendix 6-7 Prices List of Coking Coal and Steam Coal in Period 1989-1994



Price difference (US$/MT)

Hard/semi-soft	8.00	8.60	8.60	9.10	9.60	9.05
Hard/steam	11.25	11.95	11.95	12.40	12.95	11.10

Source: Coal News. April 4. 1994 (No. 2025)

Appendix 8.1~8.7

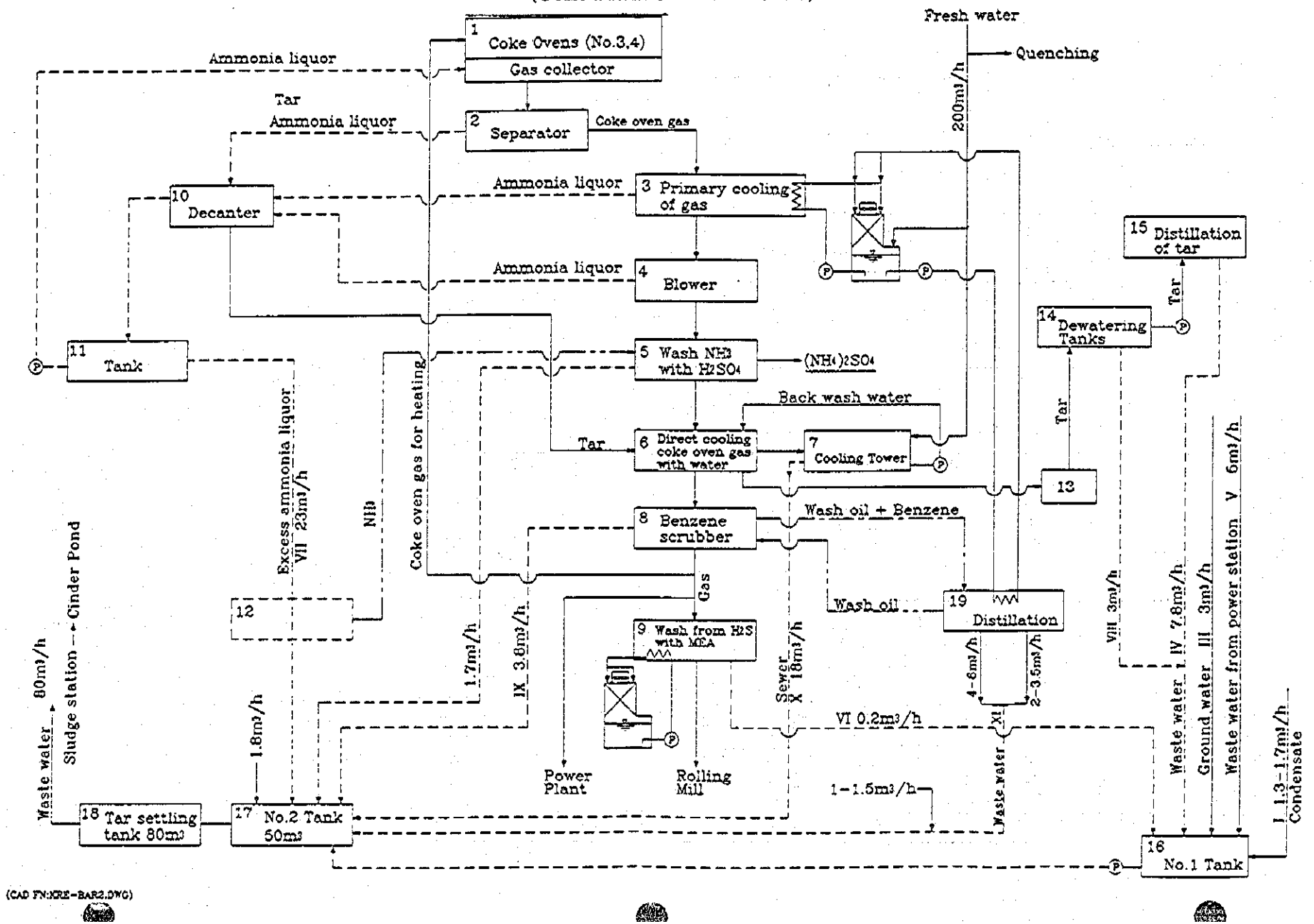
Environmental Pollution Prevention (Water)

Appendix 8-1 Water Balance at Kremikovtzi Steelworks unit(m3/h)

No.	Plant name	Supply water: Tailing Pond	Supply water: Botunetze Lake	Supply water: Pancharevo Lake	Recycled water: Waste water	Recycled water: Clean water	Treatment water: WT	Treatment water: CP	Treatment water: TP
1	Refractory plant	80					40	30	
2	Coke oven	360				3,400	250	100	
3	Ore preparation plant	1,200+A			1,800	800	50		1,600
4	Sintering plant	300	900			950	200		1,000
5	Blast furnace	500			2,520	6,000	350	150	
6	Ferro-alloy plant	200				200	150	50	
7	Converter	200			910	610	100	70	
8	Electric arc furnace	100			720	1,400	50	30	
9	Hot rolling mill	1,200			8,800	5,260	1,200		
10	Cold rolling mill	400				4,570	200	200	
11	Pipe plant	300			380		150	50	
12	Power plant	1,000	-A			28,025	300		
13	Deminelizer etc.	900						300	
14	Oxygen plant	150				6,370	150		
15	Mechanical shop	200					200		
16	Compress shop					2,210			
		(A:400)							
		5,890	2,100		15,130	59,795	3,590	980	2,600
		7,990			74,925		7,170		

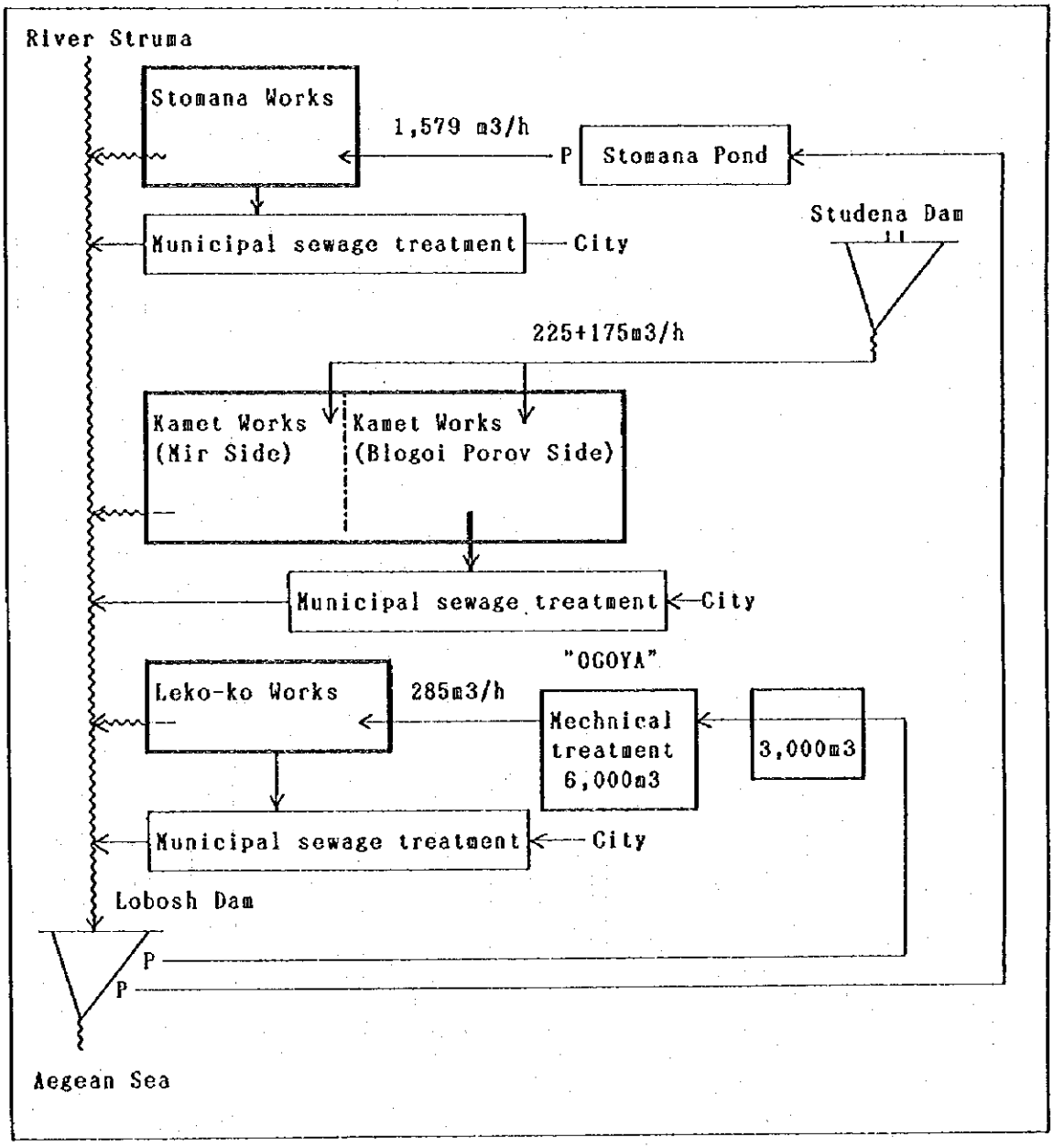
Note:WT(Wastewater Treatment Plant) CP(Cinder Pond) TP(Tailing Pond)

Appendix 8-2 Wastewater Flow Sheet (Coke Plant at Kremikovtzi)

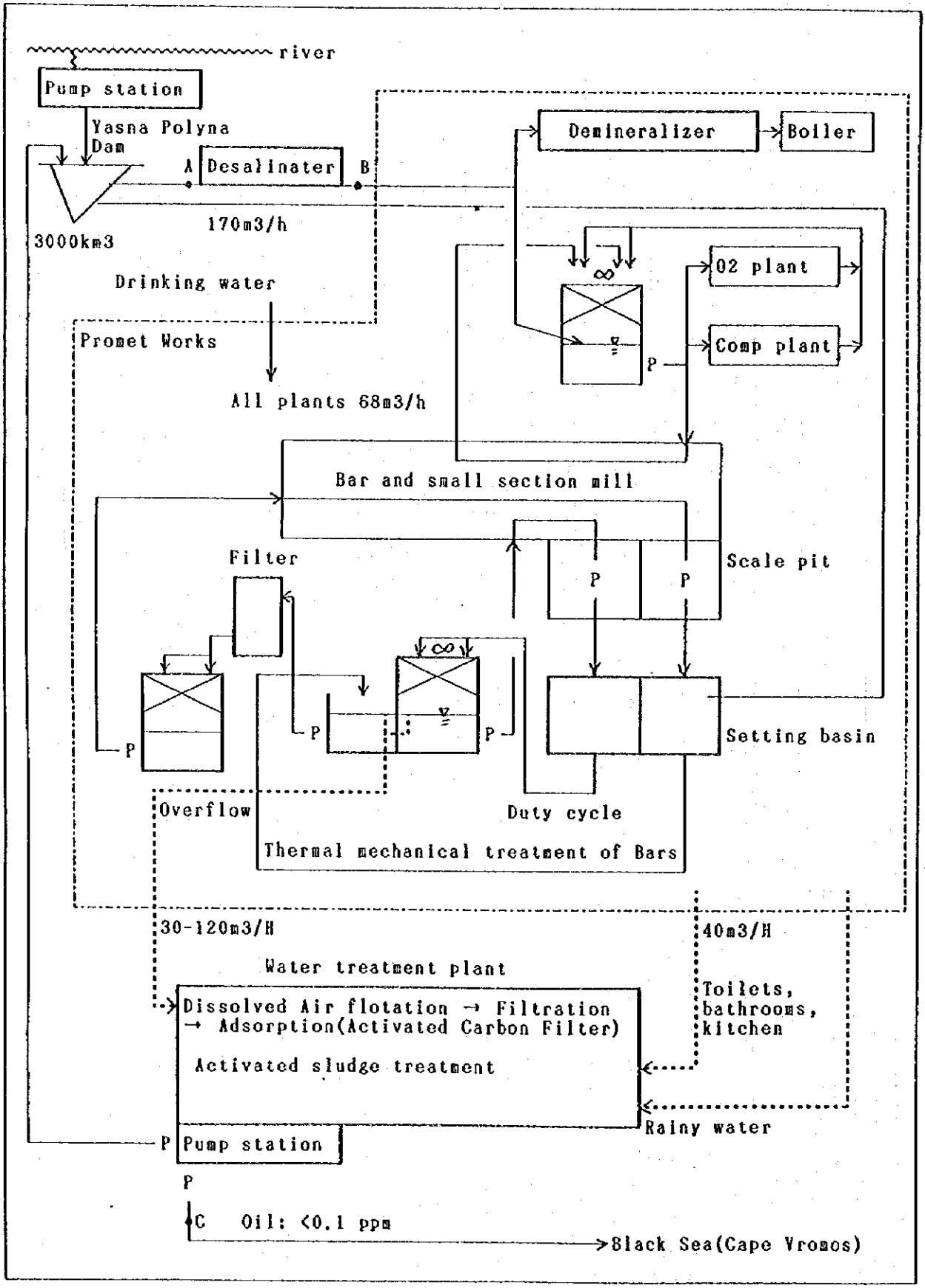


(CAD FN:XRE-BAR2.DWG)

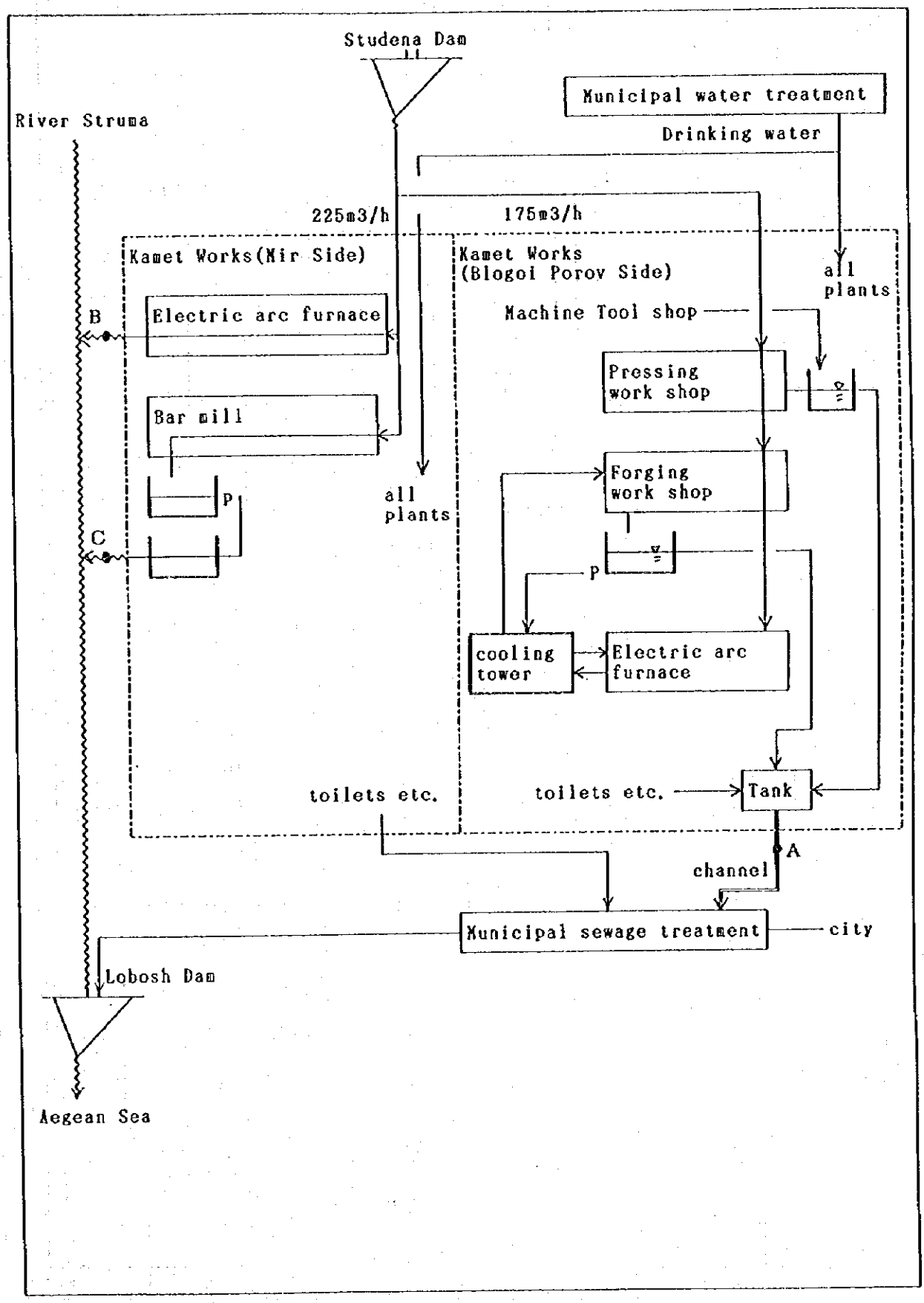
Appendix 8-3 Water Balance at Stomana, Kamet and Leko ko Steelworks



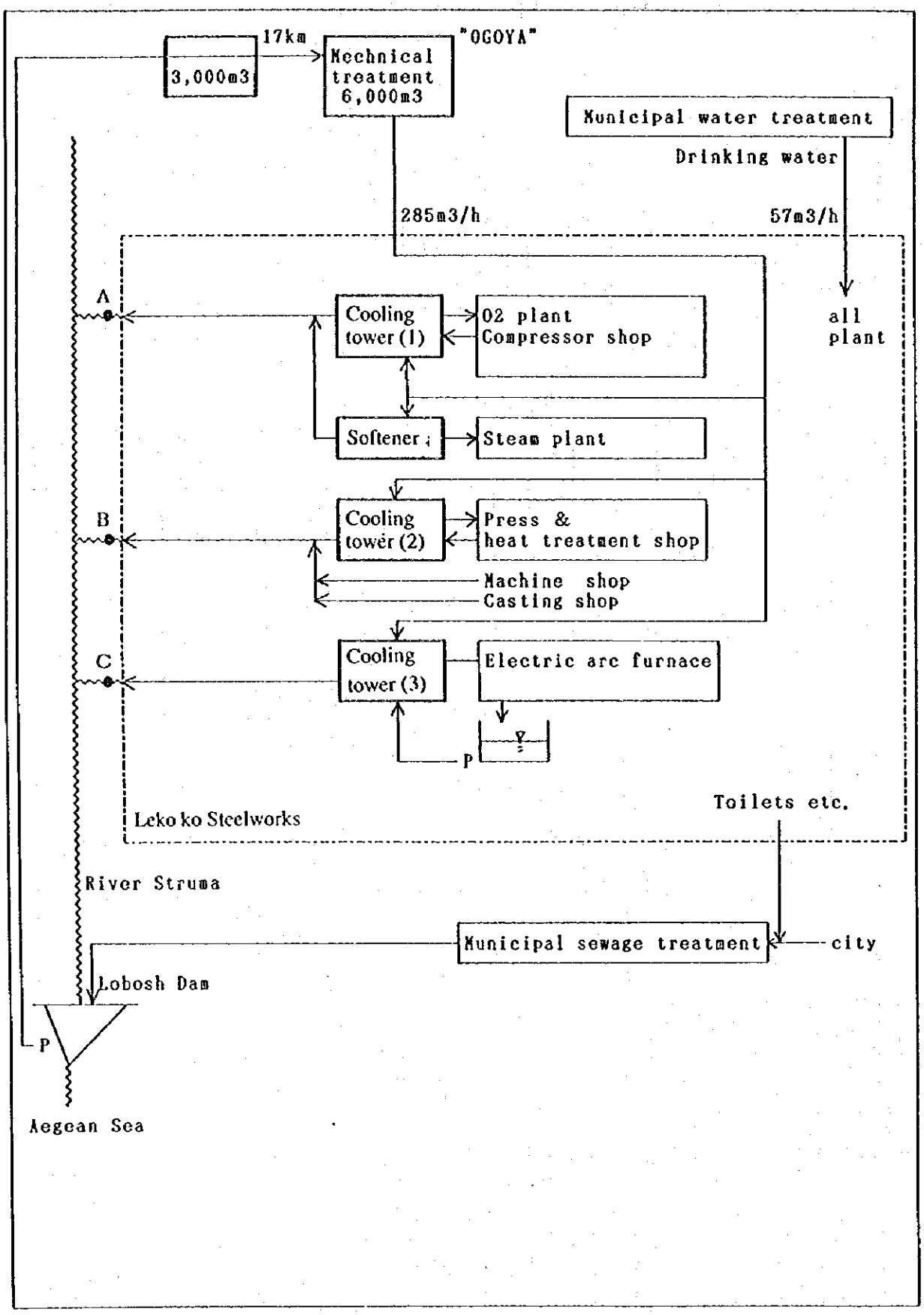
Appendix 8-4 Water Balance at Promet Steelworks



Appendix 8-5 Water Balance at Kamet Steelworks



Appendix 8-6 Water Balance at Leko ko Steelworks



Appendix 8-7 Recommendations of Wastewater Facility

Although the effluent water meets the statutory water quality standards, the following items in water treatment facilities need to be improved.

1) Kremikovtzi Steelworks

a) Industrial water recovery rate

When the industrial water recovery rate is raised, algae development, scale deposition, and corrosion occur more readily. Since industrial water is very hard, caution is needed to prevent defective heat exchange due to scale development and growth in indirectly-cooled areas within the blast furnaces and heating furnaces that receive thermal load. Caution is needed also to prevent scale deposition from clogging of water supply pipes in the dust collection water line of converters and blast furnaces. To check corrosion conditions, the corrosion rate(MDD) of the circulating water system and the water quality (pH, total hardness, chloride ions, sulfate ions etc.) at main plants should be measured periodically.

Corrosion becomes conspicuous with a chloride ion level of about 150 ppm in cooling water. In such cases, corrosion inhibitors must be injected into the indirect cooling water system. Should problems occur, implement the following countermeasures:

- Decrease the volume of treated wastewater sent to Botunetze Lake.
- Use a corrosion inhibitor that best suits the water quality of indirect cooling water.

b) Cinder Pond operation

Cinder Pond accepts and treats wastewater from the neutralizing wastewater facility, sludge, reclaimed waste liquid of the demineralizer resin, coke oven gas liquor, and slurry from blast furnaces, converters and electric furnaces.

These materials are transported first by pipes, then through an open U-shaped channel system. Since these waste liquids are highly concentrated, transporting them from the steelworks to Cinder Pond is difficult and involves the following problems.

- If waste acids are not sufficiently neutralized, the transporting pipes will corrode and leak. (Because of this, the piping is being replaced with inner surface coated piping.)
- The pipe of the neutralized sludge transporting line is not suitable-that is, it is too wide, thereby reducing the flow rate and making the pipe liable to clogging.
- The transporting line is susceptible to wear by the sludge from blast furnaces and converters, leading to leaks.

Furthermore, the slurry within Cinder Pond may become dry and release dust. This is being treated by chemicals.

In the future, the slurry should be recycled, and the pond should be abolished to eliminate

the costs of electric power needed for the sludge pump, repair charges for the transporting line and expenses for pollution measures.

c) Tailing Pond operations

Scattering of dust due to Tailing Pond driving up is also a problem, and therefore water is sprinkled periodically. In the future, treatment by thickeners at the steelworks site and recycling of slurry should be attempted to reduce power expenses for the conveying pump and expenses for maintaining the pond.

d) Wastewater treatment facilities inside the steelworks

Oil content

The inflow of oil into the circulating water system at each plant is excessive by Japanese standards. In addition, several ppm of oil are present in the water at almost all parts of the indirect cooling water system. Further detailed investigation and setting up of countermeasures are necessary.

Blast furnace dust collection water line

Dust collection wastewater is treated with three thickener units. As no coagulant is injected, the suspended solid (SS) concentration of the treated water is 37 ppm. The water supply piping to the blast furnace dust collector can clog due to scale deposition; therefore, two water supply lines are provided to enable periodic changing of pipes. The costs for such pipe changes should be studied and compared to the costs for dispersants by conducting a pipe clogging prevention test with dispersants injected into the pipe.

The suctioning ability of the slurry pump that conveys of sludge to Cinder Pond is being impeded by scale, work is being performed to removal the scale (by air blowing). A coarse-grain separator such as a dust conveyor should be installed on the return section of the dust collection wastewater lines for both blast furnaces and converters, and an attempt made to recover coarse grains in the dust collector wastewater (upon checking that zinc has not increased through in creased use of scrap in the converters) to reduce scale removal work.

Converter dust collection water line

Dust collection wastewater is treated by two thickener units. Scale growth inside the water supply line of the converter dust collection water reduces the inside diameter of the piping and decreases the water supply, causing problems.(pH 11.3, total hardness 802 ppm) Injection of polyelectrolyte flocculant has been started as a countermeasure, and the current SS level in the treated water is about 10 ppm. Completely solving the problem would require the injection of a dispersant. (Subsequently, an injection test has been started.)

Hot rolling mill water treatment facility

The water treatment facility of the direct cooling water system is divided and located in two places, one for wastewater from the rolling line and one for wastewater from the hot run table. The facilities are of a horizontal sedimentation type.

Coagulant is injected into only some of the sedimentation tanks and therefore the quality of the treated waters shows an SS level of 30 – 34 ppm and an oil content of 7 to 14 ppm. If cooling water with a low SS level becomes needed, it will be necessary to inject a coagulant or install filters.

An oil film or oil layers are seen floating on the surface of the sedimentation basin. The oil is recovered and used as some of the fuel for the power plant, but mixing of oil from the plant into the circulating water should be reduced as much as possible.

Since descaling pumps are prone to corrosion, indirect cooling water is used. The water quality should be improved or the nature of the pump material should be changed to allow use of direct cooling water and reduce the use of industrial water.

Neutralization water treatment facility

In Japan, the general treatment method for hydrochloric acid pickling waste acid is to recover the hydrochloric acid by a hydrochloric acid recovery equipment on the pickling line and produce iron oxides (Fe_2O_3). Water that has unavoidably been contaminated by weak acid (such as water used to clean steel sheets) is treated by a neutralizing facility.

Acidic wastewater, including waste acid, in this steelworks is treated by the neutralizing plant (located on both the 3rd basement and on the 2nd floor, all inside the building).

First, the rough quality of the used hydrated lime must be improved. Although the quality of the hydrated lime was not examined, it is believed to be quite poor. Only one pH meter was seen in the neutralizing plant. At least two pH meters, one for measuring neutralization (control) and one for measuring treated water are necessary.

In the future, hydrochloric acid recovery equipment should be installed for treatment of waste pickling solutions of hydrochloric acid in order to reduce purchasing expenses for hydrochloric acid and to produce and sell iron oxides (Fe_2O_3). This will reduce expenses for repairing the transporting line to Cinder Pond.

2) Stomana Steelworks

- The quality of the direct cooling water being sent to CC (treated water at the water treatment facility) has a high SS level, 34 ppm. At Japanese steelworks, this level is usually below 5 ppm. High levels of SS in cooling water can cause trouble, possibly,

triggering corrosion or clogging nozzles. We propose that you use a coagulant, install filters, or take other measures to lower this SS level.

- Currently, blow water from some indirect cooling water systems is discharged. To raise the recovery rate of industrial water, the blow water of indirect cooling water systems should be reused as make-up water for direct cooling water systems, and the supply of industrial water to direct cooling water system should be stopped.
- It is recommended that filters be installed on the make-up water line for CC mold cooling water to reduce the SS level in the circulating water. Furthermore, if the circulating water is softened (possibly, made into a closed system), the life of molds will be extended. This possibility should be studied along with investment effects.

3) Promet Steelworks

- The wastewater from the bar mill (direct cooling water circulation system) contains a great deal of oil and layers of oil can be seen floating in the sedimentation basin. Step 1 and step 2 given in the outline, "Water pollution prevention measures" must be taken.
- Since the SS level at the filter outlet of the final wastewater treatment facility is high, at 15 ppm, a heavy load is imposed on the active carbon filter. Improvements such as checking the filter and reviewing of the regenerating conditions are necessary.

4) Leko-ko Steelworks

The industrial water is filtered before being supplied to the steelworks, but the SS level of the water quality after filtering is high, at 38 ppm. Check the filter and improve maintenance so that the SS level does not exceed 10 ppm. Continued use of cooling water with high SS levels makes the piping susceptible to corrosion or slime deposition trouble.

Appendix 9-1

Sources of Raw Materials and Energy

1. Raw Material Source Plan (Iron ore, Coal and Steel scrap)

The results of the study indicate no reason for concern about future supplies of iron ore and raw coal in each scenario.

1.1 Consumption of raw materials

1) Table 1 shows the iron ore consumption in each scenario.

There is no obstacle for supply of iron ore because its consumption quantity for one of scenarios is not so much.

Table 1 Iron Ore Consumption for Restructuring the Bulgarian Steel Industry

Kremikovtzi Steelworks

(Unit : 1,000MT/Y)

Items		Number of Scenario					
		A	A-2	B-1	B-2	C	C-2
Total ore	100%	1,615	2,167	1,433	1,433	1,615	2,167
Sinter feeds	90%	1,454	1,950	1,289	1,289	1,454	1,950
Pellet	5%	80.5	106	72	72	80.5	106
Lumpy ore	5%	80.5	106	72	72	80.5	106

2) Table 2 shows coal consumption in each scenario.

There is no obstacle for supply of coking coal beause its consumption quantity is not so much.

Table 2 Coal Consumption for Restructuring the Bulgarian Steel iIndustry

Kremikovtzi Steelworks

(Unit : 1,000MT/Y)

Item	Number of Scenario					
	A	A-2	B-1	B-2	C	C-2
Coking coal	658	873	587	587	658	871

3) Table 3 shows steel scrap consumption in each scenario.
In scenario number A-2 & C-2, the production quantity of molten iron at Kremikovtzi Steelworks is programmed to be increased, and the quantity of import scrap is planned to be zero in exchange for the molten iron.

Table 3 Scrap Consumption for Restructuring the Bulgarian Steel Industry

(Unit : 1,000MT/Y)

	Number of Scenario								
Items	A	A-2	B-1	B-2	C	C-2	D-1	D-2	D-3
① Kremikovtzi & Stomana									
Total scrap	1,194	859	1,274	1,274	1,167	834	2,157	2,141	2,141
Domestic scrap	600	600	600	600	600	600	600	600	600
Import scrap	335	0	443	443	333	0	1,296	1,297	1,295
Cast iron	0	0	0	0	0	0	15	15	15
Return scrap	259	259	231	231	234	234	245	231	231
② Leko ko									
Total scrap	85	85	85	85	85	85	85	85	85
Domestic scrap	56	56	56	56	56	56	56	56	56
Return scrap	29	29	29	29	29	29	29	29	29
③ Total steel mills (①+②)									
Total scrap	1,279	944	1,359	1,359	1,252	919	2,242	2,226	2,226
Domestic scrap	656	656	656	656	656	656	656	656	656
Import scrap	335	0	443	443	334	0	1,296	1,296	1,296
Cast iron	0	0	0	0	0	0	15	15	15
Return scrap	288	288	260	260	263	263	274	260	260

1.2 Forecast of future supply

1) Iron ore and raw coal

Kremikovtzi steelworks already purchases iron ore and raw coal in world markets. Kremikovtzi steelworks imports iron ore by railway via Bulgas port or Lom port, and raw coal via Bulgas port.

2) Steel scrap

Steel scrap generated in Bulgaria is expected to total 697,800 t/year in the future. Consumption of 600,000 t/year of scrap should be planned for Kremikovizi and Stomana steelworks, and 58,000 t/year for Leko ko steelworks. Shortfalls should be covered by imported scrap.

1.3 Prospect for unit price of raw materials

Table 4 shows the unit price of iron ore and coking coal. Table 5 shows the unit price of steel scrap.

The price of iron ore and coking coal are planned to be near to those prices in developed countries.

Table 4 Iron Ore and Coking Coal Price (Unit : $/t)

Powdery ore	30.00
Coking coal	60.00

Raw materials in detail are shown in Appendix 11-1.

Average price of steel scrap in scenario number A-2 & C-2 are planned to be lower than the other scenarios because both have no import scrap. Either of the mentioned scenario is expected to be the best one.

Table 5 Steel Scrap Price

(Unit : US$/t)

Items	Number of Scenario								
	A	A-2	B-1	B-2	C	C-2	D-1	D-2	D-3
① Kremikovtzi									
Domestic scrap	95	95	95	95	95	95	95	95	95
Import scrap	145	145	145	145	145	145	145	145	145
Ave. Do. & Imp.	113	95	116	116	113	95	129	129	129
Cast iron	170	170	170	170	170	170	170	170	170
Return scrap	57	57	57	57	57	57	57	57	57
Ave. of scrap	98	73	80	80	98	73	120	121	121
② Stomana									
Domestic scrap	95	95	95	95	95	95	95	95	95
Import scrap	145	145	145	145	145	145	145	145	145
Ave. Do. & Imp.	113	95	116	116	113	95	129	129	129
Return scrap	57	57	57	57	57	57	57	57	57
Ave. of scrap	104	89	110	110	106	90	122	123	123
③ Leko ko									
Domestic scrap	95	95	95	95	95	95	95	95	95
Return scrap	57	57	57	57	57	57	57	57	57
Ave. of scrap	82	82	82	82	82	82	82	82	82

2. Energy Source Plan

The annual amount of purchased energy (natural gas, electric power) of the steelworks is estimated in order to confirm that the energy supply system will not restrict the selection of scenarios.

The estimated amount of purchased energy shows that there should be no restriction on scenario selection because the present actual energy supply system in the steelworks has adequate capacity.

1) Consumption

The following Table 6 shows that the selected scenarios are classified into 4 groups by conditions (steel production, plant composition) that affect energy supply and demand.

Table 6 Crude Steel Production and Plant Composition in Each Scenario

Scenarios	Kremikovtzi				Stomana	
	Crude steel Production (Kt/y)	Composition			Crude steel Production (Kt/y)	Composition
		BF	COV	EF		
A	1,474	2	3	1	546	2
C	1,474	2	3	1	521	2
B - 1	993	2	3	(1)	1,002	2
B - 2	993	2	3	(1)	1,002	2
D - 1	979	-	-	2	1,027	2
D - 2	993	-	-	2	1,002	2
A - 2	1,474	2	3	-	546	2
C - 2	1,474	2	3	-	521	2

The estimated annual amount of natural gas and electric power purchased in each scenario group is shown in Table 7. The annual amount is estimated on the basis of unit consumption and production after improvement.

Table 7 Annual Natural Gas and Electric Power Purchased in Each Group

Steelworks	Scenario A, C		Scenario A-2, C-2		Scenario B-1, B-2		Scenario D-1, D-2, D-3	
	Electric power (10^6Kwh)	N.Gas (10^6Nm^3)	Electric power (10^6Kwh)	N.Gas (10^6Nm^3)	Electric power (10^6Kwh)	N.Gas (10^6Nm^3)	Electric power (10^6Kwh)	N.Gas (10^6Nm^3)
Kremikovtzi	730.2	233.8	646.1	169	478.2	223.6	731.5	373.2
Stomana	510.7	91.1	510.7	91.1	835.1	95.8	854.6	97.2
Promet	(51.4)	(12.6)	(51.4)	(12.6)	78	19.8	78	19.8

2) Suppliers, quality and supply capacity

Table 8 and Table 9 show a comparison of the supply capacity and the purchased amount (consumption) of natural gas and electric power in the steelworks. The purchased amount (consumption) in the Table is the maximum quantity in the scenario group. This table shows that actual supply system has adequate capacity under all scenarios.

(1) Natural gas

Supplier : Bulgar Gas Company

Quantity : Unit calorific value: 7,920 ~ 8,000 Kcal/Nm^3

Composition: CH_4 98.54%, C_2H_4 0.32%, C_3H_8 0.09%, C_4H_{10}- C_5H_{12} 0.04%, $CO_2$0.03%, N_2 0.98%

Supply capacity and consumption: Refer to the following table.

Table 8 Comparison of Natural Gas Supply Capacity and Consumption at Kremikovtzi, Stomana and Promet

Steelworks	Estimated supply capacity	Average consumption per hour
Kremikovtzi	$85 \times 10^3Nm^3/h$	$43 \times 10^3Nm^3/h$
Stomana	$85 \times 10^3Nm^3/h$	$11 \times 10^3Nm^3/h$
Promet	$85 \times 10^3Nm^3/h$	$2.3 \times 10^3Nm^3/h$

(2) Electric power

Supplier: National Electric Company
Supply capacity and purchased amount: Refer to the following table.

Table 9 Comparison of Electric Power Supply Capacity and Purchases Amount at Kremikovtzi, Stomana and Promet

Steelworks	Estimated supply capacity	Average consumption per hour
Kremikovtzi	860 MVA	98 MVA
Stomana	630 MVA	115 MVA
Promet	120MVA	10 MVA

3) Transportation routes

Natural gas and electric power can be supplied to each steelworks using the existing pipe lines and overhead lines without reinforcement.

4) Unit price

The prospective unit prices of purchased natural gas and electric power have already been mentioned in Sections 7.4.1 and 7.4.2 as follows.
Natural gas : $ 0.12/Nm^3 ($0.015 /Mcal)
Electric power : $ 0.05/kwh in average
The unit price of power by time period is $ 0.024/kwh in night time, $ 0.048 /kwh in day time, and $ 0.088/kwh at peak time (estimated).

The power plant of Kremikovtzi, which generates power using natural gas only during peak time, can be operated profitably (at a natural gas price of $0.015/Mcal, the unit cost of generated power is estimated at $0.069/Kwh, which is lower than the unit price only at peak time).

Appendix 10-1 Products and Quality of Coil and Sheet

Products	Sizes	Steel Grade
1.Hot rolled Sheet	(2.0-2.8)T * (770-1,050)W * (2-3m)L (3.0-3.8)T * (770-1,250)W * (2-6m)L (4.0-12)T * (770-1,500)W * (2-6m)L	Carbon Steel DIN17100/80--St33,St37, DIN1614/86 part1--St22,St23 DIN17210/86--C10,C15 DIN17200/87--C22,C25,C30, C35,C40,C45,C50
Strip	(3-6)T*(120-600)W*OD(1.1-1.9m)*ID (740)	Alloyed Steel DIN17102/83--TStE355 DIN17200/87--15Mn3,30Mn4 DIN17155/83--H1,H11 DIN17405--RFE120,RFE100
Coil	OD(1,100-1,900) * ID(850)	
Checker plate	(4.0-8.0)T * (770-1,250)W * (2-6m)L	
2.Cold rolled Sheet	(0.5-0.65)T * (720-1,000)W * 2mL (0.7-1.2)T * (720-1,250)W * (2-2.5m)L (1.2-2.0)T * (720-1,250)W * (2-4m)L	DIN1623/83part1--St12,St13,St14 DIN1623/86part2--FeP01～04 DIN1623/87part3--EK2,EK4 DIN1616/84--T50,52,57,61,65
Coil	(0.24-2.5)T * (720-1,250)W * ID (300, 600)	
Strip	(0.28-2.0)T * (10-500)W * ID(300,600)	DIN1623/83part1--St12,St13,St14 DIN1623/86part2--FeP01～04
Plate	(0.24-0.5)T * (512/712)	DIN1623/83part1--St12,St13,St14
Sheet with organic coating	(0.55-0.63)T * (750-1,000)W * (2-5m)L (0.7-0.8)T * (750-1,100)W * (2-5m)L (1.0-1.5)T * (720-1,250)W * (2-5m)L	DIN17100/80 DIN1623/83
CGL Sheet	(0.5-0.63)T * (710-1,000)W * 2mL (0.7-0.8)T * (710-1,100)W * 2mL (1.0-1.5)T * (710-1,250)W * (2-2.5m)L	DIN 17162/77part1--St01Z,St02Z
Coil	ID(600,420)	
CAL-ETL Sheet Coil	(0,24-0,36)	

Appendix 10-2 Products and Quality of Welded Pipes and Cold Bent Sections

Products	Sizes	Steel grade
1.Welded pipe		
General purpose pipe	ϕ 57 * (3, 3.5, 4.0)^{T} * (4-8m)^{L}	DIN17100/80--St33,St37-2
	ϕ 63.5 * (3, 3.5, 4.0)^{T} * (4-8m)^{L}	DIN1626/87--St37.0,St44.0
	ϕ 76 * (3.5, 4.0)^{T} * (4-8m)^{L}	
	ϕ 89 * (3, 3.5, 4.0)^{T} * (4-8m)^{L}	
Tubular scaffold	ϕ 48 * 3.5^{T}	
Water/Gas pipe	ID(10-80) * OD(17.2-89) * (2.6-5.4)^{T}	
Square pipe	□(50-90) * (3.6, 4)^{T} * (4-10m)^{L}	DIN17100/80--St37-2
2.Cold bent	Channel(100-220)^{W} * (40-160)^{H} * (4-6)^{T},	DIN17100/80--St33,St37-2
	Trough like section 223 * 72 * (2.5-3.0)	DIN17200/87--C22
	Road side fence section 270 * 77 * 4	DIN17210/86--C10

Appendix 10-3 Products and Quality of Rods, Seamless Pipes and Billets

Production	Sizes	Quality
1.Rod	ϕ 5 - ϕ 16 Coil weight 1.3 ton	DIN17100/80--St37-2
		DIN17100/87--C35,40,45,50,55,60
		DIN17145/80--USD-7,10MnSi5
		Air patented processed
2.Seamless pipe	ϕ (50-57) * (4-10)^{T} * (4-12m)^{L}	DIN17200/87--41Cr4
	ϕ 63.5 * (4-12)^{T} * (4-12m)^{L}	DIN1629/84 --St37.0,St44.0
	ϕ (70-159) * (4-12)^{T} * (4-12m)^{L}	
Cold drawn pipe	OD(42-75)* (3-6)^{T} * (4-11m)^{L}	
3.Billet	ϕ (100,120,140) * (6-12m)^{L}	DIN17100/80--St33,St37-2
	□(80,100,115,120) * (4-12m)^{L}	DIN17200/87--C10,22,25,35,45,60
		DIN17102/83--TStE355

Appendix 10-4 Products and Quality of Plates and Shapes & Bars No. 1

Production	Sizes	Quality
1.Plate	(8-25)T * (1,400-2,000)W * (3-8m)L	DIN17100--St33,37-2,37-3,44-2, 44-3,50-2,52-3 DIN17200--Ck10,15,C22,25,30,40, C45,28Cr4,34Cr4,41Cr4 Lloyd-Germany , DIN17155 H
2.Shapes	L 50×50 - 100×100 [60×30 - 80×40	DIN17100--St37-2,44-2,50-2
	□(80 - 120) * (3-8m)L	DIN17100--St37-2,44-2,50-2
	Flat bar (25-60)T * (100-140)W * (2-8m)L	DIN17200--C25,35,45,28Cr4,34Cr4 ,41Cr4
	Bell shaped , Trough shaped, Chute shaped,Railway connections, Plough share , U- shaped	
3.Bars	ϕ 10- ϕ 100	DIN488--BSt420,500
4.Ball	ϕ 40- ϕ 120	

Appendix 10-5 Products and Quality of Plates and Shapes & Bars No. 2

Production	Sizes	Quality
1.Plate	(8-25)T * (1,400-2,000)W * (3-8m)L	DIN17100--St33,37-2,37-3,44-2, 44-3,50-2,52-3 DIN17200--Ck10,15,C22,25,30,40, C45,28Cr4,34Cr4,41Cr4 Lloyd-Germany , DIN17155 H
2.Shapes	L 50×50 - 100×100 [60×30 - 80×40	DIN17100--St37-2,44-2,50-2
3.Bars	ϕ 10- ϕ 100	DIN488--BSt420,500
4.Ball	ϕ 40- ϕ 120	