Section 4 Non-flat Rolling Operation

Contents

1. Status quo of long products mill

A total of 16 mills in 13 steel works or factories in Viet Nam was observed in the survey. The production of these 16 mills covers more than 95% of the total long products production in Viet Nam. The locations of mills are shown in Figure 4-1. The main specifications of each mill are shown in Table 4-1. The typical features of long products mills in Viet Nam are summarized as follows.

1) Investment for long products mill

In Viet Nam, a large investment for long products mills has been made since 1990 and production capacity was greatly increased by starting many new mills in 1995 and 1996. The investment for mills is classified as follows.

- Medium investment by joint venture with foreign company
- Similar small investment for existing factories located in the same area

2) Type and capacity of mill

Semi-continuous mills with small capacity still form the major part and only two joint venture mills are of modern continuous type.

- Continuous mills and medium capacity	2 mills
- Semi-continuous mills and small capacity	7 mills
- Semi-continuous mills and very small capacity	3 mills
- Manual operation mills	4 mills

3) Products of mill

The existence of many combination mills which can produce wire rods and bars and/or sections is a typical feature of long products mills in Viet Nam. Bar & rod combination mills might be useful for a small market, but too many similar combination mills is not an effective investment if market growth in the future is considered.

- Bars and wire rods	6 mills
- Bars , sections and wire rods	2 mills
- Sections and wire rods	1 mills
- Bars only	4 mills
- Wire rods only	3 mills

4) Feature of products

The steel market is not yet matured, and the products are limited to low grade and small coil weight.

- Small coil weight of wire rod
- Large production of small sizes
- Construction grade only, and no high-grade steel

- Small production of sections

5) Materials

Replacement of ingots by CC billets for domestic material is under way. Billet supply from own steel making plant is an important theme in Viet Nam. The features of materials for mills are as follows.

- Billet shortage and import of large quantities of billet
- Small billet weight
- Use of pencil ingots at several mills

6) Mill drive

Typical features of mill drive except for a few modern joint venture mills are as follows. Operation without speed control is very difficult and limit improvement of mill performance.

- Common drive
- AC motor without speed control
- No looper control

7) Finishing equipment

Finishing equipment is not well mechanized and manual handling is still the norm.

- Manual bundling
- Manual stacking of sections

8) Inspection of products

Insufficient consideration is given to inspection of products, and quality assurance of products appears difficult even if the steel is construction grade.

- No inspection space in finishing line
- No ends trimming and inspection of wire rods
- No weighing machine

2. Level of actual production

Production capacity of long products mill in Viet Nam by region and product is shown in Table 4-2 and operation results of long products mill in 1996 are shown in Table 4-3. The level of actual production of long products is summarized as follows.

1) Production

Production of long products in 1996 is about 800,000 tons and this is a all of

hot rolled steel products in Viet Nam. Capacity of long products is about 1,700,000 tons /year including the mill under the construction. That is, because of much investment for bar and rod mill in past few years, the mill is in over capacity currently.

2) Mill performance
Except for a few joint venture mills, mill performance is at a very low level and needs further improvement for following items.
- Low productivity
- High energy consumption
- Low yield
- Poor quality control

3) Capacity of mills by region and products
Features of the present capacity are summarized as follows.
- Almost equal production capacity in the south and the north
- Very small production capacity in the central region
- Small production of sections
- Flexible products mix by bar & rod combination mills

3. Rehabilitation and modernization of mill

3.1 Improvement in short term

The production capacity of bars and wire rods for construction steel has been increased greatly in the last few years, and expansion of production capacity is not needed in the short term. The main theme in the short term is improvement of mill performance as follows.

1) Fuel consumption
- Installation of recuperater
- Improvement of mill efficiency

2) Yield
- Replacement of ingots by billets
- Reduction of cobble

3) Productivity
- Inverter control of mill motors
- Application of looper control
- Atomization of three high mill operation

- Application of lifting magnet crane for billet and bar handling
- Mechanization of bar finishing
- Automatic strapping of coil

4) Quality control
- Inspection of surface quality
- Management of heat

5) Roll
- Up-grading of roll material

3.2 Modernization in long term

The above-mentioned improvements are important. However, there should be a limit to improvement in existing small mills, and large investment in existing small mills is not efficient. In Viet Nam, similar small investment has been made for all existing plants in past. The main point of investment from now on should be modernization of mills by centralization to high productivity mills. A comparison of mill specifications and performance between mills in Viet Nam and Japan is shown in Figure 4-2 to 4-7 for reference of mill modernization. A guide line for construction of modern mills is as follows.

- Billet weight Min. 1 ton
- Tons per hour 100 ton/hour
- Mill speed Bar 16 m/sec, Rod 100m/sec
- Productivity 5,000 ton/man/year
- Yield 96%
- Fuel consumption 300,000 kcal/ton

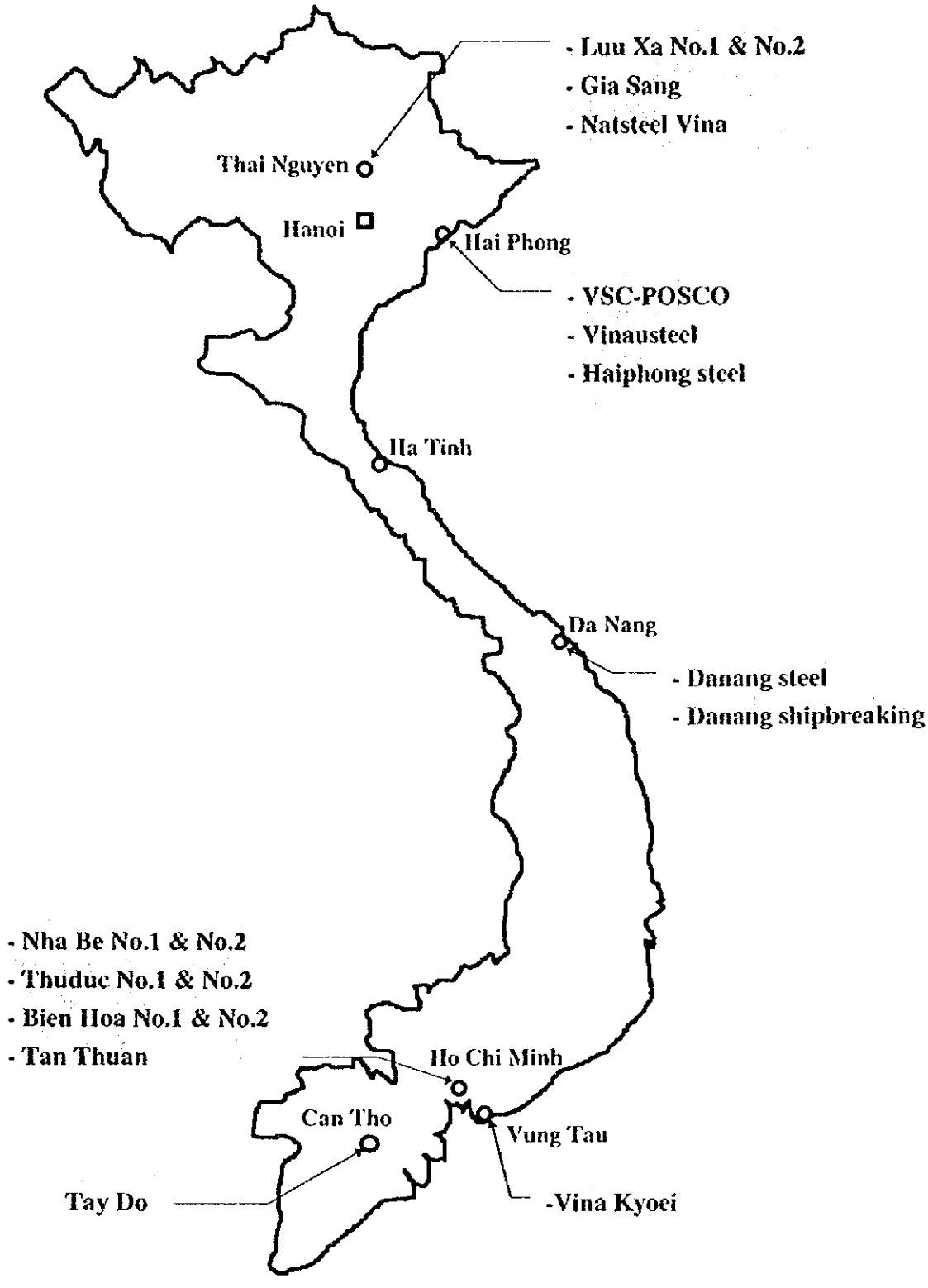

Figure 4-1 Location of long products mill in Viet Nam

Table 4-1 Long products mill in Viet Nam

- Including the mill under construction in 1997-

(1) Joint Venture Mill

Plant (VN partner)	Capacity (ton/year)	Products (mm)	Material	Reheating furnace	Rolling speed (Max.)	Type of mill	Start of operation	Partner	Share of Vietnam	Investment cost (US$million)	Steel - making
Vina Kyoei (VSC)	240,000	Bar 10 / 32 Rod 5.5 / 10	Billet 650kg 120mm square 130mm square	Pusher type 60 t/h	Bar 12.6m/s Rod 60m/s	Continuous	1996	Kyoei (Japan)	40%	55	None
VSC-POSCO (VSC)	200,000	Re-bar 10 / 32 Bar 12 / 32 Rod 6 / 10	Billet 650kg 120mm square 130mm square	Pusher type 45 t/h	Bar 13.4m/s Rod 60m/s	Continuous	1995	POSCO (Korea)	50%	56	None
Vinausteel (TISCO)	180,000	Re-bar 10 / 32	Billet 330kg 120mm square	Pusher type 40 t/h	Bar 12m/s	Semi continuous	1996	(Australia)	40%	10	None
Natsteel Vina (TISCO)	120,000	Re-bar 12 / 32 Rod 6 / 10	Billet 400kg 120mm square	Pusher type 35 t/h	Rod 30m/s	Semi continuous	1995	Natsteel (Singapore)	44%	10	None
Tay Do Steel (SSC)	120,000	Bar, Rod	Billet		Bar 10m/s Rod 25m/s	Semi continuous	1997	(Taiwan)	45%	12	None
Total	860,000										

Re-bar; Steel bars for concrete reinforcement

Table 4-1 Long products mill in Viet Nam (continued)

(2) Thai Nguyen Iron and Steel Corporation (TISCO)

Plant		Capacity (ton/year)	Products (mm)	Material	Reheating furnace	Rolling speed (Max.)	Type of mill	Start of operation	Latest Investment	Future plan	Steel making
Luu Xa	No.1	120,000	Bar 16 / 100 Rod 6 / 8 Angle 63 / 125 Channel 80 / 160 I-Beam 100 / 160	Billet 340kg 120mm sq. Ingot 340kg	Pusher type 35 t/h	Bar 6.8m/s Angle 3.4m/s Rod 33m/s	Semi continuous	1978	1995 10stands for bar 16 to 48mm 1997 Rod line for rod 6 to 8mm (US$3million)		EAF 96,000t/y
	No.2	20,000	Rod 6 / 8	Billet 60kg 60mm sq.			Semi continuous	1996			
Gia Sang		100,000	Bar 10 / 32 Rod 8 Angle 40 / 60	Billet 230kg 100mm sq. Ingot 180kg 148mm sq.	Pusher type 22 t/h	Rod 14m/s Bar 12m/s	Semi continuous	1975	1985		EAF 75,000t/y
Total		240,000									

Table 4-1 Long products mill in Viet Nam (continued)

(3) Southern Steel Corporation (SSC)

Plant		Capacity (ton/year)	Products (mm)	Material	Reheating furnace	Rolling speed (Max.)	Type of Mill	Start of operation	Latest Investment	Future plan	Steel-making
Nha Be	No.1	50,000	Rod 6 Angle 40 / 63 Flat bar	Ingot 70kg 100mm sq.	Pusher type 8t/h x 2set	Angle 5m/s Rod 8m/s	Manual	1973		Stop of rod production and upgrade of Angle line	EAF 70,000t/y
	No.2	120,000	Re-bar 12 / 20 Rod 8 / 10	Billet 150kg 100mm sq.	Pusher type 15t/h x 2set	Bar 9.8m/s Rod 14.5m/s	Semi continuous	1996	1996 New Mill (US$2.6million, FOB)		
Thuduc	No.1	35,000	Rod 6 / 10	Ingot 70kg	Pusher type 6 t/h		Manual	1965			EAF 35,000t/y
	No.2	120,000	Re-bar 10 / 20	Billet 110mm sq.	Pusher type 25 t/h	Bar 10m/s	Semi continuous	1994	1994 New Mill (VND 4billion)		
Bien Hoa		90,000	Re-bar 12 / 16 Bar 12 / 18 Rod 8	Billet 140kg 110mm sq.	Pusher type 12t/h x 2set	Bar 6.0m/s Rod 12m/s	Semi continuous	1969	1990 ~improvement (US$1million)		EAF 50,000t/y
Tan Thuan		30,000	Rod 6 / 8	Billet 120kg 100mm sq. Ingot 70kg	Pusher type 5 t/h	Rod 12m/s	Semi continuous	1996	1996 New Mill (US$1million)	Bar & angle line	None
Total		445,000									

Table 4-1 Long products mill in Viet Nam (continued)

(4) Others

Plant	Capacity (ton/year)	Products (mm)	Material	Reheating furnace	Rolling speed (Max.)	Type of mill	Start of operation	Latest Investment	Future plan	Steel-making
Danang Steel Factory	40,000	Re-bar 12 / 20 Rod 8 / 10	Billet 70kg Ingot 60kg	Pusher type 8 t/h	Bar 4.5m/s Rod 10m/s	Semi continuous	1992	1996 upgrade		EAF 10,000t/y
Danang Shipbreaking	24,000	Re-bar 10 / 32	Scrap plate	Pusher type		Manual	1993			None
Haiphong Steel Factory	8,000	Re-bar 10 / 22	Ingot 60kg	Pusher type	Bar 3.2m/s	Manual	1993			EAF 1997
Others	50,000	Re-bar				Manual				None
Total	122,000	Bar, Rod, Section								

Table 4-2 Production capacity by area and product
- Including the plant under planning in 1997 -

Plant		Capacity (1,000 ton/year)			
		Bars	Wire rods	Sections	Total
North	VSC-POSCO	140	60	0	200
	Vinausteel	180	0	0	180
	Natseel Vina	60	60	0	120
	Luu Xa-No.1	50	30*	40*	120
	Luu Xa-No.2	0	20*	0	20
	Gia Sang	50	30*	20*	100
	Haiphong Steel	20*	0	0	20
	Total	***500***	***200***	***60***	***760***
Middle	Danang Steel	20	20	0	40
	Danang Shipbreaking	24	0	0	24
	Total	***44***	***20***	***0***	***64***
South	Vina Kyoei	160	80	0	240
	Tay Do Steel	80	40	0	120
	Nha Be-No.1	0	0	40*	40
	Nha Be -No.2	80	40	0	120
	Thuduc-No.1	0	35*	0	35
	Thuduc-No.2	80	40	0	120
	Bien Hoa No.1&2	40	30	0	70
	Bien Hoa No.3	0	0	50*	50
	Tan Thuan	0	30*	0	30
	Total	***440***	***295***	***90***	***825***
	Others	50*	0	0	50
	Total	**1,034**	**515**	**150**	**1,699**

Remark :

1) Section includes small & medium sections only here.

2) Nha Be No.1 has a plan to stop wire rod production and to increase the angle production by up-grading of the mill.

3) Bien Hoa No.3 is under planning for construction in 1998.

Table 4-3 Operation of long products mill in Viet Nam in 1996

Plant		Productivity (ton/man year)	Yield (%)	Fuel (litter/ton)	Production in 1996 (1,000 tons/year)			
					Bar	Rod	Section	Total
Joint Venture	Vina Kyoei	2,857	95	40	70	60	0	130
	VSC-POSCO	1,481	96	40	36	50	0	86
	Vinausteel	1,500	96		73	0	0	73
	Natsteel Vina	1,333	94	36	0	63	0	63
TISCO	Luu Xa No.1	210	92 Billet 88 Ingot	58	110	20	48	178
	Luu Xa No.2							
	Gia Sang	200	93 Billet 83 Ingot	76				
SSC	Nha Be No.1	303	85	60	160	70	34	264
	Nha Be No.2	1,600	90	60				
	Thuduc No.1	333	83	68				
	Thuduc No.2	1,091	91	60				
	Bien Hoa	571	88	60				
	Tan Thuan	435	85					
Others	Danang Steel	606	85	100	7	0	0	7
	Danang Shipbreaking	240	85	63	?	0	0	?
	Haiphong Steel	100	85	coal	6	0	0	6
Others					?	0	0	?
Total					462	263	82	807

Productivity = Yearly production capacity / number of mill operator

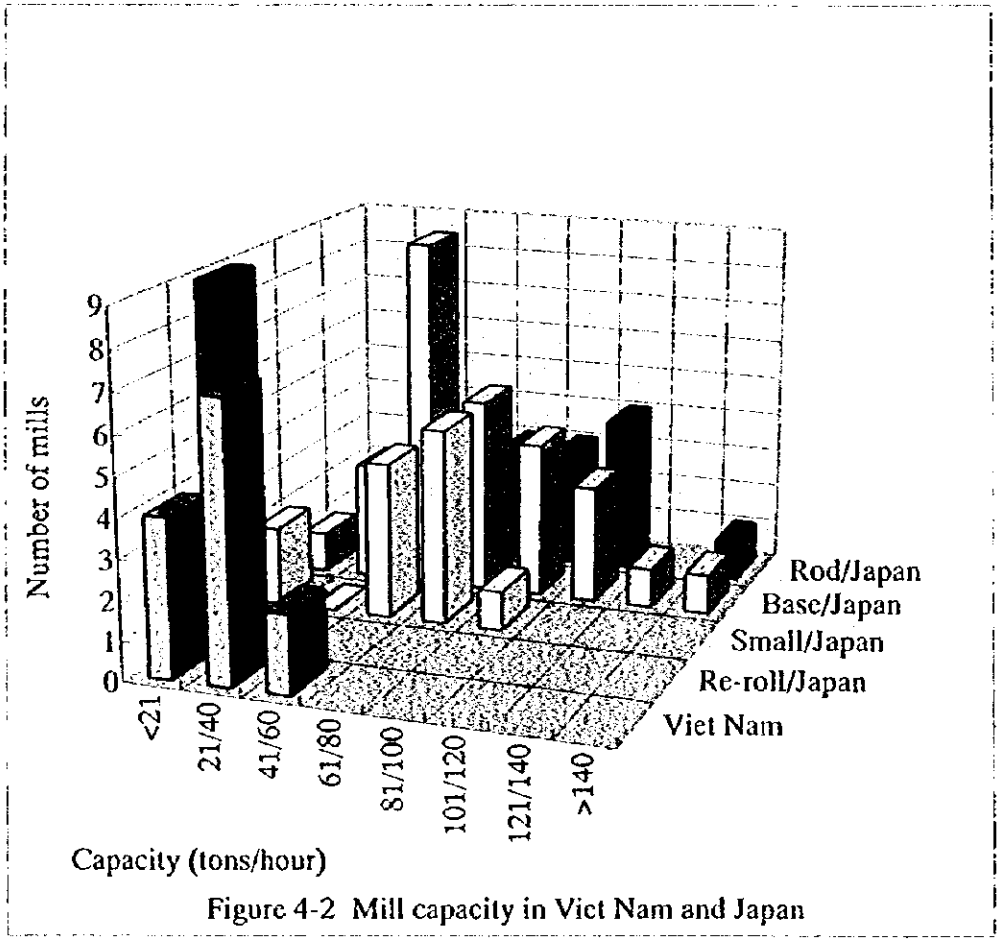

Figure 4-2 Mill capacity in Viet Nam and Japan

Remarks:

Re-roll/Japan :	Japanese mill which uses scrap plate as a material
Small /Japan :	Japanese mill which produces small size Re-bar only
Base /Japan :	Japanese mill which produces base size Re-bar mainly
Rod /Japan :	Japanese wire rod mill

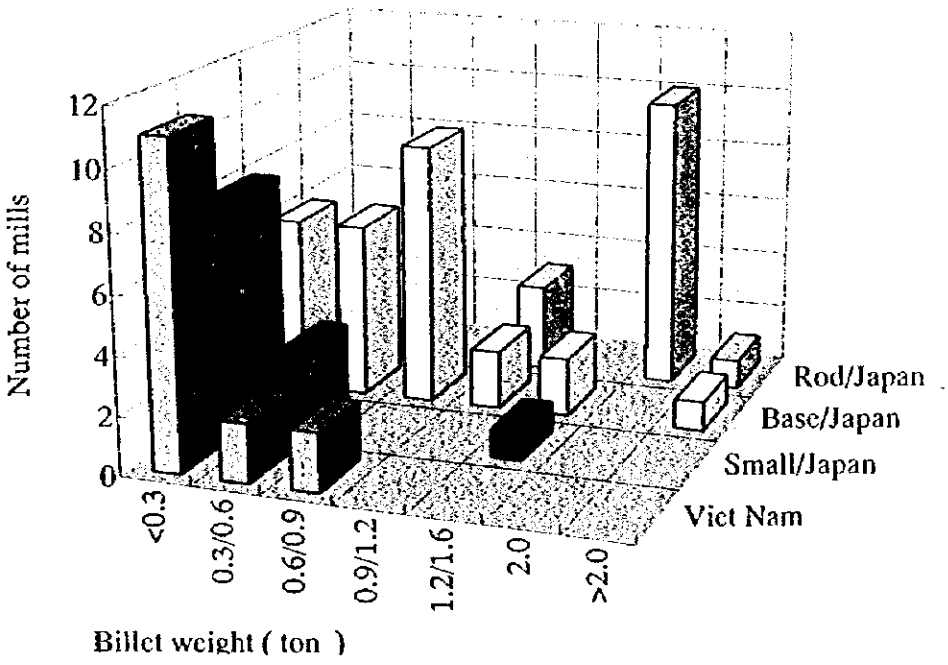

Figure 4-3 Billet weight in Viet Nam and Japan

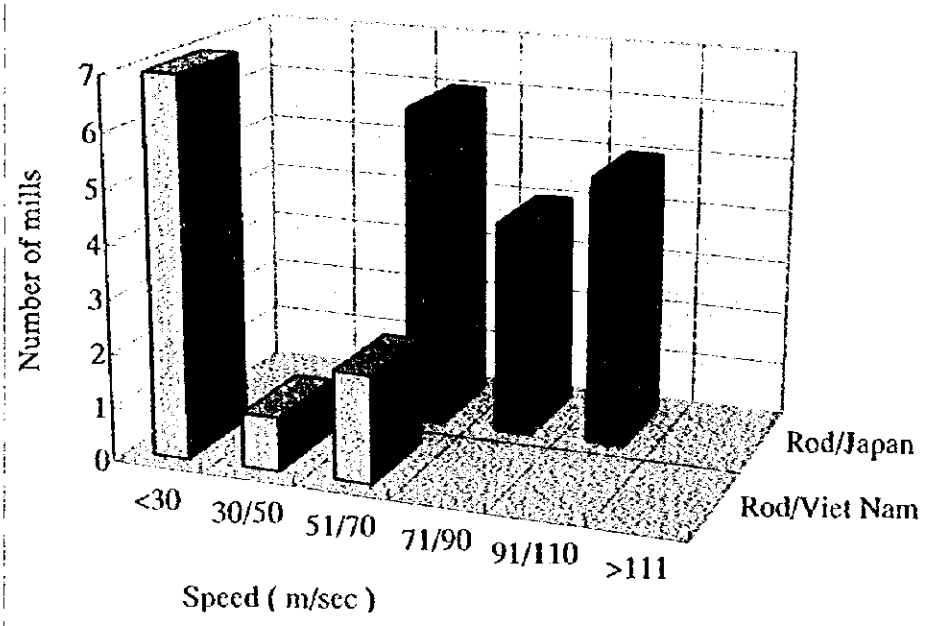

Figure 4-4 Maximum rolling speed of wire rod in Viet Nam and Japan

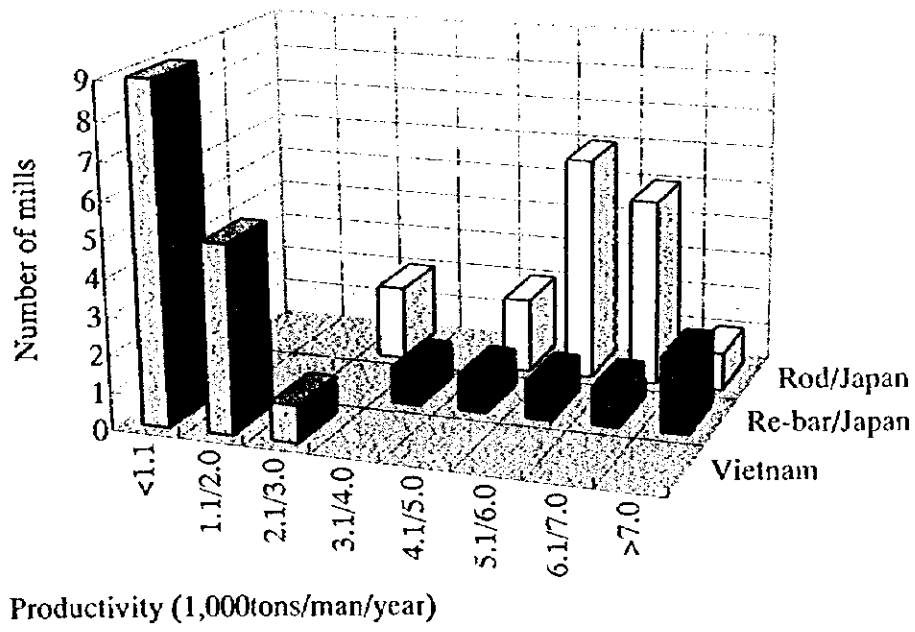

Figure 4-5 Productivity of mill in Viet Nam and Japan

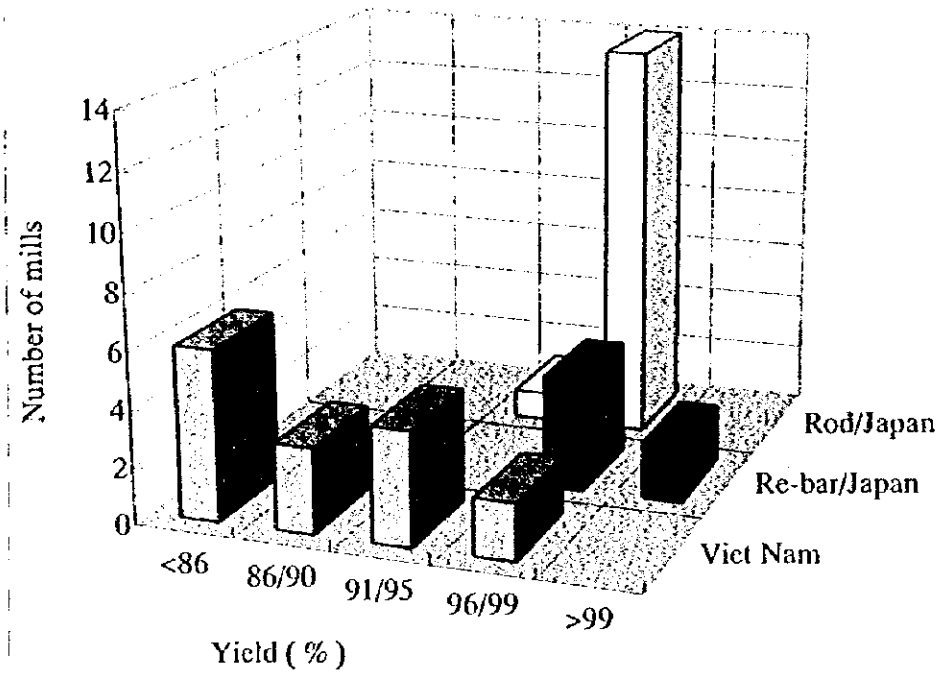

Figure 4-6 Yield of mill in Viet Nam and Japan

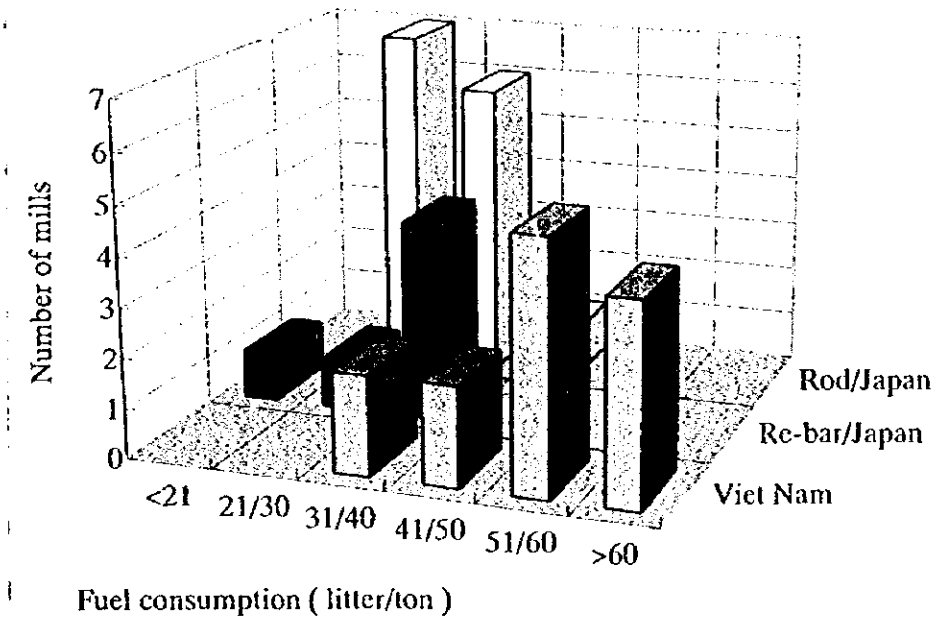

Figure 4-7 Fuel consumption of mill in Viet Nam and Japan

Section 5 Flat Product Production

Contents

1. General

No rolling mills for flat products have been constructed in Viet Nam so far. Only some downstream facilities such as galvanizing lines, pipe mills etc. have been put into operation just recently by joint venture companies with foreign partners.

But demand for flat products is expected to rapidly increase in the future. Therefore many joint ventures are now planning to establish various plants producing flat products.

In this section the present situation of flat product plants is described, including the plants already operating, those under construction and those under planning.

2. Present overall situation of flat product plants

Summarized lists of flat product plants is shown in Table 4.1 and 4.2.

- Table 5.1: Joint Ventures with Viet Nam Steel Industry for Flat Products
- Table 5.2: Joint Ventures with Viet Nam Steel Industry for Pipe Products

The following is a brief explanation on the present situation of flat product plants.

3. Galvanizing line

Now three joint ventures (POSVINA, Maruviena and SSSC) have started operation of galvanizing lines based on wet flux technology.

The galvanizing lines of POSVINA and Maruviena are of sheet type, and that of SSSC is of continuous type.
POSVINA is now planning to modify the line from sheet type to continuous type.

Two CGL plants (wet flux type) are now under planning, one in the north and the other in the south. The production capacity of each plant is about 30,000 - 50,000 t/y.

Total production capacity of the above CGLs (wet flux type) will exceed 200,000 t/y in two or three years, which will cover the total demand of galvanized sheets used for private housing.

But it will be very difficult to produce the galvanized sheets with higher quality to be used for plant building by the above wet flux type CGLs. Therefore it is preferable that some joint ventures should construct dry flux type CGLs in the future which will satisfy the demand of galvanized sheets used for plant building.

In addition to the above mentioned dry flux type CGLs which may be installed at joint ventures, one or two high standard CGLs of NOF/DDF(non oxidizing furnace / direct firing furnace) type will need to be installed in the new integrated steel plant which will supply a wide range of galvanized sheets used for plant building, electrical appliances, automobiles etc.

4. Electrical tinning line

At the moment no electrical tinning lines (ETL) are operating in Viet Nam. Feasibility studies have been done by several foreign companies, but positive results have not been obtained so far because demand for tinplate at present does not seem large enough for the viability of the project.

5. Cold rolling mill

No cold rolling mills yet exist in Viet Nam.
But one Taiwan-based company is now doing a feasibility study to establish a cold rolling plant consisting of the following facilities:

for the first stage: reversing cold rolling mill, pickling line, annealing furnace, temper mill

for the second stage: CGL, color coating line, additional reversing cold rolling mill

If the study result is feasible, the initial stage of the project is expected to be complete at around 2000 - 2001, and the second stage hopefully at around 2005.

The above cold rolling mill project is given a very high priority among various projects now under planning in Viet Nam because the supply of cold rolled coils to the galvanizing plants and other users is effective to reduce the importation of cold rolled coils.

6. Hot rolling mill

No hot rolling mills have been installed in Viet Nam.
But construction of a hot rolling mill at early stage is considered also an important target for Viet Nam steel industry because the supply of hot rolled coils to the reversing cold rolling mills and other users is effective to reduce the importation of hot rolled coils.

One joint venture is now doing a feasibility study for the construction of a hot rolling mill using medium thickness slab technology based on EAF/CCM/HSM process route.
But, as the feasibility of this project seems very uncertain, it has been agreed between the JICA team and the steering committee members of Viet Nam including VSC members that the master plan should be prepared based on the condition that this project will not be realized.

7. Welded pipe manufacturing plant

7.1 Electric resistance welding mill (ERW mill)

1) VINA PIPE, a joint venture company consisting of POSCO, Pusan steel and VSC, started operation of its two ERW mills in 1994.
VINA PIPE has one slitting line in its plant.
According to the information obtained, the present production capacity is 30,000 tpa, and will be increased to 45,000 tpa in the future.
The diameter of pipes being produced is 1/2 - 8 inches.

2) Another joint venture company named Saigon Steel Pipe consisting of Pusan steel, Daewoo and HCMC (Ho Chi Minh City) has started operation of its ERW mill this year.
Production capacity is estimated to be about 70,000 tpa.

7.2 Spiral pipe welding mill (SPW mill)

No SPW mill has been installed in Viet Nam so far.
According to the information from VSC, VINA PIPE is considering to install a SPW mill sometime in the future, maybe at around 2003, as its second stage expansion project.
The SPW mill capacity is expected to be around 150,000 tpa, and the maximum pipe diameter will be around 40 inches.

7.3 Necessity of additional pipe manufacturing mills

1) ERW
VINA PIPE have already two small diameter ERW mills with a capacity of 45,000 tpa for each mill.
Saigon Steel Pipe is just starting up a ERW mill with a capacity of 70,000 t/y.

By 2010, one or two additional ERW mills will be installed, if necessary, preferably by VINA PIPE or Saigon Steel Pipe or other joint ventures.

2) SPW mill
If the SPW mill under planning by VINA PIPE is realized, no more SPW mills will be required until 2010.

3) UOE mill (U-ing/O-ing/Expanding mill)
Installation of a UOE mill is considered unnecessary until 2010 in Viet Nam because demand for UOE pipe is not expected to be large enough to justify the high investment cost.

As mentioned above, it is considered appropriate that all pipe mills required until 2010 will be installed by joint ventures as necessary.
Therefore installation of pipe mills in the integrated steel plant is not taken into consideration in this master plan.

Table 5-1 Joint ventures in Vietnam's steel industry for flat products

Name of company (VN Partner)	Start-up (year)	Place	Product	Facilities	Capacity (tpa)	Partner	Share of VN	Raw material	Const. cost (US$m.)	Remarks
POSVINA (SSC)	1993	HCMC	Galv. sheet	Shear Sheet HDG	50,000	POSCO(Korea)	50 %	Imported cold coil	5	Planning to install uncoiler & recoiler.
SSSC (SSC)	1997	Phuong Nam (near HCMC)	Galv. sheet Color sheet	CGL (wet,used) CCL	50,000 (initial)	Nomura(Japan) FIW(Malaysia)	45 %	Imported cold coil	14	Sister company of NIPPOVINA South. Steel Sheet Co.
Maruviena (CMC)	1996	HCMC	Galv. sheet	Shear Sheet HDG	18,000	Marubeni(Japan) Nat steel etc.	30 %	Imported cold coil	3	Under control of CMC (not VSC)
NIPPOVINA (SSC)	1995	HCMC	Galv. sheet Color sheet	Forming center	6,000	Nomura(Japan) FIW(Malaysia)	50 %	Imported galv. & colored coil	1	Nomura 20% Malaysia 30%
Integrated mini-mill (VSC)	2001	Quang Ninh?	Hot coil for pipe, plate, GI	EAF/ISP (90 - 120 mm)	1,000,000 (stage 1)	POSCO & Daewoo (Korea)		Scrap(80%) DRI(20%)		Under F/S
CGL plant (VSC)	1998	Hanoi	Galv.sheet	CGL(Wet)	50,000	BHP(Australia)			19	High possibility
ETL plant (VSC)			Tinplate	ETL	80,000	Kawasho,HICOM, Mitsubishi			74	Under F/S(seems difficult)
CGL plant		South	Galv. sheet	CGL(Wet)	30,000	Nisho				
Reverse CSM	1999 (2005)	Vung Tau	CRA.(Ph-1) CC, Color(Ph-2)	PK,RCM,BA,TM(P) CGL,CCL,RCM(2)	215,000 215,000	Sysco(Taiwan)		Imported hot coil		Under F/S (First priority)

Table 5-2 Joint ventures in Vietnam's steel industry for pipe products

Name of company (VN Partner)	Approval (year)	Start-up (year)	Place	Product	Facilities	Capacity (tpa)	Partner	Share of Viet Nam	Raw material	Const. cost (US$ million)	Remarks
VINAPIPE (VSC)	1993	1994	Haiphon	Welded pipe	Slitter, ERW X 2	30,000	POSCO(Korea) Pusan Steel (Korea)	50 %	Imported coil	11	45,000 tpa(future)
Vingal Industries (SSC)	1995	1998	HCMC	Galv.pole Steel structure		20,000 GP 25,000 SS	Australia	30 %	Imported coil		
Saigon Steel Pipe (HCM)	1995	1997?	HCMC	Welded pipe	ERW	70,000	Pusan Steel Pipe, Daewoo(Korea)				Under control of HCMC (not VSC)
Large size welded pipe		(2003?)	Haiphon or Southern	Dia. max. 40"	SPW	150,000	VSC or JV			30	2nd stage of VINAPIPE. No details.

Part 3 Present Situation of Development Plan of Infrastructure

Section 1 Present Situation of Development Plan of Power Generation, Power Transmission Network and Tele-Communication Network

Contents

1. Power generation and power transmission network

1.1 Outline of investigation

Since a new steelworks consumes a large amount of electrical energy, an adequate power supply will be required at the site of the new steelworks to be constructed. Therefore, the actual situation of supply and demand for electric power in Viet Nam, a development plan for power generation, and the power supply conditions around the site were investigated.

1.2 Actual situation of supply and demand for electric power, power generation and transmission network in Viet Nam

(1) Supply and demand for electric power
Actual figures for the power supply, consumption and demand are shown in Table 1-1.

Table 1-1 Actual power supply and demand

		Northern Vietnam	Central Vietnam	Southern Vietnam	Whole country (Loss other)	Whole country
Supply	Available power generation capacity in 1995	2,673 MW	263 MW	1,499 MW	-	4,435 MW
	Actual power demand in 1995	1,315 MW	251MW	1,080 MW	-	2,646 MW
Demand	Actual power consumption					
	in 1994	5.556 TWh	0.783 TWh	4.487 TWh	1.45 TWh	12.28 TWh
	in 1995	4.916 TWh	1.005 TWh	5.272TWh	3.44 TWh	14.64 TWh
	in 1996	n.a.	n.a.	n.a.	n.a.	16.96 TWh

Source: Energy Institute of Viet Nam

The recorded growth in annual power consumption averaged approx.15% during the past three years.

(2) Existing power plants
The existing main power plants are shown in Table 1-2.
Approx.70% of available capacity is generated by hydropower and the remainder by thermal power.

Table 1-2 Existing main power plants

Plant name	Type	Location (province)	Capacity (MW)	Year of completion
Thac Ba	Hydropower	Yen Bai (N)	120	1960s
Uong Bi	Thermal - Coal	Quang Ninh (N)	105	1970s
Ninh Binh	Thermal - Coal	Ninh Binh (N)	100	1960s
Pha Lai	Thermal - Coal	Quang Ninh (N)	440	1983
Hoa Binh	Hydropower	Hoa Binh (N)	1,920	1994
Vinh Son	Hydropower	Binh Dinh (C)	66	1994
Tri An	Hydropower	Dong Nai (S)	440	1993
Thac Mo	Hydropower	Song Be (S)	150	1994
Da Nhim	Hydropower	Khanh Hoa (S)	160	1960s
Ba Ria	Thermal - Gas	Vung Tau (S)	150	1994
Thu Duc	Thermal - Gas	HCM city (S)	165	1994
Tra Noc	Diesel	Can Tho (S)	33	1970s
Others			586	
Total			4,435	

Source: Energy Institute of Viet Nam
Note : (N) Northern Viet Nam, (C) Central Viet Nam, (S) Southern Viet Nam

(3) Outline of existing transmission network

The main transmission network in Viet Nam comprises the following:

- 500kV transmission line of approx. 1,487km
- 220kV transmission line of approx. 3,477km
- 110kV transmission line of approx. 6,032km

The 500kV transmission line, which started operation in April 1994, is used for interconnecting between northern Viet Nam and southern Viet Nam over a distance of 1,487km with a transmission capacity of 800 MW. This 500kV transmission line is an important line because it supplies 600MW (max.) and 400MW (normal) of power from northern Viet Nam to southern Viet Nam.

The 220kV transmission line is used for connecting the main power plants to the 500kV substations and between main distribution substations.

The 110kV transmission line is used for distribution to main load centers from the 220kV substations.

1.3 Development plan for the power generation and transmission network in Viet Nam

(1) Expected power supply and demand

The power consumption and demand from 1996 to 2010 as estimated by the Energy Institute is shown in Table 1-3. The annual growth in power consumption for ten (10) years will average approx. 11% .

Table 1-3 Expected power supply and demand

	Northern Vietnam	Central Vietnam	Southern Vietnam	Whole country
Expected power consumption				
in 2000	12.098 TWh	2.447 TWh	15.560 TWh	30.105 TWh
in 2005	20.228 TWh	4.324 TWh	29.049 TWh	53.601 TWh
in 2010	32.497 TWh	7.265 TWh	48.054 TWh	87.816 TWh
Expected power demand				
in 2000	-	-	-	5,360 MW
in 2005	-	-	-	9,150 MW
in 2010	-	-	-	14,350 MW

Source : Energy Institute of Viet Nam

Note : Power consumption and demand from 1996 to 2010 are estimated on the basis of an average GDP growth of 9.49% per year categorized as follows.

- Industry : 12.79 %
- Construction : 15.24 %
- Service : 9.93 %
- Agriculture : 3.99 %

(2) Development plan for power generation

The development plan for power generation is shown in Table 1-4 and Table1-5 .

Table 1-4 New power plants to be constructed

Plant name	Type	Location (province)	Capacity(MW)			Year of completion
			2000	2005	2010	
Phu My No.2	Thermal - Gas	Vung Tau (S)	288			1997
Yaly	Hydropower	Gia Lai (C)	180			1999
Song Hinh	Hydropower	Phu Yen (C)	70			1999
Ham Thuan	Hydropower	Binh Thuan (C)	472			2000
Total (MW)			1,010			

Source : Energy Institute of Viet Nam
Note : (S) Southern Viet Nam, (C) Central Viet Nam

Table 1-5 New power plant to be planned

Plant name	Type	Location	Capacity (MW)		
			2000	2005	2010
Pha Lai No.2	Thermal - Coal	Northern Viet Nam	600		
Quang Ninh	Thermal - Coal	Northern Viet Nam	300	600	300
Son La	Hydropower	Northern Viet Nam			2,400
Dai Thi	Hydropower	Northern Viet Nam		250	
Yaly	Hydropower	Central Viet Nam	360	180	
Ban Mai	Hydropower	Central Viet Nam		530	
A Vuong	Hydropower	Central Viet Nam			145
An Khe	Hydropower	Central Viet Nam			116
Se San No.3	Hydropower	Central Viet Nam		220	366
Plei Krong	Hydropower	Central Viet Nam		120	
Up Kontum	Hydropower	Central Viet Nam		260	
Dai Ninh	Hydropower	Central Viet Nam		300	
Dong Nai No.4	Hydropower	Central Viet Nam			200
Dong Nai No.8	Hydropower	Central Viet Nam		140	
Buonkuop	Hydropower	Central Viet Nam		85	
Tra Noc	Thermal - Gas	Southern Viet Nam	150		
Phu My	Thermal - Gas	Southern Viet Nam	1,632	1,432	344
Gas turbine	Thermal - Gas	Southern Viet Nam		400	1,600
Western	Thermal	-			600
Southern	Thermal	Southern Viet Nam			900
Ba Ria(exp.)	Thermal - Gas	Southern Viet Nam	149.5		
Total (MW)			3,191.5	4,517	6,971

Source : Energy Institute of Viet Nam
Note: (exp.) means to expand the existing plant

(3) Development plan for power transmission network
Total length of the planned transmission network is shown in Table1-6.

Table 1-6 Planned transmission network

	2000	2005	2010
500kV transmission line	-	770	717
220kV transmission line	3,668	1,212	-
110kV transmission line	3,401	1,095	-

Source: Energy Institute of Viet Nam

The planned new 500 kV transmission line between northern Viet Nam and southern Viet Nam will supplement the existing 500 kV line.

1.4 Evaluation of future supply and demand for electric power

(1) Comparison between supply and demand for electric power
Table 1-7 shows a comparison between supply and demand from 1995 to 2010 in Viet Nam.

Table 1-7 Comparison of future supply and demand

Year	Supply (MW)	Peak demand (MW)	Average demand (MW)	Reserve margin (%)	Load factor
1995	4,435.0	2,646	1,671	67.6	0.632
2000	8,636.5	5,360	3,437	61.1	0.641
2005	13,153.5	9,150	6,119	43.8	0.669
2010	20,124.5	14,350	10,025	40.2	0.699

Source : Energy Institute of Viet Nam

No shortage of electric power in Viet Nam will occur if power generation capacity is developed according to the plan shown in Table 1-5.

(2) Electric power supply for the new steelworks
Average power consumption and maximum power demand per hour in 4.5 million ton / year steelworks are estimated to be 268 MWh/h and 316 MW respectively. Moreover estimated peak power demand per 1 minute is approximately 360MW.

These figures show that there will be a large fluctuation in power systems even if a power plant with adequate capacity is installed. Only a 500 kV

substation will be able to supply the required power at 220 kV to the new steelworks to ensure low voltage fluctuation and a stable power supply.

The recommendation of IEC555-3(1982) "Voltage fluctuation "states that the voltage fluctuation should be within 3% at the receiving point of a plant; therefore, a large-scale steelworks requires a sufficiently low-impedance power supply system. In the next stage of the feasibility study for the new steelworks, a detailed power supply analysis of the system will be needed.

The existing 500kV transmission line runs from Hoa Binh in Hanoi to Phu Lam in HCM city, having the five substations which comprise Hoa Binh substation (Hanoi), Thachdien substation (Ha Tinh), Da Nang substation (Da Nang), Pleiku substation (Kontum) and Phu Lam substation (HCM city). Power for the new integrated steelworks to be planned will be supplied from Tachdien or Da Nang substation.

The short-circuit level of Da Nang substation is estimated to be 2790 MVA at the 220kV bus in 2005 by the Energy Institute (Tachdien substation will be same level as that of Da Nang substation). This short circuit level will be insufficient for the new steelworks, so measures to solve this problem should be studied at the detailed planning stage.

2. Tele-communication network

2.1 Actual and estimated number of telephones in the local network

Table1-8 shows the actual and estimated number of telephones in the local network in Viet Nam.

The number of telephones in 2010 is predicted to be approximately 13 times the present number.

Table 1-8 Actual and estimated number of telephones

Year	1994	1995	2000	2010	(Unit)
Total Number in country	46	74	240	1,000	10,000 phones
Number per 100 population	0.6	1.0	3.0	10.5	Pones /100 population
Number in HCM city	10	18	110	220	10,000 phones

Source : Feature on business (published in Viet Nam)
Main Industry of Viet Nam(published in Japan)

2.2 Development plans for local network

To meet the future demand of local lines shown in Table1-8, the project listed in Table 1.9 has been planned under BCC (business cooperation contract) or MOU (memorandum of understanding) basis with various foreign companies.

Table 1-9 Main development plan for local network

Type of project	Location	Foreign company	Number of line	Remarks
Upgrade and expansion	Hanoi	Korea Telecom	100×10^3 lines	
〃	Hanoi	NTT international	25×10^3 lines	
〃	Hanoi	England C & W		Southeast
Upgrade and expansion	HCM city	France Telecom	500×10^3 lines	East
〃	HCM city	Australia Telstra		West
New wireless system	HCM city	Kanematsu / USA HNS Inc.	100×10^3 lines	
Upgrade and expansion	Hai Phong	Korea Telecom	160×10^3 lines	
〃	Danang	England C & W		
Upgrade and expansion	Quy Nhon	Korea Telecom		
Upgrade and expansion	Towns and Villages	New Zeland Teles International		Approx. 5,400 towns and villages
New mobile telephone network	Whole country	Sweden Comvik International		

Source : Main Industry of Viet Nam in 1996 (published in Japan)
Note : NTT: Nippon Telegraph and Telephone, HNS: Hughes Network Systems

Section 2 Present Situation and Development Plan of Port

Contents

Page

1. General

Viet Nam has around 3,000km of coastline spreading along the country and many estuaries, which are used as sea and river ports since old times.
The most existing ports and port facilities were constructed before Viet Nam war. Besides, the port sites near the big cities such as Hanoi and HCMC have no coastline which is suitable for the deep sea ports. For that, the recent serious problem is that the capacity of them has not met the rapidly increasing transportation amounts by sea.
In this section, present situation of port and future plans are described.

2. Present situation of port and future plan

Present situation of port and future plans are shown in the following Table 2-1 ~ Table 2-5 (Source: Interview survey).

Table 2-1 Port managed by MOT (1)

	1.Quang Ninh Port	2. Hai Phong Port	3. Da Nang Port	
1. Location	Located in Halong bay around 170 km east of Hanoi.	Located 35 km from the estuary of Cam river and around 100 km from Hanoi.	Located in a bay in central Viet Nam. It comprises two subport. Song Han Port	Tien Sa Port
2. Depth at berth	-4m to -5m	-7.5 m	-3m to -4m	-6 m to -10 m
3. Number of berths	1 floating berth	19 berths and 2 anchorages	6 berths	4 berths
4. Total length of berth	160m	2,252m	850m	720m
5. Maximum ship characteristics	10,000 DWT	6,000 DWT	3,000 DWT	30,000 DWT
6. Channel length & depth	7 km	35 km, -4.2m	in a bay	
7. Cranes	by ship's gear three 14t capacity cranes and one 63t capacity crawler crane	Twenty-five 5-16t capacity shore cranes, two 40t capacity container cranes and one 60 to 100t capacity floating crane	Several 25t capacity cranes and a 100t floating pontoon	
8. Storage space	Warehousing: 27,000m^2	Warehousing: 74,300m^2, Open: 53,000m^2	Warehousing:14,875 m^2	
9. Staffing	830 persons	6,682 persons	n.a.	
10. Use	Coal, fertilizers, machinery, cement, etc.	Steel, fertilizers, machinery, foodgrains, etc.	Agricultural products, fertilizers, machinery, steel, etc.	
11. 1989 traffic	298,000 t/y (1990)	2,700,000 t/y	666,000 t/y	
12. Port projects	Plan (depend on ODA): construction of a 266m berth dredging to a depth of -13m to accept 30,000 DWT of strip	n.a.	Future: construction of a berth	

Table 2-2 Port managed by MOT (2)

	4. Saigon Port	5. Qui Nhon Port	6. Nha Trang Port
1. Location	Located on the Saigon river 85 km from its the estuary.	Located around 340 km of Da Nang in a well-protected bay.	Located 250 km south of Qui Nhon in a well-protected bay.
2. Depth at berth	-8 m to -13 m	-7m to -9m	-7m to -10m
3. Number of berths	19 berths	2 berths	2 berths
4. Total length of berth	1,965m	348m	173m
5. Maximum ship characteristics	15,000 DWT	10,000 DWT	10,000 DWT
6. Channel length & depth	85 km,-7m	In a well-protected bay	In a well-protected bay
7. Cranes	Ten 6-25t capacity mobile cranes fourteen 5-6t rail-mounted cranes	Seven 5-10t capacity shore cranes	Eight 5-10t capacity shore cranes
8. Storage space	n.a.	Warehousing: 6,000m^2, Open: 134,000m^2	n.a.
9. Staffing	4,083 persons	559 persons	
10. Use	Rice, wood, fertilizers, steel products, etc.	Timber, cement, etc.	
11. 1989 traffic	Over 4,000,000 t/y	1990; 300,000 t/y	
12. Port projects	On going: construction of a 66 berth Future: dredging access channel to a depth of -11m to allow to 18,000 DWT	n.a.	

Table 2-3 Port managed by MOE(1)

	1. Cam Pha Port	2. Hon Gai Port	3. Dien Cong Port
1. Location	Located in Hai Phong.	Located 50 km south of HCMC.	Located north of Hai Phong.
2. Depth at berth	-12m	-7m	n.a.
3. Number of berths	2 berth	1 berth	↓
4. Total length of berth	400m	140m	↓
5. Maximum ship characteristics	10,000 DWT	6,000 DWT	↓
6. Channel length & depth	-8m to -12m	-7.5m	↓
7. Buoys	4,000,000 t	n.a.	↓
8. 1990 throughput	5,420,000 t/y	n.a.	↓
9. Port projects	3 million t/y	1.5 million t/y	↓

Table 2-4 Port managed by MOE(2)

	4. B12 Port	5. Nha Be Port	6. Can Tho Port
1. Location	Located north east of Hai Phong in a protected bay.	Located around 15 km downstream of HCMC.	Located in DaNang bay.
2. Depth at berth	n.a.	n.a.	n.a.
3. Number of berths		↓	↓
4. Total length of berth		↓	↓
5. Maximum ship characteristics	3,000 DWT	↓	30,000DWT
6. Channel length & depth	n.a.	↓	n.a.
7. Buoys	4 mooring buoys	4 open-sea buoys	↓
8. 1990 throughput	n.a.	n.a.	↓
9. Port projects	n.a.	n.a.	↓

Table 2-5 Port managed by MOE(3)

	7. Thuong Ly Port	8. Vung Tau Port	
1. Location	Located in Hai Phong.	Located 50 km south of HCMC.	
2. Depth at berth	n.a.	n.a.	
3. Number of berths			
4. Total length of berth			
5. Maximum ship characteristics			
6. Channel length & depth			
7. Buoys			
8. 1990 throughput			
9. Port projects		Planning: to allow access to 80,000 DWT	

Section 3 Present Situation and Development Plan of Road

Contents

Page

1. General

The total length of existing road network is estimated at around 106,048km in Viet Nam. The classifications of roads are as follows;

Table 3-1 The classifications of roads

National road	10,000km
Provincial road	15,300km
District road	25,000km
Village road	46,200km
Others	9,548km
Total length	106,048km

Source: Viet Nam Steel Corporation

The rate of asphalt-surfaced road is about 10%, and the main roads are route 1, route 5, route 14, route 18 and route 51.
Having many bridges is the characteristic of the road in Viet Nam (Table 3-2). The problem which should be solved is that around half of all is decrepit or temporary.

Table 3-2 The Number of bridges

National road	2,777(82,881m)
Provincial road	2,753(43,840m)
District road	2,750(47,874m)
Total	8,280

Source: Interview survey

2. Present situation of port and future plan

Present situation and future plan of routes 1 and 5 related with the new integrated steelworks are shown in the following Table 3-3 (Source: Viet Nam Steel Corporation).

Table 3-3 Present situation and future plan of routes 1 and 5

	ROUTE 1	ROUTE 5
1. Location	Linking the north VN-Chinese border to Nam Cam by way of Lang Son, Hanoi, Vinh, Da Nang, Nha Trang, Bien Hoa, HCMC, Can Tho. It is the main line from north to south.	Linking Hanoi to Quang Ninh by way of Haiphong-Port. It is the main line in Hanoi.
2. Total length	2,300 km	107 km
3. Width of road	Most of the roads are about 6-8m wide and a one lane highway.	Most of the roads are about 6-8m wide and a one lane highway.
4. Road condition	Paved road filled with asphalt, but poor condition. The level of the road is one to two meters higher than the ground level. Roads are sometimes flooded.	Paved road filled with asphalt, but poor condition.
5. Road project	Construction of highways Location: inland side from existing route 1 Width: 12m, two lanes (taking plan to widen the road into consideration) On going; (1) From Hanoi to Vinh and from HCMC to Can Tho - Total Length: 430 km - Term: 1996-2002 - Fund: US$176 million by World Bank (2) From HCMC to Nha Trang - Total Length: 435 km - Term: 1996-2002 - Fund: US$141 million by Asia Develop Bank (3) From Cau Mau to Nam Can - Total Length: 52 km - Term: 1995-1998 - Fund: By Viet Nam Government Future; (1) From Vinh to Dong Ha (F/S) - Total Length: 291 km - Term: 1997-2003 - Fund: US$220 million by World Bank (2) From Hanoi to Lang Son and from Dong Ha to Nha Trang (F/S) - Total Length: 870 km - Term: 1997-2003 - Fund: US$358 million by Asia Develop Bank (3) From Can Tho to Cau Mau (F/S) - Total Length: 100 km - Term: 1998-2003 - Fond: US$60 million	Completion: The 15 km extension through Hai Duong. (December 25,1996)

Section 4 Present Situation and Development Plan of Railway

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Page

1. General

The railway in Viet Nam was constructed in the France rule age. The main routes use the narrow gauge, single track, and light rail. The damage of the rail, tie, bridge, tunnel, and signal is serious because of superannuating.
The railway between Hanoi and HCMC was started constructing in 1899. About 37 years were spent until its completion. It takes 36 hours for transportation between Hanoi and HCMC by the passenger car, 50 hours by freight car. Moreover, the amounts of transportation during a year are 10,000,000 passengers and 10,000,000 tons of freight.

2. Present situation of port and future plan

The total length of existing railway network is estimated at around 2,504 km in Viet Nam. Its railway routes in Viet Nam are shown in Table 4-1.

Table 4-1 The routes of existing railway network in Viet Nam

Route	Length	Gauge
Hanoi - HCMC	1,730km	1,000mm
Hanoi - Hai Phong	102km	1,000mm
Hanoi - Lao Cai	283km	1,000mm
Hanoi - Lang Son	148km	1,000mm+1,435mm
Hanoi - Thai Nguyen	75km	1,000mm+1,435mm
Hanoi - Baichay	166km	1,000mm
Total	2,504km	

Source: Viet Nam Steel Corporation

The future plan of the railway is shown in Table 4-2.

Table 4-2 The future plan of railway network in Viet Nam

Route	Length	Note
Hanoi - Gia Lam	15km	Electrification
Thap Cham - Da Lat	89km	
Total	104km	

Source: Viet Nam Steel Corporation

Table 4-3 shows the list of the vehicle which can be used.

Table 4-3 The list of the available vehicle

Vehicle	The number of possession	Available
Steam locomotive	139	15
Diesel locomotive	141	110
Passenger car	5,540	2,500
Freight car	1,060	1,000

Source: Interview survey

Chapter III Master Plan for the Vietnamese Steel Industry up to 2010

Part 1 Summary of Master Plan

Section 1 Introduction

Contents

Page

1. Introduction

The master plan for the Vietnamese Steel Industry up to 2010 was prepared on the basis of the scope of work laid down in the memorandum concerning "the Master Plan Study for the Development of the Steel Industry in Viet Nam", exchanged between the Socialist Republic of Viet Nam and the Japan International Cooperation Agency (JICA) on June 12, 1996, and was submitted as an interim report of the study in June 1997.

This interim report, different in nuance from ordinary interim reports, aimed to describe what the Vietnamese steel industry should be in 2010 in the form of a master plan for the steel industry.

For this purpose, the site study was carried out twice in various fields, i.e., the first site study from October 1996 to December 1996, and the second site study from February 1997 to March 1997 (spending a total of 11 weeks, namely, 7 weeks for the first site study and 4 weeks for the second site study).

The master plan including a phased construction plan for an integrated steelworks was prepared through analysis of the projected data obtained as the result of the study on the present state and future outlook for society and the economy, the present state and future improvement outlook of the infrastructure, the present state and future outlook of natural resource development, including demand for steel products, the production capacity of the existing steelworks, etc., in Viet Nam.

While the trend towards borderless and globalized activities gets increasingly active, it will be highly risky to push too hard the construction of an integrated steelworks which requires huge investments. Even if the Vietnamese steel demand in 2010 would justify in terms of quantity the construction of the integrated steelworks based on the existing production capacity plus added capacity through implementing expansion plans, the way to realize this should be cautiously sought.

In view, however, of political, social and other considerations as a nation in relation to neighboring countries in East Asia, apart from the economic argument for the existence of an individual industry, policies for the steel industry different from the one pursued in this master plan should not be negated.

This report presents the results of the objective study based on given preconditions up to 2010, and therefore does not itself recommend the construction of the integrated steelworks. Careful study, therefore, by the Vietnamese side is recommended in deciding on the questions of whether or not the construction of the integrated steelworks is appropriate, and, if appropriate, when it should be started.

Section 2 Master Plan Outline

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Page

1. Master plan outline

The steel production capacity of the existing steelworks, as indicated in Chapter II, can be summarized as below.

Melting capacity: 400,000 t/y
Rolling capacity: 1,500,000 t/y

According to the survey of the existing steelworks, the production of rolled products was about 1,000,000 tons in 1996. This means that a significant quantity of the rolled products were produced from imported billets.

To cope with such shortage of billets, the idea of setting up billet centers has been studied by VSC, and billet production by joint ventures is planned.

For production of flat products in preparation for increased demand for them, VSC has been studying various joint venture projects. These projects, however, are mainly for manufacture of cold-rolled sheets and coils and coated products, and therefore are plans for production on the downstream side.

On the other hand, the total steel demand in 2010 is estimated at 6,400,000 tons, as indicated in Part 2 and Part 3 of Chapter IV, and 3,500,000 tons of which will be the demand for flat products, and 2,900,000 tons for bars, sections, and wire rods.

Figure 2-1 on the next page shows one of the scenarios to address the supply-demand gap for steel products in 2010. In other words, an image of the Vietnamese steel industry in 2010 is shown in the form of the "Master Plan for the Steel Industry".

Details of this scenario are described in appropriate chapters. It should be emphasized, however, that careful study is necessary before starting the construction of the integrated steelworks.

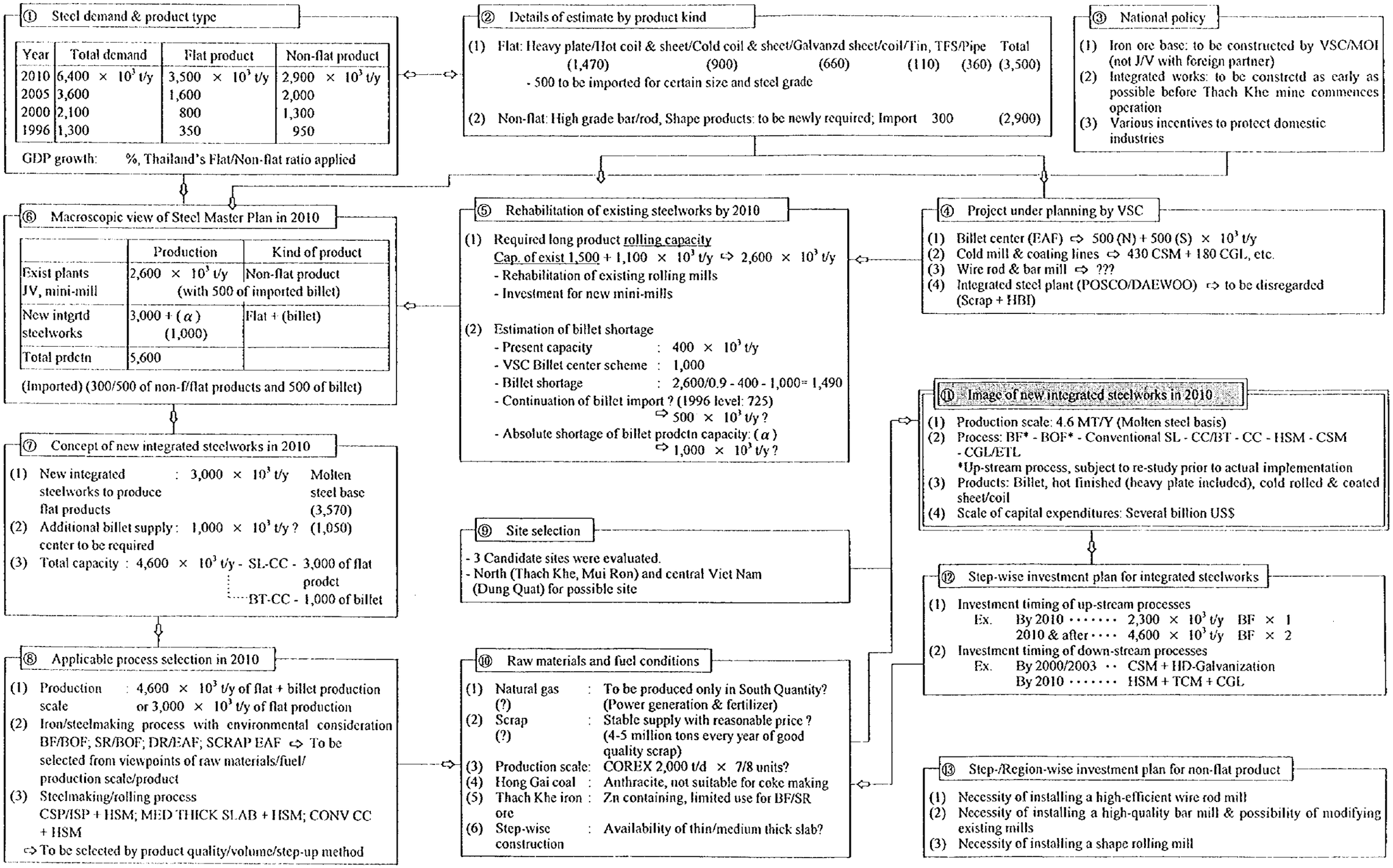

Figure 2-1 Master Plan for the Development of Steel Industry in Viet Nam

Section 3 Necessity for the Construction of a New Integrated Steelworks and Its Capacity

Contents

1. Steel product balance in 2005

The material balance and the production flow in the Vietnamese steel industry in 2005 based on the market research are as shown in Figure 3-1. The demand for each type of steel product has provided the basis of calculation for the balance and flow sheets.

Even after introduction of a hot strip mill and a cold strip mill which will supply material to CGLs, import of special size, stainless steel, and special steel products may have to remain. For plate, hot-rolled, cold-rolled, and galvanized products, import of about 10% of the demand is assumed to remain.

The quantity shown on the "Domestic Supply" line is the domestic production calculated by subtracting the imported quantity from the total demand.

If appropriate yield figures based on Japanese data are applied here, the production by the cold strip mill can be calculated. Likewise, the production by upstream processes can also be calculated. The results of these calculations are shown in Figure 3-1.

Productions by feasible joint ventures have also been taken into account in these calculations.

In Figure 3-1, however, neither iron-making equipment nor steelmaking equipment is shown at this stage as a part of the line equipment for production of flat products. Because huge investments are required for iron-making equipment and steelmaking equipment, the investment timing for them must be carefully studied considering the viability, foreign currency balance in Viet Nam, amount of funds required, etc.

Accordingly, import of semi-products (slabs) is suggested for the production of flat products in 2005.

The equipment and their capacities of the new integrated steelworks may well be planned as below.

Hot Strip Mill: 1,800,000 t/y
Cold Strip Mill: 620,000 t/y

CGL: 100,000 t/y

Joint venture projects taken into account are as shown below.

Billet Center (North):	500,000 t/y	(Mitsubishi/NKK)
Billet Center (South):	500,000 t/y	(Vinakyoei)
Cold Strip Mill (South):	230,000 t/y	(Taiwan)
CGL1:	50,000 t/y	(BHP)
CGL2:	30,000 t/y	(Nissho Iwai)
Bar & Section Mill:	400,000 t/y	

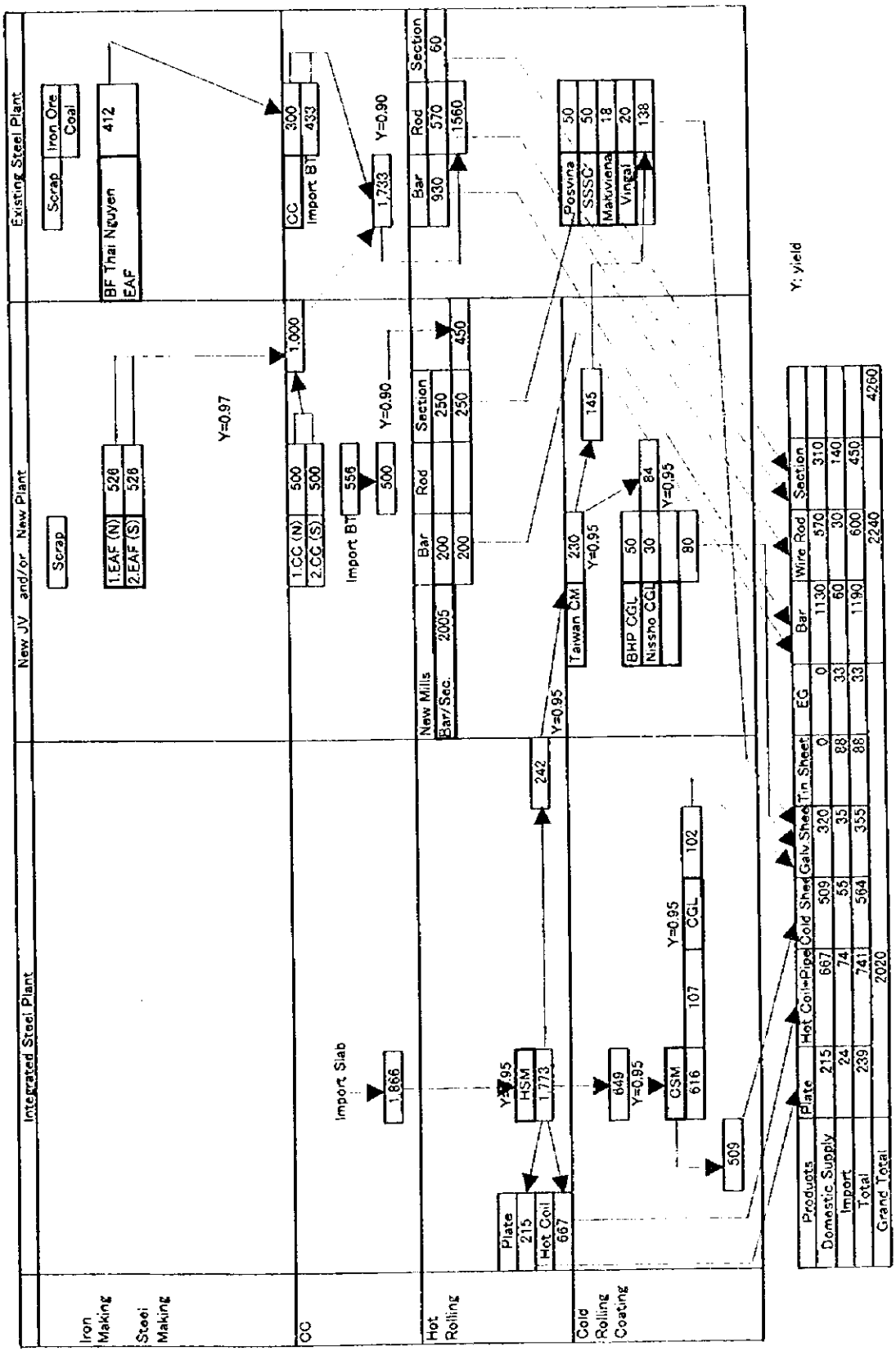

Figure 3-1 Material balance in 2005 (Master plan)

2. Steel product balance in 2010

A material balance sheet and a production flow sheet for the Vietnamese steel industry in 2010 based on the market study are shown in Figure 3-2.

The concept of the material balance calculation is the same as that described in item 1 above. At this stage, however, both iron-making equipment and steelmaking equipment are entered in the production flow sheet.

The total production of the new integrated steelworks at this stage is projected to exceed 4,600,000 tons/year, which, according to Japanese data and experience, can be considered as justifying the construction of an integrated steelworks furnished with integrated iron- & steelmaking equipment. Financial study, however, must be conducted carefully.

The production line equipment and capacities of the new integrated steelworks in 2010 may well be planned as below.

BF/BOF:	4,600,000 t/y	(New investment)
CC (Slab):	3,400,000 t/y	(New investment)
CC (Billet):	1,050,000 t/y	(New investment)
Hot Strip Mill:	3,200,000 t/y	(Additional investment)
Cold Strip Mill:	1,070,000 t/y	(Additional investment)
CGL:	230,000 t/y	(Additional investment)
ETL:	110,000 t/y	(Additional investment)

Joint venture projects taken into account are as shown below.

Cold Strip Mill (South):	430,000 t/y	(Taiwan, Phase 2 work)
CGL:	100,000 t/y	(Taiwan)
Wire Rod Mill:	325,000 t/y	
Bar Mill:	320,000 t/y	

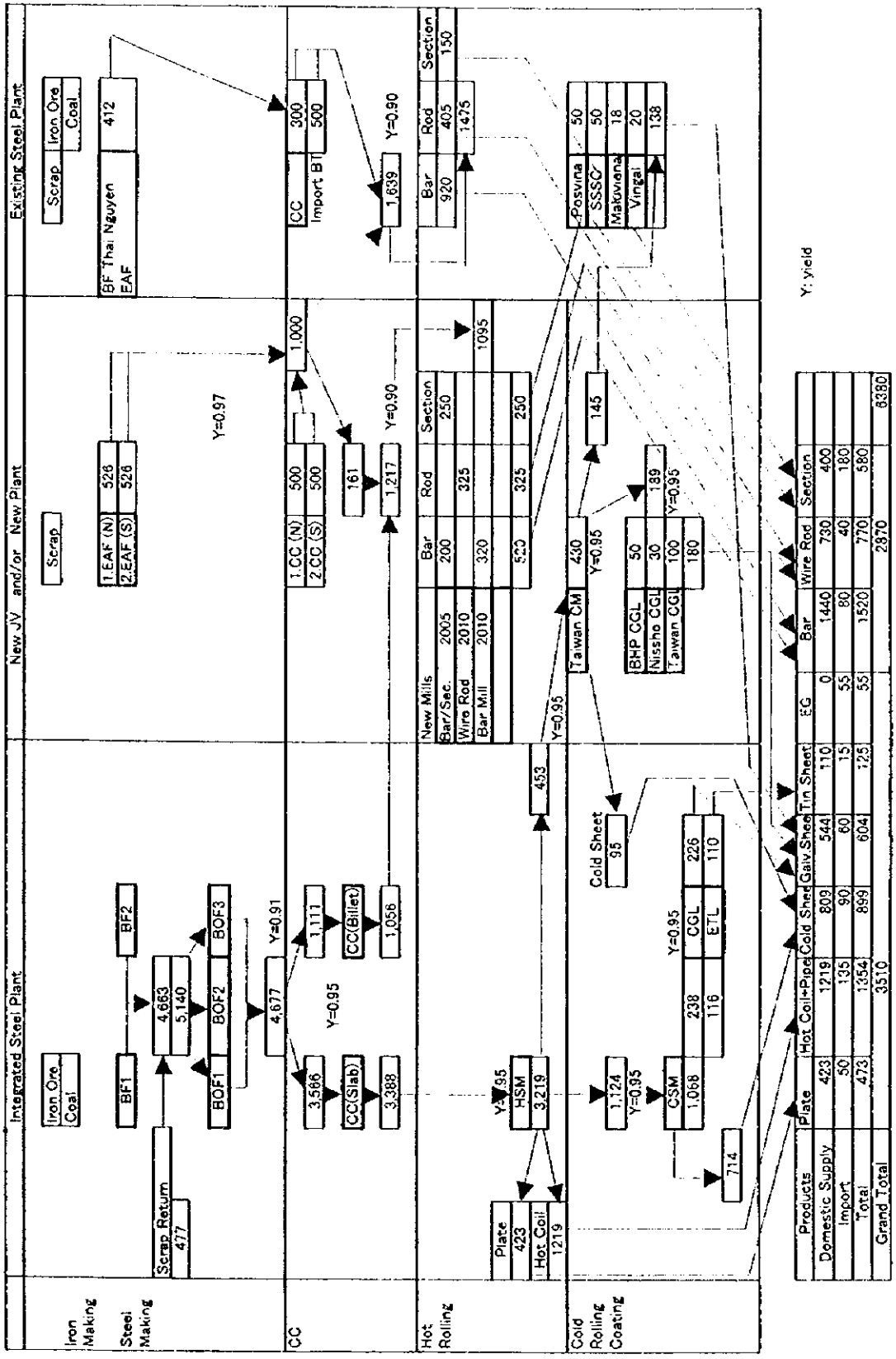

Figure 3-2 Material balance in 2010 (Master plan)

Section 4 Applicable Production Processes for the New Integrated Steelworks

Contents

1. Applicable production processes for the New Integrated Steelworks

Of the important items to be considered when planning the construction of an integrated steelworks, the most important are the following items.

(1) Stable supply routes for raw materials and fuels
(2) Production quantities and types of products to be produced

In short, study must be made to determine what types of products should be produced in what quantities using what raw materials and fuels by means of what processes and equipment.

The production quantities and types of products to be produced in (2) above have been determined by market study and the results are shown in Section 3.

The main raw material for the production of steel products is iron which comes from iron ore or steel scrap. In case of steel scrap, the stable supply of large electric energy is necessary to melt, and in the case of iron ore, the economical and stable supply of reducing materials (coal, natural gas, etc.) to remove combined oxygen from iron ore for producing steel products.

Shown in Figure 4-1 is a comprehensive table of items requiring study.

This table shows that the BF-BOF process alone remains to be the only applicable process for future study among various other processes, judging from the raw material and fuel situations in Viet Nam and the envisaged production scale (4,600,000 tons/year).

The result of the study on an applicable process from molten steel stage to hot rolling is shown in Figure 4-2. What should be kept in mind, however, is that the construction of the integrated steelworks will start with the rolling mill, namely, a downstream process. This mean that until the upstream process is completed, semi-products, i.e., slabs, need to be imported. It will be unrealistic to import thin slabs 100 mm or less thick for use by the CSP or the MSP. In view of the upstream process to be constructed in the future, the CBM and the CVM are two options, and in consideration of construction cost, the CBM must be selected.

Determining factors / Process alternatives	Raw materials/fuels conditions				Production scale	Product quality			Energy & utility supply		Capital cost expenditure	Maturity of technology	Applicable process
	Scrap	Iron ore	Coal	Natural gas	4.6 mt/y	Non-flat for construction	Non-flat for mechanical use	Flat product	Electricity	Water			
Scrap-based EAF	Not easy to procure	-	-	-	Large capacity of EAF is existing worldwide.	No serious problem	Quality scrap & secondary refining are required	Not suitable for high grade quality	Stable & low cost supply is essential.	No serious problem	Low	Established as proven technology	Not applicable due to less availability of good quality scrap.
BF - BOF	-	Thach Khe ore is not usable. Ore must be imported.	No coking coal available. Coal must be imported.	-	Suitable for large scale production.	No problem	No problem	No problem	-	No serious problem	High	Established as proven technology	Applicable.
Smelting reduction (COREX) (2,000 t/day)	-	Thach Khe ore quality to be studied.	Domestic coal quality to be studied.	-	2,000 t/d/module, 7 modules are required.	No problem	No problem	No problem	-	No serious problem	High	Established as proven technology But, scale-up of plant capacity is required.	Not applicable due to small production capability of plant module.
Gas-based D-R (MIDREX)	-	Thach Khe ore quality to be studied.	-	Availability in North & Central regions is uncertain. Gas price is uncertain.	No problem	No problem	No problem	No problem	Stable & low cost supply is essential.	No serious problem	Medium	Established as proven technology	Not applicable due to uncertain availability of natural gas.
Coal-based D-R (Small scale)	-	Thach Khe ore quality to be studied.	Domestic coal quality to be studied.	-	Many units of rotary kiln are required.	No problem	No problem	No problem	Stable & low cost supply is essential.	No serious problem	High or medium	Established as proven technology	Not applicable due to small production capability of plant module.

Note: Key factors giving serious problem.

Problematic items, to be solved with investment.

Figure 4-1 Summary of Study for Applicable Process - Iron & Steelmaking

Determining factors / Process alternatives	Raw materials/fuels conditions: Scrap	Iron ore	Coal	Natural gas	Production scale: 4.6 mt/y	Product quality: Non-flat for construction	Non-flat for mechanical use	Flat product	Energy & utility supply: Electricity	Water	Capital cost expenditure	Maturity of technology	Applicable process
Scrap-based EAF	Not easy to procure	-	-	-	Large capacity of EAF is existing worldwide.	No serious problem	Quality scrap & secondary refining are required.	Not suitable for high grade quality	Stable & low cost supply is essential.	No serious problem	Low	Established as proven technology	Not applicable due to less availability of good quality scrap.
BF - BOF	-	Thach Khe ore is not usable. Ore must be imported.	No coking coal available. Coal must be imported.	-	Suitable for large scale production.	No problem	No problem	No problem	-	No serious problem	High	Established as proven technology	Applicable.
Smelting reduction (COREX) (2,000 t/day)	-	Thach Khe ore quality to be studied	Domestic coal quality to be studied	-	2,000 t/d/module, 7 modules are required.	No problem	No problem	No problem	-	No serious problem	High	Established as proven technology But, scale-up of plant capacity is required.	Not applicable due to small production capability of plant module.
Gas-based D-R (MIDREX)	-	Thach Khe ore quality to be studied.	-	Availability in North & Central regions is uncertain. Gas price is uncertain.	No problem	No problem	No problem	No problem	Stable & low cost supply is essential.	No serious problem	Medium	Established as proven technology	Not applicable due to uncertain availability of natural gas.
Coal-based D-R (Small scale)	-	Thach Khe ore quality to be studied.	Domestic coal quality to be studied.	-	Many units of rotary kiln are required.	No problem	No problem	No problem	Stable & low cost supply is essential.	No serious problem	High or medium	Established as proven technology	Not applicable due to small production capability of plant module.

Note: Key factors giving serious problem.

Problematic items, to be solved with investment.

Figure 4-1 Summary of Study for Applicable Process - Iron & Steelmaking

Determining factors / Process alternatives	Slab conditions: Thickness	Width	Surface conditioning	Cooled slab	Production capability: With one furnace operation	With two furnace operation	With 3-4 furnace operation	Up-stream process	Available products	Flexibility for small-scale production	Operating cost	Capital cost expenditures	Number of operating mills	General comments	Applicable process
CSP (Compact strip production) (Original ISP Included)	Approx. 50 mm	1,000 - 1,550 mm	Impossible	Scrap-down	t/y 800,000 (max)	t/y 1,600,000 (max)	N/A	Scrap - EAF (DRI)	Very limited (Mainly commercial quality)	Very difficult to accept small orders. Production of commercial quality without orders.	No significant difference with other processes.	Low (Up-stream plant cost is low: EAF/TSC.)	Many mills Nucor: (Scrap/EAF) Hambo: (Scrap/EAF) POSCO #1: (EAF)	Suitable for production of commercial grade mainly for construction use in large market such as USA, etc.	Not to be adopted for Viet Nam's integrated steelworks.
					Production capability is low.										
MSP (Medium slab process) (Modified ISP Included)	Approx. 100 mm	900 - 1,550 mm	Impossible	Scrap-down	t/y 1,000,000 (max)	t/y 2,000,000 (max)	N/A	Scrap - EAF (DRI)	Limited (High grade is difficult due to no slab conditioning.)	Difficult to accept small order. Production of commercial quality without orders.	No significant difference with other processes.	Low/Medium (Up-stream plant cost is low: EAF/MSC.)	Few mills (Only few mills under operation, construction or planning) (BHP America Trico, Siam, POSCO #2)	Suitable for small production of medium class product in medium or large markets. This process is still under development.	Not to be adopted for Viet Nam's integrated steelworks.
					Production capability is low.										
CBM (Compact coil box mill)	Approx. 200 mm	650 - 1,550 mm (600 - 1,900)	Possible	Usable	t/y 1,000,000 (ave)	t/y 2,000,000 (ave)	t/y 3,000,000 (max)	BF - BOF (DRI/EAF)	Almost all products (High quality steel is possible.)	Possible to accept small orders (charging cold or warm slabs into reheating furnace).	No significant difference with other processes.	Medium (Up-stream plant cost depends on processes: EAF of BF, etc.)	Many mills (BHP, STELCO TOKYO, Sahaviria, TATA)	Suitable for small production of various grades of products in small, medium or large markets.	To be adopted for Viet Nam's integrated steelworks.
					Production capability is medium.										
CVM (Conventional 3/4 HSM)	Approx. 200 - 300 mm	650 - 1,900 mm (600 - 2,400)	Possible	Usable	t/y N/A	t/y 3,000,000 (ave)	t/y 6,000,000 (max)	BF - BOF	All products (Highest quality is possible.)	Possible to accept small orders (charging cold or warm slabs into reheating furnace).	No significant difference with other processes.	High (Up-stream plant cost is high: BF process.)	Numerous mills (Most HSMs in Japan and developed countries)	Suitable for large production of all kinds of products in large markets.	To be considered for Viet Nam's integrated steelworks taking into account the future expansion.
					Production capability is high.										

Note: Not favorable Subject to further study

Figure 4-2 Applicable Process - Continuous Slab Casting/Hot Strip Mill

Determining factors / Process alternatives	Slab conditions: Thickness	Width	Surface conditioning	Cooled slab	Production capability: With one furnace operation	With two furnace operation	With 3-4 furnace operation	Up-stream process	Available products	Flexibility for small-scale production	Operating cost	Capital cost expenditures	Number of operating mills	General comments	Applicable process
CSP (Compact strip production) (Original ISP Included)	Approx 50 mm	1,000 - 1,550 mm	Impossible	Scrap-down	t/y 800,000 (max)	t/y 1,600,000 (max)	N/A	Scrap - EAF (DRI)	Very limited (Mainly commercial quality)	Very difficult to accept small orders. Production of commercial quality without orders.	No significant difference with other processes.	Low (Up-stream plant cost is low. EAF/TSC)	Many mills Nucor (Scrap EAF) Hambo (Scrap EAF) POSCO #1 (EAF)	Suitable for production of commercial grade mainly for construction use in large market such as USA, etc.	Not to be adopted for Viet Nam's integrated steelworks.
					Production capability is low.										
MSP (Medium slab process) (Modified ISP Included)	Approx 100 mm	900 - 1,550 mm	Impossible	Scrap-down	t/y 1,000,000 (max)	t/y 2,000,000 (max)	N/A	Scrap - EAF (DRI)	Limited (High grade is difficult due to no slab conditioning.)	Difficult to accept small order. Production of commercial quality without orders.	No significant difference with other processes.	Low Medium (Up-stream plant cost is low. EAF/MSC)	Few mills (Only few mills under operation, construction or planning) (BHP America Trico, Siam, POSCO #2)	Suitable for small production of medium class product in medium or large markets. This process is still under development.	Not to be adopted for Viet Nam's integrated steelworks.
					Production capability is low.										
CBM (Compact coil box mill)	Approx 200 mm	650 - 1,550 mm (600 - 1,900)	Possible	Usable	t/y 1,000,000 (ave)	t/y 2,000,000 (ave)	t/y 3,000,000 (max)	BF - BOF (DRI/EAF)	Almost all products (High quality steel is possible.)	Possible to accept small orders (charging cold or warm slabs into reheating furnace).	No significant difference with other processes.	Medium (Up-stream plant cost depends on processes: EAF of BF, etc.)	Many mills (BHP, STELCO TOKYO, Sahavirla, TATA)	Suitable for small production of various grades of products in small, medium or large markets.	To be adopted for Viet Nam's integrated steelworks.
					Production capability is medium										
CVM (Conventional 3-4 HSM)	Approx 200 - 300 mm	650 - 1,900 mm (600 - 2,400)	Possible	Usable	t/y N/A	t/y 3,000,000 (ave)	t/y 6,000,000 (max)	BF - BOF	All products (Highest quality is possible.)	Possible to accept small orders (charging cold or warm slabs into reheating furnace).	No significant difference with other processes.	High (Up-stream plant cost is high. BF process)	Numerous mills (Most HSMs in Japan and developed countries)	Suitable for large production of all kinds of products in large markets.	To be considered for Viet Nam's integrated steelworks taking into account the future expansion.
					Production capability is high										

Note: Not favorable; Subject to further study

Figure 4-2 Applicable Process - Continuous Slab Casting/Hot Strip Mill