Section 5 Technical Propositions for Site Selection

Contents

Page

1. Technical propositions for site selection ---------------------------------- 1

1. Technical propositions for site selection

Regarding the site selection for the construction of the new integrated steelworks, the Vietnamese side reduced the number of proposed sites by the site selection criteria presented (during the first site study) from 10 to 3 (actually 4). A field survey was conducted by the Japanese group at each site during the second site study.

As is shown in Table 5-1, four sites have been compared from both the short-term viewpoint of initial investment amount etc., and the long-term viewpoint of items represented by the cost of raw material and product transport. The results have indicated that in the case of short-term viewpoint, all sites except Dung Quat, which is disadvantageous in terms of land development and harbor construction, have shown no difference, while from the long-term viewpoint, there are no significant differences among the four sites.

Following the result, the Vietnamese side selected Mui Ron in Hatinh Province during the third site study as the site for the construction of the new integrated steelworks.

Prior to the fourth site study, however, VSC requested a re-study of the Dung Quat area. The re-study of Dung Quat was conducted in the fifth site study.

Part 2 Steel Demand Projection

Section 1 Present Situation of Supply and Demand of Steel Products

Contents

Page

1. Steel supply ---------- 1

2 Steel demand ---------- 1

1. Steel supply

Quantity of steel products supplied to Vietnamese market in 1992-1996 is shown in Table 1-1.

Table 1-1 Total steel supply to market

(Unit: 1,000t)

	Company	1992	1993	1994	1995	1996
Domestic products	VSC	190	230	270	370	450
	JVs	0	0	0	0	400
	Other companies	30	50	90	120	150
	Sub total	220	280	360	490	1,000
Imported products		320	540	630	610	300
Total supply		540	820	990	1,100	1,300

Source: VSC, JV companies

2. Steel demand

Total steel demand in Viet Nam in 1992-1996 is summarized in Table 1-2.

Table 1-2 Total steel demand

(Unit: 1,000t)

Year	1992	1993	1994	1995	1996
Demand	540	820	990	1,100	1,300

Steel demand by steel type in 1996 is summarized in Table 1-3.

Table I-3 Steel demand by steel type in 1996

(Unit: 1,000t)

Non-flat steel		Flat steel	
Steel type	Demand	Steel type	Demand
(1) Bar	470	(1) Plate	58
(2) Wire rod	300	(2) Hot rolled coil/sheet	48
(3) Rolled section	140	(3) Cold rolled coil/sheet	65
		(4) Welded section	0
		(5) H-D galv.	128
		(6) EG galv.	11
		(7) Tin plate	40
		(8) Welded pipe	40
Total	910 (70%)	Total	390 (30%)

Section 2 Projection of Future Steel Demand in Viet Nam (Macroscopic Projection)

Contents

Page

1. General ---------- 1

2. Projection of GDP growth rate ---------- 1

3. Projection of steel demand ---------- 1

4. Projection of flat products quantity ---------- 2

1. General

In general, when the steel demand (Apparent steel consumption/capita) in a country exceeds a certain level, it shows a clear relation with its GDP/capita figure. At present both indexes in Viet Nam are not high enough to show this relation, so steel demand projection was carried out in relation to the projected GDP growth rate.

2. Projection of GDP growth rate

The actual and expected GDP growth rate until 2000 is shown in Table 2-1.

Table 2-1 GDP growth rate

(Unit: %/y)

Five-year Plan	Planned GDP growth rate		Actual GDP growth rate	
	Total GDP	Manufacturing Industry	Total GDP	Manufacturing Industry
1991-1995 Five-year Plan	5.5 – 6.5	7.5 - 8.5	8.2	13.3
1996-2000 Five-year Plan	9 – 10	14 - 15	-	-

Source: General statistical office

Through discussion with the governmental agencies and VSC, the GDP growth rate after 2000 is considered to be 8-9% p.a. during 2001-2005 and 7-8% p.a. during 2006-2010. These figures are used for the projection of GDP growth rate after 2000.

3. Projection of steel demand

For projection of steel demand, two cases are taken:

1) Base case (most probable case)
The Growth rate of steel consumption for 1996-2000 is assumed to be 16%/y. After the year 2000, it is projected to be lower than those of the preceeding years and is assumed to be 12%/y on average from 2001 through 2005. When annual production quantity comes to a certain level, the growth rate usually declines, and the growth rate will drop further again to 9%/y on average during 2006-2010.
2) Optimistic case (maximum case)
In this case, average growth rates are set to be 10-25% higher than those of the Base case.

In Table 2-2 and Figure 2-1 the projection of steel demand up to 2010 for both cases are shown. By this projection, steel demand in 2010 will be

1) Base case : about 6.4 million ton/y
2) Optimistic case : about 8.3 million ton/y

Table 2-2 Projection of steel demand up to 2010

Case	Average growth rate (%/y)			Steel demand (1,000t)			
	1996-2000	2001-2005	2006-2010	1996	2000	2005	2010
1) Base case	16	12	9	1,300	2,350	4,150	6,380
2) Optimistic case	20	15	10	1,300	2,700	5,200	8,340

4. Projection of flat products quantity

With the modernization and industrialization of a country, the ratio of flat products demand to the total steel demand of the country rises. In most industrialized countries including Thailand, these ratios are ranging around 50 to 60%, and in Viet Nam it is assumed it will go up to 55% in 2010. In Table 2-3 the projection of the flat products ratio and its quantities are summarized.

Table 2-3 Projection of flat products ratio and its quantity

Subject	1996	2000	2005	2010
Flat products ratio (%)	30	37	46	55
(1) Base case (1,000t)	390	870	1,910	3,510
(2) Optimistic case (1,000t)	390	1,000	2,390	4,590

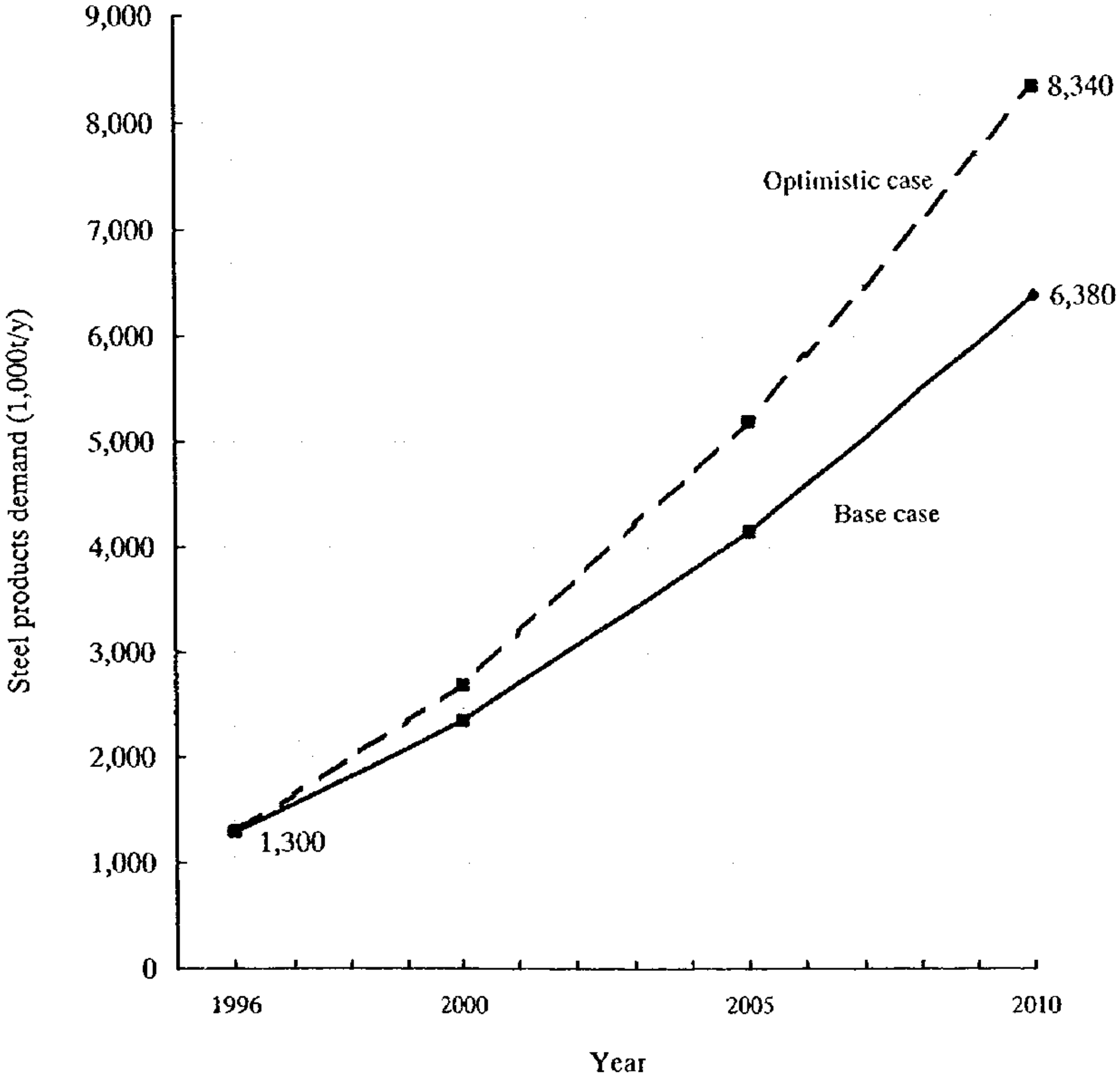


Figure 2-1 Macroscopic projection of steel products demand

Section 3. Steel Demand by Industrial Sub-sector (Microscopic Projection)

Contents

Page

1. Steel demand by industrial sub-sector (Microscopic projection)-------------- 1

1. Steel demand by industrial sub-sector (Microscopic projection)

The microscopic projection in terms of steel demand quantity, steel type, steel grade, size, etc. for the following industries was conducted with certain adjustments by macroscopic projection for some industries:

- Building construction
- Infrastructure
- Capital investment field
- Shipbuilding industry
- Automobile industry
- Household appliances
- Can industry
- Containers
- Machine tool

Section 4 Projection of Steel Demand by Steel Type

Contents

Page

1. Projection of steel demand by steel type ---------- 1

1. Projection of steel demand by steel type

Based on the macroscopic and microscopic survey of the present and future industrial structure in Viet Nam, as well as the case of neighboring countries, future demand by steel type in Viet Nam is projected as shown in Table 4-1 as the Base case.

Table 4-1 Demand projection for Base case

(Unit: 1,000t)

Product		1996	2000	2005	2010
Non-flat products	Bar	470	770	1,190	1,520
	Wire rod	300	440	600	770
	Section	140	270	450	580
	Sub total 〔% of non-flat steel〕	910 〔70%〕 (1,010)	1,480 〔63%〕 (1,640)	2,240 〔54%〕 (2,490)	2,870 〔45%〕 (3,180)
Flat products	Plate *	58	93	239	473
	Hot coil/sheet **	48	195	501	994
	Cold coil/sheet	65	177	454	899
	Galvanized sheet	139	228	388	659
	Tin plate	40	65	88	125
	Welded pipe	40	112	240	360
	Sub total 〔% of flat steel〕	390 〔30%〕 (430)	870 〔37%〕 (970)	1,910 〔46%〕 (2,120)	3,510 〔55%〕 (3,900)
Grand total ***		1,300 (1,440)	2,350 (2,610)	4,150 (4,610)	6,380 (7,080)

* : Plate : thickness ≧ 6.0mm
** : Hot coil/sheet : thickness < 6.0mm
*** : Figures in parenthesis show crude steel base.

Present area-wise steel demand ratio is as follows, and is assumed to be unchanged in 2010.

North area	Central area	South area	Total
30%	5%	65%	100%

Source: VSC

Part 3 Applicable Process

Section 1 Raw Materials Sources

Contents

Page

1. Preface ---------- 1

2. Iron sources ---------- 1

2.1 Iron ore ---------- 1

2.2 Scrap ---------- 1

3. Fuel sources ---------- 4

3.1 Natural gas in gas reduction processes ---------- 4

3.2 Coking coal in blast furnaces ---------- 4

4. Conclusion ---------- 4

4.1 Conclusion from iron source ---------- 4

4.2 Conclusion from fuel source ---------- 5

1. Preface

This section is aiming at clarifying which materials are recommendable for the New Integrated Steel Plant from the viewpoint of long and stable raw material supply taking the present situations of domestic raw material sources and foreign sources into consideration. As a result, this refers to recommendable iron making process for the New Integrated Steel Plant.

2. Iron sources

The following is the comparison of the materials able to be used in Viet Nam as a source of iron for iron and steel making process.

2.1 Iron ore

There is no realistic prospect of utilizing any known domestic deposit as a possible feed material for a large scale steel plant for the reasons set out in Section 1, Part 2, Chapter Ⅱ.

2.2 Scrap

The generation of domestic scrap in Viet Nam is very small. In 1996 it was approximately 300,000 tons. The quality of this scrap estimated by a visual inspection at site is poor from the point of view of steelmaking.

It is possible to extrapolate the amount of future generation of scrap from the present levels and this is shown in Table 1-1 which shows the forecast about the future scrap generation according to the optimistic assumption.

From this extrapolation it can be seen that domestic generated scrap cannot become the main iron source of raw material for a large scale steel plant in Viet Nam in the near future.

From Figure 1-1, Figure 1-2 and Figure 1-3, it can be seen that:

a) all ASEAN countries are importing scrap and it can be anticipated that the gap between domestic supply and demand in each country will become even larger in the near future;

b) scrap exports from the large exporting countries is not increasing; and

c) scrap prices are not stable.

From this it can be concluded that the supply of scrap in ASEAN is very tight and this situation is likely to continue for the foreseeable future.

Table 1-1 Forecast of obsolete scrap generation

Year	Accumulation of steel products	Apparent steel consumption	Obsolete scrap generation
	t	t	t
1992	8,550,000	540,000	214,000
1993	9,090,000	820,000	227,000
1994	9,910,000	990,000	248,000
1995	10,900,000	1,100,000	273,000
1996	12,000,000	1,300,000	300,000
2000	20,380,000	2,700,000	509,000
2005	41,080,000	5,200,000	1,027,000
2010	75,936,000	8,340,000	1,898,000

Assumption for the calculation in the table
- Scrap generation in 1996 is 300,000 tons
- Ratio of scrap generation against accumulation of steel products is 2.5 % (higher value over the world).
- Demand is to be the domestic consumption
- No export of iron or products made of iron or steel

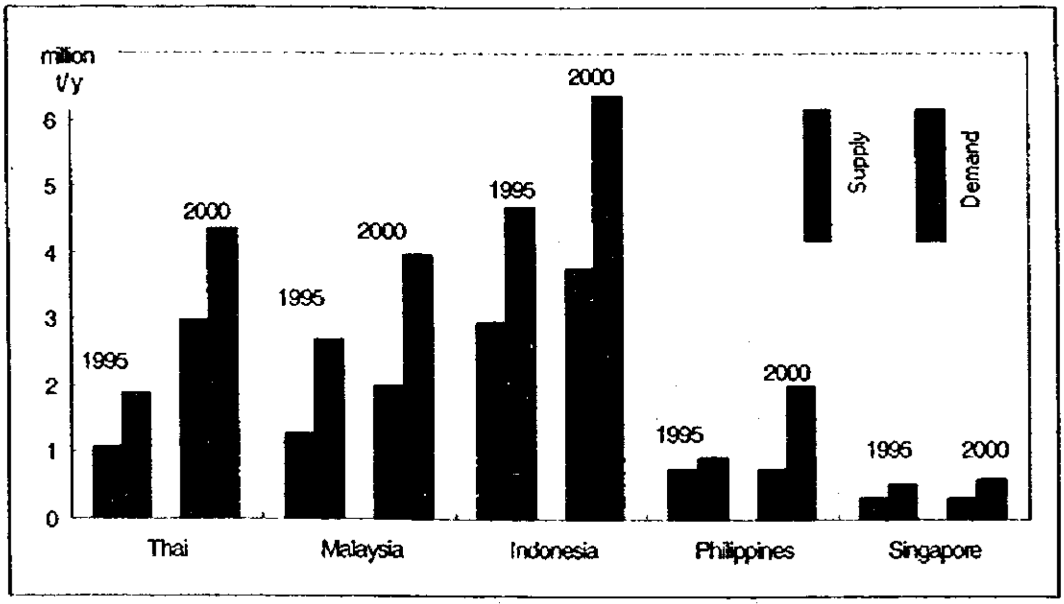


Figure 1-1 Demand and supply of ferrous materials in ASEAN countries
(Ferrous material=scrap+sponge iron+cold pig iron)

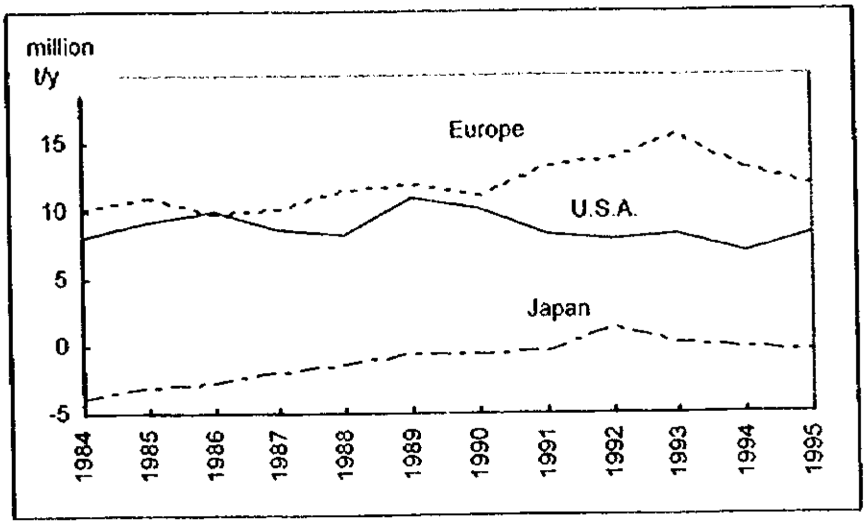


Figure 1-2 Net scrap export from main export countries
*1:Net export =Export-Import
*2:Europe=England+France+Holland+Germany

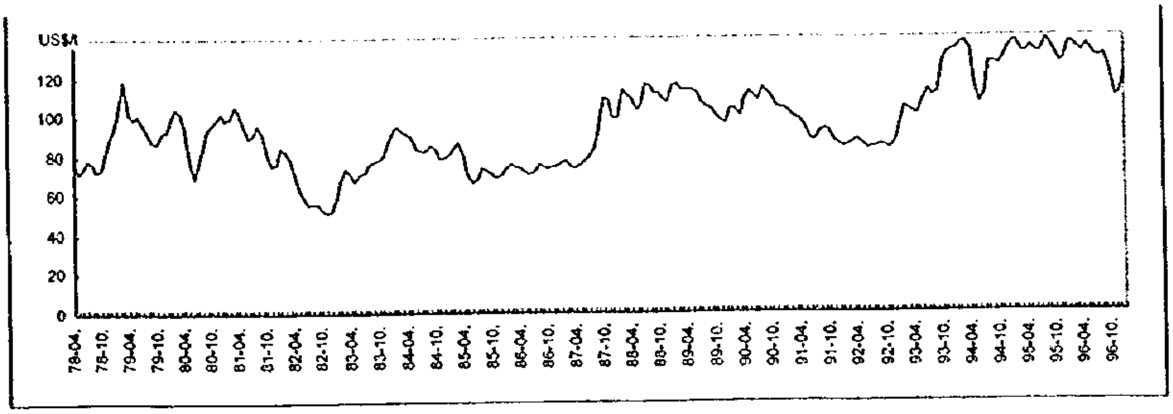


Figure 1-3 Transition of scrap price (HMS No.1 scrap composite in U.S.A.)

3. Fuel sources

The following is the comparison in Viet Nam of the fuels possible to be used as a source of fuels for the iron and steel making process.

3.1 Natural gas in gas reduction processes

Present reserves of natural gas in Viet Nam are not abundant. (as mentioned in Section 1, Part 2, Chapter II) They are not large enough to be used as fuel source over a long period. In addition the present plan is to use the available reserves for electricity generation. The importation of natural gas for steel making is not a realistic option because of the high cost of transportation and world reserves are forecast probably to be exhausted within the next century.

3.2 Coking coal in blast furnaces

Viet Nam has very large reserves of anthracite which cannot be used for cokemaking. The deposits of coking coal are not so substantial and proven reserves of coking coal will not increase due to the fact that exploration is limited because geological information is not positive.
World coal reserves are substantial.

4. Conclusion

4.1 Conclusion from iron source

There is no realistic possibility of using domestically generated scrap or domestically mined iron ore as the main source of feed to a large scale steel plant in Viet Nam.

It is recommended that imported iron ore is used as at present around 450 million tons per year of iron ore is traded worldwide, reserves are plentiful and the price has been stable over a long period.

4.2 Conclusion from fuel source

Viet Nam has insufficient natural gas and coking coal reserves to use a fuel for a large scale steel plant. It is therefore not possible to use a domestic fuel.

The only long term viable possibility is to develop a blast furnace based plant using imported coking coal of which there are abundant worldwide reserves.

If a new technology becomes available using anthracite of which Viet Nam has abundant reserves, and is proven, then that process could be introduced.

Coal reserves over the world are shown in Table 1-2 for reference.
Provided that all coal production comes from bituminous coal or anthracite recoverable reserves coal will be available for the next 140 years. The percentage of coking coal consumption to total coal production is estimated to be very small at about 15%. On the other hand, the percentage of coking coal reserve to coal reserve of bituminous and anthracite is estimated 20 % or more. This means coking coal will be available longer than 140 years. Technology to utilize soft or poor coking coal has been developed to prolong the life of coking coal.

Table 1-2 Coal reserves over the world (based on the data in 1986)

Country	Coal Reserves (billion t)						Coal production (billion t/y)
	Bituminous/ Anthracite			Sub bituminous / brown coal			
	Geo[*1]	Pro[*2]	Rec[*3]	Geo[*1]	Pro[*2]	Rec[*3]	
U.S.A	696	238	132	874	205	132	0.86
Australia	556	49	27	230	42	38	0.19
U.S.S.R.	2,299	136	109	3,203	157	136	0.32
China	2,311	611	99	427	127	N.A.*4	1.29
Others	1,073	355	147	297	195	112	0.96
World total	6,935	1,387	514	5,031	726	418	3.62

Note: Abbreviation
Geo.[*1]=Geological reserve, Pro[*2]=Proven reserve,
Rec[*3]=Recoverable reserve,
N.A.[*4]=not available.

Section 2 Ironmaking Processes

Contents

Page

1. Introduction of iron and steelmaking routes---------------------------- 1

2. Selection of iron and steelmaking processes---------------------------- 1
2.1 Selection of representative processes---------------------------------- 1
2.2 Detail process flow of representative processes----------------------- 1

3. Evaluation of representative processes---------------------------------- 9
3.1 Preconditions for investment cost and molten steel cost calculation---9
3.2 Evaluation of representative processes---------------------------------- 9

1. Introduction of iron and steelmaking routes

The steelmaking routes are shown in Figure 2-1.
There are mainly four routes.

- Blast furnace - Converter
- Direct reduction - Electric arc furnace (EAF)
- Smelting reduction - Converter
- Electric arc furnace

Each iron and steelmaking process is explained in Appendix.

2 Selection of iron and steelmaking processes

2.1 Selection of representative processes

(1) Process routes for iron and steelmaking process

Four routes for steel making process are classified as follows.
Route A : Blast furnace - converter
Route B : Direct reduction furnace- electric arc furnace
Route C : Smelting reduction furnace - converter
Route D : Electric arc furnace
Among four routes, the route B and route C have many processes. The representative process needs to be selected in each route.

(2) Representative process selection of route B group and route C

The results which are compared with various points of view are shown in Tables 2-1 and 2-2.
The representative process is as follows.
Route B : MIDREX - electric arc furnace process
Route C : COREX - converter process

2.2 Detail process flow of representative processes

The material and gas flows are shown in Figures 2-2, 2-3, 2-4 and 2-5.

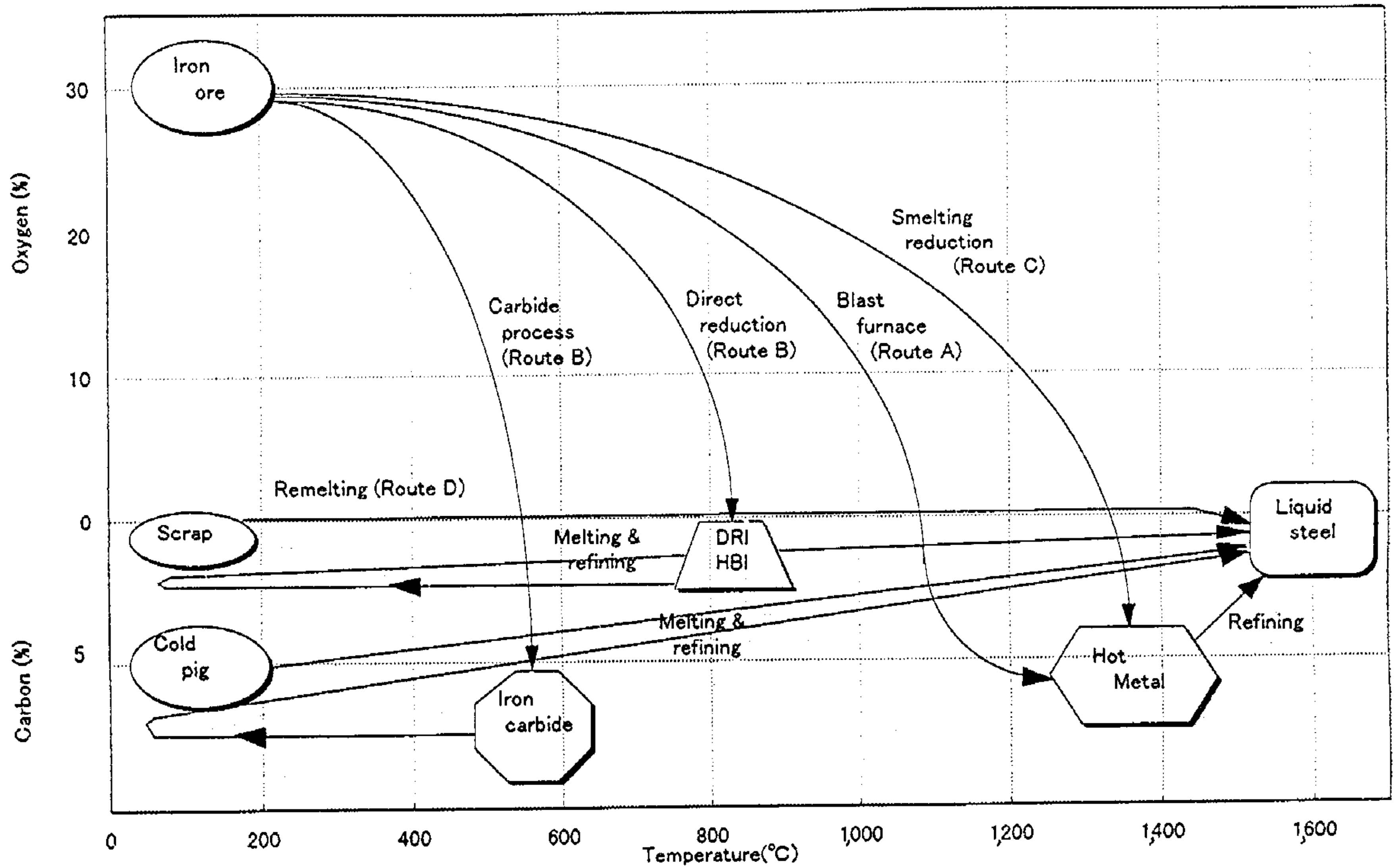


Figure 2-1 Process route for making liquid steel from various ferruginous materials

Table 2-1 Representative process selection of route B group

	Gas based				Coal based	
	MIDREX	HYL-III	FINMET [former FIOR]	Iron-carbide	SL/RN	FASTMET
Status	Industrial	Industrial	Industrial	Industrial	Industrial	Pilot scale Test
Iron source	Pellets Lump	Pellets Lump	Fines Size:sinter feed	Fines Size: 0.1-1mm	Pellets Lump	Fines
Fuel source	Natural gas	Natural gas	Natural gas	Natural gas	Coal	Coal
Pressure (kg/cm^2)	Atomos-pheric	5	11 - 12	0.8	Atomos-pheric	Atomos-pheric
Typical plant capacity ($\times 10^3$ tons/y)	1,000	1,000	FINMET: 1,000 FIOR:400	320	150-250	450
Plant installed (modules)	39	13	1	1	8**	0
Total capacity installed ($\times 10^3$ tons/y)	20,010	6,370	400	300	1,320**	0
Selection evaluation*	I The most spread process	I Less plants than MIDREX	II Few industrial plants	II Few industrial plants	II Small scale plant	III Under develop-ment
Representative process	○					

* I : Representative process
II : Next representative process
III : Not mature
** : SL/RN plants of production over 150,000 tons/y

Table 2-2 Representative process selection of route C group

	DIOS	COREX	ROMELT
Status	Pilot plant test	Industrial beginning '89 Start up	Pilot plant test
Iron source	Fines	Pellets Lump	Fines
Fuel source	Non-coking coal	Non-coking coal	Non-coking coal
Pressure (kg/cm^2)	1.9	2.0	Atmospheric
Typical plant capacity ($\times 10^3$ tons/year)	1,000	600	350
Plant installed (modules)	0	2	0
Total capacity installed ($\times 10^3$ tons/year)	0	900	0
Selection evaluation*	Ⅲ No industrial plant	Ⅰ Few industrial plant	Ⅲ No industrial plant
Representative process		○	

* Ⅰ : Representative
Ⅱ : Next representative
Ⅲ : Not mature

Production : 3,000.000 t/y molten steel

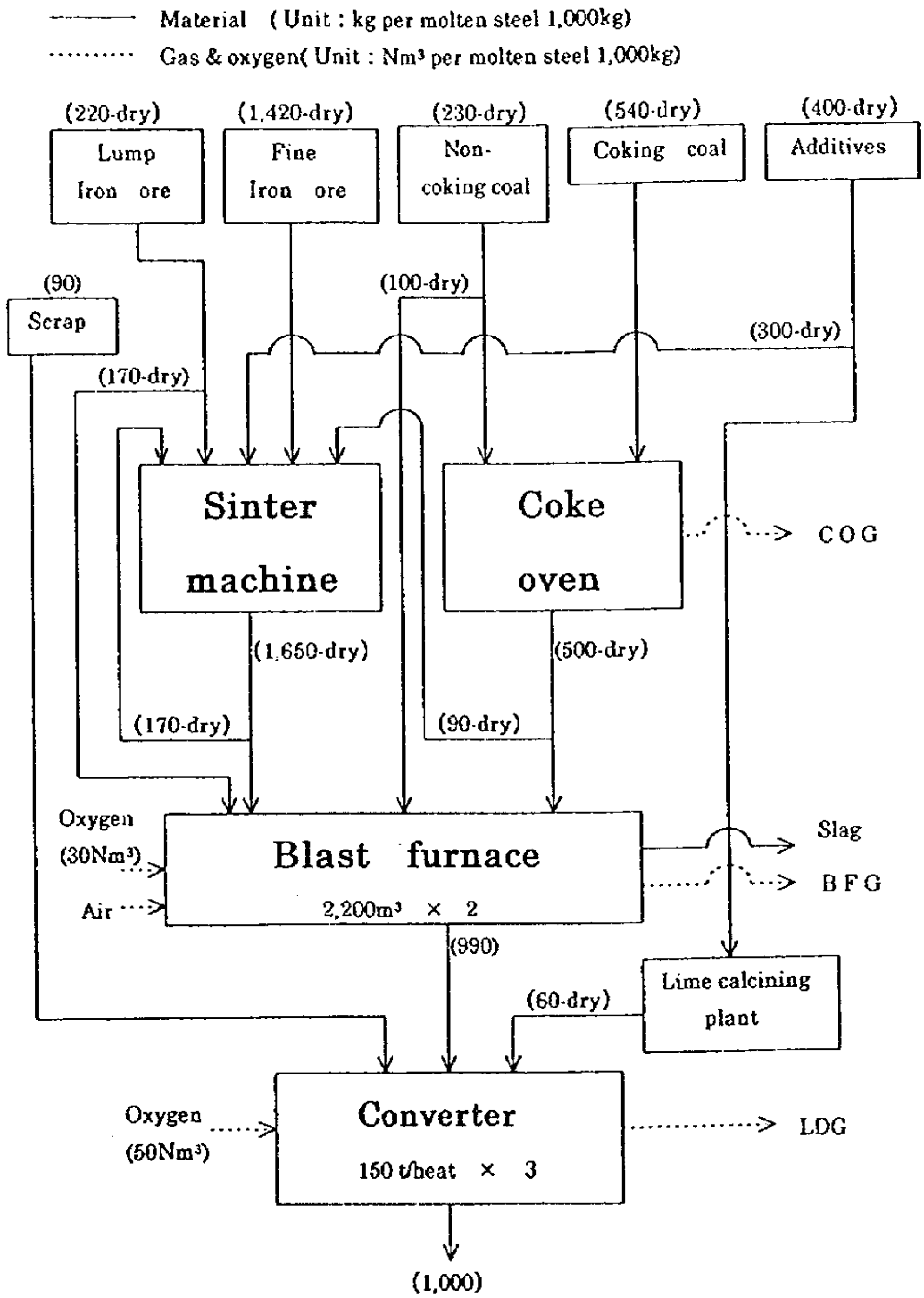


Figure 2-2 Blast furnace - converter process

Production: 3,000,000t/y molten steel

——— Material (Unit : kg per Molten Steel 1,000kg)

·········· Gas or Oxygen (Unit: Nm^3 or Mcal per Molten Steel 1,000kg)

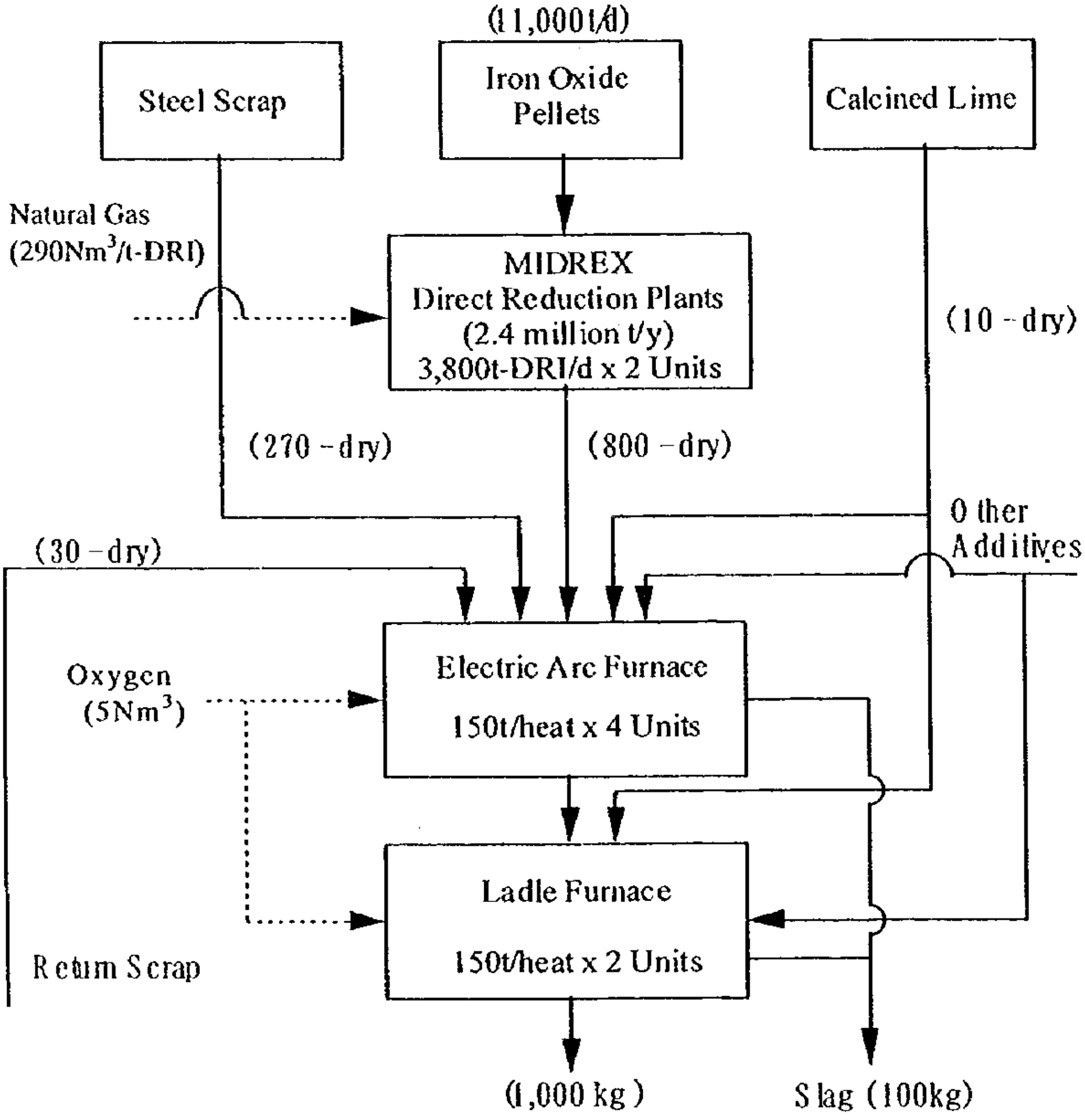


Figure 2-3 Material flow of Midrex DR - EAF process

Production : 3,000,000 t/y molten steel

——— Material (Unit : kg per Molten Steel 1,000kg)

········· Gas &or Oxygen(Unit : Nm³ per Molten Steel 1,000kg)

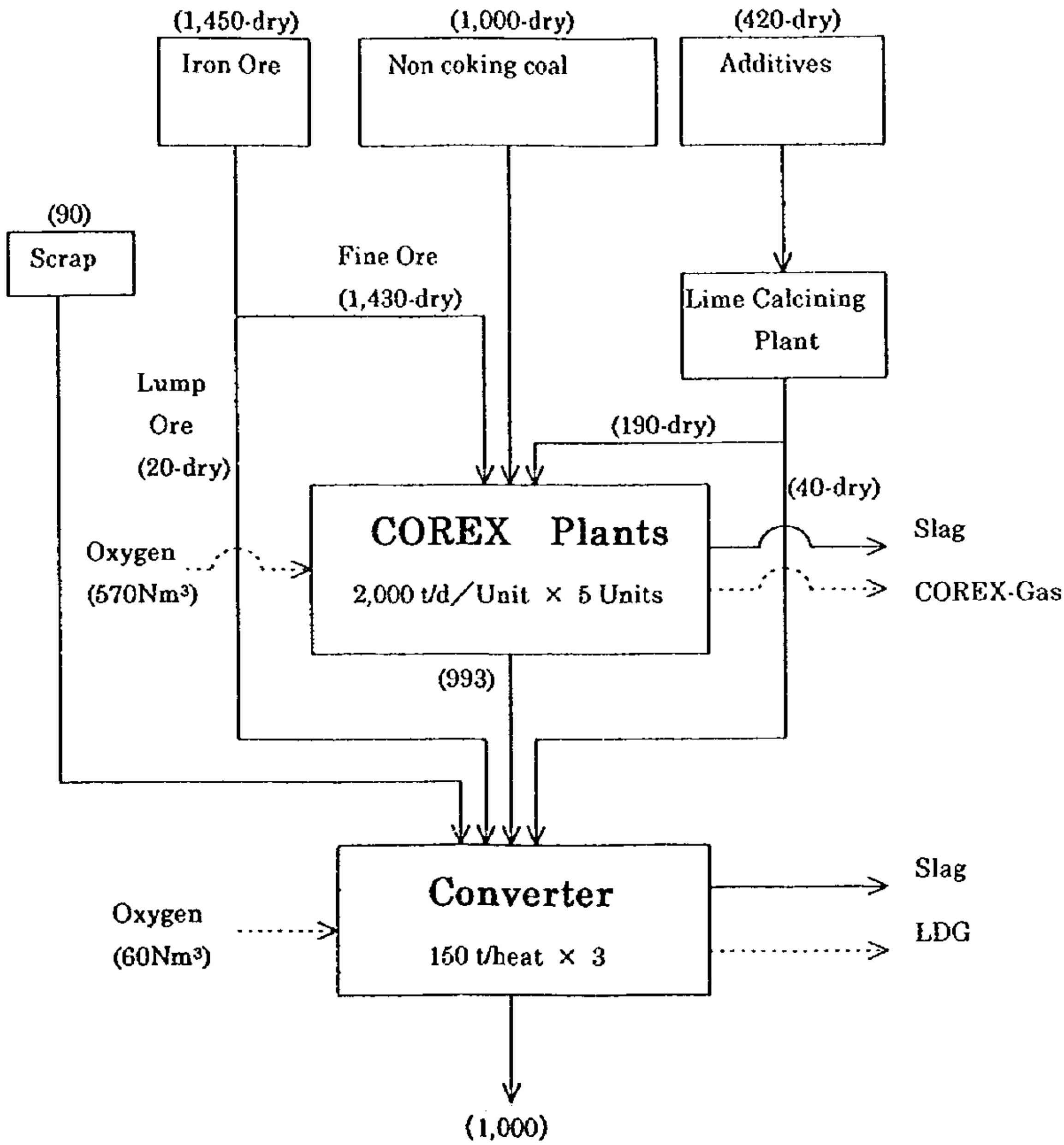


Figure 2-4 COREX - converter process

Production : 3,000,000 t/y molten steel

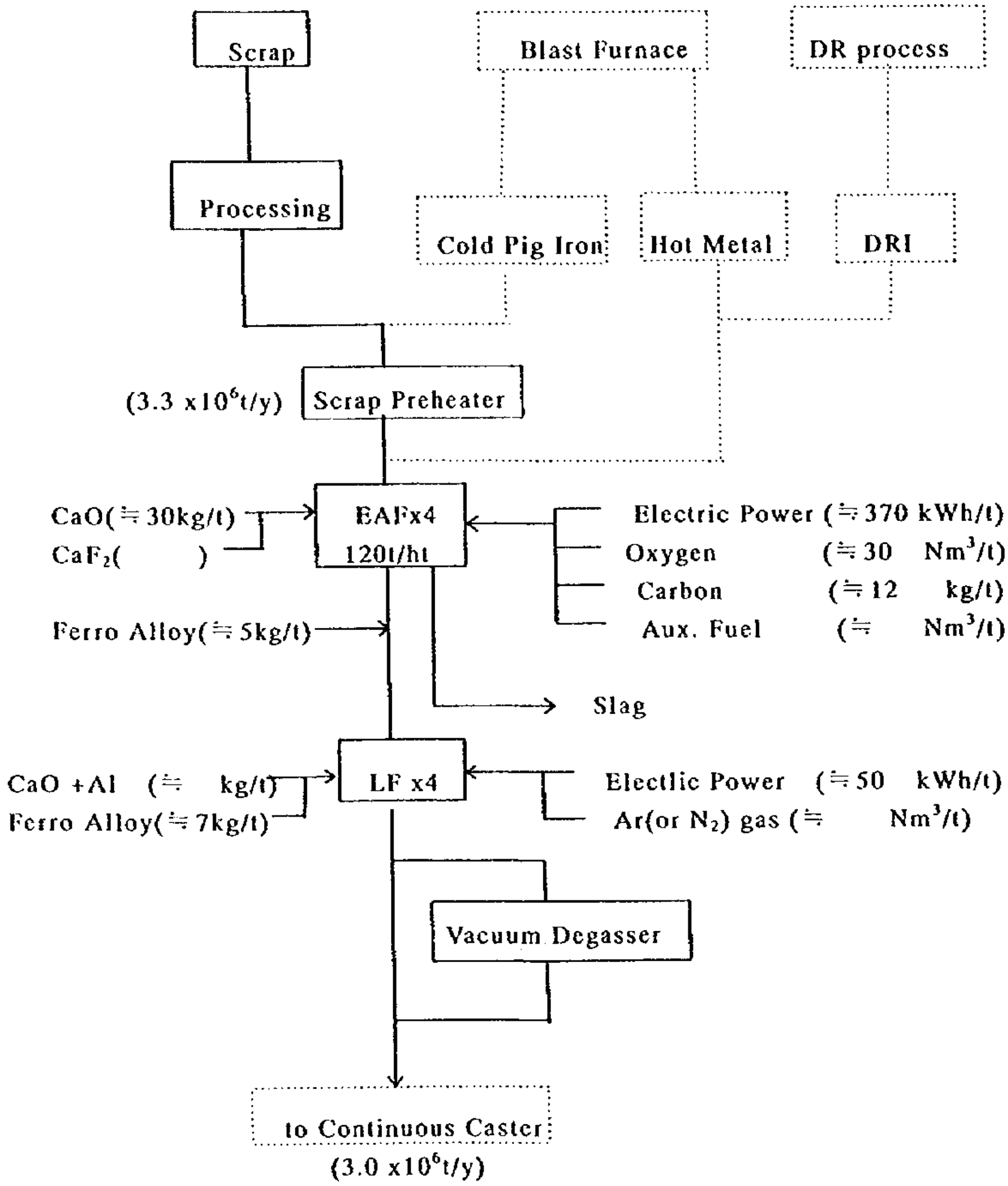


Figure 2-5 Material flow of EAF process

3. Evaluation of representative processes

3.1 Preconditions for investment cost and molten steel cost calculation

The basic preconditions for investment cost and steel cost calculation are shown as follows.

(a) Production scale : molten steel 3 million tons/ year

(b) Green field basis

(c) Investment cost :
Ironmaking plants (including the raw material yards)
Steelmaking plants (not including the continuous casting plants)
Oxygen plants
Power plants

(d) Unit price of main materials are shown as follows.

	Unit	Case A (Close to Viet Nam condition)	Case B (Other condition)
Natural gas	$/MMBTU	3	1.5
Scrap	$/t	170	120
Power	$/kWh	0.08	0.04

(e) Molten steel cost
Include fixed costs(including the investment costs) and variable costs (the raw materials, fuels, etc.)

3.2 Evaluation of representative processes

The investment costs, molten steel costs and evaluation table are shown in the following pages.

(a) Summary of domestic raw materials
- Coal : The large quantity production of anthracite at north region of Viet Nam. Coking coal supply is impossible because of the present production and poor amount of deposits.

- Natural gas : In case of central or north region for the integrated steelworks, it is impossible to procure cheap and large quantity of natural gas.
- Scrap : Insufficient supply of the domestic scrap.
- Iron ore : Developing the Tach Khe iron-ore deposit, but the feasibility study has been suspended.

(b) Blast furnace - converter process
- The most popular and technologically established process
- Necessary of importing coking coal
- Import or Tach Khe deposit for iron ore
- Possible for integrated steelworks process

(c) Direct reduction - EAF (Electric Arc Furnace) process
- The second share in iron-steel making process
- Difficult of adopting direct reduction process in the region of high price and small quantity natural gas production.
- Possible of adopting direct reduction process in the south region of Viet Nam

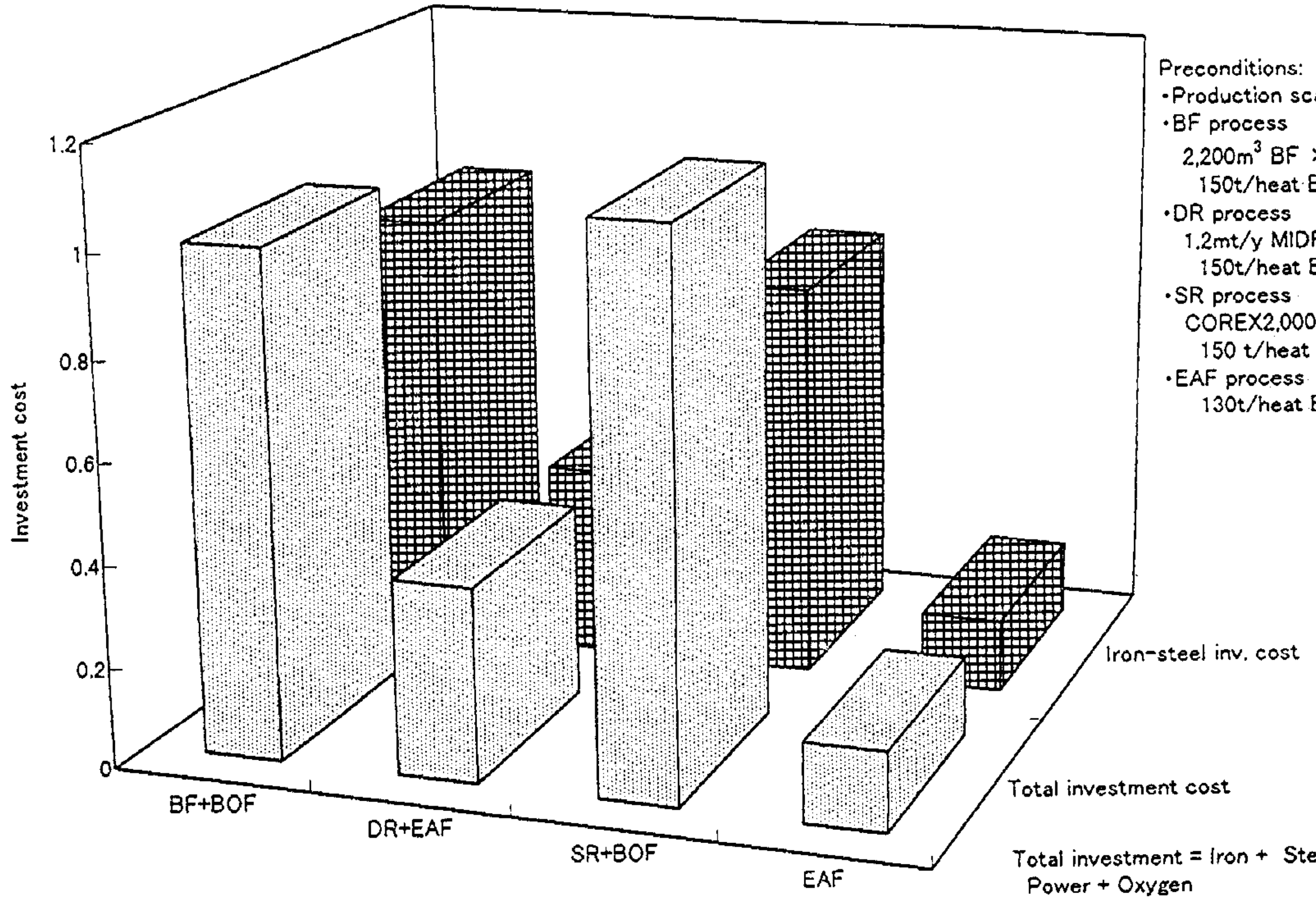
(d) Smelting reduction - converter process
- No need of coking coal but restriction for coal quality, equal to no-coking coal.
- Need of agglomerated or lump iron ore. Import or Tach Khe deposit for iron ore.
- Maximum plant scale : 600 thousand tons/year.
- Two industrial plants in operation.

(e) EAF
- Need of high quality scrap.
- Need of sufficient power supply source.

(f) Investment cost & production cost
- Investment cost : SR > BF > DR > EAF
- Production cost (molten steel) : BF < SR < DR < EAF

It is difficult to select the Direct reduction and EAF because of natural gas and scrap condition. The Smelting reduction (COREX) - converter process has experienced only 2,000 tons/day, however, the new integrated steel works needs more than 13,000 tons/day of pig iron.

The Blast furnace -converter process should be selected at the moment.
But the iron making process selection should be restudied considering the available process technology and up-dated information of raw materials and fuels in Viet Nam at the later stage in future.



Preconditions:
- Production scale 3.0 mt/y
- BF process
  2,200m³ BF × 2 +
  150t/heat BOF × 3
- DR process
  1.2mt/y MIDREX × 2
  150t/heat EAF × 4
- SR process
  COREX2,000 t/d × 5
  150 t/heat BOF × 3
- EAF process
  130t/heat EAF × 4

Total investment = Iron + Steel + Power + Oxygen

Figure 2-6 Comparison of investment cost between iron-steel making processes

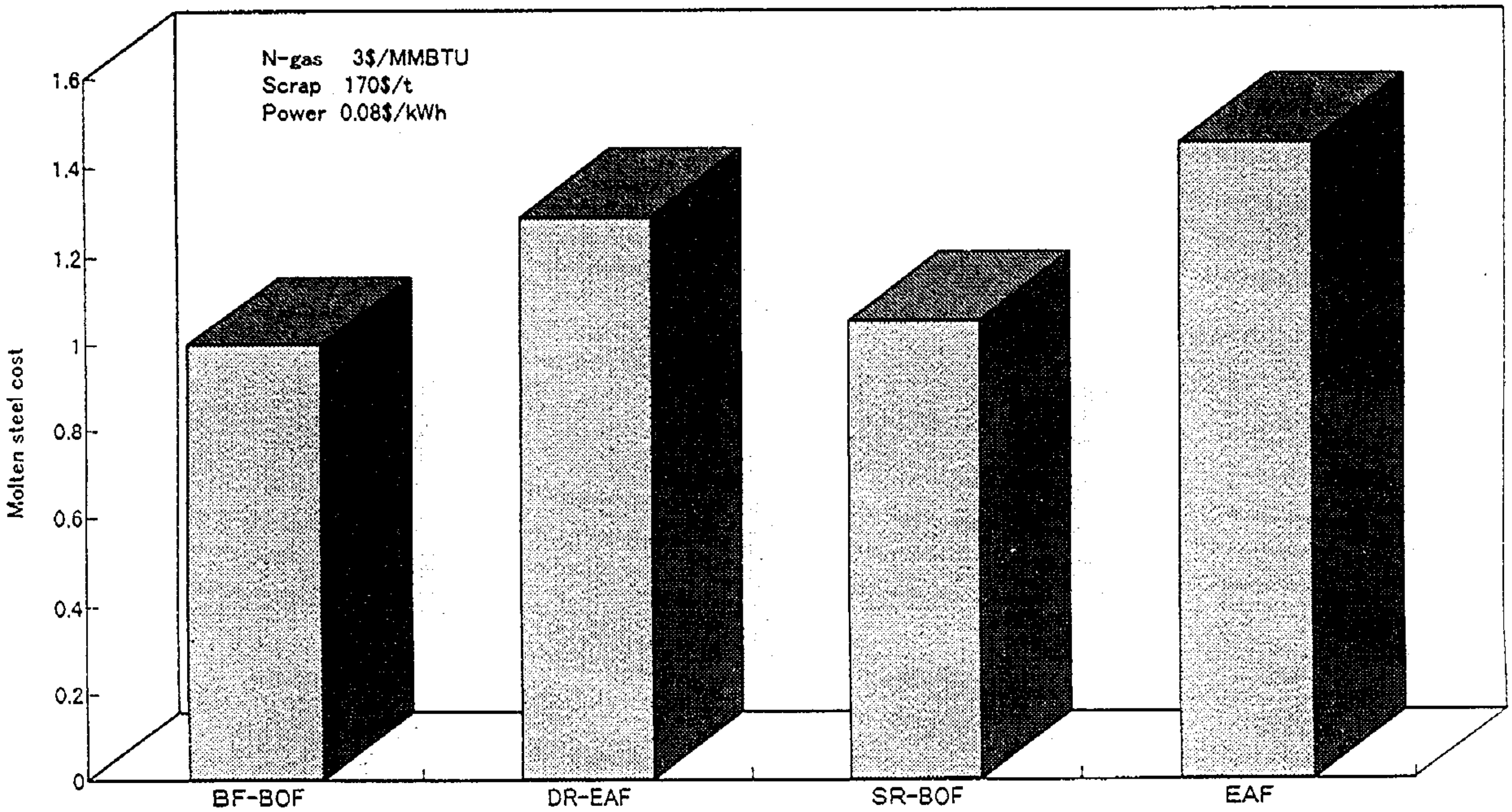


Figure 2-7 Comparison of molten steel cost between iron-steel making processes (case A)

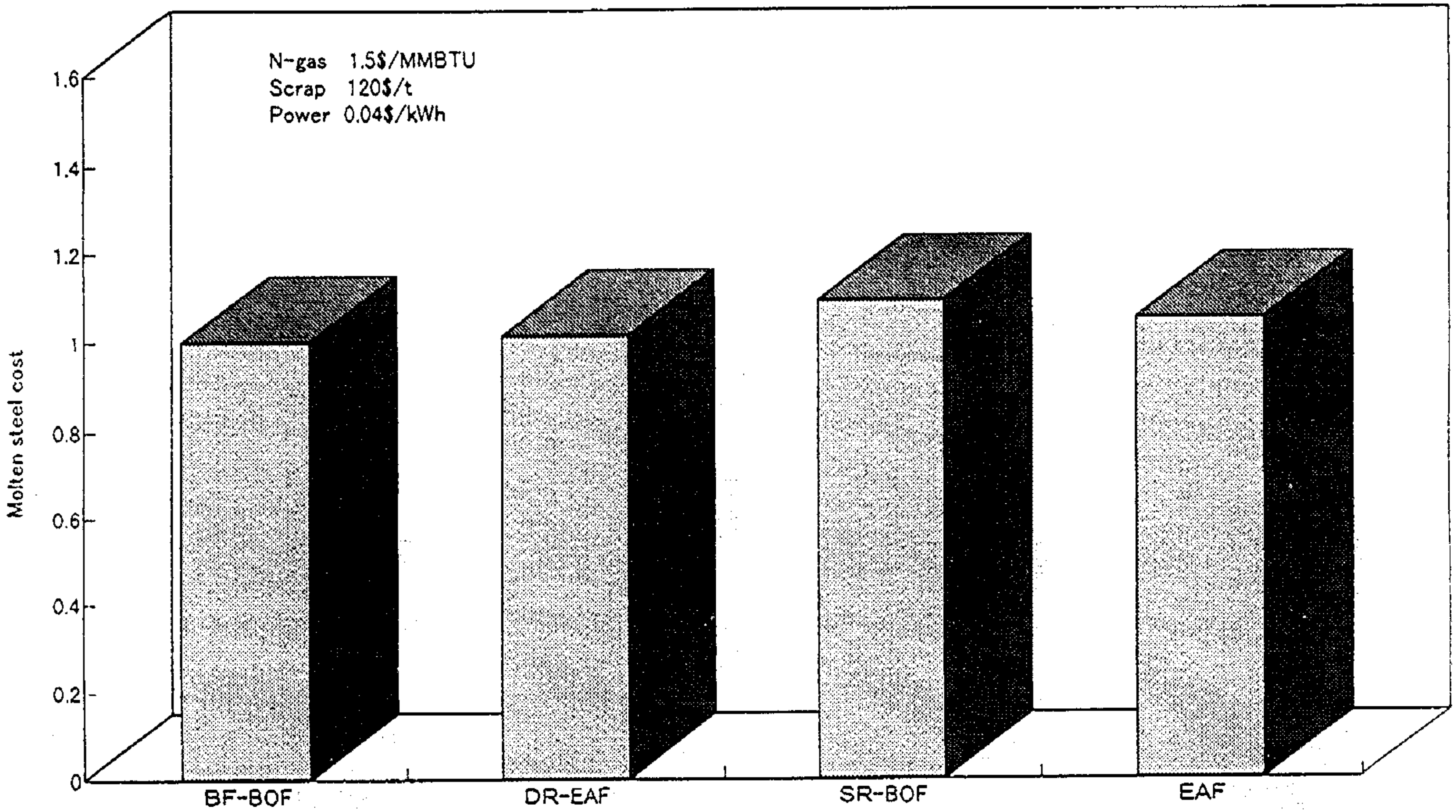


Figure 2-8 Comparison of molten steel cost between iron-steel making processes (Case B)

Table 2-3 Evaluation about iron-steel making processes

	Blast furnace - Basic oxygen furnace (BOF)	Direct reduction MIDREX - EAF	Smelting - reduction COREX - BOF	Electric arc furnace (EAF)
Process flow Production scale : 3.0 mt/y mt/y : million tons / year tht/y : thousand tons / year	Coal – CO Iron ore – DL BF 2200m³× 2 Pre- treatment BOF 150t/ht× 3	Natural gas Gas reformer Iron ore DR Shaft Furnace 1.2mt/y ×2 EAF 150t/ht×4 LF	Coal, Iron ore Reduction Shaft furnace Melter Gasifier 0.6mt/y ×5 Pre-treatment BOF 150t/ht× 3	Scrap EAF 120t/ht×4 LF
Process characteristic	· The most popular process · Based on coking coal	· The first share of direct reduction process · Based on natural gas	· Based on non-coking coal · Large quantity of excess gas	· Based on high quality scrap · Simple plant and low investment cost
Maximum Iron-making plant scale per one unit (tht/y)	3,700 (12,000t/d)	1,200	600	1,000 (120 t/heat)
Status	Industrial	Industrial	Industrial beginning	Industrial
Iron ore	· Sinter, Pellet, Lump ore · Import (domestic)	· Pellet, Lump ore · Import (domestic)	· Pellet, Lump ore · Import (domestic)	· Scrap · Import
Fuel	· Coking coal (Import)	· Natural gas	· Non-coking coal	· Electric power
Main unit consump.(Iron m.p.)	· Coal : 770 Kg/t-steel	· N-gas : 290 Nm³/t-DRI	· Coal : 1,000 Kg/t-steel	· Ele. power:420 kWh/t-steel
Steel products	· Possible to high grade quality	· Possible to high grade quality	· Possible to high grade quality	· High grade quality restricted by residual elements and nitrogen
Investment cost (I : low, IV : high)	III	II	IV	I
Molten steel cost (I : low, IV : high)	I	III	II	IV

Section 3 Steelmaking Process

Contents

Page

1. Study of applicable steelmaking process ---------- 1

1.1 Steel demand and production quantity ---------- 1
1.1.1 The characteristics of flat product ---------- 1
1.1.2 The characteristics of non-flat product ---------- 1

1.2 Steel grade and applicable steelmaking process ---------- 2
1.2.1 Iron source selection ---------- 2
1.2.2 The characteristics of steel making process ---------- 2
1.2.3 Comparison of refining process ---------- 2
1.2.4 The steel grade vs. an outline of steelmaking process ---------- 3

1.3 The applicable slab continuous casting (SL-CC) process ---------- 6
1.3.1 The outline of continuous casting/hot rolling processes ---------- 6
1.3.2 Selection of continuous casting process---------- 6
1.3.3 The thickness of slab ---------- 7

1.4 The applicable billet continuous casting (BT-CC) process ---------- 10

1.5 The summary of applicable steelmaking plant for the ISW ---------- 10

1. Study of applicable steelmaking process

1.1 Steel demand and production quantity

Table 3-1 shows the product mix which shall be produced in the new integrated steelworks (NISW).

Table 3-1 Demand by steel grade produced in NISW

		Steel grade	Production Final Production (Slab) $x10^3 t/y$
Flat	Hot coil/sheet	Hot rolled coil	340
		Skin passed coil	400
		As rolled hot coil	700
	Hot rolled sheet/plate	Hot rolled sheet/plate	360
	Cold	Pickled coil	200
		Cold rolled coil/sheet	700
	Surface coated	Galvanized sheet/coil	200
		Tin plate	100
	Sub total		3,000 (3,225)
Non Flat	Billet	1) Wire rod	310
		2) Bar	610
		3) Bar section	180
	Sub total		Billet (1,100)
Total			(4,325)

1.1.1 The characteristics of flat product

The main product is for construction use of houses and factory, commercial grade steel.

- The demand for high grade steel as outer panel of automobile use is very low, the process doesn't require so sophisticated process at 2010 year stage.
- NISW shall have provision to apply the processes for high grade steel.
- Application for many kinds of steel grade is required.

1.1.2 The characteristics of non-flat product

- Main product is commercial grade steel for construction use, it does not include high grade steel as high carbon wire, high alloy steel, etc.
- The caster shall be of high productivity, and of low cost machine.

1.2 Steel grade and applicable steelmaking process

1.2.1 Iron source selection

- The source of iron is discussed and the BF/BOF process is selected in the preceding section from the viewpoint of energy and raw materials availability.
- Especially, the EAF process is not adopted, because of difficulty of scrap procurement in the world. The concept of scrap availability is shown in Figure 3-1.
- The demand of scrap becomes larger than the supply herein after, especially the high grade scrap shall be in short supply, because the increasing mini-mills use them for flat production.

1.2.2 The characteristics of steel making process

The outline of EAF and BOF process is presented in Appendix.

1.2.3 Comparison of refining process

Table 3-2 and Table 3-3 show the comparison of the main refining process.

- The EAF/Scrap process has disadvantage of [N] content, and residual element (tramp element).
- The DRI/Scrap/EAF is rather improved on the aforesaid weak points, but the DRI is not available due to shortage of energy as natural gas in Viet Nam.
- The BF/BOF process shall be adopted to the NISW.
- This process is suitable for the high grade steel which is not produced at the first stage but will be produced in future.

Table 3-2 Attainable level of each steel making process

Process	[N]level (before Tap)	Tr-El. Cu+10Sn	[P]-level	[S]-level	Inclusion
unit	ppm	%			
BF(& Corex)—BOF	10～20	0.02～	Same level	Same level	Same level
DRI/HM-------EAF／LF*1	20～30	0.02～	Same level	Same level	Same level
Scrap-----------EAF／LF	60～100	0.30～	Same level	Same level	Same level

Note: *1 by VAI in Iscor Vanderbijlpark works
Tr. El: Tramp Elements

Table 3-3 Attainable hi-grade steel quality of each steel making processes

Process	Tr-El.	De [N]	De [C]	De [S]	De [P]	De [H]
A) BF---D[S]---BOF---CAS----CC	O	O	△	O	O	x
B) BF---D[S]---BOF----D-gas--CC	O	O	O	O	O	O
C) DRI------EAF---LF----------CC	O	△	△	O	△	x
D) DRI------EAF---LF--D-gas--CC	O	△	O	O	△	O
E) Scrap----EAF---LF----------CC	x	x	△	O	O	x
F) Scrap----EAF---LF--D-gas---CC	x	△	O	O	O	O

Note: O:Possible as required quality △:Possible but restricted x :Impossible
Tr. El: Tramp Elements, De[N]: De-nitrogenization,

1.2.4 The steel grade vs. an outline of steelmaking process

Table 3-4 shows the steel grade and steelmaking process of BF/BOF process. The BOF process is consisted of three processes in general, and the required functions and equipment are as follows.

1) Hot metal pretreatment:
The desulfurization treatment is applicable, because the LD converter process is not efficient for desulfurization.

2) LD converter:
The combination blowing method (the oxygen gas from the top and agitation gas from the bottom of converter) is applicable.

3) Secondary refining:
At the first stage, a simplified ladle refining is applicable.
At the time of the commencement of plate and ultra low carbon steel production, the introduction of degassing process will be planned.

1) Supply & demand of scrap at the year 2000 in Asia

(unit; x10^6 t/y)

Year	1994	2000		Coutry
a) Scrap Import	12.6	17.15	to	China, ASEAN, Taiwan, Korea, India
b) Scrap export (Capacity)	12.6	11.1	from	U.S.A., Japan, EC, Austraria, CIS
c) Balance a)−b)	0	Δ 6.0		

2) The mini mill projects in the world

a) Project number of process

	Thin slab	Medium slab	Total
Operation	11	2	13
Contracted	9	6	15
Planning	6	2	8
Total	26	10	36

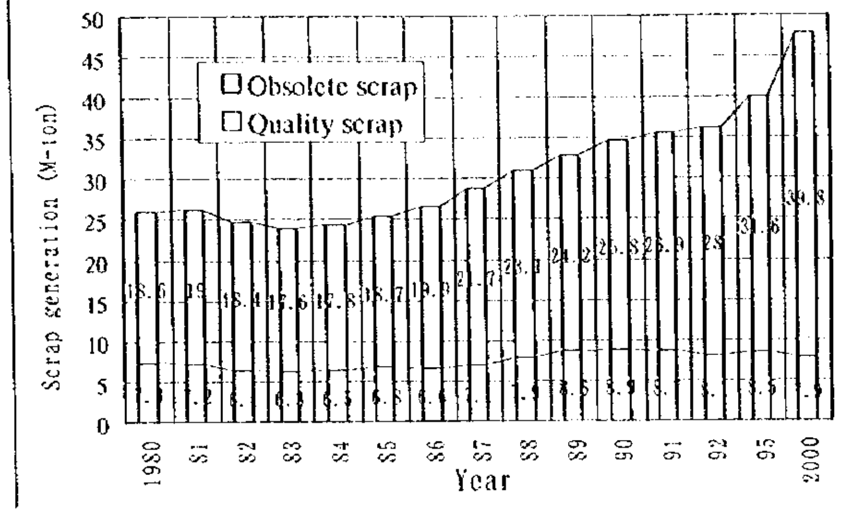
b)Projected number by area ('95)

	America	Europe	Asia	Total
Operation	9	2	2	13
Contracted	8	2	5	15
Planning	4	2	2	8
Total	21	6	9	36

Total production papacity = Approx. 36x10^6 t/y

Production by mini mill is increasing.
Prompt scrap shall be more required.

3) The estimation of market scrap genetation(in Japan)



The generation of obsolete scrap increases, but quality scrap does not increase (approx. 25% of total scrap).

The trend is assumed in the matured countries(USA, EC).

5) In 2000, importing quantity of Asia increase, and exporting capacity to Asia decrease. Scrap balance trends to be shortage

The high quality scrap for flat products is much little.
(Approx. 25% (in case of Japan) is prompt scrap)

6) Viet Nam requires (2010 year) :

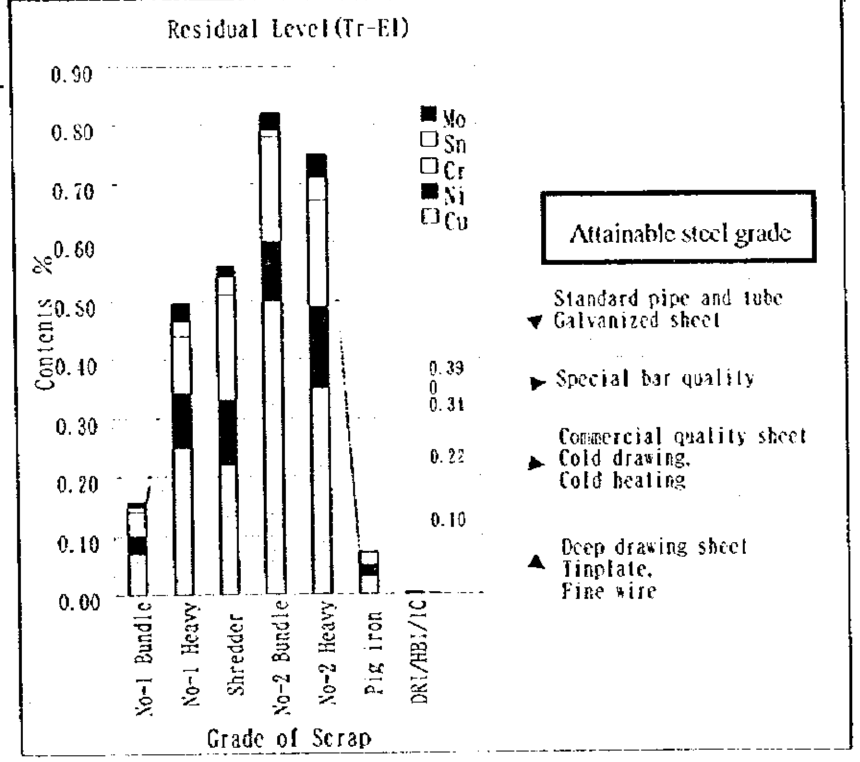
① The high grade scrap for flat products : approx. 3 x10^6 t/y

② The low grade scrap (obselete) for non flat products : approx. 2 x10^6 t/y

Price up and instability

Flat product by the method of Importing scrap／EAF is difficult .
(Use of DRI etc. is necessary.)

4) Steel grade and scrap quality required
Indicates maximum percent(%) of Cu, Ni, Cr, Sn
Source : J.W.B. Associates



Flat product by EAF needs high grade scrap.

Necessity of high quality scrap increases in export countries as USA.

Mini mills require DRI, IC, etc. (virgin iron).

Figure 3-1 The possibility of scrap procurement

Table 3-4 The steel grade and the steelmaking process

	Group of Steel Grade	Typical Application	Steel Deoxida-tion	Process					Remarks
				Steelmaking			Continuous casting		
				Hot Metal Pretreatment	BOF	Secondary Refining	Casting Speed	Conditio-ning	
Hot final	1) Welded pipe	General construction C-Steel piping general use	MC ASK	De-[S]	Combina-tion blowing	S.L.R.	Middle	Low	LC-AK —Low Carbon Al Killed MC-ASK —Middle Carbon Al-Si Killed S.L.R. —Simplified Ladle Refining (CAS) VD —Vacuum Degassing (in future)
	2) Welded section	Construction	MC ASK			S.L.R.	Middle	Low	
	3) Hot rolled coil/sheet	Automobile inner sheet Electric appliances Furnitures Drums	LC AK MC ASK			S.L.R.	High	Low	
	4) Hot／Plate	Construction Ship building	MC ASK			S.L.R. (VD)	High	Low	
Cold rolled	5) Cold rolled sheet Surface treated sheet	Construction Automobile outer sheet Atmospheric resistance	LC AK			S.L.R. (VD)	High Middle	High	
Surface coated	6) EG.	Automobile outer sheet Household	LC AK			S.L.R. (VD)	High	Middle	
	7) Hot-Dip galva.	Construction Household Electric appliances	LC AK			S.L.R	High	Middle	
	8) Tin plate	Food and beverage can	LC AK			S.L.R. (VD)	Middle	High	

1.3 The applicable slab continuous casting (SL-CC) process

1.3.1 The outline of continuous casting/hot rolling processes

The feature of thin slab process, medium slab process and conventional slab process are described in Appendix.

1.3.2 Selection of continuous casting process

a) The following processes are compared:
① Thin Slab Direct rolling (DR) Process (TSP)
② Medium Slab DR Process (MSP)
③ Conventional Slab with conditioning Process (CVP)
Where, "DR" means directly connected the continuous casting machines to the hot rolling mill without slab cooling and conditioning.
The comparison of each process is described in Table 3-5 and Table 3-6.

b) On the production capacity (See Table 3-6)
- The existing plants of TSP, MSP are approx. 900～1,000 x10^3t/y/strand.
- The production capacity of the new integrated steel works in Viet Nam is approx. 3,500 x10^3t/y. It requires three or four strands of casting machines.
- The construction of TSP, MSP shall be (2 str. CC + 1 Hot) x 2 modules.
- In the case of CVP, it requires 2 or 3 strands CC + 1-Hot strip mill.

c) Construction cost
- In the case of CVP method, the cost of Continuous Casting Machine (CCM) is a little high, but the total cost including hot-strip mill is not so high than other cases.

d) Slab importing: in case of constructing hot strip process prior to up stream processes
- Impossible to import the thin slab from the world markets
- Reheating furnace shall be required for imported slabs.
- The wide reheating furnace is necessary (usually less than 15m wide) Example:100 mm thick, Slab length approx. 23m, width 1m, weight 18ton

e) Quality
- The TSPs, and MSPs are not actually adopted for the high steel grade such as tin plate, deep drawing quality as car outer door plate.
- TSP, MSP are the processes which have developed for mini mills to produce commercial grade quality steel by low investment.
- DR processes (as TSP, MSP) are impossible to condition the slabs of irregular operation. Conditioning is necessary for high surface grade steel as Tin plate and steel sheet for automotive use.

- There are some information that the quality is getting to better by using parallel and thicker mold, it shall be confirmed in these few years (these plants have just started recently).

f) All kind of steel grade will be produced by the Integrated Steel works.
  - At the beginning of production, small quantity of high grade steel is imported, but in the future, all kind of steel grade shall be produced.
  - The selection of TSP,MSP is impossible to remodel to the CVP process in the future.

g) Reheating cold slabs
  - In TSP, MSP, it is difficult to reheat cold slabs which have been stocked in the yard, because these processes take the DR process using tunnel furnace.
  - CVP method is possible to handle such slabs, because the walking beam type reheating furnace is normally used, which is flexible to heat up.

h) (Hot rolled) plate thickness is restricted.
  - As the plate for shipbuilding requires the reduction ratio of more than 3～4, the slab thickness should be more tnan 100 ㎜ (Plate thickness is assumed 16～30 ㎜).

i) The development status of technology of processes
  - As TSP／MSP are new technology, it is not clear whether the process can be applied for high grade steel and big capacity production (3.5 x 10^6t/y) in the world.

j) Conclusion;
  <u>Conventional CC-Hot Process is recommendable.</u>
  - The outline of plant construction
    - ・Approx. 200～250 mm thick slab caster, with conditioning facilities
    - ・WB (walking beam) type reheating furnace, rougher mill, and finishing mill

1.3.3 The thickness of slab

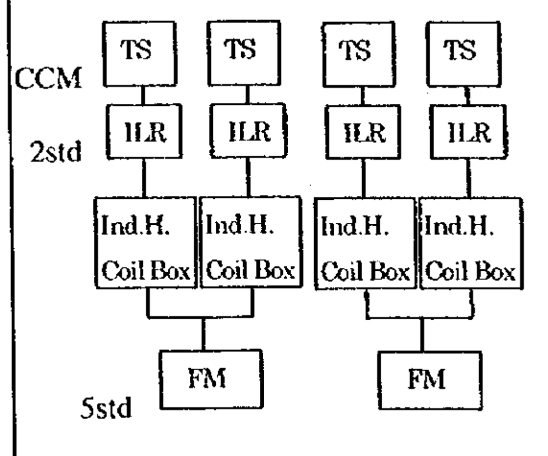
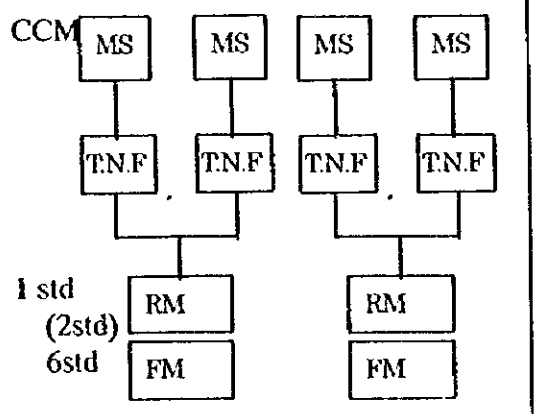
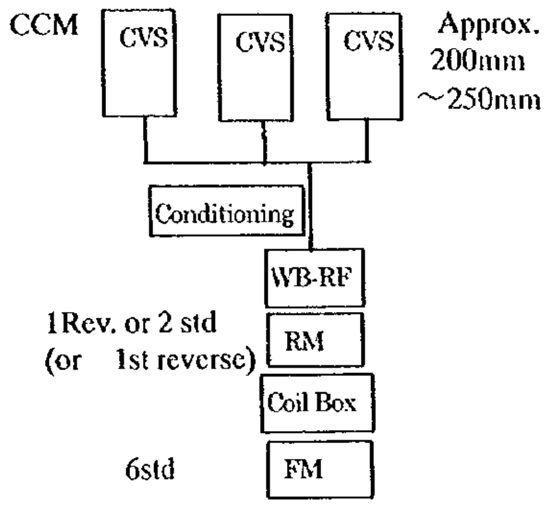
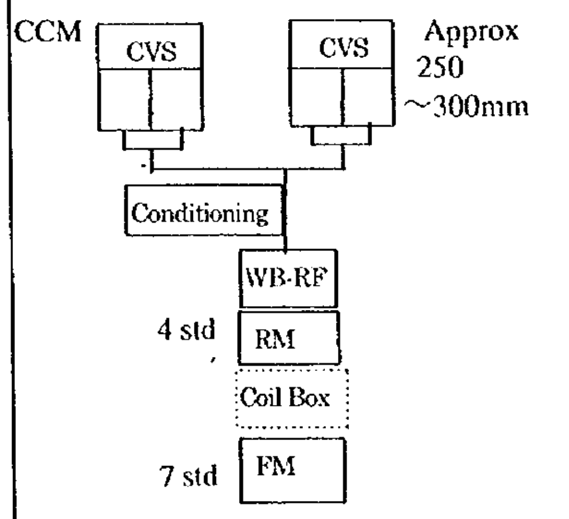
Although detail study is necessary, the popular thickness of 200～250 mm will be selected.

It is easy to get such size of slab at the world market, during Step-1.

Table 3-5 The comparison of CC－Hot process (1／2)

Case		I		II		III-1, III-2
Process	Type of Process	Thin Slab - Direct Rolling No conditioning (TSP)		Medium Thick Slab - Direct Rolling No conditioning (MSP)		Conventional - Direct Rolling／Hot Charge Rolling With conditioning (CVP)
Typical process		① ISP : M-Demag	② CSP: SMS	① Conroll:VAI	② SMI Process	Many makers (Demag,Concast,VAI, Danieli--)
Suitable Works	Works : Raw material	Mini-Mill : Scrap(DRI)-EAF		Mini-mill : Scrap(DRI)-EAF		Integrated steel making works : Iron ore－BF/BOF
	Works in operation(example)	Arvedi, Posco (Kwangyang)	Nucor (USA), Hambo(KOREA)	Armco(Mansfield)	BHP/North star, Trico Steel	Almost integrated works adopted
	Productivity Production capacity	0.9～1.0 t/y Str. 2 x10^6t /y /2str Existing		1.0～1.3 x10^6 t/y Str. 1 x10^6t/y /1str Existing		1.0～2.0 x10^6 t/y str. Large Production is possible
	Steel grade	・LC、MC、HC(Plate-Restricted) ・Mainly commercial grade, ・Compact process is aimed		・LC、MC、LC(Plate－Restricted)、peritectic ・Improving surface quality by thicker slab, parallel mold、EMS(Electro Magnetic Stirrer)		・LC, MC, HC, plate, deep drawing, tin、peritectic and all steel grade is possible ・Requisite for SULC(car body), DDQ, EDDQ
Continuous casting	Mold :Type, Thickness Width change	Parallel 75mm(～100) thick	Funnel 180/50～60 mm Impossible	Parallel 75～125 mm	Parallel 90 mm Impossible	Parallel 200～250 mm Possible
	Casting speed mpm	LC:5mpm, MC:3mpm		LC:5mpm MC:3mpm		LC:1.0～2.5, Mc:0.5～1.5mpm
	In line reduction (ILR)	Soft + ILR	No reduction	－－－	Soft reduction	Soft reduction
	Conditioning	Nothing (Direct rolling)		Nothing (Direct rolling)		With machine／manual scarfer
Hot rolling mill	Reheating furnace	Tunnel and/or Induction heater		Tunnel and/or Induction heater		Walking beam type
	Cold slab reheating for slab procurement	Impossible due to direct rolling		Impossible due to direct rolling		Possible due to walking beam type furnace
	Rougher ＋finishing stand	ILR 2 std ＋4 std	0 ＋ 6 std	－－－	1～2 ＋ 5～6 std	2 st Reverse or 4st tandem ＋ 6 std
Guarantee of product quality	Conditioning (scarfing) the irregularly casted slab to guarantee the quality	No slab inspection, no conditioning (scarfing) . For substandard product, substitute coil shall be delivered or alternative use		No slab inspection, no conditioning (scarfing) . For substandard product, substitute coil shall be delivered or alternative use		Slab inspection and operation control, Slab conditioning (scarfing) and guarantees the quality
Lot size	Width & steel grade flexibility	Difficult Usually mono-size multi sequence casting		Width change possible, steel grade change is difficult Mono size and multi sequence casting is usual		Possible Width change and steel grade change is usual
Industrial status		ISP: Commercial Posco just started	Commercial, Many plants operate	Started '95 (Armco-MF)	Just started ('98) BHP	Commercial, many works
Cost	Construction cost (CC-Hot) (per product)	The difference is small		The difference is small		The difference is small
Evaluation	Recommendable [I] ＞ [II] ＞ [III]	1) Impossible to produce high surface grade steel and plate (restricted due to thickness) 2) Applicable to not strict request on quality 3) No existing large integrated steel works applied this process 4) Impossible to purchase slab in the world market [III]		1) Impossible to produce especial high surface grade steel, and plate(restricted due to thickness) 2) Applicable to not especially strict request on quality 3) No existing large integrated steel works applied this process [II]		1) All steel grade is possible to produce 2) Fundamentally the quality of product is guaranteed 3) The construction cost is not so high compared to others 4) Large products capacity, many existing works 5) Possible to purchase slab in the world market [I]

Table 3-6 The comparison of CC – Hot process ---the plant construction (2／2)

	I	II	III-1	III-2
Molten steel	Scrap/EAF or BF/BOF	Scrap/EAF or BF/BOF	BF – BOF	BF – BOF
Process	Thin Slab CC Process (TSP) (ISP Type Image)	Medium Slab CC Process (MSP) (SHI, VAI Image)	Convectional CC(CVP) + Coil Box Hot Process (as compact as possible)	Conventional CC(CVP) + (Coil Box) Hot Process
Schematic construction of Plant Note; ILR : Inline Reduction Ind.H: Induction Heater TNF : Tunnel Furnace WB.RF: Walking Beam type Reheating Furnace RF : Roughing Mill FM : Finishing Mill	 Approx. 1.8 x10^6 t/y 1.8 x10^6 t/y 1 -module	 Approx.. 1.8 x10^6 t/y 1.8 x10^6 t/y 1 -module	 Approx. 3.5 x10^6 t/y	 Approx. 6.0 x10^6 t/y
Equipment Construction CCM ILR Conditioning Heater Coil box Rough Mill Finish Mill	1st CCM x 2str. x 2 modules 2stand x 2str. x 2 modules – – – Induction H. x 2str. x 2 modules Coil box x 2str. x 2 modules – – – n std-Hot x 2 modules	1st CCM x 2str. x 2 modules – – – – – – Tunnel furnace x 2str. x 2 modules – – – N-std. x 2 modules M-std-Hot x 2 modules	1st CCM x 3str – – – Conditioning x 1 WB.type R.F x 1 Coil box x1 (make compact HRM) 1or2 std R.M x 1 n std-Hot x 1	1st CCM x 3str – – – Conditioning x 1 WB.type R.F x 1 (Coil box x1) 1or2 std R.M x 1 n std-Hot x 1
Basic concept of plant construction	· Connection of the 4 str. CCM with 1-HRM is impossible, and no existing plant. · It requires two module constructions.	· Connection of the 4 str. CCM with 1-HRM is impossible, and no existing plant. · It requires two module constructions.	· Connection of the 3 str. CCM with 1- HRM is possible, and many existing plants. · It requires one module constructions. · Coil box makes a plant compact.	· Connection of the multi str. of CCM with a big capacity HRM, and many existing plants. · It requires one module constructions. · It is suitable for large capacity plant.
No conditioning yard	· Not applicable to high surface quality steel · Cold slab is not usable, all slab must be rolled directly.	· Not applicable to high surface quality steel · Cold slab is not usable, all slab must be rolled directly.	· Applicable to high surface quality steel · Usable a (purchased) cold slab · Possible to roll directly or after surface conditioning	· Applicable to high surface quality steel · Usable a (purchased) cold slab · Possible to roll directly or after surface conditioning.
Construction cost	Difference is not so large	Difference is not so large	Base	High

1.4 The applicable billet continuous casting (BT-CC) process

Table 3-7 shows the product-mix required to produce at Step-3, and the applicable process is outlined.

Table 3-7 Steel grade and production process

Steelgrade	Application	Product. $x10^3t/y$	Process	
			BOF	BT-CC
Wire rod	Re-bar Low carbon wire High carbon wire *Welding wire Spring steel	Approx. 310	1) Hot metal treatment −TDS 2) BOF −Combination blowing 3) Secondary refining −CAS-OB	1) Type −7 or 8 strands BT-CCM 2) Casting speed −approx. 2.5 mpm 3) Size −150 sq. (130sq.)
Bar	Re-bar General structure Chains *Cold finish C-steel for hot forging *L-alloy for hot forging	Approx. 610		
Section	Re-bar General structure Welded structure	Approx. 180		
	Total	1,100		

Note: The steel grade marked (*) in Table 3-7 is not produced at Step-3.

1.5 The summary of applicable steelmaking plant for the NISW

a) The BOF process is applied for steelmaking, and it uses mainly the hot metal produced by the BFs and home scrap as the raw material.

b) Capacity of the BOFs is approx. 200 ~250 t/ht, and 2 out of 3 furnaces are in operation.

c) The BOFs, slab CCMs and billet CCM are constructed in one steelmaking plants to decrease the investment cost.

d) The conventional slab CCM and coil box type hot rolling mill process are adopted.

e) The multi-strand type billet CCM is adopted for billet casting to match the production capacity between BOFs, slab CCMs and billet CCM.

Section 4 Hot Strip Mill

Contents

Page

1. General--1
2. Four types of HSMs---1
3. Results of comparison of the four types of HSMs------------------------3
3.1 The item-by-item comparison---3
3.2 Brief comments on the four types of HSMs ------------------------------6
3.3 Recommendation of HSM type---8

1. General

The decision of the HSM type is very important because it has a decisive influence on the basic characteristics of the rolling plant such as product range, product quality, production capacity, construction cost, etc.

Main technical factors influencing the decision of the HSM type are as follows:

1) Range of products to be produced
2) Amount of products to be produced
3) Necessity for future expansion of the plant capacity
4) Type of upstream processes, i.e. iron and steel making processes

2. Four types of HSMs

The following four types of HSMs are studied and compared regarding suitability for the new integrated steel works.

1) Compact Strip Production process using thin slab (CSP)
2) Medium thickness Slab Process (MSP)
3) Coil Box Mill using conventional slab (CBM)
4) Conventional three quarter Mill (CVM)

Equipment configurations of the above four types of HSMs are shown on the Figure 4-1.

- Figure 4-1: Schematic drawing of four types of HSMs

Note: Following abbreviations are used in Figure 4-1.

TD: Tundish	MD: Mold
TF: Tunnel furnace	FM: Finishing mill
DC: Down-coiler	IR: Inline reduction
IF : Induction furnace	CB: Coil box
RF: Reheating furnace	RM: Roughing mill
SL: Slab	

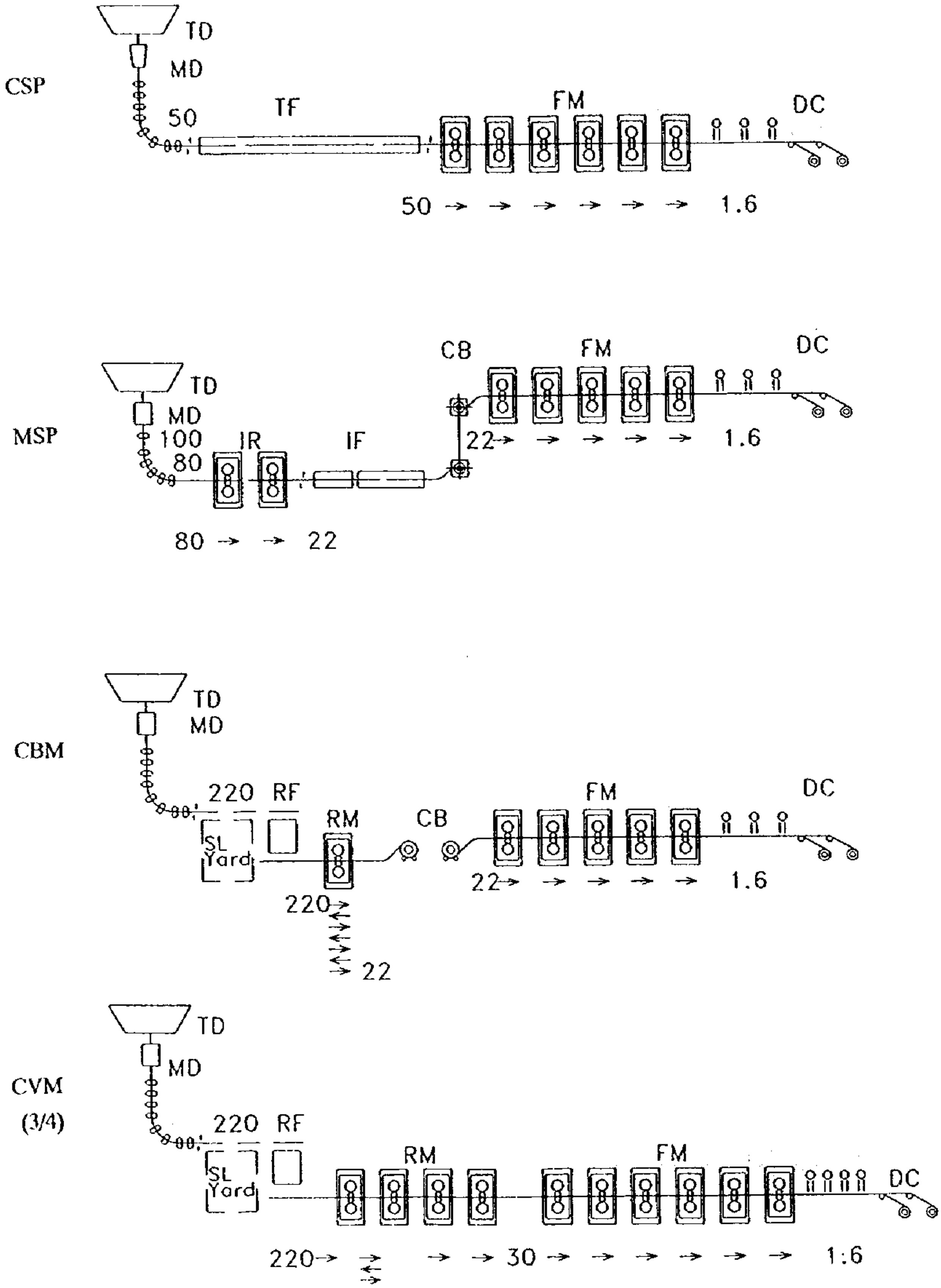


Figure 4-1 Schematic drawing of four types of HSMs

3. Results of comparison of the four types of HSMs

3.1 The item-by-item comparisons

The item-by-item comparisons of the four types of HSMs are shown in Table 4-1.

Table 4-1(1/2) Comparison of hot strip mill types (CSP, MSP, CBM and CVM)—(1/2)

	CSP (Compact Strip Production) (Original ISP included)	MSP (Medium Slab Process) (Modified ISP included)	CBM (Compact Coil Box mill)	CVM (Conventional 3/4 HSM)
1 Slab				
1) Thickness	Approx. 50 mm	Approx. 100 mm	Approx. 200 mm	200 - 300 mm
2) Typical width range	1000 - 1550 mm	900 - 1550 mm	650 - 1550 mm	650 - 1900 mm
3) Surface conditioning	Impossible	Impossible	Possible	Possible
4) Cooled slabs	To be scrapped down	To be scrapped down	To be charged into RF	To be charged into RF
2 Production capacity	Low	Low	Medium	High
1) with one furnace	Approx. 800,000 tpa	Approx. 1,000,000 tpa	1,000,000 - 1,500,000 tpa	--------N/A---------
2) with two furnaces	Approx. 1,600,000 tpa	Approx. 2,000,000 tpa	2,000,000 - 3,000,000 tpa	3,000,000 - 4,000,000 tpa
3) with 3 - 4 furnaces	--------N/A-----------	-------N/A-----------	3,000,000 tpa (max.)	4,000,000 - 6,000,000 tpa
3 Typical up-stream process	Scrap/EAF or DRI/EAF	Scrap/EAF or DRI/EAF	BF/BOF or DRI/EAF	BF/BOF
4 Available products	Limited (mainly commercial quality)	Limited (high quality is difficult)	Almost all products (highest quality is possible)	All products (highest quality is possible)

Table 4-1(2/2) Comparison of hot strip mill types (CSP, MSP, CBM and CVM)—(2/2)

	CSP	MSP	CBM	CVM
5 Flexibility for small orders	**Difficult to accept small orders** (due to no edger, difficulty of seq. casting with different steels and no use of cooled slabs)	**Difficult to accept small orders** (due to weak edger, difficulty of seq. casting with different steels and no use of cooled slabs)	**Possible to accept small orders** (using cold or warm slabs)	**Possible to accept small orders** (using cold or warm slabs)
6 Production system	**Generally, production without orders**	**Generally, production without orders**	**Generally, production with orders**	**Generally, production with orders**
7 Equipment cost of HSM	**Low (Up-stream equipment cost is low : EAF/TSC)**	**Low - Middle (Up-stream equipment cost is low : EAF/MSC)**	**Middle (Up-stream equipment cost depends on processes : EAF or BF etc.)**	**High (Up-stream equipment cost is high : BF)**
8 Number of operating mills	**Many mills** (Nucor: Scrap/EAF, Hambo: Scrap/EAF)	**Few mills. Only few mills under operation or construction** (BHP America, Trico, Siam)	**Many mills** (BHP, STELCO, Tokyo steel, Sahaviria, TATA)	**Numerous mills** (Almost all HSMs in Japan and developed countries)
9 General comments	**Suitable for small production of commercial products mainly for building/housing construction in medirm or large markets such as USA etc.**	**Suitable for small production of medium class products in medium or large markets. This technology is still under development.**	**Suitable for small or medium production of various products in small or medium or large markets.**	**Suitable for large production of all kinds of products in large markets.**

3.2 Brief comments on the four types of HSMs

Brief comments on the four types of HSMs are given below.

1) Compact strip production (CSP)

CSP is considered suitable for production of commercial grade products in large markets provided that sufficient scrap or DRI is available at low cost. For example, Nucor, a famous flat product producer using CSP, has been successful in the USA market which satisfies the above conditions.

The major merit of this process is that an integrated steel plant with the (DRI)/EAF/CCM/HSM/(CSM) process route can be established at a very low investment cost compared with the BF/BOF/CCM/ HSM/(CSM) process route.

But CSP is not considered so suitable for VSC because of the following reasons:

a) It is very difficult to supply a wide range of products required in Viet Nam market.

b) CSP can produce high quality products when DRI is used as a major raw material. But sufficient DRI is not expected to be available in Viet Nam due to the lack of natural gas and electricity at low cost.

c) In the case of CSP, the construction of a HSM and upstream processes(iron & steel making plants) must be done at the same time. Consequently, separate construction of the HSM earlier than the upstream processes becomes impossible, which may cause an inconvenience in case the blast furnace process is selected as iron-making process.

2) Medium slab process (MSP)

The merit of MSP, as with CSP, is that an integrated steel plant with EAF/CCM/HSM can be established at a very low investment cost.

This process may have the possibility to produce the high quality product in the future if enough DRI and high quality scrap are available at a reasonable price because thicker slabs than those of CSP are used.
But this technology is still under the development stage and not yet completely proven at present.

MSP is not considered recommendable for VSC because of the similar reasons described in above CSP.

3) Coil Box Mill (CBM)

CBM is based on the same design concept as the conventional mill (CVM) which is equipped with reheating furnaces and roughing mills to use conventional slabs as raw material.

CBM has been developed by a Canadian steel company for the purpose of reducing the length of mill line and the required force power of finishing stands without sacrificing the quality or available range of products.

The differences between CBM and CVM are:

a) CBM is very compact because rough bars are coiled at the coil box, and usually only single roughing mill is required.

b) The motor power of the finishing mill is very small in the case of CBM because the acceleration of rolling speed is not necessary.

c) The maximum production capacity of CBM is limited to approx. 3 million t/y, lower than the 4 - 6 million t/y of CVM.

CBM can be appropriately combined with either upstream processes, BOF or EAF, and can produce a wide range of products if hot metal or DRI is used as a major raw material.

Construction cost of CBM itself is relatively low, and considered not so different to CSP or MSP.

4) Conventional mill (CVM)

Almost all hot strip mills operating in the developed countries at present are of the CVM type, producing all kinds of products including highest quality products.

Production capacity of this process is very high, but its construction cost is also very high.

CVM is usually combined with the upstream processes of BF/BOF because its high production capacity is well compatible with the BF/BOF process.

CVM is suitable for steel plants requiring a large production capacity higher than 3 million t/y.

3.3 Recommendation of HSM type

As described in the previous pages and Table 4-1 of this section, the type of HSM recommended by JICA team and agreed by VSC for the new integrated steel works is the coil box type of hot strip mill (CBM).

The reasons are summarized as follows:

1) CBM is well compatible with the upstream process of BF/BOF which will be installed at later stage or may be installed at the same time as HSM.

2) CBM can produce almost all products required in the Viet Nam market using slabs to be purchased from the international market, even in the case that the upstream processes are installed at a later stage.

But the stable procurement of large amount of slabs with high quality at reasonable cost from the international market is not so easy.
Therefore it is considered an important prerequisite to establish a procurement system of slabs from the international markets on a long term basis.

If properly purchased, the quality of slabs from the international market is expected to be much better than that of slabs to be produced by the scrap-based mini-mill process.

According to our past experience and recent investigation, it is considered difficult to use the scrap from the international market for production of high quality flat products because of the high content of harmful elements such as Cu, S, Sn etc. while such scrap can be used for almost all long products without any serious problems.

3) The production capacity of CBM can meet the market demand which will increase from 1 million t/y up to 3 million t/y required in 2010.
But precisely speaking the required production capacity of HSM in NISW is 3,225,000 t/y, which is a little higher than that of an ordinary coil box type HSM (CBM).
Therefore a special consideration is required in the case of VSC regarding the roughing mill design.

Part 4 Technical Suggestion of Site Selection

Section 1 Technical Suggestion on Site Selection of Three Candidate Sites from Proposed Ten Sites

Contents

Page

1. Purpose of the investigation ---------- 1
2. Formulation of criteria for site selection ---------- 1
3. The result of the investigation for the ten proposed sites and other areas ---------- 5
4. Selection of three proposed sites ---------- 18

1. Purpose of the investigation

In order to provide technical advice for selection of three candidate sites from proposed ten sites, the following investigation is carried out on the ten proposed sites.

1) Outline of land form such as location and ground condition
2) Actual condition and future plan of infrastructure (road, port , etc.)
3) Actual situation and development plan of utilities (power plant, transmission network tele-communication network, etc.)
4) Actual utility consumption of existing steel works

2. Formulation of criteria for site selection

"The criteria for site selection in the 1st survey" presented for Viet Nam's counterpart are shown on the next page.

The Criteria for Site Selection in the 1st Survey

1. Preconditions of the Site Selection

1.1 Production capacity:

3,000,000 t/year

1.2 Iron and steel making processes:

1) Blast furnace and basic oxygen furnace (BF & BOF)
2) Direct reduction (DR)
3) Smelting reduction (SR)
4) Electric arc furnace(EAF)

1.3 Rolling and downstream processes:

Hot-strip mill + cold- strip mill + coated lines

2. Criteria for Site Selection

2.1 Required area(excluding residential & welfare facilities)
2.2 Required water volume
2.3 Required electricity from outside power transmission network
2.4 Manpower requirement for construction and plant operation
2.5 Required amount of raw materials and fuels

Relevant figures for the items above are shown in Table 1-1.

Table 1-1 The criteria for site selection in the 1ST survery

		BF & BOF	DR & EAF	SR & BOF	EAF
1. Site area (ha)		300～350	250～300	280～330	200～250
2. Water volume (m^3/day)		130,000 ～150,000	120,000 ～140,000	120,000 ～140,000	90,000 ～110,000
3. Electricity from outside network (MW)		160	250	170	210
4. Manpower (persons)		For construction --- 10,000～15,000			
		For operation --- 10,000～15,000			
5. Raw materials & fuels	5.1 Ore (t/year)	4,500,000	4,500,000	4,500,000	-
	5.2 Scrap (t/year)	-	-	-	3,500,000
	5.3 Coal (t/year)	2,500,000	-	3,000,000	-
	5.4 Others *1	1,000,000	500,000	1,500,000	200,000
	5.5 Natural gas or fuel	-	10,000,000 Gcal-net/year	-	-

*1 Such as limestone, ferroalloy, etc.

Note:

1. For places where sea water is not available, 1,000,000 m3/day for BF & BOF processes and 2,000,000m^3/day for other three processes should be added as cooling water of power plant in case of in-plant power generation.

2. In case of purchasing power from outside network, voltage should be 220 kV and voltage fluctuation should be within ±3%.

Reference Information for the Criteria of Site Selection (Port Data)

1. Preconditions of the port data

1.1 Production capacity:

3,000,000 t/year

1.2 Quantity of imported raw material

Relevant figures for quantity of imported raw material are shown in Table 1-2.

Table 1-2 Quantity of imported raw material

	Case 1	Case 2
Kind of imported raw materials	Ore & Coal	Coal
1. Ore (t/year)	4,500,000	-
2. Coal (t/year)	2,500,000	2,500,000

Note: Case 1 means to import both iron ore and coal.
Case 2 means to import only coal and to use domestically produced iron ore.

2. The port data of each case

Relevant figures for the port data of each case are shown in Table 1-3.

Table 1-3 Relevant figures for the port data

	Case 1	Case 2
1. Ore		
1.1 Capacity of maximum ship weight	200,000 (DWT)	-
1.2 Required water depth for berthing	about 20 (m)	-
2. Coal		
2.1 Capacity of maximum ship weight	50,000 (DWT)	50,000 (DWT)
2.2 Required water depth for berthing	about 10 (m)	about 10 (m)

3. The result of the investigation for the ten proposed sites and other areas

The results of the investigation for the ten proposed sites are shown in Table 1-4 ~ Table 1-14.

Also, The ten candidate sites are shown on the map of the next page.

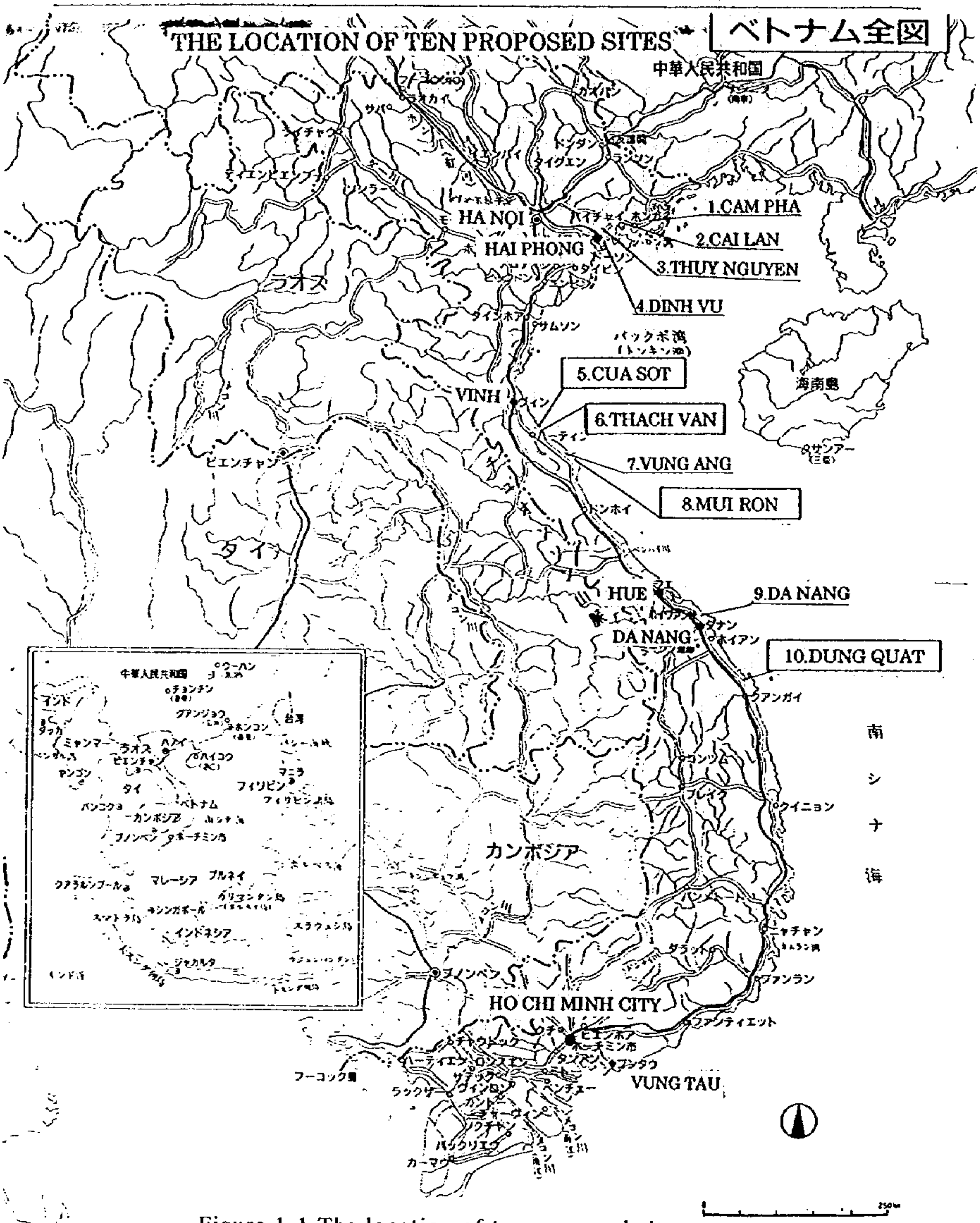


Figure 1-1 The location of ten proposed sites

Table 1-4 The investigation results of ten proposed sites

Item \ Name of site	1. Cam Pha	2. Cai Lan	3. Thuy Nguyen	4. Dinh Vu	5. Cua Sot
1.The proposed criteria					
1.1 Site area **More than 300(ha)**	A	C	C	C	A
1.2 Water supply volume **More than 150,000m3/day**	B	A	B	B	A
1.3 Electricity from outside network **More than 350MW**	A	A	A	A	B
1.4 Man power For construction, operation **More than 15,000 persons**	B	B	B	B	B
Note	A : Satisfies criteria, B : Uncertain, subject to further information, C : Not satisfies criteria.				
2. Remarks	- Near the Cam Pha mine - Near Hanoi	- Not satisfies criteria of site area	- Not satisfies criteria of site area	- Not satisfies criteria of site area	- Near the Thach Khe mine - Deep water depth - Ascertained water supply - Insufficient power source

Item \ Name of site	6. Thach Van	7. Vung Ang	8. Mui Ron	9. Da Nang	10. Dung Quat
1.The proposed criteria					
1.1 Site area **More than 300(ha)**	A	B	A	C	B
1.2 Water supply volume **More than 150,000m3/day**	A	A	A	B	B
1.3 Electricity from outside **More than 350MW**	B	B	B	B	B
1.4 Man power For construction, operation **More than 15,000 persons**	B	B	B	B	B
Note	A : Satisfies criteria, B : Uncertain, subject to further information, C : Not satisfies criteria.				
2. Remarks	- Near the Thach Khe mine - Deep water depth - Ascertained water supply - Insufficient power source	- Near the Thach Khe mine - Deep water depth - Ascertained water supply - Insufficient power source	- Near the Thach Khemine - Deep water depth - Ascertained water supply - Insufficient power source	- Deep water depth - Insufficient power source	- Central of Viet Nam - Deep water depth - Development plan of other plan - Insufficient power source

Table 1-5 The investigation results of Cam Pha and Cai Lan(1)

Item		Name of site	1.Cam Pha	2.Cai Lan
1.The proposed criteria				
1.1 Site area			More than 300ha A	Around 30ha (Because of being not allowed by local government) C
1.2 Water supply volume			More than 150,000m3/day available B	More than 150,000m3/day available A
1.3 Electricity from outside network			More than 350MW available A	More than 350MW available A
1.4 Man power		For construction	More than 15,000 persons available	More than 15,000 persons available
		For operation	More than 15,000 persons available	More than 15,000 persons available
			B	B
Remarks			A : Satisfies criteria, B : Uncertain, subject to further information, C : Not satisfies criteria.	
2.Other condition				
2.1 Site condition	2.1.1 Location		(1) The site is planed to be located at 5km far from the Cam Pha mine, and the distance from route 18 to the site is around 1km. Presently the site is sand field. (2) The distance from the site to Hanoi is around 180km. (3) Present height of the site is nearly sea level.	(1) The site is planed to be located at 10 km far from the Han Gai mine and face to route 18. Presently the site is reclaim field. (2) The distance from the site to Hanoi is not informed. (3) Present height of the site is nearly sea level.
	2.1.2 Banking of site		It is necessary to bank up to height of around 5.0m.	It is necessary to bank up to height of around 5.0m.
	2.1.3 Cutting of site		Not necessary.	Not necessary.
	2.1.4 Other		Earth for banking is provided from river.(earth dredged for channel)	Earth for banking is provided from sea.(earth dredged for channel)
2.2 Water supply	2.2.1 Source		Water is planned to be supplied from the river 15km far from the site. But dam or pond does not exist.	Existing dam is located around 12km far from the site. But reserved water volume is not informed.
	2.2.2 Water pipeline		Water pipeline from river to near the site does not exist.	Water pipeline from river to near the site does not exist.
2.3 Electric power supply	2.3.1 Source		Power is planned to be supplied from Hoanh Bo S/S 40km far from the site.	Power is planned to be supplied from Hoanh Bo S/S 8km far from the site.

Table 1-6 The investigation results of Cam Pha and Cai Lan(2)

Item	Name of site	1.Cam Pha	2.Cai Lan
	2.3.2 Supply substation	Supply substation will be installed in 2000.	Supply substation will be installed in 2000.
2.4 Port	2.4.1 River or sea condition near the site	(1) The site faces to sea. (2) The distance from seaside to the point of water depth -10m, -20m was not informed. (3) If raw material is imported, seaberth based on information reference for criteria should be constructed in offshore.	(1) The site faces to sea. (2) The distance from seaside to the point of water depth -10m, -20m was not informed. (3) If raw material is imported seaberth based on information reference for criteria should be constructed in offshore.
	2,4,2 Existing port near the site	(Cua Ong port) (1) This prot is used for exporting coal. (2) Port faces to sea and has 1 berth with water depth -9m. Ship capacity of berth is 15,000DWT. (3) In offshore, cargoes are reshipped from 50,000DWT to 15,000DWT .	(Cai Lan port) (1) Port faces to sea. (2) Port has 1berth with 166m and has water depth -9m. Ship capacity of muximum berthing is 20,000DWT. (3) In offshore, cargoes are reshipped from 50,000DWT to 10,000DWT .
2.5 Road	2.5.1 To Hanoi, To HCMC	(Existing) Route 18 with width 8 to 10m. (Upgrade plan) Planning	(Existing) Route 18 with width 8 to 10m. (Upgrade plan) Planning
2.6 Circumstance of the site			

Table 1-7 The investigation results of Thuy Nguyen and Dinh Vu(1)

Item		Name of site: 3.Thuy Nguyen	4.Dinh Vu
1.The proposed criteria			
1.1 Site area		Maximum 50ha (Because of being not allowed by local government) C	Maximum 50ha (Because of being not allowed by local government) C
1.2 Water supply volume		More than 150,000m3/day available B	More than 150,000m3/day available B
1.3 Electricity from outside network		More than 350MW available A	More than 350MW available A
1.4 Man power	For construction For operation	More than 15,000 persons available More than 15,000 persons available B	More than 15,000 persons available More than 15,000 persons available B
Remarks		A : Satisfies criteria, B : Uncertain, subject to further information, C : Not satisfies criteria.	
2.Other condition			
2.1 Site condition	2.1.1 Location	(1) The site is planned to be located at 40 km far from the Hon Gai mine, and the distance from route 5 to the site is around 15km. Presently the site is reclaimed field. (2) The distance from site to Hanoi is around 130km. (3) Present height of the site is nearly sea level.	(1) The site is planned to be located at 60 km far from the Hon Gai mine, and distance from route 5 to the site is around 5km. Presently the site is shallow field. (2) The distance from site to Hanoi is around 120km. (3) Present height of the site is nearly sea level.
	2.1.2 Banking of site	It is necessary to bank up to height of around 5.0m.	It is necessary to bank up to height of around 5.0m.
	2.1.3 Cutting of site	Not necessary.	Not necessary.
	2.1.4 Other	Earth for banking is provided from river.(earth dredged for channel)	Earth for banking is provided from sea.(earth dredged for channel)
2.2 Water supply	2.2.1 Source	Water is planned to be supplied from the river 2km far from the site. But dam or pond does not exist.	Not clear
	2.2.2 Water pipeline	Water pipeline from river to near the site does not exist.	Not clear
	2.3.2 Supply substation	Supply substation will be installed in 2000.	Existing

Table 1-8 The investigation results of Thuy Nauyen and Dinh Vu(2)

Item	Name of site	3.Thuy Nguyen	4.Dinh Vu
2.3 Electric power supply	2.3.1 Source	Power is planned to be supplied from TRANG BACH S/S 30km far from the site.	Power is planned to be supplied from HAIPHONG S/S 15km far from the site.
2.4 Port	2.4.1 River or sea condition near the site	(1) The site faces to river. (2) Ship capacity of maximum berthing is 3,000 to 5,000DWT becouse of being constructed bridge at lowerstream of river. (3) If raw material is imported, seaberth based on information reference for criteria should be constructed in offshore.	(1) The site faces to sea. (2) The distance from seaside to the point of water depth -10m and -20m is not informed. (3) If raw material is imported, seaberth based on information reference for criteria should be constructed in offshore.
	2,4,2 Existing port near the site	(Hai Phong port) (1) No.2 international port in Viet Nam. It faces river and is located 30km far from mouth river. (2) Port has 5sections with 2,500m of berth and has water depth -7m. Ship capacity of maximum is 10,000DWT. (3) In offshore, cargoes are reshipped from 50,000DWT to 10,000DWT .	(Hai Phong port) (1) No.2 international port in Viet Nam. It faces river and is located 30km far from mouth river. (2) Port has 5sections with 2,500m of berth and has water depth -7m. Ship capacity of maximum is 10,000DWT. (3) In offshore, cargoes are reshipped from 50,000DWT to 10,000DWT .
2.5 Road	2.5.1 To Hanoi, To HCMC	(Existing) Route 5 with width 8 to 10m. (Upgrade plan) High way is to be completed until 1997 and now under constructing.	(Existing) Route 5 with width 8 to 10m. (Upgrade plan) High way is to be completed until 1997 and now under constructing.
2.6 Circumstance of the site			

Table 1-9 The investigation results of Cua Sot and Thach Van(1)

Item		Name of site: 5.Cua Sot	6.Thach Van
1.The proposed criteria			
1.1 Site area		More than 300ha A	More than 300 (ha) A
1.2 Water supply volume		More than 150,000m3/day available A	More than 150,000m3/day available A
1.3 Electricity from outside network		More than 350MW available B	More than 350MW available B
1.4 Man power	For construction For operation	More than 15,000 persons available More than 15,000 persons available B	More than 15,000 persons available More than 15,000 persons available B
Remarks		A : Satisfies criteria, B : Uncertain, subject to further information, C : Not satisfies criteria.	
2.Other condition			
2.1 Site condition	2.1.1 Location	(1) The site is planned to be located at several km far from the Thach Khe mine, and distance from route 1 to the site is around 10km. Presently the site is field. (2) The distance from site to Hanoi is around 350km. (3) Present height of the site from sea is +0.7m.	(1) The site is planned to be located at several km far from the Thach khe mine, and distance from route 1 to the site is 10km. Presently the site is field. (2) The distance from site to Hanoi is around 360km. (3) Present height of the site from sea is +2.5m to +5m.
	2.1.2 Banking of site	It is necessary to bank up to height of around 4.5m.	It is necessary to bank up to height less than 2.5m.
	2.1.3 Cutting of site	Not necessary.	Not necessary.
	2.1.4 Other	Earth for banking is provided from sea.(earth dredged for channel)	Earth for banking is provided from sea.(earth dredged for channel)
2.2 Water supply	2.2.1 Source	Existing dam with water reserved 18 to 20 billion m^3 is located at around 20km far from the site.	Existing dam with water reserved 18 to 20 billion m^3 is located at around 20km far from the site.
	2.2.2 Water pipeline	Water pipeline from river to near the site does not exist.	Water pipeline from river to near the site does not exist.

Table 1-10 The investigation results of Cua Sot and Thach Van(2)

Item	Name of site	5.Cua Sot	6.Thach Van
2.3 Electric power supply	2.3.1 Source	Power is planned to be supplied from Tinh S/S 200km far from the site. But power source is insufficiently.	Power is planned to be supplied from Tinh S/S 15km far from the site. But power source is insufficiently.
	2.3.2 Supply substation	Supply substation will be installed in 2000.	Supply substation will be installed in 2000.
2.4 Port	2.4.1 River or sea condition near the site	(1) The site is planned to be located at mouth of river. (2) The distance from seaside to the point of water depth -10m is 3km, and to the point of water depth -20m is 8km. (3) If raw material is imported, seaberth based on information reference for criteria should be constructed in offshore.	(1) The site is planned to be located next to the seaside. (2) The distance from seaside to the point of water depth -10m is 3km, and to the point of water depth -20m is 7km. (3) If raw material is imported, seaberth based on information reference for criteria should be constructed in offshore.
	2,4,2 Existing port near the site	Nothing	Nothing
2.5 Road	2.5.1 To Hanoi, To HCMC	(Existing) Route 1 with width 8 to 10m. (Upgrade plan) High way is to be constructed until 2010.	(Existing) Route 1 with width 8 to 10m. (Upgrade plan) High way is to be constructed until 2010.
2.6 Circumstance of the site			

Table 1-11 The investigation results of Vung Ang and Mui Ron(1)

Item		Name of site: 7.Vung Ang	8.Mui Ron
1.The proposed criteria			
1.1 Site area		Around 200ha (Because of being not allowed by local government) B	More than 300ha A
1.2 Water supply volume		More than 150,000m3/day available A	More than 150,000m3/day available A
1.3 Electricity from outside network		More than 350MW available B	More than 350MW available B
1.4 Man power	For construction For operation	More than 15,000 persons available More than 15,000 persons available B	More than 15,000 persons available More than 15,000 persons available B
Remarks		A : Satisfies criteria, B : Uncertain, subject to further information, C : Not satisfies criteria.	
2.Other condition			
2.1 Site condition	2.1.1 Location	(1) The site is planned to be located at around 50km far from the Thach Khe mine, and distance from route 1 to the site is 5km. Presently the site is field. (2) The distance from site to Hanoi is around 400km. (3) Present height of the site from sea is +2.5m.	(1) The site is planned to be located at around 60km far from the Thach Khe mine, and distance from route 1 to the site is 5km. Presently the site is field. (2) The distance from site to Hanoi is around 400km. (3) Present height of the site from sea is +3.5m to +7m because of hill.
	2.1.2 Banking of site	It is necessary to bank up to height of around 2.5m.	It is necessary to bank up to height less than 1.5m.
	2.1.3 Cutting of site	Not necessary.	It is necessary to cut down to height less than 2m.
	2.1.4 Other	Earth for banking is provided from sea.(earth dredged for channel)	
2.2 Water supply	2.2.1 Source	Existing dam with water reserved 18 to 20 billion m^3 is located at around 70km far from the site.	Existing dam with water reserved 18 to 20 billion m^3 is located at around 60km far from the site.
	2.2.2 Water pipeline	Water pipeline from river to near the site does not exist.	Water pipeline from river to near the site does not exist.

Table 1-12 The investigation results of Vung Ang and Mui Ron(2)

Item	Name of site	7.Vung Ang	8.Mui Ron
2.3 Electric power supply	2.3.1 Source	Power is planned to be supplied from Ha Tinh S/S 30km far from the site. But power source is insufficiently.	Power is planned to be supplied from Ha Tinh S/S 35km far from the site. But power source is insufficiently.
	2.3.2 Supply substation	Supply substation will be installed in 2000.	Supply substation will be installed in 2000.
2.4 Port	2.4.1 River or sea condition near the site	(1) The site is planned to be located at the seaside. MOT is constructing new port for woods exported several km far.(JICA mission do not know the detail specification of port). (2) The distance from seaside to the point of water depth -10m is 0.2km, and to the point of water depth -20m is 1.5km. (3) If raw material is imported, seaberth based on information reference for criteria should be constructed to offshore.	(1) The site plan to be located at several km far from seaside. (2) The distance from seaside to the point of water depth -10m is 0.2km, and to the point of water depth -20m is 2km. (3) If raw material is imported, seaberth based on information reference for criteria should be constructed to offshore.
	2,4,2 Existing port near the site	Nothing	Nothing
2.5 Road	2.5.1 To Hanoi, To HCMC	(Existing) Route 1 with width 8 to 10m. (Upgrade plan) High way is to be constructed until 2010.	(Existing) Route 1 with width 8 to 10m. (Upgrade plan) High way is to be constructed until 2010.
2.6 Circumstance of the site			

Table 1-13 The investigation results of Da Nang and Dung Quat(1)

Item		Name of site: 9.Da Nang	10.Dung Quat
1.The proposed criteria			
1.1 Site area		Around 100 (ha) (Because of being not allowed by local government) C	Around 200 (ha) (Because of being not allowed by local government) B
1.2 Water supply volume		More than 150,000m3/day available B	More than 150,000m3/day available B
1.3 Electricity from outside network		More than 350MW available B	More than 350MW available B
1.4 Man power	For construction	More than 15,000 persons available	More than 15,000 persons available
	For operation	More than 15,000 persons available	More than 15,000 persons available
		B	B
Remarks		A : Satisfies criteria, B : Uncertain, subject to further information, C : Not satisfies criteria.	
2.Other condition			
2.1 Site condition	2.1.1 Location	(1) The site is planned to be located in industrial park where will arrange in future, and faces to route 1. Presently the site is hill sand. (2) The distance from site to Da Nang central is around 20km. (3) Present height of the site from sea is +2.0m to +10m because of hill.	(1) The site is planned to be located in the industrial park of central area development plan (phase Ⅱ), and faces to mouse of river. Presently the site is sand field. (2) The site is planned to be located at center between Hanoi and HCMC. The distance is around 1,000km each. (3) Present height of the site from sea is +3.0m.
	2.1.2 Banking of site	It is necessary to bank up to height less than 3m.	It is necessary to bank up to height around 2m.
	2.1.3 Cutting of site	It is necessary to cut down to height less than 5m.	Not necessary.
	2.1.4 Other		Earth for banking is provided from sea.(earth dredged for channel)
2.2 Water supply	2.2.1 Distance to source	Water is planned to be supplied from the river 15km far from the site. But dam or pond does not exist.	Water is planned to be supplied from the river 12km far from the site. But dam or pond does not exist.
	2.2.2 Water pipeline	Water pipeline from river to near the site does not exist.	Water pipeline from river to near the site does not exist.

Table 1-14 The investigation results of Da Nang and Dung Quat(2)

Item	Name of site	9.Da Nang	10.Dung Quat
2.3 Electric power supply	2.3.1 Source	Power is planned to be supplied from Da Nang S/S 10km far from the site. But power source is insufficiently.	Power is planned to be supplied from Da Nang S/S 100km far from the site. But power source is insufficiently.
	2.3.2 Supply substation	Supply substation will be installed in 2000.	Supply substation will be installed in 2000.
2.4 Port	2.4.1 River or sea condition near the site	(1) The site is planned to be located at several km far from seaside. (2) The distance from seaside to the point of water depth -10m is 2km, and to the point of water depth -20m is 5km. (3) If raw material is imported, seaberth based on information reference for criteria should be constructed to offshore.	(1) The site is planned to be located at mouth of river. (2) The distance from seaside to the point of water depth -10m is 2km, and to the point of water depth -20m is 5 to 6 km. (3) If raw material is imported, seaberth based on information reference for criteria should be constructed to offshore.
	2,4,2 Existing port near the site	(Da Nang port) (1) There are 2 berths whose ship capacity of maximum berthing is 20,000DWT. (2) In offshore, cargoes are reshipped from 50,000DWT to 20,000DWT . (3) Some sea area near Da Nang port has water depth around -20m.	Nothing
2.5 Road	2.5.1 To Hanoi, To HCMC	(Existing) Route 1 with width 8 to 10m. (Upgrade plan) High way is to be constructed until 2010 .	(Existing) Route 1 with width 8 to 10m. (Upgrade plan) High way is to be constructed until 2010.
2.6 Circumstance of the site			

4. Selection of three proposed sites

(1) Date of meeting for the selection of three proposed sites
Oct. 27, 1996 at VSC

(2) The name of three proposed sites
- Around Thach Khe iron ore mine (Cua Sot, Thack Van)
- Mui Ron
- Dung Quat

(3) The selected reason of three proposed sites
Viet Nam sides explained below- mentioned items and determined three proposed sites as shown above.

1) Results of JICA investigation in the 1st survey
Especially, a) brief criteria for site selection in the 1st survey, b) land form condition for constructing deep water port in case of importing raw materials, and c) accessibility to steel product market.

2) Opinions and information of VSC
The reasons of Viet Nam's side to select three proposed sites from ten proposed sites are as follows:

a) Cam Pha (not selected)
- Far to southern steel product market
- Not deep in water depth
- Only uses Cam Pha coal for smelting reduction

b) Cai Lan (not selected)
- Not satisfies criteria of site area

c) Thuy Nguyen (not selected)
- Not satisfies criteria of site area

d) Dinh Vu (not selected)
- Not satisfies criteria of site area

e) Around Thach Khe iron ore mine (selected)
(Cua Sot, Thack Van)
- Satisfies criteria of site area and has deep water depth

f) Vung Ang (not selected)
- Not informed the reasons of Viet Nam's side

g) Mui Ron (selected)
- Satisfies criteria of site area and has deep water depth

h) Da Nang (not selected)
- Not satisfies criteria of site area.

i) Dung Quat
- Considered important area of Viet Nam
- Planned to the new steel works by Viet Nam's goverment
- Deep water depth