

Site	72	personal	<input type="checkbox"/>	production	<input checked="" type="checkbox"/>
Shortname	CVRD - Ferteco	ferro-alloys	<input type="checkbox"/>	office/sales	<input type="checkbox"/>
Name	Ferteco	iron ore	<input checked="" type="checkbox"/>	trader	<input type="checkbox"/>
Address1		iron + steel	<input type="checkbox"/>	supplier	<input type="checkbox"/>
Address2		energy	<input type="checkbox"/>	scrap	<input type="checkbox"/>
City	Brumadinho	bx/alumina	<input type="checkbox"/>	equipment	<input type="checkbox"/>
State	Minas Gerais	primary	<input type="checkbox"/>	consultant	<input type="checkbox"/>
Zip		secondary	<input type="checkbox"/>	trade body	<input type="checkbox"/>
Country	Brazil	rolled	<input type="checkbox"/>	publisher	<input type="checkbox"/>
Code	<input type="checkbox"/>	extruded	<input type="checkbox"/>	financial	<input type="checkbox"/>
Updated	05 July 2005	castings	<input type="checkbox"/>	government	<input type="checkbox"/>
		other	<input type="checkbox"/>	legal	<input type="checkbox"/>

NOTES - GENERAL

This site is the iron ore operations of CVRD, formerly Ferteco Mineracao, in Brazil.

In September 2003 CVRD absorbed Ferteco Mineracao and the company ceased to exist as a separate entity. For information in the total southern system of CVRD, see site no. 5745.

**HISTORY**

Ferteco Mineracao SA operates the Fabrica and Corrego do Feijao mines in the Belo Horizonte area of Minas Gerais.

In 1810 Baron von Eschwege, chief inspector of mines for the King of Portugal, arrived in Brazil. He designed and built a smelting plant at Fabrica, which operated Catalan type forges from 1812 to 1821 as Fabrica Patriotica do Ribeiro de Prata. In 1910 the area was explored by the German group Erzstudiengesellschaft. In 1913 a new company was founded (Brasilianische Bergwerks- und hutten-gesellschaft – BBHG) by German steel companies. In 1923 the predecessor company of Ferteco, Cia. Do Mineracao de Ferro e Carvao (F&C) was founded and in 1924 it acquired Cia. De Mineracao Serra Moeda (MSM, founded in 1913), which held iron ore concessions. In 1931 BBHG was transferred to Konsortium Brasiliana, a private company owned 84% by Vereinigte Stahlwerke (a cartel of German steelworks) and 14% by Hoesch. In 1937-41 mine development took place. In 1952 Konsortium Brasiliana was acquired by a group comprising Thyssen 52.7%, Hoesch 37.5%, Krupp 5% and Rhein Stahl 5%. In 1953 the first shipment was made from the Fabrica mine to Germany. By 1958 Ferteco Mineracao was organised as an affiliate of F&C and MSM. Ferteco is the main shareholder in MSM and the operating company. MSM holds part of the mining rights.

The first production at Corrego do Feijao mine was in 1963. Development of the Joao Pereira deposit at Fabrica began in 1971.

In 1997 Ferteco contributed \$200m to the purchase of the privatised MRS railway (see MBR for details).

In 1998 development of a new mine (Agua Limpia) with capacity of 10m t/y of lump, sinter feed fines and sinter feed fines at a cost of \$200m was proposed, including a mine, simple concentrator and a cable belt of 15-20 km to the rail line. Also in 1998 doubling of pellets capacity was proposed at a cost of \$180m. Both projects would be part of a company strategy to increase capacity from 15.5m t/y to 30 mty by 2008, of which 25m t/y would be for export.

Before 1992 Ferteco was owned by Krupp Stahl, Hoesch Stahl and Thyssen in the proportions shown. In 1992 Krupp and Hoesch were merged. In 1998 Krupp-Hoesch and Thyssen were merged into Thyssen-Krupp Stahl, which became the sole owner. The mine is managed by Exploration und Bergbau, itself a subsidiary of the same steel companies.

Ownership of Ferteco Mineracao was:

- Krupp Stahl, Germany - 5.0%
- Hoesch Stahl, Germany - 37.3%
- Thyssen Stahl, Germany - 57.7%

In 2000 TKS decided to sell Ferteco. Bids were received from CVRD, BHP, Rio Tinto, LKAB and Phelps Dodge. In April 2001 CVRD acquired Ferteco for \$566m (also reported at \$650m) plus assumption of \$131.3m debt, of which \$100m was long-term debt.

In November 2001 CVRD acquired 50% of Caemi and established with Mitsui & Co. New Caemi (owned CRD 50%; Mitsui & Co. 50%). New Caemi was intended to incorporate both MBR and Ferteco. This required CVRD to sell 50% of Ferteco to Mitsui & Co.

In 2001-2 Ferteco made engineering studies for expansion of the pellet plant by 4-5m t/y at an estimated cost of \$150m.

In September 2003 CVRD absorbed Ferteco and consolidated Ferteco's assets at their published value at 31 July 2003 of R1.31 bn.

## NOTES - PRODUCTS AND MARKETS

CVRD - Ferteeco, Brumadinho

site 72

## IRON ORE - PRODUCT RANGE

From the Fabrica plant products are:

natural pellet/lump ore at -30 +6 mm  
 natural sinter fines at -6.3 +0.1 mm  
 BF pellets at -25 +5 mm

At Corrego do Feijao products are:

natural fines at -6.4 mm  
 natural pellet/lump ore at -19 +13 mm  
 natural lump ore at -32 +19

## IRON ORE - MARKET

At the Feijao mine 80 km NW of Fabrica the ore is higher grade and can be classified into BF and DR lump qualities.

BF lump is shipped mainly to the domestic market (about 600,000 t/y).

A major effort to expand production of DR lump made Ferteeco one of the larger suppliers, with sales of about 600,000 t/y to a range of countries.

Sales of DR pellet feed fines were also developed, with sales to Imexsa (Mexico), GIIC (Bahrain) and Iran, totalling 1.2-1.5m t/y. Following the acquisition by CVRD, it is likely that these sales were ended or incorporated into the product range of CVRD. Shipments of pellet feed fines were probably not made from the new terminal at Sepetiba.

For sinter fines and BF pellets the largest customers was Thyssen Krupp, taking about 6m t/y in 2000. Under arrangements for the sale of Ferteeco to CVRD in 2001, TKS entered a long-term contract for products from Ferteeco. From 2006 expanded pellet capacity will require sales to third parties.

## NOTES - TECHNOLOGY AND OPERATIONS

CVRD - Ferteeco, Brumadinho

site 72

## IRON ORE - CURRENT OPERATIONS

## FABRICA OPERATIONS

## Mining

## Drilling and Blasting

20% of the ore requires drilling and blasting to create 13m benches. Holes of 250 and 90 mm are drilled on a spacing of 8m x 6m in overburden, 7m x 5m in friable ore and 6m x 4m in compact ore. Blasting is with ANFO and TNT primers. Equipment includes:

## Rotary drills

2 for 250mm holes  
 3 for 90mm holes

The ratio of waste to ore is 0.6.

## Loading

Run-of-mine ore and waste are loaded by shovels. Equipment includes:

## Shovels

2 x P&H 1900 electric rope shovels, 7.6 m<sup>3</sup>  
 2 x P&H 1400 electric rope shovels, 3.5 m<sup>3</sup>

## Wheel loaders

1 x LeTourneau 800, 7.6 m<sup>3</sup>  
 1 x Caterpillar 992  
 1 x Caterpillar 824

## Tracked bulldozers

3 x Caterpillar

## Mine Haulage

Run-of-mine ore is loaded to trucks. Waste is loaded to trucks for haulage to the waste dump. Equipment includes:

## Trucks

6 x Lectrahaul diesel electric, 85/100 tonnes  
 6 x Wabco diesel electric, 120 tonnes

Haulage distance to the primary crusher is 3.5-5.0 km downhill, average 4 km.

Primary Crushing and Transport. The primary crusher is at the plant.

## Beneficiation

At Fabrica run-of-mine ore is unloaded at the plant. The primary crusher reduces ore to -200 mm (8"). Crushed ore is conveyed to two belding stockpiles of 350,000 tonnes each.

Ore is withdrawn from the stockpile and taken into the concentrator for washing in a plant built in 1976-79. Washed ore is crushed to -30 mm in secondary and tertiary

crushers. The crushed ore is wet screened and -30, +6.3 mm is recovered as lump ore. The -6.3 mm fraction is washed and classified at +0.1 mm in a plant with Batac type jigs and spiral classifiers built in 1991. Ore at -6.3, +0.1 mm is stockpiled as sinter feed fines.

Middlings from this plant are ground in a ball mill and the ball mill discharge is cycloned. Ore at -0.1 mm from this plant goes with material of -0.1 mm from the spirals plant to two stages of Jones high intensity magnetic separation. In 1988 three Jones high intensity wet magnetic separators were added, to give a total of nine. The purpose was to reduce P and alumina content of the feed to the pellet plant.

The resulting concentrate at -0.1 mm is ground with solid fuel and limestone in ball mills to 1800-1900 Blaine for sinter feed fines. The sinter feed fines product is filtered and conveyed to the pellet plant. Tailings are pumped to a storage pond.

Equipment includes:

1 x Primary Crusher: 1.37m rotary, built in 1972-74  
1 x Secondary Crusher  
1 x Tertiary Crusher  
Washing  
Classification: wet spirals + Batac jigs  
1 x Grinding Mill: ball mill  
Magnetic Separation: 9 x Jones high intensity wet magnetic separators

Agglomeration

The pellet plant was built at Fabrica in 1977.

Sinter feed fines concentrate is fed to 5 balling drums and mixed with 2.0-2.5% hydrated lime and 1.5-2.0% limestone, the combined addition being 4%, giving a partially fluxed pellet.

Green pellets at -16, +8 mm are fed to a lurgi travelling grate for induration at 1300°C. The plant has 38 windboxes. An aftercooler built in 1994 reduces pellet temperature to <100°C, so that water spraying to control dust does not damage the pellets.

Pellets are screened at -25, +7 mm. Undersize at -7 mm is stockpiled as sinter feed fines.

The pellet plant has facilities for admixing charcoal with the green pellets. With charcoal at 20 kg/t fuel oil consumption is reduced to 13-14 kg per tonne of pellets. Charcoal can also be injected into the recuperation hood and this can reduce fuel consumption to 8 kg. Total fuel consumption is then fuel oil 330 MJ/t, admixed charcoal 480 MJ/t, injected charcoal 290 MJ/t, for a plant producing partially fluxed pellets. The plant can use fuel oil, charcoal fines and coke breeze as fuel.

Product from the concentrator is fed to thickeners, then to disc filters, green balling drums. In the green balling plant bentonite is added at the rate of 7.6 kg/t (17 lbs/t), and then to the grate-kiln furnaces. Equipment includes:

Indurating Lines

1 x Lurgi travelling grate, 3.5m x 111m, Step 1, 1967 (2 lines closed in 1982)

Transport to Shipping Point

At the Fabrica plant products are loaded to trains.

Reclaim + loading: 4000 t/h

Operator: Ferteco + EFVM (100% subsidiary of CVRD)

Distance: 107 km to the main line of EFVM at a maximum grade of 0.5% against the load; 605 km on the main line of EFVM to Tubarao 450 km to Sepetiba (Ferteco terminal) 460 km to Guaiba (MBR terminal)

Railcar size:

Train size: 10,000 tonnes

Frequency:

Railway fleet

Ore for local steel and pig iron plants is trucked to Belo Horizonte.

CORREGO DO FEIJAO

Mining

Drilling and Blasting

At Corrego do Feijao drilling and blasting is used to create 10m benches. Holes of 165 and 90 mm are drilled. Blasting is with ANFO.

Rotary drills

2 for 165mm holes

2 for 90mm holes

The ratio of waste to ore is 0.5.

Loading

Run-of-mine ore and waste are loaded by shovels. Equipment includes:

Shovels

1 x hydraulic [8.0 m<sup>3</sup>]

Wheel loaders

5 x Caterpillar 966, 6.0 m<sup>3</sup>

Tracked bulldozer

1 x Caterpillar

Graders

1

Mine Haulage

Run-of-mine ore is loaded to trucks. Waste is loaded to trucks for haulage to the waste dump. Equipment includes:

Trucks

20 x Mercedes 1113/1513, 10 tonnes

Haulage distance to the primary crusher is 1 km.

Primary Crushing and Transport.

The primary crusher is at the plant.

Beneficiation

At Corrego do Feijao run-of mine ore is unloaded at the plant. The primary jaw crusher and secondary cone crusher reduce ore to -76 mm (-3"). Crushed ore is fed to a tertiary crusher and double deck wet screening with openings at 31.8 mm and 13 mm to recover lump products. Undersize is processed by spiral classifiers and sieves to -6.3, +0.1 mm as sinter feed fines. Fines from this process pass to cyclones added in 1995, to produce concentrate at -0.1 mm for DR pellet feed fines.

In 1996 Ferteeco also tried crushing and screening the hematite sinter feed fines to a size range of - 0.1, + 0.1 mm for feed to iron carbide plants.

Equipment includes:

1 x Primary Crusher, jaw type

1 x Secondary Crusher, cone

1 X Tertiary Crusher

Classification: wWet spirals + sieves, cyclones

Transport to Shipping Point

At Corrego do Feijao products are hauled by truck 8 km to Alberto Flores station and loaded to trains.

Reclaim + loading:

Operator: MRS Logistica, formerly Brazil Central Railway

Distance: To Sao Paulo for domestic steel plants; 832 km to Tubarao, via EFVM for export; 530 km to Sepetiba (Ferteeco terminal); 540 km to Guaiba (MBR terminal)

Railcar size

Train size

Frequency

Railway fleet

Ferteeco participated in the privatisation of the state railway and owns 18% of MRS Logistica. From mid-1999 Feijao ore was moved on the MRS Railway to the new terminal at Sepetiba. The capacity of MRS railway was expected to be 70m t/y in 2000.

Shipments via the new terminal were expected to be 6-8m t/y rising to 20m t/y by 2005. This route was expected to save \$4.70 per tonne. In 1997 a new train loading station was built at Alberto Flores.

Reclaim + loading

Operator: MRS Logistica, formerly Brazil Central Railway

Distance: 540 km Feijao to Sepetiba terminal

Railcar size

Train size

Frequency

Railway fleet

#### TRANSPORT TO CUSTOMERS

At the port of Tubarao ore is handled at the terminal of CVRD (see CVRD Southern System, site 5745, for details).

At the port of Rio de Janeiro ore was loaded at the public port operated by Cia. Docos do Rio de Janeiro, 20 km from the terminal of MBR.

In 1992 future plans indicated that this port would be closed to bulk cargoes and Ferteeco studied with Sumitomo Metal Industries the development of a new ore terminal to continue exports of Feijao ore. It was intended that this terminal should be used also by Itaminas and Esperanca.

In 1995 Ferteeco made the only proposal to Cia. Docos do Rio de Janeiro for a project for a new iron ore export terminal In 1996 the project was agreed, with capacity of 6m t/y. Ferteeco would develop the terminal with an initial investment of \$86.5m, to commence operation in 1999 as Cia. Portuaria da Baia de Sepetiba, a 100% subsidiary of Ferteeco. This was part of a total investment of \$200m in port and rail facilities, mainly for Feijao ore. The port project was completed at a cost of \$120m. The facility would be expandable to 12m t/y and would be leased by Ferteeco from the federal government company Cia. Docos for 25 years with an option to renew for a further 25 years. Capacity would be 7.5m t/y within 2-3 years at a cost of \$100m, financed 70% by debt from KfW of Germany and 30% equity from Ferteeco and Camargo Correa..

Under the agreement Cia. Docos would deepen the access channel to 19m and permit the handling of 150,000 dwt ships. Phase II of the project would dredge the channel to 20m to permit the maximum ship size to be increased to 230,000 dwt. Facilities were planned to include:

This terminal would not affect the long-term arrangement with CVRD for export through Tubarao.

Other facilities in the area of this terminal were a coal import terminal of CSN and an alumina terminal of Valesul (site 846)

Berths: 1

Operator: Ferteeco

Railcar unloading: 8000 t/h car dumper  
 Stockyard: 2 million tonnes  
 Reclaim:  
 Shiploading: 1 x 10,000 t/h radial  
 Channel depth: 18.7m  
 Depth alongside: Maximum ship draught 16.5 metres; from 2002: 18.0 metres  
 Ship maximum beam  
 Ship maximum length  
 Ship maximum size: 180,000 dwt  
 Port capacity: 15m t/y

In 1998 an agreement was reached with MBR for the co-ordination of shipping between Ferteeco's new Sepetiba terminal and MBR's terminal (renamed from Sepetiba to Guaiba Island), 15 km distant. Ferteeco will load smaller MBR vessels at Ferteeco's new terminal.

Shipping of products to the owners is to Rotterdam, where Thyssen holds 50% of a terminal, Ertsoverlagsbedrijf Europoort, at which ore is transhipped into barges for movement on the Rhine.

#### OTHER MINES

Ferteeco buys run-of-mine ore from private mines near Fabrica. At one of these, Rio Verde, close to Fabrica, supplying 2-3m t/y, a tailings dam collapsed in July 2001.

#### MANPOWER

1997: total employment - 1410

#### NOTES - RAW MATERIALS AND LOGISTICS

CVRD - Ferteeco, Brumadinho

site 72

#### IRON ORE - MINERAL RESERVES

At the Fabrica mine near Congonhas, MG, 65 km S of Belo Horizonte, the reserves of the company comprise the Joao Pereira deposit (rights owned by MSM) and the Fabrica deposits (rights owned by Ferteeco). Ore is semi-rich soft hematite underlain by itabirite. Underlying proven and indicated reserves of itabirite with 35-53% Fe are in the region of 2 billion tonnes. These ores cannot be processed at the existing concentrator. Fabrica ore is classified into 7 types: compacto; chapinha (biscuit); jacutinga (blue dust), limonitico, iratirito/limonitico, itabirito 1, itabirito 2.

The Corrego do Feijao mine is 80 km NW of Fabrica in the municipality of Brumadinho, MG and 40 km W of Belo Horizonte. The ore is mainly compact and friable hematite. In addition to high-grade reserves Corrego do Feijao has 300m tonne of low-grade reserves in the range 40-605 Fe.

Agua Limpa is an undeveloped deposit in the Gandarella mountain range with 800m tonnes of hematite and rich itabirite, of which 400m tonnes are proven. Ferteeco has mining rights on part of the area, with an option to lease the rest on a royalty basis. In 1998 development of a new mine with capacity of 10m t/y of lump, sinter feed fines and sinter feed fines at a cost of \$200m was proposed.

Total reserves of Ferteeco were reported in 2001 at 263m tonnes of hematite + itabirite.

#### NOTES - ENERGY

CVRD - Ferteeco, Brumadinho

site 72

#### NOTES - FUTURE PROJECTS

CVRD - Ferteeco, Brumadinho

site 72

#### IRON ORE - 2006

Project: A new pellet plant at Ferteeco.

Status: In March 2004 the President of CVRD indicated that a decision had been taken to build a new pellet plant at Ferteeco. The plant would have the capability to produce either BF or DR pellets. The plant will be located alongside the existing pellet plant, which had capacity of 4.5m t/y.

Capacity: 6.0m t/y

#### OUTLOOK

Ferteeco Mineracao operated the Fabrica and Corrego de Feijao mines in the Belo Horizonte area of Minas Gerais. Until 2001 the company was owned by Thyssen Krupp Stahl of Germany and managed by their subsidiary Exploration and Bergbau. In 2001 Ferteeco was acquired by CVRD.

At Fabrica, where iron ore has been mined since 1810, hematite ore is mined and processed (capacity: 1.5m t/y lump; 5.5m. t/y sinter feed, 0.5m t/y DR pellet feed for sale and 3.8m t/y pellets). This production is moved 710 km on CVRD's Vitoria-Minas railway and loaded under arrangements with CVRD at Tubarao. Most this production is shipped to the parent companies in Germany.

At the Feijao mine 80 km NW of Fabrica the ore is higher grade and can be classified into BF and DR lump qualities (capacity: 0.6m t/y BF lump; 0.6m t/y DR lump; 1.1m t/y sinter fines). BF lump is shipped mainly to the domestic market. A major effort to expand production of DR lump has made Ferteeco one of the larger suppliers, with sales to a range of countries. Ferteeco has also been able to develop sales of DR pellet feed. Movement from Feijao was on the Brazilian state railway to Rio de Janeiro. In 1996 Ferteeco participated in the privatisation of this railway (now MRS Logistica) with MBR and constructed a new export terminal in the Sepetiba Bay area near Rio, to be leased exclusively from the government port company. This increased export capacity and reduce costs.

Reserves at Fabrica are about 200m tonnes of high-grade ore with large reserves of lower-grade itabirite. Reserves at Feijao are about 120m tonnes. These reserves will permit the continued operation of these mines with a view to supplying the parent companies with a basic tonnage and expanding sales in the export markets, particularly in the higher value DR products

#### NOTES - CONFIDENTIAL

CVRD - Ferteeco, Brumadinho

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Site: 69  
 Shortname: CVRD - MBR  
 Name: CVRD MBR - Mineracaoes Brasileiras Reunidas SA  
 Address1:   
 Address2:   
 City: Aguas Claras  
 State: Minas Gerais  
 Zip:   
 Country: Brazil  
 Code:   
 Updated: 23 July 2004

Phone:   
 Fax:   
 Email:   
 Internet:   
 EU VAT:

- personal  production
- ferro-alloys  office/sales
- iron ore  trader
- iron + steel  supplier
- energy  scrap
- bx/alumina  equipment
- primary  consultant
- secondary  trade body
- rolled  publisher
- extruded  financial
- castings  government
- other  legal

NOTES - GENERAL

This site is the iron ore operations of MBR – Mineracaoes Brasileiras Reunidas in Minas Gerais state in Brazil.

MBR – Mineracaoes Brasileiras Reunidas mines high-grade hematite in the Belo Horizonte area of Minas Gerais. Major owners include Caemi, Japanese companies and Bethlehem Steel.

The Caemi group was founded by Auhusto Trajeno de Azavedo Antunes (1907-1996). His company Icomi started industrial iron ore mining in Minas Gerais and was the first supplier to CSN in the 1930's. He also started the Icomi manganese ore mine, which began to export in 1957.

In 1942 mining started at Pico. In 1958 Hanna Coal & Ore Corporation, with Leo Model & Associates, New York, acquired a controlling interest in St. John del Rey Mining Co. Ltd. That company had a deep gold mine, which had been operated for many years but was not profitable. Other minerals on its property included iron ore for which Hanna wished to explore.

In the early 1960's mining started at Mutuca.

In 1966 MBR was created by the merger of Cia. Auxiliar de Empresas de Mineracao (Caemi) with St. John del Rey Mining Co. Ltd. The new company was owned 51% by EBM – Empreendimentos Brasileiros de Mineracao SA and 49% by St. John.

In 1970 the Aguas Claras project was committed and started production in 1963 at a cost of \$260m. In 1973 the first shipment was made from the terminal at Sepetiba Bay, Rio de Janeiro.

Caemi later acquired a shareholding in St. John, but in 1983 Hanna Mining transferred to Caemi a holding in MBR equal to Caemi's holding in St. John. This gave Hanna 34.27% in MBR. In 1986 Caemi bought Hanna's holding in MBR.

In 1997 the Frering family agreed to sell 40% of Caemi's ordinary shares and 40% of its preference shares to Mitsui & Co. for \$180m. Mitsui's holding in MBR was passed to Caemi, but Mitsui acquired 40% of Caemi.

Until 2001 ownership in MBR was:

- EBM - Empreendimentos Brasileiros de Mineracao SA - 51.0%
- CMM - Caemi Mineracao e Metalurgia SA - 49.0%

Ownership of EBM was:

- CMM - Caemi Mineracao e Metalurgia SA - 70.102%
- Belem Administracao e Participacoes Ltda - 9.898%
- Japanese consortium - 20.000%

Ownership of CMM - Caemi Mineracao e Metalurgia SA was

- Frering family - 60.0%
- Mitsui & Co. - 40.0%

Ownership of Belem Administracao e Participacoes Ltda was:

- Bethlehem Steel International Corporation -100%

Ownership of the Japanese consortium was:

- Nippon Steel - 23.370%
- NKK - 8.235%
- Sumitomo Metal Industries - 8.235%
- Kawasaki Steel - 8.235%
- Kobe Steel - 1.000%
- Nisshin Steel - 0.925%
- Itochu - 15.500%
- Sumitomo Corporation - 7.500%
- Marubeni Corporation - 7.500%
- Mitsui & Co. - 15.500%
- Mitsubishi Corporation - 4.000%

This ownership pattern gave net holdings of

Frering family - 50.851%  
 Mitsui & Co. - 33.901%  
 Bethlehem Steel - 5.048%  
 Other Japanese - 10.200%

In 2000 the Frering family indicated a wish to sell their shares in Caemi. The opportunity was evaluated by CVRD, BHP, Rio Tinto, LKAB, Anglo American and Billiton. In January 2001 BHP submitted the highest a bid of \$332m for 60% of Caemi's the voting shares and 20% of the preference shares in Caemi. In 2001 Mitsui & Co. exercised their right of first refusal on those shares and bought them for that amount. In 2001 CVRD offered \$280m for 50% of Caemi's voting shares. In October 2001 this sale was approved by the European Commission, subject to the sale by Caemi of its holding in QCM, Canada. The merger would lead to the creation of CMM - Caemi Mineracao e Metalurgia SA (New Caemi), which could incorporate MBR and Ferteco.

In October 2001 CVRD bought the 5.0% holding of Belem Administracao e Participacoes from Bethlehem Steel International Corporation (99.99% of the holding bought by CVRD, 0.01% bought by CVRD's subsidiary Docepar for \$25m, of which \$9.4m was in cash and the remainder a credit against iron ore purchases in 2001-2002.

As a result of these changes ownership of MBR from 2001 was:

EBM - Empreendimentos Brasileiros de Mineracao SA - 51.0%  
 CMM - Caemi Mineracao e Metalurgia SA - 49.0%

Ownership of EBM was:

CMM - Caemi Mineracao e Metalurgia SA - 70.102%  
 Belem Administracao e Participacoes Ltda - 9.898%  
 Japanese consortium - 20.000%

Ownership of the voting capital of CMM - Caemi Mineracao e Metalurgia SA was

CVRD - 50.0%  
 Mitsui & Co. - 50.0%

Ownership of Belem Administracao e Participacoes Ltda was

CVRD - 100.0%

Ownership of the Japanese consortium was as above. In 2002 NKK and Kawasaki were merged as JFE Steel so that JFE owned 16.470% of the Japanese consortium.

This ownership gave net holdings of

CVRD - 47.424% (17.876% via EBM/CMM + 24.500% via CMM direct + 5.048% via EBM/Belem)  
 Mitsui & Co. - 42.376% (17.876% via EBM/CMM + 24.500% via CMM direct)  
 Japanese excluding Mitsui - 10.200% (via EBM)

In April 2003 CVRD agreed to buy from Mitsui & Co. its 50% holding of the ordinary share (voting capital) and 40% of the preference shares of CMM for \$426.4m. CMM was stated to own 84.75% of MBR. As a result CVRD would own 100% of the voting capital of CMM, 40% of the preference shares and 60.2% of the total capital. In July 2003 this transaction was approved by the European Commission. CVRD stated that after this transaction it would continue to operate Caemi with a separate stock exchange listing in Brazil, but would merge Ferteco and MBR into its Southern System

This would result in net ownership of MBR of:

CVRD - 89.800% (35.750% via EBM/CMM + 49.000% via CM direct + 5.048% via Belem)  
 Japanese excluding Mitsui - total 10.200%, of which

Nippon Steel (site no. 4896) - 2.384%, calculated as 23.370% of 10.2%  
 JFE Steel, formerly NKK (site no. 4790) - 0.840%, calculated as 8.235% of 10.2%  
 JFE Steel, formerly Kawasaki Steel (site no. 4790) - 0.840%, calculated as 8.235% of 10.2%  
 Sumitomo Metal Industries (site no. 4965) - 0.840%, calculated as 8.235% of 10.2%  
 Sumitomo Corporation (site no. 4965 for ownership) 0.765%, calculated as 7.500% of 10.2%  
 Kobe Steel (site no. 4832) - 0.102%, calculated as 1.000% of 10.2%  
 Nisshin Steel (site no. 4925) - 0.09435%, calculated as 0.925% of 10.2%  
 Itochu (site no. 8415) - 1.581%, calculated as 15.500% of 10.2%  
 Marubeni Corporation (site no. 6065) - 0.765%, calculated as 7.500% of 10.2%  
 Mitsui & Co. (site no. 926) - 1.581%, calculated as 15.500% of 10.2%  
 Mitsubishi Corporation (site no. 721) - 0.408%, calculated as 4.000% of 10.2%

We consider that after this transaction CVRD controls all production and marketing at MBR, with Japanese partners receiving iron ore under commercial contracts.

## NOTES - PRODUCTS AND MARKETS

CVRD - MBR, Aguas Claras

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## IRON ORE - PRODUCT RANGE

Iron ore products of MBR are:

BF lump  
DR lump  
sinter fines  
pellet feed fines

## IRON ORE - PRODUCTION AND SALES

Results for Caemi (including Caemi's 85% share of MBR):

2002: revenue - R1.82 bn; net loss - R323m; net debt - R884m  
2003: revenue - R2.31 bn; net profit - R442m (\$152m); net debt - R484m

Results for MBR:

2002: iron ore sales - 33m tonnes; revenue - R1.38 bn  
2003: iron ore sales - 38m tonnes, of which 27% to China; 52% to Asia; production - 36m tonnes; revenue - R1.82 bn

2003:

In March 2003 MBR stated that capacity would reach 36m t/y by 2005 (30m t/y export, 6m t/y domestic). This would be the end of a programme of \$370m, raising capacity from 26m t/y in 1999. The exact timing of completion depended on environmental approval for Capao Xavier mine and conveyor at Guaiba Island terminal.

## IRON ORE - MARKETS

DR Lump

MBR has a strong market position in this product.

Sinter fines

Japanese buyers have contracts for about 7m t/y of ore from MBR from 1994, but the largest sales are of sinter feed to Europe.

Pellet Fines

MBR has become a significant supplier of DR pellet fines with sales of 1.4m t/y of Imexsa (Mexico). Sales were made to GIIC (Bahrain) up to 1996.

BF pellet fines were sold at about 1.6m t/y to Hoogovens pellet plant (Netherlands), but this ended in 2001. BF pellet fines have also been sold at about 250,000 t/y to the pellet plant of OneSteel (formerly BHP) at Whyalla in Australia. Pellet feed fines were specified in the contracts with Japanese buyers, but in practice the Japanese consumers used these products as sinter fines.

Contracts with Japanese buyers were:

Period: Core contract - April 1997 to March 2003; Flex contract - April 2000 to March 2003

Quantity: Core contract - total 21.0m tonnes at 3,500 per year for 6 years; Flex contract: 1.4 to 3.7m t/y

Purchasers: Expected tonnages were:

Nippon Steel - 46.4%: core 1615; flex 1160 (650-1725)

NKK - 16.4%: core 575; flex 410 (230-605)

Kawasaki - 16.4%: core 575; flex 410 (230-605)

Sumitomo - 16.4%: core 575; flex 410 (230-605)

Kobe Steel - 2.2%: core 80; flex 55 (30-80)

Nisshin Steel - 2.2%: core 80; flex 55 (30-80)

The distribution by product was expected to be:

Core: lump 1000; sinter fines 400; pellet fines 2100; total 3500

Flex: lump 900; sinter fines 400; pellet fines 1200; total 2500

Loading: 40,000 t/d; turn time 12 hours

up to 50,000 dwt: despatch - \$0.12c/tonne; demurrage - \$0.14/tonne

50-120,000 dwt: despatch - \$0.04/tonne; demurrage - \$0.08/tonne

over 120,000 dwt: despatch - \$0.035/tonne; demurrage - \$0.07/tonne



## TECHNOLOGY AND OPERATIONS - IRON ORE

## AGUAS CLARAS/TAMANDUA

In 1994 MBR took over Tamandua mine, which supplied the local market. In 2001 Tamandua was expanded to replace Aguas Claras in 2002.

## Primary Crushing and Transport

Run-of-mine ore is crushed in a semi-mobile in-pit primary crusher to –200 mm.

## Beneficiation

The beneficiation plant at Tamandua was upgraded in 1994. The ore from this mine is chemically similar to Aguas Claras and metallurgically similar to Mutuca. Products include DR lump. The concentrator at Tamandua has capacity of 2.1m t/y. The remainder of the run-of-mine ore is transferred to the Mutuca mine by conveyor.

1 x Primary Crusher

Screening

Classification: Hydroclassification + cyclones

Filtering

Thickening

## MUTUCA/CAPITAO DO MATO

In 2000 Mutuca had reserves of 92m tonnes. It was expected to be exhausted by 2003 and replaced by production from Tamandua and Capitaio do Mato.

## Primary Crushing and Transport

In 2001 a primary crushing plant was installed at Capitaio do Mato, designed to process run-of-mine for movement to a new plant at Vargen Grande.

## Beneficiation

The beneficiation plant at Mutuca includes:

Crushing

Screening

Classification: Hydroclassification + cyclones

Filtering

Thickening

In 1995 MBR completed a 4 km conveyor to move ore from Mutuca to Olghos d' Agua stockyard and rail station on the Federal Railway.

In 1999 a new beneficiation plant was built at Vargas Grande, near the Andaime loading station. Crushed ore from Tamandua and the new Capitaio de Mato mines will be treated at the Vargas Grande plant, capacity 8m t/y. The mine at Tamandua started up in 2001 and the mine at Capitaio de Mato was scheduled to start up in 2002.

## PICO/CAPAO XAVIER

In 1991 an expansion project at Pico, 50 km S of Belo Horizonte, commenced, designed to raise capacity from 3m t/y to 11m t/y. This was completed in 1994 at a cost of \$240m.

Hematite from Pico will be exhausted by 2006, after which time production will be from itabirite. In 2002 the company decided to proceed with a new mine at Capao Xavier, close to Mutuca. This was necessary to maintain production of hematite BF lump ore because of exhaustion of Mutuca, Capacity was 8m t/y at a cost of R 263m This ore will be moved via the Olghos d'Agua train loading station.

The project for Capao Xavier (8m t/y at \$263m) had a delay of about one year in obtaining environmental permits. The licence was granted by the state of Minas Gerais in March 2004, but court injunctions prevented the mine starting production. In 16 June 2004 the Capao Xavier project was started up, more than 12 years after initial environmental studies for the project. The capital cost for the project was \$263.. Full capacity of 8m t/y would be reached only after 2005. Capao Xavier was intended to replace Mutuca, exhausted in 2004 after 40 years.

## Primary Crushing and Transport.

Run-of-mine ore is crushed in a semi mobile in-pit primary crusher to –200 mm.

## Beneficiation

Pico has two processing plants, for hematite and itabirite ores. Beneficiation was greatly expanded in Pico's expansion project. New equipment included:

1 x Secondary Crusher

Screening

Classification: Hydroclassification + cyclones

Column flotation:

2x rougher, 3.67m diameter x 14m, supplied by Cominco

1x cleaner, 3.67m diameter x 14m, supplied by Cominco

Filtering

Dam for tailing from ore washing

Products from the plant are hauled on a new 5.2 km belt conveyor to a railcar loading station at Andaime on the Steel Railway.

## TRANSPORT TO SHIPPING POINT

Products from Aguas Claras and Mutuca are loaded to trains at Olghos d'Agua station. Products from Pico (and from the new plant at Vargen Grande) are loaded at

Andaime station. Lines from both sites join at Jaceaba Junction and proceed to the port at Sepetiba Bay.

Operator: Until 1996 Rede Ferroviaria Federal SA, from 1996 MRS Logistica. MRS operates both Steel Railway and Central Railway, both 1.6 metre gauge  
 Reclaim + loading:  
 Distance: Steel Railway: 586 km, Olghos d'Agua station to Guaiba Bay; Central Railway: 639 km, Olghos d'Agua to Guaiba Bay  
 Railcar size: 93.5 tonnes  
 Train size: 120 cars  
 Frequency: Round trip 2.9 days  
 Railway fleet:  
 Railway capacity: 67m t/y

In September 1996 MBR, with Ferteco and other companies, formed a consortium to bid for the concession to operate the 1674 km South East rail network for 30 years. The consortium was the sole bidder in the auction and paid a reserve price of 888.9m reais (\$871m). The consortium operates as MRS Logistica. The ownership of MRS Logistica is:

MBR - 19.72% of ordinary shares; 48.44 of preference shares; 32.53% of total  
 BBA (bank) - 1.59% of ordinary shares; 0% of preference shares; 0.88% of total  
 CSN (steel company, site 1914) - 19.19% of ordinary shares; 48.44% of preference shares; 33.41% of total  
 Fibra (bank) - 2.12% of ordinary shares; 0% of preference shares; 1.18% of total  
 Ferteco (iron ore, site 72) - 17.74% of ordinary shares; 0.21% of preference shares; 9.92% of total  
 Usiminas/Cosipa (steel company, site 1976) - 19.92% of ordinary shares; 0.24% of preference shares; 11.14% of total  
 Gerdau (steel company, site 1939) - 2.15% of ordinary shares; 0% of preference shares; 1.19% of total  
 Celato (transport) - 3.97% of ordinary shares; 0.02% of preference shares; 2.21% of total  
 Ultrafertil (fertiliser) - 8.99 of ordinary shares' 0% of preference shares; 4.98% of total  
 ABS Bradesco (bank) 1.99% of ordinary shares; 0.03% of preference shares; 1.11% of total  
 Others - 2.62% of ordinary shares; 2.62% of preference shares; 2.62% of total

The total ownership of the company was divided as holders of ordinary shares - 55.39%; holders of preference shares - 44.61%

Under the new arrangements, from 1 December 1996 MRS operated both the Steel Railway and the former state railway. Caemi (MBR) owns 20% of MRS.

Railway capacity was raised from 46m t/y to 67m t/y by 2000, with a target of 80m t/y by 2001.

The Steel Railway between Belo Horizonte and Sao Paulo was commissioned in 1995, with 1.6m gauge, including a spur line to CSN at Volta Redonda. Construction was interrupted in 1976. MBR provided finance of \$70m by advance payment for ore movement and the state railway company RFFSA completed a 320 km section between Jeceaba and Saudade. MBR completed a 57.5 km section as part of the Pico expansion project from Jeceaba to Andaime at a cost of \$125m. The railway has capacity of 40m t/y and is designed for 120 car trains with 5 locomotives. It has 10 tunnels and 18 viaducts.

With the opening of the Steel Railway, MBR was able to ship loaded cars on it and return empty cars on the Central Railway.

#### TRANSPORT TO CUSTOMERS

The existing terminal at Sepetiba Bay was built by MBR in 1973 on Guaiba Island in Sepetiba Bay, near Mangaratiba, RJ, 120 km W of Rio de Janeiro. The longstanding name Sepetiba Terminal was changed to Terminal de Ilha de Guaiba (TIG) to avoid confusion with the new Ferteco terminal 15 km away.

Port facilities at Guaiba Island, Brazil include:

Location: 23.30S, 44.02W

Port Authority:

Compahia Docas do Rio de Janeiro  
 Gerencia de Porto de Sepetiba  
 Estrada da Ilha da Madeira, km 18  
 23854-410 Itaguaí, RJ  
 Brazil

Tel: +55 21 2688-1402

Fax: +55 21 2688-1287

Operator: MBR

Berths: 2 (North and South)

Railcar unloading: 4000 t/h car dumper + new car dumper in 2001

Stockyard: 3.0m tonnes live in 3 stockpiles + 2 million tonnes dead

Reclaim: 2 x stacker/reclaimer + 1 x stacker/reclaimer in 2002

Shiploading: 8,400 t/h; 40,000 t/d wwdshinc

Channel depth: 22.5m minimum

Depth alongside: North berth - 19m; South berth - 24m; sailing draft 20 metres

Tide: range 2.22m

Ship maximum beam: 56 metres

Pier length: 470m

Ship maximum length: 350 metres

Ship maximum size: North berth - 100,000 dwt; South berth - 300,000 dwt. Record cargo was 301,764 wlt loaded to Alster Ore in March 1996.

Port capacity: 28m t/y. A new conveyor was proposed for the terminal, with completion by 2005 depending on environmental approvals. This would raise the capacity of the terminal to 30-31m t/y. Target capacity was 32m t/y in 2002 and 34m t/y in 2004.

In 1998 an agreement was reached with Ferteco to coordinate shipping between Ferteco's and MBR's terminals. MBR will load up to 2m t/y of Ferteco cargoes in large vessels at MBR's Guaiba Island terminal. Ferteco will load smaller MBR vessels at its new Sepatiba terminal.

#### MANPOWER

Total employment of MBR was reported as about 2000 in 1997.

#### IRON ORE - 2004

In 2004 the company planned to complete an expansion at \$370m to raise capacity to 40m t/y.

## NOTES - RAW MATERIALS AND LOGISTICS

CVRD - MBR, Aguas Claras

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## MINERAL RESERVES - IRON ORE

The total reserves of deposits held by MBR are 1.5 billion tonnes of hematite averaging 64% Fe. Reserves of itabirite are 4 billion tonnes averaging about 53% Fe.

In March 2003 reserves were stated as more than 1.4 billion tonnes averaging 65% Fe, plus 4.4 billion tonnes of itabirite at 56-645 Fe.

Under a medium-term development plan Aguas Claras will be closed in 2001 and replaced by the new mine at Tamandua and Mutuca will close in 2003 and be replaced by a new mine at Capao Xavier, while Pico will be expanded and a new mine opened at Capitaio do Mato. New reserves found in 1999 in the Sapecado deposit will permit continued production of lump ore at Pico until 2009. The net result of this was intended to be a reduction in lump ore capacity, but an increase in sinter feed fines and sinter feed fines by 1998.

Because of the large reserves of itabirite, MBR was considering pellet capacity in 2001.

## Aguas Claras

In 2000 Aguas Claras were stated as 195m tonnes.

## Mutuca/Capitaio do Mato

In 2000 Mutuca had reserves of 92m tonnes. It was expected to be exhausted by 2003 and replaced by production from Tamandua and Capitaio do Mato.

## Capao Xavier

In 2002 reserves at this deposit were stated as sufficient for 8m t/y for 17 years [136m tonnes of finished products]. In June 2004 reserves at Capao Xavier were stated as 173m tonnes, with an expected mine life of 22 years.

## NOTES - ENERGY

CVRD - MBR, Aguas Claras

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## NOTES - FUTURE PROJECTS

CVRD - MBR, Aguas Claras

site 69

## IRON ORE - UNDATED

Project: Following completion of an expansion, in 2004 the company was considering further expansion

## OUTLOOK

In 2002 our outlook for the operation was stated as:

"From 1997 to 2001 ownership of MBR was 86.4% by the Caemi group of Brazil (which since 1997 is itself owned 40% by Mitsui & Co.), 8.6% by other Japanese companies and 5.0% by Bethlehem Steel. In 2000 CVRD and Mitsui acquired Caemi and bought Bethlehem's share.

The company mines high-grade hematite in the Belo Horizonte area of Minas Gerais at the Aguas Claras, Mutuca and Pico Mines. Total capacity is: 6.9m t/y BF lump; 2.7m t/y DR lump; 18.0m t/y sinter fines; 4.0m t/y pellet feed for sale.

Ore from these mines is crushed and screened. DR lump is produced at Mutuca and MBR is the largest supplier of DR lump selling plants in several countries. Japanese buyers have contracts for about 7m t/y of BF lump, sinter fines and pellet feed (for Kobe Steel) from MBR from 1994 but the largest sales are of sinter feed in Europe, with some shipped to Bethlehem in the USA..

Aguas Claras has reserves of 195m tonnes and Mutuca 92m tonnes, whereas the total reserves of deposits held by MBR is 1.5 billion tonnes of hematite average 64% Fe. Reserves of itabirite, about 53% Fe on average, are 4 billion tonnes. Under a medium-term development plan Aguas Claras will be closed and replaced by a new mine at Tamandua and Mutuca will be replaced by a new mine at Capao Xavier, while Pico will be expanded. The net result of this will be a reduction in lump ore capacity, but an increase in sinter feed and pellet feed by 1998.

MBR also committed major investment in railway capacity by participating in the Ferrovia do Aco (Steel Railway) project. The purpose of this was to build another route from Belo Horizonte to the Rio area in order to avoid the capacity limits of the existing state railway link. With the opening of the new railway in 1993 MBR was able to ship loaded cars on it and return empty cars on the state (RFFSA) system, effectively doubling rail haulage capacity to MBR's terminal in Sepetiba Bay near Rio. In 1996 MBR participated in the privatisation of this railway (now MCS Logistica).

At Sepetiba ships to 250,000 dwt can be handled (record cargo 271,000 tonnes). The Sepetiba terminal changed its name to Guaiba Island in order to void confusion with the new Ferteco terminal, 15 km away.

The large investment by MBR places the company strongly for the long term and we estimate that the company has some of the lowest costs in the industry while having premium products."

## NOTES - CONFIDENTIAL

CVRD - MBR, Aguas Claras

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Site	125	personal	<input type="checkbox"/>	production	<input checked="" type="checkbox"/>
Shortname	CVRD - Northern	ferro-alloys	<input type="checkbox"/>	office/sales	<input type="checkbox"/>
Name	CVRD - Northern Iron Ore System	iron ore	<input checked="" type="checkbox"/>	trader	<input type="checkbox"/>
Address1	Carajas Mine	iron + steel	<input type="checkbox"/>	supplier	<input type="checkbox"/>
Address2		energy	<input type="checkbox"/>	scrap	<input type="checkbox"/>
City	Carajas, Maraba	bx/alumina	<input type="checkbox"/>	equipment	<input type="checkbox"/>
State	Para	Phone	91 327-1232	primary	<input type="checkbox"/>
Zip		Fax	91 327-4004	secondary	<input type="checkbox"/>
Country	Brazil	Email		rolled	<input type="checkbox"/>
Code	<input type="checkbox"/>	Internet		extruded	<input type="checkbox"/>
Updated	05 July 2005	EU VAT		castings	<input type="checkbox"/>
				other	<input type="checkbox"/>
				legal	<input type="checkbox"/>

NOTES - GENERAL

This site is the iron ore operation of CVRD's Northern System. The company head office is as site no. 547. See CVRD – Southern System (site no. 5745) for general history and ownership.

From 1981 CVRD's operations were divided into two: Northern and Southern systems. The Northern system is based around the open pit mine at Carajas in Para state in the Amazon region.

The deposit at Serra dos Carajas was found by chance in August 1967 by a survey team seeking manganese ore from US Steel's subsidiary Cia. Meridional de Mineracao between the Tocantins and Xingu rivers, 550 km from Belem.

Amazonia Mineracao was set up in 1970, owned by US Steel 49% and CVRD 51%. US Steel had the right to buy up to 50% of the ore and CVRD had the exclusive right to marketing. A drilling programme was completed in 1972. In 1977 US Steel sold its share to CVRD in return for \$52m for work done.

In 1980 CVRD decided to proceed with the project. The mine was developed on the basis of long-term contracts with steelmakers in Europe and Japan, including an agreement signed in 1981 with 7 Japanese mills for 145.5m tonnes over 15 years from April 1985, and extended in 1991 with a further agreement for 9m tonnes over 9 years from April 1992. 15-year contracts were signed for a further 14m t/y with European steel mills before the start of production, with another major contract also with Posco of South Korea. Export shipments began in June 1986.

In 1982 the World Bank signed a contract to support the project.

Total project cost up to the end of 1987 was \$5.094 billion. The original 1981 budget and the actual cost for capacity of 25m t/y in 1986 were: (\$m)

Mine: budget - 628; actual - 439  
 Railway: budget - 2127; actual - 1549  
 Port: budget - 258; actual - 251  
 Townsites: budget - 198; actual - 167  
 Total fixed assets: budget - 3211; actual - 2406

Accords: budget - 0; actual - 87  
 Engineering: budget - 149; actual - 145  
 Administration + inspection: budget - 551; actual - 418  
 Pre-operating expenses: budget - 739; actual - 715  
 Contingencies: budget - 440; actual - 34

Total: budget - 4930; actual - 3805

Financing for the project included:

European Coal & Steel Community loan - \$600m  
 World Bank loan - \$304m  
 Eximbank of Japan loan - \$50m  
 Japan bank + Exim syndicate - yen 65 bn + \$250m  
 Japanese syndicate loan - yen 39 bn + \$150m  
 Kreditanstalt fur Wiederaufbau loan - \$130m  
 Morgan Guaranty loan - \$27m  
 European suppliers' credits - \$37m  
 Japanese suppliers' credits - \$36m  
 US Eximbank loan - \$58m  
 US bank loans - \$200m

The loan of \$150m from the Japanese syndicate was for 10 years with a 4-year grace period, with part of the interest rate at base rate + 0.4%, with the remainder at a floating rate. The loan of \$250m was by Japanese banks and Exim bank to Nippon Carajas Iron Ore Co., to be passed on to the project. Only 43.2 billion yen was needed from this loan. Terms were 15 years with a 5-year grace period at 8.61% per annum for the period from 1 January 1988. The ownership of Nippon Carajas Iron Ore are:

Nippon Steel - 39.0%  
 NKK - 17.1%  
 Sumitomo Metal Industries - 15.1%

Kawasaki Steel - 15.6%  
Kobe Steel - 9.3%  
Nisshin Steel - 3.2%  
Nakayama Steel - 1.7%

The first shipment of Carajas ore was loaded at Itaqui and left on 5 May 1985 (30356 tonnes of sinter feed fines for Nippon Steel. The first cargo left Ponta da Madeira on 6 January 1986 (126883 tonnes of sinter feed fines for Nippon Steel, Oita),

In 1995 the mine reached initial full capacity of 35m t/y and was expanded to a revised full capacity of 44m t/y in 1995.

In 1993 development of a joint mine venture (CVRD 51%; China Metallurgical Import & Export Corporation 49%) was proposed, with capacity of 8m t/y at the N4E deposit.

In 1998 the company announced construction of a DR pellet plant at Sao Luis. This was completed in early 2002 at a cost of \$407m for capacity of 6m t/y.

## NOTES - PRODUCTS AND MARKETS

CVRD - Northern, Carajas, Maraba

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## IRON ORE - PRODUCT RANGE

The products of the Northern System are:

natural lump  
sinter fines  
DR pellet fines  
DR pellets  
BF pellets

## IRON ORE - PRICES

2002

prices to Thyssen Krupp were settled on 29 May 2002 after the longest negotiation ever at: Carajas fines: 29.31

2003

to Thyssen Krupp, settled around 18 June 2003 (c/dmtu, FOB Ponta de Madera): Sao Luis pellet - 52.96; Carajas lump - 37.36

## IRON ORE - MARKETS

## DR fines

With the development of the DRI industry, equipment was installed to re-screen fine ore to yield DR fines suitable for the iron carbide or new fines based processes such as Iron Dynamics. DR fines were produced from 1998. CVRD Northern has capacity for 0.9m t/y of DR fines. These were supplied to Cleveland Cliffs Circored plant in Trinidad.

## Sinter fines

The bulk of production is sinter feed fines at -9.5 mm. Initial production of sinter feed fines was in 1995. CVRD Northern has capacity of 44m t/y for sinter fines. The mine was developed on the basis of long-term contracts with steelmakers in Europe and Japan, including an agreement signed in 1981 with seven Japanese mills for 145.5 million tonnes over 15 years from April 1985 and extended in 1991 with a further agreement for 9m. tonnes over 9 years from April 1992. 15-year contracts for a further 14m t/y were signed with European steel mills before the start of production, with another major contract also with Posco of South Korea. In practice Carajas ore is delivered within Europe to Germany, Belgium, Spain, France, Italy and the UK. Sales are also made to other markets on a smaller scale.

Contracts with Japanese buyers for Carajas ore were:

## Basic Agreement

Period: 15 years April 1986 to March 2000

Quantity: total 145.5m tonnes at 10.0m t/y + 10% at buyers option; minimum 80% guaranteed by buyers.

Product: sinter fines with lump shipped as single year contracts, expected to be 500-800,000 t/y in 1988 to 1991.

Price: annual prices; 6% discount for quantities above 50% of the base quantity

Purchasers: lead mill was Nippon Steel. Expected average normal quantities were (000 tonnes):

Nippon Steel: 3700

NKK: 1600

Kawasaki: 1600

Sumitomo: 1500

Kobe: 950

Nisshin: 450

Nakayama: 200

Total: 10000

## Core Extension Contract

Period: 7 years April 2001 to March 2008

Quantity: total 63.0m tonnes at 9.0m t/y +/- 10% at buyers option

Product: sinter fines

Price: annual prices

Purchasers: lead mill was Nippon Steel. Expected average normal quantities were (000 tonnes):

Nippon Steel: 3300

NKK: 1470

Kawasaki: 1480

Sumitomo: 1310

Kobe: 880

Nisshin: 400  
Nakayama: 160  
Total: 9000

#### Flex Extension Contract

Period: 3 years April 2001 to March 2004

Quantity: total: 4.2-7.8m tonnes at 1.4 to 2.6m t/y

Product: sinter fines

Price: annual prices

Purchasers: lead mill was Nippon Steel. Expected average normal quantities were (000 tonnes):

Nippon Steel: 510-950

NKK: 230-420

Kawasaki: 230-430

Sumitomo: 200-380

Kobe: 140-260

Nisshin: 60-100

Nakayama: 30-50

Total: 1400-2600

From March 2002 Nakayama was not able to take tonnage as its blast furnace was closed.

Pellet fines

CVRD Northern has capacity of 1m t/y of DR pellet feed fines for sale. Sales has been made to Imexsa (Mexico) and Iran, but sales have been limited in recent years. Sales of BF pellet fines has been made at about 1.2m t/y to the pellet plant of Kobe Steel in Japan. This product was sold as sinter fines.

#### BF lump

CVRD Northern has capacity of 6m t/y of BF lump. Lump from Carajas is exported in small quantities, but is used mainly to supply independent blast furnaces in northern Brazil. Natural pellet/lump ore is also produced at -32 + 9.5 mm at up to 10% of production, rising eventually to 15% of production. In 2002 CVRD claimed to be the largest supplier of lump ore to Europe, with sales of over 5m tonnes

#### DR pellets

In 1998 CVRD committed the construction of a new DR pellet plant at Sao Luis to use pellet fines from Carajas.

In 2002 CVRD signed a 5-year contract with Ispat group for DR pellets, to be delivered from Sao Luis. In September 2002 the first shipment from the pellet plant was 60,000 tonnes Caribbean Ispat. The contract was for 2.5m t/y from 2003.

Pellet production at Sao Luis was:

2002, expected in March 2002: 2m tonnes (plus 23m tonnes from Tubarao);

2002, expected in August 2002: 1m tonnes mainly DR pellets for Carribbean Ispat

2003 expected in December 2002: 4.0-4.5m tonnes, limited by shiploading capacity. The No.3 pier is scheduled to be built in 2004, raising total export capacity from the port from 52-53m t/t to 70m t/y. In August 2003 production was expected to reach an annual rate of 6m t/y by the end of 2003.

### NOTES - TECHNOLOGY AND OPERATIONS

CVRD - Northern, Carajas, Maraba

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#### IRON ORE - CURRENT OPERATIONS

##### MINING

In 1986 mining commenced at N4E deposit. In 1994 development of part of the N4W deposit (central) began. In 1997 N4E deposit reached the water table and capacity was reduced from 35 to 20m t/y. Mining started in N4W (northern) deposit, which would permit 20 years of operations from N4W. In 1998 mining started at N5. In 2000 3 of the 63 deposits in the Carajas area were being worked.

A decision on the development of Serra Lesta (initially 2m t/y), was expected in 2002. This operation would require a small beneficiation plant.

Mining operations are on 2 x 9 hours and 1 x 6 hour shifts, 7 days a week.

At the N4E mine ore of over 65% Fe is mined and converted to sinter feed fines with a minimum of processing. The orebody is expected to yield 83% sinter feed fines and 17% coarse ore. Of the fines, natural sinter feed fines comprises 60-65% of the mineable ore, with 18-23% below 150 microns (100 mesh) and therefore possible for sinter feed fines. Run-of-mine ore was expected to have the following sizing:

Carajas Run-of-Mine Ore  
(cumulative %)

+ 254 - 4

+ 127 - 9

+ 51 - 17

+ 25 - 26

+ 13 - 37

+ 6 - 50

##### Drilling and Blasting

In 1985 initial development consisted of removing 11m tonnes of cnaga (overburden).

In 1985 mining started in the N4E orebody at 745m above sea level. In 1996 the mine was at 520m and mining will end at 340m. Mining is on 15m benches. 80% of the deposit is soft hematite requiring light blasing. 15% is hard hematite and 5% is blue dust. Hard hematite and canga require blasting. In total some 30% of the ore requires blasting. Drilling creates 250 mm holes. Equipment includes:

##### Rotary drills

1 x D80K, 251 mm holes

1 x D80K, 311 mm holes

2 x 45RI, 251 mm holes

ANFO is used at 0.15 per tonne blasted.

The overall ratio of waste to ore on the N4E deposit is 0.47. For the first 15 years of operation 1985-2000 the average ratio was expected to be 0.15. In 1995 89.4m tonnes of material were mined to yield 52.8m tonnes of run-of-mine ore (waster:ore ratio 0.70) and 43.2m tonnes of product (81.8% recovery of ROM ore to product). The average ratio of waste to ore was reported as:

1987: 0.40  
 1988: 0.31  
 1989: 0.29  
 1990: 0.62  
 1991: 0.65  
 1992: 0.63  
 1993: 0.64  
 1994: 0.60  
 1995: 0.68  
 1996: 0.93  
 1997: 0.73  
 1998: 0.54  
 1999: 0.43  
 2000: 0.50

#### Loading

Broken ore and waste are loaded by shovels. Equipment include:

#### Shovels

1 x P&H 2800XTB electric rope shovel, 29.1 m3 (38 yd3)  
 1 x H4855 electric rope shovel, 22.9 m3 (30 yd3)  
 1 x Bucyrus Erie 295BII electric rope shovel, 16.8 m3 (22 yd3)  
 2 x H485 electric rope shovels, 16.8 m3 (22 yd3)  
 3 x Bucyrus-Erie BC electric rope shovels , 9.2 m3 (12 yd3); added in Phase 2  
 1 x P&H electric rope shovel, 6.9 m3 (12 yd3)

#### Wheel loaders

3 x Marathon LeTourneau L1800, 16.8 m3 (22 yd3)  
 2 x Marathon LeTourneau L1100  
 3 x Caterpillar 992C, 6.9 m3 (9 yd3)

#### Bulldozers

17

#### Wheel tractors

4

#### Mine Haulage

Run-of-mine ore and waste is loaded to trucks. Average haul for ore is 1.3 km in the northern section and 1.5 km in the southern section. Maximum grade against the load is 8%. Equipment includes:

#### Trucks

6 x Wabco Haulpak diesel electric, 218 tonnes, 2000 HP  
 8 x Dresser, diesel electric, 218 tonnes, 2250 HP  
 15 x Caterpillar diesel mechanical, 218 tonnes  
 9 x Caterpillar diesel mechanical, 172 tonnes; added in Phase 2  
 5 x Euclid R170 diesel electric, 170 tonnes

3 x Wabco Haulpak, diesel electric, 120t; retired  
 3 x Terexc, 35t; retired

#### Motor graders

6

#### Water trucks

4

### PRIMARY CRUSHING

The primary crusher is at the plant.

### BENEFICIATION

At the plant ore is unloaded from trucks to a grizzly and passes to the primary crusher. Equipment includes:

1 x Primary Crusher: 1.22m x 1.88m (48 x 74 inch), gyratory, 500 HP motor; 50m t/y  
 3 x Secondary Crushers: 2.14m (84") cone, 500 HP motor each  
 6 x Tertiary Crushers: 2.14m (84") cone, 500 HP motor each  
 2 x Rod mills  
 Classifiers: spiral

The primary crusher reduces ore to -200 mm. Ore is further crushed in the secondary crushers to -50 mm. Tertiary wet screen crushing reduces the ore to -20 mm. All +20 mm product is natural pellet/lump ore. All 9.5 mm product from the crushers is finished sinter feed fines. Ore at -20 +9.5 mm is fed to rod mills at 460 t/h. Output from these mills is fed to spiral classifiers.



Of the total feed to the plant, 73% is sinter feed fines, 10% natural pellet/lump ore, 17% reject tailings. Siliceous sinter feed fines can also be produced by adding silica in the rod mills.

In 1995 \$3.5m was spent on a pilot plant for converting part of the tailings to sinter feed fines.

In 1996 it was decided to spend \$7m on a plant of 0.9m t/y to screen sinter feed fines to produce DR fines for a contract for Cleveland Cliffs' Circored DRI plant in Trinidad and Qualitech's iron carbide plant in USA. The plant passes normal sinter feed fines over screens sprayed with water, with openings of 1.0 and 0.15 mm. Oversize is returned as sinter feed fines, undersize goes for processing as sinter feed fines. The product is sized fines at  $-1.0 + 0.15$  mm. In 1998 this plant was expanded to 2m t/y at a cost of \$8m.

Products are stacked with 2 stackers at 2 x 5000 t/h to a stockpile with capacity of 1m tonnes sinter feed fines and 0.4m tonnes lump. Ore is reclaimed with 2 x 8000 t/h bucket wheel loaders to conveyors for movement to 2 silos at the rail loading station.

#### TRANSPORT TO AGGLOMERATION AND SHIPPING POINT

Ore is loaded at the mine site from silos to railcars and moved on the company's railway to the port of Ponta da Madeira at Sao Luis, Maranhao State.

Operator: CVRD

Train loading: 2 x 2500 t/h, 28 seconds per car

Distance: 890 km single track, Carajas to Ponta da Madeira, with 47 spur tracks

Railcar size: 101 tonnes

Train size: 204 cars + 3 locomotives

Frequency: 5 trains per day

Railway fleet: Locomotives: for 15m t/y 33 x 3000 HP new + 14 x 2700 HP used; for 25m t/y a further 18 x 3000 HP were added

Railcars fleet: for 15m t/y 1446 cars; for 25m t/y 2198 cars; fleet from 1997 3066 cars

Railway capacity: 55m t/y nominal, actual in 2992 59.5m tonnes

The railway is 1.6m gauge using 12m rail at 68 kg/m welded into 368m spans. The maximum upgrade is 0.4% on the outward trip and 1% on the return trip.

Trains require 3 x 3000 HP locomotives to move the load to kilometre 591. Two more locomotives are added for the up-grade of 0.4% to kilometre 455. The train continues for the rest of the journey with 3 locomotives. The round trip takes 49 hours (24 hours laden, 5 hours load/unload, 20 hours return). Maximum speed on loaded trains is 65 km/h, on empty trains 80 km/h, average speed is 48.2 km/h.

In June 2003 the Gavião Indians in Marabá, Pará state blockaded the railway at point 46 as part of a demand for a doubling of the payment of R 122,000 per month which is paid by CVRD for rights over their land, plus a new payment of R800 per month to each of 140 Indians selected by their chiefs, plus construction of 20 houses. CVRD stated that it expected to pay R10.5m to 7 native communities in Pará state in 2003, as it had for more than 20 years.

#### AGGLOMERATION

In 1998 CVRD announced the construction of a DR pellet plant at Sao Luis, to use feed from Carajas, capacity 6m t/y, to be operated by Norpel – Pelotizacao do Norte SA (owned 99.90% by CVRD). In September 1998 it was decided to stop construction for 6 months because of weak market conditions. The project was re-started and scheduled for completion in 2002. As part of the project a new stacker/reclaimer for the Carajas mine (12,000 t/h) and a stacker (2,000 t/h) for the port were ordered in 2001 from Techint. The capital costs for the project were expected to be:

Sao Luis Pellet Plant (\$m)

Pellet plant	284
Mine expansion	60
Railway expansion	23
Port expansion	40
Total	408

In early 2002 the project was completed at a cost of \$407m. Products from the pellet plant will be moved 5-6 km to the port of Ponta da Madeira by conveyor. On 26 May 2002 the pellet plant at Sao Luis was officially opened. In 2002 production started. Capacity was 6.0m t/y at a cost of \$355m, including construction of Pier 3 at Ponta da Madeira at \$29m. This project raised the total capacity of the Northern System from 56 to 62m t/y.

#### TRANSPORT TO CUSTOMERS

Shipping is via the dedicated port and terminal at Ponta da Madeira on Sao Luis island in San Marcos Bay, 9 km SW of Sao Luis, capital of Maranhao state, and 1.5 km N of the port of Itaqui. The port was built at a cost of \$187m, opened in 1986. In 1994 pier 2 was built at a cost of \$25m, financed by Nissho-Iwai, to raise loading capacity from 35m t/y to 50m t/y. pier 2 was built as an extension of Itaqui dock, formerly a commercial dock for the port of Sao Luis, leased by CVRD since 1994.

In 1996 CVRD announced investment of \$30m for port improvements, including No.5 stockyard, with new No.3 stacker and No.3 reclaimer.

In 2001 as part of the project for CVRD's pellet plant a 2000 t/h stacker for pellets was installed at the port, supplied by Confab.

In 2003 Pier No.3 was opened, raising total port capacity by about 18m t/y. In 2004 the company allocated \$12m for an expansion at Pier III to raise total port capacity to 85m t/y by 2006.

In May 2004 the ship Cape Africa, 150,000 dwt owned by U-Ming Marine Transport Corp, Taiwan with crew of 18, carrying iron ore from Ponta da Madeira for Nippon Steel was holed off South Africa. 1800 tonnes of fuel oil were removed and the ship was towed to Cape Town

Iron ore port facilities at Ponta da Madeira, Brazil are part of the port of Itaqui:

Port Authority:

EMAP - Empresa Maranhense de Administracao Portuaria

Porto de Itaqui-

65085-370 Sao Luis, MA

Brazil

Tel: +55 98 216 6000



Fax: +55 98 216 6060  
e-mail: itaqui@empa.ma.gov.br  
www.portodoitaqui.ma.gov.br

Terminal Operator:  
CVRD  
Tel: +55 98 218 4233  
Fax: +55 98 218 4019

Location: Lat: 2.34S; Long 44.23W, 3.2 km N. of Itaqui  
Area: 2200 hectares

#### Pier No.1

Built: 1986  
Operator: CVRD  
Railcar unloading:  
Stockyard: 1.2m tonnes at mine; 4.5m tonnes total at port  
Reclaim: loading to a conveyor of 2 km to the loading berths  
Pier: 238.5m; length between outer dolphins: 480 metres; protected by two breakwaters  
Shiploading: 2 x 16000 t/h  
Depth alongside: 23 m  
Channel: Average width 1800m; draft 23-25m, minimum 23m  
Ship maximum beam: 67.5 m  
Ship maximum length: 343 m  
Ship maximum size: 420,000 dwt (previously 350,000 dwt), which exceeds the size of any existing ship. The world's largest iron ore carrier (Berge Stahl: 67.5m beam, 343m long, 23m draft, 13.5 knots, 350,000 dwt) was built to operate between this port and Rotterdam for German steel mills. The world record cargo was established by this ship in October 1995 at 361220 tonnes.

#### Pier No.2

Built: 1994  
Operator: CVRD  
Railcar unloading:  
Stockpile:  
Reclaim:  
Pier: 280 metres  
Shiploading: 1 x 8000 t/h  
Depth alongside: 17.5 metres  
Channel: 23-25 m  
Ship maximum beam:  
Ship maximum length: 280 m  
Ship maximum size: 160,000 dwt

#### Pier No.3

Built: scheduled to be built in 2001, completion delayed to January 2004. The pier was added to handle products from the pellet plant at Sao Luis  
Operator: CVRD  
Railcar unloading: Railcar tippler + 1 x stacker, Confab/Techint, 2,000 t/h)  
Stockpile:  
Reclaim:  
Shiploading: 1 x 8,000 t/y  
Depth alongside:  
Channel:  
Ship maximum beam:  
Ship maximum length:  
Ship maximum size:  
Total Port Capacity: completion of Pier 3 raised total port capacity to 52-53 million tonnes per year, rising to 70m t/y in 2004.

#### UTILITIES

Power supply to the mine site is by a 230 kV line from the Tucuruí hydroelectric project.

#### MANPOWER

Employment for 25m t/y was reported as 1640 for mine, 1890 for the railway and 500 for the port.

#### IRON ORE - 2004

Project: Expansion  
Capacity: The project was to add 14m t/y of capacity at Carajas  
Cost: The expected cost of the expansion was \$195m. This would bring the total capital cost for Carajas capacity of 70m t/y from the start of the project to \$4 bn.  
Progress: completion of the project was scheduled for 2004 Q1. This had been brought forward to coincide with the opening of No.3 berth at Ponta da Madeira. This would raise capacity at Carajas from 56 to 70m t/y. Completion was originally scheduled for 2004 Q4

## NOTES - RAW MATERIALS AND LOGISTICS

CVRD - Northern, Carajas, Maraba

site 125

## MINERAL RESERVES - IRON ORE

The Carajas deposits are located 550 km S of Belem and 100 km SW of Maraba in Para State. They are on a plateau 300 m above the surrounding jungle at an altitude of 700-800 m.

The drilling programme completed in 1972 showed at least 16 billion tonnes of high grade ore averaging 66.5% Fe and 2.2% Al<sub>2</sub>O<sub>3</sub> + SiO<sub>2</sub> and 0.05% P. 75% of the ore is soft hematite of size below 9.5 mm. The rest of the orebody is hard hematite.

The orebodies are found in 4 areas: Serra Norte (N), Serra Sul (S), Serra Leste (SL) and Serra Sao Felix (SF). At 1 January 1996 the geological reserves of the Carajas area were estimated at 17.5 billion tonnes, averaging 66.1% Fe in 38 orebodies in these 4 areas. In 2000 reserves in the Carajas area were stated as 17.4 billion tonnes.

The first orebody to be mined was N4E, being 4.5 km long, 600m wide 400m deep, and with initial reserves of 1.365 billion tonnes and mineable reserves of 1.243 billion averaging 66.3% Fe. Reserves in N4W were 1.2 billion tonnes. The next orebody to be developed was N5. The fourth orebody to be developed would be Serra Lesta, 100 km from the N4E, N4W and N5. In 2000 reserves at Serra Leste were stated as 400m tonnes.

Reserves were stated by Japanese sources as (m tonnes and % Fe):

Serra Norte:

N1: high grade - 794 at 66.8% Fe; medium grade - 59 at 61.1%; total: 854

N2: high grade - 101 at 66.4% Fe; medium grade - 9 at 61.0% Fe; total: 111

N3: high grade - 243 at 66.1% Fe; medium grade - 55 at 60.1% Fe; total: 297

N4: high grade - 2622 at 66.65 Fe; medium grade: 557 at 61.1% Fe; total: 3178

N5: high grade: 1371 at 67.1% Fe; medium grade: 208 at 60.1% Fe; total: 1579

N8: high grade: 124 at 66.4% Fe; medium grade: 28 at 62.1% Fe; total: 152

S11: high grade: 9475 at 66.8% Fe; medium grade: 860 at 61.15 Fe; total: 10335

SL1: high grade: 201 at 67.8% Fe; medium grade: 76 at 60.6% Fe; total: 277

SL2: high grade: 120 at 66.9% Fe; medium grade: 17 at 62.6% Fe; total: 137

SF1: high grade: 175 at 66.5% Fe; medium grade: 194 at 59.5% Fe; total: 369

Others: high grade: 524 at 66.8% Fe; 71 at 60.8% Fe; total: 595

In 2004 a statement of reserves showed (m tonnes and % Fe):

N4E: 800 at 66.18% Fe average

N4W: 1500 at 65.93% Fe average

N5N: 800 at 66.49% Fe average

Other: 900

Total: 4000

## NOTES - ENERGY

CVRD - Northern, Carajas, Maraba

site 125

## NOTES - FUTURE PROJECTS

CVRD - Northern, Carajas, Maraba

site 125

## IRON ORE - 2005

Project: Expansion of Carajas

Status: In November 2003 the company indicated that further expansion of Carajas from 70 mn to 85 mn t/y by 2006 was possible. This would require another shiploader at Ponta da Madeira, more sidings on the railway and more ore beneficiation plants. These investment would be discussed. In December 2003 the company brought this project forward to completion in 2005.

Capacity: Increase in capacity of 15 mn t/y of sinter fines. The increase of 15m t/y was scheduled for completion in 2005, with full production of 85m t/y in 2006.

Cost: Expected cost for the expansion to 85m t/y was \$325m

## IRON ORE - 2006

Project: Expansion of Sao Luis DR pellet capacity

Status: In March 2004 the company stated that pellet capacity production at Sao Luis was expected to rise by 7mn t/y by 2006.

Capacity: Increase from 6 to 7 mn t/y.

## IRON ORE - UNDATED

Project: Expansion of Carajas

Status: In 2005 a further increase to 100 mn t/y required board approval.

Capacity: Increase in capacity for sinter fines from 85 to 100 mn t/y by 2007. By 2010 CVRD expected to be using new deposits with 11 bn tonnes of reserves. This would require construction of a 100 km spur line and could increase the capacity of Carajas to 200 mn t/y by 2020.

## OUTLOOK

In 2002 our outlook for CVRD was stated as:

"Companhia Vale do Rio Doce (CVRD) is the world's largest supplier of iron ore. CVRD was privatised in 1997. The company's operations are now divided into two distinct segments. The CVRD Northern System is based around the open pit mine at Carajas in Para state in the Amazon region. Ore of over 65% Fe is mined and converted to sinter feed with a minimum of processing. It is moved on the company's own railway 890 km to the dedicated port of Ponta da Madeira at Sao Luis in

Maranhao state. The normal maximum vessel at this port is 280,000 dwt, but in practice the world's largest iron ore carrier (Berge Stahl at 350,000 dwt, record load 356,000 tonnes) was built to operate between this port and Rotterdam for German steel mills.

Our forecasts indicate that CVRD's Northern System will need to produce by 2020 0.8m t/y of DR fines.

Mineable reserves in the Carajas region are estimated at around 18 billion tonnes and the reserves of the orebody now being mined (N4E) are 1.2 billion tonnes averaging 66.9% Fe, sufficient for around 30 years production. Further development of orebodies in the Carajas region will be necessary in the long term, but reserves are more than adequate for the foreseeable future. Carajas also provides the possibility of expansion to meet any long-term requirements for additional sinter feed. Despite the enormous capital cost for mine development, railway and port, the production costs of Carajas ore are low and will provide the baseline for competition in the iron ore market for many years."

Site	5745	personal	<input type="checkbox"/>	production	<input checked="" type="checkbox"/>
Shortname	CVRD - Southern	ferro-alloys	<input type="checkbox"/>	office/sales	<input type="checkbox"/>
Name	CVRD - Southern Iron Ore System	iron ore	<input checked="" type="checkbox"/>	trader	<input type="checkbox"/>
Address1		iron + steel	<input type="checkbox"/>	supplier	<input type="checkbox"/>
Address2		energy	<input type="checkbox"/>	scrap	<input type="checkbox"/>
City	Tubarao, Vitoria	bx/alumina	<input type="checkbox"/>	equipment	<input type="checkbox"/>
State	Espirito Santo	primary	<input type="checkbox"/>	consultant	<input type="checkbox"/>
Phone	27 335-5881	secondary	<input type="checkbox"/>	trade body	<input type="checkbox"/>
Fax	27 228-1424	rolled	<input type="checkbox"/>	publisher	<input type="checkbox"/>
Country	Brazil	extruded	<input type="checkbox"/>	financial	<input type="checkbox"/>
Code	<input type="checkbox"/>	castings	<input type="checkbox"/>	government	<input type="checkbox"/>
Internet		other	<input type="checkbox"/>	legal	<input type="checkbox"/>
EU VAT					
Updated	05 July 2005				

NOTES - GENERAL

This site is the southern iron ore system of CVRD, mainly in the state of Minas Gerais in Brazil.

Information on the headquarters operations of CVRD is under site 547.

CVRD – SOUTHERN SYSTEM AND PELLET PLANTS

General

Companhia Vale do Rio Doce (CVRD) is the world's largest supplier of iron ore.

CVRD was founded in 1942 when representative from the USA, UK and Brazil met in Washington to look for alternative sources of iron ore. CVRD was formed from two companies: Cia. Brasileira do Mineracao e Sidergica SA, which had taken over Cia. Itabira de Mineracao SA (UK owned as British Itabira Iron Co.) in 1940, and Estrada de Ferro Vitoria e Minas, formed in 1901 to build the railway from Minas Gerais to Vitoria. British Itabira Iron Co. acquired the rights to Caue, Conceicao and Dois Corregos deposits and control of the Virotia-Minas railway. The Brazilian government took over British Itabira Iron Co. in the 1930's.

The first shipments of products were made from the Vitoria area in 1954. By 1957 the company had reach capacity of 1.5m t/y.

Until privatisation in May 1997 the company was 100% owned by the Brazilian state. In 1997 41.73% of CVRD was sold to a consortium for \$3130 million. In 1998 the government planned to sell its remaining holding of 29%, but this was delayed by stock market conditions. CSN subsequently became the largest shareholder in the Valepar group. In 2000 Billiton bought for \$327.3m from George Soros 39.06% of the voting shares of Sweet River Investments Ltd. This gave BHP Billiton a holding of 69.97% in Sweet River. At the time Sweet River Investments owned 7.75% of Valepar, equivalent of 2.1% of CVRD. Subsequent changes of shareholding led to ownership in 2001 as:

- Valepar - 34.0%
- Pension funds - 13.0%
- Others - 24.0%
- State - 29.0%

Ownership of Valepar was:

- Litel Participacoes - 39.0%
- CSN - 25.0%
- BNDEspar - 9.0%
- Employees stock fund - 1.0%
- Electron SA - 17.0%
- Sweet River Investments - 9.0%

In 2001 CSN sold its holding in CVRD and the Brazilian government and BNDEspar held 32% of the shares. At the same time CVRD sold its holding in CSN. In 2002 the government announced its intention to sell its 32% shareholding in CVRD to private investors.

In January 2003 BHP Billiton (with other shareholders Bank of America, Goldman Sachs and Lehman Brothers) allowed CSN to exercise an option to buy Sweet River Investments' holding in Valepar of 11.56%. BHP Billiton was expected to received \$343m for its holding of 69.97% in Sweet River. Valepar owned 27% of CVRD. By this action CSN acquired 0.1156 x 0.27 = 0.0312 (3.12%) of CVRD. [The implied total cost of this 3.12% was \$512m]

In April 2003, at the same time as a restructuring of holdings in New Caemi, Mitsui agreed to buy a holding of 15% in Valepar from BNDEspar for \$830m. In July 2003 Capital Resources and Management Company, USA bought 5.0% of the voting capital of CVRD via American Depositary Receipts for an estimated \$1.5 bn. An associate of CRMC, Capital Group International Inc. already controlled 4.99% of the voting shares. At that time ownership of CVRD was reported as:

- Valepar (control group) - 33.6%
- publicly traded - 32.1%
- Government of Brazil - 1.3%
- financial institutions and company pension plan - 43.0%

At the time of privatisation in 1997 CVRD had significant shareholdings in other iron and steel companies:

- CST – Siderurgica de Tubarao - 22.69%

Usiminas - 7.74%  
 Acominas - 5.00%  
 CSN - 9.85%  
 California Steel, USA - 50.00%  
 Siderar, Argentina - 4.85%

In 1999 the Secretaria de Direito Economico concluded that CVRD should sell holdings in Brazilian steel companies for anti-trust reasons. CVRD sold its holding in CSN in 2000. Those shares ultimately passed to the new owners of CSN, Vincunha Group. Under the terms of the sale CVRD acquire rights to market surplus iron ore from CSN's mines.

In the period 1981-2000 CVRD's operations were divided into two: Northern and Southern systems. The Northern system is based around the open pit mine at Carajas in Para state in the Amazon region. This is described in a separate profile.

The major expansion of CVRD's Southern System was based on the development of a number of mines in the Iron Quadrilateral of Minas Gerais state, including Caue, Conceicao, Dois Corregos, Picarrao, Timbopeba and Capanema. Those mines remain the major producers, as other mines (Caraca, Periquito, Sao Luiz, Tamandua) have been closed through exhaustion since the mid 1980's.

In 2001 CVRD proposed development of a new mine of 8m t/y as a 50:50 joint venture with Shanghai Baogang (Boavale), to supply the steel plant at Baoshan. The basis for this development was Samitri's Agua Limpia mine. As part of the arrangement a contract for 6m t/y was signed with Baosteel.

In 2002 programme to raise production in the Southern System from 72.7m to 88m tonnes was announced, including the following:

Minas Centrais mines: increase in production from 12.3 to 21.5m tonnes. This would include expansion by 3m t/y at Gongo Soco mine of Socoimex by 2004 at \$7.02 per tonne. This mine would be exhausted by 2010. It will be replaced by Brutcuta, which will open in 2006 at 12m t/y at \$16.18 per tonne and rise to 18m t/y in 2010. This would also replace Corrego do Meio (formerly Ferteco), which would be exhausted. In this area the Ganderela deposits should be developed as a joint project of CVRD, Ferteco and MBR.

Itabira mines: raise production from 39.5 to 42m tonnes. Itabira would maintain production at 42m t/y for more than 20 years.

Mariana mines: raise production from 18.8 to 20.5m tonnes. This would include exhaustion of Minas de Serra Geral in 2003 to be replaced by a former Samitri mine Fabrica Nova at 13m t/y Nova by 2005 at \$6.39 per tonne. Run-of-mine ore from Fazendinha would feed a beneficiation plant at the Alegria mine of Samitri.

Other mines: raise production from 2.1 to 4.0m tonnes

Major environmental issues are how to use fines stockpiled at Serra Azul and Itatiaicu mines.

In 2001-2 CVRD acquired Ferteco (see CVRD - Ferteco, site no. 72), MBR/Caemi (see CVRD - MBR, site no. 69) and Samitri (site no. 2247). In December 2002 the Economic Monitoring Secretariat recommended that the anti-trust body CADE approve CVRD's acquisition of Socoimex, Samitri, Ferteco and Caemi. Under the terms of this approval CVRD was required to charge in the Brazilian market the same prices as in the export market, less the costs of export, port charges and rail to port.

In April 2004 a delegation from China visited Brazil to discuss a potential investment by China of \$5 bn in ports and railways for iron ore, including a possible rail link to the port of Mejillones in Chile. That port has been expanded to handle Capesize ships and is a major port for copper concentrates. Shipping from Chile to China would cut 10 days from the voyage time compared to shipping from Brazil.

## NOTES - PRODUCTS AND MARKETS

CVRD - Southern, Tubarao, Vitoria

site 5745

## IRON ORE - PRODUCT RANGE

Products of CVRD's Southern System are:

DR fines  
 sinter fines  
 pellet fines  
 BF lump  
 DR lump  
 BF pellets  
 DR pellets

## IRON ORE - PRODUCTION AND SALES

Total CVRD:

2003: sales R20.21 bn (+ 32.4%); net profit - R4.5 bn (\$1.5 bn); exports - \$3.95 bn; total iron ore sales - 186.81m tonnes.  
 2004: production of mines in Minas Gerais (Southern System) - 98.8 mn tonnes

## IRON ORE - PRICES

Under the terms of the Brazilian government approval of CVRD's acquisition of Socoimex, Samitri, Ferteco and Caemi in 2002 CVRD was required to charge in the Brazilian market the same prices as in the export market, less the costs of export, port charges and rail to port.

Iron ore prices from the Southern system were reported as (c/dmtu, FOB Tubarao):

2002

to Thyssen Krupp, settled on 29 May 2002 after the longest negotiation ever, at: Tubarao Itabira fines - 28.62 (63.4% Fe); Tubarao BF pellet - 47.36. The nominal freight differential between PDM and Tubarao was 0.50.

2003

to Japanese, settled with Nippon Steel around 28 May 2003, effective 1 April 2003 (c/dltu): fines - 27.64/dltu; lump - 29.32/dltu  
 to Thyssen Krupp, settled around 18 June 2003 (c/dmtu): pellet - 52.00

In April 2003 CVRD requested a price increase from customers of 12.6% for PDM iron ore.

2004

to Europe, settled with Arcelor on 13 January 2004: (c/dmtu) Carajas CJF fines - 37.90 FOB Ponta da Madeira (+ 18.62%); Tubarao standard sinter feed (SSF) - 36.45 FOB Tubarao (+ 17.43%).

to Europe, settled with ThyssenKrupp Stahl AG on 6 February 2004: (c/dmtu) Tubarao BF pellets - 61.88c FOB Tubarao (+ 19.0%); Sao Luis BF pellets - 63.60 FOB Ponta da Madeira (+ 20.1%); Carajas lump ore - 44.46c , FOB Ponta da Madeira, Brazil (+ 19,0%)

to Japan, settled with Nipon Steel on 14 January 2004 (c/dltu): Carajas fines - 33.29; Itabira fines - 32.79. These prices remained in long ton units, although Australian producers quoted prices in metric ton units for the first time in their settlements for 2004.

To China, settled with Shanghai Baosteel Group on 16 January 2004 (c/dmtu): Carajas fines - 32.76 (+18.27%); Itabira fines - 32.27

#### IRON ORE - MARKETS

The CVRD Southern System is based on a number of mines in Minas Gerais, including Caue, Conceicao, Timbopeba and Capanema. These mines remain the major producers as other mines (Caraca, Periquito, Sao Luiz, Tamandua) have been closed through exhaustion since the mid 1980's.

##### Sinter fines

CVRD Southern has capacity of 30 mt/y of sinter fines. Sinter fines are supplied to the domestic market and export. Exports are moved about 700 km on the company's Minas-Vitoria railway to the port of Tubarao for export. Tubarao can handle ships to 270,000 dwt (record 294,000 tonnes loaded). From Tubarao CVRD exports its "Itabira" ores to a very wide range of customers in all parts of the world.

##### Pellet feed fines

CVRD Southern has capacity of over 20m. t/y of pellet feed fines for CVRD's and associates' pellet plants, for both BF and DR qualities.

Pellet pellet feed fines are also exported to third parties. DR pellet fines have been sold to Imexsa, (Mexico) at about 1.5m t/y, GIIC (Bahrain), which is now affiliated to CVRD, in quantities rising from 1m t/y to 3m t/y and to Iran at about 3m t/y. BF pellet fines has been sold at about 1.4m t/y to the pellet plant of Corus (Netherlands), to pellet plants in China at 1-1.9m t/y and to the pellet plant of Kobe Steel in Japan at about 450,000 t/y. The ore for Corus is believed to be from Socoimex, which was acquired by CVRD after it developed this business.

##### BF lump

CVRD Southern has capacity of 20m t/y of BF lump. Lump ores are delivered to the domestic steelmakers and independent blast furnaces in Minas Gerais.

##### BF pellets

At Tubarao CVRD operates one wholly-owned pellet plant and three pellet plants for consortia; Hispanobras, Itabrasco, Nibrasco and Kobrasco (see separate sites).

Capacity at the existing plants is being expanded. In 1995 Pohang Iron & Steel (Posco) of Korea agreed to a 50:50 joint venture with CVRD to construct a new pellet plant (Kobrasco), scheduled to start up in late 1998. This was intended to produce BF pellets for Posco and a mix of BF and DR pellets for CVRD.

BF pellets are sold in Brazil and exported mainly to Italy, Spain, Japan. The market in China is also showing major growth for CVRD's pellets. Our forecasts indicate that CVRD's plants will need to increase production from 15 million tones of BF pellets in 2002 to 22m tonnes in the long term. This expansion is already partially accounted for by the plant of Kobrasco and the current investment programme to raise capacity at the existing pellet plants.

##### DR pellets

At Tubarao CVRD's pellet plant has capacity of 4m t/y of DR pellets. Hispanobras and Itabrasco each produce some DR pellets, which are marketed by CVRD, while BF pellets are supplied to the partners from CVRD's share. CVRD's production of DR pellets is about 9 million tonnes and the company is the largest supplier to the international DR pellet market, with sales of Tubarao pellets to most DR plants in the international market in recent years. CVRD is also a major supplier of DR pellet feed fines to Bahrain and Iran.

##### General

In 2002 CVRD sold 17.6m tonnes of iron ore products to China, Sales in 2003 were expected at 20m tonnes.

In June 2002 CVRD signed a long term contract for 600,000 t/y of BF pellets with China Steel, its first long-term contract with the company.

Exports were expected to reach 120 million tonnes in 2003 (2002 114.6m tonnes). Demand is 122m tonnes. Iron ore shipments were being rescheduled because of high demand, this means delaying 18m tonnes of additional tonnages beyond contract tonnages for 1-3 months. Ships are waiting 15-25 days in port to load, demurrage costs are running at \$2m per month. Target production for 2003 was 60m tonnes in the North and 74m tonnes in the South.

In May 2003 it was reported that CVRD would supply 16m tonnes of iron ore to Arcelor in 2003.

In August 2003 CVRD signed a contract with Maanshan Iron & Steel (site no. 4054) for 25m tonnes from 1 April 2004 to 31 March 2010. This was the largest iron ore supply contract of Maanshan and was connected to the startup of two blast furnaces in 2004. Maanshan already had a 3-year contract 2001-2003 for 2m t/y.

In October 2003 CVRD indicated expected sales to China in 2003 of 20.8m tonnes (2002 17m tonnes, 2001 10.2m tonnes). CVRD stated that all Chinese customers (at least 6) had signed contracts for 3-10 years, replacing the previous system of spot purchases covering 12 months. Before this the only long-term contract was a 20-year contract with Baosteel. CVRD operates a joint venture mining operation at Agua Limpia mine with Baosteel.

In December 2003 CVRD and Shanghai Baosteel Group Corp., China's largest steelmaker, signed a new iron ore contract. The agreement and an addendum to an existing contract, which was announced by CVRD on 10 October 2001, were signed by Madame Xie Qihua, CEO of Baosteel, and Roger Agnelli, CEO of CVRD, and will cover a ten-year period extending from the year 2006 through 2016. According to the new contracts, iron ore shipments to be made by CVRD will increase yearly, to meet Baosteel's growing requirements, and will reach 14 million tons per year from the year 2010 onward. The existing contract is for 6m t/y. With the new provisions CVRD's iron ore sales to Baosteel will rise to 20 million t/y by 2010.

In 2004 CVRD was expected to supply in excess of 22 million tons of iron ore to Arcelor.

In 2002 Corus (site 107) bought about 4m tonnes from CVRD. In August 2002 Corus agreed a new contract for 5m t/y for 3 years. On 16 February 2004 CVRD and Corus Group signed a 10-year iron ore supply contract, effective 1 January 2004, replacing the 2002 contract, which either party may terminate after five years. The contract makes CVRD Corus' largest iron ore supplier, accounting for about 40% of Corus' total requirements. Previously Corus had been the one major European steel producer with which CVRD did not have leading position, as Corus had been more dependent on iron ore from Australia. The 2004 contract does not cover lump or pellets. CVRD will supply Carajas and Itabira sinter fines and pellet feed. In June 2004 CVRD fixed 36 iron ore cargoes to Corus from 1 January 2005 to 31 December 2007 on an on-term COA at a base rate of \$8.25/tonne, with rate and fuel adjustments for each voyage. Rates above the base rate are likely to be shared between the owner and the charterer. The owner will still receive \$8.25 if the market falls below \$8.25. For CVRD to charter ships implies that it is prepared to operate on CIF basis.

CVRD is the largest diversified mining company in the Americas and the fifth largest company in the global metals and mining industry with a market capitalization of about US\$22 billion. CVRD is the largest global producer and exporter of iron ore, pellets, and the world's second largest producer of manganese and ferro alloys with operations in Brazil, the US, France, Norway and Bahrain.

On 20 February 2004 CVRD announced that it has signed a long-term contract with Arcelor, of Paris, France, the world's largest steel producer, for the supply of iron ore. The new contract will consolidate CVRD's long-term relationship with the Arcelor group and will supply Arcelor's steel mills in Europe with 20 million tons of fine and lump ores per year until 2009. Items not included in the contract are pellet sales from Hispanobras, a Brazilian joint venture between CVRD and Arcelor, and from CVRD to Arcelor, as well as the iron ore and pellet sales to Arcelor's steel mills in Brazil. Roger Agnelli, CEO of CVRD, said, "This is the biggest iron ore contract signed in CVRD's history, and it reflects the interest of both companies in strengthening their long-term relationship, which exists since 1968."

In March 2004 CVRD expected to produce 25m tonnes of pellet in 2004 from its plants at Tubarao (including the share of the partners), plus 4.5m tonne from Ferteco, 6m tonnes from Sao Luis and 4m tonnes from GIC (including the share of the partner). Pellet production in Tubarao was expected to rise by 3m t/y by 2007, Ferteco to 10.5m t/y by 2006 and Sao Luis to 7m t/y by 2006.

In 2003 CVRD's demurrage costs were \$46m (2002 \$20m). 90% of exports are sold on FOB basis, so these costs were for delays at CVRD's ports.

In April 2004 CVRD stated that it had signed contracts to deliver 35 million metric tons of iron ore to China in 2004. In 2003, CVRD shipped 29 million metric tons of iron ore to China at a value of \$580 million. The company was planning to build a ship for exclusive use for its iron ore sales to China. CVRD estimates a 7.8% expansion in the Chinese economy in 2004; a 7.5% increase next year. In 2003, the Chinese economy jumped 9.1%.

In May 2004 CVRD and Nippon Steel announced renewal of a 70m tonne contract over 10 years, covering 3m t/y of Itabira ore and 4m t/y of Carajas ore. This will follow on from a 5-year contract for Itabira ore expiring in 2004 and a 7-year contract for Carajas ore expiring in 2007. This agreement was separate from 2m t/y of Nibrasco pellets under an existing 5-year contract and 2m t/y of MBR ore under a 3-year contract.

In 2004 CVRD signed a contract with China Steel for 4.1m tonnes of pellets by 2011.

In 2004 CVRD signed a contract with Shougang for supply of 11.3m tonnes, raising sales to Shougang to 15.7m tonnes over the period 2004-2012.

In 2004 CVRD signed a contract with JFE Steel for 70m tonnes over 10 years from 2005.

In October 2004 CVRD signed a contract with Sumitomo Metal Industries for 2m t/y of iron ore for 2005-2014, replacing a series of contracts which were expiring. No increase in tonnage, annual price negotiations.

In November 2004 CVRD signed a contract with Posco for 103m tonnes of iron ore over 10 years, effective from March 2005 when the existing contract expires. Estimated value was \$2.1 bn. Posco and CVRD have had contracts since 1979. The sales of pellets from Kobrasco are covered under separate contracts. The new contract was separate from a contract with MBR.

In 2003 CVRD also purchased from independent mines in the Southern System 10m tonnes. This was expected to rise to 12.5m tonnes in 2004.

In April 2005 CVRD was in negotiation with CADW, the Brazil anti-monopoly body, over a recommendation from SDE - Secretariat of Economic Defence that some of CVRD's iron ore assets should be sold to increase competition.

#### Iron Ore Purchases

In 2002 CVRD bought 4m tonnes from outside sources, including CSN. In 2003 this was expected to be 8m tonnes and 10m tonnes in 2004. Purchases would be reduced by the start up of new mines at Fabrica Nova (2005) and Brucutu (2006). In May 2003 CVRD considered increasing its purchases of iron ore from CSN at Casa de Pedra. CVRD has an agreement to have first right of refusal on iron ore from CSN surplus to CSN's needs. This was set up in 2001 when the two companies eliminated cross shareholding. In 2003 CVRD exercised this right and bought from CSN for the first time, at market prices.

#### FERRO-ALLOYS

In 2004 CVRD signed a contract with Corus to supply 30,000 t/y of ferro-alloys

## IRON ORE - CURRENT OPERATIONS

In 1995 total equipment of all CVRD mines was reported as:

Drills - 26  
Shovels - 23  
Wheel loaders - 37  
Trucks - 124  
Bulldozers/tractors - 53  
Graders - 14

The mines in the Itabira area are designed to produce at 35m t/y. After 2000 this was planned to fall to 30m t/y and by 2003 the existing mines were expected to be exhausted.

CVRD has a long-term programme to shift production to the Northern system, while investing in processing facilities in order to maintain production of fine ores from the Southern system into the long term. The further processing of itabirite will also generate quantities of fines which would be best suited to palletising, so further investments in pellet capacity will be considered for the long term.

Operations can be described according to their geographical location.

### CAUE

This mine is part of CVRD's Itabira district.

#### Reserves

In 1981 reserves at Caue were reported as 329m tonnes of hematite and 636m tonnes of itabirite.

#### Mining

The Caue mine at Itabira, MG was opened in 1972 and reached a design capacity of 26m t/y in 1976.

#### Drilling and Blasting

Mining is on 13m benches. Blasting is necessary in hard hematite and in some soft hematite, but not in itabirite. Drilling equipment includes:

Rotary drills  
3 x Bucyrus-Erie 45R  
1 x Tamrock C60  
various small drills

Blasting is with a mixture of ammonium nitrate and venegatlbe oil (ANVO), using 0.13 kg/tonne in hard ore and 0.125/tonne in soft ore.

#### Loading

Broken ore and waste are loaded by shovels. Equipment includes machines of 4.6m<sup>3</sup> to 12.2m<sup>3</sup>:

Shovels  
5 x Bucyrus Erie 215B electric rope shovels  
4 x Demag H4855, diesel hydraulic shovels

#### Wheel loaders

3 x Caterpillar 994  
various small loaders

#### Mine Haulage

Run-of-mine ore is loaded to trucks of 100-153 tonnes for haulage to the primary crusher. Equipment includes:

30 x Caterpillar 789 diesel mechanical  
3 x Caterpillar 793 diesel mechanical  
Water trucks

#### Primary Crushing

The primary crusher is at the plant.

#### Beneficiation

At Caue the plant has 3-stage crushing and classification of hematite, classification and concentration of itabirite and floatation. The primary crusher handles 50:50 hematite and itabirite, reducing run-of-mine ore to -200 mm.

For hematite secondary crushing reduces the ore to -25 mm. Hematite ore yields 37% natural pellet ore (-25, +6 mm), 46% sinter feed fines (+0.15, +0.15 mm), 17% sinter feed fines (-0.15 mm). Finished products are loaded to trains for shipment at 6000 t/h.

For itabirite run-of-mine ore is finely divided at -25 mm and requires no crushing or grinding. At the plant ore is reclaimed from stockpile and screened to -6, +10 mm and -1.0, +0.6 mm. The oversize ore at +1.0 mm is high grade sinter feed fines at 66% Fe without further treatment. The undersize is itabirite which is fed to separators, producing a concentrate, middling and tailing. The concentrates are pumped to cyclones and divided to -70 microns sinter feed fines and -6, +0.007 mm sinter feed fines. The concentrator can treat 20m t/y of itabirite by magnetic separation to recover 14m t/y of sinter and sinter feed fines.

This is the world's largest wet magnetic separation plant, with 28 lines. It was the first of its kind when it started up in 1972. The concentrator upgrades itabirite from about 50% Fe to 67-68% Fe. In 1983 a cationic plant (1600 t/h) was added to reduce silica from 2.4% to 0.8-1.2% for DR pellet feed fines.

In 1984 a gravitational concentrator with jigs started up to improve the sinter feed fines quality from 60.8% Fe 64.0% Fe and reduce silica from 10.6% to 6.5% and alumina from 1.1% to 0.7%.



### Transport to Shipping Point

At Caue ore the concentrator is reclaimed from stockpile and loaded to trains for movement to Tubarao, 10 km from Vitoria.

Reclaim: 2 x bucketwheel, 6000 t/h each  
 Operator: Estrade de Ferro Vitoria-minas (EFVM, 100 % subsidiary of CVRD)  
 Distance: 708 km, Caue to Tubarao 540 km double track, 168 km single track  
 Railcar size: 75 tonnes  
 Train size: 160 cars + 3 locomotives (GM, 3500 HP)  
 Frequency:

The railway has a gauge of 1 metre and was double-tracked in the late 1970's. Rail capacity is 100m t/y. Maximum speed is 60 km/hour. The line also carries ore from Samitri and Ferteco. Diesel consumption was reported as 2.38 litres per 1000 tonne/kilometres. EFVM railway is linked to the federal railway system (1.6 metre gauge) at Miguel Bernier Station, near the steel plant of Acominas.

See separate section below on CVRD's railway system under IRON ORE TRANSPORT TO SHIPPING POINT

### CONCEICAO

This mine is part of CVRD's Itabira district.

#### Ore Reserves

In 1986 reserves at Conceicao/Dois Corregos were reported as 498m tonnes of hematite and 1640m tonnes of itabirite.

#### Mining

##### Drilling and Blasting

Mining is on 13m benches, with holes drilled to 14m for hematite. Blue dust requires no drilling. The ratio of waste to ore is 0.63. Drilling equipment includes:

##### Rotary drills

3 x Bucyrus-Erie 45R  
 1 x Tamrock T60

##### Loading

Broken ore and waste are loaded by shovels. Equipment includes:

##### Shovels

1 x Bucyrus Erie 198B electric rope shovel  
 2 x Bucyrus Erie 295B electric rope shovels  
 3 x P&H 1900 electric rope shovels  
 2 x P&H 2100BC electric rope shovels

##### Wheel loaders

3 x Caterpillar D994

##### Mine Haulage

Run-of-mine ore is loaded to trucks of 60 and 120 tonnes. Average haulage distance to the primary crusher is 2.1 km, to the waste dump 2.2 km. Equipment includes:

##### Trucks

9 x Caterpillar 785 diesel mechanical  
 21 x Haulpak 120 diesel electric, 120 tonnes

##### Bulldozers

13

##### Graders

4

#### Primary Crushing and Transport

Coarse ore is fed to a primary crusher (capacity 48m t/y) at 1000 t/h. 50% requires secondary crushing at 500 t/h. Screening produces a product at -2.5 mm, which is blue dust, a very soft and fine ore at 67.4% Fe, used as sinter feed fines for the plant at Tubarao. Hematite is moved to the concentrator

#### Beneficiation

The concentrator at Conceicao processes ore from the mines at Conceicao and Dois Corregos. Hematite ore from the tertiary crusher is dry and wet classified. Ore of +2.5 mm is natural pellet ore, ore at -2.5, +0.6 mm is sinter fed. Ore at -0.6 mm is sinter feed fines. Itabirite is wet screened to recover a natural pellet ore at +2.5, The -0.6 mm fraction is gravimetrically and magnetically concentrated using wet high intensity magnetic separation, as at Caue. Column flotation was added to reduce silica content. Equipment was supplied by Cominco, including:

6 x roughers, 3m x 5m x 14m each  
 3 x cleaners, 3m x 5m x 14m each

The capacity of the concentrator is 24m t/y.

### DOIS CORREGOS

This mine was operated until 1967. It was reopened in the late 1970's and operates in conjunction with Coceicao. Ore from the mine is crushed in primary and secondary crushers, screened and transported 1.2 km to Conceicao for tertiary crushing.

### PICARRAO

In 1977 the orebody at Picarrao was reported to contain 34m tonnes averaging 45% Fe, mainly hematite and itabirite, with some magnetite.

The mine at Picarrao opened in 1972, located 26 km N of Itabira, at a cost of \$26m for the open pit mine, concentrator and 18 km railway spur line.

Mining was on 10.8m benches, with no blasting. Ore and waste was loaded by shovels of 1.9m<sup>3</sup> and front-end loaders of 3.4m<sup>3</sup>. Ore was hauled to the primary crusher in 12 x 35 tonnes trucks. The ore was fed to the primary crusher at 850 t/h and reduced to -12 mm for feeding to the concentrator. The mine closed in 1985 from exhaustion.

Crushed itabirite ore was fed to the concentrator and processed to fines of -1.0 mm.

Ore was loaded at 6000 t/h to railcars and moved on CVRD's spur line 18 km to Desembargado Drummond, where they were made up with cars from other locations to trains on the railway to Tubarao (see Caue above).

#### PERIQUITO

This mine is located between Caue and Conceicao

#### Ore Reserves

In 1986 reserves were reported as 353m tonnes of hematite and 447m tonnes of itabirite.

#### Mining

Ore is mined, primary crushed and classified.

#### FAZENDAO AND BRUCUTA

Fazendao was opened in 1995. Ore is mine, primary crushed and classified. The product is intended to be sinter feed fines and siliceous ores. Another new deposit was opened in 1994 at Brucuta. This was planned to have ultimate capacity of 20m t/y.

#### CARACA

Mining is conducted through a subsidiary of CVRD, Caraca Ferro e Aco SA, operating the Sao Luis, Tamandua and Alman deposits.

#### Reserves

In 1995 reserves were reported as 22m tonnes of hematite and 21m tonnes of itabirite.

#### Mining

Ore is mined, primary crushed and classified.

#### CAPANEMA

The operation at Capanema is 50 km N of Ouro Preto and about 30 km E of Itabirito Station. The operating company is Minas do Serra Geral SA. Ownership of MSG is:

CVRD - 51.00%  
Japanese consortium - 49.00%

Consolidated ownership is:

CVRD - 51.0%  
JFE Steel, formerly Kawasaki Steel (site no. 4709) - 24.50%  
Nomura Trading - 7.16% (later known as Nomura Boeki)  
Kawasho Corporation - 6.82%  
Mitsubishi Materials (site no. 721) - 5.62%  
Nissho Iwai (site no. 6261) - 1.96% (later known as Metal One)  
Itochu Corporation (site no. 8415) - 1.96% (later known as Marubeni Itochu Steel)  
Tomen Corporation (site no. 442) - 0.98%

In 2003 Kawaski Steel became part of JFE Steel (site no. 4709).

In 1976 a joint venture agreement was signed to establish MSG - Minas de Serra Geral to own and operate a new mine. In July 1982 production started. Initial capital cost was \$120m. At the start of production reserves at the mine were 360m tonnes.

In March 1996 a sales agreement was reached with CVRD for supply to CVRD of a total of 63m tonnes of ROM ore for 7 years from April 1996 to March 2003, when mining would end. Run-of-mine ore was sold to CVRD, which upgrades the ore at Timbopeba for supply of 2m t/y to CST steelworks at Tubarao and the remainder for export. CVRD's purchase price of Capanema run-of-mine ore is agreed at 24.5% of the average export price of CVRD ores.

In 2003 these reserves were exhausted and the Capanema mine was scheduled for closure in 2003 Q3. Ore would be replaced by a new Fabrica Nova mines (also known as Ouro Fino II and III) mine from 2005

In July 2003 JFE Steel reached agreement with CVRD and the Japanese partners to become 50% owner of the mine. JFE bought 1% from CVRD and 24.5% from the other Japanese partners. Ownership became:

JFE Steel, Japan - 50%  
CVRD - 50%

New MSG was expected to be formally created later in 2003 and capitalised at R 82m (\$29m). These arrangements were made to permit JFE to assist in developing Fabrica Nove. MSG would own facilities such as the ore conveyor and lease them to CVRD, the mine operator. In July 2003 reserves of Fabrica Nova were stated as

450m tonnes. Production of Fabrica Nova would be 10m tonnes in 2005, rising to 15m t/y by 2007. At its peak Capanema produced 14m t/y.

JFE also signed a 12-year contract with CVRD to take 2.0m t/y of blended ore from 2005, most ore from a new Fabrica nova mine E of Capanema. This would result in an increase in JFE's total purchase of Brazilian ore from 7m t/y in 2003 to 8m t/y. Of the 7m t/y from Brazil CVRD Southern System (Capanema) supplied 1m t/y, all of which is shipped to PSC - Philippine Sinter Corporation (site no. 5323). The increased quantity of 2m t/y would also all be shipped to PSC.

#### Ore Reserves

Reserves at Capanema were stated to be sufficient only to 2002, subsequently extended to 2004. In 1998 the partners agreed to open the Ouro Fino deposit. Ouro Fino I commenced operation in 1998. Ouro Fino II and III were scheduled to replace Capanema in 2002 without loss of capacity.

#### Mining

Drilling and Blasting. Mining is on 13m benches, with 76 and 165 mm holes drilled to 10m. Drilling equipment includes:

##### Rotary drills

5 x truck mounted, 76 mm holes  
1 for 165 mm holes

##### Loading

Broken ore and waste are loaded by shovels. Equipment includes:

##### Shovels

3 x P&H 1900 electric rope shovels, 8.4m<sup>3</sup> (11 yd<sup>3</sup>)

##### Wheel loaders

2 x Marathon, 7.6m<sup>3</sup>

Mine Haulage. Run-of-mine ore is loaded to trucks for transport 3 km to the primary crusher. Equipment includes:

##### Trucks

11 x Wabco diesel electric, 120 tonnes

##### Tracked bulldozers

4 x Caterpillar D8

Primary Crushing and Transport. Coarse ore is fed to a primary crusher. Ore from the primary crusher is screened and oversize is fed to secondary crushers. Ore is classified at -100 mm and stockpiled. Ore is reclaimed from stockpile and loaded to a conveyor of capacity 2850 t/h for transport 11.7 km to the plant at Timbopeba for processing. Equipment includes:

1 x Primary Crusher: Faco gyratory, 1.37m x 1.88m  
1 x Secondary Crusher

#### Manpower

Total employment at Capanema was reported as:

1996: 309  
1997: 265  
1998: 242  
1999: 210

#### TIMBOPEBA

The mine at Timbopeba was completed in 1982 and opened in 1984. Initial investment was \$180m for capacity of 7.5m t/y. In 1992 the mine shipped the 100th million tonne.

#### Ore Reserves

In 1988 geological reserves were reported at 213m tonnes of hematite and 1.5 billion tonnes of itabirite. Mineable reserves were 165m tonnes, of which 115m tonnes was hematite averaging 67.5% Fe. Itabirite reserves are considered as rejects and are stockpiled. In 1995 reserves were reported as 145m tonnes of hematite and 160m tonnes of itabirite.

#### Mining

##### Drilling and Blasting

20% of the ore requires blasting. Equipment includes:

##### Rotary drills

1 x Tamrock T60

##### Loading

Broken ore and waste are loaded by shovels. Equipment includes:

##### Shovels

3 x P&H 1900 electric rope shovels, 7m<sup>3</sup>

##### Wheel loaders

2 x Caterpillar 994, 7m<sup>3</sup>

##### Mine Haulage

Run-of-mine ore is loaded to trucks for transport to the primary crusher at the beneficiation plant. Equipment includes:

## Trucks

5 x Caterpillar 785, diesel mechanical  
7 x Haulpak 120T diesel electric, 120 tonnes

## Tracked bulldozers

9

## Grader

1

Primary Crushing. The primary crusher is at the plant

## Beneficiation

A concentrator was built at Timbopeba in 1984 and a new concentrator was added in 1994. The plant initially processed only ore from the mines of Minas de Serra Geral at Capanema and 3m tonnes of stockpiled mine tailings.

Rin-of-mine ore from the Timbopeba mine is fed to the primary crusher. Crushed ore is classified in a dry circuit into natural pellet ore at -2.5, +0.6 mm. Ore at -0.6 mm is sinter feed fines. The capacity of this circuit is 7.5m t/y.

Capanema ore is treated by dry classification, tertiary crushing and wet classification in spirals. Of the ore entering the circuit, 35% is rejected in tailings, 20% is natural pellet ore at 67.9% Fe and 45% is sinter feed. The capacity of this circuit is 11.5m t/y.

In 1994 a second plant was added at a cost of \$30m, including column flotation, to process hard itibirite and tailings to recover a sinter feed fines and reduce tailings to 12% of the input. Column flotation equipment was from Cominco. Equipment included:

1 x Primary Crusher, Faco gyratory  
1 x Secondary Crusher  
1 x Tertiary Crusher  
Dry classification  
Wet classification: spirals  
Column flotation:  
2 x rougher, 4m diameter x 15m each  
1 x cleaner, 4m diameter x 15m

## Transport to Shipping Point at Tubarao

Products from Timbopeba are loaded to trains for movement to Tubarao.

## Reclaim:

Operator: Estrada de Ferro Vitoria-minas (EFVM, 100 % subsidiary of CVRD)  
Distance: Spur line of 2.5 km to the main EFVM line, 610 km, Timbopeba to Tubarao, one-way time 17-18 hours  
Railcar size: 75 tonnes  
Train size: 800 cars + 1 locomotive  
Frequency:  
Railway fleet:

Part of the production goes direct to the CST steelworks at Tubarao.

## TRANSPORT TO SHIPPING POINT

## Railways

In April 2003 CVRD and CSN announced plans to exchange holdings in railway companies.

CSN would sell to CVRD its 11.95% holding in FCA - Ferrovia Centro-Atlantica. CVRD would sell to CSN its 50% holding in the No.1 container terminal of Sepetiba port (Tecon). CVRD would sell to CSN and Taquari Participacoes its 32.4% holding in CFN - Cia. Ferrovia to Nordeste.

This would give CSN 100% of Tecon and 40% of CFN. Tecon exports steel and other products.

FCA has network of 7080 km from NE to SE Brazil. links with CVRD's existing Vitoria-Minas railway and with MRD railway, in which CVRD has holdings via MBR and Ferteco. CVRD already has about 60% of the Brazil rail cargo market. CVRD operates FCA, in which CVRD's subsidiary Mineracao Tacuma hold 45.65%. Brazilian law currently limits the holding of any company to 20% in a former state railway. CVRD already exceeds this in FCA and would hold more than 50%. CVRD planned to integrate FCA with V-M railway and the port of Tubarao to raise transport capacity by 44% at 400m R over 5 years.

## TUBARAO

## Agglomeration

At Tubarao CVRD operates one wholly-owned pellet plant and four pellet plants for consortia in which CVRD is a partner:

## Hispanobras (site 5748)

CVRD - 50.89%  
Arcelor (site 2929) - 49.11%

Arcelor's holding was obtained with the acquisition of Aceralia, Spain in 2001.

For analytical purposes we consider that CVRD controls 100% of the production and sales from this plant, with a contractual commitment to Arcelor for its share of the production.

## Itabrasco (site 5749)

CVRD - 50.90%  
Riva, Italy (site no. 2444) - 49.10%

Riva's holding was obtained with the acquisition of Ilva.

For analytical purposes we consider that CVRD controls 100% of the production and sales from this plant, with a contractual commitment to Riva for its share of the production.

Nibrasco (site 5750)

CVRD - 51.00%  
Japanese consortium - 49.00%

Consolidated ownership is:

CVRD - 51.00%  
Nippon Steel (site 4896) - 25.39%  
JFE Steel, formerly NKK (site 4790) - 6.06%  
JFE Steel, formerly Kawasaki Steel (site 4790) - 5.97%  
Sumitomo Metal Industries (site 4965) - 5.98%  
Kobe Steel (site 4831) - 2.99%  
Nisshin Steel (site 4923) - 1.63%  
Nissho Iwai (site 6261) - 0.98%

For analytical purposes we consider that CVRD controls 100% of the production and sales from this plant, with a contractual commitment to the Japanese partners for their share of the production.

Kobrasco (site 5751)

CVRD - 50.00%  
Pohang Iron & Steel, Korea (site no. 5092) - 50.00%

For analytical purposes we consider that CVRD controls 100% of the production and sales from this plant, with a contractual commitment to the Posco partners for their share of the production.

CVRD's wholly owned plant started construction in 1967. Equipment is:

Indurating Lines

No.1 pellet line, Voest-Alpine/Lurgi, 1970, cost \$14.5m  
No.2 pellet line, Voest-Alpine/Lurgi, 1973

Equipment installed at this plant included:

Item  Step 1  Step 2  Step 3

Concentrate thickener

Step 1: 2 x 50' diameter  
Step 2: 2 x 65' diameter  
Step 3: 2 x 65' diameter

Slurry tanks

Step 1: 2x 6000 dlt, 575,000 gallons  
Step 2: 2x 6000 dlt, 575,000 gallons  
Step 3: 2x 6000 dlt, 575,000 gallons

Disc filters

Step 1: 14 x 6'9" diameter  
Step 2: 10 x 8'10" diameter  
Step 3: 12 x 8'10" diameter

Vacuum pumps

Step 1: 4 x Nash, 900 ft3/m each  
Step 2: 10 x IR, 10500 ft3/m each  
Step 3: 12 x IR, 10,500 ft3/m each

Snap blow compressors

Step 1: 2 x Sullair, 2000 ft3/m each  
Step 2: 4 x IR, 900 ft3/m each  
Step 3: 3 x Sullair, 2000 ft3/m each

Concentrate bins

Step 1: 12 x 450 lt  
Step 2: 10 x 450 lt  
Step 3: 10 x 450 lt

Balling drums

Step 1: 12 x 32' x 10' diameter  
Step 2: 12 x 33' x 12' diameter  
Step 3: 12 x 33' x 12' diameter

Grate

Step 1: 3 x 12' x 112', 320 lt/h feed  
Step 2: 2 x 15' x 144', 520 lt/h feed  
Step 3: 2 x 15' x 144', 520 lt/h feed

Rotary kiln

Step 2: 3 x 120' x 18.5' diameter  
Step 2: 2 x 140' x 20' diameter  
Step 3: 2 x 140' x 22' diameter

Cooler

Step 1: 3 x 7' x 50' diameter

Step 2: 2 x 8' x 56' diameter  
 Step 3: 3 x 8' x 56' diameter  
 Waste gas fans  
 Step 1: 3 x 322000 ft<sup>3</sup>/m each  
 Step 2: 2 x 591000 ft<sup>3</sup>/m, 3000 HP  
 Step 3: 2 x 591000 ft<sup>3</sup>/m, 3000 HP  
 Preheat fans  
 Step 1: 6 x 211000 ft<sup>3</sup>/m, 800 HP  
 Step 2: 4 x 410000 ft<sup>3</sup>/m, 1500 HP  
 Step 3: 4 x 410000 ft<sup>3</sup>/m, 1500 HP  
 Cooling fans  
 Step 1: 6 x 130000 ft<sup>3</sup>/m, 700 HP  
 Step 2: 4 x 182000 ft<sup>3</sup>/m, 900 HP  
 Step 3: 4 x 182000 ft<sup>3</sup>/m, 900 HP

Sinter feed fines is 80% blue dust from Conceicao. Feed enters the plant as a slurry with 70% solids and is ground to 95% -45microns (350 mesh), thickened to 8% moisture and 3% hydrate d lime is added. Filter cake moves to balling discs. Green balls are fired in Dravo-Lurgi travelling grates of 79.5m x 3.5m diameter at a temperature of 1350o C.

CVRD reduced oil consumption in the 1980's by adding alternative fuels. Fuel consumption in the 1970's was 36 kg per tonne of pellets. This was reduced by 1-012 kg by mixing powdered charcoal into the sinter feed fines. It was reduced a further 6 kg by injecting powdered charcoal into the recuperator header above the furnace. Fuel mix per tonne was at one time oil/gas 500 MJ, admixed charcoal 220 MJ, injected charcoal 230 MJ, total 900 MJ. The use of charcoal is varied according to the relative price of fuel oil and charcoal.

#### Hispanobras:

No.1 pellet line, 1978

#### Itabasco:

No.1 pellet line, 1977 □  
 Balling discs: 5 x 7.5m diameter  
 Grate: 3.5m x 129m

#### Nibrasco

No.1 pellet line, 1978  
 No.2 pellet line, 1978

The total investment for Nibrasco was \$167m In 1994 a continuation agreement was signed, giving each partner entitlement to 50% of the production, based on normal capacity of 7.0m t/y. Actual capacity of the plant in 1994 was 8.1m t/y.

The plant receives 85% sinter feed fines and 15% sinter feed fines, with an average silica content of 2.16%. The plant has the facility to use pulverised coal as a substitute for fuel oil. Use of 10.25 kg/t of coal reduced fuel oil consumption to 18.48 kg/t.

In 2002 Nibrasco restarted NO.5 plant after a closure of 1.5 months. No.6 plant was idle from January 2002 for market reasons. Nibrasco sales of pellets were (million tonnes)

2000 total 8.76  
 2001 total 6.99; exports 2.31; Brazil 4.68

Average selling prices were:

2000 \$30.13 per tonne  
 2001 \$29.80

In 1995 CVRD announced an expansion programme for all the pellet plants, raising capacity by increased grinding and other efficiency improvements.

#### Kobrasco

In 1995 CVRD agreed with Pohang Iron & Steel (Posco) of South Korea to proceed with a new pellet plant at Tubarao as Kobrasco for the construction of a pellet plant of capacity 4m t/y (3m t/y of BF pellets, 1m t/y of DR pellets), for completion in June 1998 at a cost of \$215m (of which \$77m for the pellet plant alone). Posco contracted to take 2.3m t/y of the production, but in 1998 sought to replace part of the commitment to take pellets with a commitment to take additional fines.

The plant started production in November 1998.

In 2000 CVRD started a programme to upgrade all pellet lines at Tubarao at a cost of \$100m. This was intended to raise total pellet capacity at Tubarao from 25 to 28m t/y by 2003.

Also in 2000 CVRD started a study of a new pellet plant in Minas Gerais for 4-6m t/y at a cost of \$300-400m.

## TRANSPORT TO CUSTOMERS

### Port of Tubarao

The port of Tubarao was built in 1966 at a capacity of 20m t/y, with maximum ship size of 100,000 dwt at a cost of \$40m. It was expanded with an increase in shiploading capacity from 8000 to 14000 t/h, with dredging to permit ships of 150,000 dwt at Pier No.1. By 1973 the capacity was 50m t/y, when a further expansion was completed with a new Pier No.2, permitting 250,000 dwt and new shiploaders at 2 x 16000 t/h. In the late 1970's capacity was expanded to 80m t/y. Facilities include:

### Port Authority and Operator:

CVRD  
 Porto de Tubarao  
 PO Box 1078  
 29072-970 Tubarao ES  
 Brazil

Tel: +55 27 3333-4282  
Fax: +55 27 3333-5429  
e-mail: navegacao@cverd.com.br

Location: Lat 20.17N; Long 40.15W on the Atlantic Ocean  
Channel: 3800m x 285m x 22.5m deep

#### Pier No.1 (2 berths)

Opened: 1966  
Operator: CVRD  
Railcar unloading:  
Stockyard: CVRD - 3.5m tonnes, total all piers; Samitri - 1m tonnes; Ferteco - 400,000 tonnes  
Reclaim:  
Shiploading: 1 x 6000 t/h (North), 1 x 8000 t/h, simultaneous loading of 2 vessels  
Depth alongside: 16.0 metres; sailing draft 14.5m + tide = nominal 15.24 metres, actual 16.0 metres  
Ship maximum beam: 55 metres (North); 48 metres (South)  
Ship maximum length: 320m (North); 280 metres (South)  
Ship maximum size: 200,000 dwt (North); 170,000 dwt (South)

#### Pier No.2

Opened: 1966  
Operator: CVRD  
Railcar unloading:  
Stockyard:  
Reclaim:  
Shiploading: 2 x 16000 t/h, limited by conveyor belt capacity of total 16000 t/h combined  
Depth alongside: 22.5 metres; sailing draft 20 metres + tide  
Ship maximum beam: 62m  
Ship maximum length: 350m  
Ship maximum size: 365,000 dwt. The record vessel accepted was the Berge Stahl (364,767 dwt) loading 325186 tonnes

Pier 3 handles grain and cereals

Pier 4 handles fertilisers, containers and general cargo

Pier 5 handles bulk liquids

In 2003 it was stated that this port handles 60-65% of the pellet production from Tubarao.

At Tubarao CVRD also loads ore from Ferteco and Samitri, with some cargoes for MBR in emergencies.

The port of Vitoria is adjacent to Tubarao, located 570 km from Belo Horizonte and 510 km from Rio. At the port CVRD operates the Paul dock for loading pig iron. At Tubarao CST operates a dock at Praia Mole, adjacent to CVRD's terminal, for discharge of coal and loading of steel slabs. Praia Mole was built by a consortium of Portobras, Siderbras and CVRD, with capacity 5.8m t/y. Praia Mole has two terminals:

#### Coal Import Terminal:

Depth alongside: 18m  
LOA: max 330m  
Unloading: 15,000 t/d  
Maximum ship size: 170,000 dwt

#### Steel Export Terminal

TPS - Terminal de Productos Siderurgicos is owned 33% by Acominas.

Depth alongside: 14.5m  
Pier length: 638m  
Loading: 5 x steel loaders, 35 tonnes each  
Maximum ship size: 70,000 dwt

#### IRON ORE - 2004

Project: CVRD planned to add 3.5m t/y of capacity at Gongo Soco (Socoimex, JFK site 68) and Brucutu in 2004. Capacity at Capaneme (a deposit of Minas de Serra Geral, JFK site 5745) would be depleted in 2004, with loss of 7.5m t/y of capacity. This would be replaced by opening deposits at Ouro Fino II and III (Fabrica Nova) with capacity of 11.5m t/y

## NOTES - RAW MATERIALS AND LOGISTICS

CVRD - Southern, Tubarao, Vitoria

site 5745

## MINERAL RESERVES - IRON ORE

In 1993 CVRD's proven ore reserves in the Minas Gerais areas were estimated at:

- 1.39 billion tonnes of high-grade hematite, averaging 66% Fe
- 9.49 billion tonnes of hard itabirite
- 9.18 billion tonnes of soft itabirite, averaging 50% Fe
- 10 billion tonnes of lower grade materials. Itabirite is hematite with a high silica content, grading 48-53% Fe, requiring beneficiation.

In 2002 CVRD's reserves of iron ore were stated as 26.1 billion tonnes.

In July 2004 CVRD stated that as a result of the new study iron ore reserves at Itabira were 1.13 bn tonnes and not 666m tonnes as previously estimated. The mine at Itabira was expected to produce 43m t/y from 2003. Total CVRD reserves in Minas Gerais were increased from 4.0 to 4.45 bn tonnes. Including the reserves of Ferteco and MBR, total CVRD reserves in Minas Gerais would be 19.3 bn tonnes. Total CVRD production in Minas Gerais is 140m t/y.

Caue: In 1981 reserves at Caue were reported as 329m tonnes of hematite and 636m tonnes of itabirite.

Conceicao: In 1986 reserves at Conceicao/Dois Corregos were reported as 498m tonnes of hematite and 1640m tonnes of itabirite.

Picarrao: In 1977 the orebody at Picarrao was reported to contain 34m tonnes averaging 45% Fe, mainly hematite and itabirite, with some magnetite.

Periquito: In 1986 reserves were reported as 353m tonnes of hematite and 447m tonnes of itabirite.

Caraca: In 1995 reserves were reported as 22m tonnes of hematite and 21m tonnes of itabirite.

Timbopeba: In 1988 geological reserves were reported at 213m tonnes of hematite and 1.5 billion tonnes of itabirite. Mineable reserves were 165m tonnes, of which 115m tonnes was hematite averaging 67.5% fe. Itabirite reserves are considered as rejects and are stockpiled. In 1995 reserves were reported as 145m tonnes of hematite and 160m tonnes of itabirite.

## Capanema

Reserves at Capanema were stated to be sufficient only to 2002, subsequently extended to 2004. Reserves were exhausted in 2003 and the mine closed in 2004 Q1.

## Fabrica Nova

In 1998 the partners agreed to open the Ouro Fino deposit. Ouro Fino I commenced operation in 1998. Ouro Fino II and III were scheduled to replace Capanema in 2002 without loss of capacity. Fabrica Nova was developed from 2005 to replace Capanema. In July 2003 reserves of Fabrica Nova were stated as 450m tonnes. Production of Fabrica Nova would be 10m tonnes in 2005, rising to 15m t/y by 2007. At its peak Capanema produced 14m t/y.

## NOTES - ENERGY

CVRD - Southern, Tubarao, Vitoria

site 5745

## IRON ORE ENERGY - POWER

Electric power is purchased from power utilities. During national power cuts of 25% in 2001 CVRD hired 55 x 1.7 MW electrical generators to maintain power at the mines and at Tubarao.

In 2004 Petrobras supplied natural gas to two of the 7 pellet plants at Tubarao. From January 2005 this would increase to 4

## NOTES - FUTURE PROJECTS

CVRD - Southern, Tubarao, Vitoria

site 5745

## IRON ORE - 2005

Project 1: In November 2003 CVRD announced an expansion of pellet capacity at Tubarao by 12% from 25 to 28m t/y at \$100 with completion in 2005. This included \$5.2m for a new shiploader at Praia Mole.

Project 2: A new mine at Fabrica Nova

Status: In 2002 a project was committed for a new mine at Fabrica Nova to replace the exhausted deposit at Timbopeba and increase capacity. In December 2004 construction was completed. In April 2005 the mine was officially opened. The project was completed a year ahead of schedule because of strong demand.

Capacity: Total capacity of 15 mn t/y, with estimated breakdown as BF lump - 4.05; DR lump - 0.50; sinter fines - 9.45; DR fines - 1.00.

Project 3: Expansion at Brucutu.

Status: In 2004 the company committed an expansion at Brucutu.

Capacity: An increase in capacity of 12 mn t/y of sinter fines, expected completion in 2005.

## IRON ORE - 2006

Project 1: A new pellet plant of 6m t/y at Ferteco (see JFK site no. 72).

Project 2: Expansion of pellet capacity at Tubarao

Status: In March 2004 the company stated that pellet production in Tubarao was expected to rise by 3m t/y by 2007. In May 2004 the company stated that total CVRD pellet production was expected to rise from 47 to 57m t/y by 2007, of which 1m t/y at Sao Luis by 2005 (JFK site 125), 3m t/y at Tubarao by 2006 (this project) and a new 6m t/y pellet plant at Fabrica Nova by 2007 (JFK site 72). In addition Samarco would add No.3 pellet plant, 7m t/y (JFK site 70) and GIIC would add 5m t/y in Bahrain (JFK site 5798).

Capacity: Expansion by efficiency improvements, total capacity increase of 3.0 mn t/y at Tubarao, estimated breakdown as BF pellets - 1.80; DR pellets - 1.20. Expected completion in 2006.

Project 3: capacity at Timbopeba (deposit of Minas de Serra Geral, JFK site 5746) would be depleted in 2006, with loss of 12.9 mn t/y of capacity. This was replaced by the capacity at Fabrica Nova in 2005.

## IRON ORE - 2008

Project: Expansion at Fazendao

Status: In 2004 the company committed to an expansion of sinter fines capacity at Fazendao

Capacity: An increase in capacity of 7 mn t/y, expected completion in 2008.

## IRON ORE - UNDATED



Project 1: In 2003 CVRD expected to consider a proposal for a new pellet plant in Minas Gerais in 2004.

Project 2: Further expansion

Status: In March 2004 the company stated that by accelerating mine expansions from 2009 to 2007 it would reach production of 280m t/y in 2007 (including MBR and Samarco) at a cost of \$706m. In May 2004 the company stated that its Southern System would increase output by 50% to 150m t/y by 2008, of which 24m t/y from Brucutu (of which 12m t/y already had board approval for completion in 2005); Fazandao 14m t/y (7m t/y approved); Fabrica Nova 15m t/y (all approved); a further 8 mt t/y for pellet projects

Capacity: A total increase of 61 mn t/y in the Southern System, of which 42 mn t/y had been approved and is included in committed projects above, and 19 mn t/y awaited approval

Cost: In May 2004 the cost of the expansion by 61 mn t/y was estimated at \$715m. In April 2005 this was stated at R 35 bn (\$1.4 bn).

#### OUTLOOK

Our forecasts indicate that CVRD's plants will need to increase production from 15 million tonnes of BF pellets in 2002 to 22m tonnes in the long term. This expansion is already partially accounted for by the plant of Kobrasco and the current investment programme to raise capacity at the existing pellet plants.

Our forecasts indicate that CVRD's pellet plants (including the plant in the Northern System) will need to increase production from 9 million tonnes to over 16 million tonnes of DR pellets in the long term. Combined with BF pellet demand, total pellet production will need to rise from 24 to 38 million tonnes.

Iron ore reserves in the Minas Gerais area are very large, but reserves of high-grade hematite are now estimated at 1.4 billion tonnes, with 19 billion tonnes of itabirite, lower-grade material of around 53% Fe requiring beneficiation. CVRD therefore has a long-term programme to shift production of sinter fines to the Northern System while investing in processing facilities in order to maintain production of fine ores from the Southern System into the long term. A new concentrator was built at Timbopeba in 1994 and concentrators are also operating at Caue and Conceicao. The further processing of itabirite will also generate quantities of fine ore which would be best suited to pelletising, so further investments in pellet capacity will be considered for the long term. As a result the Southern System will yield less lump and sinter fines and more pellets and pellet feed

With further investment CVRD will be able to maintain its position as a major supplier to all large consumers of iron ores. Expansion of the company's total capacity (rather than a short-term switch of emphasis to the Carajas mine) would require heavy investment in processing facilities."

Printed	05 July 2005	JAMES F. KING DATABASE - SITES		Samarco, Anchieta	
Site	70	personal	<input type="checkbox"/>	production	<input checked="" type="checkbox"/>
Shortname	Samarco	ferro-alloys	<input type="checkbox"/>	office/sales	<input type="checkbox"/>
Name	Samarco Mineracao SA	iron ore	<input checked="" type="checkbox"/>	trader	<input type="checkbox"/>
Address1	Rodovia do Sul ES 060, km 14	iron + steel	<input type="checkbox"/>	supplier	<input type="checkbox"/>
Address2	Ponta Ubu	energy	<input type="checkbox"/>	scrap	<input type="checkbox"/>
City	Anchieta	bx/alumina	<input type="checkbox"/>	equipment	<input type="checkbox"/>
State	Espirito Santo	Phone	27 3361-9474	primary	<input type="checkbox"/>
Zip	29230-000	Fax		secondary	<input type="checkbox"/>
Country	Brazil	Email	borloth@samarco.com.bri	rolled	<input type="checkbox"/>
Code	<input checked="" type="checkbox"/>	Internet	samarco.com.br	extruded	<input type="checkbox"/>
Updated	05 July 2005	EU VAT		castings	<input type="checkbox"/>
				other	<input type="checkbox"/>
				legal	<input type="checkbox"/>

#### NOTES - GENERAL

This site is the iron ore operations of Samarco Mineracao in Brazil. Mining is in the state of Minas Gerais and the pellet plant and shipping terminal are at Ponta da Ubu in the state of Espirito Santo.

The head office of the company is at site 5757. All notes on operations, etc are under this site 70.

#### HISTORY

Samarco was formed in 1973 with ownership of 51% Samitri, 49% Utah International. Utah was later acquired by BHP of Australia. For details of Samitri, see the separate profile for that company.

The basis of the project was a transfer from Samitri of 1650 million tonnes of itabirite ore at deposits at Germano and Alegria Sul in Minas Gerais. Samarco developed the Germano mine and concentrator and constructed a slurry pipeline to feed a new pellet plant at Ponta da Ubu. The pellet plant was opened in 1977. The total costs of the initial project was \$600m. Initial capacity was 17m t/y at the Germano mine, 7m t/y at the concentrator, 12m t/y in the pipeline and 7m t/y at the pellet plant (5m t/y of pellets and 2m t/y of sinter feed fines for sale). This was increased to 8.5m t/y by adding a regrind ball mill at the concentrator.

As the Germano mine deepened, costs increased and grade of ore fell towards 50%. In 1988 consideration was given to mining Alegria do Sul, starting in 1991. In 1989 it was decided to invest \$70m to develop Alegria Sul at 12m t/y. Mining started in 1992. The Germano mine was closed in September 1993 and the concentrator now receive ore from Alegria Sul.

It was also decided to purchase 1.4m ty of sinter feed fines from a new concentrator built by Samitri at its Alegria operations. In order to supply this sinter feed fines to the pellet plant at Ponta da Ubu, 4.5 km of 208 mm (8") pipeline was required. In 1992 the capital cost of this (\$20m) was financed by loans from Nissho Iwai (\$7.5m), Mitsubishi Corporation (\$7.5m) and Kobe Steel (\$5m). The loan was to be repaid by delivery of sinter feed fines under a contract with Kobe Steel, which was doubled from 500,000 to one million t/y.

In 1995 construction of a second pellet plant at Ponta da Ubu was approved, with capacity of 5m t/y at a cost of \$230m, to start production in 1997.

In December 1995 the 100th million tonne of product was shipped from Ponta da Ubu in a cargo to Sollac in France.

Until 2001 ownership in Samarco was:

Samitri - 51.0%  
BHP, Australia - 49.0%

In 2001 CVRD acquired over 99% of Samitri. At that time BHP paid CVRD \$8.2m to increase its holding in Samarco from 49% to 50%. Ownership of Samarco is:

CVRD - 50.0%  
BHP, Australia - 50.0%

In 2001 BHP merged with Billiton to become BHP Billiton

Samarco is operated as a joint venture by the partners. . The company's interest in Samarco is managed by BHP Billiton Brasil Ltda (Mr. Sebastiao Ribeiro, Executive President).

## NOTES - PRODUCTS AND MARKETS

Samarco, Anchieta

site 70

## IRON ORE - PRICES

2003

to Europe, settled with Arcelor on 6 June 2003 (the first pellet price established for 2003), c/dmtu FOB Ponta Ubu: BF pellets - 51.36  
The nominal freight Ubu-Rotterdam was \$5.75/tonne based on 65.7% Fe. A nominal freight differential between Ubu-Rotterdam and Tubarao-Rotterdam was agreed at \$0.45/tonnes (CVRD 64.9% Fe)

2004

to Europe, settled with Erzkontor Ruhr, acting for Rogesa (c/dmtu FOB Ponta Ubu): BF pellets - 60.86

## IRON ORE - PRODUCTION AND SALES

Production: (m wet tonnes)

2002: pellets - 12.22; total products - 14.8 total, of which 4.5m to China (+55% over 2001 and = 37% of pellet sales).  
2003 expected: pellets - 12.67; total - 15.47

Sales: (m tonnes)

2002: total - 14.8

2003: pellets - 13.7; pellet feed fines - 2.7; total - 16.4

2004: pellets - 13.8; pellet feed fines - 1.4; total - 16.2

## IRON ORE - MARKETS

BHP Minerals had the right to market 2m t/y of pellet feed and 4m t/y of pellets. Samitri's former parent company Arbed had the right to market 1m t/y of pellet feed. In 1997 Samarco opened a second pellet plant to give the current capacities. This development reduced to a low level the quantity of sinter feed available for export.

Pellet Feed Fines. Samarco has capacity for pellet feed fines for sale of 2.7m t/y. BF pellet feed were shipped to Hoogovens in the Netherlands and Kobe Steel in Japan for use in their BF pellet plants and also to some steelmakers who use it as sinter feed (particularly Usinor in France). DR pellet feed has been shipped mainly Bahrain and Iran.

Kobe Steel: contract for 1993-1999 for 1m t/y of pellet feed fines. This was terminated in March 1998 and replaced with a new contract for April 1999 to March 2004 for 800,000 t/y (500 pellet feed and 300 BF pellets) +/- 15% at buyer's option. The contract is administered through Mitsubishi Corporation and Nissho Iwai.

BF Pellets. Samarco has capacity for BF pellets of 5.5m t/y. BF pellets are exported mainly to Europem, particularly to Rogesa, part of the former Arbed (now Arcelor) group, in Germany. Samarco's existing markets for BF pellets are likely to show no growth. Under the influence of CVRD, the company may choose to concentrate future growth on DR pellets.

DR Pellets. Samarco has capacity for DR pellets of 6.5m t/y. With the opening of the new plant Samarco moved close to CVRD as a supplier to DR pellet market. Samarco ships about 5m t/y of DR pellets, mainly to Argentina, Egypt, Libya, Indonesia and Malaysia. Our forecasts indicate that these markets can take about 8m t/y from Samarco in the longer term.

The Alegria deposit has reserves of 160m tonnes and will therefore support production beyond the next decade. In the longer term further ore sources will be needed.

In August 2003 Samarco signed a letter of intent for a 3-year contract for 2007-2009 for 1m t/y of BF pellets to a new plant to be built by Hangzhou Iron & Steel as Zhejiang Dexin Iron & Steel at Ningbo. Samarco was already supplying 950,000 t/y of pellets to Hanhzhou under a contract expiring in 2004.

In October 2003 Samarco signed a 10-year contract to supply iron ore to Shaoguan Iron & Steel (site no. 3994). The ore would be supplied from late 2004 or early 2005 for a planned new plant at Huizhou, Guangdong as well as for the existing plant. Samarco already supplies Shaoguan.

Marketing of BF pellets in Europe was handled from 1967 by Brasilux, an affiliate of Samitri. Marketing of DR pellets is by BHP.

The port improvements of 2003 were expected to result in a small premium on Samarco pellets to Europe, including Arcelor (formerly Arbed) and TKS. For sales outside Europe Samarco takes CVRD's benchmark price.

Samarco sells on FOB prices to Europe and on C&F prices for part of sale to Asia. In 2003 and 2004 Samarco made no sales to the spot pellet market because of strong demand for contracts.

In December 2004 Samarco signed a letter of intent with Wuhan Iron & Steel (JFK ite 4133) for 1 mn t/y of pellets for 10 years. Samarco started supplying pellets to Wuhan in 1999. Shipments in 2003 were 450,000 tonnes, expected to be similar in 2004.

## NOTES - TECHNOLOGY AND OPERATIONS

Samarco, Anchieta

site 70

## IRON ORE - CURRENT OPERATIONS

## GERMANO

## Mining

Operations at the Germano mine were conducted from the beginning of 1977. The orebody was 0.6 km wide and 1.25 km long.

Drilling and Blasting. The ore was friable and required minimal drilling. Ore was generally broken by a bulldozer before loading. The ratio of waste to ore was 0.17.

Loading. Run-of-mine ore was loaded to trucks. Equipment included:

## Wheel loaders

7 x Caterpillar 992, 6.3 m<sup>3</sup>

## Tracked bulldozers

6

## Mine Haulage.

Run-of-mine ore was moved in trucks to hoppers which fed a conveyor belt to the concentrator. Optimal distance of the conveyor from the face was 100m and the conveyor was moved to maintain this distance. Ore was conveyed within the pit of 2 x 100m conveyors, feeding a single conveyor leading outside the mine.

Primary Crushing and Transport. The primary crusher was at the plant.

## Beneficiation

At the Germano concentrator run-of-mine ore at 52% Fe was received by conveyor. A primary crusher reduced ore to -100 mm. Further crushing reduces it to -8 mm before feeding to the ball mills.

Crushed ore is processed in 4 grinding lines. Ore is reduced to 85% -0.15mm (100 mesh). The ground ore is discharged to flotation cells which reduce SiO<sub>2</sub> from 2.0% to 1.1% by cationic flotation.

In 1992 column flotation was installed with equipment from Cominco. This was expected to save 20-40% of the capital costs and 20% of the operating costs of conventional equipment.

1 x Primary Crusher: reducing to -100 mm

1 x Secondary Crusher:

1 x Tertiary Crusher: reducing to -8 mm

4 x Grinding Lines: each with one ball mill with 1750 HP motor

1 x Re grind ball mill: with 2 x 3000 HP motors

2 x Roller Presses (2002)

## Column Flotation:

3 x recleaners, 3m x 4.6m x 13.6m each

4 x recleaners, 3.67m diameter x 13.6m each

2 x scavengers, 3m x 4m x 13.5m each

1 x scavenger, 2.44m diameter x 10m

1 x rougher, 3m x 4m x 12m

1 x cleaner, 3m x 2m x 12m

The final mill product is 100% -75 microns (200 mesh), 96% -45 microns (325 mesh) at 67% Fe. The discharge is diluted to 35-40% solids for pumping by slurry pipeline to Ponta da Ubu.

In order to supply additional ore for the new pellet plant, the concentrator at Germano was expanded in 1997 from 45,000 to 50,000 t/d, including 4 column flotation cells and either a roller press or 2 balls mills of 151 x 30'. In 2002 roller presses were installed.

## ALEGRIA DO SUL

## Mining

Alegria do Sul is 4.5 km from Germano. The mine opened in January 1992 and full capacity is 13m t/y. Orebodies 3 and 5 are mines in one pit and Orebodies 1 and 6 in another. Orebodies 8 and 9 were scheduled to be mined from 1999, with mine life extending to 2014.

In 1996 mining was at 45,000 t/d to recover 28,000 t/d concentrate and 17,000 t/d tailing. Crude ore grades from 52% down to 42% Fe. To obtain 12.5m t/y concentrate, 21m t/y of crude ore and 9m t/y of waste are mined. By 1997 crude ore mining was expected to be 22m t/y.

## Drilling and Blasting

The ore is friable and required minimal drilling. Ore is generally broken by a bulldozer before loading.

## Loading

Run-of-mine ore is loaded to trucks. Equipment includes:

## Wheel loaders

9 x Caterpillar 992B, 6.3 m<sup>3</sup> (8 yd<sup>3</sup>)

5 x Caterpillar 994, 12.6 m<sup>3</sup> (16 yd<sup>3</sup>); new in 1996

## Tracked bulldozers

6 x Caterpillar D8

4 x Caterpillar D11; new in 1996

#### Mine Haulage

Run-of-mine ore is loaded to trucks, hauled 1-3 km and dumped to hoppers which feed an overhead conveyor belt which moves the ore 4.5 km to the Germano concentrator. Ore is also moved to a new concentrator at Alegria, completed in 1994. Equipment includes:

#### Trucks

11 x Caterpillar 773B diesel mechanical, 50 tonnes  
10 x Caterpillar 200 diesel mechanical

#### Primary Crushing and Transport

The primary crusher is at the Germano concentrator.

#### Beneficiation

In addition to the production at the Germano concentrator, 1.4m t/y of sinter feed fines is processed at a concentrator at Alegria Sul (see Samitri), completed in 1994. Product from that plant is transferred as a slurry to Germano in a new 4.5 km pipeline built in 1993. At Germano the new pipeline joins the existing line, which has sufficient capacity. By this means the total sinter feed fines leaving the Germano area was increased from 8.2m t/y to 9.6m t/y.

#### Transport to Agglomeration and Shipping Point

Ore is pumped in slurry form from the concentrator to the pellet plant at Ponta do Ubu in a pipeline which started operation in 1977. The pipeline is 460-510 mm diameter, a distance of 396 km. The capacity of the pipeline after expansion in 1997 was 13.2m t/y, operating at 1.5 m/s. there are two pumping stations, each with 7 x 1250 HP pumps (6 operating, 1 on standby), one at Germano and one at Matipo, 250 km from the terminal. The pipeline pumps slurry for 16 hours/day at 1.5 m/s and water for 8 hours/day. Slaked lime is added to maintain the pH of the slurry. In 2003 the capacity of the pipeline was stated as 15m t/y, but not fully utilised.

#### Agglomeration

The pellet plant is located at Ponta do Ubu, Espirito Santo. Equipment includes;

#### Indurating lines

No.1: Dravo-Lurgi travelling grate, oil, 1977  
No.2: Lurgi-Kvaerner travelling grate, 704sm, oil, 1997  
Expansion of No.2 and No.3 lines in 2000, with addition of 2m t/y of capacity.

At the plant there is pond storage for slurry of 450,000 tonnes. Slurry is recovered from the pond by a cutterhead suction dredger and dewatered by vacuum discs to 8% moisture. Part of this is a finished product, exported as sinter feed fines.

In the pellet plant dewatered sinter feed fines is fed to the green ball plant, mixed with 3% hydrated lime (or 0.1% bentonite + 2.0% hydrated lime) and coal and fed to balling discus.

Bentonite is received by truck 4700 km from Paraiba in North East Brazil. Limestone is received from a local quarry in Espirito Santo state.

Green pellets are discharged to a roller screen to size them at -15, +8 mm and fed to the Dravo-Lurgi travelling grate of 704m<sup>2</sup>. Pellets are subject to updraft and downdraft drying and indurated at 1316oC (2400oF), then cooled to 100oC on a belt. Process time is 36 minutes. Pellets are screened to remove fines at -6.3 mm.

The plant has the facility to use coal as a substitute for fuel oil. 1.6% high ash steel coal has been added to the sinter feed fines and 4 kg/tonne of low ash (12%) steam coal has been injected into the cooling hood of the indurating furnace. An increase in steam coal consumption to 3% of feed would reduce oil consumption to 16 kg/t of pellets. Fuel consumption was separately reported as:

BF pellets: 16 kg/t fuel oil; 20 kg.t pulverised coal  
DR pellets: 23 kg/t fuel oil; 10 kg/t pulverised coal

In 1994 construction of a second pellet plant at Ponta da Ubu was studied and in 1995 the project was approved and a contract for engineering services was awarded to Davy International. The technology for the plant was from Lurgi. A new plant of capacity 6.0m t/y was completed in 1997 at a cost of \$325m, of which \$201m was for the pellet plant and \$61.3m was for expansion of the concentrator at Germano. The plant was intended to run a product mix of between 40:60 and 60:40 BF:DR pellets.

In 2000 the new owners committed an expansion of pellet capacity at Samarco to 14m t/y, for completion in 2002 and aimed at the Asian market for BF pellets. A new pellet plant of 6, t/y was also under consideration in 2001.

In January 2003 Samarco expected to complete an expansion of pellet capacity from 12.5 to 13.8m t/y at a cost of \$25m. The expansion was achieved by installation of two roller presses from Germany, located in a 52 metre high building at the end of the slurry pipeline. Processing by the roller presses at Ponta da Ubu permits transport of slightly coarser pellet feed through the pipeline to Ponta da Ubu. The presses are designed to improve and homogenise iron ore qualities via grinding, increasing the surface area, improving pellet formation and allowing greater efficiency.

#### Transport to Customers

The pellet plant is at the port of Ponta do Ubu. Products are moved from the plant to a stockpile by conveyor and stacked by 2 x 1500 t/h stackers

The port of Ponta do Ubu, Espirito Santo located on the South Atlantic Ocean. The operating company is:

Samarco Mineracao SA  
Terminal de Ponta Ubu  
Rodovia do Sul ES 060, km 14  
Ponta Ubu  
29230-0005 Anchieta  
Brazil

Tel: +55 27 3361-9474  
e-mail: borloth@samarco.com.bri

Products are reclaimed from stockpile and conveyed 3 km to a shiploader. Port facilities include:

Location: 20.47S; 40.35W, 65 km S of Vitoria.

Operator: Samarco

Berths: The pier project from the eastern portion of the breakwater to a distance of 685m from the shore, with berths on each: 2 - Capesize on one side of the quay;

Panamax on the other side

Pier width: 22m

Stacking: 2 x 1500 t/h

Stockyard: 1m tonnes sinter fines + 2m tonnes pellets

Reclaim: 1 x bucketwheel

Shiploading: 1 x rail mounted loader with 41.6m boom with 280 deg turning angle and 19.5m air draft; nominal loading capacity of 8-9000 t/h for pellets and pellets

feed; contract loading rate is 50,000 t/d

Channel depth: 18.9m, 200m wide

Depth alongside: 19m on one side of the berth; 15m for Panamax size on the other side

Tide: average - 0.75m; maximum - 1.6m

Ship maximum beam:

Ship maximum length: Pier length of 313m, vessel maximum of 308m

Ship maximum size: From 2002 - 200,000 dwt with draft of 16.8 metres; previously 170,000 dwt with a draft of 15.7m + tide (maximum 1.6m, average 0.75m). The

record vessel before 2002 was Arcadia I in 1996 at 163,000 dwt.

Port capacity: 20m t/y

In 2002 Samarco completed dredging and port improvements to raise the maximum size of vessel to 200,000 dwt, 16.8 metre draft. Shiploading rates were also raised to 7000 t/h on two berths. The total port capacity was stated as 15m t/y.

In October 2003, at a time of high demand, average waiting time at Ponta da Ubu was 4 days.

#### MANPOWER

1997 - Total employment was reported as 1481.

#### IRON ORE - 2003

In January 2003 Samarco expected to complete an expansion of pellet capacity from 12.5 to 13.8m t/y at a cost of \$25m. The expansion was achieved by installation of two roller presses.

#### NOTES - RAW MATERIALS AND LOGISTICS

Samarco, Anchieta

site 70

#### IRON ORE - MINERAL RESERVES

In 1986 measured reserves at the Germano mine, 70 km SE of Belo Horizonte, were 141m tonnes averaging 52.3% Fe down to a level of 960m. Indicated deeper reserves were 255m tonnes of itabirite averaging 40% Fe.

The Alegria Sul deposit has proven mineable reserves of 190m tonnes averaging 53% Fe, with 760m tonnes of itabirite/hematite averaging 42% Fe above 1000m (90m below the mine surface) and a further 600m tonnes of itabirite inferred. In 2004 these reserves at Alegria were also stated as 160m tonnes proven and 210m tonnes unconfirmed.

The total reserves of the Alegria complex, both Samarco and Samitri, are estimated at 19 billion tonnes, of which 6 billion are at Samarco's Alegria mine.

Estimates of current reserves for all mines are in a separate report.

#### NOTES - ENERGY

Samarco, Anchieta

site 70

#### ENERGY

In 1997 International Finance Corporation agreed to provide a loan of \$18m to Samarco for the construction of a hydroelectric power station. This was the first power station to be built after the opening of the electricity industry to private investment. The station was designed to supply 15% of the plant's needs. Samarco will also receive power from a station of 140 MW being built in a joint venture with the steel company Belg-Mineira. This will supply 35% of Samarco's needs.

#### NOTES - FUTURE PROJECTS

Samarco, Anchieta

site 70

#### IRON ORE - 2006

Project: Expansion.

Capacity: The capacity of the existing pellet plant line would be increased to from 15.5 to 16.5 mn t/y by 2006 by the addition of a third pumping station at a cost of \$25m.

#### IRON ORE - 2007

Project: Expansion with a new pellet plant.

Progress: In January-April 2004 Samarco had a feasibility study under way for an expansion. The study was scheduled for completion by the end of 2004 with submission to shareholders in early 2005. In May 2004 the expected completion was 2007. In December 2004 the expected completion was 2007 H2.

Capacity: The expansion would increase capacity by 7 mn t/y to a total of 24m t/y, including 21m t/y of pellets and 2m t/y of fines. The project included a No.3 pellet plant of 7m t/y alongside the existing two plants. using travelling grate technology and producing both BF and DR pellets, as at No.1 and No.2 pellets plants. The study would consider installation of a new slurry pipeline to Ponta Ubu. The project required construction of a slurry pipeline of 8m t/y, compared to the existing pipeline capacity of 15.5m t/y. The capacity of the existing line would be increased to 16.5m t/y by 2006 by the addition of a third pumping station at a cost of \$25m.

Cost: In 2004 the cost of the expansion by 7m t/y was estimated at \$550m

**OUTLOOK**

Samarco Mineracao. Samarco was formed in 1973 with ownership of 51% Samitri, 49% Utah International. Utah was later acquired by BHP of Australia. Until 2001 Samarco was owned 51% by Samitri and 49% by BHP Minerals International (US subsidiary of the Australian company). In 2001 CVRD acquired Samitri.

Samarco operates an open pit mine in the Belo Horizonte area of Minas Gerais and a pellet plant at Ponta do Ubu on the coast. The ore mined averages about 56% Fe and requires beneficiation to produce pellet feed. Until 1993 mining was at the Germano open pit which had been operating since 1977. Because of falling reserves this mine was closed and replaced by mining at the Alegria mine, a property 5 km away owned by Samitri. Products are moved by pipeline 396 km to Ponta Ubu where some is processed to pellet and some exported as pellet feed for sale. The port of Ponta Ubu can handle vessels to 160,000 dwt.

Site	5760	personal	<input type="checkbox"/>	production	<input checked="" type="checkbox"/>
Shortname	CMP - Min. del Pacifico	ferro-alloys	<input type="checkbox"/>	office/sales	<input type="checkbox"/>
Name	CMP - Min. del Pacifico, El Romeral	iron ore	<input checked="" type="checkbox"/>	trader	<input type="checkbox"/>
Address1	Pedro Pablo Munoz 675	iron + steel	<input type="checkbox"/>	supplier	<input type="checkbox"/>
Address2	Casilla 559	energy	<input type="checkbox"/>	scrap	<input type="checkbox"/>
City	El Romeral, La Serena	bx/alumina	<input type="checkbox"/>	equipment	<input type="checkbox"/>
State		primary	<input type="checkbox"/>	consultant	<input type="checkbox"/>
Zip		secondary	<input type="checkbox"/>	trade body	<input type="checkbox"/>
Country	Chile	rolled	<input type="checkbox"/>	publisher	<input type="checkbox"/>
Code	<input type="checkbox"/>	extruded	<input type="checkbox"/>	financial	<input type="checkbox"/>
Updated	24 July 2004	castings	<input type="checkbox"/>	government	<input type="checkbox"/>
Phone	51 208025	other	<input type="checkbox"/>	legal	<input type="checkbox"/>
Fax	51 208140				
Email	cmpsa@cmp.cl				
Internet	www.cmp.cl				
EU VAT					

NOTES - GENERAL

This site is the iron ore operations of CMP - Cia. Minera del Pacifico SA at El Romeral in La Serena Region in Chile.

Ownership of the company is:

CAP - Cia. Acero del Pacifico - 100%.

CAP also owns GSH, the steel integrated producer in Chile (head office at site 2037).

Information on El Algarrobo, Los Colorados and Huasco operations is under site 5759. Information on El Laco operations is under site 5761.

NOTES - PRODUCTS AND MARKETS CMP - Min. del Pacifico, El Romeral, La Serena site 5760

For information on products and markets, see site 5759.

NOTES - TECHNOLOGY AND OPERATIONS CMP - Min. del Pacifico, El Romeral, La Serena site 5760

IRON ORE - CURRENT OPERATIONS

EL ROMERAL

History

In 1910 French interests acquired the El Tofo mine in Coquito province and built a charcoal blast furnace new Valdivia. In 1913 El Tofo was leased by Bethlehem Chile Iron Mines Co. (Bethlehem Steel, USA) and began production in 1922. By 1924 it was supplying 1.8m t/y to Bethlehem's plant at Sparrows Point via the port of Cruz Grande in northern Chile. The mine closed in 1932-3 because of the depression. In 1936 Bethlehem acquired El Romeral to replace El Tofo, but El Tofo continued production until 1957. Final cleanup operations were still taking place in 1990-1004 by a contractor, shipping the resulting ore by truck to Guayacan for sale to CAP. The last shipment from El Tofo was in 1994.

In 1929 Bethlehem offered to buy the deposit at El Romeral and bought it in 1936. In 1950, with El Tofo depleting, Bethlehem began to drill the deposit. The initial development was at 1m t/y, including the mine, concentrator, 38 km railway and port at Guayacan. The first production was in 1955, with the first cargo shipped in that year to Bethlehem's plant at Sparrows Point, Maryland (using purchased ore) and the first cargo of produced ore in 1956. From 1955 El Romeral was operated as a joint venture with CAP in order to supply CAP's plant at Huachipato, which opened in 1950. Byb 1963 capacity was 2.3m t/y. In 1968 equipment was installed to recover -30, +6 mm material, as previously all shipments had been of lump ore. The operation was sold to CAP in 1971 under the threat of nationalisation. Also in 1971 CAP acquired about 30 deposits from Cia. Minera Santa Fe and Cia. Minera Santa Barbara.

Mining

At El Romeral CMP mines crude ore with 55% Fe.

Drilling and Blasting  
Holes are drilled at 250 mm. Equipment includes:

Rotary drills  
2 x Bucyrus-Erie 45R, for 251 mm holes  
1 x Ingersoll Rand T4, for 241 mm holes

The average ratio of waste to ore over the remaining life of the mine to 2006 is expected to be 72/54 = 1.33. This compares with the ration in 1994 of 3.47.

Loading  
Run-of-mine ore and waste are loaded by shovels. Equipment includes:

Shovels  
1 x Bucyrus-Erie 295B electric rope shovel, 9.9 m3 (13 yd3)  
3 x Bucyrus-Erie 195B electric rope shovels, 9.2 m3 (12 yd3)

Wheel loaders



1 x Caterpillar 992C, 9.2 m<sup>3</sup> (12 yd<sup>3</sup>)  
 1 x Caterpillar 988B, 3.8 m<sup>3</sup> (5 yd<sup>3</sup>)  
 2 x Payloader; for cleanup

Track bulldozers  
 2 x Caterpillar D9  
 2 x Caterpillar D8  
 1 x Komatsu D5T

Graders  
 2 x Caterpillar 14E

Mine Haulage. Run-of-mine ore was loaded to trucks for haulage to the primary crusher. Haulage distances are 1.8 km to the waste dump and 1.2-1.7 km to the primary crusher. Equipment includes:

Trucks  
 6 x Caterpillar 785B diesel mechanical, 140 tonnes; on ore  
 9 x Lectra Haul M100 diesel electric, 100 tonnes; on waste  
 6 x Caterpillar 773B diesel mechanical, 50 tonnes

8 x Dart diesel mechanical, 75 tonnes; retired  
 8 x Dart diesel mechanical, 32 tonnes; retired

Sprinkler trucks  
 2

Fuel truck  
 1

Primary Crushing and Transport.  
 The crusher is at the beneficiation plant at the mine site.

#### Beneficiation

Run-of-mine ore at 50% Fe is received at the plant at Romeral, built in 1972. Ore is primary crushed to -150 mm. From the primary crusher ore at average 50% Fe at -150, +75 mm (-6", +3") is fed to secondary crushing for reduction to -25 mm (1") and to tertiary crushing for reduction to -16 mm (5/8"). Any product -25 mm is stockpiled and reclaimed for further processing.

Some of the -30, +6 mm ore is separated for feed as coarse ore to Huachipato. The rest is reclaimed and passed to magnetic separation before proceeding to a quaternary coarse ore crushing plant, installed in 1987, including Symons cone crushers and Rotopac crushers. From the crushers -3 mm ore proceeds to wet concentration, -6, +3 mm proceeds to high speed drums and +6 mm proceeds to magnetic separators and then high speed drums.

A new plant was built in 1990 with capacity 1.2m t/y. Ore is fed at 160 t/h to a ball mill and ball mill discharge is fed to drum magnetic separators. Product is then dewatered to 8% moisture to product a sinter feed fines product of 77% - 45 microns (325 mesh) at 69% fe. A further product of 90% -45 microns (325 mesh) is shipped as heavy media for coal washing plants in the USA.

Equipment in the concentrator includes:

1 x Primary Crusher: Allis Chalmer jaw, 1.5m x 2.13m (84" x 60"); reducing to -150 mm  
 1 x Secondary Crusher: Nordberg cone, 2.13m (84")  
 2 x Secondary Crushers: Nordberg shorthead cone, 2.13m (84")  
 1 x Secondary Crusher: LJ Cedar Rapids RC66 Rollercone, 1.67m (66")  
 1 x Secondary Crusher: Nordberg Gyradisc 1.67m (66")  
 1 x Quaternary Crusher: Barmac Rotopactor, 900 mm, 250 HP; reducing to -6 mm  
 Separation: wet magnetic + high speed drums  
 1 x Grinding Mill: ball mill 5.48m x 7.62m (18' x 25'), 5000 HP; reducing to -45 microns

#### Transport to Shipping Point

Products are loaded to trains for movement to the port of Guayacan.

Operator: CMP, 1m gauge railway  
 Loading: 50 minutes per train  
 Distance: 38,5 km, mine to Guayacan  
 Railcar size: 52 tonnes for coarse ore, 55 tonnes for fines  
 Train size: 23 cars + 3 locomotives of 660 HP  
 Frequency: 12 trains per day  
 Railway fleet: Locomotives: 3 x 1300 HP + 3 x 660 HP; railcars: 102  
 Rail capacity: 4.12m tonnes

In 1997 CMP had to declare force majeure for 41 days because a bridge on the rail line to Guayacan was destroyed by floods. Trucks were used for emergency movements of 3,000 t/d.

#### Transport to Customers

Shipments are from the port of Guayacan. The larger vessels are part-loaded and topped off with pellets at Huasco, 125 km from Guayacan. The topped off vessels serve Nippon Steel, Kawasaki and NKK in Japan.

Coarse ore is loaded to ships of 30-35,000 dwt for movement to CAP's steel plant at Huachipato.

Port facilities include:

Port: Guayacan, Chile on the Pacific Ocean  
Location: 29.58S, 71.22W

## Operator:

Compania Minera del Pacifico SA  
Puerto Pablo Munoz 675  
La Serena  
Chile

Tel. +56 51 208025  
Fax +56 51 208140

Train unloading: 55 minutes per train

Stockyard: 800,000 tonnes coarse ore + 450,000 tonnes fines

Stockyard: 1.1 million tonnes

## Reclaim:

Berths: Guayacan Ore Pier, 208 metres long

Shiploading: Loading tower of 118.9 metres on the pier; loading by 1 x 3000 t/h conveyor belt; loading boom extends 24m from the face of pier; max air draft 19m;

actual loading of 100,000 tonnes takes 50 hours

Channel depth: 62-66 metres, min 741m wide

Depth alongside: 17.2metres; maximum draft of vessel 16.2m

Tide: max range 1.5 metres

Ship maximum beam: 50 metres

Ship maximum length: 315 metres

Ship maximum size: Normally 150,000 dwt. The largest vessel handled is the Kenryu Maru (305m LOA, 50.0m beam, 210,915 dwt), but not fully loaded. The largest cargo was 160,708 long tons in the Shin Ogishima Maru.

Port capacity: Traffic in 2001: 75 vessels, handling 3.559m tonnes

## UTILITIES

At Guyacan the company operated a power station of 8.2 MW for the Romeral mining and shipping operations until 1985. Since then the operation has been supplied by the national utility Endesa.

## NOTES - RAW MATERIALS AND LOGISTICS

CMP - Min. del Pacifico, El Romeral, La Serena

site 5760

## MINERAL RESERVES - IRON ORE

## El Romeral

The El Romeral deposit is in the province of Elqui (Region IV), 22 km N of La Serena. Reserves at El Romeral were reported in 1995 as 71m tonnes of hematite and magnetite at a cutoff of 30% Fe, an increase from the previous estimate (1991) of 54m tonnes. At a cutoff of 30% Fe, the average grade is 54.5% Fe, with an expected balance of 40:60 lump:fines. A further 164m tonnes of low-grade material (averaging 29.6% Fe) was available in the West Unit, of which the economically mineable reserve was 51m tonnes. Romeral will continue to mine to a final depth of 40m below sea level. In 2000 reserves were reported as sufficient for 10-12 years (extended from the previous expectations of 2006 and, earlier, 2002).

In December 1995 reserves at El Romeral were stated by Japanese sources as 48.421m tonnes, average 55,76% Fe,

## El Tofo

In April 2004 Admiralty Resources, Australia announced an agreement with Hanwell Holdings, Hong Kong to acquire 70% of a 25m tonnes magnetite deposit. Hanwell will receive A\$ 600,000 and 42m Admiralty shares and Admiralty will acquire 70% of Cia Miera Hanos De El Tofo. The stockpile is at Yacimiento Llanos De El Tofo La Serena with 24m tonnes of lump and fines. Admiralty was discussing sales to 4 Chinese plants, including Benxi Iron & Steel. CMP stated that it held ownership rights at Minera Hanos De El Tofo and was unaware of any takeover. CMP stated that the stockpiled ore is transported about 100 m to an existing processing plant and supplied from there to Huchipato.

## NOTES - ENERGY

CMP - Min. del Pacifico, El Romeral, La Serena

site 5760

## NOTES - FUTURE PROJECTS

CMP - Min. del Pacifico, El Romeral, La Serena

site 5760

## NOTES - CONFIDENTIAL

CMP - Min. del Pacifico, El Romeral, La Serena

site 5760

Site	<input type="text" value="5759"/>	personal	<input type="checkbox"/>	production	<input checked="" type="checkbox"/>
Shortname	<input type="text" value="CMP - Min. del Pacifico"/>	ferro-alloys	<input type="checkbox"/>	office/sales	<input type="checkbox"/>
Name	<input type="text" value="CMP - Min. del Pacifico"/>	iron ore	<input checked="" type="checkbox"/>	trader	<input type="checkbox"/>
Address1	<input type="text"/>	iron + steel	<input type="checkbox"/>	supplier	<input type="checkbox"/>
Address2	<input type="text"/>	energy	<input type="checkbox"/>	scrap	<input type="checkbox"/>
City	<input type="text" value="Huasco"/>	bx/alumina	<input type="checkbox"/>	equipment	<input type="checkbox"/>
State	<input type="text"/>	primary	<input type="checkbox"/>	consultant	<input type="checkbox"/>
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Updated	<input type="text" value="05 July 2005"/>	castings	<input type="checkbox"/>	government	<input type="checkbox"/>
		other	<input type="checkbox"/>	legal	<input type="checkbox"/>

NOTES - GENERAL

This site is the iron ore operations of CMP - Cia. Minera del Pacifico SA at Huasco in Chile.

Ownership of the company is:

CAP - Cia. Acero del Pacifico (site 2037) - 100%.

CAP also owns GSH, the steel integrated producer in Chile.

The company is a 100% subsidiary of CAP – Companhia Acero del Pacifico, which was privatised by the Chilean government in 1985. Major shareholders of CAP include:

Employees - 20.0%  
 AMIDUS - 29.5%  
 Mitsubishi Corporation - 4.9%

Information on Romeral and El Laco operations are under site 5760 and 5761 respectively.

Ore reserves at El Algarrobo and a former mine at Los Colorados were depleted. In order to continue operations on 6 September 1995 CAP and Mitsubishi Corporation established a joint venture for a new Los Colorados mine. Ownership of the new company, Cia. Minera Huasco, was:

CMP - 50%  
 MC Inversiones Ltda - 50%

CMP was a wholly owned subsidiary of CAP SA

MC Inversiones was a wholly owned subsidiary of Mitsubishi Corporation.

Initial investment was expected to be \$107m, provided by Mitsubishi Corporation. CAP supplied a mining lease and other assets.

**IRON ORE - PRODUCT RANGE**

The operations of CMP at Algarrobo/Huasco, El Romeral and El Laco produce:

BF lump  
 sinter fines  
 BF pellet feed fines  
 DR pellets feed fines  
 BF pellets  
 DR pellets

**IRON ORE - PRODUCTION AND SALES**

In 2004 the company produced about 7.5m tonnes of fines and used these to produce 4.5m tonnes of pellets, of which 1.2m tonnes were used at Huchipato and 3m tonnes exported to Asia, mainly China and Indonesia..

**IRON ORE - MARKETS**

At Algarrobo/Huasco pellets are mainly of BF grade (self-fluxing with a basicity of c. 1.3), with small quantities of two grades of DR pellets for Midrex and HYL processes. Pellets are shipped to CAP's steel plant at Huachipato and for export. Exports of pellets under contracts to Japanese steel mills are 1.5m t/y. Other sales are made to Germany and Korea. All exports to Korea in 2000 were for use in Posoc's Corex plant. Pellets are suitable for Corex and HYL because of their basicity. Contracts with Japanese were:

Period: To March 1998, extended in June 1997 for a further 5 years April 1998 to March 2003  
 Quantity: total 6.79m tonnes of BF pellets +/- 15% at buyer's option,

Purchasers: main mills were NKK and Kawasaki; contract administered by Mitsubishi Corporation; expected distribution of tonnage (000 tonnes) was:

NKK - 710  
Kawasaki - 200  
Nippon Steel - 100  
Kobe Steel - 300 (only 90 in 1998)  
Nisshin Steel - 90  
Total - 1400

Price: price to be set annually, plus bonus of 0.5 cents/Fe unit if annual average of quantities shipped is < 0.075%P (in force since 1991).

Loading: a schedule of loading was established:

up to 80,000 dwt: 25,000 t/d; despatch - \$5,000/day; demurrage - \$10,000/day  
80-120,000 dwt: 30,000 t/d; despatch - \$6,000/day; demurrage - \$12,000/day  
120-160,000 dwt: 55,000 t/d; despatch - \$7,000/day; demurrage - \$14,000/day  
160-200,000 dwt: 60,000 t/d; despatch - \$8,000/day; demurrage - \$16,000/day  
over 200,000 dwt: 65,000 t/d; despatch - \$9,000/day; demurrage - \$18,000/day

El Romeral lump ore is shipped to Huachipato.

El Romeral sinter feed fines are sold mainly to Japan and Korea. Contracts to Japanese were:

Period: To March 1998, extended in June 1997 for a further 5 years April 1998 to March 2003

Quantity: 1.1m t/y of sinter fines +/- 15% at buyer's option.

Purchasers: NKK; contract administered by Mitsubishi Corporation; expected distribution of tonnage (000 tonnes) was:

NKK - 200  
Kawasaki - 300  
Nippon Steel - 350  
Sumitomo M.I. - 250  
Total - 1100

Price: price to be set annually, plus bonus of 0.5 cents/Fe unit if annual average of quantities shipped is < 0.075%P (in force since 1991).

Loading: a schedule of loading was established:

up to 80,000 dwt: 25,000 t/d; despatch - \$5,000/day; demurrage - \$10,000/day  
80-120,000 dwt: 30,000 t/d; despatch - \$6,000/day; demurrage - \$12,000/day  
120-160,000 dwt: 55,000 t/d; despatch - \$7,000/day; demurrage - \$14,000/day  
160-200,000 dwt: 60,000 t/d; despatch - \$8,000/day; demurrage - \$16,000/day  
over 200,000 dwt: 65,000 t/d; despatch - \$9,000/day; demurrage - \$18,000/day

Some sinter feed fines were also sold to the USA for coal washing.

El Romeral BF pellet feed fines were shipped to Clabecqin Belgium (before closure) and to Kobe Steel in Japan. BF pellet fines was also shipped to other Japanese plants and used as sinter fines. Contracts to Japanese were

Period: To March 1998, extended in June 1997 for a further 5 years April 1998 to March 2003

Quantity: total 5.25m tonnes of pellet feed fines +/- 15% at buyer's option

Purchasers: NKK; contract administered by Mitsubishi Corporation; expected annual distribution of tonnage (000 tonnes) was:

NKK - 700  
Kawasaki - 100  
Kobe Steel - 250  
Total - 1150

Price: price to be set annually, plus bonus of 0.5 cents/Fe unit if annual average of quantities shipped is >69.00% Fe

Loading: a schedule of loading was established:

all ship sizes: 30,000 t/d; despatch to vary by size of ship as for Romeral fines:  
up to 80,000 dwt: despatch - \$5,000/day; demurrage - \$10,000/day  
80-120,000 dwt: despatch - \$6,000/day; demurrage - \$12,000/day  
120-160,000 dwt: despatch - \$7,000/day; demurrage - \$14,000/day  
160-200,000 dwt: despatch - \$8,000/day; demurrage - \$16,000/day  
over 200,000 dwt: despatch - \$9,000/day; demurrage - \$18,000/day

Product from El Laco is run-of-mine ore for shipment to Argentina.

Export marketing is through Pacific Ores & Trading, a subsidiary of CMP.

## IRON ORE - CURRENT OPERATIONS

### EL ALGARROBO AND LOS COLORADOS

#### History

In 1913 the property at El Algarrobo was purchased from Carbonel & Conde Armad of France by NV Algarrobo Mijnen, a wholly owned subsidiary of Wm. P. Mueller & Co. of the Netherlands. This sale was disputed in the courts until 1926. In 1959 the property was acquired by CAP from Algarrobo Mijnen for \$24m, with reserves reported as 50-70m tonnes. In 1960 construction started with a contract to Koppers, USA to coordinate development of the mine and design and erection of crushing, screening and handling equipment. In 1961 the operation began with portable crushing and screening at 1.0m t/y lump for open hearth furnaces and 0.5m t/y of fines for blast furnace. These were shipped through the port of Las Losas near Husaco. A new port was developed at Guacolda, where the No.1 berth opened in 1962 with a first shipment to Bethlehem Steel at Sparrows Point, USA. Initial capacity was 1.8m t/y of lump ore. A secondary crusher was added in 1964, raising capacity to 3.3m t/y by shipping lump and fine ore. Magnetic fines recovery was added in 1970, raising capacity to 3.6m t/y.

In 1973 CMP signed a contract with Mitsubishi Corporation for 32m long tons of pellets over 12 years for 5 Japanese steel mills (Kawasaki, NKK, Nippon Steel and Sumitomo Metal Industries). This was the basis for the development of the El Algarrobo mine and pellet project, which was constructed in 1977-78 at a cost of \$250m. Finance for the El Algarrobo project was:

CAP – Compania Acero del Pacifico - \$108.8m  
 Mitsubishi Corporation - \$76.5m  
 Lazard Brothers - \$9.7m  
 Consortium of banks under Bankers Trust - \$55.0m  
 Total - \$250.0m.

The pellet plant at Huasco was opened in 1978 at a capacity of 3.5m t/y. The first cargo from the project was in February 1978 to CAP's plant at Huachipato. The first export shipment was in April 1978, 38,000 tonnes loaded to Eisho Maru for Japan. The first export to the USA was in March 1979 to US Steel at Fairfield, USA via Mobile. The plant was the first in South America to use the grate-kiln process and to produce a self-fluxing pellet.

Reserves at El Algarrobo were depleted and the mine was scheduled to closed in 1998, to be replaced by a new mine at Los Colorados.

The history of Los Colorados began with private mines in the 1950's. Cia. Minera Santa Fe was launched by private individuals in 1951. In the same are as Cia. Minas Santa Barbara. By 1954 Santa Fe was buying ore from small local producers. The deposit at Los Colorados was mined from 1955 by Cia, Minera Santa Fe. In 1957 shiploading was established to replace loading to fishing boats for offshore transshipment. In 1957 two loading ports were built at Chanaral and Caldera, 100 km apart. By 1959 Santa Fe operated open pits in the Chanaral, Coquimbo and Copiapo zones, 700-1100 km N of Santiago, producing 2m t/y (Las Losas, Carmen, Cerro Iman, etc. mines, selling as Los Colorados ores). In 1961 the owners of Santa Fe sold to Philipp Brothers, New York. By 1965 production was 4m t/y. The Carmen mine had 12m tonnes of high grade magnetite in one block. Ore was primary crushed and screened to open hearth lump, BF ore and fines (open hearth lump was high grade magnetite used to sweeten the bath and large and dense enough to penetrate the slag in the steel furnace). Ore was moved by 13 km conveyor to Hermolita station, dumped to railcars and moved 90 km on Chilean National Railways to the port of Chanaral, loaded at 2000 t/h to the company's 47,000 dwt S/S Santa Fe Pioneer and Santa Fe Explorer. At Coquimbo the company installed the world's first dry magnetite beneficiation plant.

In 1971 Santa Fe was taken over by CMP. Lump and fines were produced for export to Japan until the mid 1980'sd. The small ports were closed by the mid 1980's and shipment of Los Colorados ore were made through the port of Guacolda at Husaco.

In 1991-1993 additional drilling revealed new ore reserves of 400m tonnes at 500 metres. In 1995 an agreement was reached to establish a joint venture company of CMP and Mitsubishi Corporation, operating as Cia. Minera Huasco, to expand the operation at Los Colorados. The operating company for the project wa Compania Minera Huasco. Ownership of CMH was:

CMP - 50.0%  
 MC Inversiones - 50.0%

Ownership of MC Inversiones was:  
 Mitsubishi Corporation - 100%

This company developed a mine, which started production in January 1995 at an initial capacity of 1m t/y. This was intended to be expanded to 5m t/y by 1998 in order to maintain the combined production of El Algarrobo and Los Colorados high enough to maintain production at the Huasco pellet plant. The project was expected to cost \$106.4m, including:

Pre-production stripping - \$15.2m  
 Equipment - \$27.3m  
 Primary crusher - \$8.0m  
 Pre-concentration plant - \$25.6m  
 Infrastructure - \$6.5m  
 Other -\$23.8m  
 Total - \$106.4m

In 1997 the revised capital cost of this prject was put at \$113.7m, including a new rail spur of 20 km. Mitsubishi Corpotation provided all the investment capital, CMP provided mining rights, intangible and tangible assets. Cia. Minera Huasco leases the pellet plant at Huasco from CMP. Mitsubishi Corporation is responsible for marketing 50% of the production.

The operations at Romeral are not part of the CMH joint venture and remain under the control of CMP.

The history of the El Laco deposit is also related to Santa Fe. In 1958 Cia. Minera Santa purchased the El Laco deposit.

#### Mining

The mine had two active pits, Penoso and El Algarrobo C, 5 km apart. Penoso was scheduled to close at the end of 1995 at a level of 1130m. El Algarrobo C wa scheduled to close in 1997 at a level of 810m.

Drilling and Blasting  
 Equipment included

Rotary drills  
 1 x Ingersoll Rand DM45E, for 250 mm holes  
 2 x ingersoll Rand T4BH, for 216 mm holes

The ratio of waste to ore was 3.7.

Loading  
 Run-of-mine ore and waste were loaded by shovels. Equipment included

Shovels  
 1 x Bucyrus-Erie 190B electric rope shovel, 4.6 m<sup>3</sup> (6 yd<sup>3</sup>)  
 3 x Bucyrus-Erie electric rope shovels, 6.1 m<sup>3</sup> (8 yd<sup>3</sup>)

Wheel loaders  
 1 x Caterpillar, 9.6 m<sup>3</sup> (12.5 yd<sup>3</sup>)  
 1 x Caterpillar D992D, 10.7 m<sup>3</sup> (14 yd<sup>3</sup>)  
 4 x Caterpillar D988B, 5.4 m<sup>3</sup> (7 yd<sup>3</sup>)

Track bulldozers

5 x Caterpillar D9N; new in 1994

#### Mine Haulage

Run-of-mine ore was loaded to trucks for haulage to the primary crusher, 3 km from Penoso, 2.4 km from Algarrobo C. Waste is loaded to trucks for haulage to the waste dump. Equipment included:

#### Trucks

15 x Lectra Haul Unit Rig M100 diesel electric, 100 tonnes  
7 x Lectra Haul Unit Rig diesel electric, 85 tonnes  
4 x Wabco 50B diesel electric, 50 tonnes

#### Primary Crushing and Transport

The crusher is at the beneficiation plant at the mine site.

#### Beneficiation

At the plant run-of-mine ore at 48% Fe was unloaded at a preconcentration plant at the mine site. At the plant ore was primary crushed from -600 mm (24") to -150 mm (6"). Crushed ore was screened and oversize sent to secondary crushing. From the secondary crusher ore was screened and oversize was tertiary crushed at 9.5 mm. Quaternary crushing was at 12.5 mm.

1 x Primary Crusher: Birdsboro jaw, 1.52m x 2.13m, 1400 HP; reducing to -150 mm  
1 x Secondary Crusher: Symons cone, 2.13m (7)  
2 x Tertiary Crushers: Symons, 350 HP each; reducing to -9.5 mm  
2 x Quaternary Crushers: Gyradisc, 400 HP each; reducing from 12.5 mm  
Separation: Eriez magnetic, 0.91m diameter

Material at 6.4mm was sent to magnetic separation. The produce from the plant was a preconcentrate grading 59% total Fe (55% magnetic Fe) at 96-97% -6 mm. Input of 21000 t/d of run-of-mine ore yielded output of preconcentrate of 16500 t/d. This product was fed to a stockpile of 30,000 tonnes and then reclaimed for loading to trains. Magnetic iron recovery in preconcentrate was reported at 96%, total weight recovery 77.8%.

#### Transport to Shipping Point

At the preconcentration plant ore is loaded to trains for movement to the plant at Huasco.

Operator: 50 km on a branch line operated by CMP. At Maitencillo this joins the national railway Ferronor for 27 km and the final 8 km is on a company branch line to the plant at Huasco. The railway is 1 metre gauge.

Distance: 85 km, mine to Huasco

Railcar size: 58 tonnes

Train size: 24 cars + 1 locomotive of 1310 HP

Frequency: 10 trains per day

Railway fleet: Locomotives: 6 x GR12; Railcars: 123

#### LOS COLORADOS

This mine is located 28 km NW of Vallenar and 110 km NE of the pellet plant at Huasco. The mine started stripping in 1997 and produced its first ore in July 1998. Initial investment was expected to be \$107m, provided by Mitsubishi Corporation. CAP supplied a mining lease and other assets.

#### Mining

In 1997 pre-stripping of the Los Colorados Este deposit started. Pre-production stripping was planned at 43.3m tonnes. The mine was developed on 15m benches. The first mining was at 540m above sea level and the final level was expected to be 445m, a depth of 105m. Mining in 2000 was from the Los Colorados Este pit, with small quantities from Algarrobo and the old Los Colorados B.

#### Drilling and Blasting.

Equipment was expected to include:

#### Rotary drills

2

#### Loading.

Run-of-mine ore and waste are loaded by shovels. Equipment was expected to include:

#### Shovels

1 x 33.6 m<sup>3</sup> (44 yd<sup>3</sup>)

#### Wheel loaders

1 x 13.8 m<sup>3</sup> (18 yd<sup>3</sup>)

#### Mine Haulage

Run-of-mine ore was loaded to trucks for haulage to the primary crusher. Equipment was expected to include:

#### Trucks

10 x 200 tonnes

Primary Crushing and Transport. The crusher is at the beneficiation plant at the mine site.

#### Beneficiation

At the plant run-of-mine ore at 47.35 Fe is unloaded at a primary crusher and reduced to -165 mm (6.5") and is then passed to secondary and tertiary crushing. Ore at

-6, +3 mm passess to high speed magnetic separation and -3 mm goes to a high speed drum for final treatment. The preconcentrate leaves the plant at 58% Fe.

The mine requires water at 15 litres/second, mainly for dust control, Electricity for the mine is from the utility Endesa via a new 15 km line and a new substation.

1 x Primary Crusher: Svedala gyratory, 1.37m x 1.88m (54" x 74"); reducing to -165 mm

2 x Secondary Crushers: Symonds cone, 2.13m (84")

1 x Tertiary Crusher: KHD roller press

2 x Tertiary Crushers: Svedala deagglomerators; reducing to -6 mm

Separation: dry, high speed magnetic + high speed drum

#### Transport to Shipping Point

At the preconcentration plant ore is loaded to trains for movement to the plant at Huasco.

Operator: 14 km spur line built by CMP in 1990 to the main line of the national railway Ferronor

Distance: 109 km, mine to Huasco

Railcar size: 58 tonnes

Train size: 48 cars

Frequency: 5 trains per day

Railway fleet: 12 locomotives; 168 railcars

Railway capacity: 4.9m t/y

#### HUASCO

##### Agglomeration

At Huasco ore is unloaded to a stockpile with capacity of 400,000 tonnes. Ore is reclaimed and fed to ball mills. Products are screened, hydroseparated and magnetically separated. The final product for sinter feed fines is 85% -45 microns (325 mesh, 1500-1800 Blaine). Concentrate is dewatered to 70% solids and fed to disc filters for thickening to 8.5-8.8% moisture. This product at up to 69% Fe enters the pellet plant.

In 1994 a new tailings disposal area was built.

In 1997 CMP ordered a roller press from KHD Humboldt Wedag to treat 5m t/y of concentrate.

The pellet plant at Huasco opened on 28 December 1977 and started commercial production in January 1978; on-specification pellet production started in March 1978, with a capacity of 3.5m t/y. The first cargo was loaded to the Eisho Maru (38,000 tonnes) on 6 April 1978. In 1988 the capacity of the plant was raised from 3.5 to 4.2m t/y.

Pellet plant equipment includes:

3 x Regrinding Mills: ball mills, Kobe, 5.03m x 11.43m, 6000 HP, 64 mm balls

Separation: wet magnetic

Thickening: Dewatering + disc filters

6 x Green Balling Disc: 7.5m diameter

No.1 pellet line: Allis-Chalmers grate-kiln, 1978

Grate: 55.5m x 4.7m

Kiln: 50m long x 6.9m diameter

Fines from the concentrator are fed to balling discs at 180 t/h. Binder is hydrated lime at 2.7% with some organic binder. The green pellets at 90% -17, +10 mm are fed to the grate kiln. The plant design was similar to Eveleth Mines No.2 plant, installed in 1975. Pellets are dried on the grate and preheated for induration at 1350 deg C (2450 deg F) in a kiln. Pellet basicity was reduced from 1.5 to 1.35. This reduced consumption of hydrated lime and lowered the induration temperature to 1335 deg C +/-50C.

The plant was designed to use No.6 fuel oil. In 1983 equipment to permit coal firing was added and the switched to 100% coal. Burnt lime is received from Huachipato and converted to hydrated lime consuming 107,000 t/y

Pellets are screened to +5 mm. Pellets from the plant are of BF grade and two grades of DR pellet 9for midrex and HYL processes). Production of DR grades began in 1993. Pellet chips are also a product at about 120,000 t/y.

Pellets are stockpiled by a stacker.

#### Transport to Customers

The pellet plant is at the port of Guacolda. Pellets are reclaimed from stockpiles and conveyed to the port. The port of Guacolda was expanded in 1985 with a second berth as Guacolda 2. Port facilities include:

Port: Guacolda, Chile on the Pacific Ocean

Location: 28.27S, 71.14W, situated between Point Negra and Guacolda Peninsula.

Operator:

Operator:

Compania Minera del Pacifico SA/Empresa Electrica de Guacolda S.A.

Brazil Street 1050

Vallenar

Chile

Tel: +56 51 208950

Fax: +56 51 208902

e-mail: gguajardo@cmp.cl

Berths:

Guacolda 1: for unloading coal by Empresa Electrica Guacolda SA  
 Guacolda 2: for loading iron ore by CMP  
 Stacking: 2 x 1500 t/h  
 Stockyard: 800,000 tonnes pellets + 200,000 tonnes fines  
 Reclaim: 2 x bucketwheel  
 Shiploading:  
 Unloading at Guacolda 1: 2 x cranes of 770 t/h each unloading to 3 reception hoppers on the pier; conveyor belt to stockyard 2000 km.  
 Loading at Guacolda 2: conveyor belt to 1 x shiploader with 43m outlay; 3500 t/h quadrant; contractual loading rates vary between 25,000 t/d for ships below 80,000 dwt and 60,000 t/d for ships over 200,000 dwt.  
 Channel depth:  
 Depth alongside: 24.8m; maximum draft of vessel 24.0m at Guacolda berth 2  
 Tide: range of 1.68 metres  
 Ship maximum beam: 50 metres  
 Ship maximum length: 315 metres  
 Ship maximum size: The largest vessel handled was the Weser Ore (270,000 dwt, beam 52.0m, LOA 335m, draft 18.5m), loading 262,544 long tons from 28 April to 3 May 1988 for Klockner via Rotterdam. This was loaded in 122 hours. The record pellet shipment was 180,000 tonnes to Kawasaki Steel in 1987.  
 Port capacity: traffic in 2001: 50,031m tonnes handled; importing coal, exporting iron ore

#### MANPOWER

At Algarrobo (mine and preconcentrator) employment was reported in 1994 as 683, down from a peak of 929 in 1981. Total CMP employment was reported in 1989 as 2545.

#### NOTES - RAW MATERIALS AND LOGISTICS

CMP - Min. del Pacifico, Huasco

site 5759

#### IRON ORE - MINERAL RESERVES

##### El Algarrobo

The deposits of El Algarrobo are in the province of Huasco (Region III), 48 km SW of Vallenar, 1300 m above seal leve. Orebodies are Algarrobo C (1200m long x 1000m wide x 400m deep) and Penoso Hill (900m x 700m x 370m). The deposits are 4.5 km apart. In 1995 ore reserves at El Algarrobo and at the previous Los Colorados deposits were 20m tonnes averaging 54% Fe (of which 44% is magnetic), 0.48% P and 0.46%S.

CMP therefore closed the existing Algarrobo and Los Colorados mines in 1998 and opened the new Los Colorados mine.

##### Los Colorados

The Los Colorados Este deposit is 28 km NW of Vallenar, with the surface of the mining are at 540m above sea level. In 1991-1993 additional drilling revealed reserves of 400m tonnes down to 500m above sea level. Proven reserves were reported in 1995 as 245m tonnes above 30% Fe. With a cut-off of 30% the average ore grade is expected to be 48% Fe. Total reserves at Los Colorados Este and adjoining deposits were estimated at 336m tonnes averaging 46.2% Fe, of which 119m tonnes are mineable by open pit.

#### NOTES - ENERGY

CMP - Min. del Pacifico, Huasco

site 5759

#### NOTES - FUTURE PROJECTS

CMP - Min. del Pacifico, Huasco

site 5759

#### IRON ORE - 2006

Project: in November 2004 the company announced an expansion  
 Capacity: an increase of 4m t/y to 11.5m t/y, including a return to exports of iron ore fines.  
 Progress: completion was expected by early 2006

#### OUTLOOK

Cia. Minera del Pacifico (CMP). Iron ore is mined by CMP, a subsidiary of CAP, at three operations. The small El Laco mine near the Argentinian border produces lump ore which is sold to Zapla in Argentina and moved by truck. At El Algarrobo magnetite ore of 56% Fe is mined and processed to a pre-concentrate which is moved by rail to Huasco on the coast. The concentrate is further processed to pellet feed and processed in a pellet plant at Huasco. Products from Huasco are shipped from the port of Guacolda near the plant, which can handle ships to 270,000 dwt.

At El Romeral CMP mines magnetite ore with 55% Fe and upgrades this to products for sale. Products from Romral are moved by rail to the port of Guayacan which can handle vessels to 200,000 dwt (record load 211,000 tonnes).

Products are sinter fines, pellet feed fines for sale, pellet chips as sinter fines, BF lump, BF pellets, DR pellets,

BF Lump. CMP has capacity for BF lump of 1.2m t/y from Romeral. Lump ore is shipped to steel plant of the the affiliated company CMP at Huachipato in Chile.

Sinter Fines. CMP has capacity for sinter fines of 2.0m t/y from Romeral, plus 0.2m t/y pellet chips as sinter feed from Husaco. Sinter fines are sold mainly to Japan but also to Korea.

Pellet Feed Fines. CMP has capacity of 1.2m t/y of pellet feed fines for sale at Romeral and 0.5m t/y at Huasco. BF pellet feed fines are sold to the Japanese mills, who use them as sinter feed.

BF Pellets. CMP has capacity for BF pellets of 4m t/y. Pellets are shipped to the CAP steelworks at Huachipato and for export. Exports of BF pellets are under contract to Japanese steel mills at 1.5m t/y. Other sales are made to Germany (Bremen) and Korea (Posco). BF pellet sales are forecast to rise from 2.3 to 3.0 million tonnes in the long term.

DR Pellets. CMP has capacity for DR pellets of 1.0m t/y. DR pellets sales have increased substantially to Indonesia and Malaysia and CMP expanding capacity for DR pellets for export market. Our forecasts indicate that production would need to rise from 1.0 to 1.8m t/y for these customers, requiring an expansion of capacity. This may be beyond the financial strength of the operation, since it is not regarded as a mainstream part of the parent company's business, which is principally steel production for the local market.

The Romeral mines has reserves of 54m tonnes of current grade (54.5% Fe) and a further 164m tonnes of low-grade material (29.6% Fe). Romeral was scheduled to



be mined out by 2002 and it seems unlikely that the low-grade deposit can be economically processed. New resources will have to be discovered and developed if Chile is to continue to supply the world market from this location in the future.

Site	135	personal	<input type="checkbox"/>	production	<input checked="" type="checkbox"/>
Shortname	Shougang Hierro	ferro-alloys	<input type="checkbox"/>	office/sales	<input type="checkbox"/>
Name	Shougang Hierro Peru SA	iron ore	<input checked="" type="checkbox"/>	trader	<input type="checkbox"/>
Address1		iron + steel	<input type="checkbox"/>	supplier	<input type="checkbox"/>
Address2		energy	<input type="checkbox"/>	scrap	<input type="checkbox"/>
City	Marcona, Nasca	bx/alumina	<input type="checkbox"/>	equipment	<input type="checkbox"/>
State		primary	<input type="checkbox"/>	consultant	<input type="checkbox"/>
Phone	34 525085	secondary	<input type="checkbox"/>	trade body	<input type="checkbox"/>
Fax		rolled	<input type="checkbox"/>	publisher	<input type="checkbox"/>
Country	Peru	Email	sales@shp.com.pe		
Code	<input type="checkbox"/>	Internet	www.shp.com.pe		
Updated	05 July 2005	EU VAT			
		castings	<input type="checkbox"/>	government	<input type="checkbox"/>
		other	<input type="checkbox"/>	legal	<input type="checkbox"/>

NOTES - GENERAL

This site is the iron ore operations of Shougang Hierro Peru SA in Peru. The head office of the company is at site 133.

In 1992 the company was bought from the government by Shougang Corporation, China and ownership became:  
 Shougang Corporation, China (site 4125) - 100%

**HISTORY**

Mineral anomalies were noticed in the Marcona area of southern Peru from 1815. In 1943 Corporacion Peruana del Santa was formed by the government to build a steelworks at Chimbote and Marcona reserves were assigned to Santa. In 1952 there was an agreement with Utah Construction Co. to provide ore for Chimbote and for export, leading to the development of the mine and port at San Juan. In 1953 Marcona Mining Corporation was established as a joint venture of Utah and Cyprus Mines, both US companies. In 1954 Hierro Peru started mining at the Marcona open pit mine. In 1958 a concentrator was built at San Juan. In 1967 the concentrator was moved to San Nicolas and operations at San Juan were ended. Operations started up at San Nicolas in 1962 and port facilities were developed there.

In 1975 Marcona Mining was nationalised and replaced by Empresa Mineral del Hierro Peru.

In 1992 the company was bought from the government by Shougang Corporation, China for a total of \$311.8m (\$120m in cash, \$180m in future investment, \$42m debt assumption) and became Shougang Hierro Peru SA.

In 1996 the company called tenders for a third pellet plant.

In 1997 a new agreement was reached for Shougang to spend \$137m by 2000, including expansion of the pellet plant and a project to recover copper from tailings.

NOTES - PRODUCTS AND MARKETS Shougang Hierro, Marcona, Nasca site 135

**IRON ORE - PRODUCT RANGE**

Products of Hierro Peru are:

- sinter fines
- pellet feed fines
- BF lump
- BF pellets
- DR pellets.

**IRON ORE - MARKETS**

Sinter fines

Capacity for sinter fines is 2.5m t/y. Sinter feed is shipped to China and to Posco (Korea).

Pellet Feed Fines

Capacity for pellet feed fines is 1.4m t/y. Regular contract sales are for BF pellet feed fines were to Kobe Steel, Japan at 750,000 t/y. DR pellet fines have been sold to Imexsa at about 500,000 t/y since 1992.

The contract with Kobe Steel was:

Period: 3 years April 1999 to March 2002  
 Product: pellet feed fines  
 Quantity: 750,000 t/y +/- 10% at buyer's option  
 Purchaser: Kobe Steel; contract administered by Nissho Iwai  
 Loading:  
 40-50,000 dwt: 48,000 t/d; despatch - \$2,000/day; demurrage - \$4,000/day  
 50-70,000 dwt: 50,400 t/d; despatch - \$2,250/day; demurrage - \$4,500/day  
 70-90,000 dwt: 52,800 t/d; despatch - \$2,500/day; demurrage - \$5,000/day

90-100,000 dwt: 55,200 t/d; despatch - \$3,000/day; demurrage - \$6,000/day  
 over 100,000 dwt: 60,000t/d; depatch - \$,3000/day; demurrage - \$6000/day

#### DR pellets

Capacity for DR pellets is 0.5m t/y. DR pellets have been sold to Mexico (Inmexsa) and to Georgetown Steel (USA). Other sales have been on a spot basis. Under Shougang's ownership, emphasis is likely to be on supplying BF quality material to the Chinese market.

#### BF Pellets

Capacity for BF pellets is 4.6m t/y. BF pellets are delivered to the Sidereru works at Chimbote. Regular contract sales are for BF pellet to Posco (Korea). Shougang now takes the largest quantity of pellets (over 2m t/y) to China for its own plant and for sale to other plants.

Other sales have been on a spot basis.

### NOTES - TECHNOLOGY AND OPERATIONS

Shougang Hierro, Marcona, Nasca

site 135

#### IRON ORE - CURRENT OPERATIONS

##### MINING

Mining is from numerous open pits.

##### Drilling and Blasting

Overburden varies from a few centimetres to 6 metres. All ore is blasted to firm 15m benches. Equipment includes:

##### Rotary drills

10

##### Loading

Run-of-mine ore and waste are loaded by shovels. Equipment includes:

##### Shovels

4 x electric rope shovels, 4.6 m<sup>3</sup> (6 yd<sup>3</sup>)  
 2 x electric rope shovels, 7.6 m<sup>3</sup> (10 yd<sup>3</sup>)  
 4 x electric rope shovels; 9.3 m<sup>3</sup> (12 yd<sup>3</sup>)

##### Wheel loaders

##### Mine Haulage

Run-of-mine ore was loaded to trucks for haulage to the primary crusher. Equipment includes:

##### Trucks

45, 60, 100 and 120 tonnes

#### PRIMARY CRUSHING

Run-of-mine ore at is fed to the primary crusher at the mine site and reduced to -100 mm. Equipment includes:

1 x Primary Crusher: jaw, 1200 t/h  
 1 x Secondary Crusher: rotary, 2000 t/h

Ore from the primary crusher is moved by conveyor 15.4 km to the plant at San Nicolas. Power generated from the gravity fall on this conveyor is 1 kWh per tonne of ore, sufficient for the conveyor's requirements.

#### BENEFICIATION

At the plant crushed ore at 55% Fe is fed to the concentrator, Equipment includes:

1 x Tertiary Crusher  
 1 x Quaternary Crusher, reducing to -18 mm  
 Separation: magnetic cobbing  
 Separation: heavy media wet separation  
 Separation: Gravity concentration  
 5 x Grinding Lines: ball mills  
 Flotation: installed in 1996

The concentrator products magnetite sinter feed fines, magnetite pellet feed fines for sale and for the on-site pellet plant. The sinter feed fines are high in sulphur. An additional circuit for grinding and filtering with flotation was added in 1996 in order to reduce S in the sinter feed fines from 0.8-1.0% to 0.4%.

#### AGGLOMERATION

The pellet plant at San Nicolas produces DR and BF pellets, with 24 hours required to switch between grades. Equipment includes:

No.1 pellet line; Lurgi travelling grate, 52.9m x 2.49m, 1963  
 No.2 pellet line: Lurgi travelling grate, 87.78 x 3.05m, 1966  
 No.3 pellet line: Lurgi travelling grate, 2002

In January 1999 orders for No.3 pellet plant were placed with Banco Bilbao Vizcaya Trade, Lurgi Espanola and Mecanica de la Pena (subsidiary of Kvaerner).

**TRANSPORT TO CUSTOMERS**

Products are shipped from the port of San Nicolas, opened in 1962. Port facilities include:

Port: San Nicolas, Peru

Port Authority and Operator: Shougang Hierro Peru (head office at site 133)

Location: Lat 15.15S; Long 75.14W on the Pacific Ocean

Stacking:

Stockyard: 1.7 million tonnes

Reclaim:

Pier: the pier is situated at the south side of the bay and is protected by a breakwater of 809 metres. Pier length: 304m, width 15m

Berths: 1

Shiploading: 1 x 6,000 t/h maximum, 3,500 t/h normal; height clearance 12.26 metres; loading boom extends 18.3 metres from the face of the pier and can be retracted to 9.45 metres. Iron ore can be loaded in slurry form at 3000 t/h.

Channel depth:

Depth alongside: iron ore is loaded on the west side of the pier; depth 18.9m; maximum draft of vessel 17.67m; sailing draft 18 metres. General cargo is discharged on the east side of the pier with 12.5 metres alongside

Ship maximum beam: 49 metres

Ship maximum length: 320 metres; Pier length 300m

Ship maximum size: 208,000 dwt

Port capacity:

**UTILITIES**

Power is supplied by a power station of 63 MW. In 1996 the company considered installing a new power station of 300 MW at a cost of \$300m, to be fueled by coal moved from China in returning iron ore ships.

Water is supplied from desalination plants.

**MANPOWER**

1996 - employment was reported as 1500

**NOTES - RAW MATERIALS AND LOGISTICS**

Shougang Hierro, Marcona, Nasca

site 135

**IRON ORE - MINERAL RESERVES**

The Marcona deposit is on a coastal plateau 530 km S of Lima at 730m above sea level, 16 km from the port of San Nicolas. The Marcona concession covers 150 square kilometres.

Reserves at Marcona are 440m tonnes proven to a depth of 245 metres and a further 500m tonnes probable. The bottom of the orebody extends below 360 metres.

The ore is hematite in the upper leached zones, mixed hematite/magnetite in the middle zone and massive magnetite in the underlying primary zones. The hematite in the upper zone is over 60% Fe, the magnetite of the underlying primary zone is 55% Fe.

In 2004 Japanese sources stated reserves as 780m tonnes plus a further 620m tonnes of resources.

**NOTES - ENERGY**

Shougang Hierro, Marcona, Nasca

site 135

**NOTES - FUTURE PROJECTS**

Shougang Hierro, Marcona, Nasca

site 135

**OUTLOOK**

In 2002 our outlook for the operation stated:

"Our forecasts indicate that the demand for pellets in China could permit this plant to double capacity in the longer term. We expect that Shougang will work to achieve this, subject to local political conditions.

**NOTES - CONFIDENTIAL**

Shougang Hierro, Marcona, Nasca

site 135

Site	1165	personal	<input type="checkbox"/>	production	<input checked="" type="checkbox"/>
Shortname	CVG Ferrominera	ferro-alloys	<input type="checkbox"/>	office/sales	<input type="checkbox"/>
Name	CVG Ferrominera Orinoco CA	iron ore	<input checked="" type="checkbox"/>	trader	<input type="checkbox"/>
Address1	Via Caracas, Zona Industrial Ferrominera	iron + steel	<input type="checkbox"/>	supplier	<input type="checkbox"/>
Address2	PO Box 399	energy	<input type="checkbox"/>	scrap	<input type="checkbox"/>
City	Puerto Ordaz	bx/alumina	<input type="checkbox"/>	equipment	<input type="checkbox"/>
State		primary	<input type="checkbox"/>	consultant	<input type="checkbox"/>
Phone	286 930-3139	secondary	<input type="checkbox"/>	trade body	<input type="checkbox"/>
Fax	286 930-3656	rolled	<input type="checkbox"/>	publisher	<input type="checkbox"/>
Country	Venezuela	extruded	<input type="checkbox"/>	financial	<input type="checkbox"/>
Email	aoliveros@ferrominera.com	castings	<input type="checkbox"/>	government	<input type="checkbox"/>
Internet	www.ferrominera.com	other	<input type="checkbox"/>	legal	<input type="checkbox"/>
Code	<input type="checkbox"/>				
Updated	05 July 2005	EU VAT			

NOTES - GENERAL

This site is the iron ore operations of FMO - CVG Ferrominera Orinoco at various locations in Venezuela.

The first mining concession in Venezuela was granted in 1893. Industrial scale production began in 1950, when Iron Mines of Venezuela (Bethlehem Steel) started up. In 1947 a deposit was discovered at Cerro La Parida (now Cerro Bolivar) and Orinoco Mining Company (US Steel) was established, starting production in 1954.

In 1974 private concessions were abolished, but supply contracts were signed with both companies. In December 1975 CVG Ferrominera Orinoco was established.

Ownership of CVG Ferrominera Orinoco CA is:

Corporacion Venezolana de Guayana (CVG) - 100%

Ownership of Corporacion Venezolana de Guayana is

Government of Venezuela - 100%

In March 2004 Cliffs International Management Co., a subsidiary of Cleveland-Cliffs Inc, Cleveland, entered into an agreement to provide technical assistance to CVG Ferrominera Orinoco of Venezuela, whereby Cliffs will assist Ferrominera to achieve stable and sustainable production at its iron ore pellet plant in Bolivar state, Venezuela.

Ferrominera Orinoco is a government-owned company responsible for the development of Venezuela's iron ore industry. The company owns a 3.3 million metric ton pellet plant at Puerto Ordaz, on the Orinoco River in Venezuela where it processes high-grade ores from its main iron ore deposits in Ciudad Piar, for domestic consumption and sale to international markets.

Under terms of the agreement, Cliffs International will provide a technical assistance team that will reside in Venezuela and work full time at the pellet plant. The team will assist current management in various operational functions including operations and process control, maintenance, safety, environmental, training and quality control.

John S. Brinzo, Cliffs' chairman and CEO, said, "The contract with Ferrominera represents Cliffs' re-entry into international iron ore operations. Although we hold no equity interest in the project, it provides an excellent opportunity to demonstrate to the international community our technical and operating capabilities."

IRON ORE - PRODUCT RANGE

Products are

- sinter fines
- pellet feed fines for sale
- BF lump
- BF pellets
- DR pellets

IRON ORE - PRODUCTION AND SALES

Production was: (m tonnes)

2002 - 18.4, of which 55% was for the domestic market and 45% export. This was a record level of production.

2003 - 22.1

2004 target in January 2004 - 22.2

IRON ORE - MARKETS

DR Fines

FMO supplies DR fines to domestic DRI producers RDI, formerly Fior, and Orinoco Iron. Our forecasts do not include continued production from Orinoco Iron and future sales of DR fines will be limited.

### Sinter Fines

FMO's capacity for sinter fines is 17m t/y. Sinter fines are sold principally to the USA and Europe (Belgium, France, Netherlands, Italy, Spain, UK), with some sales also to Japan.

### Pellet Feed Fines

FMO supplies pellet feed fines for the DR pellet plant of Sidor in Venezuela. Sales to Sidor are about 4.6m t/y, of which a small part, perhaps 0.4m t/y, is used for BF pellets and the rest for DR pellets. Ore is moved to Sidor by conveyor.

FMO's export sales of pellet feed fines are 0.6-1.0m t/y. Some sales were made to Kobe Steel in Japan. Most sales are now to the pellet plant of Corus in the Netherlands. The contract to the Japanese was:

Period: April 2001-March 2002

Quantity: 600,000 tonnes of pellet feed fines

Purchaser: NKK

Price: A price of 19.43 cents/Fe unit FOB; the FOB price is notional; delivery was on CIF terms assuming Rotterdam bunker fuel of \$75/tonne, buyner factor of 0.018, with addition of 95 cents for 2-port discharge; assumed loading - 40,000 t/d; unloading - 35,000 t/d; despatch - \$8,750/day; demurrage - \$17,500/day

### DR Lump

FMO's capacity for lump ore is 4m t/y. Most of this is DR lump supplied to domestic DRI plants.

### BF Lump

FMO supplies small quantities of BF lump to the USA and Europe.

### BF Pellets

FMO's capacity for BF pellets is 1.0m t/y. Pellets are produced in a new pellet plant, opened in 1994. Proposals were made for a second plant in 1998. BF pellets are exported to the USA and Spain. Before FMO opened its pellet plant these were produced by Sidor and sold by FMO. We expect the plant to focus on DR pellets, with limited sales of BF pellets.

DR Pellets. FMO's capacity for DR pellets is 2.6m t/y. FMO ships about 2m t/y of DR pellets to the domestic DRI plants and has limited exports. DR pellets have been sold since 1994 to Mexico and Trinidad. Our forecasts imply that over 5m t/y of DR pellets will be shipped in the long term to the domestic market, with some exports to Trinidad. This will require construction of the second DR pellet plant.

Production from the pellet plant was: (m tonnes)

1997 - 2.94, a record not exceed until 2003

2003 expected in June 2003 - 2.75

2004 expected in June 2003 - 3.3

FMO supplies lump ore to the domestic DRI industry. Exports are largely of sinter feed fines with small quantities of lump, principally to the USA and Europe (Belgium, France, Italy, Spain, UK), with some sales to Japan. DR pellets are supplied to the domestic industry and exported to Mexico and Trinidad. DR pellet feed fines are supplied to Sidor for processing into DR pellets within Venezuela.

FMO supplies DR lump ore to the domestic DRI industry and exports products to the international market. Faced with the rapidly increasing demand for DR ore and the depletion of the Pao deposit which supplied DR lump, FMO built a DR pellet plant of 3.3m t/y in 1994 and added a second unit in 1999.

In August 2002 FMO signed a contract to supply 2.9m tonnes of ore to Corus over a 2-year period.

In May 2003 an official visit to Iran discussed supply of iron ore to the plant at Mobarakeh.

In November 2004 supplies of iron ore for the DRI industry in Venezuela were tight, caused by tests for a restart at Posven, a restart of a third line at Orinoco Iron and maintenance closure of one pellet furnace at FMO.

As shown in the latest edition of our World Capacity & Production Report – Iron Ore Products, product capacities are:

### Product Capacities

(000 tonnes product as shipped)

#### Item

Run-of-mine crude ore  21000

BF lump  4000

DR lump  0

Sinter feed fines  16500

BF/EF fines  0

DR fines  500

BF pellet feed fines for sale  600

DR pellet feed fines for Sidor  (6000)

BF pellets – total  700

BF pellets – flux  0

DR pellets  2600

Information on product specifications and prices is available in separate reports.

## IRON ORE - CURRENT OPERATIONS

CVG Ferrominera Orinoco (FMO) operates two divisions – Piar and Pao.

In the Piar Division are the mines of Cerro Bolivar, San Isidro, Los Barrancos and Las Pailas. At these mines ore averaging around 65% Fe is extracted by open pit methods and loaded to trucks which transfer the ore directly to railcars for movement 146 km (from Cerro Bolivar) and 163 km (from San Isidro) to a crushing and screening plant at Puerto Ordaz. At the Pao mine ore of 64% Fe was extracted and crushed before being moved by rail 55 km for crushing, washing and screening at the port of Palua, across the River Caroni from Puerto Ordaz, where it was loaded to ships of 65,000 dwt. The deposit at Pao was mined out in 1996 and at that time Palua was connected to Puerto Ordaz by a railway bridge across the River Caroni, so that the port of Palua can also be used to load ore from Puerto Ordaz.

## PIAR DIVISION - CERRO BOLIVAR

## Mining

## Drilling and Blasting

Drilling is to 18 m in 310/380 mm holes. Blasting is with ANFO at 600 kg per hole to create benches of 15m

## Loading

Run-of-mine ore and waste are loaded by shovels. Equipment included

## Shovels

electric rope shovels, 7.6 m<sup>3</sup>

## Mine Haulage

Run-of-mine ore was loaded to trucks for haulage to a rail loadout. Equipment included:

## Trucks

90 tonnes

## PIAR DIVISION - LOS BARRANCOS

## Mining

Mining of the Los Barrancos deposit started in 1990.

Mine Haulage. Run-of-mine ore is loaded to trucks for haulage to a primary crusher.

## Primary Crushing and Transport.

A primary crusher (7m t/y) was built at Ciudad Piar to serve Los Barrancos and San Isidro.

## PIAR DIVISION - SAN ISIDRO

## Mining

This mine is located about 140 km S of Puerto Ordaz. Mining of the San Isidro deposit began in 1985 in order to replace and supplement Cerro Bolivar.

## Mine Haulage

Run-of-mine ore is loaded to trucks for haulage to the primary crusher.

## Primary Crushing and Transport.

Ore from San Isidro is crushed at the primary crusher. Equipment includes:

2 x Primary CrusherS; jaw, 450 t/h

2 x Secondary Crushers: cone, 548 t/h

6 x Tertiary Crushers: cone, 225 t/h

## Transport to Further Processing

Run-of-mine ore from Cerro Bolivar was dumped directly to railcars for movement to Puerto Ordaz. Crushed ore from Los Barrancos and San Isidro is loaded to railcars and moved on the same railway.

## Operator: CVG Ferrominera

Distance: Cerro Bolivar: 11 km to marshalling yard + 157 km main line to Puerto Ordaz

Los Barrancos: 2.5 km on spur to join San Isidro spur

San Isidro: 17 km on spur line, completed in May 1985 + 146 km on main line to Puerto Ordaz, either to the pellet plant or to the loading port.

Railcar size: 90 tonnes

Train size: Cerro Bolivar: 35 cars moved down a grade of 3.1% to marshalling yard, where are formed into trains of 125 cars + 3 locomotive of 2000 HP.

San Isidro: 144 cars

Frequency: Cerro Bolivar: 6 trains per day; San Isidro: 5 trains per day

## Railway fleet

Railway capacity: 26m t/y

## Beneficiation

At Puerto Ordaz run-of-mine ore from Cerro Bolivar and crushed ore from San Isidro is unloaded from trains and fed to the plant. Ore from the primary crusher is at -200 mm. Ore from the secondary crusher is at -100 mm and from the tertiary crusher at -32mm. Product is screened at -32, +10 mm. The -10 mm fraction is stockpiled in two blending piles of 300,000 tonnes each. The capacity of the screening plant is 20m t/y.

Screened ore is reclaimed for drying from 6% to 55 moisture in rotary kilns using natural gas. Dried ore is screened into final lump and fine products for shipment.

Equipment includes:

1 x Primary Crusher: Allis-Chalmers 60-89, 2180 t/h  
 2 x Secondary Crusher: Allis-Chalmers 30-70, 860 t/h each  
 4 x Tertiary Crusher: Nordberg shorthead cone, 2.13m (84"), 550 t/h each, built in 1973  
 Drying: 2 x rotary kilns 30.5 metres, gas fired

In 2002 approval was received for investment of \$70m in a new concentrator.

#### AGGLOMERATION

In 1994 a pellet plant of capacity 3.3m t/y opened at a cost of \$300m at Punta Cuchillo. The operating company for the pellet plant is Topcco. The pellet plant was upgraded in 2003. Equipment includes:

No.1 pellet line: Allis/Kobe grate-kiln, gas fired

Feed for the pellet plant is a blend of Cerro Bolivar and San Isidro ores. The project included a lime plant with capacity of 500,000 t/y.

In 2003 CVG upgraded the pellet plant to raise production from 340 to 390 t/h, aiming at production of 3.1m tonnes in 2004 of capacity of 3.3m t/y. The project included replacement of the travelling grate and relining the rotary kiln.

#### TRANSPORT TO SHIPPING POINT

Pellets are moved by rail 8.9 km to FMO's dock at Puerto Ordaz. Other products from the concentrator are also moved to FMO's dock.

#### TRANSPORT TO CUSTOMERS

Products are loaded at the port of Puerto Ordaz on the Caroni River. Port facilities include:

Port: Puerto Ordaz, Venezuela

Berths: 2

Operator: FMO

Stacking:

Stockyard: products are blended from San Isidro, Cerro Bolivar, Los Barrancos and Pas Pailas in three yards:

main blending yard: 600,000 tonnes

main raw materials yard: 700-1,000,000 tonnes

product yard: 600,000 tonnes

Final storage capacity is 2,1m tonnes, including

2 x blending and loading beds of 300,000 tonnes each for sinter feed fines

2 x blending and loading beds of 300,000 tonnes each for pellet feed fines

Reclaim:

Shiploading: 7500 t/h maximum, 5000 t/h normal. The dock can load two vessels

Channel depth: The Rio grande Channel in the Orinoco River is 341 km between Ciudad Guayana (Puerto Ordaz) and the bar at the entry to the Atlantic. The draft of the Orinoco River is 9.4-11.2 metres in January-May and 12.4-13.4 in June-December. Ships are normally limited to 80,000 dwt, 12.8 metres (42 feet). The channel is continuously dredged by a company dredger.

Depth alongside: 9.2m at minimum low water (February/March), 12.8m at high water (August/September)

Ship maximum beam: 43.0m

Ship maximum length: 266.5m

Ship maximum size: 120,000 dwt; record ship size 149,000 dwt, normally 80,000 dwt

Port capacity: screening capacity at the port is 20m t/y

The port at Puerto Ordaz has limited depth. The record ship at this port was Orinoco in July 1987 (148,583 dwt; 266.5m LOA, 43.0m beam; 17/4m draft). To overcome this a transfer station was set up in 1987 in the Orinoco River. Under this system vessels part-load at Puerto Ordaz and proceed 495 km downstream to the transfer station which is the vessel Boca Grande (227,558 dwt; LOA 314m; Beam 50.05m; draft 20.413m) permanently moored from 15 June 1989 between Venezuela and Trinidad. The Boca Grande was converted from a bulk carrier to self-loading/unloading. It is fed by self-unloading shuttle ships Rio Orinoco (88,868 dwt; LOA 240.01m; beam 38.05m; draft 13.72m) and Rio Caroni (86815 dwt; LOA 240.8m; beam 38m; draft 14.75m), which unload on to the transfer vessel. The combined capacity of these shuttle ships is 8m t/y. Ore is loaded by conveyors from the transfer vessel to top off the ships proceeding from Puerto Ordaz. This reduces ocean freight costs, but because of the complex arrangement FMO normally sells ore on C&F pricing terms. Transfer facilities include:

Port: Boca Grande transfer station, Venezuela

Operator: FMO

Stockyard: 185,000 tonnes on Boca Grande

Shiploading: 6000 t/h, 40,000 t/d from Boca Grande to export vessel

Depth alongside: 30m at the transfer vessel; Boca Grande is 20.412 metres

Ship maximum beam: 52m; Boca Grande is 50.07 metres

Ship maximum length: Boca Grande is 314 metres

Ship maximum size: 200,000 dwt

Port capacity:

In December 2004 the river level on the Orinoco fell to 27 feet (8.2 metres). This prevented ships entering the channel to load at Plua and Puerto Ordaz.

#### PAO DIVISION - PALUA

Mining

The mine at El Pao was exhausted in 1996. The description below refers to operations before the closure. The port of Palua continues to operate using ore from other FMO operations.



**Drilling and Blasting**

Drilling was to 18 m in 180/250 mm holes. Blasting was with ANFO at 600 kg per hole to create benches of 15m. Equipment included:

**Hammer drills**

7

**Loading**

Run-of-mine ore and waste were loaded by shovels. Equipment included

**Shovels**

9 x electric rope shovels, 10.7 and 3.4m<sup>3</sup>

**Wheel loaders**

1

**Tracked bulldozers**

9

**Backhoe**

1

**Mine Haulage**

Run-of-mine ore was loaded to trucks for movement to a primary crusher at the mine. Equipment included:

**Trucks**

26 x 45 tonnes and 100 tonnes

**Graders**

1

**Primary Crushing and Transport**

Run-of-mine ore was dumped at the primary crusher, which reduced ore to -635 mm.

**Transport to Further Processing.**

Crushed ore was loaded to trains for movement to the plant at the port of Palua.

**Operator: CVG Ferrominera**

Distance: 57 km, plant to Palua

Railcar size: 64 tonnes

Train size: 44 cars

Frequency:

Railway fleet:

**Beneficiation**

At Palua crushed ore was unloaded at the plant. Equipment included:

2 x Secondary Crushers: gyratory

Washing plant: built in 1975, 853 t/h, 27300 litres/min

Screening

Ore was washed and classified into two products: -25.4, +6.3 mm and -6.3 mm, +149 microns.

**Transport to Customers**

FMO normally loaded only washed lump ore at Palua, with other products handled through Puerto Ordaz. The port of Palua is across the River Caroni from Puerto Ordaz and on the Orinoco River. In 1996 Palua was connected to Puerto Ordaz by a railway bridge across the River Caroni. This enables the port of Palua to be used to load ore from Puerto Ordaz, since ore from Pao was exhausted in 1996. Port facilities include:

Port: Palua, Venezuela

Operator: FMO

Stacking:

Stockyard: 650,000 tonnes

Reclaim:

Shiploading: 3000 t/h

Channel depth:

Depth alongside: 9.2m minimum at low water (February/March), 12.8m at high water (August/September)

Ship maximum beam:

Ship maximum length:

Ship maximum size: 100,000 dwt

Port capacity:

Other ports in Palua include:

Orinoco Iron (site 2258): quay in port of Palua, loading 20,000 t/d.

Posven (site 2260): quay in the port of Palua, loading maximum 55,000 dwt

Sidor (site 2273): quay at mile 175 on Orinoco, capacity 2.7m t/y

Venprecar (site 2278): quay in the port of Palua, loading 20,000 t/d.

**MANPOWER**

1985 - The company's total employment was reported as 3,500.

## NOTES - RAW MATERIALS AND LOGISTICS

CVG Ferrominera, Puerto Ordaz

site 1165

## IRON ORE - MINERAL RESERVES

Geological reserves in the area of the existing operations total 1.2 billion tonnes averaging around 65% Fe. FMO can continue to supply the rapidly expanding domestic market, but this expansion may limit the availability of exports. We estimate that FMO has exceptionally low production costs. Major investment in processing capacity will be necessary to provide the expected volumes of pellet for the DRI industry.

Geological reserves in the area of the existing operations total 1.2 billion tonnes averaging around 64% Fe.

## Piar Division

In the Piar Division are the mines of Cerro Bolivar, San Isidro, Los Barrancos and Las Pailas.

Cerro Bolivar is in tMunicipio Centurion, Edo. Bolivar, 140 km SE of Puerto Ordaz at 790 metres above sea level. The deposit is 9,5 km long, 3 km wide and is a mixture of hematite and limonite with reserves reported in 1991 at 196m tonnes at 64.6% fe.

Part of the Cerro Bolivar deposit is Cerro Altamira, also in Municipio Centurion., 130 km SE of Puerto Ordaz and 15 km NE of Piar. The deposit is 5 km long and 2 km wide.

San Isidro is 163 km from Puerto Ordaz. The deposit adjoins Cerro Bolivar. In 1991 reserves were stated at 264m tonnes, averaging 66.5% Fe. The ore deposit is about 3.5 km x 2.5 km at 435-700 metres above sea level. Ore is hematite and martite with a sedimentary structure. Solid material is found near the surface (Costra), under which are black fines as about 65% of the ore, with 30-40% as fines of -15 microns.

## Pao Division

Cerro El Pai is in Municipio Andres Eloy Blanco, Edo. Bolivar, 45 km E of Puerto Ordaz at 590 m above sea level. ore is mainly hematite at 64% Fe, In 1990 reserves were stated as 6m tonnes at 64% Fe. The deposit at Pao was mined out in 1996. Operations at El Pao also included the Gutierrez deposit.

In May 2003 total iron ore reserves in Venezuela were stated by CVG to be 14 billion tonnes.

## NOTES - ENERGY

CVG Ferrominera, Puerto Ordaz

site 1165

## NOTES - FUTURE PROJECTS

CVG Ferrominera, Puerto Ordaz

site 1165

## IRON ORE - 2004

Project: In January 2004 operations at Puerto Ordaz were closed for 5 days for maintenance and installation of new rail wagon tipping and ore crushing equipment at Bs1.4 m.

## IRON ORE - 2005

Project: the company had an investment programme of \$'78m for the period 2003-2006.

Capacity: In May 2003 bids invited for a project to raise pellet capacity to 4.0m t/y.

Suppliers: Bidders were Danieli; a consortium of MetChem, Duro Felguera and Techint; a consortium of Marubeni and Kobe Steel.

Progress: completion of the project was planned for 2005 H2.

## IRON ORE - 2006

Project: in August 2003 the company had a project to build a concentrator at Puerto Ordaz

Capacity: concentrator capacity would be 8m t/y. This would be the first concentrator of FMO and would upgrade lower grade ore from the Altamira mine to 65% Fe, which was required to permit the company to reach a long-term production target of 25m t/y.

Suppliers: a contract was awarded to a consortium of Metchem and Duro-Felguera, but by November 2003 they had not been able to raise finance. Other contracts, including Voest, Ferrostaal and Techint were reported to be interested.

Cost: the expected cost was \$230m for the concentrator and \$100m for infrastructure, including an aqueduct to bring water from the Guri dam and a new electrical plant. Project financing guarantees were awaited from Cesce, a Spanish development bank. In November 2003 discussions on finance were held in Canada and with Deutsche Bank.

Progress: in November 2003 the company confirmed that construction would start in 2004 H2. The first stage would be a pilot plant. Completion of the plant was expected in 2006

## IRON ORE - UNDATED

Project: From 1998 the company had a plant to install a second pellet plant of 3.3m t/y, raising total capacity to of 6.6m t/y.

## NOTES - CONFIDENTIAL

CVG Ferrominera, Puerto Ordaz

site 1165

Site	5766	personal	<input type="checkbox"/>	production	<input checked="" type="checkbox"/>
Shortname	LKAB	ferro-alloys	<input type="checkbox"/>	office/sales	<input type="checkbox"/>
Name	LKAB - Luossavaara Kirunavaara AB	iron ore	<input checked="" type="checkbox"/>	trader	<input type="checkbox"/>
Address1		iron + steel	<input type="checkbox"/>	supplier	<input type="checkbox"/>
Address2		energy	<input type="checkbox"/>	scrap	<input type="checkbox"/>
City	Kiruna	bx/alumina	<input type="checkbox"/>	equipment	<input type="checkbox"/>
State		primary	<input type="checkbox"/>	consultant	<input type="checkbox"/>
Zip		secondary	<input type="checkbox"/>	trade body	<input type="checkbox"/>
Country	Sweden	rolled	<input type="checkbox"/>	publisher	<input type="checkbox"/>
Code	<input type="checkbox"/>	extruded	<input type="checkbox"/>	financial	<input type="checkbox"/>
Updated	05 July 2005	castings	<input type="checkbox"/>	government	<input type="checkbox"/>
		other	<input type="checkbox"/>	legal	<input type="checkbox"/>

NOTES - GENERAL

This site is the iron ore operations of LKAB - Luossavaara Kirunavaara AB at Kiruna in Sweden. The head office of the company is at site 3141.  
 The company was established in 1890. The company is state owned. The mines are located north of the Arctic Circle.  
 In 1955 the first pellet plant was opened, in Malmberget. This closed in 1981. Other operations continue at Malmberget (site 5767).

NOTES - PRODUCTS AND MARKETS LKAB, Kiruna site 5766

IRON ORE - PRODUCT RANGE

The products of LKAB at Kiruna include:

- sinter fines
- pellet fines
- BF pellets
- DR pellets

IRON ORE - MARKETS

Information on the markets for all LKAB products is at this site 5766.

Shipments of high P ores ended in 1996

DR fines

Products from the operation include MAC grade fines for shipment via Narvik to iron powder producer Hogganas in Sweden.

Pellet Fines

In 1993-1998 200-300,000 t/y of DR pellets fines were supplied to GIIC (Bahrain). This is not expected to continue following the acquisition of GIIC by CVRD.

The main sale of pellet fines is BF pellet fines to the pellet plant of Corus (Netherlands) at 1.5-2.0m t/y.

BF Pellets

Pellets from Svappavaara are supplied mainly to Germany.

In 2001 LKAB started production of a new pellet grade KPBA at Kiruna. Developed for Stahlwerke Bremen, this pellet has lower MgO than the flux pellet grade KPBO which uses olivine. KBPA uses quartzite and permits lower Mg, which reduce the saleability of BF slag to the cement industry.

## IRON ORE - CURRENT OPERATIONS

## MINING

At Kiruna mining is by underground methods using sub-level caving. In 1997 Kiruna underground mine started mining at the 1045 metre level to open up a further 300m tonnes of reserves and maintain production to 2016. Working at the 997m level was exhausted in 1999 and all ore is from the 1046m level since that time.

Further work was committed in 1996 at a cost of SK 394m to develop new ore under Lake Luossojarvi at the mine's north end, in order to release a further 115m tonnes at the 1045 metre level. This requires construction of a dam on the lake and draining the area for safe mining, which was scheduled to start in 2001, later delayed to 2003. The area will be mined at 4-5m t/y, with 60m tonnes recoverable. This will extend Kiruna's life to 2018.

Drilling and Blasting  
Loading

Mine Haulage. Underground mine haulage is by load-haul-dump (LHD) vehicles of 25 tonnes. In 1999 LKAB launched a programme to introduce a System for Automated Loading and Transport – driverless LHD vehicles of 25 tonnes running at 18 k/h underground.

## PRIMARY CRUSHING

## BENEFICIATION - KIRUNA

At Kiruna LKAB has two concentrators, KA1 and KA2.

KA1 was completed in December 1994, rated at 4.3m t/y. The plant has two parallel lines fed with high P crushed ore. Each line has 2-stage grinding. The first set is autogenous mills in closed circuit with spiral classifiers. This plant was LKAB's first to use autogenous grinding. Morgardshammar Mining supplied five grinding mills for the plant.

Grinding  
2 x autogenous, 6.5m diam x 5.5m long, each with 3500 kW (400 HP) motor  
2 x pebble mills, 6.5m diam x 8.5m long, each with 4000 kW motor  
1 x flux grinding, 3.5m diam x 4.8m long

Separation  
3 x drum magnetic separators after autogenous mills (dry + wet)

Cyclones  
3 drum magnetic separators after pebble mills (dry + wet)

Flotation  
13 x 38 m<sup>3</sup> cells

Dewatering by disc filters

Oversize from the autogenous mills is screened, pebbles are used in the pebble mill and the remainder is to the autogenous mill. Undersize is passed to three drum magnetic separators, then to a flotation plant with capacity of 4m t/y, designed to reduce P content. Slurry is dewatered on disc filters.

KA1 is designed to produce mainly DR grade pellets, to feed KK2 pellet plant.

KA2 is an older concentrator. In this plant crushed ore is ground in ball mills, followed by grinding in pebble mills, with dry and wet magnetic separation after each stage.

Grinding  
in ball mills and pebble mills

Separation  
magnetic separators after ball mills (dry + wet)  
magnetic separators after pebble mills (dry + wet)

In 1998 the company committed a further investment of SK195m on the KA1 concentrator and pellet plant in order to expand capacity to 5.0m t/y. In the concentrator this included expansion of dry magnetic separation. In 2000 an investment of SK 93m was committed for KA1 to introduce flotation of phosphorus. This is required because of higher P levels in the Lake ore to be mined from 2002-3. The flotation plant added 500,000 t/y to the capacity of the concentrator in 2001.

## BENEFICIATION - SVAPPAVAARA

Run-of mine ore from Kiruna is processed at the concentrator at Svappavaara to pellet feed. Crushed ore is ground in a rod mill, followed by intermediate wet low intensity magnetic separation and further grinding in a pebble mill. Mill operates in open circuit.

Grinding  
in rod mills and pebble mills

Separation  
magnetic separators after rod mills (wet low intensity)

## AGGLOMERATION - KIRUNA

Kiruna has two pellet plants KK2 and KK3.

KK2 is a grate kiln plant opened in 1981. Dewatered pellet feed fines from Concentrator KA2 is fed to seven parallel balling circuits with drums and roller screens.

KK3 was opened in 1995 with a capacity of 4.0m t/y, adjacent to KK2. Slurry is received from the concentrator.

For BF pellets olivine (magnesium silicate) is added to the concentrate. This permits high productivity, low slag volume and low fuel rate at the blast furnace. For DR pellets dolomite and lime are added in order to produce good reduction properties in DR shaft furnaces. The flux materials are ground in balls mills and added to slurry before dewatering. Slurry is dewatered by air pressure filters. Bentonite binder is added before balling in balling drums. Green balls are screened on roller screens and -10 mm is returned to the balling circuit. Green balls at 10-15 mm are fed to the pellet furnace

Green balls are fed to the pellet plant and laid 25 cm thick on the grate, dried and preheated to 1200oC. In the grate heat is released from the magnetite equivalent to 10 litres of fuel oil per tonne of pellets. Pellets pass from the grate to the kiln, fired mainly by coal at a temperature of 1200oC. Pellets drop from the kiln to an annular cooler, reducing temperature to below 100oC. Heat is recovered and returned to the kiln as hot air. Pellets are conveyed to a storage bin ready for loading. Waste gas not already used is passed through a dust separator, heat exchanger and gas purifier before released into the atmosphere. Of the water used at the concentrator and pellet plant 85% is recovered by the thickeners, 15% goes to a tailings pond and is pumped back after settling.

KK3 produces BF and DR pellets.

Pellet plant equipment includes:

Plant KK2

Green balls  
7 x balling drums + roller screens

Pellet line  
1981, Allis Chalmers, coal

Plant KK3

Dewatering  
4 x air pressure filters

Green balls  
5 x drums 5m x 13m, 300 t/h each + roller screens

Pellet line  
1995, Svedala Allis  
Grate: 246 m<sup>2</sup>  
Kiln: 6.7m diameter x 35.5m long, coal  
Cooler: annular, 250 m<sup>2</sup>

#### AGGLOMERATION - SVAPAVAARA

The pellet plant at Svappavaara (KK1) opened in 1968 with rated capacity of 1.8m t/y. In 1998 the company committed SK285m for modernisation of the concentrator and pellet plant at Svappavaara in order to continue operations until 2020. The plant produces BF pellets.

At the plant concentrate slurry is dewatered on drum filters and fed to 5 balling circuits with drums and roller screens.

Pellet plant equipment includes:

Plant KK2

Dewatering  
Drum filters

Green balls  
5 x balling drums + roller screens

Pellet line  
1968, Allis Chalmers grate-kiln, coal

#### TRANSPORT TO SHIPPING POINT

Haulage from Kiruna is by rail to the port of Narvik in Norway. In 1995 LKAB began a process of acquiring an interest in the railway companies (Swedish state railways to the border, Norwegian state railways from the border to Narvik) as part of the privatisation of those companies. From 1996 the railway was operated by subsidiaries of LKAB, MTAB (owned by LKAB 51%; SJ - Swedish Railways 24.5%; BSBO – Norwegian Railways 24.5%) and MTAS.

In 1998 the company approved an investment of SK 1.1bn for new rolling stock by 2005, comprising 9 locomotives and 209 railcars. The intention is to raise axle weight on the lines from Kiruna to Narvik and from Malmberget to Lulea from 25 to 30 tonnes. Approval was received in 1998 to upgrade the Swedish section of the line for this. Upgrading of the Norwegian section requires approval.

Operator: MTAB  
Distance  
Railcar size  
Train size  
Frequency  
Railway fleet: Railcars - more than 900 with 25 tonne axle load  
Railway capacity - 23m t/y

#### TRANSPORT TO CUSTOMERS

Products are shipped from the port of Narvik. Port facilities include:

## Port Authority:

Narvik Havn KF  
Fagernesveien 2  
PO Box 627  
8508 Narvik  
Norway

Tel: +47 7695-0370  
Fax: +47 7695-0384  
e-mail: narvikhavn@narvik.kommune.no  
Internet: www.portofnarvik.com

## Terminal Operator:

LKAB  
Tel: +47 7692-3800  
Fax: +47 7694-4925

LKAB Bulk Pier No.3/4 loads olivine sand and other bulk cargoes on one side (No.3) and unloads bulk cargoes on the other side (No.4)  
Pier: 434m long  
Depth alongside: 13-14 metres

LKAB Pier No.5 handles iron ore  
Stockyard: total 1.6m tonnes  
Pier: 208 metres long  
Shiploading: 1 x 5,000 t/h; horizontal coverage: 220 m  
Channel depth: harbour entrance 700m wide x 26-30m depth  
Depth alongside: 27 metres; 25m at mean water level; ship maximum draft 18.48 metres  
Ship maximum beam  
Ship maximum length: 299.9 metres  
Ship maximum size: 350,000 dwt; record load 280,000 tonnes  
Port capacity: traffic in 2001: 12.258m tonnes

## UTILITIES

## MANPOWER

1996: Total manpower - 3285

## NOTES - RAW MATERIALS AND LOGISTICS

LKAB, Kiruna

site 5766

## Ore Reserves

In 1997 proven reserves in the Kiruna area were reported at:

Proven □ 580m tonnes down to 1045 metre level  
Probable □ 320m tonnes at 1045-1300 metre level  
Possible □ 200-500m tonnes at 1300-1500 metre level

Ore is magnetite/hematite ores of around 56% Fe. Part of the reserves contains apatite with phosphorus content. These high P ores cannot now be sold and must be processed into pellets.

## NOTES - ENERGY

LKAB, Kiruna

site 5766

## NOTES - FUTURE PROJECTS

LKAB, Kiruna

site 5766

## IRON ORE - UNDATED

Project: Expansion

Progress: In June 2004 the company was studying 2 new pellet plants to add to the existing 5 plants. The main investment would be at Kiruna for 5m t/y. Construction would take 4 years from the date of approval, of which 2 years would be required to obtain environmental approvals.

## NOTES - CONFIDENTIAL

LKAB, Kiruna

site 5766

Site	3141	personal	<input type="checkbox"/>	production	<input type="checkbox"/>
Shortname	LKAB HQ	ferro-alloys	<input type="checkbox"/>	office/sales	<input checked="" type="checkbox"/>
Name	LKAB - Luossavaara Kirunavaara AB	iron ore	<input checked="" type="checkbox"/>	trader	<input type="checkbox"/>
Address1	Head Office: Varvsgatan 45	iron + steel	<input checked="" type="checkbox"/>	supplier	<input type="checkbox"/>
Address2	PO Box 952	energy	<input type="checkbox"/>	scrap	<input type="checkbox"/>
City	Lulea	bx/alumina	<input type="checkbox"/>	equipment	<input type="checkbox"/>
State		primary	<input type="checkbox"/>	consultant	<input type="checkbox"/>
Phone	920 38000	secondary	<input type="checkbox"/>	trade body	<input type="checkbox"/>
Zip	97128	rolled	<input type="checkbox"/>	publisher	<input type="checkbox"/>
Country	Sweden	extruded	<input type="checkbox"/>	financial	<input type="checkbox"/>
Code	<input type="checkbox"/>	castings	<input type="checkbox"/>	government	<input type="checkbox"/>
Updated	21 June 2004	other	<input type="checkbox"/>	legal	<input type="checkbox"/>
		EU VAT	<input type="checkbox"/>		

NOTES - GENERAL  
 This site is the head office of LKAB - Luossavaara Kirunavaara AB in Sweden. LKAB is a producer of iron ore. The company also operates an experimental blast furnace at the site of SSAB in Lulea (site 3132). Information on the operations at Kiruna (including Svappavaara) is under site 5766 and information on the operations at Malmberget is under site 5767.

NOTES - PRODUCTS AND MARKETS LKAB HQ, Lulea site 3141

PRODUCTS AND MARKETS - IRON ORE

Shipments: (m tonnes)  
 2003 - 21.6, of which pellets 67%

Iron ore production is by LKAB, which operates underground mines at Kiruna and Malmberget (in the town of Gallivare) and pellet plants at Kiruna, Malmberget and Svappavaara in northern Sweden (combined capacity: 1.0m t/y BF lump; 8.3m t/y sinter feed; 11.0m t/y BF pellets; 4.9m t/y DR pellets). LKAB mines magnetite/hematite ores of around 56% Fe from large underground operations, processing this in concentrators and the pellet plants.

Sales of about 5m tonnes are made in Sweden and shipped by rail to the port of Lulea and by small ship to SSAB's plant at Oxelosund and truck to SSAB's plant in Lulea. Exports of sinter feed and BF pellets are mainly to Finland (Dalsbruk and Rautaruukki, via rail to the port of Lulea (maximum 60,000 dwt) and Belgium, Luxembourg, France, Germany and Netherlands (mainly via rail to the port of Narvik in Norway, maximum at least 250,000 dwt). LKAB offers olivine flux pellets for the BF market and retains a leading position in BF pellets in Europe. The company has also developed DR pellets and is a supplier of most DR operations where imported ore is needed (Egypt, Libya, Qatar, Saudi Arabia, Indonesia). Because of the growth in the DR pellet market, LKAB added a pellet plant at Kiruna in 1995. LKAB is currently the second largest supplier of DR pellets to the international market, after CVRD.

Reserves at Kiruna are in the range of 1.8 billion tonnes of recoverable material and at Malmberget 600m tonnes. Mining at Kiruna is at the 775 metre level with development proceeding at the 1000 m level, to be mined from 1997. At Malmberget mining is at the 815 m level which will continue until 2002. Despite underground mining and long rail hauls, costs of production at LKAB are estimated to be very competitive in the European market, but increasing depth will require further emphasis on relatively high value products such as DR ores.

SUMMARY AND OUTLOOK

LKAB. Iron ore production is by LKAB, which operates underground mines at Kiruna and Malmberget (in the town of Gallivare) and pellet plants at Kiruna, Malmberget and Svappavaara in northern Sweden. LKAB mines magnetite/hematite ores of around 56% Fe from large underground operations, processing this in concentrators and the pellet plants.

Products for Sweden are moved by rail to the port of Lulea and by small ship to SSAB's plant at Oxelosund and truck to SSAB's plant in Lulea. Exports to Finland are moved by rail to the port of Lulea (maximum 60,000 dwt). Other exports are moved by rail to the port of Narvik in Norway, maximum at least 250,000 dwt).

Products are sinter fines, pellet feed fines, BF lump, BF pellets and DR pellets.

Sinter Fines. LKAB's capacity for sinter fines is 8.3m t/y. Exports of sinter fines are mainly to Finland (Dalsbruk and Rautaruukki), Belgium, France, Germany and Netherlands.

Pellet Feed Fines. BF pellet fines are shipped to Netherlands (Corus). DR pellet fines are shipped to Bahrain (GILC).

BF Lump. LKAB's capacity for BF lump is 1.0m t/y.

BF Pellets. LKAB's capacity for BF pellets is 11.0m t/y. Sales of about 5m tonnes are made in Sweden (SSAB at Oxelosund and Lulea). LKAB offers olivine flux pellets for the BF market and retains a leading position in BF pellets in Europe. Exports of BF pellets are mainly to Finland (Dalsbruk and Rautaruukki, France, Germany and Turkey). Our forecasts indicate that the heavy emphasis of BF pellet sales on the European market will mean that demand for LKAB's product would be static at about 11m t/y in the long term. An increase in BF pellet sales would require new markets in Eastern Europe or China.

DR Pellets. LKAB's capacity for DR pellets is 4.9m t/y. The company has developed a strong position in the DR pellet market and is a supplier of most DR operations where imported ore is needed (Egypt, Libya, Qatar, Saudi Arabia, Indonesia). Because of the growth in the DR pellet market, LKAB added a pellet plant at Kiruna in 1995. In 2002 LKAB was the third largest supplier to the international DR pellet market after CVRD and Samarco and about the same as GILC in Bahrain. Our forecasts indicate that these markets will require 5.0m t/y of LKAB pellets in the long term, still within the capacity of the existing plant.

Reserves at Kiruna are in the range of 1.8 billion tonnes of recoverable material and at Malmberget 600m tonnes. Mining at Kiruna was shifted from the 775 metre

level to the 1000 m level in 1997. At Malmberget mining is at the 815 m level, which was scheduled to continue until 2002. Despite underground mining and long rail hauls, costs of production at LKAB are estimated to be very competitive in the European market, but increasing depth will require further emphasis on relatively high value products such as DR ores.

#### DISTRIBUTION

LKAB operates a trading subsidiary Minelco Minerals. This was created when the minerals division of Frank & Schulte, part of Stinnes AG, was taken over by Minelco. Minelco supplies iron ore to refractories, heavy media separation and water treatment.

NOTES - TECHNOLOGY AND OPERATIONS	LKAB HQ, Lulea	site 3141
NOTES - RAW MATERIALS AND LOGISTICS	LKAB HQ, Lulea	site 3141
NOTES - ENERGY	LKAB HQ, Lulea	site 3141
NOTES - FUTURE PROJECTS	LKAB HQ, Lulea	site 3141
NOTES - CONFIDENTIAL	LKAB HQ, Lulea	site 3141



Site	4436	personal	<input type="checkbox"/>	production	<input checked="" type="checkbox"/>
Shortname	KIOCL - Kudremukh Iron Ore	ferro-alloys	<input type="checkbox"/>	office/sales	<input type="checkbox"/>
Name	KIOCL - Kudremukh Iron Ore Company Ltd.	iron ore	<input checked="" type="checkbox"/>	trader	<input type="checkbox"/>
Address1	Baikampady Industrial Area	iron + steel	<input checked="" type="checkbox"/>	supplier	<input type="checkbox"/>
Address2		energy	<input type="checkbox"/>	scrap	<input type="checkbox"/>
City	Mangalore	bx/alumina	<input type="checkbox"/>	equipment	<input type="checkbox"/>
State	Karnataka	primary	<input type="checkbox"/>	consultant	<input type="checkbox"/>
Phone		secondary	<input type="checkbox"/>	trade body	<input type="checkbox"/>
Zip		Fax		rolled	<input type="checkbox"/>
Country	India	Email	kioclpur@nsvl.com	publisher	<input type="checkbox"/>
Code	<input type="checkbox"/>	Internet	www.kudremukh.com	extruded	<input type="checkbox"/>
Updated	05 July 2005	EU VAT		castings	<input type="checkbox"/>
				other	<input type="checkbox"/>
				legal	<input type="checkbox"/>

NOTES - GENERAL

This site is the iron ore operations, pellet plant and ironmaking plant of KIOCL - Kudremukh Iron Ore Company Ltd. at Mangalore in India.

The head office of the company is at site 93. All notes on operations are at this site 4436.

The company also operates a blast furnace at this site as Kudremukh Iron & Steel Co.

Ownership of KIOCL is:

Government of India - 100%

In 2002 the Government of India scheduled the company for privatisation. By April 2003 the government was unable to proceed until guidelines for the privatisation of natural resource companies had been determined. Such companies were:

MOIL (site 8960)  
Kudremukh Iron ore (site 4436)  
NMDC (site 714)

KIOCL was opened in 1980 to produce sinter fines and pellet feed fines. Initial operations were based on a large contract with Iran, which was not honoured by the Iranians. Subsequently the company reacted to surplus fine ore capacity in a difficult market (sales were made mainly to Romania at this time) by building a pellet plant at Mangalore, opened in 1986. Kudremukh mines a taconite (quartz magnetite) ore at 38.6% Fe, which is concentrated at the mine site. The beneficiation plant was modified at the time of pellet plant construction to permit DR quality pellets to be produced. The ore is moved 67 km by slurry pipeline from the mine to the plant/port at Mangalore. Shipments are from the port of Mangalore (maximum vessel size 100,000 dwt).

The Kudremukh orebody, located at Kudremukh, 110 km E of New Mangalore, KA in the western Ghats, a north-south mountain range was discovered in 1913 by a state geologist. The word Kudremukh means "horse's face" in Kannada.

The project was developed to produce sinter feed fines for export to Iran. In 1975 an agreement was signed by National Iranian Steel Company to take the entire production of concentrates at 7.5m t/y for 20 years and extend credit for the full costs of \$630m. In 1976 the Government of India authorised the project as Kudremukh Iron Ore Co. (KIOC) a wholly-owned company of the Union government, and the Iranian government released the first tranche of \$100m. Iran paid a total of \$225m and stopped payments in 1978. In 1977 the company selected Met-Chem Canada as its technical associate. This relationship continues to the present. A major study of the plant was made in 1993 and improvements implemented in 1994.

Kudremukh Iron Ore Co. started production in 1980. In October 1981 the first shipment of concentrate was made.

In 1982 KIOC made an agreement with Lurgi and the Romanian government for a pellet plant of 3.0m t/y. Lurgi supplied process technology and the Romanians supplied detailed engineering and equipment in a barter for iron ore concentrates. Pellet production began in 1986.

The originally estimated capital costs for the project were \$m

Mine site production facilities - 518  
Pellet plant - 100  
Pipeline - 10  
Power station - 60  
Port - 61  
Road - 11  
Other infrastructure + townsites - 59  
Total - 819

In August 2002 it was reported that the total capital cost of the project over its life had been R 50 bn.

In 1998 the Government of India, owner of 99% of the equity, indicated a wish to privatise part of the company and appointed financil advisers. In 2001 the government indicated a wish to sell 30% to private investors.

In 2000 operations were stopped for 60 days because of a landslip which damaged the slurry pipeline.

The company had a 30-year mining lease, which expired in July 1999. One-year permits were granted while an application for a 20-year extension on 4600 hectares was reviewed. The central governmentn supported the 20-year lease, but the state government approved only 5 years because the mining areas is in Kudremukh

National Park. One solution was to remove 3,700 hectares from the boundaries of the park to allow continued mining. In September 2001 the Government of India approved extension of the lease for 20 years, subject to a decision of the Supreme Court. Pending that decision, in November 2001 a further one-year extension of the lease was granted until 24 October 2002 by the central and state governments. In September 2002 a ruling by the Supreme Court allowed Kudremukh to continue operating beyond October 2002. In February 2003 the Supreme Court decided that mining should end on 31 December 2005 on its mining area of 485 hectares.

In early 2004 the company made a petition to the Supreme Court to continue mining on 40 hectares, part of the 485 that had not been mined, where 30m tonnes of weathered ore is available.

In 2001 KIOCL proposed a new mine at Ongole in Prakasam District, AP, located 18 km from the coast, with capacity of 1.5-2.0m t/y for export at a cost of R2.5bn. Reserves at this deposit were stated to be 60m tonnes, with ore similar to Kudremukh. In 2002 the project received lower priority when further information on the reserves became available. In April 2002 the company decided to abandon the Ongole project after spending 3 billion rupees. The deposit was found to contain only 45m tonnes of ore.

In May 2002 KIOCL was seeking mining leases in the Ramandurga area of the Bellary-Hospet region, with a view to moving fine ore as pellet feed to Mangalore by rail. The deposit was estimated to have reserves of 270m tonnes of a total of 715m tonnes in the area. 70m tonnes of the reserve of 270m tonnes had been allocated to Jindal, as it is close to the Jindal Vijaynagar plant and another 70m tonnes had been reserved for a steel plant. KIOCL requested rights to all 270m tonnes with a contract to supply Jindal or 140m tonnes of its own. In August 2002 the company indicated that it could mine in the area of Tumkur, Orissa, near Bellary Hospet. Ore in that area was 66-67% Fe.

In November 2002 Austeel Pty. Ltd. of Brisbane, Australia proposed a project to move the concentrator from KIOCL to Western Australia and to ship concentrate back to the pellet plant in Mangalore, with Austeel taking 3m t/y of pellets. The capital cost was estimated at \$15-20m to move the equipment to Australia.

In June 2004 the Minister for Steel in the new government of India indicated he would support a petition by KIOCL at the Supreme Court to extend its mining permit beyond December 2005.

In September 2004 KIOCL failed to secure leases in Bellary Hospet. KIOCL signed a contract with NMDC for the supplier of 2m t/y of fines and hoped to buy a further 2m t/y. KIOCL's mine was scheduled to close in December 2005. In order to supply the fines to the pellet plant, KIOCL planned a railway at R350m.

On 28 September 2004 SAIL (site 4496) signed a joint venture with KIOCL - Kudremukh Iron Ore Co Ltd to develop Barsua, Taldih and Kalta iron ore deposits in Orissa. This would give reserves of 300m tonnes. The joint venture could raise production at these mines from 5m to 10m t/y. An alternative was the purchase of Kalinga Iron Works (site 4430), which had its own captive mines.

## NOTES - PRODUCTS AND MARKETS

KIOCL - Kudremukh Iron Ore, Mangalore

site 4436

## IRON ORE - PRODUCT RANGE

Products of KIOCL are:

sinter fines  
pellet feed fines  
BF pellets  
DR pellets.

## IRON ORE - PRODUCTION AND SALES

Production:

2001/2: 22m tonnes of run-of-mine ore to produce 7.5m tonnes of concentrate; pellet exports - 3.2  
2002/3: 15m tonnes of run-of-mine ore to produce 5.4m tonnes of concentrates, further to processed to 3.3m tonnes of pellets  
2003/4 target: 16m tonnes of run-of-mine ore to produce 5.53m tonnes of concentrates, further processed to 3.75m tonnes of pellets; actual production of pellets - 3.6  
2004/5 target: pellets - 3.6m tonnes, most to be exported

## IRON ORE - PRICES

In February 2004 the company was reported to be selling iron ore pellets to China at 125 c/Fe unit FOB, equivalent to \$82-85/tonne FOB. This price was up from 105 c/Fe unit in December-January. In March 2004 the company had a tender for 60,000 tonnes to China t \$100/tonne FOB for 65% Fe pellets.

In March 2004 KIOCL sold pellets to China at about \$130/tonne FOB. By May 2004 prices were at \$65/t.

In September 2004 KIOCL sold 60,000 tonnes of pellets to China at \$115/tonne FOB and a quantity of DR pellets to Indonesia at \$120/tonne FOB.

In October 2004 KIOCL selling price for spot pellets was \$115/tonne.

In December 2004 KIOCL spot prices were \$95-100/tonne

## IRON ORE - MARKETS

Under the company's status as an export company, only 25% of production can be sold in India.

## Sinter Fines

Kudremukh now sells sinter fines mainly to Japan and China

## Pellet Feed Fines

Sales of pellet feed fines are DR pellet fines to Iran at about 800,000 t/y; BF pellet fines to Kobe Steel (Japan) at about 150,000 t/y and to OneSteel (formerly BHP) at Whyalla.

## BF Pellets

BF Pellet capacity is 2.0m t/y. Pellets are sold as BF pellets to Turkey, China, Taiwan and Australia (OneSteel, formerly BHP). The strong demand in China indicates

that BF pellet demand for KIOCL could exceed 3m tonnes if supply is available.

#### DR Pellets

DR pellet capacity is 2.2m t/y. A small expansion of capacity (0.5m t/y), in the form of shaft furnaces, was added in 1997. DR pellets have been sold in the export market only to Indonesia, but sales in India are substantial.

### NOTES - TECHNOLOGY AND OPERATIONS

KIOCL - Kudremukh Iron Ore, Mangalore

site 4436

#### IRON ORE - CURRENT OPERATIONS

##### MINING

Open pit mining

Drilling and Blasting.

##### Loading

Run-of-mine ore and waste are loaded by shovels. Equipment includes:

##### Shovels

8 x 10.7 m<sup>3</sup>

##### Mine Haulage

Run-of-mine ore is loaded to trucks. Waste is loaded to trucks for haulage to the waste dump. Equipment includes:

##### Trucks

30 x 120 tonnes

#### PRIMARY CRUSHING

The primary crusher is at the plant.

#### BENEFICIATION

The plant is at the mine site. At the plant run-of-mine ore at 38% Fe is beneficiated in a wet concentrator to sinter feed and pellet feed fines. The concentrator uses spirals and chemical froth flotation.

In 1995 the company added Floatex cells to process rougher spiral product by density separation to remove silica and eliminate non-impregnated clay particles and limonite. This unit was designed to handle 800 t/h and reduce the use of flotation chemicals.

Column flotation equipment from Cominco was installed in 1998 to reduce silica.

1 x Primary Crusher

1 x Secondary Crusher

Separation: wet spirals

##### Flotation:

8 x Floatex chemical froth flotation cells, 800 t/h

2 x rougher, 4m diameter x 12m

6 x scavenger, 4m diameter x 12m

In 1995 KIOC retained Mineral Technologies, Australia to advise on processing tailings. The company has a stockpile of 150m tonnes of tailings at 22-24% Fe in Lakya Dam, which could be beneficiated to 66-67% Fe concentrates at 2m t/y. Mineral Technologies estimated a capital cost of R 260m for a plant to process 117m tonnes of tailings into 22m tonnes of concentrate.

#### TRANSPORT TO AGGLOMERATION

Products from the concentrator are moved to the pellet plant at Mangalore by a slurry pipeline of 67 km. The pipe is 13 km of 457 mm diameter and 54 km of 406 mm diameter, with maximum wall thickness of 18.3 mm, and is powered by 5 pumps. Lime is added to the slurry to prevent corrosion. The slurry is pumped from an elevation of 800 metres at the start to 847 metres at mid-point, then downhill to Mangalore at sea level.

In November 2002 the cost of concentrate delivered to the pellet plant was stated as \$15/tonne.

In September 2004 KIOCL signed a contract with NMDC for the supplier of 2m t/y of fines and hoped to buy a further 2m t/y. In order to supply the fines from NMDC's mines in Bellary Hospet to the pellet plant in Mangalore, KIOCL planned a railway at R350m. The rail line of 236 km from Mangalore to Arsikere, which links Mangalore to Bangalore and the rest of the Indian Railways system was planned for an upgrade, which would reduce the capacity available for carrying iron ore for KIOCL.

#### AGGLOMERATION

At Mangalore the company operates a pellet plant, with technology from Lurgi and Romanian engineering, with initial capacity of 3,0m t/y, subsequently adapted to produce both BF and DR pellets.

Equipment at the pellet plant includes:

1 x Regrinding Mill: for pellet chips -6 mm □

Dewatering: Filters

1 x Flux/binder Grinding Mill: Bradley roll grinder, 2.03m (80"), 30 t/h

1 x Flux/binder Grinding Mill: Svedala roll grinder, 12 t/h, new in 1997

6 x Balling Discs: 132 kW motor each, 190 t/h  
No.1 pellet line: Lurgi travelling grate 1986

At the pellet plant concentrate slurry is dewatered in filters. Filter cake is reclaimed at 3000 t/h by 1 of 2 bridge reclaimers. Additives are bentonite binder, limestone flux and coal, which are ground in a roll grinding mill.

In 1994 Met-Chem Canada was contracted to supply new burners and controls, double deck roller screens, a roll press and new bentonite grinding equipment in order to permit operation at full capacity of 3.5m t/y and prepare for expansion to 4.0m t/y, including production of flux BF pellets.

Filter cake was coarse, with Blaine of 1500-1600, which made preparation of green balls difficult (Blaine of 1800 is preferred). Filter cake moisture was also high, at 9.5%. In order to improve the grind a high pressure roller press (KHD RPSR 7-140/110) was installed in 1999 at 600 t/h. This press raised the Blaine by 300, reduced recirculation by 25%, bentonite by 0.4% and moisture by 0.7%.

The plant was designed to use hydrated lime as a binder, but this was inadequate because of the coarse grind of the concentrate. Hydrated lime was replaced by bentonite, ground with limestone and coal. The Bradley roll grinder was inadequate for the expanded capacity and was supplemented by a roll grinder from Svedala in 1997 to grind bentonite only. Coal will be replaced by coke breeze, which will become available from coke imported for KIOCL's blast furnace project. A chip regrind mill will be used to grind coke breeze.

Green balls are produced on six balling discs, each with a 132 kW motor rotating at 5-7 rpm. Each disc has design capacity of 113.5 t/h, upgraded to 190 t/h. Disc scraper life has been increased to 40 weeks.

Green balls are passed over double deck roller screens, installed by Met-Chem in 1996, designed at 92-94% -16+9 mm, with <1% at - 5mm.

The indurating furnace was designed to use 50% bunker C fuel oil and 50% coarse coal because of Indian government concern about oil imports. By the time of the start of production oil import restrictions had been lifted. The plant never used coal. Fuel oil consumption was 17.6 litres per tonne in 1995/6. Oil consumption was expected to be 13.1 litres/tonne at 500 t/h and 9.1 litres/tonne at 571 t/h (4m t/y).

The plant uses 25,000 grate bars per year, costing about \$8 each.

The plant was designed with a low pellet depth of 400 mm (490 mm is used in North America), which reduces the requirements for air draft and electricity consumption in fans. KIOCL increased the pellet depth to 480-500 mm within the capacity of the existing fans. In order to achieve production of 4m t/y the plant requires 571 t/h, which needs pellet depth of 540 mm. This requires additional fan capacity equivalent to 3 kWh per tonne.

The design of the plant included regrinding of pellet chips of -6 mm (too small for sinter feed) in a regrind mill of 14 t/h. In practice chips could be sold as sinter feed.

In 1995 an expansion of capacity from 3.0 to 3.5m t/y was approved at a cost of \$10m (also reported as R 350m). A separate project to add three vertical shaft pellet furnaces, total capacity 500,000 t/y, at a cost of \$15m (also reported as R 400m) was approved, with an engineering contract to Mayme Research & Engineering, Perrysburg, OH, for completion in 1997. The total cost of the shaft furnace was stated in 2002 to have been R850 for capacity of 650,000 t/y.

In 2002 capacity at the pellet plant was raised from 3.0 to 3.5m t/y and a shaft furnace of 500,000 t/y was built, to give total capacity of 4.0m t/y.

In 2004 it was decided to continue pellet production using pellet fines from NMDC and purchases.

#### TRANSPORT TO CUSTOMERS

Products are shipped from the port of New Mangalore on the Arabian Sea. Port facilities include:

Port Authority and Operator:  
New Mangalore Port Trust  
Panambur  
Mangalore 575010  
India

Tel: +91 824 407341  
Fax: +91 824 408390  
Internet: www.newmangaloreport.com

Berths: The port has 10 berths. Berth No.8 is used by Kudremukh Iron Ore Company for loading iron ore

Berths: 1

Railcar unloading: none

Stockyard: 200,000 tonnes of concentrates + 400,000 tonnes of pellets (2 x 200,000 t buildings)

Reclaim: 2 x 4,000 t/h

Shiploading: 1 x 6000 t/h; maximum 65,000 tonnes loaded in 24 hours; actual 30,000 t/d

Pier length: berth length 285 metres

Depth alongside: December to July: 12.5m with tide (= max 15.2m); August to November 12.0 metres with tide

Ship maximum beam: 39 metres

Ship maximum length: 245 metres

Ship maximum size: 70,000 dwt

In 1996 it was reported that KIOCL was planning to form a joint shipping company with other state steel companies SAIL and Rashtriya Ispat. In 2002 the company considered importing fines for its pellet plant and stated that the port could handle import vessels of 65,000 dwt.

#### UTILITIES

In 1996 the company added 2 x 15 MW diesel generators to the existing 2 x 9.36 MW units to make the operation self-sufficient in power. The cost of power to the company in 1996/7 was expected to exceed 1 billion rupees, based on a rate from the state electricity board of 8 paise/kWh, compared to the agreement with the central government that the maximum price would be 2.5 paise.

Because of the expansion of pellet capacity in 2000 the total power requirement will be 80 MW. Discussions were held with Karnataka Power Corporation for a new 100 MW power station. The company decided to proceed independently and in 1997 decided to install a new 68 MW power station from GE Power Corporation, to use naphtha. This project was delayed and a project for 62 MW was proposed in 2000

**MANPOWER**

Total employment was reported as:

1997 - 2460  
2002 - 2000

In June 2004 th Minister for Mines stated that the closure would cost 12,000 jobs.

**NOTES - RAW MATERIALS AND LOGISTICS**

KIOCL - Kudremukh Iron Ore, Mangalore

site 4436

**MINERAL RESERVES - IRON ORE**

The Aroli Ganga deposit being mined is mixed hematite and magnetite in the upper zone, with magnetite at depth, similar to Bong in Liberia. Mining started in 1981 and continues in the weathered upper zone of the deposit. In 2000 a contract was awarded to Met-Chem Canada (now a subsidiary of US Steel) to study the feasibility of mining the primary ore deposit to give 17 more years' life.

Ore reserves of taconite grading 38.6% Fe at the deposit were estimated in 1992 at 450m tonnes. In 1993 reserves were reported at 13 years' life at an extraction rate of 21.8m t/y run-of-mine ore (equivalent to 283m tonnes). In 1997 the deposit was reported to have held an original quantity of 630m tonnes of proven reserves. In 1998 reserves were stated as 160m tonnes in the upper layer and 300m tonnes of magnetite below. In 2001 reserves were stated as sufficient for 6-7 years without development of new mining areas.

Other deposits in the area have possible reserves of 4 billion tonnes. In 1994 the company obtained prospecting licences for other deposits in Karnataka State at Nellibeedu (120m tonnes) and Gangkrikal (370m tonnes). In 2001 the state government ruled out granting mining leases for these deposits.

Reserves at Kudremukh are 630m tonnes of which 450m tonnes are mineable. Other deposits in the area have possible reserves of 4 billion tonnes.

In August 2002 the company stated that it had reserves of 350m tonnes of primary ore after the current mine site was exhausted. This could be developed with investment of R 300-400m and would require 90 hectares of land. The mine at that time occupied 450 hectares.

In April 2003 it was stated that the company would run out of existing reserves of weathered ore before its mining lease expires in December 2005. In early 2004 the company made a petition to the Supreme Court to continue mining on 40 hectares where 30m tonnes of weathered ore is available.

**RAW MATERIALS - IRON ORE**

In 2004, in anticipation of ending mining in December 2005, KIOCL arranged to purchase pellet fines from NMDC at Bellary Hospet at 1m tonnes in 2004/5 and 2m tonnes in 2005/6. The price of ore from NMDC was about R800/tonne FOB. Rail freight raised this to R2000 delivered. Processing of the ore was estimated to cost R500 to give a total of \$2500, compared to the cost of KIOCL's own ore of \$R800.

**NOTES - ENERGY**

KIOCL - Kudremukh Iron Ore, Mangalore

site 4436

**NOTES - FUTURE PROJECTS**

KIOCL - Kudremukh Iron Ore, Mangalore

site 4436

**IRON ORE - 2005**

Project: complete closure of iron ore mining, but continuation of pellet production using purchased feed or feed from new mines of KIOCL.

Progress: In December 2004 the company planned to continue pellet production. 3 of 11 ball mills were moved from the mine to the pellet plant. It was expected that NMDC would supply pellet fines at 2m t/y and KIOCL would buy 2m t/y of pellet fines.

**NOTES - CONFIDENTIAL**

KIOCL - Kudremukh Iron Ore, Mangalore

site 4436

Reserves at Kudremukh are 630m tonnes of which 450m tonnes are mineable. Other deposits in the area have possible reserves of 4 billion tonnes. The reserves offer scope for long-term production, but the extent of processing of the low-grade ore raised production cost.

The company had a 30-year mining lease, which expired in July 1999. One-year permits were granted while an application for a 20-year extension on 4600 hectares was reviewed. This was opposed by the state government because the mining areas is in Kudremukh National Park. One solution was to remove 3,700 hectares from the boundaries of the park to allow continued mining. In September 2001 the Government of India approved extension of the lease for 20 years, subject to a decision of the Supreme Court. Pending that decision, in November 2001 a further one-year extension of the lease was granted by the central and state governments.

In 2001 Kudremukh proposed a new mine at Ongole in Prakasam District, AP, located 18 km from the coast, with capacity of 1.5-2.0m t/y for export at a cost of R2.5bn. Reserves at this deposit were stated to be 60m tonnes, with ore similar to Kudremukh. In 2002 the project received lower priority when further information on the reserves became available. The company also applied for licences to mine in the Bellary-Hospet region, with a view to moving fine ore as pellet feed to Mangalore by rail.

The future of KIOCL as a supplier is in doubt. One alternative is to retain the pellet plant at Mangalore and use purchased, perhaps imported, pellet feed.