SHADEED IRON & STEEL
OMAN, SOHAR PORT

THE FIRST HOTLINK STEEL PLANT

TOPICS

- Introduction
- SHADEED Project History
- SHADEED Design Basis
- DRI Hotlink Technology
- Advantages of Hotlink
- Melt shop Design basis
- Conclusions

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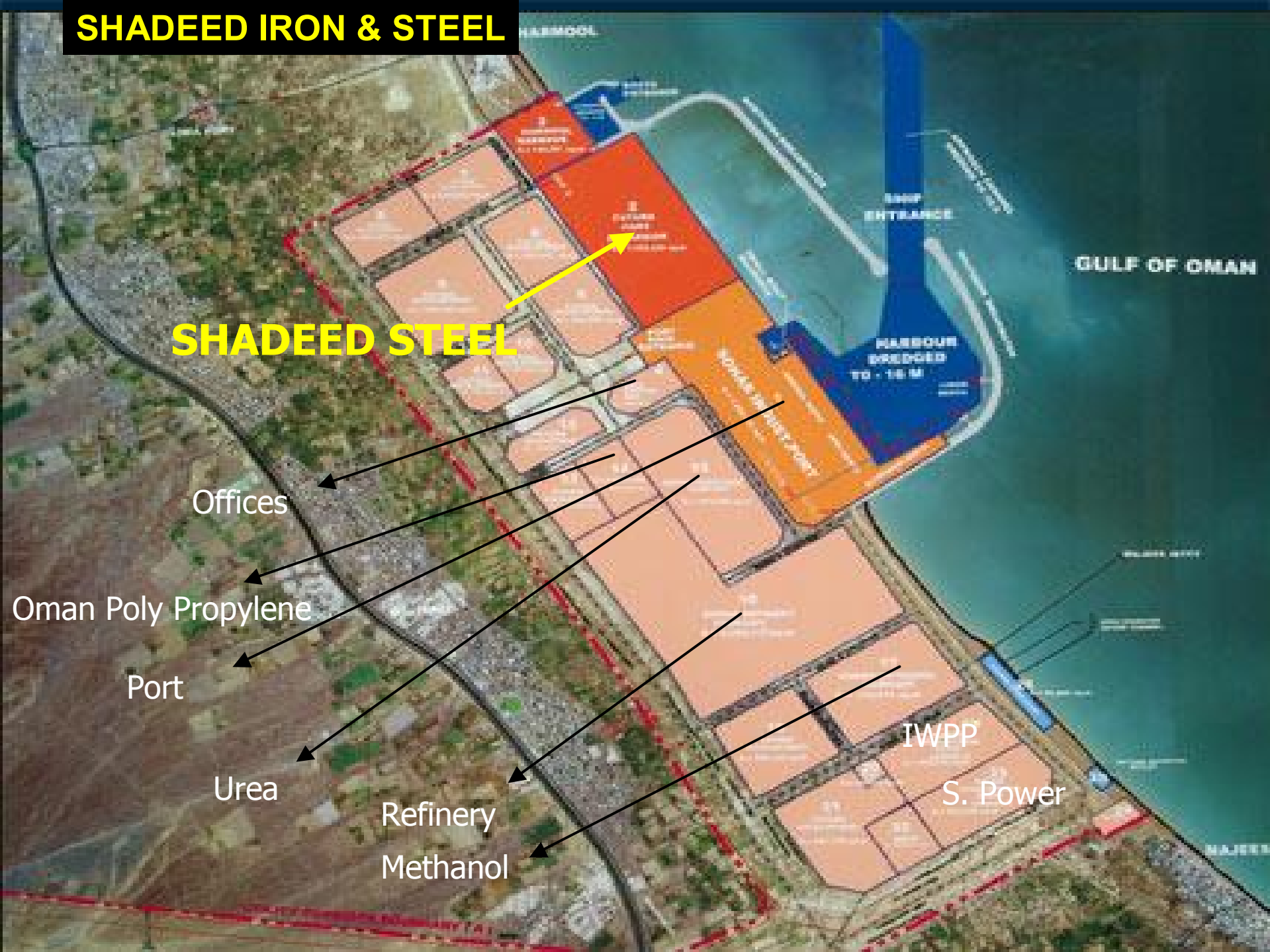


PRIME LOCATION

The project site is a prime location, 60m away from the sea shore with dedicated quay wall. The total area of the plot is more than one million square meters which will give us the possibility of a flexible future expansion. All infrastructure like gas, power, sea water for cooling purposes are committed by relevant entities in Oman.

QUAY WALL ADVANTAGES

- First steel plant in the region equipped with a Quay wall having **draft of -19.0m**
- This will give the plant ability to receive **Capesize vessels** of 175,000 DWT
- This will result in substantially **reduced cost of raw material** having a significant bearing on production costs.

PROJECT HISTORY

- Steel Market study started on 25 May 2003.
- Steel project preliminary study started on July, 2003.
- Feasibility study on March, 2004.
- Signing MOU with Midrex, USA for supplying DRI HOTLINK® license & technology on 28 May 2004.
- EPC evaluation started on 6 January 2005.
- Signing the EPC contract with KOBE STEEL Japan, the owner of MIDREX Technology on 12th of September, 2005
- Royalty agreement for the HOTLINK has been signed
- Down Payment has been released to KSL
- At the stage We are involved in the basic and detailed engineering activities.

OUTLINES

Project Investment Value: $ 700 Million
Working Capital $ 120 Million
Equity to Debt Ratio is 80:20

Design Capacity of DRI: 1,500,000 MTPY.

400,000 of HBI & 1,100,000 of HDRI.

First DRI plant in the world using the unique HOTLINK® technology

Labor efficiency: 6000 MT / Y / Person

CO2 emission will be at minimum level because all CO2 generated in the process is recycled.

Designed for minimal dust emissions.

Dedicated Port with loading & Unloading facility.

OUTLINES

Total Manpower: 225 persons

Gas Consumption: 60,000 NM3/hr

Oxygen Consumption: 12,000 NM3/hr

Nitrogen Consumption: 4,000 NM3/hr

Power Consumption: 100 Million kWh per Month

Connected load: 195 MW

Sea Water (Cooling): 5000 M3/hr

Process water: 1000 M3/hr

DESIGN CONCEPT

Furnace Type	MIDREX MEGAMOD(6.65 m ID)-HOTLINK®
Reformer	16 Bays (480 Tubes – 30 Tubes/Bay).
Hot DRI Transport	HOTLINK® Gravity Feed System.
Start-Up	1st Half 2008.
Production Rate	187.5 tons/hr
Capacity	1.5 Million Tons Per Year Hot DRI & HBI. 1.1 Million Tons HDRI. 0.4 Milion Tons HBI.

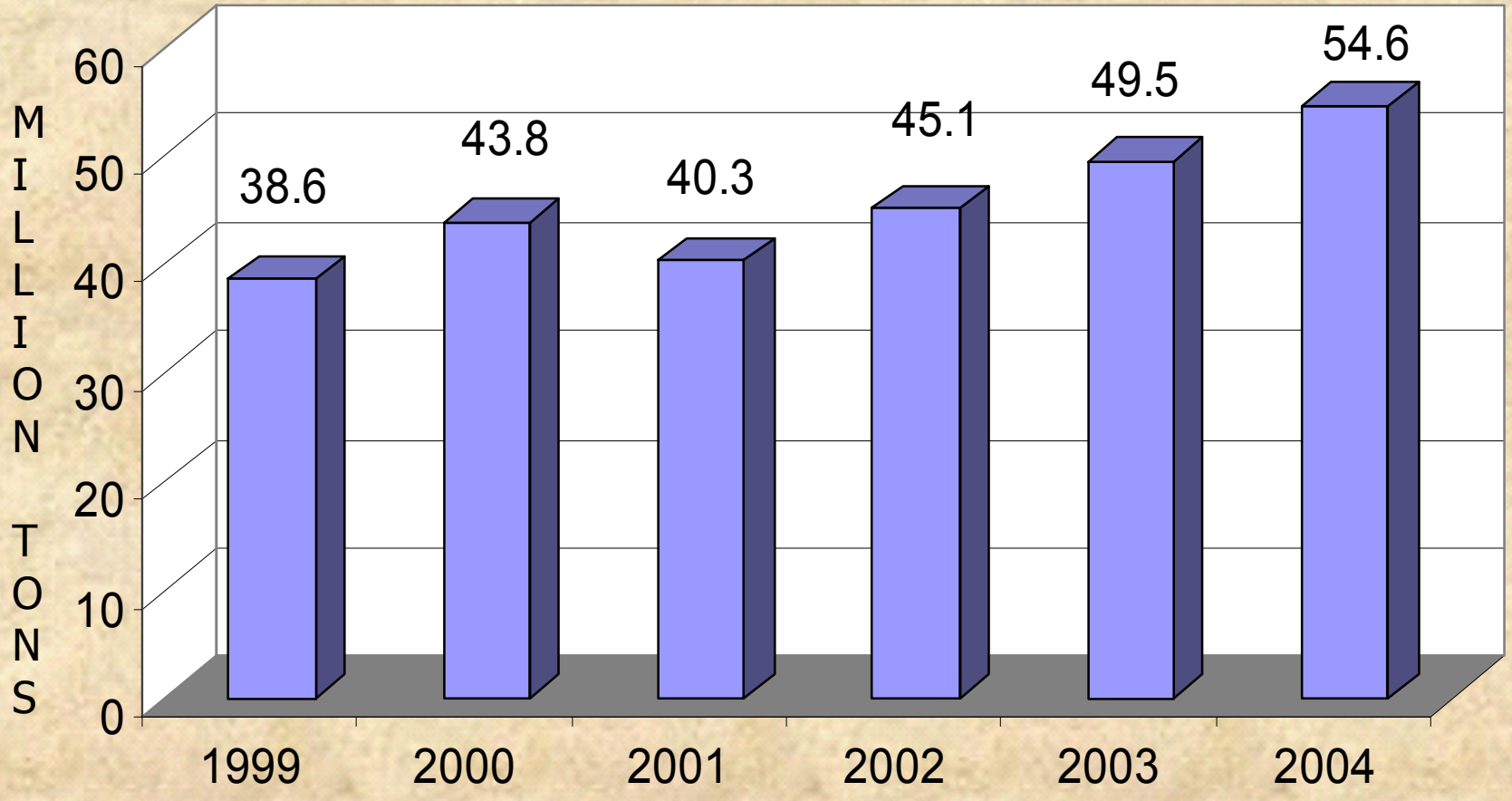
Product Specification

Metallization	93% min.
Carbon	1.5% min.
Discharge Temperature	650 Deg C **min**.

DRI PROCESS - ADVANTAGES

- High Productivity.
- Most efficient use of Gas & Electricity.
- Environment Friendly Process.
- Continuous Process.
- Very High Plant availability.
- Consistent Product Quality.
- Low Operating Consumables.

DRI PRODUCTION TREND



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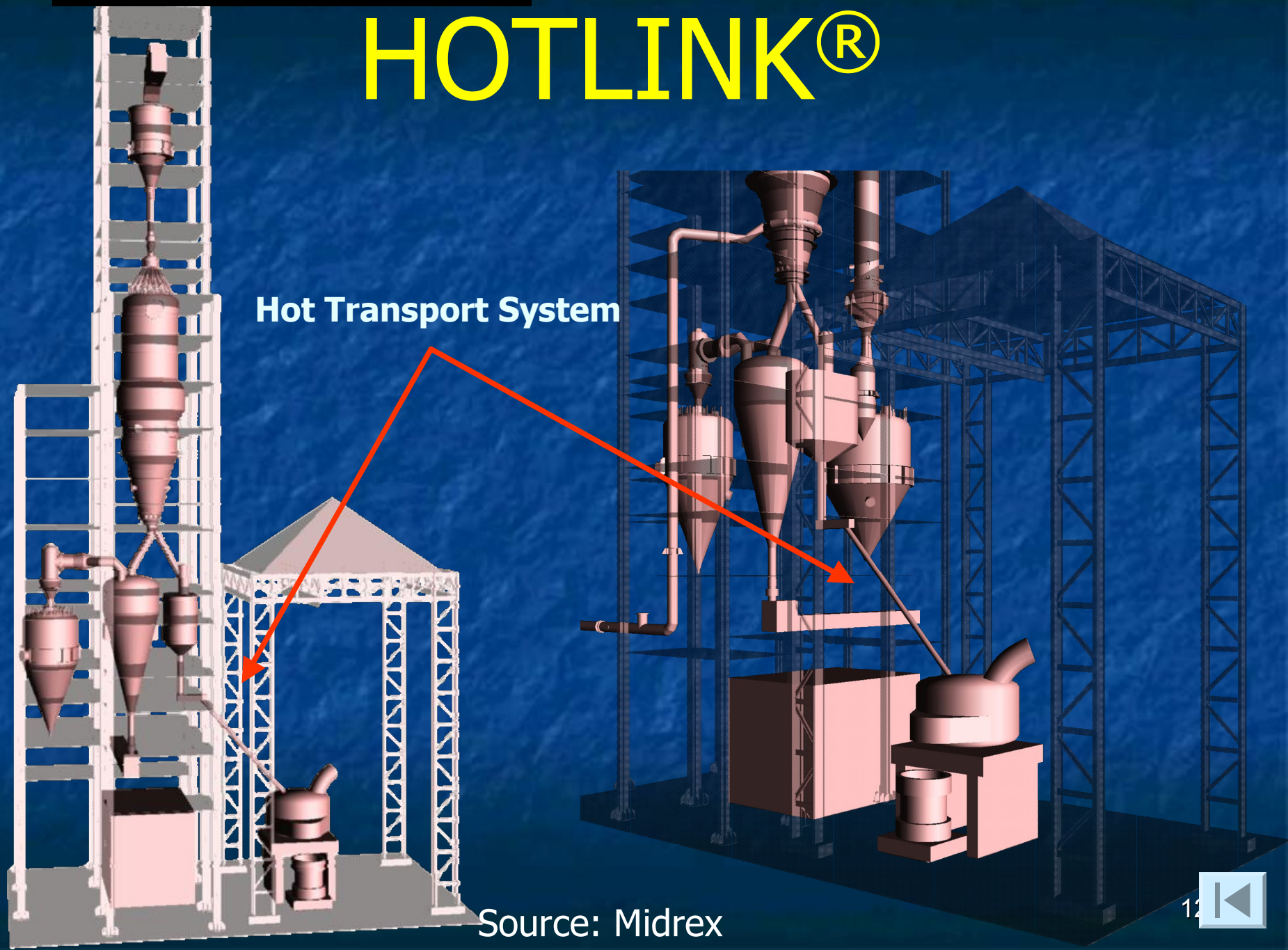
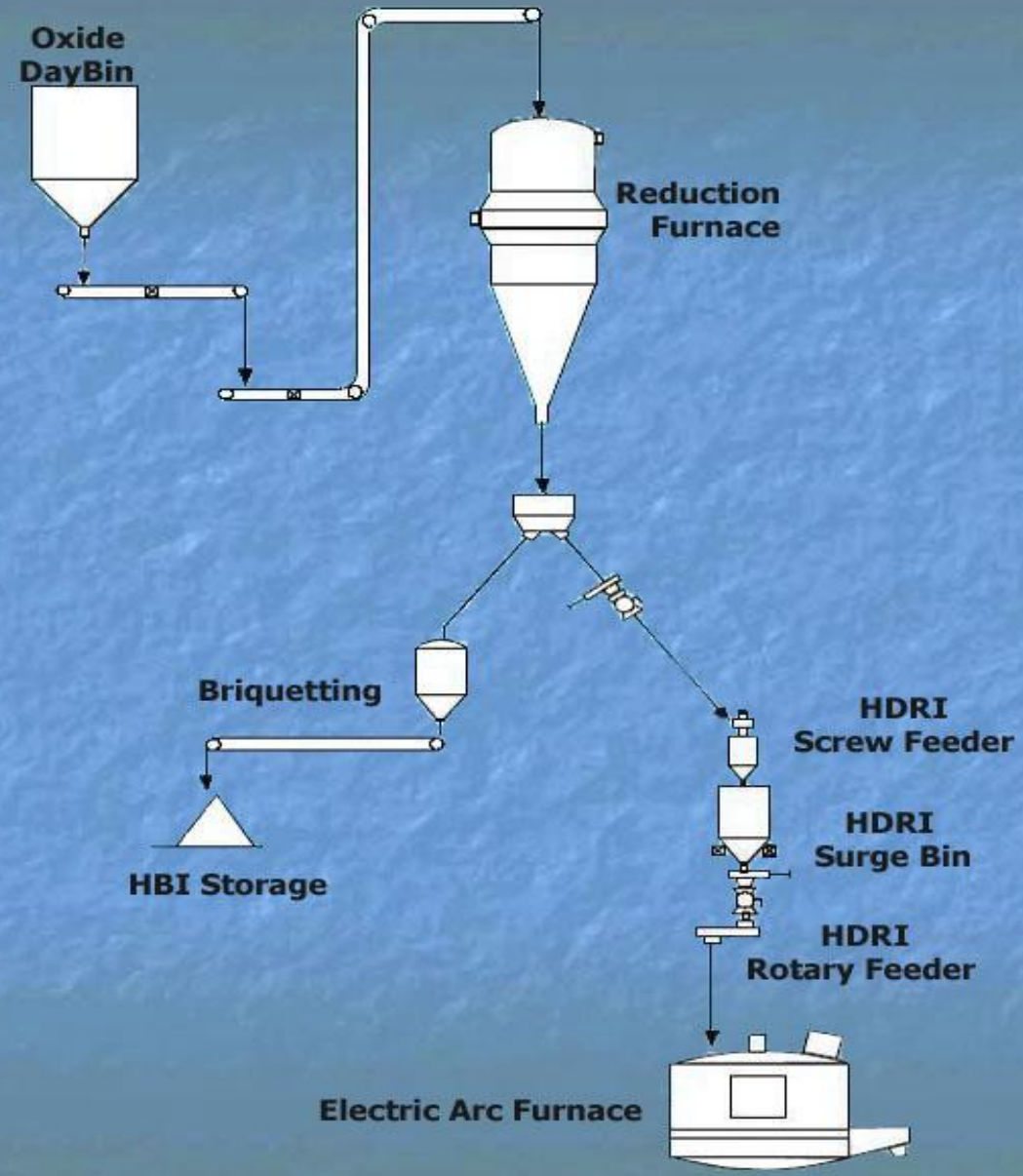
HOTLINK®

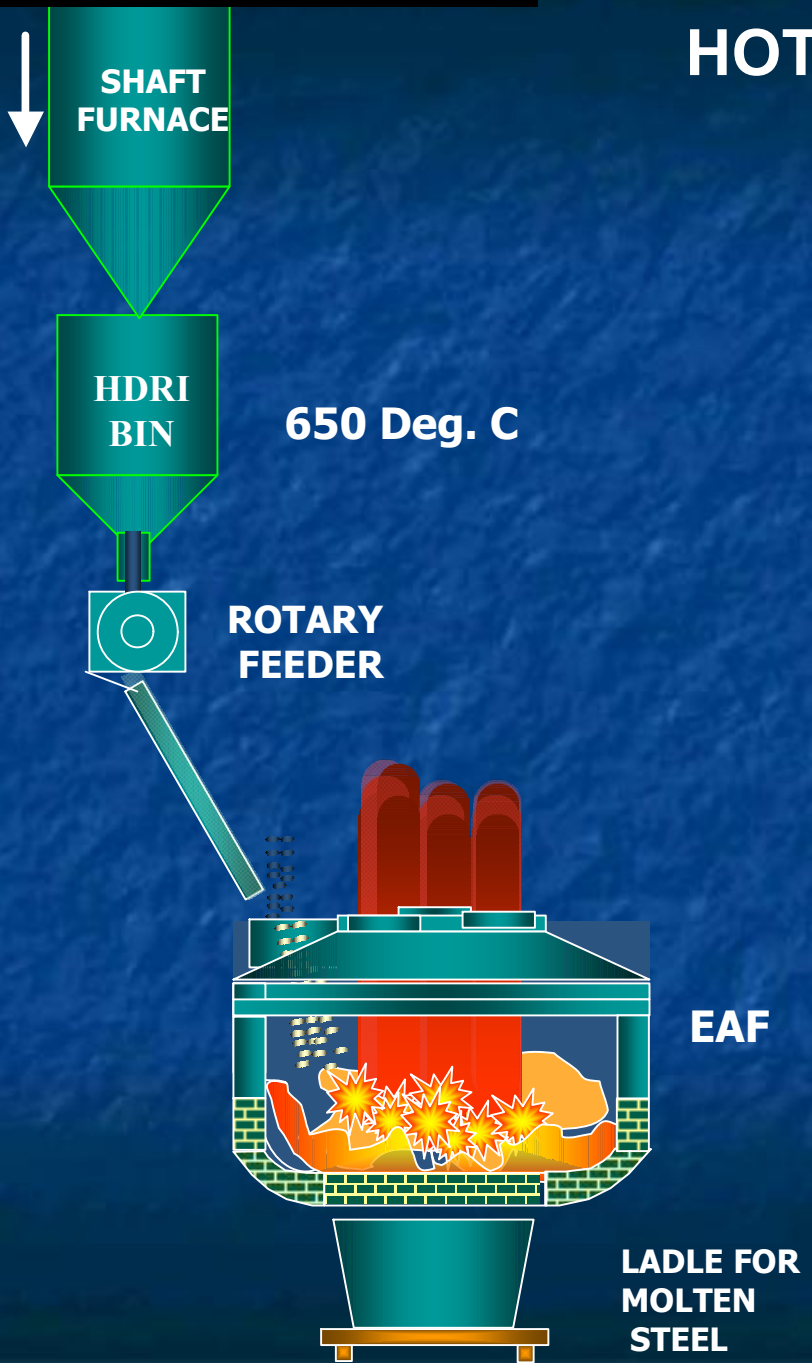


Source: Midrex

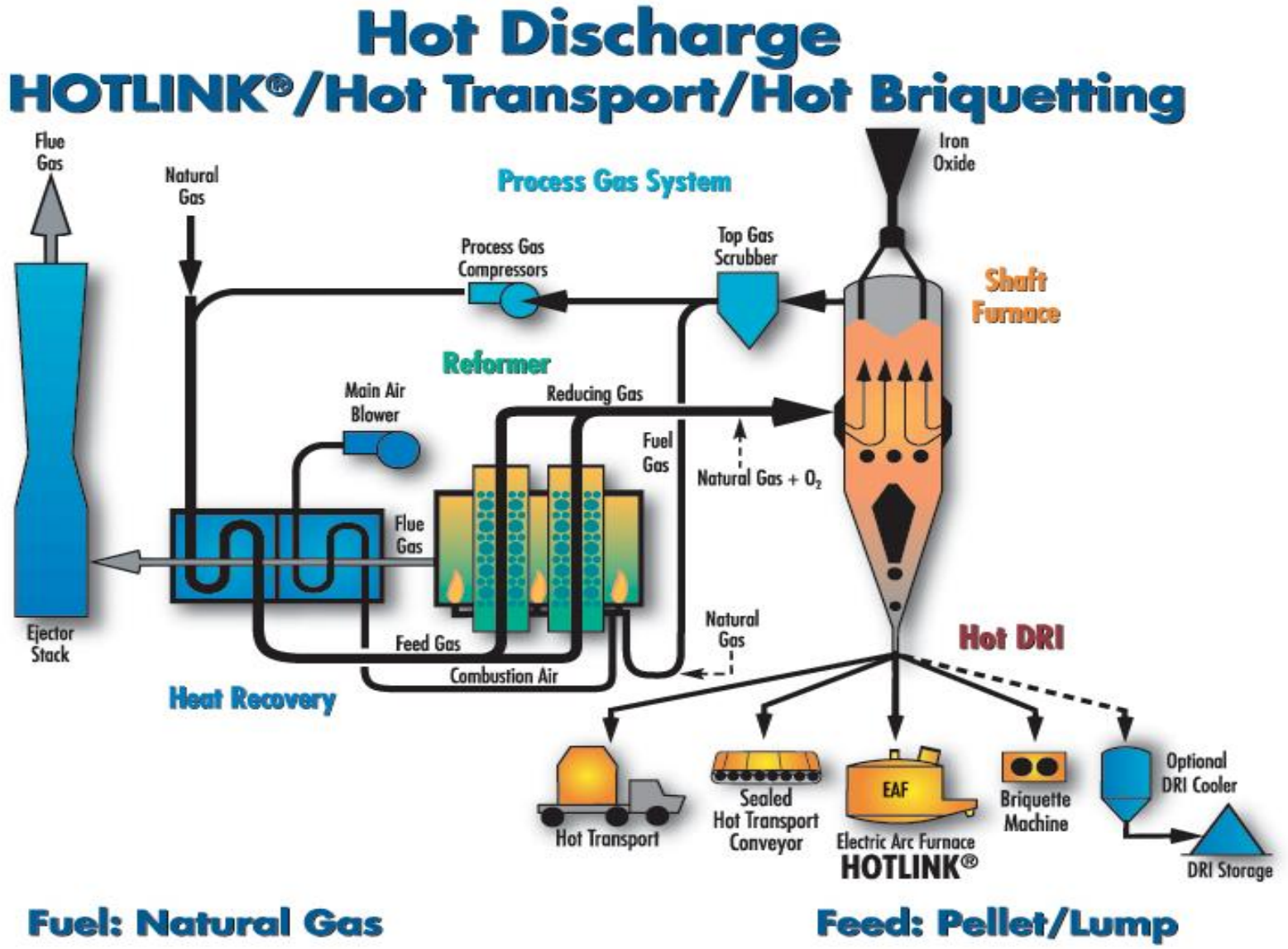
HOTLINK PROCESS FLOW SHEET



HOTLINK PROCESS



DR Plant Process Flow sheet



DRI HOTLINK TECHNOLOGY ADVANTAGES

- Makes use of the sensible heat of Hot DRI at **650 deg c min**
- Delivery by **Gravity** to EAF makes it hassle free transport
- **100% sealing** of Hot link delivery system till it reaches the roof of EAF
- Delivers **HDRI** at 650 deg c to EAF
- **Minimizes** the Handling and Handling losses
- **No Bulk storage** requirements
- **Environment friendly** technology, no gas venting, low dust emission due to direct charge to EAF

DRI HOTLINK TECHNOLOGY ADVANTAGES

- **No loss of Metallization** during handling/storage
- **Increases EAF productivity by 20%** due to reduction in Tap to Tap Time.
- **Reduction in power & Electrode** consumption
- **Less expensive DRI** handling circuits
- **Less space** requirement for the plant
- **Minimal Maintenance** and high reliability
- Overall **saving** in Capital cost

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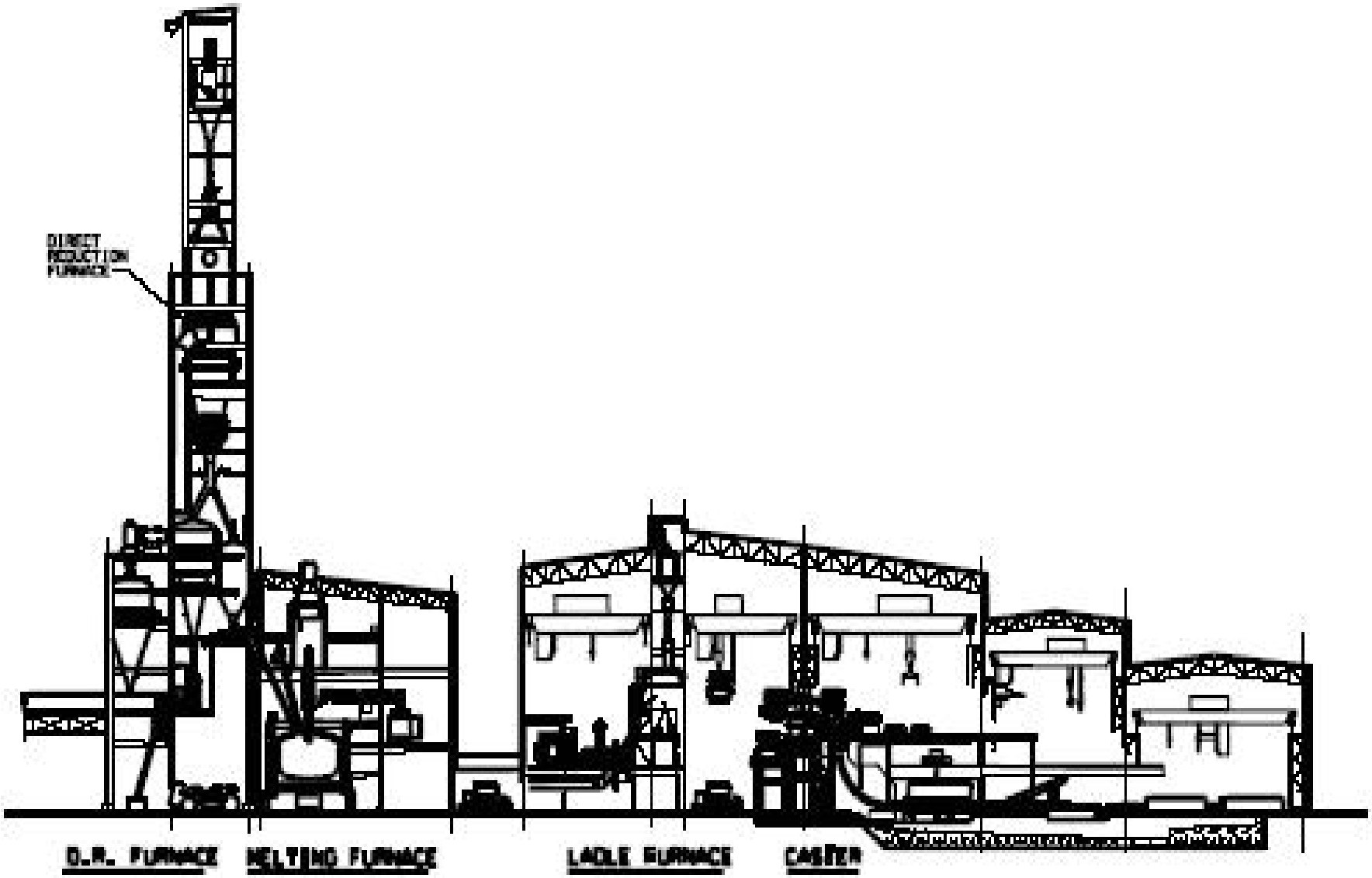
PLANT LAYOUT

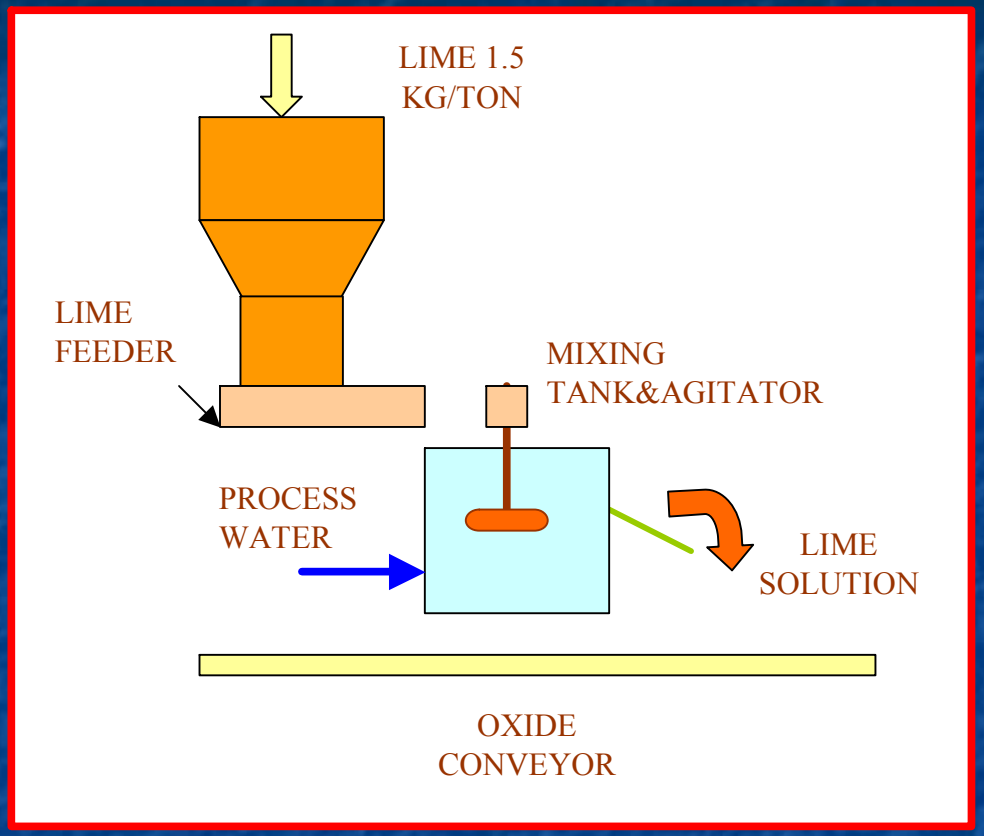


THE CUTTING EDGE

Special features incorporated in **Shadeed Iron & Steel** Plant for increasing productivity & product quality.

- **Double Bustle Port** Refractory Design.
- **Combustion air preheat** 675 Deg C.
- **Feed gas preheat** 580 Deg C.
- **Oxide Coating**.
- **Oxygen Injection**
- Transition Zone & Enrichment **Natural Gas Preheat** to 380 Deg C.
- **Centrifugal Compressors for Process gas**
- **Process gas** to control bustle gas temperature

OXIDE COATING SYSTEM



CONCEPTUAL DIAGRAM

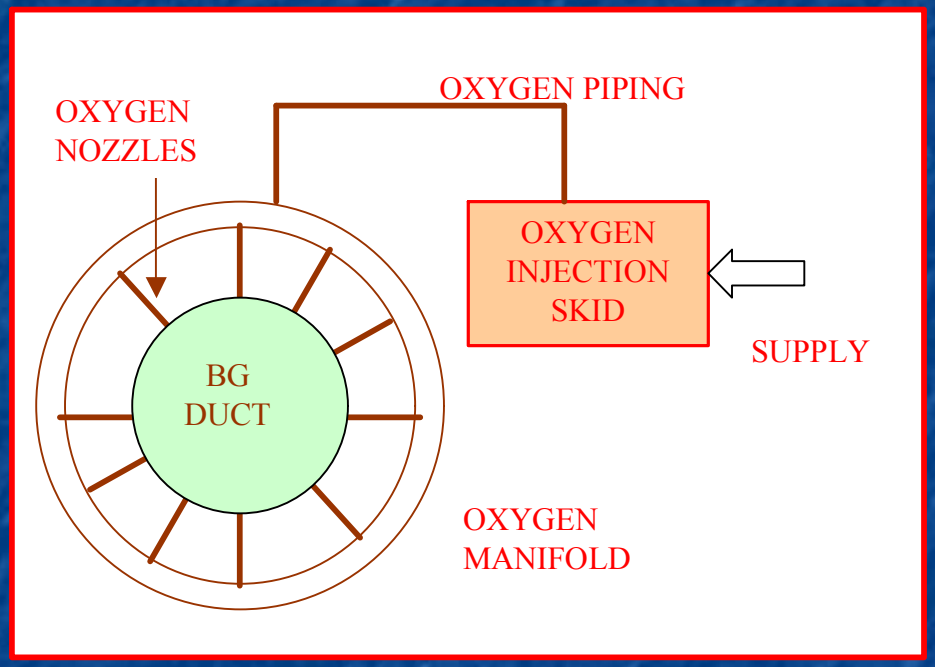
- OXIDE COATING SYSTEM

  This system is used to coat the oxide feed with lime solution on-site. The system consists of lime storage bin with loss in weight system and a solution making arrangement.
- An Oxide Coating System to operate at high bustle gas temperatures without clustering
- Fully automated operation with HSE feature for handling lime

  Without emissions.
- Design rate 1.5 kg/ton of Oxide.

Source: MIDREX

OXYGEN INJECTION SYSTEM



CONCEPTUAL DIAGRAM

- OXYGEN INJECTION SYSTEM
- Injection of oxygen in the bustle gas to increase the bustle gas temperature by heat of combustion with reductants.
- The system consists of oxygen piping, control skid and 10 nos of injection nozzles with flame controls.
- By increasing the bustle gas temperature, the plant production could be increased with the same product quality.
- Oxygen Flow 4000 m3/hr.

Source:MIDREX

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HOT DRI TRANSPORTATION

BATCH DISCHARGE IN VESSELS

Advantages : - Possible to be adapted in an already functioning DRI unit without any disturbance to the plant or any shutdown requirements for any unit.

Disadvantages :- Cannot utilize 100% DRI produced being a batch operation
- Restriction in size of the vessel decided by the layout of both DRI producing unit and also the melting unit.
- There is an inevitable temperature drop in DRI to the extent of about 100 deg.C.
- Lot of manual intervention

PNEUMATIC CONVEYING

Advantages : - Can utilize a larger percentage of hot DRI in furnace feed mix
- Temperature drop is quite low
- Low manual intervention

Disadvantages : - Requires maintenance and operation of big pneumatic system

THROUGH METALLIC CONVEYORS

Advantages : - Can utilize a higher percentage of hot DRI in the furnace feed mix
- Temperature drop is low
- Low manual intervention

Disadvantages :- Higher investment cost for installing and maintaining the metallic conveyor system

GRAVITY FEEDING THROUGH CHUTE

Advantages : - No mechanical system required to feed DRI to melt shop
- The temperature drop is quite minimal
- Low manual intervention

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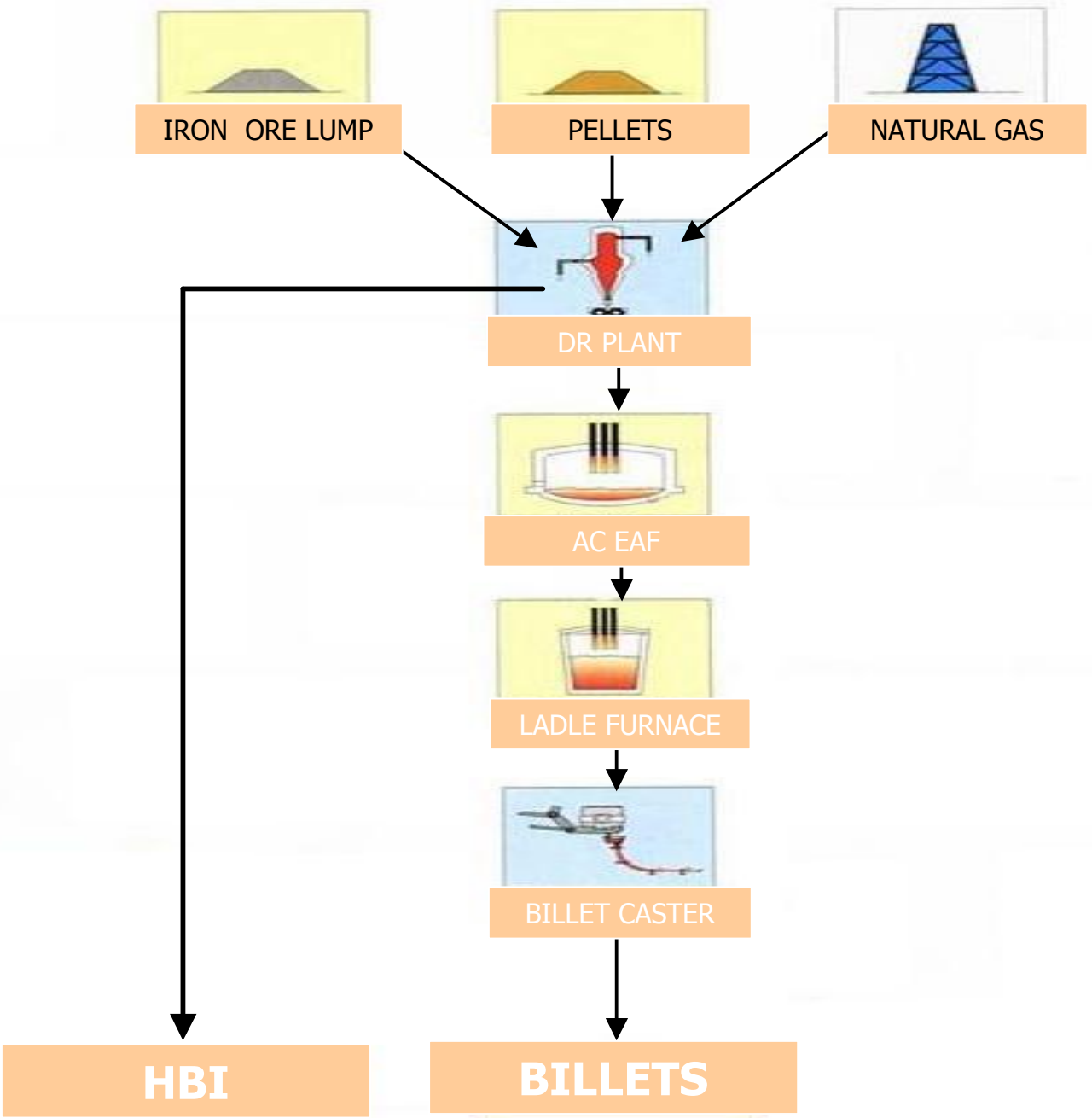
SHADEED PROCESS FLOW



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STEEL MAKING ROUTES

BLAST FURNACE – BOF - LF – CCM

Advantages :
- High Quality
- Low Operating costs

Disadvantages:
- High investment cost
- Higher Greenhouse Gas Emission (mainly CO_2)

BLAST FURNACE (+ DRI/SCRAP)- EAF– LF– CCM

Advantages :
- Wide range of quality
- Relatively lower Operating costs
- High Flexibility

Disadvantages:
- High investment cost
- Still high Greenhouse Gas Emission (mainly CO_2)

DRI – EAF - LF – CCM

Advantages :
- High Quality w. r. to lower tramp elements, sulphur and phosphorus
- Low investment
- No dependency on scrap market
- Lesser operating cost compared to scrap
- Low Greenhouse Gas Emissions

Disadvantages:
- Dependency on natural gas supply
- High energy consumption
- Lesser productivity

*This leads to higher melting cost a propos to scrap.

SCRAP – EAF – LF - CCM

Advantages :
- Very low investment
- High Productivity
- Lowest Greenhouse Gas Emissions

Disadvantages
- Restriction in product range
- Dependency on ever buoyant scrap market with regards to, both price and availability

ELECTRIC ARC FURNACE

TYPE	ECCENTRIC BOTTOM TAPPING
SIZE	150t
HOT HEEL	30t MINIMUM
TRANSFORMER	130 MVA
SHELL DIA.	7600 MM
CHARGE MIX	HDRI/HBI/SCRAP
CAPACITY	+ 1.0 MT LIQUID STEEL

AUXILIARIES:	POWER CONDUCTING ARMS
	WALL MOUNTED LANCES
	DUST COLLECTION SYSTEM
	LEVEL II PROCESS CONTROL
	FOAMY SLAG MANAGER

PRODUCTIVITY 155 TPH

LADLE FURNACE

HEAT SIZE	150t NOMINAL
TRANSFORMER	24 MVA
ELECTRODE DIA.	456 MM
HEATING RATE	+ 4.0 Deg.C
PROCESS TIME	36 MINUTES AVERAGE

AUXILIARIES	POWER CONDUCTING ARMS
	EMERGENCY STIRRING
	AUTO TEMP./SAMPLING
	WEIGHING SYSTEM
	LEVEL II PROCESS CONTROL

CONTINUOUS CASTING MACHINE

PRODUCT	BILLET
STRANDS	6
SIZE RANGE	100 MM^2 to 160 MM^2
CASTING SPEED	4.3 M/min
CASTING RADIUS	8 M
MOULD LENGTH	1000 MM

AUXILIARIES	AUTO MOULD LEVEL CONTROL
	TURRET/TUNDISH WEIGHING
	FLYING NOZZLE CHANGE
	TORCH CUTTING MACHINE
	LEVEL II PROCESS CONTROL

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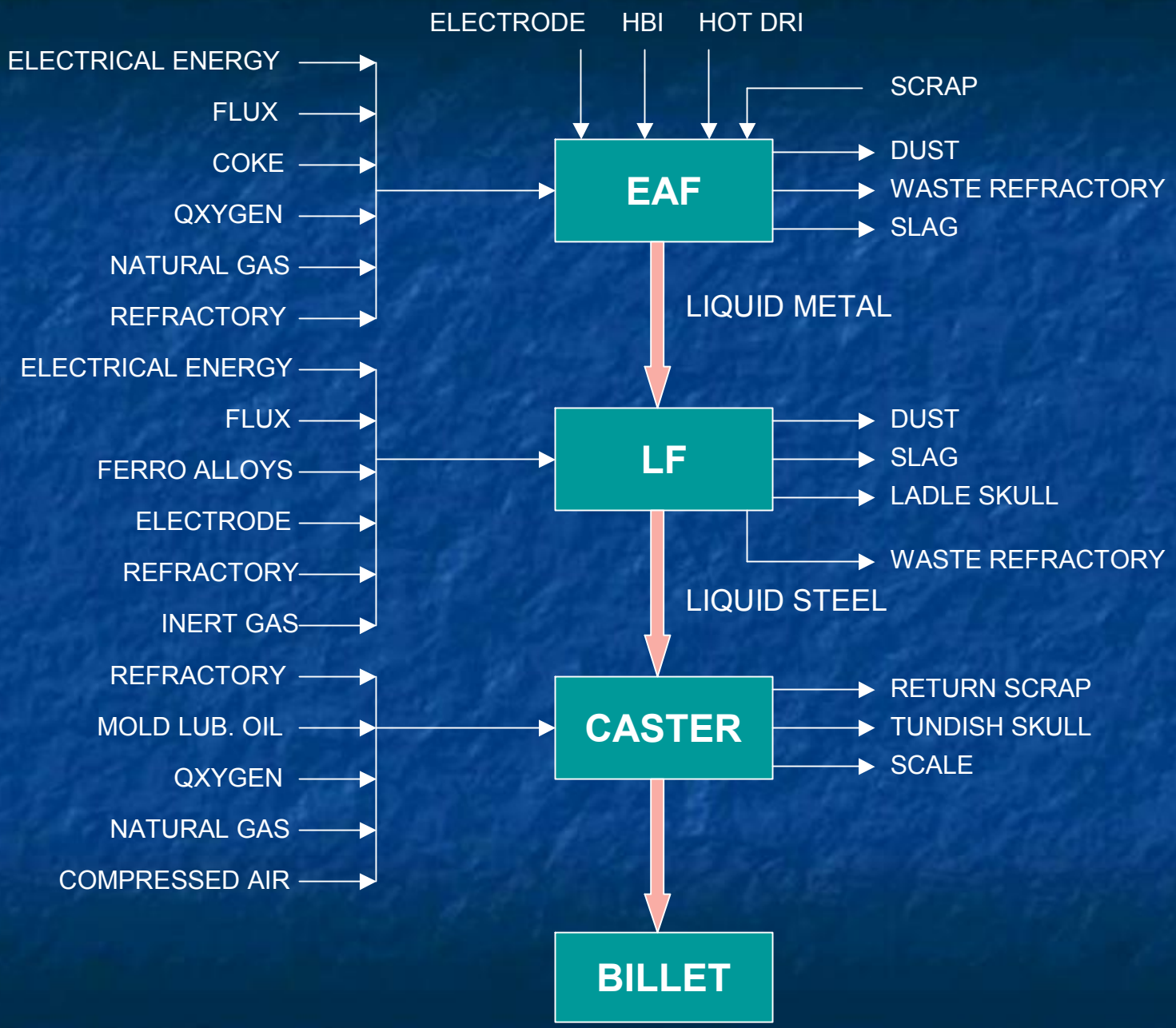
STEEL MELT SHOP MATERIAL FLOW



KEY PERFORMANCE PARAMETERS

Parameters	Scrap	Cold HBI	Hot DRI
TTT	52 Min	70 Min	**58 Min**
Power On	37 Min	59 Min	**47 Min**
Energy	400 Kwh	590 Kwh	**450 Kwh**
Carbon	10 Kg	18 Kg	**15 Kg**
Oxygen	36 Nm^3	30 Nm^3	**30 Nm^3**
Electrode	1.3 Kg	1.8 Kg	**1.4 Kg**
Flux	45 Kg	65 Kg	**65 Kg**
Productivity	170 TPH	129 TPH	**155 TPH**

With these operating parameters we can match the productivity and cost per ton of liquid steel with scrap, at the same time with no dependency on scrap and also have much cleaner steel.

BENEFITS OF HOTLINK TECHNOLOGY

Main Savings		Unit cost
Electricity	140 kwh/t	0.043 US$/kwh
Electrode	0.4 kg/t	3.40 US$/Kg

1132960 t/a X 140kwh/t X 0.043 USD/kwh = 6,820,419 USD

1132960 t/a X 0.4kg/t X 3.40 USD/Kg = 1,540,825 USD

→ **Saving:~ 8.36 million US$**

Additional Production (with respect to HBI or DRI):

Liquid steel	~194,180 t/a	Cash operating cost:~ 260 US$/t
Billets	~191,200 t/a	Sales price for billets:~ 350 US$/t

→ **Additional Profit:~17.2 million US$**

→ **TOTAL Additional Profit per annum. 25 Million US $**

Further Savings:

Less refractory wear

VISION

Setting up an integrated steel Plant based on Natural Gas and Power availability, as a first plant in the world designed on HOTLINK base; the processes will be interconnected together to minimize the logistic overheads.

MISSION

To produce high quality steel products using the local resources with the aim of covering market apparent and future steel demand (short plan) , expanding into neighborhood markets (Medium plan) and finally reaching the booming markets.

THANK YOU