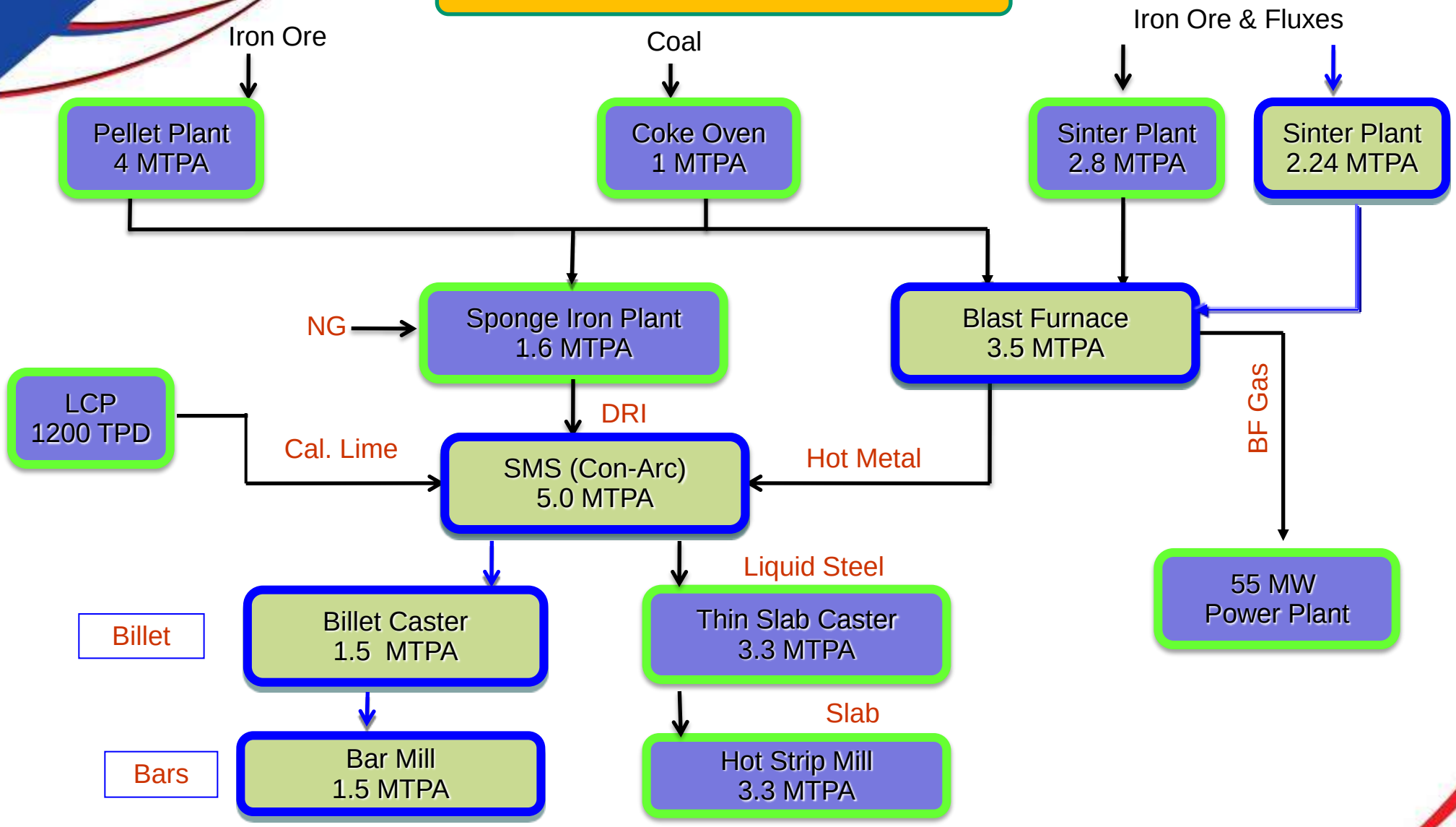
Innovative Approach at JSW Steel, Dolvi Works with Emphasis on SIP Process.

JSW STEEL LTD, DOLVI

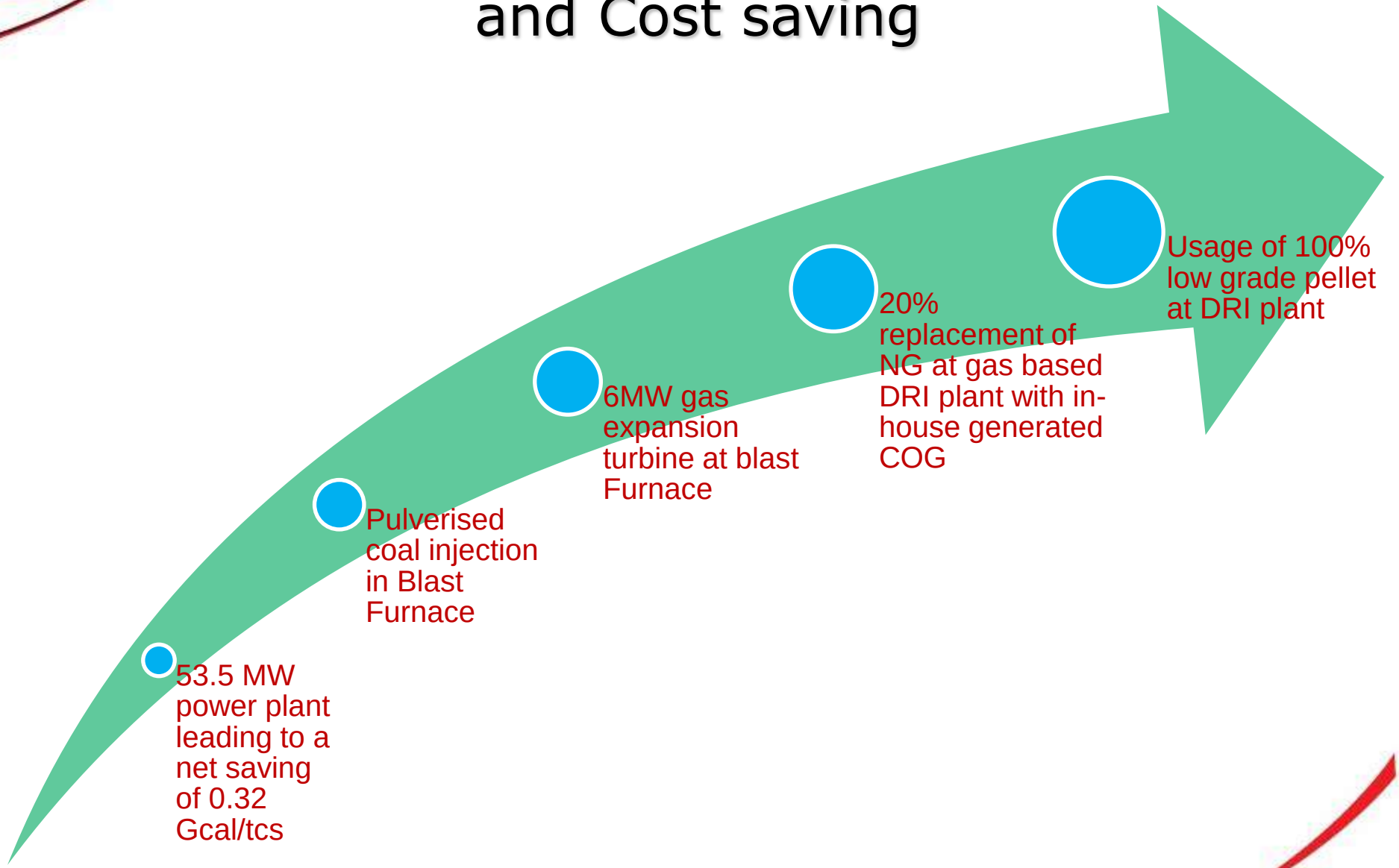
Making Steel is our Profession ...

Generating Smile is our Passion...

5 MTPA CONFIGURATION



In plant Initiatives towards Energy and Cost saving



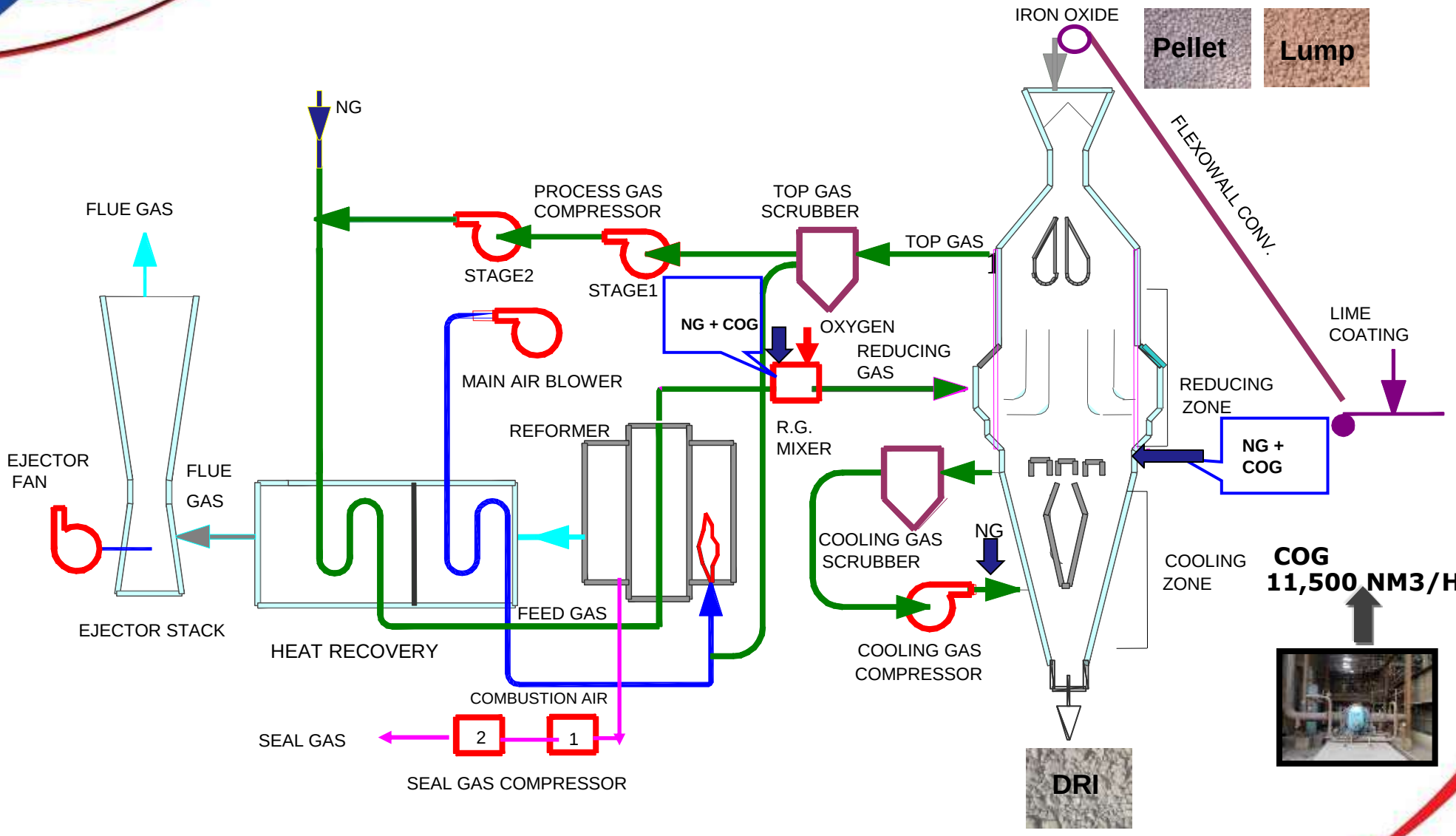
Case Study
Sponge Iron Plant

(Coke oven gas usage in Sponge Iron Plant)

Sponge Iron Plant: Overview

- Technology MIDREX, Gas based
- Commissioned -1994
- Original capacity-1.0 MTPA
- World's first mega module DRI plant.
- After De bottlenecking in 2005 capacity 1.6 MTPA
- Designed to use only Natural gas as a source of hydrocarbons for Production of Hydrogen & Carbon mono-oxide by catalytic reforming.

SIP Process Flow Diagram



Project background

1. Surplus Coke oven gas availability after commissioning of coke oven battery in Feb'14.
2. Coke oven gas is having useful components like H2, CO & Methane with small amount of impurities like Benzene, H2S, Tar, CnHm etc.
3. Coke oven gas use in SIP was not possible because it has detrimental effect on reformer catalyst.
4. Other Plants in complex have no more margin to utilize available coke oven gas thus was bound to be vented.

Element	COG Composition
CH4	23 – 27 %
CmHn	2 – 4 %
H2	56 – 60 %
CO	5 – 8 %
CO2	1.5 – 3 %
O2	0.3 – 0.8 %
N2	3 -7 %
Benxene	33 gm/NM3
HCN	0.28 gm/NM3

Break Through steps

1. A series of brain storming session were taken to access how to use coke oven Gas.
2. Way out found to use coke oven gas in Furnace. By using Furnace heat and DRI as catalyst to reform coke oven gas.
3. Next task as to implement it in house without much investment and least modifications.
4. Scheme developed for coke oven gas injection in Furnace.
5. Looked for available equipment in-house.
6. A spare lobe type compressor for seal gas service was available , decided to use the same with modifications.

Hurdles with Counter Measure

Sr	Hurdle	Counter Measures	Start date	End date
1	Impurities content in COG (like CnHm, Benzene, Tar etc)	COG composition @ 10000 NM3/Hr was checked for it's suitability to use in DRI Plant. Found no major change in gas quality.	18-11-13	20-11-13
2	Low Pressure COG supply	Spare Seal gas compressors modified to make it suitable for Coke oven gas.	25-11-13	02-05-14
3	Civil Foundation of 3rd Seal gas compressor	Old 3rd Seal gas compressor foundation was modified to install single motor driven two stage Cold COG compressors to boost pressure from 0.10 bar g to @ 2 bar g.	20-05-14	04-04-14
4	COG Supply tapping	Tapping of 400 mm size was taken from COG main header going to Tunnel Furnace	05-04-14	10-04-14
5	Piping, Instrumentation & DCS modification	Developed In-house piping scheme & Process interlocks system.	02-04-14	25-04-14
6	DCS Graphic, PLC interlocks & Process calculations	Used available spare IOs of existing DCS system	01-05-14	15-05-14
7	Seal legs & Drain water	New Seal legs of 30 mtr deep drilled in sump for drains of Compressor, Dampners & aftercooler	20-05-14	26-05-14
8	Excess moisture, solid contaminants & steady pressure	Spare Propane knock out pot installed at Compressor suction to remove free moisture & solid contaminants in COG	25-05-14	30-05-14
9	Blockage of Compressor lobes due to scaling	Replaced Process water with Soft water for compressor spary water.	20-06-14	15-07-14

Process monitoring Before & After COG Addition

Date	Unit	12-Aug-14 Before COG addition	8 to12 Nov 14 After Cold COG addition
Production	Mt	3411	3367
Production rate	TPH	142	140
Process Gas Flow	KNM3/Hr	142	140.0
Process NG Flow	KNM3/Hr	23.3	20.3
NG to Furnace	KNM3/Hr	15.2	12.2
Reformed gas Temp	DegC	940	958
Reformed gas Methane	DegC	0.82	0.52
Process Gas CnHm	%	Nil	Nil
Bustle Gas Temperature	DegC	930	930
Oxygen Flow	SM3	1127	1692
Oxygen Consumption	NN3/Mt	7.94	12.1
Total NG	KSM3/Day	924	781
COG Flow	KSM3/Day	0.0	279
	NM3/Hr	**0.0**	**11500**
COG Temp	DegC	0	38
Sp Heat	Gcal/Mt	2.392	2.358
Power	kWh/Mt	89.4	94.1
Reduction in NG consumption	KSM3/Day		137
Reduction in NG w.r.t COG	%		**49**
Product Quality			
Metallization	%	94.1	94.1
Carbon	%	1.72	1.76

Financial Benefits

Sr	Paratemerts	Unit	Value
1	Production Rate	tph	160
2	COG Flow	nm3/hr	11500
3	Reduction in NG (50% of COG use)	nm3/hr	5750
4	Natural rate (Yearly Average)	Rs /SCM	30.0
5	COG rate	Rs /SCM	4.25
6	Power Consumption	Kwh	600
7	Power Rate	Rs /SCM	5.0
8	Cost of NG (Sr 3 x Sr 4)	Rs Lacs	1.73
9	Cost of COG (Sr 2 x Sr 5)	Rs Lacs	0.489
10	Cost of Utility (Sr 6 x Sr 7)	Rs Lacs	0.04
11	Savings per hour (Sr 8 -Sr 9 -Sr 10)	Rs Lacs	1.20
12	**Saving per NM3 of COG (Sr 11/Sr 2)**	**Rs/NM3**	**10.40**

Use of 1 NM3 of COG results in saving of Rs 10.40
Annual savings of 98 Crores

Benefits after COG Usage in DRI Plant

- First plant in the world to use COG for DRI Production. This was the real morale booster to SIP
- Injection of 11500 NM3/Hr Cold COG at 35-40 Deg.C with the help of lobe type compressor resulting in saving of 5750 NM3/Hr Natural gas.
- Reduction in energy consumption after using Coke oven gas in DRI plant @ 1.5 to 2.0%.
- Reduction in CO2 emission by 0.50% by using coke oven gas in DRI process as compared to using coke oven gas as a fuel in other facilities.
- Reduced dependency on expensive, imported natural gas by @ 45 million standard cubic meters per annum

Cold COG to Furnace

Energy Reduction of using COG in place NG

- Coke oven gas is available in house.
- Reduction in Energy to transport LNG from source to destination in India by ship.
- Saving in Energy to gasify LNG to RLNG at unloading station in India.
- Reduction in Energy to compress the RLNG to 75 ~ 80 bar for transportation to end user.
- Reduction in Fuel consumption to reform CH4 into Hydrogen & Carbon Monoxide required for reduction of Iron oxide.
- Saving in Foreign currency to buy costly RLNG.

Way Forward:

- Implementation of the same scheme in SIP across JSW group.

- 100 % Replacement Natural gas from present 20% by using Coke oven gas.

Thank You...