Tulane Engineering Forum

15 April, 2011
• Nucor
• Nucor Steel Louisiana LLC
• DRI Technology
Nucor Overview

- **Steel Mills** 26.7 Million Tons
  - Hot rolled sheet, bars, structural, plate

- **Steel Products** 4.7 Million Tons
  - Steel Joists, Steel Deck, Cold Finished Bars, Steel Buildings, Rebar Fabrication, Mesh & Metal Grating, Fasteners

- **Raw Materials**
Nucor Steel Mills

- 13 Bar Mills
- 4 Sheet Mills
- 2 Structural Mills
- 2 Plate Mills
- 2 Castrip Plants
Growth Platform – International
Duferdofin-Nucor beams & long products joint venture

Giammoro

San Giovanni

San Zeno

Pallanzeno

Italy
Nucor Steel Products

128 operating facilities in the U.S. & Canada
Nucor Raw Materials

72 operating facilities – scrap processing & other raw materials services

Trinidad DRI Facility
Nucor Steel Louisiana LLC

• $750 million direct reduced iron (DRI) facility
• 2.75 million tons annual capacity
• First phase of a multi-phase plan
• Next step in implementation of raw materials strategy
• Leverages strong skill set established by our Nu-Iron Team at our 1.8 million-tons-per-year DRI plant in Trinidad
• Long-term supply of attractive-cost natural gas secured
Plant Location – St. James Parish La
NSLA Layout
Engineering

- Port – floating dock
- Material Handling – pipe conveyor
  - 3.75 M tpy iron ore pellets
  - 2.5 M tpy DRI out
- DRI Process – HYL
- Construction Engineering
  - Reactor vessel 900 metric tons
  - Soil condition
DRI Technology

ZR Process
General scheme configuration

DRI Technology

ZR Process Scheme

Basic Principles

- The ZR process allows the reduction of iron ores without the use of a reformer by taking advantage of the fact that metallic iron is a very good catalyst for natural gas reforming.

- The reduction zone of the DR shaft is used to perform simultaneously the Reduction of the Iron Ore and the reforming of natural gas.

- When natural gas reforming takes place under a limited amount of steam, some carburization of the catalyst will occur.

- In the case of the ZR, since the catalyst is the DRI, carburization is intentional and controlled.

- The rate of carburization can be controlled by adjusting the content of steam (humidity) present in the gas stream.

- In the ZR process the carburization of the catalyst (DRI) takes place at high temperature resulting in the formation of Iron Carbide Fe₃C.
**DRI Technology**

**ZR Process Scheme**

**Features: “In-situ” Reforming and Reduction**

**IN-SITU Reforming:**
- Conditions for natural gas reforming:
  - presence of Oxidants and hydrocarbons \((H_2O+CO_2 + C_nH_{2n+2})\)
  - high temperature
  - presence of catalyst

**Iron Oxides Reduction:**
- The conditions for the reduction of iron oxides are:
  - presence of reductants
  - \((H_2+CO)/(H_2O+CO_2) \gg 1\)
  - high temperature
  - presence of iron oxides

In the reactor, reduction zone all these conditions are present, making possible the “in-situ” reforming and reduction simultaneously.

**Reforming**

\[
\text{CH}_4 + H_2O \rightarrow CO + 3H_2
\]

\[
\text{CH}_4 + CO_2 \rightarrow 2CO + 2H_2
\]

**Reduction**

\[
\text{Fe}_2O_3 + 3CO \rightarrow 2\text{Fe}° + 3CO_2
\]

\[
\text{Fe}_2O_3 + 3H_2 \rightarrow 2\text{Fe}° + 3H_2O
\]

**Carburization**

\[
3\text{Fe}° + \text{CH}_4 \rightarrow \text{Fe}_3C + 2H_2
\]

Nucor Steel Louisiana LLC

- Mission
- 150 Teammates
- Start-up 2013
Thank You!