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## **Successful Startup and Operation of HYL Energiron ZR Micro-Module at GSPI in Abu Dhabi**

The world's first Micro-Module is now in full operation at Gulf Sponge Iron, LLC in Abu Dhabi, UAE. This new plant is designed to produce 200,000 tons per year of highly metallized, high carbon DRI, and opens the door for interesting possibilities for the Indian DRI market.

The tendency in the direct reduction industry has been for plants to grow in capacity to take advantage of economies of scale. This is evident in new ENERGIRON plants – the two modules at Emirates Steel are each of 1.6 million tpa capacity in single modules, although the first module has already proven to be able to produce close to 2.0 million tons per year. The plants under construction at Ezz Steel and Suez Steel in Egypt are of 1.9 million tons per year capacity, and new projects are under way in different regions with similar sized plants as well as plants with capacities of 2.5 million annual tons in a single unit.

For the small steelmaker, this is of little consequence since steel mills with capacities of under 1 million annual tons of liquid steel cannot justify the investment for such a large DRI facility. For this reason, Tenova HYL developed the Micro-Module concept – a high efficiency, low cost DR module for producing 200,000 metric tons per year of high quality, high carbon DRI. In fact, the Indian market was taken specifically into account when designing this type of plant. Since India has a widespread coal-based DR industry that caters to the small steelmakers and to the commercial markets for DRI, it is the major market where such a small plant can be a viable option. The environmental problems associated with current coal-based DR plants in India make it necessary to consider a technology shift to satisfy the demand for DRI, but with clean, more efficient technology.

The Micro-Module is a unique concept in today's industry, designed for small iron and steel making production facilities but at an investment cost per ton of product that is in line with that of much larger installations.

### **GSPI Micro-Module provides high carbon DRI in a small capacity module**

The first of this type of plant was built and put into operation for Al-Nasser Industries at their GSPI plant in Abu Dhabi, UAE. The concept is an Energiron ZR plant configuration with no gas reformer and a compact, efficient plant design to produce DRI of  $\geq 94\%$

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metallization and carbon typically around 3.6%. The investment cost, despite the small size of the plant, is only slightly above the capex per ton of capacity as that of a large (>1.0 million tpa) plant. While the Micro-Module is of higher capital investment than the current coal-based plants used in India, it offers not only more capacity but also clean operation, higher quality, higher commercial prices for the product since demand is greater, and is an investment which will pay for itself in a short number of years. Additionally, it complies with the strictest environmental regulations and the possibility of having CO<sub>2</sub> as a saleable by-product and/or as CO<sub>2</sub>-credits.



Gulf Sponge Iron Micro-Module DRI Plant at Mussafah, Abu Dhabi, UAE

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## GSPI Plant Configuration

The GSPI plant was designed to use both iron ore lump and pellet feed, in any combination up to 100% of either material. The current feedstock is GIIC pellet.

The design is based on the ZR or reformerless process developed by Tenova HYL, in which the in-situ reforming, reduction and carburization reactions occur within the reduction shaft. By eliminating the need for an external natural gas/steam reformer, the plant is able to be designed for a much smaller area and requires less equipment. The ZR process allows the use of any hydrocarbon reducing agent, either direct feeding of natural gas, or – if available or convenient – the use of syngas or COG is possible.

GSPI commissioned the plant in March 2010. The core reduction plant was provided by Tenova HYL, in partnership with Electrotherm India Ltd. and including various sub-suppliers, i.e., the CO<sub>2</sub> Removal System was designed by BASF, detail engineering was supplied by SNC Lavalin and Civil engineering was under the charge of MN Dastur.

The plant includes basically, the DR reactor, process gas heater, recycle gas compressor, cooling gas ejector, CO<sub>2</sub> removal system, water systems, material handling system and distributed control system (DCS). The GSPI plant is also equipped with a complete laboratory for Process Quality Control.

Power supply for the plant is 11 KV and 6.6 KV fed from the ESL supply feeder, with a 220 KV supply line for power requirements for lighting, air conditioning and minor equipment needs. There is also a 350 KVA supply for emergency standby power for utilities and critical pumps when needed.

The water requirements for the plant are 750 m<sup>3</sup> per day, and the plant has a reservoir capacity of 2000 m<sup>3</sup>, with water being sourced from Abu Dhabi Distribution Company (ADDC).

## GSPI Performance

Since the plant entered full operation, the product quality has in all cases been better than the guaranteed or expected levels in both chemical and physical properties. This can be seen in Tables 1 and 2 comparing actual results to the plant guarantee figures. In July of 2010 the plant successfully completed its performance test, exceeding parameters in all aspects and is now in full operation mode. Performance during the test averaged 27 tons

per hour of high quality, high carbon DRI, with metallization levels of 91 to 95% and carbon content from 3.1 to 4.0% as iron carbide.

Current operation since startup has been with 100% pellet feedstock from GIIC. The plan is to begin use of a mix of lump ore with pellets in the near future, with the aim of reducing overall iron ore costs for the plant, since it is already proven that HYL Energiron process plants can easily use lump ore in any proportion up to 100% lump ore charges. The high carbon DRI product is being used at the adjacent meltshop (Emirates Steel Co.), also owned by the Al Nasser Group.

	<b>Guaranteed</b>	<b>Actual</b>
Fe(T) %	90 Min	91
Fe(M) %	84 Min	85.5
Metallization %	93 Min	94
Carbon %	3 ± 0.2	3.2
Sulfur %	0.015 Max.	0.005
Phosphorous %	0.045 Max	0.035

**Table 1. – GSPI Direct Reduced Iron Chemical Properties**

<b>Properties</b>	<b>DRI</b>	
Size	+ 25 mm	2% Max
	- 25 + 3 mm	93%
	- 3 mm	5% Max
Bulk Density	1.7 to 1.8 T/M <sup>3</sup>	

	target	Actual
Sulfur %	0.015 Max.	0.005
Phosphorous %	0.045 Max	0.035

**Table 2. – GSPI Direct Reduced Iron Physical Properties**

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GSPI Quality Control Laboratory

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GSPI Micro-Module Control Room