

## **Status of technology development and demonstration in India**

### **Coal beneficiation**

Currently, the capacity for the beneficiation of thermal coals is estimated at ~ 70 million tonnes per annum in India, with an additional 20 million tonnes per annum proposed. But this capacity also is being utilized only partially. During 2005-06, India produced 380 million tonnes of thermal coals, out of which only 17 million tonnes were beneficiated. This indicates that only about 22 million tonnes of coal i.e. 5% of the total annual coal production were fed for beneficiation (assuming an average yield of 80% for beneficiation process). In India, policy guidelines were introduced in 1997, which restricted the use of unwashed coal in thermal power plants situated more than 1,000 km away from the mine site as well as those located in critical, sensitive, and urban areas. The use of 100 % washed coal in thermal power generation is targeted by 2017.

### **Coal Liquefaction**

In India, Indian Institute of Technology, Kharagpur initiated the primary research on coal liquefaction, with the objective of developing indigenous catalysts. The syngas was first produced using fixed bed gasification process at 800–900°C. Tests were carried out on number of chemicals such as zeolite supported iron catalyst. The oil output of 4 litres per day was soon reached. Coal liquefaction research was also pursued in R&D laboratories of IOCL which has put up a pilot plant for conversion of low sulphur Assam coal to oil at Duliajan, in Assam. This was due to the fact that Assam coal with its low ash content has better suitability to liquefaction. Coal India is planning to set up a commercial-scale coal liquefaction plant of coal processing capacity of 3.5 Mt per annum. The Ministry of Coal has supported R&D on improved coal mining and processing technologies since 1976. These activities have focused more on the adaption of proven technologies from around the world to Indian conditions (e.g., high-ash coals and high- ambient temperatures).

### **Supercritical and ultra-supercritical technology development in India**

BHEL had collaborated with Alstom in 2007, which enabled BHEL to produce 1,000-MW size power plants based on supercritical technology. BHEL had also signed a MOU with Siemens for cooperation in the field of advanced power plant technology. India's first supercritical thermal power station was erected in Sipat, Chhattisgarh by NTPC. The total approved capacity of Sipat is 2980 MW, which includes 3x 660-MW supercritical units in

Stage I and 2x 500-MW supercritical units in Stage II. The stage I of the plant is currently under installation. The two commissioned UMPPs at Mundra and Sasan are another examples of supercritical power plants in India.

### **IGCC technology development in India**

BHEL pioneered IGCC research in India by setting up a IGCC pilot plant (6.2-MWe) at its R&D Center in Tiruchirapalli (Trichy) in 1985. It included pressurized fluidized bed gasifier and a 4.0-MW Mitsubishi gas turbine using cold-gas clean up. BHEL's also has considerable annual expenses towards IGCC research and development at about 8 crores/year. The scaling up of the BHEL pilot plant is also planned at Vijaywada Thermal Power Station 125-MW IGCC project along with Andhra Pradesh Generating Company (APGENCO). Separately, NTPC has also proposed building a 100-MW IGCC demonstration plant, with focus on adapting IGCC technology to Indian conditions.

### **CCS technology developments in India**

Carbon capture and storage involves separating the CO<sub>2</sub> from flue gas, transporting it to a storage location and injecting it into suitable underground geological formations such as depleted oil and gas fields, un-mineable coal seams and saline water-bearing reservoir rocks. All forms of CCS require careful preparation and monitoring to avoid environmental damage. The CCS is also extremely costly and the technology is also not fully commercialized. The CCS is an emerging technology within Europe but at very early stage in India. Currently, India has annual CO<sub>2</sub> emissions of around 1343 Mt, with about 50% being emitted from large point sources suitable for CO<sub>2</sub> capture. A recent Government of India initiative to develop a total of sixteen Ultra-Mega Power Projects (UMPPs) will add approximately 36,000 MW of installed capacity, with a corresponding increase in CO<sub>2</sub> emissions of approximately 275 Mt per year. Considering India's status as a large emitter of CO<sub>2</sub> it may be worthwhile for India to also explore CO<sub>2</sub> capture and storage as a mitigation option.

### **Case Study-Mundra ultra mega power project**

New power plant installations in India have started adopting numerous clean coal technologies in India. One recent example is Mundra Ultra Mega Power Project, located in Gujarat state. The plant is India's first and one of the two UMPPs commissioned till date. This project is developed by Tata Power Ltd which is India's largest private sector company in power sector. Mundra power plant contains 800 MW sized supercritical boiler. The plant

has an output of 4000 MW (five boilers x 800 MW each). The boilers were supplied by UK based manufacturer Doosan Babcock, the make which is also being used for the supply of many other of India's new supercritical plants. Most notably the seven units at Kudgi, Lara and Raipur. The Mundra project was completed in March 2013. The plant's location near the major Mundra coal port allows it to use an imported high quality coal from Indonesia. Although more expensive than domestic coal, its lower levels of sulphur and ash mean reduced emissions and less space that needs to be allocated for ash disposal facilities. The plant's emissions of greenhouse gases is estimated at 0.75 kg of CO<sub>2</sub> per kWh, compared with the national average of 1.259 kg per kWh for coal based power plants. Mundra power plant also utilizes electro static precipitators to control particulate matter emissions, low NO<sub>x</sub> burners which reduce NO<sub>x</sub> emissions by some 35 %, dust control and dust suppression systems and a coal ash storage pond. Mundra Power plant can be considered as the most modern and energy efficient coal-based power plant in India