

Expansion of Coal-fired Thermal Power Generation Business in India and Globalization of Indian Manufacturing Base



Mitsubishi Hitachi Power Systems, Ltd.

The joint venture boiler company L&T-MHPS Boilers Private Ltd. (LMB), and the joint venture turbine/generator company L&T-MHPS Turbine Generators Private Ltd. (LMTG), which were established jointly by Mitsubishi Hitachi Power Systems, Ltd. (MHPS) and Larsen & Toubro (L&T) to construct high-reliability and high-performance ultra-supercritical coal-fired thermal power plants in India, a country facing constant power shortages, are marking their 10th anniversaries in 2017. Mitsubishi Electric Corporation (MELCO) also participates in LMTG as a contributor.

During these ten years, we have received orders for 18 boilers and 15 steam turbines/generators in India, among which 7 boilers and 9 steam turbines/generators have started operation. In the future, we will expand the coal-fired thermal power generation business in India including after-sales service not only for newly-built plants, but also for existing plants and the replacement of aging plants with ultra-supercritical power plants. Furthermore, we are promoting our Selective catalytic NO_x reduction (SCR) technology to meet new environmental regulations in India, aiming at the realization of coal-fired thermal power plants with much higher environmental compatibility than ever before.

Utilizing the high quality and reliability cultivated in Indian projects, we have also delivered boilers, pulverizers and steam turbines manufactured in India to the markets outside that country such as Japan, the United States, Southeast Asia, and the Middle East. We will continue to utilize our manufacturing facilities in India more widely as a manufacturing base for boilers, pulverizers and steam turbines for global markets.

1. LMB and LMTG, joint venture companies established by MHPS and L&T

To "resolve the constant power supply shortage" in India and "utilize the abundant coal resources in the country," and also respond to needs for "the introduction of high-performance coal-fired thermal power generation technology with excellent environmental compatibility" and "the development of domestic industries," MHPS established LMB and LMTG jointly with L&T in 2007, and built a boiler and steam turbine/generator manufacturing plant in Hazira, Gujarat State in Western India (**Figure 1**). In 2009, we added a pulverizer manufacturing plant and a foundry to produce pulverizers, which are main pieces of boiler equipment, and large casting parts of steam turbine casings.



Figure 1 LMB/LMTG Hazira Plant

During factory construction, to maintain the same level of quality as the Japanese factories, the same important facilities as those in Japan were introduced under the guidance and promotion of MHPS and MELCO.

Based on a technology licensing agreement, in parallel with the construction of the plants, MHPS and MELCO introduced their state-of-the-art technologies of ultra-supercritical power generation equipment. In addition, many Japanese engineers were dispatched to not only introduce the technology to all manufacturing processes of LMB & LMTG (such as quality, design, manufacture, construction, and trial operation), but also inculcated "Japanese craftsmanship" mind in all processes.

With the introduction of hard and soft technologies, a manufacturing process meeting the global quality requirements was ensured, and as a result, the plant has grown into a manufacturing base for boilers, pulverizers, steam turbines and generators.

2. Supply records of LMB and LMTG

2.1 Supply records to the Indian market

In the ten years since the establishment of LMB and LMTG in 2007, we have received orders for 18 boilers and 15 turbines (**Figure 2**). In February 2014, NPL (Nabha Power Limited) Rajpura unit 1, which was also one of the first power plant units supplied by LMB & LMTG, was put into commercial operation, and since then, 7 boilers and 9 steam turbines and generators have started commercial operations. Initially, the steam temperature of 566°C for the main steam and 593°C for the reheating steam was prevalent in Indian projects. From the establishment of the joint venture company, we promoted the introduction of ultra-supercritical power plants to India, which are equivalent to Japan's state-of-the-art power plants, and in 2015 received an order for NTPC (NTPC Limited) Kharagone, with 600°C steam temperatures for main and reheating. This project is now under manufacturing and site erection (**Figure 3**).

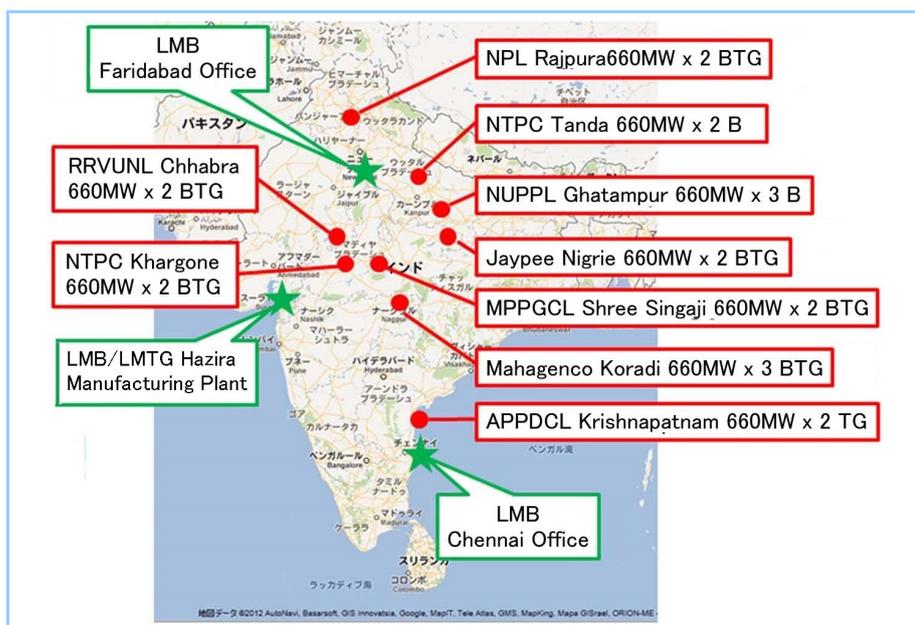


Figure 2 Bases of LMB/LMTG and project sites in India



Figure 3 NTPC Kharagone (manufacturing and construction state)

2.2 Supply records to the global market

As a result of the licensed technology application and the technical support in the implementation of Indian projects, these manufacturing bases have grown and satisfy global quality requirements. We are now able to utilize the superior competitiveness of LMB/LMTG for MHPS's global projects, and we are actively utilizing them as manufacturing bases for boilers/pulverizers and steam turbines.

When introducing Indian products to Japanese and other overseas customers, we invited them to visit our factory in India so that they could understand our manufacturing quality by seeing the actual products during the manufacturing process in the factory. We have received orders for boiler pressure parts (6 projects), pulverizers (13 projects) and steam turbines (12 projects) manufactured by LMB/LMTG for delivery to Japan, the United States, Southeast Asia and the Middle East (**Figure 4**).

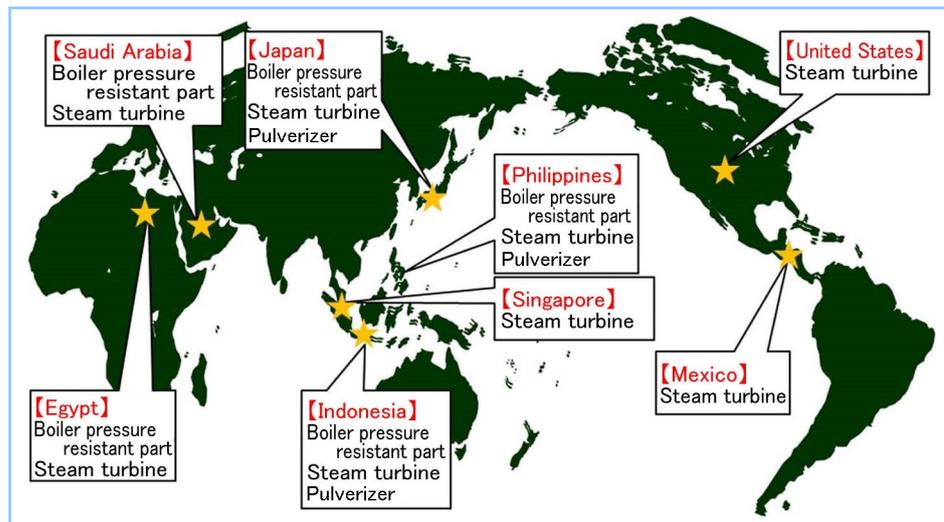


Figure 4 Order reception and delivery of MHPS's projects

3. New development in India

3.1 Introduction of technology to deal with new environmental regulations

In December 2015, new environmental regulations were implemented in India, which gave birth to a huge environmental equipment market for not only new installations, but also for after-sales service projects. Regarding the SCR technology, we are promoting its introduction to LMB through our technology licenses and supporting the NUPPL (Neyveli Uttar Pradesh Power Limited) Ghatampur project, where the SCR technology equipment will be applied to an actual plant for the first time in LMB.

3.2 Initiatives towards after-sales service

Three years have already passed since the start of commercial operation of NPL Rajpura unit 1, and after-sales services such as periodic inspections of plants delivered by LMB/LMTG have also started. In addition, LMTG also conducts gas turbine inspection work making full use of its high-speed rotation test facility, and in the future it will also expand to the after-sales services area for equipment other than that delivered by LMB/LMTG.

3.3 Efforts to maintain and improve quality of LMB and LMTG

Based on the reflection of quality problems faced in initial projects, we continued to provide technical support to LMB and LMTG. As a result, the culture of maintaining and improving the quality level gradually developed and globally accepted quality has been realized. It is important to maintain and further improve this level of quality. We will continue guidance by dispatching our personnel not only to the management of the joint venture, but also to the sales, design, and manufacturing areas, so that the required level of quality can be secured. In addition, we will continue to dispatch MHPS's experts regularly to LMB/LMTG plants and project erection sites to conduct audits and other various improvement activities (**Figure 5**).



Figure 5 Project audit and improvement activities

4. Future prospects

In addition to newly-built plants, suggestions for the replacement of aging coal-fired plants with supercritical or ultra-supercritical plants are being offered. We will continue to expand the coal-fired thermal power generation facility business including after-sales services in the Indian market.

For global markets, we will utilize LMB/LMTG plants as one of the manufacturing bases for MHPS's boilers/pulverizers and steam turbines, and further strengthen our competitiveness by selecting the most suitable production base for any project.

We will also promote the global utilization of human resources in the design, construction and commissioning departments in LMB and LMTG, which have been cultivated during technology transfers.