Globalization of Large Thermal Power Plant Business

—Example Projects and Future Developments in Southeast Asia—

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OVERVIEW: For reasons of economics and security of supply, worldwide use of thermal power generation is forecast to grow in the future, with rapid growth anticipated in Southeast Asia. Hitachi has been utilizing its overseas operation bases to strengthen the global operations of its thermal power plant business. In Southeast Asia, Hitachi was part of the consortium of three companies (including a local construction company) that undertook the North Bangkok Combined Cycle Power Plant Block I Developing project in the Kingdom of Thailand, which commenced commercial operation in 2010. Hitachi intends to continue contributing to resolving global-scale energy and environmental problems by supplying thermal power plants with high efficiency and excellent environmental performance.

INTRODUCTION

THE history of Hitachi's thermal power plant business goes back about 85 years, during which it has supplied thermal power plants in Japan and overseas that featured the best efficiency and reliability possible at the time. Overseas business commenced in the 1960s with the supply of turbine and generator units and expanded into EPC (engineering, procurement and construction) projects for total plant in the 1980s. The company established local operation bases, particularly in North America and Europe, which it had identified as key markets, and pursued a strategy of encouraging local management of those local operations. With the slowing down of the economies in North America and Western Europe in recent years, growth markets have emerged in places like Southeast Asia and Eastern Europe. Competition has also become fiercer with the entry of emerging nation suppliers onto the global market.

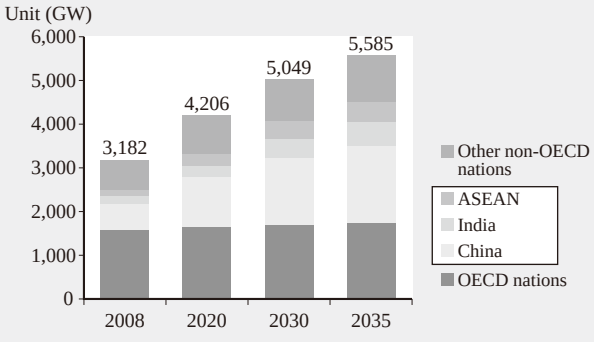
Given these circumstances, Hitachi's strategy for its thermal power business is to grow its plant business by increasing its competitiveness through measures such as enhancing the performance of its core products, increasing the proportion of production carried out outside Japan, globalization of procurement, and collaboration with local companies and emerging nation suppliers, and also by organizing projects and offering products and systems in ways that suit local requirements.

This article describes the history of Hitachi's thermal power business outside Japan, its policies towards Southeast Asia, and a number of recent projects.

TRENDS IN OVERSEAS MARKET FOR THERMAL POWER AND CHANGES IN GLOBAL OPERATIONS

Market Trends

Fig. 1 shows the forecast for thermal power generation capacity. The market for new plants is shifting to emerging economies, particularly China, India, and other parts of Asia. In the Association of Southeast Asian Nations (ASEAN) region, demand for electric power is outstripping generation capacity and while most of these nations are rich in natural fuel resources such as coal and gas, they suffer from a



Source: IEA "World Energy Outlook 2010"

OECD: Organization for Economic Co-operation and Development
ASEAN: Association of Southeast Asian Nations
IEA: International Energy Agency

Fig. 1—Forecast Growth in Thermal Power Generation Capacity.
Construction of new plants is increasingly taking place in emerging economies, particularly in the ASEAN nations, India, China, and other parts of Asia. Total installed capacity is expected to reach around three times its current level by 2035.

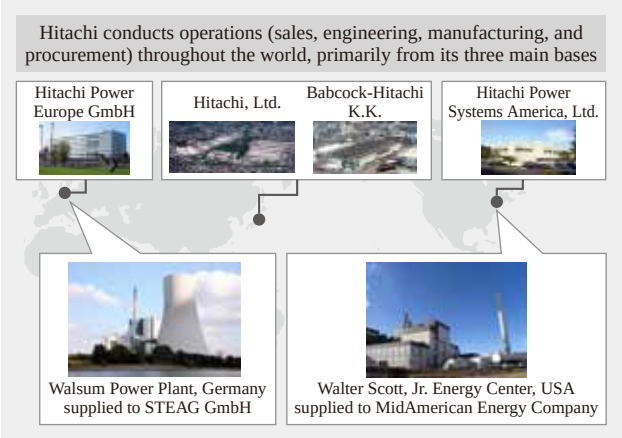


Fig. 2—Example Overseas Operations of Hitachi's Thermal Power Business.
Outside Japan, Hitachi has also established bases in the USA and Germany. The company is pursuing a strategy of local management with these bases taking a lead role and has won EPC contracts for large plants.

chronic shortage of investment finance. Accordingly, if this problem is to be solved, it is also important to take advantage of yen-denominated government credits, the Japan Bank for International Cooperation (JBIC), the Japan International Cooperation Agency (JICA), and other similar sources of finance.

Transformation of Globalization

Because Hitachi supplies the key power plant components itself; namely boilers, turbines, generators, and environmental equipment such as AQCSs (air quality control systems), it is able to optimize the overall plant while also providing a consistent and reliable supply of equipment. Fig. 2 shows the key bases for Hitachi's thermal power business and example projects in which these companies have taken the role of lead contractor. For North America and Europe, Hitachi established Hitachi Power Systems America, Ltd. (HPSA) in New Jersey, USA in 2005 to manage the North American region and Hitachi Power Europe GmbH (HPE) in Duisburg, Germany in 2006 to manage the European region.

Past Deliveries of Key Plant and Equipment

Table 1 lists the major overseas projects to which Hitachi has delivered major items of plant for thermal power systems. The first such project was the delivery of the Senoko Power Station (120 MW × 3,250 MW × 5, sub-critical pressure oil-fired power plant) to Senoko Power Ltd. of the Republic of Singapore in 1976, which was followed by the Bin Qasim Power Plant (210 MW × 4, sub-critical pressure oil-fired power plant) supplied to the Islamic Republic of Pakistan in 1984, the Tarong Power Station (350 MW × 4, sub-critical pressure coal-fired power plant) supplied to Australia in 1984, and the Lagos Power Plant (220 MW × 6, sub-critical pressure oil-fired power plant) supplied to the Federal Republic of Nigeria in 1985. More recent examples include the Genesee Power Plant (495 MW × 1, super-critical pressure coal-fired power plant) supplied to EPCOR Utilities Inc. of Canada, which commenced commercial operation in 2005, and the Walter Scott, Jr. Energy Center (870 MW × 1) supplied to MidAmerican Energy Company of the USA in 2007. Such plants have been supplied around the world, mostly in developed economies.

AGGRESSIVE GLOBALIZATION OF THERMAL POWER BUSINESS

Basic Strategy for Globalization

This section describes how Hitachi manages overseas thermal power plant construction projects. While the proportion of operations handled from Japan was large in the early days, as the number of projects

Table 1. Recent Examples of Large Plants Supplied by Hitachi
Hitachi has supplied large plants, primarily in developed economies.

Plant	Output/No. of units	Pressure/Fuel	Commercial operation
Senoko (Singapore)	120 MW × 3 250 MW × 5	Sub-critical pressure/oil and gas	1976
Bin Qasim (Pakistan)	210 MW × 4	Sub-critical pressure/oil	1984
Tarong (Australia)	350 MW × 4	Sub-critical pressure/coal	1984
Lagos (Nigeria)	220 MW × 6	Sub-critical pressure/oil	1985
Tuas (Singapore)	600 MW × 2	Sub-critical pressure/oil	1999
Ilo (Peru)	125 MW × 1	Sub-critical pressure/coal	2000
Krabi (Thailand)	340 MW × 1	Sub-critical pressure/oil	2004
Genesee (Canada)	495 MW × 1	Super-critical pressure/coal	2005
MidAmerican (USA)	870 MW × 1	Super-critical pressure/coal	2007
North Bangkok (Thailand)	700 MW × 1	Gas combined cycle	2010
Keephills (Canada)	500 MW × 1	Super-critical pressure/coal	2011
Walsum (Germany)	790 MW × 1	Super-critical pressure/coal	2011 (planned)
Electrabel (Germany/ Netherlands)	790 MW × 3	Super-critical pressure/coal	2012 (planned)
Senoko: Repower (Singapore)	420 MW × 2	Gas combined cycle	2013 (planned)

Fig. 3—Globalization of Supply Chain.
Hitachi is pursuing globalization to create an integrated supply chain that extends from sales activities (including formulating the basic concept and proposal for large plants) to after-sales service.

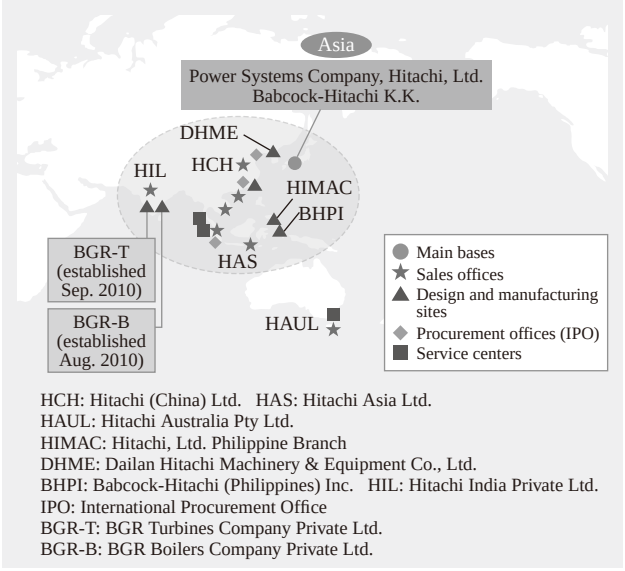


Fig. 4—Map of Thermal Power Business Bases in Asia.
Hitachi has recently firmed up the framework for its thermal power business supply chain in Asia and is embarking on activities in line with growth in the region's market.

grew, this has changed toward an approach that allows greater local management in order to handle activities like cost and schedule management of the overall project and the achievement of customer satisfaction more effectively.

Furthermore, Hitachi has established six core policies for achieving greater globalization of its supply chain. These are: (1) Strengthen coordination with sales offices in different parts of the world, (2) Promote a global approach to design, (3) Expand global procurement, (4) Establish production sites in different parts of the world, (5) Strengthen global quality assurance program, and (6) Expand global network of service centers (see Fig. 3). In addition to ensuring that bases located in large markets have a full range of capabilities, the purpose of this strategy is to take an aggressive approach to ensuring that coordination between different bases occur smoothly, with each base having a central role, and with this coordination extending from sales through to design, procurement, manufacturing, quality assurance, and after-sales service.

Hitachi's thermal power generation business is also working on the development and deployment of low-carbon technologies such as CCS (carbon capture and storage) in recognition that technologies for reducing CO_2 (carbon dioxide) emissions will be required in the future. This is in addition to its involvement in the following three areas: (1) Deployment of super-critical pressure coal-fired power plants, (2) Expansion of its environmentally conscious gas turbine business, and (3) Entry into service businesses such as maintenance and management.

Activities in Southeast Asia

The map in Fig. 4 shows the locations of Hitachi's thermal power business operations in Southeast Asia. The following sections describe some of these sites.

(1) Sales offices

Hitachi Asia Ltd. (HAS) is located in Singapore and manages offices in the Kingdom of Thailand, Socialist Republic of Viet Nam, Malaysia, Republic of the Philippines, and Republic of Indonesia. Hitachi also conducts local sales activities based out of Hitachi (China) Ltd. in China and Hitachi India Private Ltd. (HIL) in India. Although HIL was previously managed by HAS, it is now managed independently as a key global office due to the expansion of the Indian market and its identification as a key market for the entire Hitachi Group.

From these bases, Hitachi intends to undertake marketing in a way that is more closely tied to local circumstances and is seeking to increase the quality and quantity of local staff as well as expatriate staff, with a particular focus on the power systems business.

(2) Design and manufacturing sites

Babcock-Hitachi (Philippines) Inc. (BHPI) was established in the Philippines as a design and manufacturing facility in 1989 for the production of boilers. This was followed in 2000 by the establishment of Hitachi, Ltd. Philippine Branch (HIMAC), which undertakes engineering work such as plant systems and mechanical and electrical design, as well as commissioning and the provision of supervisory staff.

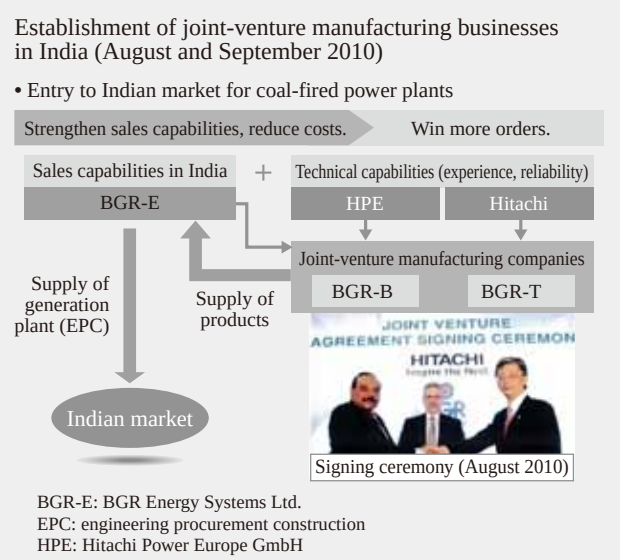


Fig. 5—Establishment of Joint-venture Companies by Hitachi and BGR of India.
Hitachi has established joint-venture companies with local Indian company BGR Energy Systems Ltd. The aim is to take advantage of India's very cost-effective labor and large youthful population to reduce costs.

In China, Dalian Hitachi Machinery & Equipment Co., Ltd. (DHME) was established in 1997 and produces parts for steam turbines and gas turbines. In India, separate joint-venture companies were established in 2010 for turbines and boilers respectively in collaboration with Indian EPC company BGR Energy Systems Ltd. with the aim of commencing local production in 2012 (see Fig. 5).

Fig. 6—Photograph of North Bangkok Combined Cycle Power Plant Block I and Scene from Opening Ceremony.
Located near the Chao Phraya River, which runs through central Bangkok, the plant helps provide a reliable supply of electric power to the city. An opening ceremony was held to mark to commencement of operation and was attended by the Thai minister responsible for electric power, EGAT president, and consortium representatives.

(3) Procurement offices

An International Procurement Office (IPO) with offices in Dailian, Shanghai, and Singapore was established in June 2011 specifically for the Asia Belt region to perform the role of procurement organization that was previously spread across the overseas bases. These offices utilize engineering skills to conduct equipment procurement in the best possible way and are helping to increase competitiveness by expanding the proportion of overseas procurement.

EPC CONTRACT FOR NORTH BANGKOK COMBINED CYCLE POWER PLANT BLOCK I DEVELOPING IN THAILAND

The following sections describe an EPC project for a combined cycle power plant in Thailand, an example of Hitachi's overseas activities in Southeast Asia.

Project Overview and Background

Sumitomo Corporation, Italian-Thai Development Public Co., Ltd. (ITD) (a construction company from Thailand), and Hitachi, Ltd. formed a consortium in March 2007 that won the EPC contract to supply a 700-MW generation system to the North Bangkok Combined Cycle Power Plant Block I of the Electricity Generating Authority of Thailand (EGAT). After design, manufacturing, and procurement of materials and equipment followed by installation and commissioning, the plant started producing power in November 2010. Motivated by concern for security of supply and environmental protection in Thailand, most of EGAT's new power plants use combined cycle generation fueled by natural gas, and the authority has a number of such plants under construction. North Bangkok Combined Cycle Power Plant Block I is one of them and its location within EGAT's headquarters site makes it a symbolic plant (see Fig. 6). It is anticipated that this project will play a role in the future expansion of Hitachi's power system business in Thailand, as well as the development of its business in Southeast Asia.

Main Specifications

The main components of the power plant are two gas turbine generators, two heat recovery steam generators, and one steam turbine generator (see Table 2).

(1) Gas turbines and generators

The gas turbine is a General Electric Company (GE) F9FA Series upgrade package with a DLN [dry low-NO*x* (nitrogen oxide)] combustion system. In order to increase the operation load range with low

TABLE 2. Main Plant Specifications
The plant features two highly efficient reheated, three-pressure boilers.

Plant output (Net)		703.6 MW
Plant power train structure		2 GT + 2 HRSG + 1 ST
Gas turbines		F9FA+e (DLN combustor) (supplied by GE)
HRSGs		Vertical, naturally circulated, reheated three-pressure (supplied by CMI)
Steam turbine		TCDF-33.5 (supplied by Hitachi)
Steam conditions	HP	130 bara/566°C
	IP	23.4 bara/566°C
	LP	5.2 bara/290°C
Rated generator capacity	Gas turbine	307 MVA × 2 unit (supplied by GE)
	Steam turbine	330 MVA (supplied by Hitachi)
Main transformer	Gas turbine	15.75/241.5 kV (supplied by Japan AE Power Systems Corporation)
	Steam turbine	18/241.5 kV (supplied by Japan AE Power Systems Corporation)
Plant control system (DCIS)		HIACS 5000M (supplied by Hitachi)

GT: gas turbine HRSG: heat recovery steam generator ST: steam turbine
DLN: dry low-NO*x* (nitrogen oxide) GE: General Electric Company
TCDF: tandem compound double flow HP: high pressure
IP: intermediate pressure LP: low pressure
DCIS: distributed control and information system

NO*x* emission, an IBH (inlet air bleed heating) system was adopted that introduces air extracted from the gas turbine air compressor into the inlet duct.

(2) Heat recovery steam generators

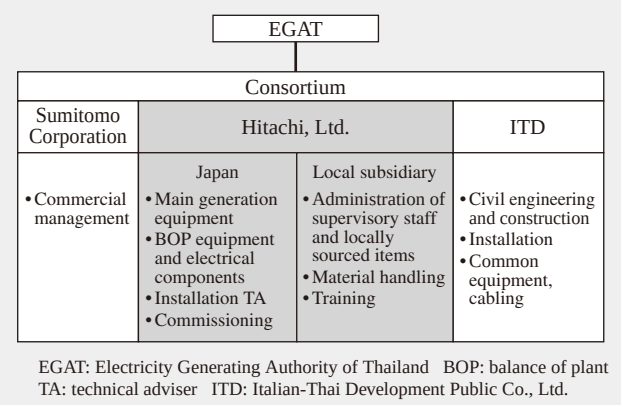
A naturally circulated and reheated, three-pressure boiler with a vertical design was adopted to achieve high efficiency and allow the plant to fit into the limited space available at the site. These units were supplied by Cockerill Maintenance & Ingénierie (CMI) Group of the Kingdom of Belgium, which has supplied other plant to EGAT in the past.

(3) Steam turbine and generator

A TCDF (tandem compound double flow) type steam turbine with 33.5-inch (85.09-cm) aft-stage blades made of Cr-Nb-Mo-V (chromium-niobium-molybdenum-vanadium) steel was selected. This material is widely used in this class of steam turbines.

Project Organization

While Hitachi's previous involvement with a major project in Thailand was the Krabi Thermal Power Plant, which commenced commercial operation in 2004, this EPC project was undertaken as a consortium in which Sumitomo Corporation managed the commercial arrangements; ITD handled civil engineering, construction, and installation; and Hitachi was responsible for design, equipment procurement, supply of supervisory staff for installation, and commissioning (see Fig. 7).



EGAT: Electricity Generating Authority of Thailand BOP: balance of plant
TA: technical adviser ITD: Italian-Thai Development Public Co., Ltd.

Fig. 7—Organization of North Bangkok Project.
As technical leader, Hitachi, Ltd. coordinated the technical side of the consortium and managed the overall project.

Hitachi also established a local subsidiary to engage in running the project and act as a local base. Its roles included human resources administration of expatriate supervisory staff, health and safety, and procurement of locally sourced equipment and materials. Timely collection of information and assessment of conditions by the local office helped to minimize the impact on the project schedule resulting from the H1N1 influenza outbreak that struck Bangkok in 2008 and 2009 and the unrest that followed political demonstrations, while still maintaining safety as a priority.

Experience in Thailand

Hitachi gained valuable experience from its first involvement in a thermal power project in Thailand, which came about 10 years ago at the Krabi Thermal Power Plant. For example, while other nearby ASEAN nations do not place an emphasis on the latest and most advanced specifications, the contract specifications can still be cumbersome. Furthermore, with the preferences of equipment suppliers being oriented to developed economies, difficulties can arise in areas like delivery inspection systems, which are subject to complex management arrangements. In the North Bangkok Project, however, particular attention was paid to strengthening mutual understanding through intensive interaction and the project proceeded without problems by, for example, getting help from EGAT's workforce for tasks such as transport within the country. The following section describes the experience Hitachi gained in solving the issues that arise from operating as a consortium.

The role of local company ITD in the consortium was to handle the civil engineering, construction, and installation work. While the civil engineering and

construction proceeded smoothly in accordance with the project schedule priorities, particular attention was paid to management and work sharing that required a higher degree of collaboration, including the coordination of design and procurement processes with construction and installation work that was closely tied to commissioning. During commissioning, time had to be spent coordinating with the customer regarding the task of managing the drawings, documents, and records associated with commissioning trials, which was part of the overall workflow, and this affected the commissioning process.

Other difficulties experienced with schedule management included work interruptions resulting from Southeast Asia's distinctive weather such as the violent squalls that struck during the rainy season. Another problem that arose was that, because the plant is sited in a low lying area, the salinity of the river used as water source rises during the dry season due to backflow from the ocean. When the water purification system proved unable to cope, management meetings were held between the senior representatives of the respective consortium partners to share information and a solution to the problem was quickly identified. Furthermore, customer and contractors came together with each party doing all they could to find solutions. In one example of a shared problem handled at the coordination meetings, the consortium worked with EGAT to use EGAT-owned barges to obtain water from further upstream to solve a water shortage.

In this way, the consortium faced up directly to the difficulties of project management during the installation and commissioning phase so that, through collaboration between consortium members and with considerable cooperation from the customer, the plant was able to commence commercial operation in November 2010.

FUTURE BUSINESS PLANS FOR SOUTHEAST ASIA

Based on its experience with the North Bangkok Project and what it has learnt from other past overseas projects, Hitachi has identified the following main considerations, over and above standard project management, for its thermal power plant business in Southeast Asia.

(1) Enhance competitiveness through measures such as taking advantage of government financing (from JICA or yen-denominated government credits), and through activities that suit customer preferences.

(2) Create a framework for collaboration with local partners in each country, starting with trading companies and engineering companies.

(3) Establish the optimum contract format and other arrangements with local businesses in each region for civil engineering, construction, and installation work.

Similarly, the following lessons were learnt from the project in Thailand:

(1) Difficulties occurred with piping and cabling work. The issues here were the large volumes of design data to be exchanged and the task of coordinating it. Improving the accuracy of this work and having it completed on schedule are vital.

(2) It is important to appoint someone to coordinate with the customer to satisfy any additional customer requests identified during commissioning. Ideally, the coordinator should be a customer with previous experience.

(3) Because attitudes and behavior regarding things like responding to urgent matters, schedule preparation, and how to conduct discussions may be different from those found in Japan, Hitachi believes that the organizational structure of the consortium needs to include a neutral consortium leader or similar position.

CONCLUSIONS

This article has described the history of Hitachi's thermal power business outside Japan, what its policies towards Southeast Asia, and its experience at a number of recent projects.

Hitachi intends to proceed with strategic initiatives including M&A (mergers and acquisitions) in order to grow its thermal power business in the Southeast Asian market, having recognized the need for: (1) Gaining competitive advantage by Hitachi's advanced technologies, particularly super-critical/ ultra super-critical pressure coal fired power plants, (2) Strengthening its ability to win contracts by collaborating on project formation from the initial stages, including feasibility studies, engineering studies, and financing, and (3) Making its supply chain (including sales, engineering, procurement, and manufacturing) more international through more local sourcing. For the future, Hitachi intends to apply the tangible and intangible assets gained from its experience with the EPC project in Thailand to its thermal power plant business, and thus contribute to the building of social infrastructure in Southeast Asia and the rest of the world.

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