Business Briefing on Engineering Headquarters

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1. Establishing the Engineering Headquarters: Background and Objectives

(1) MHI’s problems and actions for business expansion

**Business scale expansion**

- **EPC integration**
- **Split into specialized companies**

**Integration of EPC units dispersed in the company**

**Background**

<table>
<thead>
<tr>
<th>External Environment</th>
<th>Needs from society</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Increase in large-scale infrastructure projects</td>
</tr>
<tr>
<td></td>
<td>- Emergence of solution businesses</td>
</tr>
</tbody>
</table>

| Internal Environment | Limitations on growth of the business scale under the conventional style of management (with business headquarters and works) |
Integration of EPC units from three business headquarters

Before change

- Plant Engineering Procurement & Construction Division
- Overseas nuclear projects
- Large-scale infrastructure projects
- Environment & Chemical Plant Division
- Other business headquarters

After change

- Engineering Headquarters
  - Approx. 5,000 staff members (Consolidated)
- Power Systems
- Nuclear Energy Systems
- Machinery & Steel Infrastructure Systems
- Other business headquarters

1. Establishing the Engineering Headquarters: Background and Objectives
   (2) Setup of the Engineering Headquarters

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Objectives (Vision)

• Become a globally recognized engineering group with world-leading EPC capabilities.
• Build a low-risk, high-return business structure to boost the receipt of orders and earnings.
(4) MHI’s advantages: (i) Strengths of the EPC units backed by manufacturing

### Strengths of EPC units backed by manufacturing

#### Differentiation with technologies unique to manufacturers

Apply the core product technical capabilities developed through the design and production of power plant-related equipment to the engineering of equipment and machinery constituting various plants.

#### Active use of in-house R&D functions

Make effective use of extensive basic and applied technologies owned by six research and development centers to develop new technologies and to swiftly resolve emerging problems.

#### Advantage through cross-sectional expansion of control technologies

Apply the technologies embodied in power plant monitoring and control systems to environment and chemical plants and large-scale transportation systems to differentiate control technologies for plants and systems.

#### Enhanced constructing quality with advanced production technologies developed through manufacturing

Apply advanced welding, assembly, and other manufacturing technologies and production management approaches to on-site construction work to improve work quality.
Synergy enjoyed from organizational unification and economies of scale

Business growth through united efforts on companywide cross-sectional projects

Expand solution businesses that involve multiple business headquarters, such as total energy management for factories, water solutions and smart community.

Enhancement in project operation capacity through integration of common resources

Integrate resources common to different businesses, such as those for sales, design, procurement, construction and quality control, to bolster the capacity to implement projects.

Deriving economies of scale in material procurement

Derive economies of scale in cross-sectional material procurement for power plants, environmental and chemical plants, overseas nuclear plants, and large-scale infrastructure.

Cross-sectional expansion of best practices in project implementation

Share advanced project management techniques, risk management, and design tools based on extensive experience to meet the increasingly advanced, diversified, and complex needs of customers.
1. Establishing the Engineering Headquarters: Background and Objectives

(5) Acceleration of global expansion through sharing and unifying overseas bases

**Acceleration of global expansion through sharing and unifying overseas bases**

- **ATMEA**: A joint venture with France-based Areva. Development and action for authorization, marketing, and sales for the ATMEA, 1.1-MW-class medium-sized reactor.
- **MHI Engineering Vienna**: Receipt of orders, design, and project implementation for GTCC in Europe and elsewhere.
- **MEIP**: A joint venture with Oman-based SBG. EPC contractor for environmental and chemical plants.
- **MPS-India**: EPC contractor for GTCC mainly in India.
- **MTS**: MHI Technical Services Corporation. Thermal plants, environmental and chemical plants, detailed design for transportation.
- **Nanjing TianLing Energy Technology Co., Ltd.**: GTCC design and procurement.
- **Environmental Systems Division, MHIA**: A base for environmental business (CO2, multi-emission, etc.) and E&P business for the Americas.
- **ADVATECH**: A joint venture with US-based URS. Design, procurement, installation, and trial operation of flue gas desulfurization systems.
- **MPSA**: Receipt of orders, design, and project implementation for GT power trains for the Americas.
- **MNES**: Mitsubishi Nuclear Energy Systems. Receipt of orders, design, procurement, and project implementation for nuclear equipment US-APWR for the Americas.

- **MIES**: MHI Industrial Engineering & Services Private Ltd.
- **MEIP**: MHI Engineering and Industrial Projects India Private Ltd.
- **MTS**: MHI Technical Services Corporation
- **MNES**: Mitsubishi Nuclear Energy Systems
- **MPSA**: Mitsubishi Power Systems Americas
What is engineering?

Engineering is an approach of designing and constructing facilities and systems that meet social needs with the use of the knowledge and techniques (human potential) of the project team. (e.g., the Pyramids in Egypt, the Great Wall of China, and the Roman aqueducts)
2. What is Engineering?
(2) Engineering and “Project Management & System Integration”

The goal of engineering is to ensure these four qualities.

- Quality (Q)
- Cost (C)
- Delivery (D)
- Safety (S)

The goal of engineering is to ensure these four qualities.
3. Business Overview of the Engineering Headquarters
(1) Energy, environmental solutions, and industrial infrastructure

Energy, environmental solutions, and industrial infrastructure

- GTCC power plants
- IGCC power plants
- Coal power plants
- Renewable energy plants
- Overseas nuclear power plants

Energy Supply

Environment Solutions

Industrial Infrastructure

- Desalination plants
- CO₂ recovery plants
- Flue gas desulfurization plants

Water solutions

- Fertilizer plants
- Methanol plants
- Purified terephthalic acid plants
- Polyethylene plants
- Large-scale transportation systems

Smart community
3. Business Overview of the Engineering Headquarters
(2) Engineering and Manufacturing

Engineering and Manufacturing

- Renewable energy related equipment
- Power Systems [Manufacturing]
- Nuclear equipment
- Nuclear Energy Systems [Manufacturing]
- Smart community
- Large-scale infrastructure projects
- Engineering business
- Overseas nuclear plants
- Environmental and chemical plants
- Thermal plants
- Vehicle and transportation systems
- Compressors
- Machinery & Steel Infrastructure Systems [Manufacturing]
- Boilers, gas turbines, steam turbines
- Power Systems [Manufacturing]
3. Business Overview of the Engineering Headquarters

(3) Examples of the engineering business (i)

Energy (thermal plants and nuclear plants)

**Thermal plants**

- Kawasaki Thermal Power Station of Tokyo Electric Power Company Inc.

- GTCC (Indonesia)

**Overseas nuclear plants**

- US-APWR (Advanced PWR for the United States)

- Coal fired thermal plant in Chile
Renewable energy

Introducing renewable energy tailored to local conditions

Wind

Offshore wind turbines

Hydraulic

Water turbines
Srinagarind Power Station, EGAT, Thailand

Geothermal

Geothermal plant
Nesjavellir, Iceland
Fertilizer plants

Fertilizers such as ammonia and urea are essential to agricultural or food production.

Ammonia plant in Indonesia

Fertilizer plant in Oman
Desalination plants
Producing freshwater from seawater to supply water to regions short in water resources

Water molecules contained in seawater are passed through semi-permeable membranes to remove salt and hazardous substances and produce fresh water.
CO₂ recovery plants

Bahrain: 450 tons per day

United States: 500 tons per day

Schematic Diagram of CO₂ Recovery and Enhanced Oil Recovery (EOR)
A chemical absorption technique is used to recover CO₂ from the flue gas emitted from power plants and factories. The CO₂ is then conveyed through pipelines to oil fields and used for EOR.
Large-scale transportation systems

Contribution to modal shift

- **Taiwan High Speed Rail Project**
  Maximum speed in commercial operation: 300 km/h

- **Dubai Metro Project**
  Full automatic unmanned operation
4. Enlarging Existing Businesses
(1) Market scales

Power plants

Thermal plants (gas-/coal-fired)

Power plant capacity

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>1,500</td>
<td>2,000</td>
</tr>
<tr>
<td>Coal</td>
<td>1,000</td>
<td>1,500</td>
</tr>
</tbody>
</table>

Infrastructure investments in 2010-2020

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Coal</td>
<td>10</td>
<td>15</td>
</tr>
</tbody>
</table>

Environmental and chemical plants

Environmental plants (CCS and others)

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2020</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Chemical plants

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>2020</td>
<td>15</td>
<td>18</td>
</tr>
</tbody>
</table>

Source: Created by MHI on the basis of UDI, Mccoy, IEA WEO2011, IEA CCS Road Map and Engineering News Record
4. Enlarging Existing Businesses
(2) Chemical plants (i)

Recent circumstances

- Major projects
  - Fertilizer plant
  - Methanol plant
  - Purified terephthalic acid (PTA) plant
  - Polyethylene plant
- Fertilizer plants experiencing medium- and long-term growth

Actions for growth

- Positive actions centered on fertilizer and methanol plants in emerging countries in the CIS (ex-USSR) zone, in Africa, and elsewhere
- Boosting actions for effective use of natural gas
- Increasing competitiveness and accelerating global expansion with EPC implementation at overseas bases such as MIES in Singapore and MEIP in India

MHI received an order for a large-scale fertilizer plant to produce ammonia and urea in Malaysia in October 2011.

MHI signed an early work agreement for a fertilizer plant in Angola in November 2011.

- The order was jointly received from PETRONAS Chemical Fertilizer Sabah Sdn. Bhd. with APEX Energy Sdn. Bhd. and PT Rekayasa Industri.

- MHI, Toyo Engineering Corporation, Sojitz Corporation, and Sumitomo Corporation entered into an early work agreement covering part of the engineering work (plant basic design, preparation of engineering documents and contracts, site surveys and other work) for an ammonia and urea fertilizer plant with the Ministry of Geology, Mining and Industry (MGMI) of the Republic of Angola.
MHI is among the market share leaders in the worldwide market of fertilizer plants.

- Increasing food production amid population growth and improved living standards is a global issue.

One of the market share leaders with an excellent track record in fertilizer plant construction

A world-leading manufacturer of high efficiency compressors and drive turbines at the heart of plants

- A large-scale ammonia and methanol concurrent production facility for the Rep. of Tatarstan

MHI is the world’s only company to have constructed an ammonia and methanol concurrent production facility.
4. Enlarging Existing Businesses
(3) Environmental plants (i)

Recent circumstances

- Flue gas desulfurization plants:
  - Stepping up efforts to win projects mainly for seawater desulfurization plants in emerging countries
- CO\(_2\) recovery plants:
  - An industry-leading track record in orders for commercial plants (to construct 11 plants)
  - Working on projects to boost fertilizer production in the Middle East and Asia as well as a verification project in the West

Actions for growth

- Flue gas desulfurization plants:
  - U.S. environmental regulations tightened
  - Focusing energy on seawater desulfurization plants in Asia
- CO\(_2\) recovery plants:
  - Action for large-scale CCS/EOR(*) projects
  - Projects at MIES, MEIP and other overseas bases underway

Recent circumstances

- The carbon capture facility came into operation in June 2011.
- A total CO\(_2\) recovery volume reached 57,580 tons as of April 12, 2012, after 3,044 hours of operation.
- Underground storage is set to start around summer 2012.

Actions for growth

- MHI received the first order for a large-scale CO\(_2\) recovery plant for increasing methanol production from a petrochemical company in Qatar in March 2012.
- It is the first order received for a CO\(_2\) recovery plant for increasing methanol production. It will have a world-class CO\(_2\) recovery capacity for commercial systems for chemical purposes, at 500 ton/day.
- It is the first EPC order received by MIES.

(*) CCS: Carbon capture and storage, EOR: Enhanced oil recovery
CO2 recovery plants (commercial and demonstration facilities) delivered or under construction

- **1999:** 200 ton/day Malaysia <Urea>
- **2005:** 330 ton/day Japan <General>
- **2006:** 450 ton/day India <Urea>
- **2006:** 450 ton/day India <Urea>
- **2009:** 450 ton/day Bahrain <Urea>
- **2009:** 400 ton/day Abu Dhabi <Urea>
- **2006:** 450 ton/day India <Urea>
- **2009:** 450 ton/day India <Urea>
- **2006:** 450 ton/day India <Urea>
- **2009:** 400 ton/day Abu Dhabi <Urea>
- **2009:** 450 ton/day India <Urea>
- **2010:** 240 ton/day Vietnam <Urea>
- **2011:** 340 ton/day United States <CCS demonstration at coal-fired power plant>
- **2011:** 500 ton/day Pakistan <Urea>
- **2011:** 500 ton/day United States <CCS demonstration at coal-fired power plant>
- **Q2 2012:** 450 ton/day Qatar <Urea>
- **Q2 2014:** 500 ton/day Qatar <Methanol>
MHI is the world leader in flue gas CO₂ recovery technology.

- The large-scale CO₂ recovery demonstration plant (with CO₂ recovery capacity of 500 ton/day) at Southern Company’s Plant Barry in the United States.
- A CCS demonstration facility among the world’s largest at a coal-fired power plant.
- The potential for boosting capacity to 3,000 ton/day or more.

- A track record of delivering 12 commercial and demonstration facilities (with the KS-1™ process jointly developed with Kansai Electric Power Co., Inc.).
- An overwhelming market share in commercial facilities.
- Commercialization achieved earlier than the competition to lead in energy-saving technologies.
MHI is the world leader in flue gas desulfurization technology.

- Market share: 43% in Japan, 14% in the world (on MW basis)
- World-leading market share with flue gas desulfurization technology
- A track record that includes delivering more than 200 plants around the world
- Mitsubishi Flue Gas Treatment System
- MHI as a one-stop provider of boilers, denitrification equipment, electrostatic precipitators, desulfurization plants, and CO₂ recovery plants
### 5. Expanding into New Fields and Businesses

#### (1) Market scale of the large-scale infrastructure and solution business

<table>
<thead>
<tr>
<th>Large-scale infrastructure</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overseas nuclear plants</strong></td>
<td><strong>Water solutions</strong></td>
</tr>
</tbody>
</table>
| - Full-scale launch in this market after gathering EPC knowledge in the whole company | - Desalination  
- Industrial water  
- Industrial sewage  
- Recycled water |
| ![Market Scale](image1) | ![Market Scale](image2) |
| **Large-scale transportation system (railways)** | **Smart community** |
| - Overseas high speed railway projects and other large-scale railway projects | - Renewable energy  
- Power storage systems  
- Energy management (except in North America and Europe) |
| ![Market Scale](image3) | ![Market Scale](image4) |

Source: Created by MHI on the basis of materials from the Ministry of Economy, Trade and Industry, the Ministry of Land, Infrastructure, Transport and Tourism, Japan Atomic Industrial Forum, Inc. and Mitsubishi Research Institute, Inc. and Sekai Smart City Soran (Comprehensive Guide to Smart Cities of the World)
5. Expanding into New Fields and Businesses

(2) Total solutions in energy and the environment

<table>
<thead>
<tr>
<th>Generation-side</th>
<th>Consumption-side</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MHI product/ technology</strong></td>
<td><strong>Application</strong></td>
</tr>
<tr>
<td><strong>Power storage</strong></td>
<td><strong>Lithium-ion battery</strong></td>
</tr>
<tr>
<td><strong>Renewable energy</strong></td>
<td><strong>Hydraulic</strong></td>
</tr>
<tr>
<td><strong>Solar</strong></td>
<td><strong>Solar</strong></td>
</tr>
<tr>
<td><strong>Wind</strong></td>
<td><strong>Wind</strong></td>
</tr>
<tr>
<td><strong>Geothermal</strong></td>
<td><strong>Geothermal</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Biomass treatment / generation</strong></td>
</tr>
<tr>
<td><strong>Thermal power generation</strong></td>
<td><strong>GTCC</strong></td>
</tr>
<tr>
<td></td>
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<tr>
<td><strong>Nuclear</strong></td>
<td><strong>IGCC</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Waste treatment</strong></td>
<td></td>
</tr>
<tr>
<td><strong>CCS</strong></td>
<td><strong>CO₂ recovery plants</strong></td>
</tr>
</tbody>
</table>

**Total Solution**

Low-Carbon Smart Community
(as an example of total solution)
5. Expanding into New Fields and Businesses

(3) Total energy solutions in factories (an example of energy demand-supply optimization)
Four core infrastructures proposed for the industrial estate in the Sanand District in the state of Gujarat

Layer 6
Waste Treatment and Power Generation

Layer 5
Transportation System

Layer 4
Water Solution

Layer 3
Power Supply from Microgrid

Layer 2
New Factories and Residential Zone (future plan)

Layer 1
Existing Factories

Map of the Sanand District
6. Summary

**Business Target of the Engineering Headquarters**

**Targeting a two-fold increase in orders compared to 2010 in 2016**

<table>
<thead>
<tr>
<th>Year</th>
<th>New businesses (trillion yen)</th>
<th>Existing businesses (trillion yen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>0.7</td>
<td>0.2</td>
</tr>
<tr>
<td>2012</td>
<td>0.9</td>
<td>0.4</td>
</tr>
<tr>
<td>2014</td>
<td>1.2</td>
<td>1.0</td>
</tr>
<tr>
<td>2016</td>
<td>1.4</td>
<td>1.0</td>
</tr>
</tbody>
</table>

*Note: The figures include portions of relevant business headquarters (Power Systems, Nuclear Energy Systems, and Machinery & Steel Infrastructure Systems) as well as the Engineering Headquarters.*

**Missions to achieve the target**

- Expand the orders for large-scale infrastructure projects including the existing EPC business.
- Contribute to the expansion of the internal core technology and product business.
- Work on the solution business, including the smart community and general water business.
- Further business development of next-generation businesses.
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