Next generation of LNG regasification terminal through TG’s profound knowledge – Tokyo Gas Hitachi LNG Terminal –

18th April 2013
Tsutomu ENDO Tokyo Gas Co.
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   - World's largest above ground LNG tank
   - Energy saving
   - LNG shipment
   - Improvement of reliability
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1. Introduction

Transition of LNG Import volume in Japan

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>LNG Import Volume (MTPA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>0</td>
</tr>
<tr>
<td>1989</td>
<td>10</td>
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<tr>
<td>2000</td>
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<td>2002</td>
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<td>2003</td>
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<td>2004</td>
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<td>2006</td>
<td>95</td>
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<td>2007</td>
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<td>2008</td>
<td>105</td>
</tr>
<tr>
<td>2009</td>
<td>110</td>
</tr>
<tr>
<td>2010</td>
<td>115</td>
</tr>
<tr>
<td>2011</td>
<td>120</td>
</tr>
</tbody>
</table>

Fiscal 2011

Major buyer result

Tokyo Electric power
24.1 (29%)

Chubu Electric power
13.1 (16%)

Tokyo Gas
11.5 (14%)

Osaka Gas
7.9 (10%)

Kansai Electric power
6.7 (8%)

Tohoku Electric power
5.1 (6%)

(Reference: foreign trade statistics)
1. **Introduction**

**Outline of Tokyo Gas**

<table>
<thead>
<tr>
<th>Outline of Tokyo Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNG import</td>
</tr>
<tr>
<td>Gas sales volume</td>
</tr>
<tr>
<td>Residential gas customers</td>
</tr>
</tbody>
</table>

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**Japan**

**Tokyo**

**Hitachi LNG Terminal**

**Ohgishima LNG Terminal**

**Sodegaura LNG Terminal**

**Negishi LNG Terminal**

- **TG’s Pipe line**
- **Other company’s Pipe line**
- **TG’s supply area**
- **TG’s group supply area**
- **Other company’s supply area**
## 2. Overview of the Hitachi LNG Terminal

<table>
<thead>
<tr>
<th>A way to supply Gas</th>
<th>Gas transmission</th>
<th>Pipe line</th>
<th>Metropolitan area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid delivery</td>
<td>Iorry</td>
<td>Remote location</td>
<td></td>
</tr>
<tr>
<td>Ship</td>
<td></td>
<td>All over Japan</td>
<td></td>
</tr>
</tbody>
</table>

### Handling LNG

Conventional LNG and unconventional LNG (e.g., CBM) are acceptable.
2. Overview of the Hitachi LNG Terminal

A bird’s eye view
## 2. Overview of the Hitachi LNG Terminal

### Terminal Capacity

<table>
<thead>
<tr>
<th>Item</th>
<th>Final form</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capacity</strong></td>
<td></td>
</tr>
<tr>
<td>Gas transmission</td>
<td>2.2 MTPA (2900 million m³/year)</td>
</tr>
<tr>
<td>Liquid delivery</td>
<td>1 MTPA (1270 million m³/year)</td>
</tr>
<tr>
<td>Total</td>
<td>3.2 MTPA (4160 million m³/year)</td>
</tr>
<tr>
<td>Maximum gas delivery</td>
<td>500 t/h (659,000 Nm³/hour)</td>
</tr>
<tr>
<td>Gas calories</td>
<td>45 MJ/Nm³</td>
</tr>
<tr>
<td>Maximum ship capacity</td>
<td>LNG: 177,000 m³</td>
</tr>
<tr>
<td></td>
<td>LPG: 80,000 m³</td>
</tr>
</tbody>
</table>
2. Overview of the Hitachi LNG Terminal

Process Flow
2. Overview of the Hitachi LNG Terminal

Process Flow
2. Overview of the Hitachi LNG Terminal

Process Flow

- LNG tank
- LPG tank
- LNG BOG
- LPG BOG
- Recondenser system
- Flare stack
- LPGBOG suppression system
- Vent stack
- Medium pressure LNG BOG comp
- High pressure LNG BOG comp
- Supply gas
- LPG HP
- LNG HP
- ORV
- LNG Line
- LPG Line
- Gas Line
- ODORIZATION

LPG receiving facility
LNG receiving facility
LNG shipping
By domestic ships
LNG tank lorry
shipment
LPG RGB
LNG RGB
Pipe line
LNG receiving facility
2. Overview of the Hitachi LNG Terminal

Process Flow

- Necessary to absorb seasonal and hourly fluctuation on the terminal side
  ⇒ Minimum send out requirement is severe
2. Overview of the Hitachi LNG Terminal

Process Flow

- LNG tank
- LPG tank
- LNG Line
- LPG Line
- Gas Line
- LPG receiving facility
- LNG receiving facility
- LNG shipping
  - By domestic ships
  - LNG RGB
  - LPG RGB
  - LNG HP
  - LPG HP
- ORV
- Medium pressure LNG BOG comp
- High pressure LNG BOG comp
- Flare stack
- LPGBOG suppression system
- Vent stack
- Supply gas
- Odorization
- Pipe line
### 2. Overview of the Hitachi LNG Terminal

#### Master Schedule

<table>
<thead>
<tr>
<th>Milestone</th>
<th>FY2012</th>
<th>FY2013</th>
<th>FY2014</th>
<th>FY2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparatory work</td>
<td>▼ Land acquisition and commencement of construction</td>
<td>Site preparation</td>
<td>Commence operations</td>
<td></td>
</tr>
<tr>
<td>Offshore work</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land work</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commissioning</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

- Started construction of the terminal in last July
- Scheduled to start operation in fiscal 2015
- Construction period is about three and half years
2. Overview of the Hitachi LNG Terminal

Feature of the Hitachi LNG Terminal

- World's largest above ground LNG tank
- Energy saving
- LNG shipment
- Improvement of reliability
# 3. Feature of Hitachi LNG terminal

## World's largest above ground LNG tank

### Main Specifications

<table>
<thead>
<tr>
<th>Liquid to be Contents</th>
<th>LNG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Capacity</td>
<td>230,000m³</td>
</tr>
<tr>
<td>Inner Diameter</td>
<td>86m</td>
</tr>
<tr>
<td>Maximum Liquid Depth</td>
<td>40m</td>
</tr>
</tbody>
</table>

![Construction of the tank](image)

- Inner Tank
- Insulation
- Outer Tank
- PC Liquid Protective Barrier
3. Feature of Hitachi LNG terminal

Energy saving

- Process to pre-cool BOG can keep the LNG BOG condensing rate at a low level
  ⇒ Minimum send out restriction can be mitigated
3. Feature of Hitachi LNG terminal

Energy saving

- Make maximum use of cryogenic energy of LNG
- Simple and low running costs

LPG BOG Suppression System
3. Feature of Hitachi LNG terminal

LNG shipment (Lorry shipment system)

- Process simulation
- High filling rate test

<table>
<thead>
<tr>
<th></th>
<th>Conventional design</th>
<th>Hitachi LNG terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filling rate</td>
<td>100%</td>
<td>130%</td>
</tr>
<tr>
<td>Number of lorry truck lane</td>
<td>100%</td>
<td>70%</td>
</tr>
</tbody>
</table>

- System availability has improved utilizing TG’s Profound knowledge
- Effective use of land has been promoted
3. Feature of Hitachi LNG terminal

Improvement of reliability

- Process control system utilizing TG’s profound knowledge

- Alarm management methods
  - Select important alarms using operation & maintenance knowledge
  - Display the important alarms at the top of an alarm list when a large amount of alarms generate
  ⇒ Avoid operation mistakes

- Simulator system
  - Build a high precision simulator system utilizing operation knowledge
  - Design process control system by this simulator system
  ⇒ Build a high reliability process control system
Tokyo gas is constructing the new LNG terminal, Hitachi LNG terminal, in predicting a further increase in the demand for gas.

Hitachi LNG terminal is strategic and competitive LNG terminal utilizing TG’s knowledge over 40 plus years of experience.
Thank you for your kind attention