The trend toward larger plants and facilities, combined with efforts to cut fuel costs and CO₂ emissions, has stimulated demand for thin yet high-strength and easy-to-weld steel plates for use as basic construction materials. Heat treatment is critical to the manufacturing of high-strength steel plates and traditionally has been performed using gas furnaces. To date, however, the productivity of heat treatment has been approximately less than 1/20th that of hot rolling. As such, heat treatment was a barrier retarding the drive to improve the productivity of high-strength steel plates.

JFE Steel took up the challenge of developing a continuous, highly efficient heat treatment process, the dream of every engineer involved in the manufacturing of steel plates.

The greatest technical challenge in developing a continuous, highly efficient heating process was designing a high-efficiency facility that was as small as possible yet capable of processing steel plates at a level comparable to the hot rolling process. The solution, developed after much trial and error, is an extremely space-efficient induction heating unit capable of a heating rate 70 times faster than the traditional gas furnace.

The unit works according to the same principle employed in household electromagnetic cooktops. A steel plate is passed through a super-large electromagnetic coil and a current is applied to the coil, generating a magnetic field that heats the plate. This technology allows for shorter heating times, taking only 1 minute to reach 650°C and yielding an energy efficiency rate of 90% compared to 70 minutes and 25%, respectively, for the conventional method.

In January 2009, the Japan Society for the Promotion of Machine Industry presented JFE with its top prize, the Minister of Economy, Trade and Industry Prize at the 6th Promoting Machine Industry Awards for its HOP, or Heat-treatment On-line Process, for steel plates. HOP won high marks for uniqueness, innovation and economy. The event marked the first time that the Japan Society for the Promotion of Machine Industry recognized the JFE Group—not to mention the steelmaking industry—with this particular award.

HOP Heating Rate

<table>
<thead>
<tr>
<th>°C/min.</th>
<th>Gas furnace</th>
<th>HOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>650°C/min.</td>
<td>70X</td>
</tr>
<tr>
<td>40</td>
<td>650°C/min.</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>650°C/min.</td>
<td></td>
</tr>
</tbody>
</table>

HOP Energy Efficiency

<table>
<thead>
<tr>
<th>%</th>
<th>Gas furnace</th>
<th>HOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>650°C/min.</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>650°C/min.</td>
<td></td>
</tr>
<tr>
<td>3X</td>
<td>650°C/min.</td>
<td></td>
</tr>
</tbody>
</table>

Steel plates, JFE Steel’s signature product, are used for a wide variety of structures, including gas storage tanks, natural gas pipelines and machinery for construction and industrial use. JFE Steel was the first company in the world to develop and put to practical use processes for continuous steel plate manufacturing ("Super-OLAC" and "HOP"). Uniquely, even heat treatment is conducted continuously. In recognition of the vast improvements in productivity, energy-efficiency and delivery times realized by HOP, JFE Steel was honored with the highest award in the “2008 Prize for Promoting Machine Industry” by the Japan Society for the Promotion of Machine Industry.
Many hurdles stood in the way of the development, but project members with expertise in fields like process and temperature control technology, material research and electronics acted swiftly and flexibly to solve problems one by one. Their diligent efforts paid off when the world’s first Heat-treatment On-line Process (HOP) for steel plates was realized in 2003. HOP is notable for its ability to heat plates as wide as 4.5 m and synchronize with hot rolling lines. This new technology enables mass production and stable supply of high-performance steel plates.

JFE Steel’s HOP technology uses a new approach to heating that yields significant energy savings and represents a meaningful step forward in preventing global warming. Furthermore, because the HOP process produces high-strength steel plates, customers can reduce their total steel consumption and reduce the weight of vehicles and machinery for construction sites, promoting energy efficiency and reducing CO₂ emissions.

HOP technology has also made possible a series of Only One and Number One products with greatly increased product value. Demand for environmentally friendly, high-performance JFE steel plates has risen rapidly in recent years. The numbers attest to the success of HOP technology: as of April 2009, JFE Steel has produced 500,000 tons of mainly tank, pipeline, and industrial machinery products using this process.

Looking ahead, JFE Steel will continue to deliver new value to customers and other stakeholders through its Only One and Number One technologies and products.

Examples of Only One Products Developed with Super-OLAC and HOP Technologies

- **JFE-HIPER** — quake-resistant line pipe products
  A new conceptual line pipe product “JFE-HIPER” is highly resistant to the localized wrinkling that can result from extraordinary axial and bending forces imposed by earthquakes and other phenomena, and is suitable for use in long-distance pipelines. Winner of the Iwatani Naoji Memorial Award (March 2008).

- **JFE-HYD960LE and JFE-HYD1100LE** — ultra-high-strength steel plate for use in construction and industrial machinery
  JFE-HYD960LE and JFE-HYD1100LE are the first steel plate products to offer both ultra-high strength and exceptional fracture-resistance (toughness) and are perfect for use in construction and industrial machinery. Winners of the Japan Institute of Metals Technology Development Prize (September 2008).
The JFE Group

JFE Holdings, Inc., Headquarters of the JFE Group

The JFE Group is comprised of operating companies pursuing business activities under a holding company, JFE Holdings, Inc.

As the holding company, JFE Holdings stands at the center of the Group’s integrated governance system. The Company functions as the head office responsible for group-wide strategic functions, risk management, and accountability to the public.

JFE Steel Corporation

JFE Steel is an integrated steel producer ranked second in Japan in crude steel production. The company is highly competitive internationally, thanks to the respective strengths of its two major steelworks—one in eastern Japan and another in western Japan. JFE Steel produces and sells a wide range of high-value-added products and Only One and Number One products, taking advantage of its world-class technology and product development capabilities.

JFE Engineering Corporation

JFE Engineering provides high-tech solutions related to energy (pipelines and LNG plants), the environment (urban environmental plants, water/wastewater systems, biomass applications, etc.), steel structures (bridges, steel frames, etc.), and systems planning (industrial machinery, logistics, etc.).

JFE Urban Development Corporation

JFE Urban Development redevelops dormant properties, mainly condominiums and improves the effective use and value of the properties owned by the Group.

Universal Shipbuilding Corporation

Universal Shipbuilding has five shipyards and one technical research center. The shipyards construct and recondition large merchant ships, such as tankers; naval ships, such as escort vessels and mine-sweepers; and icebreakers. Through its thorough marketing activities, the company contributes to industry and society by quickly developing and building ships that satisfy customers.

Kawasaki Microelectronics, Inc.

Kawasaki Microelectronics is an LSI vendor. The company specializes in high-performance, high-value-added Application Specific Integrated Circuits (ASICs). Its strength is in ASICs for LCD panels, and it has a substantial market share worldwide.