Scope

Kawasaki Heavy Industries Quarterly Newsletter

July 2009
NO.80

Kawasaki

Kawasaki Heavy Industries
Scope Quarterly Newsletter
No. 80 July 2009

in this issue...

Frontline — 2
JJSBA Jet Ski Championships Heat up Summer

Technology at Work — 6
The Shape of Things to Come: Inside the Head of the APORO-Cutter Shield Tunneling Machine

Around the World — 8
- Tests Prove Green Gas Engine a Top Performer
- State-of-the-Art Waste Treatment Plant Delivered
- New Wheel Loaders Released
- First Gas Turbine Generator System for Offshore Platform Ordered
- Vertical Axis Wind Power Generation System Delivered to NIPR
- Two New Marine Vessels Ready for Service
- Milestone Reached with 100th M7 Gas Turbine
- Satoshi Hasegawa Takes Helm

About the Cover
Kawasaki's Jet Ski STX-15S watercraft hurtles through the waves in bright sunshine. Builte exclusively for racing, this latest model is lightweight with a minimum of equipment.

KAWASAKI HEAVY INDUSTRIES, LTD.

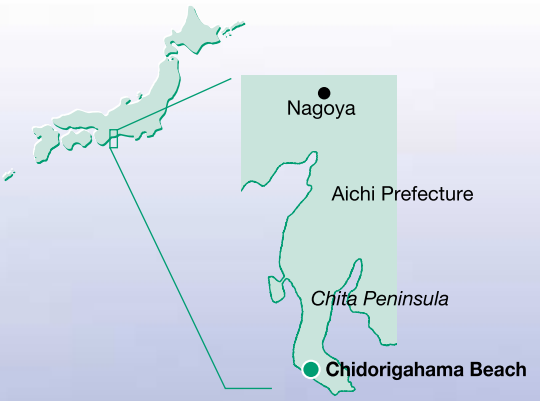
Scope

Editor-in-Chief: Kosei Nishino
Public Relations Department
World Trade Center Bldg., 4-1
Hamamatsu-cho 2-chome, Minato-ku
Tokyo 105-6116, Japan
Phone: 81-3-3435-2132
Fax: 81-3-3432-4759
URL: http://www.khi.co.jp

JJSBA Jet Ski Cha Heat up Summer

If you're someone who seeks the thrill of slicing through waves like a red-hot knife through butter, then Kawasaki's Jet Ski® watercraft just might be exactly what you're looking for. Jet skiing is a popular water sport enjoyed the world over, and Kawasaki hosts amateur racing events that promote safe, fun and unique ways to ride the personal watercraft. The Jet Ski is powered by an engine that drives a pump to propel the craft forward by water-jet thrust.

In May, enthusiasts from all over Japan descended on Chidorigahama Beach to compete against one another in races of speed and skill under the aegis of the Japanese Jet Ski Boating Association (JJSBA). The event signaled the beginning of the nation's watersports season.



mpionships

Speed and Skill Are What Jet Skis Are All About
200 Jet Skiers Race in First Round of JJSBA Tourney

● Bringing Together Aficionados

With the help of the pit crew, the riders stand by their machines and position their crafts on the starting line. Then comes the signal to start their engines. The water kicks up a storm as the roar of the engines drowns out the sound of the waves crashing against the shoreline. The riders are given the start signal, and everyone takes off at full throttle.

As their machines surf the waves, the riders skillfully navigate around the marker buoys in an attempt to outpace and outmaneuver the competition. Leaping over the waves like porpoises, the sleek machines glide along the straightaway at top speed, slashing into the surf as they skillfully negotiate each buoy. The race heats up and the excitement of the cheering fans on the beach reaches fever pitch as they hear the announcer deliver a running account of all the action in the water. The 200-odd diehard jet skiers who have come from every corner of Japan to deliver a championship performance do not disappoint the crowd.

● Safe, Exciting, Fun

The first round of the JJSBA championship was held on May 30 and 31 at Chidorigahama Beach, located at the tip of the Chita Peninsula in Aichi Prefecture. The JJSBA-sponsored tournament is an annual series of racing events for amateur jet skiers that has been held for the last 26 years. The championship provides a great opportunity for aficionados to show off the skills they have acquired through hours and hours of practice. It also provides a venue for promoting riding safety, etiquette and the "rules of the road." The JJSBA Championship is held under a banner proclaiming Jet Skiing to be "Safe, Exciting and Fun."

Each machine must go through JJSBA's stringent check before and after the race. All riders are required to hold an exclusive driving license for

About the JJSBA

The Japan Jet Ski Boating Association (JJSBA) was established in 1984 to promote water sports for Kawasaki Jet Ski riders. Today the JJSBA has 850 individual members, 35 affiliated teams, and 37 corporate and associate members from Jet Ski dealerships and related companies. Thanks to the support of this broad membership network, the JJSBA is able to sponsor a wide range of activities.

Complimentary enrollment in the Kawasaki Riders Club, also known as the Kawasaki Amusing Zone for Everybody (or KAZE, which also means "wind" in Japanese), has been an automatic benefit of JJSBA membership since 1992. The group offers members a wide range of opportunities to enjoy jet skiing, from competitive racing to fun-filled events sponsored by KAZE. Since 2007 the JJSBA has been hosting racing events jointly with local partner organizations throughout Japan, guided by the concept "Fun to Watch, Fun to Race."

Rounding the marker buoy.

Jet skis leaping over the waves like porpoises.

personal watercraft. A practice run involving all participating riders ensures that their machines are in racing condition. The riders' gear, including life jackets and helmets, are also checked.

A Feeling Like No Other

The JJSBA Championship includes a wide range of racing categories, including the Ski, Women, X-2 and Runabout classes. Each category is divided into Class A (expert riders), Class B (beginner to intermediate) and Class N (beginner). There are also three racing class divisions based on modifications made to the machines. The preliminary, consolation, semifinal and final races, added up to a total of 57 heats held during the two-day event.

The main objective of the event is for everyone to have a good time. The championship is designed to allow more riders to participate in more races, like the consolation race for those who didn't place in the preliminaries.

One of the riders, Masatsugu Suzuki, is an owner of a local Jet Ski dealership and the Snapper Racing Team leader. He has competed in the championship for the last 20 years and come in second and third in the past. This year Suzuki raced in the Division B Ski Stock Class competition (for the traditional one-person stand-up 800SX-R model fitted with a normal engine). He finished third in the preliminary and fourth in the semifinal, but unfortunately didn't make it into the top ten in the final.

"At first, jet skiing took a lot of hard work," says Suzuki, "but the more effort I put into it, the more I started to enjoy it. Now I'm hooked. The greatest thing about jet skiing is that exhilarating feeling you get when riding like the wind over the water. It's a great feeling like no other in the world. The fact that you can enjoy jet skiing no matter how old you are also makes it a uniquely wonderful activity." The championship demonstrates that you are never too old for jet skiing, with a Masters Class for those 40 and up, where riders who are young at heart can put their skills to the test.

Masatsugu Suzuki, a veteran jet skier, has competed in the Championship for the last 20 years in a row.

The tower signals the start of the race and serves as the finish line. Racers get the checkered flag as they cross the finish line.

Six Rounds of Heated Races

The racing continues at an even keel throughout the two-day event and then things really heat up as the final race kicks off on the second afternoon of the second day. The wind and surf have started to pick up a little, adding to the challenge of the course. Some riders find it difficult maneuvering through the choppy waters and tumble from their machines when trying to make it around the buoys. Suddenly the announcer yells out, "No. 35 seems to have fallen into the water while rounding buoy No. 25. Yes, he's definitely in the water! No. 18 moves up to take the lead, with No. 5 not far behind!"

Jet skiers from around Japan show off their machines under tents in a palette of colors.

Everyone on Suzuki's Snapper Racing Team put in 100% effort.

Emotion-packed victory ceremony. For many, racing is a family affair.

Thrilling dead heat.

Jet skiing is a team sport, so the teammates move the machine together.

At a little after 4 p.m. the races are all over. The two-day event is capped off with an emotion-packed awards ceremony. The winners from each race class step up to the podium, where they are bestowed with a winner's plaque and gifts from the JJSBA before being swept away by a tidal wave of joyful team members and fans.

Thanks to the help of the local tourist association, fishermen's unions and many other supporters, the big racing event scored a huge victory. The championships will continue until the sixth round, with more thrilling races to be held in different locations across Japan. It looks like summer is going to get a lot hotter.

Elated winners step up to the podium.

Latest Jet Ski Most Powerful on Planet

Kawasaki's new Jet Ski Ultra 260X reclaimed the title as the most powerful production PWC (personal watercraft) sold in the U.S. Only two years after shattering records with the supercharged, intercooled Ultra 250X, Kawasaki engineers have boosted the 1,498cc engine's output by 10* horsepower in the new model.

Increased compression ratio, new high-lift cams and revised ignition timing help raise the horsepower, as do a new impeller to translate the enhanced power into thrust. The new Ultra 260X can accelerate harder than ever, producing power comparable to a normally aspirated high-performance engine twice its size.

Unlike centrifugal superchargers or turbochargers, the high-volume, direct-drive, Roots-type supercharger force-feeds the engine 2 liters of air with every revolution, providing a stable supply of high-pressure air at all rpm, from idle through redline. This produces a smooth, linear torque curve that is perfect for accelerating this Jet Ski watercraft hard, all the way from a standstill through its breath-taking top-end.

In addition to more power and acceleration than any other production PWC on the planet, the Ultra 260X also boasts a race-developed hull. The fiberglass-reinforced plastic (FRP) hull is loaded with DNA from Kawasaki's International Jet Sports Boating Association (IJSBA) championship-winning machines. The seaworthy design is just as comfortable in rough conditions as in calm, even at high speeds.

*Horsepower measured in PS at the crankshaft under controlled conditions. Actual performance may vary.

The Shape of Things to Come: Inside the Head of the APORO-Cutter Shield Tunneling Machine

Enabling a Variety of Tunnel Shapes

Just as a mole burrows through the earth using its teeth, the large rotary cutter on the head of a shield machine excavates soil by "chewing" and spinning as the body of the machine moves forward. While these machines have been used mainly to dig tunnels with circular cross-sections, today's subway tunnels and public utility conduits require a variety of cross-sectional shapes. With reduced cross-sectional surface areas, excavation work is also reduced. What was needed was a machine that could make construction work more efficient and make avoiding underground obstacles much easier.

Kawasaki and Kajima Corporation have now developed a revolutionary new shield tunneling method that harnesses the power of their jointly developed shield machine, the APORO-Cutter. This innovative machine can be used to construct tunnels with virtually any cross-sectional shape, including circular, rectangular, oval and horseshoe shapes. It also employs a unique cutting mechanism that enables it to easily bore through hard soil.

A Perfect Figure Eight

The APORO-Cutter (short for All Potential Rotary Cutter)* was specifically developed for the construction of an underground double-railway track section in Tokyo. The biggest challenge of the project was circumventing the maze of rivers, private property, sewage pipes and existing tunnels that already crisscrossed the area. The double-track section also had to be excavated with just a single shield machine. The job required the development of a new machine with a complex figure-eight cross-sectional shape. Adding to the list of challenges was the fact that a large section of the area to be excavated consisted mainly of consolidated silt, a hard soil that wouldn't make the job any easier.

Leveraging their expertise, the Kawasaki and Kajima engineers developed a unique twin-headed shield machine that is now at work on construction of the new rail tunnel.

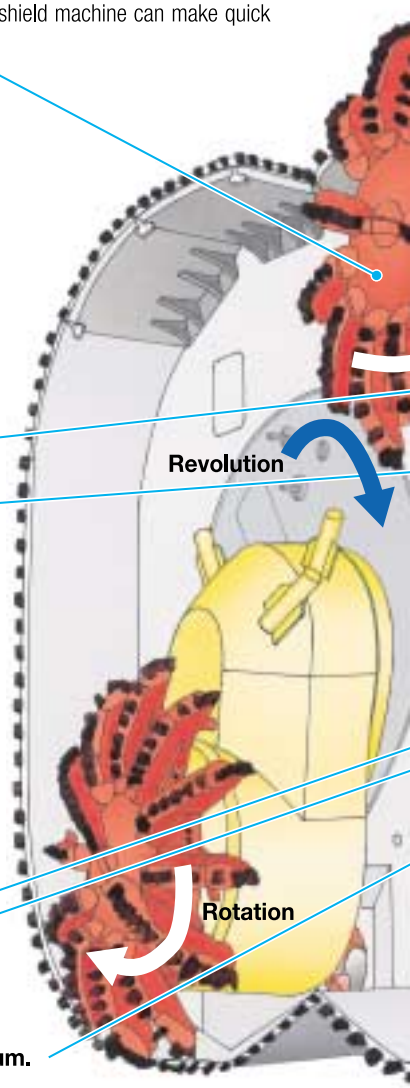
The APORO-Cutter has been turning heads across the industry. One of the things that makes this new shield machine so amazing is its ability to excavate virtually any cross-sectional shape as well as to tunnel through hard soil. Inquiries have been flooding in from around the world since the machine was first launched.

* A patent for the APORO-Cutter has been filed jointly by Kawasaki and Kajima.

Cutter head

Outfitted with abrasion-resistant hard metal cutter bits, the cutter head digs away at the underground soil. Each cutter head rotates at a high speed (4.7 rpm), about three times faster than a conventional head, so the shield machine can make quick work of tunneling through even hard soil.

Cutter heads rotate as they turn on the revolving drum.



Seven hydraulic motors drive the cutter head.

Swing frame

Innovative cutter mechanism

The cutter section, illustrated here, is comprised of a cutter head, a revolving drum that controls the cutter head position, and a swing frame. The cutter head is designed to rotate quickly and excavates the soil. The revolving drum and swing frame move simultaneously in a set pattern that enables the rapidly spinning cutter head to revolve at a low speed and cut away the exact cross-sectional shape desired.

Seven hydraulic motors drive the swing frame.

Revolving drum

Six electric motors drive the revolving drum.

Nothing Stops the APORO-Cutter

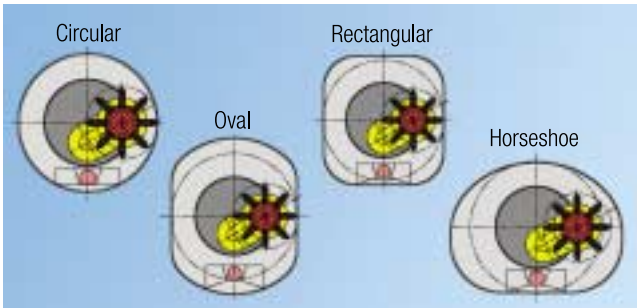
The high-speed rotating cutter head, which has been engineered to turn in only one direction, is fitted with specially designed cutter bits. The shape and arrangement of these cutter bits have been optimized through repeated simulations and tests. This optimal configuration enables the APORO-Cutter to bore through hard soil and underground obstacles such as wooden construction stakes.

Screw conveyor

The screw conveyor carries excavated soil out of the tunnel.

Soil intake

Excavated soil is carried away via a screw conveyor for removal.



Cross-sectional Shapes Made Possible by the APORO-Cutter

Underground Double-Track Project

(Contractor: Consortium consisting of Kajima, Nishimatsu Construction and Tekken Corporation)

This is an illustration of the double-head shield machine used in the underground double-track construction project in Tokyo. Measuring 7.44 m in height, 10.64 m in width and 8.95 m in length, it can excavate about 3 cm of soil per minute. The shield machine went into operation in April 2009. The entire stretch of 507 m is scheduled to be completed in less than a year.

Precise Tunnel Face Management

Conditions at the excavated face of a tunnel must be carefully managed in order to minimize the impact on above ground. The APORO-Cutter ensures precision control of the tunnel face due to the low-speed cutter head movement. Kawasaki worked with Kawaju Techno Service to develop an accurate way to control the trajectory of the cutter head. The general-purpose high-speed controller (1MZ) developed by Kawasaki's Corporate Technology Division gives operators precise trajectory control to within a 10 mm margin of error.

Rotary joint

Articulated jack
The articulated jack is used to bend the front section of the shield machine. The mechanism makes excavating curved tunnels easier than ever.

Front section

Rear section

Soil discharge

Soil

Erector
The erector is a device that assembles the segment blocks that line the tunnel.

Shield jack
The shield jacks propel the machine forward by pushing against the precast segments used to line the tunnel walls.

Segments
The shield tunneling technique uses precast steel or ferroconcrete reinforcing segments to line the tunnel walls. This illustration depicts segments formed by the APORO-Cutter in excavating the figure eight cross-section of the double-track tunnel. The shape is radically different from the segments used in a circular tunnel. These concrete segments form a permanent structure that supports the tunnel. It is also reinforced with supporting columns built along the center of the tunnel in 1.1-meter intervals as the shield machine bores through the ground. The machine can excavate the double-track tunnel's large cross-sectional diameter in one fell swoop.

Tail grout seal
The tail grout seal prevents underground water from seeping through the joints between the segment surface and the tail skin plate and into the shield machine.

Tests Prove Green Gas Engine a Top Performer

Kawasaki recently completed testing of its proprietary Green Gas Engine at a demonstration power plant at Joetsu Energy Service in Joetsu City, Niigata Prefecture. The engine operated flawlessly through 4,000 hours during the one-year testing program, demonstrating superior electrical efficiency and environmental performance, as well as ease of maintenance and reliability—the key goals of the demonstration program.

The plant is operating with the largest Green Gas Engine model. Since plant startup at the end of December 2007, the engine has maintained the world's highest electrical efficiency for grid-connected operations in spite of seasonal atmospheric fluctuations. It reduces fuel costs by more than 5% compared with conventional gas engines in the same class, and thanks to its low NOx emissions, eliminates the need for NOx-reduction equipment in most areas of Japan.

The Green Gas Engine boasts a world record-breaking electric efficiency of 48.5% and the world's lowest NOx emissions levels, with 160 ppm at 0% O2. The engine is available in four different combinations, including 12, 14, 16 or 18 cylinders, with outputs ranging from 5.0 to 7.8 MW, to meet a variety of needs.

The demonstration plant continues to operate simultaneously as Joetsu Energy Service's commercial power plant.

State-of-the-Art Waste Treatment Plant Delivered

Kawasaki Plant Systems, Ltd. recently delivered a waste treatment plant to the city of Hirakata, Osaka Prefecture, consisting of a proprietary cutting-edge stoker-type incinerator and fuel-ash melting system. In an effort to create the greenest plant in the world, the components have been designed to leave a minimum footprint on the environment.

The plant is also equipped with a steam turbine power generator that utilizes waste heat to supply the power that operates plant facilities.

Technological features of the stoker-type incinerator include:
(1) Parallel Flow Stoker-Type Incinerator
The furnace shape allows the flame to flow parallel to the direction in which refuse is incinerated, facilitating complete combustion with less air (or at a lower air ratio) and reducing more combustibles in the bottom ash compared with conventional incinerators.
(2) Water-Cooled Grate
The water cooling system for the grates that feed refuse at high temperatures improves the durability of the incinerator.

The plant not only meets strict standards for dioxins, exhaust gas, effluent emissions, fly ash leachate and slag, but also employs the above technologies to reduce emissions of soot/dust, hydrogen chloride and sulfur oxide.

This plant is the 161st waste incineration system delivered by Kawasaki, and leverages technologies and expertise developed for more than 40 years.

New Wheel Loaders Released

Two new top-performance wheel loaders were recently released by KCM Corporation: a 135ZV-2 model equipped with an ultra-heavy-duty 9.7 m^3 bucket, and a 92ZV-2 model with a heavy-duty 4.6 m^3 bucket. Both loaders boast the same great cutting-edge technologies that have earned high marks for previous models, along with outstanding new features.

The 92ZV-2 employs a 10.8-liter, 6-cylinder Cummins engine with a maximum output of 209 kW. This clean-running engine is certified as being fully compliant with the latest European and US emissions standards. The 92ZV-2 is designed to deliver optimum fuel efficiency, along with lots of power and torque. Its other features include the Efficient Loading System (ELS), which reduces fuel consumption while enhancing productivity, an idle management system for faster warm-ups and lower extended idle speeds, a Fuel Efficient (FE) mode that allows the operator to select the most efficient power setting for the job, and the Machine Operation Diagnostic Module (MODM), which provides diagnostic information for more efficient maintenance and troubleshooting.

The 135ZV-2 is fitted with a 30-liter V-shaped 12-cylinder engine with a maximum output of 537 kW (730 PS), which maximizes productivity. It features the ELS as well as the Adjustable Declutch System (ADS), which allows the operator to adjust the declutch position on the brake pedal. It is also equipped with the MODM.

Thanks to these new innovations, both new wheel loaders deliver significantly enhanced operability, durability and reliability.

135ZV-2

92ZV-2

First Gas Turbine Generator System for Offshore Platform Ordered

Kawasaki recently received an order for a gas turbine power generation system from Japex Offshore Ltd., a subsidiary of Japan Petroleum Exploration Co., Ltd. The system will be used on an offshore gas pressure booster platform to be built in the Iwafune-oki oil-and-gas field. This milestone order marks the first time that a Kawasaki gas turbine generator will meet the challenges presented by the severe environmental conditions of an offshore oil-gas exploration platform.

Production and development of crude oil and natural gas is already underway in the Iwafune-oki oil and gas field, located about 30 km northeast of the coastal city of Niigata. The Iwafune-oki is Japan's only offshore oil-gas field.

The GPB gas turbine generator is a lightweight, compact power-generation system equipped with two of Kawasaki's proprietary M1A-13 gas turbines. It is scheduled to be put into operation on the Japex platform in March 2011.

The M1A-13 gas turbine is one of Kawasaki's flagship products. Since its launch in 1989, 420 units of the turbine have been produced. This latest order is testament to the proven track record and reliability of Kawasaki's gas turbine generators. The company is actively forging inroads into the oil-and-gas market with these innovative turbines.

Vertical Axis Wind Power Generation System Delivered to NIPR

Nippi Corporation, a Kawasaki subsidiary, recently delivered a 20 kW vertical-axis wind power generating system to the National Institute of Polar Research (NIPR), marking the company's entry into the burgeoning wind-power market.

The system was installed on a site in Nikaho, Akita Prefecture, adjacent to the Nikaho Highland Wind Farm. NIPR will conduct a series of tests on it prior to installing wind power generators at the Showa Station in Antarctica. This is part of NIPR's environmental initiative aimed at promoting the use of renewable energy sources as an alternative to fossil fuels.

Nippi leveraged its wealth of technological expertise in aircraft design and manufacturing to develop the vertical axis wind power generation system. Its compact design makes it perfect for installation in urban environments, including building rooftops, parks, parking lots and harbors.

The system features:
Blades that do not need to be positioned towards the direction of the wind, eliminating loss in efficiency due to variable wind directions.

A simple mechanism designed to enhance reliability and a vertical-axis wind turbine that makes it possible to place the generator close to the ground for easy access and maintenance.

Airfoils that rotate at low speeds to assure that the system is quiet.

Nippi is working to power the future with sustainable energy and to deploy technologies and products that tap renewable energy sources, thus reducing greenhouse gas emissions and making more efficient use of the Earth's resources.

Two New Marine Vessels Ready for Service

Kawasaki Shipbuilding Corporation launched the *Komatsushima Star* bulk carrier on March 31 from Kobe Shipyard and delivered the *Energy Confidence* LNG carrier on May 1.

The bulk carrier, identified as Kawasaki hull No. 1615 and the 26th 55,100 DWT bulk carrier developed by Kawasaki Shipbuilding, was launched to Panama-based Lua Line S.A. The 189.9 m vessel has a flush deck with forecastle and five holds that are designed for optimum transport of grains, coals, ores and steel products. A new proprietary bow designed to reduce wave resistance allows the ship to operate with less fuel. Four 30-ton deck cranes are installed in the center in between hatch covers to enable cargo loading and unloading in ports where no cargo handling facilities are available.

The 289.53 m LNG carrier was delivered to Tokyo LNG Tanker Co., Ltd. and Nippon Yusen Kabushiki Kaisha. The vessel, identified as Kawasaki Hull No. 1611, is the second in Kawasaki's new line of 153,000 m^3 LNG carriers. While its capacity has been increased by about 8,000 m^3 due to the installation of a 2 m tall cylindrical extension at the midsection of the aft tanks, the hull is the same size as that of a 145,000 m^3 LNG carrier, making it able to enter most major LNG terminals around the world.

The vessel features excellent thermal insulation performance owing to the Kawasaki Panel System, which achieves a boil-off rate of 0.1 percent per day, double-hull and double-bottom protection, a computer-controlled navigation system in the wheelhouse to improve operability as well as a 360° view window that enables one-man navigation.

Komatsushima Star

Energy Confidence

Milestone Reached with 100th M7 Gas Turbine

Kawasaki recently produced its 100th M7 series gas turbine unit, a 6-to-8 MW class industrial model that was developed entirely in house. The milestone achievement marks an industry first in Japan.

Kawasaki began developing industrial gas turbines back in 1972, and today, makes gas turbines for standby generators, cogeneration systems and more. In 1994, Kawasaki delivered the M7A-01, the first model in the M7 series. The wealth of technological expertise gained over the ongoing course of developing the series has been fully incorporated into the L20A, Kawasaki's top-of-the-line 20 MW gas turbine.

Kawasaki has continued to pioneer unique innovations to enhance the performance of its M7 gas turbines, including the environmentally friendly low-NOx DLE (dry low emission) system and the flexible heat and power gas turbine (PLUS model) which can swiftly adjust to changes in thermal and electric load demand.

An increasing number of customers have discovered that these turbines are the solution to their energy efficiency and environmental performance problems. The M7 series has earned the confidence of customers everywhere with an expanded product line offering a wider range of outputs, increased efficiency that conserves energy and cuts CO_2 emissions, as well as a number of enhanced features. All these advantages are backed up by a superior reliability that's driven by innovative thinking and excellent post-sale services and support. Today Kawasaki's 100 M7 gas turbines are hard at work in a wide range of areas applications around the world, in the chemical, electronics, pulp and paper, and food processing industries.

Satoshi Hasegawa Takes Helm

Following the election of ten directors at the June 25 Shareholders' Meeting, the Board of Directors appointed the former senior executive vice president, Satoshi Hasegawa, to lead the entire Kawasaki Group as its new president. Additionally, it appointed the former president, Tadaharu Ohashi, as its new chairman. The Board also appointed four of its new directors, Yuichi Asano, Nobumitsu Kambayashi, Kyohei Matsuoka and Hiroshi Takata, as senior vice presidents. On the same day, former Kawasaki Chairman Masamoto Tazaki retired from his position as director and became a counselor, while retiring directors Akira Matsuzaki and Shinichi Tamba were named advisors.

As of April 1, Shuji Mihara and Masashi Segawa who had previously served as senior vice presidents became senior executive vice presidents.

Satoshi Hasegawa
President

Shuji Mihara
Senior Executive Vice President

Masashi Segawa
Senior Executive Vice President

Yuichi Asano
Senior Vice President

Nobumitsu Kambayashi
Senior Vice President

Kyohei Matsuoka
Senior Vice President

Hiroshi Takata
Senior Vice President

KCM develops and implements state-of-the-art technologies for wheel loaders, targeting the top position in the wheel loader market. As a core member of the Kawasaki Group, KCM contributes to the future of the earth and the environment.

KCM Corporation

http://www.khi.co.jp/kenki/

Kawasaki