

# Scope

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in this issue...

Frontline — 2  
Sky-High Expectations for Japan's  
P-X and C-X Aircraft

Technology at Work — 6  
Get Up Close to the MINEBULL  
A Landmine-eating Beast

- Around the World — 8
- H-IIA Launch Vehicle Fairing Delivered
  - VLCC Takahashi Delivered
  - Woody Biomass Power Project Testing Begins
  - Samsung Techwin Doubles Gas Turbine Generator Order
  - Blue-Collar Humanoid Robot Developed
  - 12-MW Combined Cycle Power Plant Delivered
  - Gas Compressor Units Ordered for Malaysian Project
  - Tunnel Boring Machine Reaches Seoul
  - Gigacell Battery Brings Wind of Change

About the Cover  
Randy de Puniet racing in the MotoGP World  
Championship Round 15 (Japanese Grand Prix),  
where he finished in 2nd place

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Scope

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# Sky-High Expectations for Japan's P-X and C-X Aircraft

## Kawasaki Soars Ahead with World's First Concurrent Development of Two Models

### ● "MADE PURELY IN JAPAN"

It's 10:30 a.m. on a rainy fourth of July morning and the guests have started to gather at the site of the rollout ceremony for the P-X fixed-wing maritime patrol and C-X transport airplanes to be delivered to the Japanese Ministry of Defense (MOD). The location for this unveiling is the assembly hanger for large-size components at the Kawasaki Gifu Work's South Plant. The approximately six hundred seated guests, including the MOD and government officials as well as representatives of Kawasaki and other companies participating in the joint development project begin to cheer as the brand-new white, red striped P-X and C-X planes make their debut appearance.

Everything is running like clockwork as the master of ceremonies starts things off at 11:50

a.m. on the dot. Following a solemn Shinto ceremony, Kawasaki president, Tadaharu Ohashi, delivers his opening remarks.

"This rollout of the P-X and C-X celebrates an epoch-making project in which two large-scale fixed-wing aircraft models have been developed concurrently. It is unprecedented in the history of Japanese aeronautics and perhaps a world's first. While carrying out this project we rose to the challenge of employing a number of new technologies and systems in the P-X and C-X. We have worked hand in hand with those in the Japanese aircraft industry to develop aircraft that are made purely in Japan. Following the completion of basic designs in June 2003 and manufacturing drawings in November 2005, we put our hearts and souls into building these test planes while conducting related test-

ing. Finally we are here today to rollout the fruits of our labor."

### ● KAWASAKI AWARDED PRIME CONTRACTOR STATUS IN 2001

As part of its April 2001–March 2006 Five-Year Defense Plan, the Japanese Defense Agency (or JDA, which was recently upgraded to the Ministry of Defense) decided on domestically developing the P-X and C-X to replace its aging P-3C and C-1 models.

Kawasaki has developed a well proven track record with the MOD. Part of that track record includes manufacturing and delivering one hundred and seven P-3C (including its derivatives) and thirty one C-1 models. The company made steady R&D efforts and capital investments while consistently providing



The rollout ceremony for the next-generation P-X fixed-wing maritime patrol and C-X transport aircraft (Gifu Works in Kakamigahara, Gifu Prefecture).





The P-X (left) and the C-X (right). Some five and half years were spent developing the #1 test planes, employing the latest technologies and systems.

maintenance for the P-3C and C-1. These efforts combined with Kawasaki's highly evaluated development proposal for the P-X and C-X, including the system and methodology to be employed, are what earned it prime contractor status in late 2001 to domestically develop these aircraft.

It was the first time in almost 30 years, after the development of the C-1 in 1973, that a large-scale aircraft would be developed in Japan. As noted by Ohashi, the concurrent development of the two models is probably the first undertaking of its kind in the world. On top of that, the then JDA had specified cutting costs by using identical body components for both aircraft. In response to this requirement, Kawasaki came up with a plan to use identical windscreens, main wings, horizontal tails and systems.

Since its launch in December 2001, the project has brought together the best in design and manufacturing technologies from Japanese aircraft manufacturers to develop and produce the P-X and C-X.

● **NEW TECHNOLOGIES BOOST PERFORMANCE**

The 38-meter-long P-X has a 35.4 meter wingspan, a tail height of 12.1 meters and a maximum takeoff weight of 79.7 tons. It will replace the Japan Maritime Self-Defense Force's P-3C for use in warning and surveillance along Japan's expansive coastal area starting in 2010.

The P-X employs the fly-by-light (FBL) system with high electromagnetic interference tolerance, which allows communicating flight control commands via fiber optics. It also employs new acoustics and phased array radar

systems with enhanced capabilities for detecting and tracking submarines and suspicious boats. It is equipped with new domestically developed turbo fan engines featuring high fuel efficiency for increased speed.

Boasting a maximum takeoff weight of 120.1 tons, the 43.9-meter-long C-X has a 44.4 meter wingspan and tail height reaching 14.2 meters. It is designed to replace the Japan Air Self-Defense Force's C-1 in 2010 and will be used for providing air transport in emergencies as well as international peace keeping and disaster relief operations.

The C-X's larger body increases its payload by approximately 30 tons over its predecessor, the C-1, which has a payload of approximately 8 tons. Its maximum range of approximately 6,500 kilometers also far surpasses the approximately 1,700 kilometer range of the C-1. The



Gifu Works employees celebrate the rain-soaked rollout

new technologies employed in the C-X include a new tactical flight management system and a head-up display, which enable the pilot to fly at a low altitude in mountainous terrain with much more ease than its predecessor. The aircraft is also equipped with an automatic labor-saving loading/unloading system.

● **CUTTING EDGE DESIGN CUTS COSTS**

One unprecedented aspect of both the P-X and C-X is that they share many component designs. The successful implementation of Kawasaki's unique design proposal has given the two aircraft identical outer main wing sections, horizontal tails and windscreens for the body as well as integrated display units, flight control computers, landing gear extension/retraction system control units and auxiliary power units. This unparalleled milestone achievement has paid off in lower development costs.

As the prime contractor, Kawasaki was responsible for the final assembly of the bodies and flight testing. Kawasaki employed its proprietary KMS6115 (a strong, lightweight and cost-effective composite material made from carbon fibers that was designed specifically for use in aircraft) to manufacture the forward fuselages and horizontal tails. The Kawasaki group company, NIPPI Corporation, manufactured the



Graphic image of #2 test P-X



Graphic image of #2 test C-X

wing-body fairings for the P-X. These shaped structures reduce drag by covering the joint between the main wing and fuselage.

● **SPIRITS SOAR HIGH**

At 1:00 p.m. the P-X and C-X are rolled out one after the other to the tune of marching music played by the Japan Self-Defense Forces band. As they are slowly pulled out of the factory, a thunderous applause from factory workers and

guests alike fills the air along with the lightning-like flashes of the press' cameras. Although it is raining, nothing can put a damper on everyone's spirits this day.

The rollout of the state-of-the-art #1 test P-X and C-X airplanes was a soaring success. Following their first flight, the C-X and P-X are scheduled for delivery to the Japanese Ministry of Defense by March 2008 and August 2008 respectively.



Kawasaki president, Tadaharu Ohashi



Ribbon cutting ceremony



The successful maiden flight of the #1 test XP-1 (formerly P-X) at the Gifu Works on September 28

# Get Up Close to the MINEBULL A Landmine-eating Beast



## Putting Kawasaki Technology to Work in Humanitarian Demining

Today it is estimated that over 100 million mines have been planted in 70 countries around the world in wars and conflicts, maiming or killing more than 20,000 people every year. In response to this cruel reality, non-governmental organizations are working on mine removal initiatives where mines are mainly removed manually. Demining specialists use metal detectors to discover the location of mines and then detonate them using gunpowder. This method will remove at most 100,000 mines per year, meaning that it will take more than 1,000 years to remove every existing landmine.

Kawasaki has combined its construction machinery, aerospace and plant engineering technologies to develop a state-of-the-art solu-

tion known as the BULLDOG System. The system is comprised of a detection vehicle dubbed MINEDOG, and an antipersonnel landmine (AP-mine) clearance vehicle called MINEBULL.

## Improved MINEBULL Goes to Afghanistan

The BULLDOG humanitarian demining system achieved significant results in a series of tests conducted in actual minefields in Afghanistan from 2004 through 2005. A number of improvements were made to the system based on the test results and experience gained through the testing. One MINEBULL unit, which had been improved for enhanced performance and efficiency, was delivered to Afghanistan's Mine Clearance Planning Agency (MCPA) in June 2007.



## MINEDOG Leaves No Stone Unturned

The MINEDOG is equipped with GPR (ground-penetrating radar) sensor, employing airborne sensor and robot technologies. The sensor array resembles a sleigh. As it slides along the surface of the ground, it detects AP mines planted as deep as 30 cm from the surface and antitank mines (AT mines) up to 50 cm deep and marks their locations with paint. The proprietary identification software analyzes the data

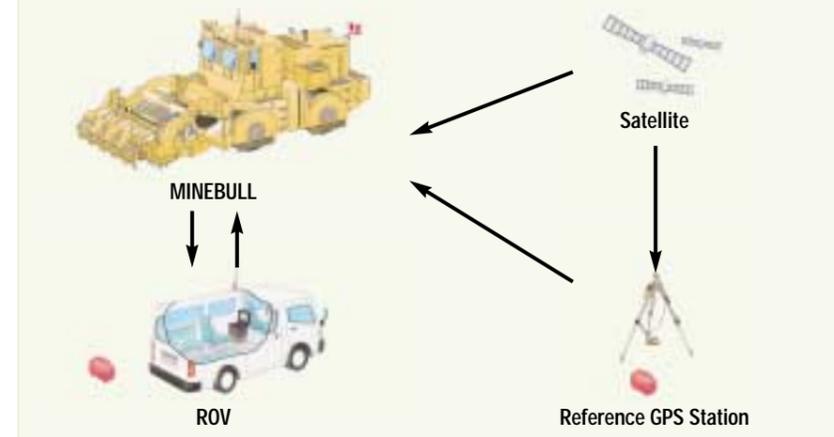
transmitted from the GPR sensors to accurately distinguish mines and unexploded ordnances from buried metal fragments. The system realizes semi-automated mine detection combined with MINEDOG's GPS (global positioning system) map system that creates an electronic minefield map. The user friendly system allows operators to easily ascertain the exact distribution of mines and unexploded ordnances.



## How the MINEBULL Works

The MINEBULL is equipped with a high-speed digging drum at the front. It employs an electronic map of mines detected and marked by the MINEDOG to safely dig up AP mines along with the surrounding dirt. The MINEBULL detonates the mines by smashing them against the digging drum and drum covers. At the same time buried metal fragments are automatically collected with permanent magnetic pulleys into a collection bucket.

The MINEBULL is normally remotely controlled but allows for manned operation as well. The antipersonnel landmine clearance system is comprised of the MINEBULL, a remote operation vehicle (ROV) and a mobile workshop for on-site maintenance and repair work.



**Drum cover**  
The multiple intercept bits on the drum cover mesh with the drum bits to detonate and smash AP mines. The drum cover has a number of openings designed to release blast pressure.

## Digging depth monitoring equipment

Equipment installed at three locations on the digging drum cover measures digging depth by the angle of the forward fin. The measurement data is displayed on the digging depth indicators in the cabin and the remote-control system together with mean values of digging depth.



- The cabin monitor** can display a variety of electronic data including AP mine maps, the time required for demining as well as the size and map of the demined areas. The same data can be viewed on the ROV's remote operation unit to facilitate remote-control operation.
- GPS antenna**
- Dustproofing**  
Sand granules in the Afghanistan desert are as small as 1 micron in diameter and can trigger mechanical problems when they invade the equipment. Dust and oil seals on the digging drums, conveyor belt, cabin and electric equipment protect the system from mechanical failure by keeping it almost dust-free.
- Route monitoring camera**
- Blast- and bullet-proof tires**  
10 cm-thick rubber tires filled with urethane rubber
- Soil**
- Blast- and bullet-proof body**  
The vehicle body, designed for safety, is protected from AT mine shrapnel.
- Metal fragment collection system**  
Metal fragments are collected with strong magnetic pulleys into a collection bucket while the dirt mixed in with metal fragments is removed via a conveyor belt after detonation. The system sweeps up nearly 100% of all exploded shrapnel including small metal fragments no bigger than the tip of your little finger.
- Cabin window**  
67 mm-thick bullet- and dust-proof glass window
- Cabin**  
Armored with a 16-mm steel plate on the front and a 12-mm steel plate on the side
- Engine room access door**  
A composite plate made from iron and Zylon®, a synthetic fiber with outstanding thermal properties that is ten times stronger (static strength) than iron
- Armored with 12-mm-thick steel plating** protecting the engine room, fuel tank, tires and joints
- Pulleys with strong magnets**
- Metal fragment collection bucket**
- Conveyer belt**
- Digging drum**  
The digging drum is made of 30 mm-thick steel plates. The number of digging bits and their arrangement are designed to prevent unexploded AP mines from being carried away with the dirt. The design is based on an in-depth analysis of the way AP mines and surrounding dirt move when they encounter the digging drum. The digging drum takes in a 2.23 m-wide swath and can penetrate to a depth of 35 cm. It can clear 3,345 m<sup>2</sup> per hour (@1.5 km/h) during AP demining operations. The digging drum is also capable of clearing vegetation up to one meter tall when the drum cover is lifted. The vehicle runs at a maximum speed of 20 kw/h.
- Digging depth monitoring equipment**

## H-IIA Launch Vehicle Fairing Delivered



This past June Kawasaki delivered the payload fairing for the Japan Aerospace Exploration Agency (JAXA) H-IIA Launch Vehicle No.13 (H-IIA F13) to the Tanegashima Space Center. The launch of the H-IIA F13 was conducted on September 14, 2007. The payload fairing is

a cover installed at the tip of a launch vehicle to protect the satellite from aerodynamic heating, acoustic noise and vibration during liftoff. After the launch vehicle leaves the earth's atmosphere, the fairing splits in two and is jettisoned, allowing the satellite to sep-

arate from the launch vehicle. Kawasaki designed and manufactured the launch vehicle at its Gifu Works before assembling and shipping it from its Harima Works.

The fairing is 4 meters in diameter with a single cover (4S), into which a large satellite will be installed. The fairing is large enough for satellites like those carried by the U.S. space shuttle or the European Ariane V. The H-IIA F13 launch vehicle carried the Selenological & Engineering Explorer (SELENE) into space. SELENE is Japan's first large lunar explorer developed by JAXA. It is a three-ton-class satellite, equipped with 15 different kinds of mission equipment. It will be used to study the moon's origin and evolution and to map its surface with an eye to future lunar exploration.

Kawasaki has developed and manufactured various types of payload fairings for H-IIA launch vehicles that can meet a wide range of launch needs including the launch of a large satellite or the simultaneous launch of two satellites. ::

## VLCC *Takahashi* Delivered

Kawasaki Shipbuilding Corporation delivered the *Takahashi* (hull No. 1585), a very large crude oil carrier (VLCC), to Gios Maritima S.A. in Dalian, China this past May. The 315,000 DWT, double-hull tanker was built at Kawasaki's affiliate, Nantong COSCO KHI Ship Engineering Co., Ltd. (NACKS) in Nantong, China.

Powered by a Kawasaki-MAN B&W 7S80MC-C diesel engine, the vessel features the latest tanker developments, including one of the largest cargo capacities that can pass through the Malacca Straits and enter primary oil tanker berths in Japan. The 333-meter-long carrier is equipped with Kawasaki's rudder bulb system with fins (RBS-F) and high-performance propellers for energy-efficient operations. ::



## Woody Biomass Power Project Testing Begins

Kawasaki Plant Systems (K Plant) recently installed and began testing of its proprietary woody biomass gasification power generation system and pellet production system for a project overseen by the New Energy and Industrial Technology Development Organization (NEDO) in Niyodogawa, Kochi Prefecture.

K Plant completed the installation of core facilities including the world's first small-scale woody biomass distributed power system consisting of a fluidized bed gasifier and a gas turbine as well as a pellet production system that utilizes exhaust heat from the turbine in March 2007. K Plant followed up with testing one month later for the purpose of evaluating the project's economic feasibility. The testing is scheduled to be conducted for a period of three years until March 2010.

The power generation system employs Kawasaki's low-calorie gas burning technology using a fluidized bed gasifier and gas turbine. The gasification occurs at a relatively low temperature of approximately 650°C. The generated gas, which contains combustible gas and tar and has a calorific value of 1,000 kcal/Nm<sup>3</sup>,



is directed to the gas turbine combustor while maintaining the same temperature and pressure. This allows for effective use of the tar which would normally have to be removed with water in conventional systems. Thanks to these features, it's three times more efficient for generating power than direct-combustion biomass power generation systems and can be applied to small-scale woody biomass systems.

During testing the system will supply 150

kW of electricity from 0.45 tons/hour of forestry wood waste via the woody biomass gasification power generation system installed on the premises of Sonia Co., Ltd. in Sakawacho, Kochi Prefecture. The recovery boiler will supply steam for a wood drier at the facility. Six hundred tons/year of wood pellets will be provided for use as an alternative fuel to four nearby facilities, including a hotel spa and an institution for disabled persons. ::

## Samsung Techwin Doubles Gas Turbine Generator Order

Kawasaki Machine Systems recently received orders for gas turbine generators from Korea's Samsung Techwin Co., Ltd. for use in cogeneration systems at two Korean hospitals, the Samsung Medical Center and Gangnam St. Mary's Hospital. The cogeneration system, now up and running at the Samsung Medical Center, was delivered jointly by Kawasaki and Samsung Techwin. Kawasaki supplied the gas turbine generator and Samsung Techwin supplied the auxiliary equipment and installation work. The second system is scheduled to begin operating at Gangnam St. Mary's Hospital in December 2007.

Samsung Medical Center, the Samsung Group's general hospital with approximately

1,200 beds, is located in Gangnam-gu, Seoul. The cogeneration system is comprised of a natural gas-fueled gas turbine power generation system employing Kawasaki's M1T-13D gas turbine engine and a heat recovery steam boiler. It supplies 2,845 kW of electricity and 9 tons/hour of steam to the hospital. This was Kawasaki's first order from Korea for a natural gas-fueled gas turbine generator used in a cogeneration system.

Gangnam St. Mary's Hospital, with approximately 800 beds, is affiliated with the Catholic University of Korea in Seocho-gu, Seoul. The system for Gangnam St. Mary's Hospital consists of a natural gas-fueled gas turbine power generation system, employing

the 2,900kW M1T-13A and 1,500kW M1A-13A gas turbine engines, and a heat recovery steam boiler. The system will supply 4,400 kW of electricity and 13.5 tons/hour of steam to the hospital and serve as a stand-by power generation system. The hospital also placed an additional order for a 3,600kW stand-by gas turbine engine to be installed in the new 1,200 bed ward it is planning to build.

Kawasaki and Samsung have been working together to provide technical and economic assessment for the implementation of cogeneration systems that enhance energy efficiency and conservation. ::

## Blue-Collar Humanoid Robot Developed

Kawasaki Heavy Industries, Ltd., Kawada Industries, Inc. and the National Institute of Advanced Industrial Science and Technology (AIST) have jointly developed the HRP-3 Promet Mk-II, a next-generation humanoid robot designed to operate in adverse environments. The robot was developed under a five-year project launched in 2002 by the New Energy and Industrial Technology Development Organization (NEDO) to develop a humanoid robot with skills that can be employed in the real world.

Kawada Industries headed up hardware development on the project while the Humanoid Research Group of AIST's Intelligent Systems Research Institute developed the software technology and Kawasaki developed the remote control technology.

The HRP-3 is 160 centimeters tall and weighs 68 kilograms, including batteries. It has 42 degrees of freedom (DOF), including

two in its waist. That is 12 DOF more than its predecessor. The robot has 13 DOF in each arm part (7 DOF in each arm and 6 DOF in each hand) that enables the robot to carry out more complex tasks. Its dust-proof, water-resistant joints and electrical system as well as cooling system to release heat generated inside the robot enable it to work under harsh and inclement conditions such as outdoor construction sites.

The robot's new extremely efficient high-output actuator designed for optimal walking performance extends the humanoid robot's period of continuous stepping endurance from 60 to 120 minutes. The HRP-3 Promet Mk-II is completely dust-proof, water-resistant, able to walk on slippery surfaces and has fully coordinated arm and leg motion. Kawasaki newly developed the autonomous/remote hybrid control technology to expand the range of tasks it can perform and the remote-control cockpit sys-



tem to provide exactly what is needed to operate the humanoid robot. ::

## 12-MW Combined Cycle Power Plant Delivered

This past spring Kawasaki Gas Turbine Asia Sdn Bhd, Kawasaki's Kuala Lumpur-based gas turbine sales and service base for southeast-ern/western Asia, and the Indonesian engineering firm, PT Euroasiatic jointly delivered a combined cycle power plant to Ajinomoto Co., Inc.'s Indonesian subsidiary.

The system is comprised of a natural gas-

fueled gas turbine power generation system employing Kawasaki's proprietary 7,000 kW class M7A-02 gas turbine, a heat recovery steam boiler and a steam turbine generator. It will generate 12,000 kW of electricity and 55 tons/hour of steam, which will be supplied to Ajinomoto's production facility. The system will boost energy savings with an overall effi-

ciency of over 90% as well as reduce the facility's CO<sub>2</sub> emissions by approximately 20%. An environmentally-friendly low NO<sub>x</sub> combustion chamber has also been employed to reduce NO<sub>x</sub> emissions. Kawasaki supplied the gas turbine generator and the steam turbine generator, while PT Euroasiatic supplied the boiler, auxiliary equipment and installation work. ::

## Gas Compressor Units Ordered for Malaysian Project

Kawasaki recently received an order for gas compressor units for the Bunga Orkid Development Project being conducted by the Malaysia-based oil and gas producer, Talisman Malaysia Limited. The order was placed through Sojitz Corporation's Malaysian

subsidiary, Sojitz (Malaysia) Sdn. Bhd.

The gas compressor units, comprised of two trains of gas turbine driven centrifugal gas compressors, will be installed onto an offshore platform in the Bunga Orkid field located off the Malay Peninsula, near Kota

Bharu (the PM-3 commercial agreement area between Malaysia and Vietnam). The units will boost natural gas pressure in order to transport the gas from the offshore platform to the onshore receiving terminals in Malaysia and Vietnam via subsea pipelines. ::

## Tunnel Boring Machine Reaches Seoul

Kawasaki has recently delivered a tunnel boring machine (TBM) to Dong-A Geological Engineering Co., Ltd. for the KEPCO (Korea Electric Power Corp.) power cable tunnel project in Seoul. The TBM, which was manufactured at Kawasaki's Harima Works, was disassembled once for transport to Korea and reassembled after arrival.

The TBM is being used to construct the 2.4 km KEPCO/Geoyo-Karak cable tunnel in Jamsil, Seoul, which is scheduled to be completed in December 2009. Combining shield tunneling technology for soft ground and high water pressure with tunnel boring technology for hard rock and gravel layers, Kawasaki's TBM is able to excavate through just about any geological composition. ::



## Gigacell Battery Brings Wind of Change

Kawasaki has successfully demonstrated the Gigacell's smoothing effect on wind power output fluctuations in testing conducted between August and December 2006. The Gigacell test was conducted jointly by Kawasaki and the Ashikaga Institute of Technology using the Institute's windmill with a rated output of 40 kW.

Although the use of wind power generation as an alternative natural energy source has swept the globe, one lingering problem has been wide fluctuations in output due to the total reliance on wind speed. This can result in power voltage and frequency fluctuations if the power is delivered directly to a power company's network system. A much anticipated solution to this problem lies in a new system employing a battery that absorbs fluctuating wind power output to provide a stable supply of power.

Storing the entire output from a windmill

in a battery and then sending a fixed amount of power to a network system, enables the delivery of a high-quality, stable supply of power and easier power control. In order to do this you need a battery with a very large storage capacity. The Gigacell is a nickel metal hydride battery employing unique Kawasaki technologies that can be easily manufactured in large capacity sizes. During testing at the Ashikaga Institute of Technology most of the wind power output was directly fed into the power system while the Gigacell either absorbed or released power, depending on output fluctuations, to provide an economical and stable supply of power. The testing demonstrated that, even when there is a sudden surge in wind power output, the Gigacell delivers a quick charge/discharge and prevents fluctuations in generated output when used in combination with Kawasaki's proprietary control system.

That control system is capable of responding to complex fluctuations in power input and output.

The Gigacell has the potential for a wide range of applications. A Kawasaki photo-voltaic power generation system with a peak-cut function employing the Gigacell has been in operation at the Yachiyo Shoin Junior High and High School in Yachiyo City, Chiba Prefecture since the summer of 2006. Kawasaki is working to expand applications of the Gigacell to include power control of microgrid distribution generation systems, battery-powered light rail vehicles and power storage systems for electric railways.

Kawasaki plans to begin larger scale verification testing at a commercial wind power plant and step up its efforts geared toward commercialization with the support of the New Energy and Industrial Technology Development Organization (NEDO). ::

# A Robot for Every Application

the highest performance robots on the planet

Kawasaki is a leading supplier of robots and robotic systems, with about 80,000 installations worldwide and automation expertise in a vast range of industries. Our products range from compact, light-weight robots to units capable of manipulating 500kg payloads—offering the ultimate flexibility in system application and process designs.

Applications include: Arc Welding, Assembly, Dispensing, Inspection, Machine Tending, Material Handling, Material Removal, Press Tending, Painting, Palletizing, Packaging, Spot Welding and many others.

