



**Environment Report / 2011**



## ● About JGC

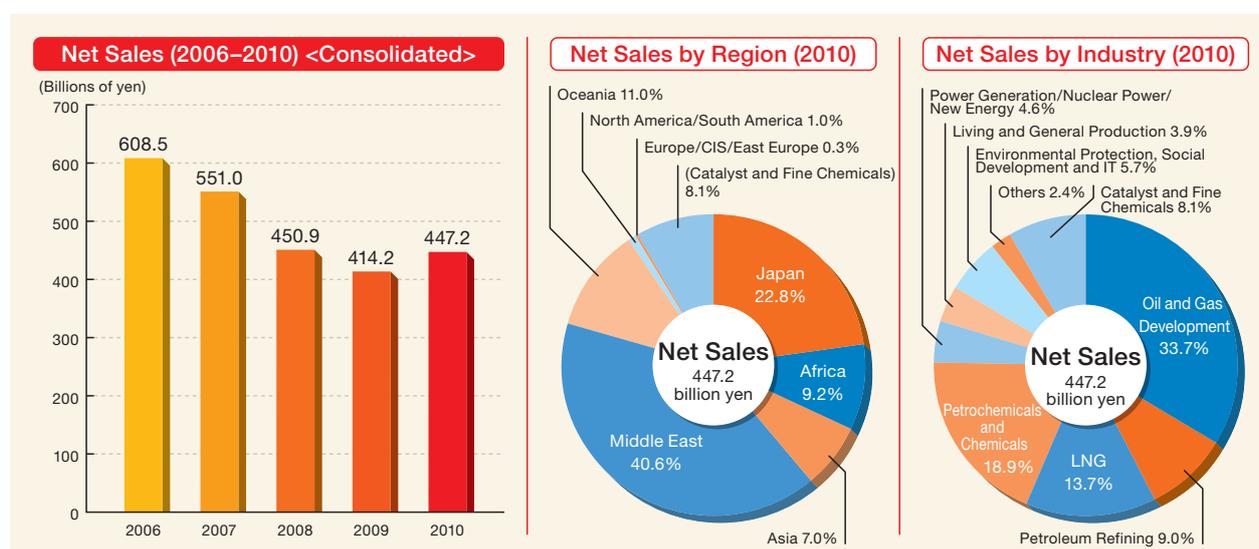
<b>Name:</b>	JGC Corporation	
<b>Location:</b>	Tokyo Corporate Office	2-2-1 Otemachi, Chiyoda-ku, Tokyo
	Yokohama World Operations Center	2-3-1 Minato Mirai, Nishi-ku, Yokohama-shi, Kanagawa
	Kamiooka Office	1-13-1 Saïdo, Konan-ku, Yokohama-shi, Kanagawa
	Research and Development Center	2205 Narita-cho, Oaraimachi, Higashi-ibaraki-gun, Ibaraki
	Domestic Office	Osaka
	Overseas Offices	Paris, Beijing, Jakarta, Perth, Abu Dhabi, Algeria and others
	Overseas Affiliates	Philippines, Vietnam, Saudi Arabia, Italy, U.S. and others

**Employees (approx.):** 8,500 persons (as of March 2011)

JGC: 2,100 persons

Domestic affiliates: 2,700 persons

Overseas affiliates: 3,700 persons



## ● The JGC Group

The JGC Group's core business is to provide planning, design engineering, construction, and commissioning services for various large-scale industrial plants and facilities. The JGC Group also operates subsidiary businesses that include investment projects, management services, manufacturing and sale of catalysts and fine chemicals, information technology services, equipment procurement, and consulting services.

The scope of this report mainly includes the JGC Group companies listed below.

### Total Engineering Business (EPC Business)

JGC  
JGC Plant Solutions  
JGC PLANTECH  
JGC Philippines

### Catalyst and Fine Chemicals Business

JGC Catalysts & Chemicals  
Nikki-Universal  
Japan Fine Ceramics

### Other Businesses (IT and Consulting Businesses)

JGC Information Systems  
Japan NUS

## ● Editorial Policy

The purpose of this report is to present to our stakeholders the environmental conservation and CSR efforts of the JGC Group. This year's report includes a feature on "Next-Generation Technology to Build a Better Future," covering our infrastructure, urban development, and new energy projects currently under way.

The report also details our activities as they relate to four pillars of our business: "Project"—Health, Safety, and Environment Concerns in Project Activities; "Management"—Environmental Consideration Based on Environmental Management; "Technology"—the JGC Group's Environmental Technology; and "Social"—Social Dimensions of Sustainability.

We also report on our response to the Great East Japan Earthquake on page 10.

### Scope of Reporting

The content of this report includes information concerning the activities of JGC Corporation ("JGC") and Group companies (listed at the bottom of the left page).

"Environmental Consideration through Environmental Management" (P23–30) covers the JGC Group's construction sites and offices in Japan and overseas and plants in Japan.

Note: Matters other than those specifically attributed to the JGC head office or individual Group companies refer to the activities of the JGC Group as a whole.

### Reporting Period

This report is compiled principally on the basis of data for fiscal 2010 (from April 1, 2010 to March 31, 2011). Important matters (those regarded as highly significant) concerning activities outside the reporting period are also reported.

### Publication of This Issue

September 2011

### Next Scheduled Publication

September 2012

### Publisher

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Public Relations & Investor Relations Department/  
Quality Assurance, Safety & Environment Office  
Contact telephone number: +81-45-682-8026  
JGC website URL: <http://www.jgc.co.jp>

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# Further Refining the Power of Engineering to Build Society

## Keisuke Takeuchi

Chairman and Chief Executive Officer  
JGC Corporation



In introducing this 2010 Environment Report, I wish to once more express my deepest sympathy to all those affected by the Great East Japan Earthquake. As I write this message, the JGC Group is maximally contributing its long-accumulated multi-disciplinary engineering expertise to aid in the recovery of its clients' facilities and the most rapid possible restoration of the disaster-affected regions as a whole.

### Engineering: A Pre-Requisite for Sustainable Development

In 1872, during the Victorian Era, at the height of the wealth and glory of the British Empire, a memorial was built in South Kensington, London, to honor the late Prince Albert for the support he gave to his wife Queen Victoria, and the prosperity he brought to the Empire. Sculptures at the base of the Albert Memorial represent the four industrial arts that were essential for the ruling of the Empire: Agriculture, Manufacture, Commerce, and Engineering.

The Memorial is a testimony to the important role that engineering has played in contributing to the development of society, alongside agriculture, industry, and commerce, starting from even before the era of the British Empire.

Over the years, the JGC Group has fully applied its engineering capabilities and experience for the design and build of energy production plants and industrial facilities, as well as the development of social infrastructure all around the world.

In the engineering and construction of energy production facilities, such as oil and natural gas plants, absolute requirements are efficient energy generation, economy of resource consumption and consciousness of environmental and social issues. The JGC Group has adopted the keywords "Energy," "Economy," and "Environment and Society" to describe these requirements, and makes full use of "Engineering" for their simultaneous achievement.

Recognizing the role of engineering in achieving efficiency, we define the corporate philosophy of the JGC Group as: "achieve enduring growth as a globally active company with a core business of engineering-based services, while contributing to world economic and social prosperity, as well as to the conservation of the earth's environment."

The JGC Group draws on its engineering experience not only to provide systems that support social and

industrial development, but also to help provide energy and environmental solutions.

The construction of facilities for the production of liquefied natural gas (LNG) is a good example. LNG processing facilities provide a cleaner energy option by removing impurities—metals, acid gases, etc.—contained in natural gas when it is extracted from underground fields. Beyond oil and natural gas applications, energy engineering is also indispensable in the development and use of renewable, including biomass, wind or solar energy. The power of engineering can also contribute solutions for water purification, soil decontamination, and the prevention of air pollution. Engineering innovations help make energy cleaner, render processes in plants more efficient, and detoxify wastes.

### **Building Relationships of Trust by Supporting Industrial Development in Emerging Countries**

In accordance with its medium-term management plan through fiscal 2010, the JGC Group revised and reformed its business structure. The purpose of the change was to transform into an engineering company capable of responding to a wide range of client needs, beyond the scope of a conventional contractor focused on engineering, procurement, and construction (EPC). By meeting such needs and acting as an investor in projects, in addition to constructing a range of plants, the aim is to contribute to the development of an efficient social infrastructure in the countries of business.

On a global basis, the JGC Group has already begun securing stable energy supplies, providing power infrastructure facilities, and delivering and operating water and wastewater facilities. This report covers progress in the fields of solar thermal and solar photovoltaic power generation, which are now drawing considerable attention as renewable energy options. The report details work conducted on low-carbon, environmentally-conscious urban and infrastructure projects, among others.

With its new medium-term management plan “NEW HORIZON 2015,” starting from fiscal 2011, the JGC Group will develop further its existing policies to become a “Program Management Contractor and Investment Partner.” While maintaining EPC as its core business, JGC intends to become a new business entity active in both investment and in planning and management services.

Specifically, in the EPC business area, JGC is

developing activities in new fields while strengthening its management capabilities and personnel expertise at overseas EPC subsidiaries. In enterprise investment, strategic priorities comprise four fields: (1) power and new energy; (2) environment and water; (3) resource development; and (4) development of urban infrastructure and new industries.

A total of 90% of JGC projects are situated outside Japan, and the strong desire of emerging countries is to develop their domestic industries. Considering economic development in the true sense of the term, they want to take construction and operation of facilities into their own hands and thereby accumulate technological experience as well as create employment opportunities.

We are eager to respond to the needs of the emerging countries and engage in the challenge of aiding their development, while demonstrating in the process the cultural and ethical qualities of the Japanese people—seriousness, integrity, and persistence. We are confident that these efforts will bring heightened trust in the JGC Group and increase its competitiveness in the global arena.

### **Future Shape of CSR Reports**

In April 2011, the JGC Group defined its CSR Basic Policy and set forth its four major CSR priorities.

They are (1) Environment: to actively contribute to environmental conservation; (2) Education: to support activities that contribute to the education of the next generation of engineers; (3) Science and Technology: to support the science and technology that will form the foundation of sustainable development; and (4) Local Contribution: to contribute to the sustainable development of the regions where the JGC Group does business.

The JGC Group views environmental and social considerations as indispensable to its industrial projects. This is why the facilities constructed must be optimized to ensure safety and peace of mind not only for the owners, but also for the employees, beneficiaries of the facility, and the local society.

The world is now facing a number of social and environmental problems. By drawing on the engineering and project management capabilities it has fostered through its experience in a wide range of fields, the JGC Group contributes to solutions to environmental problems and continues to strive for concrete results as priority matters.

# Relationships Between the JGC Group's Businesses and the Society, Environment

The JGC Group provides plant engineering services to private-sector corporations and government organizations around the world. JGC also engages in activities closely tied to society and the environment in a number of other fields, focusing on enterprise investment and service businesses.

## Business Sector

### EPC Servies

EPC: Engineering, Procurement, Construction

#### Outline of EPC Services

The JGC Group contributes to local economic and industrial development by building plants in Japan and other regions of the world, including Asia, Oceania, the Middle East, Africa, and South America. The JGC Group also creates general production facilities and facilities that respond to social needs in Japan and abroad: pharmaceutical plants, laboratories, and diverse industrial plants that meet increasingly complex and sophisticated needs, medical and welfare facilities that respond to the aging of the population, and environmental conservation facilities that use energy-saving technologies.

#### ▼ Energy and Chemicals

- Oil and Gas Development
- Petroleum Refining
- Liquefied Natural Gas (LNG)
- Petrochemicals and Chemicals
- Power Generation, Nuclear Power, New Energy



#### ▼ Pharmaceuticals, Environment and Infrastructure

- Pharmaceuticals and Research Facilities
- Medical, Welfare, Social Facilities
- Industrial Plants for Non-Ferrous Metals, etc.
- Environment and Infrastructure



### Enterprise Investment and Service Business

#### Outline of Enterprise Investment and Service Business

Taking full advantage of technology and knowledge accumulated through its EPC business, as well as trust relationships developed with customers throughout the world, the JGC Group is also expanding its investments in businesses such as desalination and power generation. JGC also delivers "planning and management services" designed from the standpoint of an operator, in fields such as business design, planning, and promotion, as well as resource development planning and infrastructure development planning.

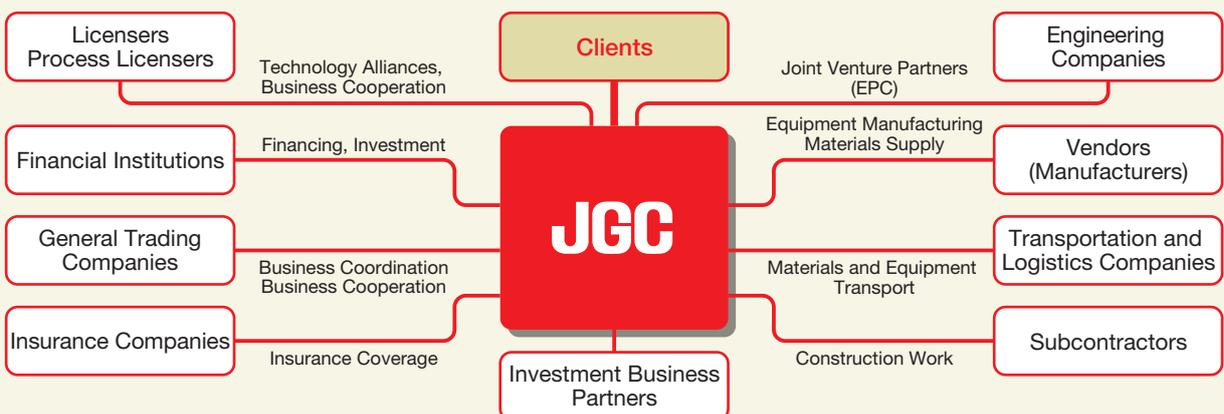
#### ▼ Enterprise Investment and Business Operation

- Power Generation and New Energy
- Resource Development
- Environment and Water
- Urban Infrastructure and New Industrial Development

#### ▼ Service Business

- Planning and Management
- Manufacturing and IT

### Companies Involved with JGC



## Engineering technologies contribute significantly to mitigating environmental impacts

Active on a global scale, the JGC Group considers the mitigation of environmental impacts as an important duty and works vigorously on environmental conservation measures.

Population growth and global issues related to expanding economies

Resource  
Depletion

Climate  
Change

Effects on the  
Air, Water  
and Soil

### Role of the JGC Group

Optimizing customer facilities through proven engineering expertise and active introduction of the latest technology, while minimizing negative impacts on ecosystems and human health

#### The JGC Group's Input Measures

Measures to reduce resource consumption, energy use and emission of pollutants

Promoting use of new energy (solar photovoltaic, petroleum substitute fuels, etc.) (see P12, 13)

Energy conservation at industrial plants (see P17)

Promotion of enhanced fossil fuels (low sulfur oil, etc.)

#### The JGC Group's Output Measures

Environmental impact reduction and detoxification measures

Promotion of natural gas use and underground CO<sub>2</sub> sequestration (see P32, 34)

CDM business (see P33)

Environmental pollutant removal and detoxification (catalyst use, enzyme use) (see P35, 36)

## Human Prosperity in a Healthy Environment



# Corporate Governance

The basic policy of JGC's corporate governance is to continuously increase corporate value through efforts to enhance management efficiency and transparency. Gaining social trust from all its stakeholders, JGC will develop its business in harmonious coexistence with society.

## Corporate Governance Framework Outline

JGC has introduced an executive officer system, which clarifies the division of management decision-making and oversight functions from executive functions. This has further enhanced management efficiency and strengthened the Company's executive accountability system. The current implementation of the system is described below.

### <Board of Directors>

- Headed by the Chairman of the Board of Directors, it consists of 15 directors and five corporate auditors and meets in principle twice a month.

### <Board of Auditors>

- The Board of Auditors consists of five corporate auditors, of which three are outside corporate auditors. It meets in principle once a month.

### <Director and Executive Officer Committee>

- The Director and Executive Officer Committee meets in principle once a month for the purposes of sharing information on management policies and status, and reporting on and confirming the execution of business operations.
- Headed by the Chairman of the Board of Directors, it consists of directors, executive officers and corporate auditors.

### <Management Strategy Committee>

- The Management Strategy Committee meets in principle once a week for the purposes of examining and making decisions on important matters for the management strategy of JGC and the JGC Group.
- The Chairman Emeritus of the JGC Group heads this committee, which consists of directors, corporate auditors, and other members.

### <Operations Steering Committee>

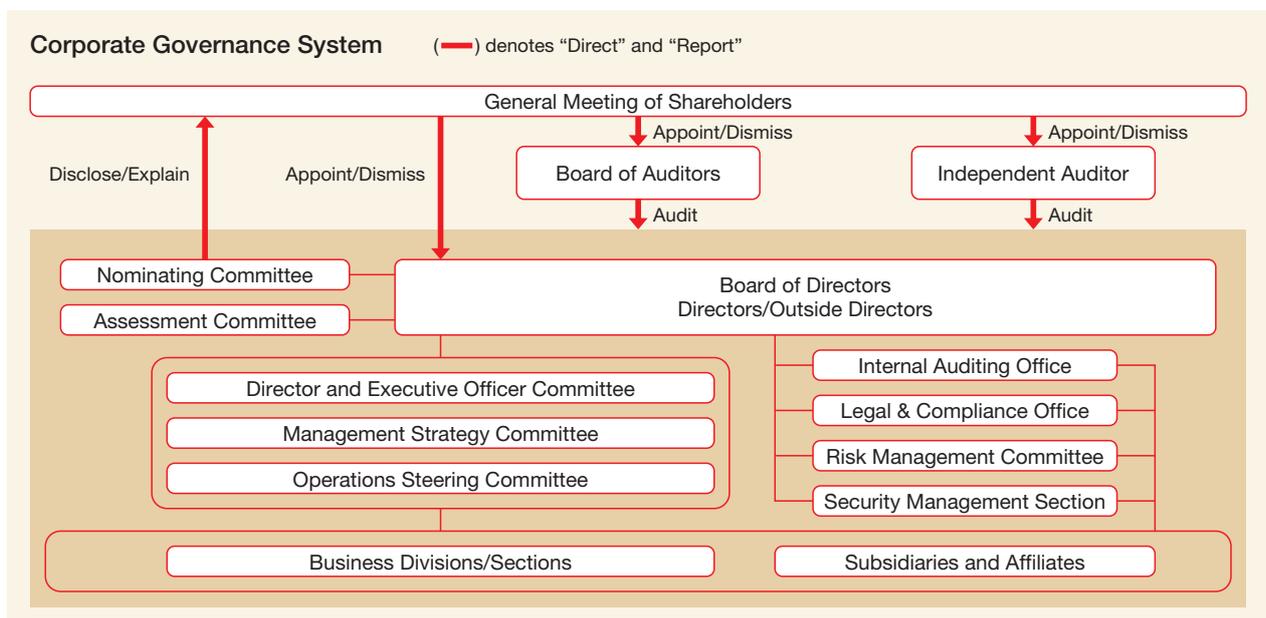
- The Operations Steering Committee meets in principle twice a month for the purpose of consultation and decision-making related to the execution of business operations of JGC and the JGC Group.
- It is headed by the President and consists of corporate auditors and other members designated by the President.

### <Nominating Committee and Assessment Committee>

- These committees meet in principle once a year for the purpose of strengthening fairness and transparency regarding the appointment and compensation of executive personnel.

### <Independent Auditor>

- The certified public accountants (CPAs) who have audited JGC's accounts are Makoto Ishikawa, Kazutoshi Isogai, and Yoshihisa Uchida of KPMG AZSA LLC. Four other CPAs and seven other individuals assist with these audits.



## Status of the Internal Control System and Risk Management System

JGC has established an Internal Auditing Office and a Legal & Compliance Office to adequately implement and operate its internal control system. Group Management Regulations instituted for Group member companies are also applied.

JGC has established a Risk Management Committee as part of a comprehensive Risk Management System designed to systematically identify corporate risks. A Security Management Section has been established for crisis management.

To provide examples of efforts undertaken in recent years, the status of activities of the Legal & Compliance Office, Business Continuity Plan (BCP), and the Security Management Section is presented below.

## Legal & Compliance Office

The Legal & Compliance Office was established in 2002 for the purpose of supporting fair and transparent corporate activities based on strict compliance and corporate ethics. Specifically, the Legal & Compliance Office plans and implements education, training, audits, and awareness surveys related to compliance education activities, institutes compliance programs, and supports guidance for improvements in Group companies.

Internal training programs include (1) new employee training, (2) e-learning, (3) training by hierarchical level, and (4) special courses, among others. In addition, active information disclosure and educational activities are implemented for employees, with compliance-related contents published on the company intranet.

# Risk Management

## Business Continuity Plan (BCP)

JGC does not have production facilities such as plants, and it conducts its business with offices, employees and a sophisticated IT infrastructure. Consequently, JGC's Business Continuity Plan (BCP) consists of three pillars: (1) Early confirmation of employee safety, (2) securing of office safety, and (3) securing of IT infrastructure.

### (1) Early confirmation of employee safety

In 2004, in advance of many other companies, JGC introduced a Safety Confirmation System for its employees. At present, the scope of the system has been extended to include not only regular employees, but also temporary staff and contract employees who work at JGC. In addition, for a quick confirmation of employee safety, an emergency liaison network has been established as a backup in each department.

### (2) Securing of office safety

In 1997, JGC transferred its office to a new building located in the Minato Mirai district of Yokohama. The new building was designed in compliance with the latest earthquake resistance standards, using simulations of the tremors of the 1995 Great Hanshin-Awaji Earthquake. Stockpiles of food and supplies are also kept on hand at all times, to provide additional support and security for workers at the Yokohama office in the event of an emergency.

### (3) Securing of IT infrastructure

In 2006, JGC was the first company in the Japanese engineering industry to obtain ISO certification (ISO 27001) for its information security management systems. Server operation and management, user authentication management, Internet operation and management including e-mail, management of communications infrastructure such as LAN/WAN, and other components of our IT infrastructure are tested through emergency drills every year, and they benefit from feedback to constantly evolve while supporting our business.

## Security Management Section

JGC employees and executives make approximately 3,500 overseas business trips per year, and with approximately 300 JGC personnel living overseas at any one time, in about 20 different countries. JGC has established a Security Management Section available on a 24-7 basis to cope immediately with any risks employees stationed overseas might face, including political turmoil, war, terrorism, kidnapping, accident, and sickness.

The Security Management Section has two operating patterns: Crisis Management Operation and Preventive Operation, as follows.

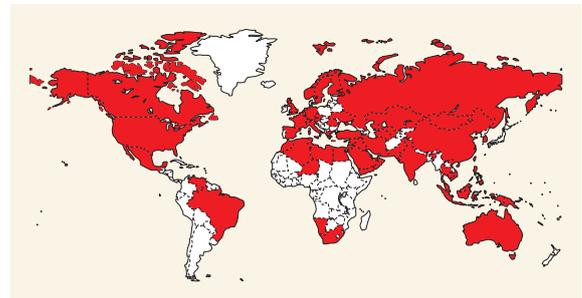
### (1) Crisis Management Operation

A range of measures is implemented upon determination of risk level in a given area, based on the Basic Rules for Risk Management.

\* Examples: business trip cancellation, temporary evacuation, etc.

### (2) Preventive Operation

- 1) Collection and communication of risk information:  
issuance of situation-specific reminders and warnings  
\* Methods: company intranet and e-mail messages to individual employees
- 2) Personnel stationed overseas and persons on business trips: coverage through the Business Trip Management System
- 3) Safety education for personnel bound for risky areas
- 4) Creation of manuals, guidelines and security standards



Countries and regions visited by JGC executives and employees on business trips in fiscal 2010

## Response to the Great East Japan Earthquake

### Initial Response Based on the Business Continuity Plan (BCP)

In response to the earthquake that occurred on March 11, 2011, Emergency Headquarters were established the same day, and the damage situation of offices and safety of Group employees were confirmed. Our offices, including those of Group companies, did not suffer noticeable damage, except for small-scale damage to testing equipment at the Research and Development Center of Oaraimachi, Ibaraki Prefecture. The safety of all employees, including those of Group companies, was confirmed on March 14. Facilities under construction by JGC did not suffer significant damage.

### Support for Restoration of Client Facilities

Several companies that were clients of JGC in the past suffered damaged facilities, mainly in the Tohoku area. JGC is currently providing emergency response and support to these companies for full recovery. As of late June, requests for support were received from more than 10 companies, and repair work was under way at seven of them.

### Relief Activities of the JGC Group

#### (1) Emergency Aid and Relief Fund (Matching Gifts)

On March 17, immediately after the disaster, JGC donated 10 million yen as emergency aid to Japan Platform, an NGO initiated by the Japanese government and business community to provide emergency assistance. At the same time, JGC also donated 40 million yen through the Central Community Chest of Japan as relief funds for victims of the disaster. In addition, a 20 million yen relief donation was added on March 31 as a joint contribution made by JGC and its employees through a matching gift program.

#### (2) Donation and Installation Free of Charge of Diesel Generators

Diesel generators were donated by the Consolidated Contractors Company (CCC, headquartered in Athens), a major construction company in Greece with which JGC has longstanding business relations. Three 545 kW generators were sent to the Port of Yokohama at CCC's expense, while JGC took care of procedures and costs in Japan. In cooperation with Japan International Cooperation Center and Kobe International Supporting Organization, it was decided that the generators should be installed at Ishinomaki City, Miyagi Prefecture. Installation work was performed in July, and the generators are now being used to power drainage equipment in areas submerged by the sea at high tide.

#### (3) Provision Free of Charge of an IT System for Maintenance Management

Since May, JGC Information Systems Co., Ltd. (J-SYS) is providing at no charge PLANITIA for SaaS to local authorities and companies that suffered damage from the disaster. Developed by J-SYS, PLANITIA for SaaS is a facility maintenance management system provided as a cloud service. By using the system, which is accessible through the Internet, local authorities and companies can manage the maintenance and understand the status of recovery of public facilities and plant equipment without rebuilding their damaged IT infrastructure.

# Next-Generation Technology to Build a Better Future

## —New Energy and Urban/Infrastructure Development Projects—

The world population will reach seven billion people at the end of 2011, and according to forecasts, exceed nine billion people by 2050. Population rise and economic growth are especially notable in emerging countries, and large increases in food, water and energy demand are consequently expected. On the other hand, climate change, environmental pollution, and other issues caused by mass energy consumption all around the world are now obvious. Because of this increased energy demand and the pressing task of alleviating environmental impacts, many initiatives towards the full use of renewable energies are now gaining momentum worldwide.

Taking advantage of its engineering and project management capabilities honed through numerous engineering, procurement and construction (EPC) projects, JGC is acting as an investor to promote water, electricity, new energy, and environment-related projects. In the 2010 edition (for fiscal 2009) of our Environment Report, we presented desalination and power generation projects in the Middle East, seawater desalination and water quality improvement projects in China, and a renewable energy project in the Philippines.

In this report, we cover JGC's projects in new energy fields that have been attracting increasing attention, such as solar thermal, solar photovoltaic, cleaner petroleum substitutes, and others. In addition, the demand for power generation and social infrastructure development are rising in emerging countries, along with demand for a sustainable urban development scheme that achieves balance between economic and environmental objectives. Specific examples of urban and infrastructure development projects promoted by JGC are also presented here.





Abengoa Solar's solar thermal power generation facilities (photo credit: Abengoa Solar)

## Developing CSP and Solar Photovoltaic Power Generation Projects

### ● Spain's first commercial Concentrating Solar Plant (CSP) project to be invested in by a Japanese company



Mirror for concentrating solar heat (photo credit: Abengoa Solar)

In August 2010, jointly with Spanish company Abengoa Solar, JGC decided to implement a new CSP project in Spain. This is the first commercial project of this type undertaken by a Japanese company in this country. The project involves construction of two new solar thermal power plants with a capacity of 50 MW each (100 MW in total) in the province of Cordoba, in south Spain, to generate power for the domestic market. Power will be purchased through a feed-in tariff system that Spain has signed into law for the purpose of reducing greenhouse gases and promoting renewable energies.

As an investor JGC is participating in the EPC and O&M management processes of the project, and JGC employees have already been dispatched to work in Spain. Power generation is scheduled to start in fiscal 2011. This project will provide domestic electric power to approximately 52,000 households and help cut greenhouse gas emissions by 63,000 tons/year.

### ● Demonstration project on solar photovoltaic power generation in Saudi Arabia

Since 2011, JGC is conducting a solar photovoltaic power generation demonstration project in Saudi Arabia. More than 10 different types of solar panels (poly-crystalline, thin-film, CIGS, etc.) have been installed, in order to collect reliable empirical data on factors such as performance under high temperature, effects of sand, and effective cleaning methods.

The Government of Saudi Arabia has announced its policy of actively using solar energy, with the objectives of reducing the domestic consumption of fossil fuels, which are essential exports for this country, protecting the natural environment, and curbing greenhouse gases. The demonstration tests will generate useful data for the improvements to the legal system and social infrastructure, and natural environment studies necessary for future large-scale solar photovoltaic power generation projects in the country.

This project is subsidized as a cooperative project with industrial leaders from oil exporting countries (fiscal 2011) by Japan's Agency for Natural Resources and Energy in the Ministry of Economy, Trade and Industry. Its purposes are to develop the infrastructure for solar photovoltaic power generation, contribute to the efficient use of solar photovoltaic energy resources, develop the solar energy market in Saudi Arabia, and establish a foundation for the industrial expansion of Japanese companies in the country.



Visit to the solar photovoltaic power generation demonstration facility in Saudi Arabia

### ● Studies start for the construction of next-generation solar photovoltaic power generation systems

Since April 2011, as a participant in the Endowed Chair of the GS+I Global Solar Plus Initiative promoted by the University of Tokyo, JGC has begun studies aimed at construction of next-generation solar photovoltaic power generation systems in the Middle East and North Africa. These regions, which are still undergoing development, are not only potential markets, but also areas JGC has strong familiarity with, based on years of experience with plant construction projects. Wishing to contribute to a stable local supply of electrical power, JGC is developing CSP and photovoltaic power generation projects in these areas, based on its initiatives in various countries, including Spain and Saudi Arabia.



## Promoting New Fuel Projects Utilizing Untapped Coal Resources

### ● An issue for Indonesia: low-rank coal accounts for 80% of domestic coal resources

Indonesia, which has a population of over 200 million people, is undergoing smooth economic development, but its oil production is continuously decreasing. Since 2004, the country has become a net importer of oil. As a result, a departure from oil dependency and efficient utilization of the low-rank coal that accounts for 80% of domestic coal resources are currently important issues in Indonesian energy policy. However, low-rank coal is young coal that has not fully matured. It has a low calorific value because of its high moisture content, and it tends to ignite spontaneously. Because of these problems, it is rarely used outside of mining regions.

### ● Utilizing low-rank coal for alternative fuels to petroleum

JGC has developed technology for quickly maturing low-rank coal and converting it into slurry. The technology works by subjecting low-rank coal to high-pressure hot water at about 330 °C, causing it to mature artificially, instantaneously recreating the process by which coal forms naturally over hundreds of millions of years. The technology can also be applied to the production of coal from biomass, and this matured coal can also be processed into a liquid slurry fuel to be used in boilers as an alternative fuel to petroleum. Application as diesel engine fuel is also expected.

JGC has named this new fuel JCF® (JGC Coal Fuel), and has begun a demonstration project aimed at spreading use of JCF®, based on Indonesia's policies for promoting a shift from oil to coal and the efficient use of low-rank coal resources. A new demonstration plant able to produce 10,000 tons/year of JCF® is under construction in Karawang, in the suburbs of Jakarta, with completion scheduled for the end of October 2011.

This project is expected to contribute to further strengthening of the relations between Japan and Indonesia, and as such, it has been selected as a grant project for fiscal 2010 by Japan's New Energy and Industrial Technology Development Organization (NEDO).



JCF® (JGC Coal Fuel)

### ● Not limited to the utilization of untapped coal resources, JCF® technology is applicable to a wide range of fields

Through the gasification of untapped coal resources, JCF® technology can be applied to the production of value-added products including natural gas, dimethyl ether (DME), and fertilizers. Moreover, JGC expects to be able to apply this technology to a wide range of fields in the future. For example, greenhouse gas reductions could be achieved by combining the JCF® technology with technologies for the capture and underground sequestration of CO<sub>2</sub> through the JCF® production process.



Conceptual image of the Smart & Compact Community

## Proposing Low-Carbon, Environmentally Conscious Urban Development

### ● Proposing urban development based on the keywords “Compact,” “Smart,” and “Localization”

In emerging countries with rapidly increasing populations, urban growth is accompanied by uncontrolled urban development at the periphery of traditional urban centers (urban sprawl), with social infrastructure development falling behind in many cases. Consequently, diverse social problems continuously appear, such as increased traffic and subsequent congestions followed by economic losses, or a declining level of safety and security in expanding informal settlements.

To solve these problems, JGC proposes the concept of the Smart & Compact Community. By locating workplaces, housing, commercial facilities and other various social systems within walking distance of each other, it will be possible to develop cities efficiently, curb disorganized urban growth, and form sustainable communities.

By gathering a wide variety of information from social systems and using these data in urban development, JGC is also proposing smart solutions aimed at making life more efficient and comfortable.

Localization is also essential to urban development. Generally, urban infrastructure tends to be massive in scale, but in emerging countries, the urban sprawl continues to progress as social investments on such a large scale become too costly. To curb this phenomenon, it will be essential to create a flexible, modular scheme for infrastructure development that can be adjusted to the speed of local growth.

### ● Participating in low-carbon, environmentally conscious urban development as part of a joint project between Japan and India

As part of the Delhi Mumbai Industrial Corridor Initiative, a project promoted jointly by Japan and India, JGC has been working since fiscal 2010 on urban development in the Shendra Industrial Area in the State of Maharashtra. Nine hundred hectares of land are currently under development, of which approximately 30% are already occupied, and full occupation should be achieved over the next five years. Based on the above mentioned keywords—Compact, Smart, and Localization—JGC is proposing Smart Service Stations to serve as community cores for the area.

Smart Service Stations are structures that provide drinking water and transportation services, such as taxis, to populations of between 2,000 and 3,000 people, while recycling wastewater and using renewable energies through the combination of solar photovoltaic power generation and energy storage systems. Depending on the conditions of social infrastructure development, the menu of services offered can be changed so that the Smart Service Stations will be community cores which provide commercial facilities, public services, etc. Information technology can be used to connect individual stations together into a network to develop services organically, contributing to the formation of low-carbon, environmentally conscious local communities.

The development of an industrial district with a convention center is planned next, in the area adjacent to the Shendra Industrial Area. In addition, a plan has also been established for five new developments in a chain pattern to the south-west of the area, where the distributed infrastructure stations proposed by JGC will be useful when implementing phased development.

# Project

## Health, Safety, and Environment Concerns in Project Activities

The JGC Group executes projects around the world in business sectors ranging from resource development, oil, natural gas, and petrochemicals, to chemicals, pharmaceuticals, water resources, new energy, and the environment. In all of its projects, the Group constantly strives to fully consider Health, Safety, and Environment (HSE) concerns. HSE consideration is indispensable not only for plant EPC (engineering, procurement, and construction), but also for marketing and all stages of project execution, from feasibility studies to maintenance, plant decommissioning and projects other than EPC such as investment and service projects. The JGC Group strives to help create a sustainable society by combining its engineering and management capabilities with advanced HSE consideration.

**JGC aims to be a No. 1 HSE contractor.**

**We aim to faithfully fulfil our social responsibility by considering HSE in every aspect of our business.**

### **Aiming to Be a No. 1 HSE Contractor**

In recent years, the interest of operators and society in HSE as it relates to the design, construction, and operation of large-scale facilities such as energy plants has risen. Requirements on contractors have become more stringent. JGC aims to maintain the trust of its clients and fulfil corporate social responsibility by becoming a No. 1 HSE contractor.

### **Combining Economic Efficiency with HSE at a Higher Dimension**

In large plants, factors such as operating stability and ease of maintenance significantly affect economic efficiency during operation. JGC constantly strives to provide plants that combine economic efficiency with HSE consideration. With the understanding and cooperation of our clients, who are also operators, we provide plants that meet our own high HSE standards as well as legal requirements and the needs of the client.

### **Balance of Long-Term and Short-Term Perspectives**

Energy and infrastructure facilities in operation around the world, even those which make full use of the latest technology, all have an impact on the environment over the long term. Parties responsible for the concepts, detail specifications, and construction of these facilities must make a prior assessment not only of short-term economic rationality, but also long-term environmental impacts. By making sure all parties involved understand the essence of HSE and overall optimization, plants can be built that will meet with the approval of clients and society. JGC is keenly aware of the need for both short-term and long-term perspectives and aims to be a company that achieves a good balance between the two perspectives.

# Health, Safety, and Environment Consideration at Every Stage of EPC (1)

In this section, we report on specific examples of the JGC Group's consideration for the environment at every stage of plant construction and other EPC services.

## The Workflow of the JGC Group's EPC Services



EPC: Engineering, Procurement, Construction

### In Marketing

Achieving balance between generating a stable energy supply and protecting the natural environment is a critical issue facing the human race. In recent years, there is a global trend moving away from using coal and oil as the primary source of energy and toward expanding the use of natural gas, which has a lower environmental impact.

To respond to these various energetic and environmental needs, the JGC Group is marketing its services actively, for example with gasoline and light gas oil desulfurization facilities, heavy oil upgrading, LNG plants, and Integrated Gasification Combined Cycle (IGCC) facilities. In addition, we are offering our services to emerging countries in particular, to help them respond to their expanding needs for energy and social infrastructure in the face of their rapid economic growth. The development of solar photovoltaic and solar thermal power generation projects, mainly in the Middle East and North Africa, and the water business (sea water desalination, water treatment and waste water treatment projects), in response to the increased global demand for water are also a major part of our marketing activities.



LNG plant (Indonesia)

### In Feasibility Studies

We consider many matters at the feasibility study stage, including market analysis, potentially useful technology, systems capabilities, facilities configuration, construction and operation cost analysis and financial arrangement. When configuring facilities, we take environmental consideration into account, along with regional characteristics and safety. We also consider secondary environmental impacts, such as whether waste disposal facilities are available in the region, or whether any transportation-related problems exist.

### In Basic Planning (FEED)

Basic engineering specifications of plant construction are decided at the Front-End Engineering Design (FEED) stage. At this stage, the JGC Group draws up specifications reflecting comprehensive consideration of plant construction costs, safety, operation costs, environmental impact, and other factors. In these specifications, the JGC Group makes use of its own technology for energy conservation and effective energy use.

During FEED, we measure the overall thermal balance of the plant and propose energy conservation and efficiency improvement measures, including “pinch technology” for optimization of heat recovery and use, aero-derivative gas turbines for power generation facilities, and combined cycle power generation. We also work to actively mitigate damaging environmental impact by reducing CO<sub>2</sub> emissions, and considering measures such as waste heat recovery maximization and flare gas emissions reduction.

# Health, Safety, and Environment Consideration at Every Stage of EPC (2)

## The Workflow of the JGC Group's EPC Services



EPC: Engineering, Procurement, Construction

### In Basic Engineering and Detail Engineering

This stage is an essential process, during which the basic design concept is optimized based on consideration of the life cycle of the plant. At this stage, we make realistic, practical examination of concrete measures for minimizing impacts on health, safety, and the environment that could arise during construction and operation. These measures are then reflected in the basic and detail engineering (equipment specification) decided at this stage.

For example, plants must be designed so that gas and liquid emissions will meet legal standards, but we also consider means to further minimize minor emissions. Every possible source of emissions is identified and the volume of discharge estimated. This includes not only stacks, vents etc., but also possible leaks from valves, flanges, or gases discharged during maintenance operations. We also review the basic engineering from the standpoint of either avoiding or reducing emissions, for example by making the operation of the plant more efficient or reusing its exhaust heat and wastewater. In addition, we determine adequate engineering specifications for every source of emissions by selecting low-emission valves and other such equipment.

### Consideration at Engineering Stages

#### An Example of Emissions Minimization

In 2010, to secure cooling water for a new plant in the Middle East, JGC was conducting a comparative examination to determine whether to adopt cooling towers using seawater or open circulation cooling towers using fresh water. Given the necessity to introduce seawater desalination equipment to produce pure water for the plant, JGC decided first to use this equipment for both cooling water and producing pure water. Then, taking into consideration the cost and environmental load, JGC adopted open circulation cooling towers using fresh water as coolant for minimum water intake and wastewater volume. With these choices, we were able to deliver a highly efficient system to the client.

### In Equipment and Materials Procurement

The JGC Group also takes environmental considerations into account at the procurement phase of projects, encouraging the materials and equipment vendors with whom we do business to adopt a forward-looking stance on environmental conservation, including protection of biodiversity.

Though transactions with vendors previously required a large volume of paper documentation, we have now switched to digital documents with our in-house JGC e-Procurement Solution System (J-PLUS). This system is environmentally friendly and has improved work efficiency by reducing the use of paper forms. After purchase order finalization, interaction with vendors at the detail engineering stage has been computerized using J-PLUS P for the same purpose, resulting in a virtually paper-free work environment.

## In Construction Planning

Meticulous concern for sustainability at plant construction sites is essential.

In many countries, construction of new plants requires submission of an environmental impact assessment (EIA) report for the purpose of understanding what impacts the construction has on the environment of the construction site and minimizing those impacts as much as possible. The EIA report describes in detail impacts that construction work will have on the air, water, soil, flora, fauna, and marine life, and it also details measures that can be taken to counter them.

JGC applies environmental management systems to construction work to ensure that we demonstrate environmental consideration in compliance with EIA reports, emphasizing the following points.

- (1) We practice strict legal compliance and environmental risk management by identifying environmental laws and regulations and environmental considerations that have bearing on construction work.
- (2) We endeavor to increase client satisfaction and reinforce communication with stakeholders.
- (3) We manage environmental risk and endeavor to minimize the possibility of environmental disasters by anticipating, preparing for, and responding to emergencies.

Before starting construction work, we consider the above matters and unflinchingly perform the following preliminary work.

- (1) Identifying environmental impacts of the construction work
- (2) Setting environmental objectives and targets for the construction work
- (3) Preparing a Construction Environmental Management Plan for the construction work
- (4) Providing new workers with environmental education and training

We incorporate the Zero Emissions Initiative, a JGC Group independent environmental conservation initiative, into this preliminary work, and thoroughly confirm environmental conservation measures before starting construction.

## In Construction

Construction work by JGC is preceded by thorough environmental consideration at the planning stage.

Matters laid out in the Construction Environmental Management Plan include project environmental policy, the organizations and persons responsible for environment-related works, environmental protection measures, environmental performance monitoring and measurement, regular testing of emergency prevention and relief procedures, monthly reporting, etc. Following the start of construction, a review of environmental aspects of the project (the relationship between construction work and the environment) is conducted to confirm whether the construction work differs from the plan. If any differences are found, the plan is revised to ensure that there are no omissions in environmental consideration in the environmental management framework.

### Philippine Subsidiary Receives Safety Milestone Hall of Fame Award

In December 2010, the Department of Labor and Employment of the Philippines (DOLE) presented Safety Milestone Hall of Fame Award to JGC Philippines for its excellent management of Occupational Health and Safety (OHS) over the last five years.

Between 2006 to 2009, JGC Philippines had already received Safety Milestone Awards for four consecutive years by setting records for most hours worked without a lost-time accident in the Philippine construction industry, among companies meeting the OHS standards. In 2010, JGC Philippines went on and achieved safety milestone of No-Lost Time Accident of 11.55 million Safe-Work Hours. The Hall of Fame Award was presented for the company's achievement of five consecutive years of OHS awards. At the same time, six employees of JGC Philippines who are DOLE accredited practitioners were likewise recognized for their significant contributions in the attainment for the company's safety milestone.

JGC Philippines has grown to be recognized as a model company for OHS in the local construction industry, and it will continue to focus on these matters to achieve its purpose.



# Health, Safety, and Environment Consideration at Every Stage of EPC (3)

## The Workflow of the JGC Group's EPC Services



EPC: Engineering, Procurement, Construction

### In Maintenance

Rigorous HSE risk assessments by specialists are conducted in the engineering phase for various industrial plants, and risk mitigation measures determined to be necessary are borne out in the engineering and construction work. However, over years of plant operation, facilities age and operating conditions or feedstock composition may change. In some cases, chemical substances not assessed as risks at the time of construction become recognized as health risks. In recent years, the necessity of the timely reassessment of HSE risks that may potentially increase over the course of long-term plant operation has long been advocated and plant operators recognize the need for this as well.

Utilizing its ability to act as a third party with the latest technology, knowledge, and ability to supply needed resources to plant operators, the JGC Group actively supports plant operators in conducting risk assessments at operating plants. Accidents at energy industry facilities carry an inherent risk of becoming worst-case scenarios. The JGC Group offers maintenance services with full consideration of these needs and risks.

### Considerations for Maintenance

#### HSE Risk Assessment in Existing Plants

When plants have to undergo successive upgrades because of their age, environmental and health standards initially set as requirements when the plants were built become often difficult to maintain. Aiming at improving the environmental performance and safety of such aged plants, JGC offers HSE risk assessments and support services. We conduct surveys during plant operation and identify problems through HSE-specific examinations. Taking advantage of the experience we have gained from numerous plant construction and maintenance service contracts, we offer realistic propositions that bring significant improvements.

### In Facilities Decommissioning

JGC also strives to minimize environmental impacts in dismantling work. For example, in the course of several hospital construction projects and pharmaceutical laboratory renewal projects we have executed since 2009, we used construction drawings and materials analysis to confirm the presence or absence of asbestos dust, PCBs, chlorofluorocarbons, and other harmful materials before dismantling facilities or existing buildings. Based on the results of the analysis, we sought to minimize environmental impact by preventing asbestos dispersion, recovering and decomposing chlorofluorocarbons etc. We measured asbestos particle concentration in the air before, during, and after construction and confirmed that asbestos had not been dispersed outside the work area.

In addition, we work on preventing occupational accidents and diseases by giving every consideration to the health and safety of workers. Measures taken include risk assessments, special health checks, wearing of personal protective equipment such as fully protective masks, and use of adequate dust control in working environments.

In an effort to reduce the processing volume of industrial waste generated during decommissioning, we dismantle each type of waste separately and promote waste recycling and reuse. In this way, we have achieved a recycling rate of 100% for concrete and asphalt. We use industrial waste control manifests to ensure appropriate treatment for industrial waste at every stage up to final disposal.

#### Consideration During Engineering and Construction of Pharmaceutical Plants

##### Engineering System for Environmentally-Conscious Facilities

During the engineering and construction of large pharmaceutical plants, laboratories, or hospitals, one major issue is to control their huge energy consumption and mitigate the environmental impact of the facility while securing its necessary functions. When designing and constructing buildings, air conditioning and electrical facilities, JGC uses optimization technology and assessment systems for low-carbon air conditioning and electrical systems, providing owners (operating companies) with facilities that can be operated in an environmentally-conscious manner.

#### Introducing “HSE Moments”

Since September 2010, JGC has introduced “HSE Moments,” five-minute lectures given at the opening of meetings of the Operations Steering Committee, which are attended by officers and executives. The purpose is for management to take the lead in addressing HSE matters, in consideration of JGC’s aim to be a No. 1 HSE contractor. These lectures raise HSE awareness at JGC through a wide range of topics, from themes closely related to day-to-day business to contents that stimulate intellectual interest. So far, the topics have included lectures such as “Analysis of Age and Experience of Persons Injured in Occupational Accidents,” “Main Industrial Accidents in Japan—Causes and Countermeasures,” “The Signaling System of British Railways and its Intrinsic Safety,” and “Biodiversity and the Response of Global Corporations.”



HSE Moments

#### Management and Control of Hazardous Chemical Substances

In overseas construction sites, we use the management system Control of Substances Hazardous to Health (COSHH) as part of our HSE efforts. COSHH is a framework of safety practices that include obtaining in advance the Material Safety Data Sheets (MSDS) of materials to be used, creating registers of harmful substances, and working to prevent the potential hazards posed by these substances. An MSDS contains safety guidelines for a given chemical substance, including information on hazards, storage methods, handling methods, which personal protective equipment should be worn when handling the substance, warnings regarding routine or non-routine use, recommended first aid measures in case of direct contact, emergency measures in case of soil contamination after accidental spillage, disposal of waste products after use, and so on. Before any operation, JGC conducts a special training session based on MSDS data for supervisory staffs and all workers involved, to ensure a comprehensive safety management system.



Handling of chemicals substances



Hazardous substance storage area

# Occupational Health and Safety

In accordance with our Health and Safety Policy, JGC conducts health and safety management covering the JGC Group companies and business partners. Above all, we focus on the prevention of occupational accidents at construction sites.

## Health and Safety Management Structure

The HSE Committee deliberates on important safety matters for the entire Group. It also reports to the Operation Steering Committee, which is chaired by the President. Matters decided by the HSE Committee are promptly acted upon by the various company divisions.

An audit group appointed by the chairman of the HSE Committee conducts health and safety audits at principal construction sites in Japan and overseas, and reports the audit results to the Operation Steering Committee.

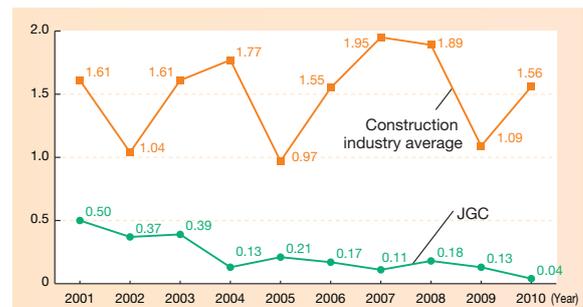


Health and Safety Management System

## Safety Performance

As a result of continuous implementation of health and safety improvement measures group-wide, our incident rate\* (ILO method) has remained at around 0.2 for the past ten years, a lower level than the average incident rate of 1.4 for the construction industry as a whole. In addition, annual Total Recordable Injury Rate (TRIR) targets have been set specifically for domestic and overseas projects, with monthly status of achievement circulated within the company to raise the awareness of safety. The TRIR is a workplace safety indicator that includes the number of cases of accidents without first aid cases. For fiscal 2010, JGC's TRIR for domestic projects was 0.60 against a target of under 0.60, and 0.08 for overseas projects against a target of under 0.18.

\* The incident rate expresses the occupational accident frequency as the toll of occupational accidents per million hours worked.



Comparison between the Incident Rate at JGC and in the Japanese Construction Industry (ILO Method)

## HSE Conference Hosted by the President

Every year in July, JGC holds an HSE conference hosted by the President. Approximately 120 corporate officers, project division heads, project department heads, project managers, and construction managers participate in the conference, where they discuss ways to improve health and safety measures and prevention measures for common occupational accidents. Through the conference, JGC seeks to enhance the health and safety awareness of officers and employees and demonstrate the leadership of the top management in HSE matters.

### Consideration for Worker Safety

#### Measures for Traffic Accident Prevention

JGC is strengthening its measures to prevent traffic accidents at overseas sites and bases. In fiscal 2010, we introduced a thorough management of vehicle operation, establishing the Seven Golden Rules for accident prevention, a traffic safety management system, and the In-Vehicle Monitoring System (IVMS). We also revised the guidelines for the prevention of traffic accidents overseas. In addition, to continuously monitor the status of traffic safety measure implementation at overseas sites and bases, JGC's management conducts traffic safety audits while mandating the submission of Monthly Traffic Safety Reports and semiannual reports.

# Environmental Consideration in Investment Projects and Research & Development

In this section, we report on the ways we consider the environment in the investment projects we promote based on our accumulated expertise in plant construction, and also in the research and development that supports our engineering business.

## Enterprise Investment Business

In addition to the EPC business, the JGC Group, as the strategic equity partner, is involved in infrastructure projects (desalination and power generation), renewable energy projects (solar thermal and solar photovoltaic power generation), resource development projects (for oil, gas, and other resources), CDM projects, new energy development projects, as well as environmental catalyst and fine chemicals manufacturing projects.

As a general rule, in the enterprise investment business, we keep the following objectives in mind:

- Development of social infrastructure
- Environmental improvement on a local or global scale
- Improvement in energy use efficiency
- CO<sub>2</sub> reduction and utilization of natural energy

In investment projects, from the feasibility study stage onward, we abide by the environmental regulations of the country or region, as well as the environmental standards set down by the World Bank Group. In our current desalination and power generation projects, we are performing detailed environmental impact assessments, and are working in compliance with the aforementioned environmental standards and regulations.

The JGC Group makes investments with the belief that environmentally considerate projects increase corporate value for the JGC Group and for our business partners.



A desalination and power generation project (Saudi Arabia)

## Research and Development

JGC conducts research and development, principally testing, at our Research and Development Center in Oarai, Ibaraki Prefecture.

At the Research and Development Center, we treat wastewater generated as a by-product of the tests we conduct by filtering, adsorption, and neutralization, in strict compliance with voluntary management criteria as well as relevant laws, ordinances and regulations. We dispose of treated water in accordance with environmental standards. In controlled areas where we use radioactive isotopes, we strive to reduce the amount of test waste liquid and hand washing wastewater generated. We treat these liquids and wastewater by ion exchange, filtering, adsorption, and concentration, and recycle them within the controlled area. Under no circumstances do we discharge this water outside the controlled area.

Furthermore, we release exhaust from the controlled area after filtering it through a high-performance HEPA filter, with continuous monitoring to confirm that it complies with emission control standards.

We aim to reduce the amount of industrial waste generated within the Research and Development Center, and we separate and dispose of waste in compliance with industrial waste disposal standards.

Part of a controlled area within the Research and Development Center suffered damage during the Great East Japan Earthquake of March 2011 and subsequent aftershocks. However, this was minor damage (fixing bolts dislodged between a wall and the duct of an indoor air exhaust ventilator) and we reported to the Ministry of Education, Culture, Sports, Science and Technology (MEXT) that no impact had occurred on the environment.



JGC Research and Development Center

# Management

## Environmental Consideration Based on Environmental Management

The JGC Group develops its business focusing on creating sustainable local communities and protecting the global environment. The specific environmental factors we take into consideration in the process of the business development are detailed in the previous section, “Health, Safety, and Environment Concerns in Project Activities (Project).” JGC also strives to improve the way we address environmental issues through the continuous improvement of our Environmental Management Systems (EMS). The year 2010 was declared as the International Year of Biodiversity by the United Nations, and it was the year of the “10th Conference of Parties to the Convention on Biological Diversity (COP10)” held in Nagoya. This section also reports on the efforts of the JGC Group for the preservation of biodiversity.

**To realize our Environmental Policy, we promote the reduction of environmental impacts through all business activities.**

In addition to quality and cost, clients in recent years have been placing more emphasis on construction safety and environmental considerations for facilities in operation or to be constructed. This trend is not limited to JGC’s clients alone, but is developing worldwide.

JGC has long emphasized HSE in plant construction. We have established a HSE Committee chaired by a Managing Director and deployed a company-wide HSE policy while balancing client requirements with social and economic needs as an engineering company.

Under the leadership of the HSE Committee, several relevant departments are in charge of overseeing concrete operations through mutual cooperation.

- **Quality Assurance Safety & Environment Office**  
: Management of and guidance on general HSE matters
- **HSE Systems Department, Engineering Division**  
: In charge of HSE in engineering for each project, from basic planning to part of construction planning
- **Construction Department, Construction Management Division**  
: In charge of HSE regarding overseas construction projects
- **Construction Management Department, Industrial & Domestic Project Division**  
: In charge of HSE regarding domestic construction projects

In addition, HSE Committee members from each division continuously conduct routine HSE activities in offices.

In this way, the JGC Group’s management recognizes that raising the awareness of HSE management within the company is essential, and takes the lead in implementing it.

To document its environmental management systems, JGC has also established an Environmental Manual in 2003 in accordance with ISO 14001.

# The JGC Group's Environmental Management

In the context of more stringent regulations, more severe environmental issues, and growing interest in sustainable development, JGC has set forth the following policy regarding its environmental performance.

## Environmental Policy

JGC, as a professional engineering contractor, is committed to achieving environmental excellence in both its corporate operations and the services it renders its clients. To meet this commitment, JGC has hereby established the following principles, which shall be applied throughout its operations.

- We shall endeavor to preserve the natural environment through the prevention of pollution and the conservation of energy and natural resources.
- We shall provide our clients with technical solutions that conserve energy and natural resources, and reduce pollution and other adverse environmental impacts.
- We shall fully comply with both environmental laws and regulations, and the environmental requirements of our clients.
- We shall reduce the production of waste through measures that emphasize reuse and recycling.
- We shall apply the following specific principles to the execution of our EPC projects:
  - Engineering Phase:  
We shall reduce the adverse environmental impacts of completed plants by minimizing the energy and resource consumption of each plant, and minimizing emissions and waste production.
  - Procurement Phase:  
We shall give preference to vendors that adopt environmentally-friendly manufacturing practices.
  - Construction Phase:  
During construction, we shall endeavor to minimize emissions, adverse impacts on the surrounding environment, energy and resource consumption, and waste production. Furthermore, we shall ensure that our subcontractors adopt work practices consistent with this principle.

To ensure the thorough, consistent and effective implementation of this policy throughout our operations, JGC shall establish, maintain and continually improve a corporate Environmental Management System in conformance with ISO 14001.

**Koichi Kawana**  
President and Chief Operating Officer,  
JGC Corporation  
1st July 2011

## Engineering is in Essence an Activity that Contributes to Environmental Conservation

JGC's engineering business, which involves providing engineering, procurement, and construction (EPC) services for oil and natural gas production plants, is intrinsically related to environmental conservation.

Since the 1960's, JGC has been grappling with environmental issues in its capacity as an engineering company. We remain keenly aware that our business activities in and of themselves must contribute to environmental conservation, and we declare that awareness in the JGC corporate philosophy. We have tested various innovations and

improvements aimed at improving environmental efficiency over the course of the EPC process, and won accolades from clients for our efforts.

In enterprise investment, a new sector outside of the EPC business, JGC is expanding further the scope of its activities that contribute to environmental conservation, for instance with solar thermal projects.

Each year, we achieve significant results from environmental impact reduction at construction sites and the home offices, including CO<sub>2</sub> reduction.

# Environmental Objectives, Targets, and Achievement

In accordance with its Environmental Policy, JGC strives for continuous improvement of its environmental management systems by setting environmental objectives and targets, and measuring and assessing achievement as shown in the table below.

## ● Fiscal 2010 Results and Fiscal 2011 Improvement

E: Completely implemented G: Extensively implemented NG: Not yet implemented  
 ↷: Substantial modification of environmental improvement measures  
 →: Continuation of environmental improvement measures

Activity objective	Fiscal 2010 results	Assessment	Initiatives for fiscal 2011	Improvement
Implementation of the Zero Emissions Initiative	<ul style="list-style-type: none"> <li>• CO<sub>2</sub> Emissions reduced to Kyoto Protocol level.</li> <li>• Soil pollution from leaks reduced to almost zero.</li> <li>• Zero industrial waste: objective achieved.</li> </ul> (see P27)	G	New start with name changed to “Zero Emissions Initiative 2015,” setting of medium-term and long-term targets, coupling with environment business promotion (enterprise investment: including shift to renewable energy, etc.) (see P28)	↷
Setting of medium-term targets	Medium-term (2020) and long-term (2050) targets established for CO <sub>2</sub> and zero waste.	E		
Environmental investment	Investment in emission-reduction credits, new energy, and water projects (to fiscal 2010). 13 of 18 investment projects	G		
Review of environmental targets	In departments that provide supervision/guidance, setting of environmental targets directly linked to original business, strengthening of linkage with quality management systems. (see P29)	G	Promotion of environmental improvements directly linked to original business.	→
Strengthening of internal auditing	Implemented at all overseas sites. Currently implemented 4 times in total. Score: 80 points (target:75 points)	E	Planning for multiple implementation at all overseas sites: 29 sites in total. Target:77 points	↷
Strengthening initiatives for biodiversity	Various initiatives besides forest conservation activities in watershed forests (expansion also at overseas sites and in Group companies.) (see P30)	G	Expansion of biodiversity initiatives directly linked to original business.	→

### Notes:

- Office activities** ... Regarding environmental targets for office activities in each department, environmental performance has reached a satisfactory level that indicates saturation. Consequently, environmental improvements in offices are now implemented with environmental targets converted into operation and maintenance items.
- Project execution** ... Divisional environmental targets for project execution were set for environmental improvements in the original business and were matched to quality targets. Consequently, targets cover a broad range of division-specific items, they are loosely linked to the quality management systems, and they produce steady results. (see P29)
- Group companies** ... Group companies also actively engaged in activities of the “Zero Emissions Initiative” and obtained significant results in environmental improvement. However, because these companies conduct very diverse forms of business, summarized environmental targets are difficult to express, and for this reason they are not mentioned in this report.

## Promotion of the Zero Emissions Initiative

Since fiscal 2008, as a part of its corporate social responsibility, the JGC Group has achieved environmental improvements through the Zero Emissions Initiative, which aims to reduce the harmful by-products of JGC's business activities to zero. The Zero Emissions Initiative covers the head office, the Research and Development Center, JGC construction sites in Japan and overseas, the JGC Group companies in Japan and overseas, and domestic and international sales bases.

- **The JGC Group Offices**

Environmental improvements were promoted in offices by adopting an environmental target of a five-year average improvement of 1% or higher in energy-related CO<sub>2</sub> emissions units.

- **JGC Domestic Construction Sites**

Environmental improvement targets were quantified in

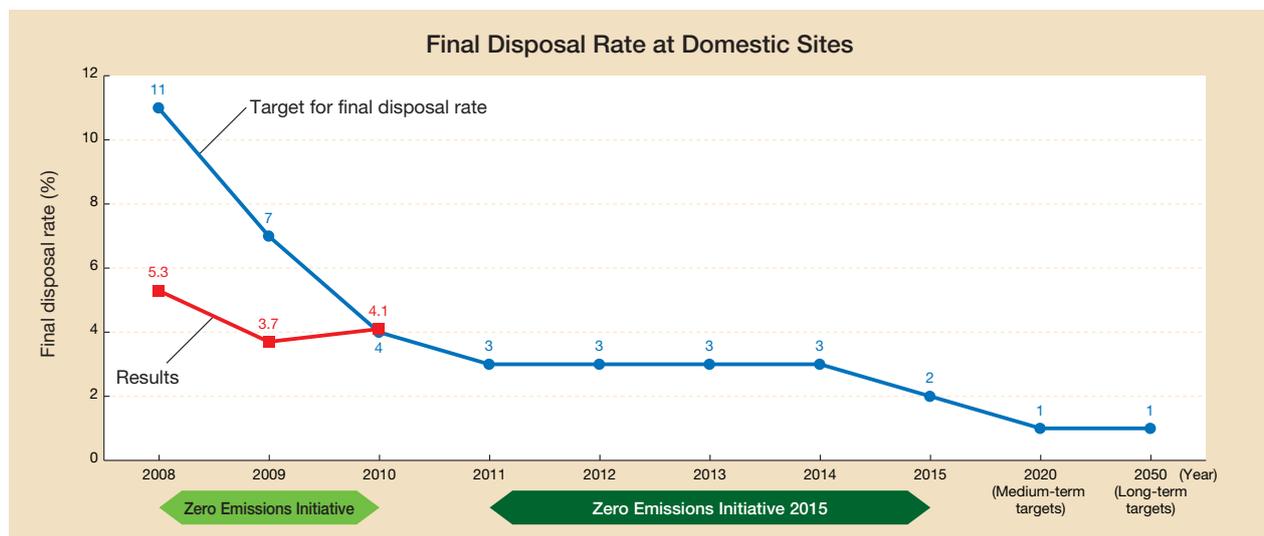
three areas: final disposal rate, number of leaks, and CO<sub>2</sub> emission units. Targets for the final disposal rate and CO<sub>2</sub> emission units were reached, while the number of leaks was reduced. The graph below shows targets and results for the final disposal rate (one-recycling rate).

- **JGC Overseas Construction Sites**

Compared with domestic sites, overseas sites have different conditions for each site, which make it challenging to quantify environmental improvement targets. In this difficult context, in an operating environment that tends to lack sufficient recycling mechanisms, efforts were made regarding the use of valuable resources, rigorous reuse of materials, and prevention, preparation of treatment, and handling of oil leaks. In addition, internal HSE audits are conducted at all sites.

- **Efforts in Group Companies**

Because these companies conduct extremely varied forms of business, they pursued independent efforts aiming at zero by-products, based on their respective business characteristics.



# JGC Environmental Indicators

Actively contributing to environmental conservation, the JGC Group is obtaining results through its environmental improvement efforts in a wide range of areas. We present indicators of environmental performance mainly in the area of by-products, which can be easily quantified. We also cover the “Zero Emissions Initiative 2015” taken by the JGC Group as environmental improvements activities.

## ● Zero Emissions Initiative Environmental Performance

Environmental indicators		Unit	Fiscal 2008	Fiscal 2009	Fiscal 2010	Fiscal 2011 forecast
<b>JGC sites in Japan</b>						
1. Final disposal rate of industrial waste	Result (Target)	%	5.3 (11)	3.7 (7)	4.1 (4)	3 (3)
2. Sites that achieved zero waste	Result	Sites	0	4	9	5
3. Number of leaks	Result (Target)	Leaks	0 (0)	2 (0)	1 (0)	0 (0)
4. Energy-related CO <sub>2</sub> emission units	Result (Target)	kg-CO <sub>2</sub> /hour	1.05 (1)	0.94 (1)	0.75 (1)	1 (1)
<b>Environmental accidents, etc.</b>						
Environmental accidents	Notification	Accidents	0	0	0	0
	Other	Accidents	0	0	0	0
Spills within facilities	JGC sites in Japan	Leaks	1	2	1	0
	JGC overseas sites	Leaks	14	1	7	0
<b>JGC sites in Japan</b>						
Energy consumption	Oil, gas, electricity	KI Crude Oil equiv.	67,907	65,231	70,630	70,000
Waste	Industrial waste	tons	36,128	36,056	34,106	36,800
	Specially controlled waste	tons	356	320	288	300
Energy-related CO <sub>2</sub> emission	Direct / indirect emissions in total	tCO <sub>2</sub> equiv.	154,017	126,177	138,934	138,500
<b>The JGC Group overseas</b>						
Energy consumption	Oil, gas, electricity	KI Crude Oil equiv.	19,475	11,748	25,484	25,700
Waste	Non-hazardous waste	tons	28,850	22,161	58,844	58,800
	Hazardous waste	tons	2,259	42	1,200	1,200
Energy-related CO <sub>2</sub> emission	Direct / indirect emissions in total	tCO <sub>2</sub> equiv.	57,114	31,880	73,561	73,300

JGC collects, analyzes, and assesses environmental data for the head office, the Research and Development Center, JGC construction sites in Japan and overseas, the JGC Group companies in Japan and overseas, and domestic and international sales bases. However, by-products produced by business activities vary substantially by country and project

type. In addition, some construction sites are managed directly by clients, making it difficult for JGC to collect data. For these reasons, major differences in our environmental monitoring occur from year to year. Accordingly, we are implementing CO<sub>2</sub> emission unit management on a working-hour basis.

### Zero Emissions Initiative 2015

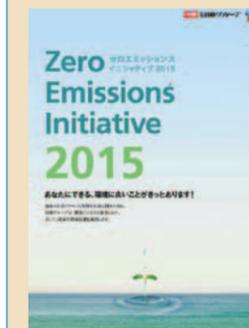
Since the start of environmental improvement activities of the “Zero Emissions Initiative” in 2008, every indicator has confirmed sufficient improvement, and the targets aimed at have been achieved. After the start of its five-year medium-term management plan “New Horizon 2015” in 2011, the JGC Group has begun a new initiative, “HSE 2015,” with the objective of becoming a “HSE No. 1 Contractor.”

In accordance with the expansion of our business fields, and emphasis on Health, Safety, and Environment (HSE) in our policies, we do not limit the environmental improvement activities of “HSE 2015” to reducing immediate by-products (wastes, leaks, greenhouse gases). Medium- and long-term targets (2020, 2050) are also set, while “Environmental Efforts through Business Activities” are promoted.

The JGC Group has now renamed its initiative “Zero Emissions Initiative 2015.” To grow toward its vision, it will accelerate its activities: Proposing, planning and implementing projects to realize the needs of global environment conservation, and operating businesses and investing in them when necessary.

#### The JGC Group's Vision

- Companies that contribute to the sustainable development of the planet
- Companies respected worldwide
- A truly global group of companies



Poster for Zero Emissions Initiative 2015

# Continuous Improvement of Management Systems

In December 2003, JGC obtained the ISO 14001 certification from Lloyds Register Quality Assurance (LRQA). ISO 14001 is the international standard for environmental management systems. Since then, the certification has been renewed twice, and the audit required for maintaining it in fiscal 2010 was completed in March 2011, including at overseas sites.

## Environmental Improvement Activities in Line with Our Business

Because environmental improvement activities at JGC's Headquarters tended to center on reducing waste, paper, and electricity consumption, our task became to shift this focus to activities in line with our actual business. To accomplish this, we reviewed our methods for identifying environmental perspectives and our procedures for target setting, with the participation of the heads of all divisions. A common recognition of the following points was reached.

- While we solve environmental issues through our original business and aim for sustainable development in society, it is important to link these processes to the creation of corporate value and improvements in competitiveness.
- While concerns over environmental issues are rising worldwide, JGC is contributing directly and indirectly to solutions through its original core business. JGC recognizes sustainability as an issue it has to address in this particular business.
- Important points that JGC must consider to develop itself sustainably are as follows:
  - (1) Implementing adequate operation and maintenance to prevent environmental problems from arising in the future.
  - (2) Continuing to implement improvements to increase corporate profits, while giving consideration to environmental matters.

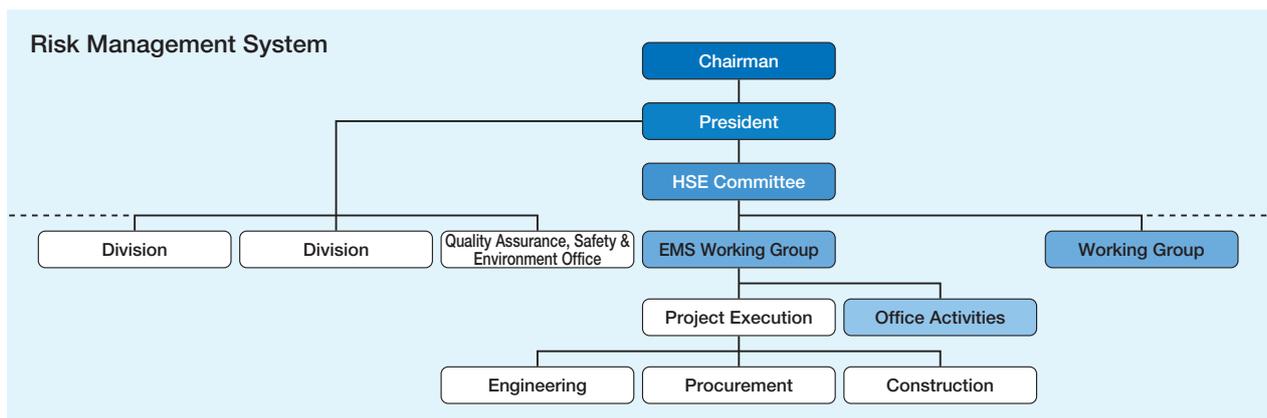
With this common recognition, JGC continuously makes a concrete review of the significance of environmental objectives and targets, and implements environmental management activities from the following perspectives.

- Environmental management activities conducted with environmental objectives and targets are not separate from business, they are business.
- The operational policies of divisions and departments are determined for substantial performance improvements of the organization and its operations.
- Our operational policy in itself is our quality targets.
- In departments that have an indirect effect on the environment, environmental targets and quality targets can be matched together.

In this way, JGC conducts environmental improvement activities in line with its original business, by loosely linking its environmental management systems to its quality management systems.

## Recycling of Construction Waste

JGC aims at minimizing final waste through the rigorous implementation of its "Zero Emissions Initiative." In fiscal 2010, we have reduced the final disposal rate of domestic construction projects to 4.1%, which is very close to our target of 4% or less. On every site, before contracting disposal to a provider of intermediate waste treatment services, we confirm its recycling rate with our own industrial waste manifest. In particular, because there are significant differences between contractors regarding the treatment methods and recycling rates of construction sludge, we carefully compare treatment methods and costs. Before starting construction, we also establish an adequate waste separation plan based on the characteristics of waste to be generated. In addition, through the rigorous separation of wastes in accordance with this plan, we seek to improve the recycling rate during construction.



# Biodiversity Initiatives

The year 2010 was declared as the International Year of Biodiversity by the United Nations. Considering the conservation of biodiversity as an important task in its corporate activities, the JGC Group has implemented various initiatives in this regard. We report here on examples at overseas construction sites and Group companies.

## Greening of Areas through the Reuse of Domestic Wastewater

With the exception of its central area, Saudi-Arabia's Jubail District is not equipped with a sewage system. In 2008, JGC investigated the possibility of making efficient use of domestic wastewater from cooking, laundry, and other uses in the housing units of a chemical plant to be built. At the start of construction, JGC installed a wastewater treatment facility using microorganisms in an aeration tank, and the disinfected water was used as irrigation water for trees.

Today, the housing development contains approximately 800 trees, with flower gardens and lawns. They receive all the treated water (80 to 120 m<sup>3</sup>) every day, and because it is rich in nutrients, the trees have grown quickly. Now, more than two years after planting, the area is covered with vegetation and wild birds can be spotted.

## Fence Installation to Protect Camels

On the construction site of a natural gas processing plant in Algeria, several ponds were installed to store temporarily wastewater from the water treatment equipment of the site's housing units. Because the area is open desert, there were no concerns about the entry of non-authorized personnel, and the ponds were not fenced.

However, the periphery of the site is used for the grazing of camels, who are precious partners for people who live in the Sahara desert. In consultation with the client, who had placed the order for the construction of the plant, JGC installed fences at no charge to prevent the camels from falling into the ponds or drinking their wastewater.



Camels can spend their days serenely: No more danger of falling in the ponds

## Mangrove Planting and Cleaning of Sea Turtle Spawning Grounds (JGC Philippines)

In July 2010, employees of JGC Philippines conducted environmental conservation activities as volunteers on two sites, in partnership with World Wide Fund for Nature (WWF) Philippines.

### (1) Mangrove planting in Subic Bay, Zambales Province

Each of the 40 participants planted two mangrove saplings in this area, in which existing mangrove forests have quickly disappeared because of the development of an industrial district.

### (2) Cleaning of Spawning Sites of Sea Turtles in Morong, Bataan Province

Thirty-five volunteers cleaned the site by collecting and separating the waste that littered the shore. In total, more than 80 kg of waste were recovered.

## Provision of Information on Biodiversity

In October 2010, the "10th Conference of Parties to the Convention on Biological Diversity (COP10)" was held in Nagoya. Employees of JAPAN NUS, a JGC group company, participated by giving lectures on the themes of biodiversity and its efficient use in two symposiums, "The Conference of Parties to CITES and Cultural Diversity" and "Before COP10 Begins—Marine Biodiversity and Cultural Diversity."

In its booth at the "Biodiversity Exchange Fair," JAPAN NUS also displayed and distributed materials to present to visitors its efforts for the conservation of biodiversity.

## Forest Conservation in the Watershed Forests of Kanagawa Prefecture

On August 1, 2008, to commemorate its 80th anniversary, JGC has become a watershed forest partner in Kanagawa Prefecture's Water Source Conservation Project and launched an ongoing environmental conservation project in the forest. Through the project, employees of the JGC Group assist with watershed forest conservation while deepening their understanding of the role of watershed forests and the importance of coexistence with nature. In fiscal 2010, 53 employees participated in the forest walking tour and aquatic wildlife observation tour and had the opportunity to enjoy contact with nature in four seasons.

In connection with these conservation activities, JGC offered a training session on April 26 at Matsuda Community Center, Kanagawa Prefecture. JGC provided 18 Forest Instructors of Kanagawa Prefecture with the hazard prediction training (*Kiken Yochi* or KY) it delivers on its own construction sites. The session was provided following a request from the instructors, who consider JGC's hazard prediction method as valuable for safer forestry work.

# Technology

## The JGC Group's Environmental Technology

The JGC Group applies the knowledge we have acquired through years of experience with a wide range of engineering projects to various environmental businesses, including electric power and water projects and Clean Development Mechanism (emissions trading) projects. In this section, we report on how the JGC Group companies have put our environmental technology to use in contributing to environmental conservation efforts. These efforts include environmental clean-up projects, development of low-environmental-impact energy resources, and initiatives to realize a low-carbon society.

**Combining technology that enriches our lives with technology that protects the environment, JGC works toward the realization of a sustainable society.**

In our global plant EPC business, JGC efficiently combines a wide range of elemental engineering technology while introducing proprietary processes when necessary. Although each kind of industrial plant we construct serves the purpose of improving our standard of living, plants may also have an impact on their surrounding environment in various ways.

JGC has always worked to create the optimal plant both for customers and society, continuously striving to combine advanced performance with minimization of environmental impact. More sophisticated plant EPC technology can be translated to more advanced environmental conservation technology.

In this way, JGC works to develop and promote diverse environmental technology that can be transformed into business solutions.

The JGC Group includes subsidiary and affiliate companies that operate in the EPC business, similar to JGC, as well as companies in the catalyst and fine chemicals business, and companies that provide process licensing, inspection, maintenance, and consulting services. In this section, we report on the new environmentally-friendly technology and mechanisms being developed by these group companies.

Looking ahead to the next generation, the JGC Group strives actively to ensure that our development and introduction of new technology can contribute to realizing a sustainable society.

# Using JGC's Environmental Technology to Solve Difficult Issues (1)

## Development of an Efficient CO<sub>2</sub> Separation and Recovery Technology

JGC has developed the High Pressure Acid-gas Capture Technology (HiPACT) process in partnership with BASF of Germany. HiPACT is a technology for high-pressure recovery of the CO<sub>2</sub> in natural gas and synthetic gas. The technology makes it possible to greatly reduce the energy use and cost of CO<sub>2</sub> underground storage, and could help promote widespread use of Carbon Dioxide Capture and Storage (CCS).

After the completion of basic technology pilot testing at our Research and Development Center, JGC conducted demonstration testing of CO<sub>2</sub> recovery (40,000 tons per year) using actual natural gas at the carbon dioxide gas removal facility of INPEX Corporation's Koshijihara Gas Plant (Nagaoka City, Niigata Prefecture) in 2010. Now that testing has confirmed that energy reduction targets can be achieved, commercial applications are possible. Because it reduces costs and operational energy, HiPACT could contribute to the early dissemination of CCS, which is viewed throughout the world as a promising technology for achieving large-scale reductions of CO<sub>2</sub> emissions. Thus, this is one way in which JGC is contributing to the mitigation of climate change.



Koshijihara Gas Plant of INPEX Corporation

## Proposal to Solve Housing Shortage in Middle East and Gulf Countries

Middle East and Gulf countries have two urgent issues to address, both of which stem from rapid population growth: an expanding need for development of infrastructure such as for water and power supply, and a need to address a shortage of housing.

To help solve the housing shortage in these regions, JGC is working on supplying housing units that use technology from Japanese manufacturers of pre-engineered houses. JGC is proposing to supply housing units adapted to local conditions by adopting specifications and construction methods suitable for the climates, environments, etc., of the regions in which the housing will be built, while taking advantage of the excellent housing technology provided by Japanese companies.

JGC has recently constructed a model house in Al-Khobar, on the eastern coast of Saudi Arabia. The three-story steel frame house, which opened in July 2011, offers 430 m<sup>2</sup> of total floor space. By using specially structured heat-insulating material and adopting Japanese architectural features for protection against direct sunlight, this house consumes 70% less power for cooling than conventional Saudi Arabian houses. Its construction time of approximately five months, almost one-third of that generally required in Saudi Arabia, has also attracted much interest. Steel frame houses are not yet common in these regions, but by offering advanced technology from the Japanese housing industry, JGC is proposing energy-saved housings in Saudi Arabia and the Middle East.



The completed model house

# Using JGC's Environmental Technology to Solve Difficult Issues (2)

## CDM Projects in China

Clean Development Mechanism (CDM) emission-reduction projects are conducted as cooperative efforts between developing countries and developed countries. Emission-reduction credits issued for CO<sub>2</sub> emission control and/or CO<sub>2</sub> absorption enhancement achieved by a given project are divided among the project participants. This system makes it possible for developed countries to apply emission reductions made in investment recipient countries toward the achievement of their own CO<sub>2</sub> emission reduction targets. JGC is participating in several CDM projects in China.

### 21.9 Million-ton greenhouse gas reduction from chlorofluorocarbon substitute gas recovery and decomposition

JGC, in partnership with Marubeni Corporation, has been executing the Juhua CDM project, the first-ever Japan-China CDM project. The objective of the project is to acquire Certified Emission Reduction (CER) credits through the recovery and decomposition of the greenhouse gas HFC23 at a chlorofluorocarbon substitute production plant in China's Zhejiang Province. The plant is owned by Zhejiang Juhua Co., Ltd. Greenhouse gas equivalent to 40 million tons of CO<sub>2</sub> will be reduced over a period of seven years. The decomposition facilities began operation in August 2006, and greenhouse gas reductions of approximately 21.9 million tons were achieved by March 2011.

### Acquisition of CER credits of 30,000 tons through residual heat power generation at a cement plant

A second CDM project in which JGC is participating involves using residual heat from cement plants to generate electricity that can in turn be used to power the plants themselves. JGC has undertaken the project in partnership with Huaibei Mining (Group) Cement Co., Ltd., and the plants are located in China's Anhui Province. JGC obtained emissions reduction credits for the equivalent of approximately 30,000 tons of CO<sub>2</sub> per year from the project by March 2011, and plans to obtain further credits for approximately 20,000 tons during fiscal 2011.

### Acquisition of CER credits of 120,000 tons through cement raw material substitution

China is the world's second-largest consumer of energy, and also accounts for 40% of the world's cement output. However, since many cement production facilities are outdated, China uses large quantities of limestone (calcium carbonate), which creates high levels of CO<sub>2</sub> emissions. Many Chinese cement plants also do not effectively utilize the surplus energy released during cement production.

JGC, in partnership with Elion Jidong Cement Co., Ltd. of the Inner Mongolia Autonomous Region, is currently involved in a cement plant CDM project that applies a new cement production method using a different raw material as a substitute for limestone. In conventional cement production, "clinker," the intermediate product, is produced using limestone as a raw material. In this project we use carbide residue (calcium hydroxide), a substance produced as a by-product at vinyl chloride production plants, as a substitute for limestone. In this new method, the by-product generated through clinker production is water vapor, not CO<sub>2</sub>. Therefore, the new method enables more than 80% reduction in CO<sub>2</sub> emissions from production processes, as well as effective utilization of carbide residue.

Through this project, JGC acquired CER credits for the equivalent of approximately 120,000 tons of CO<sub>2</sub> by September 2010, and plans to acquire the same of approximately 210,000 tons during fiscal 2011.



Elion Jidong Cement Co., Ltd. Cement Plant

### U.N. registration of a project for the recovery and use of Coal Mine Methane and Ventilation Air Methane

During coal mine operation, methane gas in the coal bed is recovered to ensure the safety of the miners. However, much of the recovered coal mine methane (CMM) is emitted into the atmosphere. In addition, the air used for the ventilation of mine shafts also contains methane gas in extremely low concentrations (0.3% to 0.7%). This is known as ventilation air methane (VAM). Since methane gas has 21 times the greenhouse gas potential of CO<sub>2</sub>, the recovery and effective use of methane gas can contribute significantly to climate change mitigation efforts, and can also improve energy conservation. A VAM recovery and utilization project in Anhui Province in China, implemented by a partnership between JGC and Huaibei Mining (Group) Co. Ltd., was registered by the United Nations as a CDM project in October 2009. This project enables emissions reduction for the equivalent of approximately 45,000 tons of CO<sub>2</sub> per year. In addition, JGC obtained U.N. registration of another CDM project to recover CMM (annual GHG reductions equivalent to 75,000 tons of CO<sub>2</sub>) in September 2010.



Coal mine VAM duct

### Medium- to Small-Scale LNG Plant Project

As the energy demand continues to rise globally, many observers consider natural gas as the most realistic solution for a bridge energy source to be used toward the advent of a low-carbon society, until renewable energy technology becomes commonplace. In addition, a large

number of countries without gas fields, such as Japan, meet their domestic demand by importing LNG.

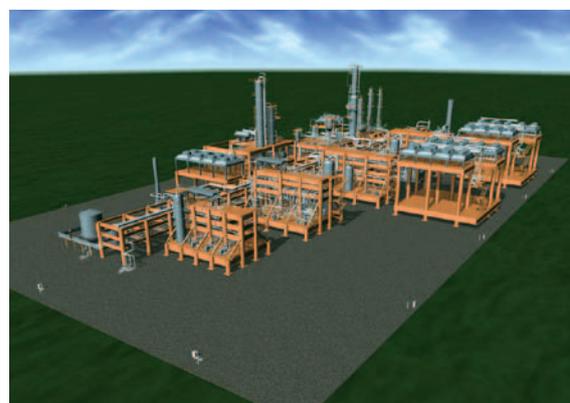
In recent years, LNG plant construction projects are scaled up to optimize investment efficiency. Many megaprojects have an annual production that exceeds five million tons and construction costs that surpass one trillion yen. Such large-scale LNG projects require vast gas fields to support them, but today, the number of large undeveloped gas fields is limited.

So far, JGC has contributed to the construction of more than one-third of the world's extant LNG plants. Making full use of the technology and knowledge it has accumulated in this field, JGC has established a concept for medium- to small-scale LNG plant businesses that can ensure sufficient economic efficiency.

#### Keywords of JGC's Proposal

- Low-cost** Standardized design for reduced engineering cost
- Short delivery** Ordering of preselected equipment and repeated orders of the same equipment for a reduced delivery time
- Compact** Modularization of plant equipment for minimized construction work on site

Through the application of these techniques, JGC will be able to work as-yet undeveloped small- to medium-sized gas fields previously considered to be unprofitable project as successful LNG operations. JGC will also shorten the time from initial planning to the start of production to about three and a half years, down from the usual six to eight years required for large LNG plants.



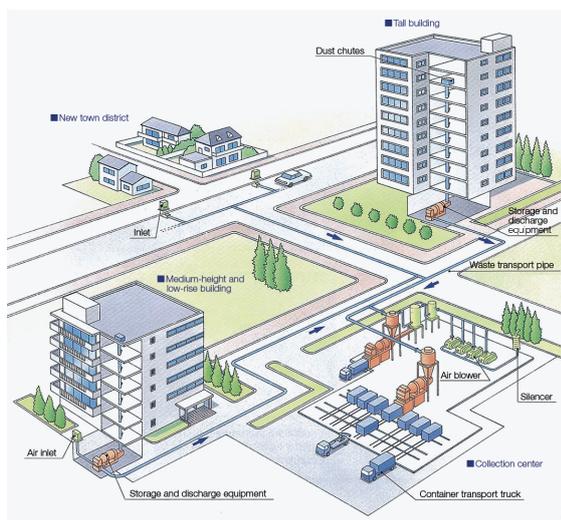
Conceptual image of completed medium- to small-scale LNG plant

# Environmental Activities at Group Companies

## Provision of Pneumatic Waste Transport System

The JGC Group company JGC PLANTECH Co., Ltd. provides engineering, construction, and maintenance services for its Pneumatic Waste Transport System. The system collects waste through waste inlets, chutes, etc., which are installed in residential and collective housing areas, and then transports it through underground pipes to the local collection center. The benefits are twofold: In addition to solving the problem of bad smells, contaminated liquids, and pests generated by waste collection stations, the system can also curb CO<sub>2</sub> emissions because collection trucks that generate them are not necessary anymore.

Recently, this system has been attracting attention overseas, and construction projects are underway in the Middle East and Korea. Having already built such systems to collect waste from several thousand households in collective housing complexes in Japan, JGC PLANTECH is also providing technical assistance to a Korean engineering company.



Conceptual view of the pneumatic waste transport system

## Introduction of a Nitrogen Oxides (NOx) Removal Catalyst in Overseas Markets

In the early 1970's, JGC Catalysts and Chemicals Ltd., a member of the JGC Group, began to develop catalysts for the flue gas de-nitrification equipment used at power plants

and other facilities. In 1976, it became the first company to offer a honeycomb structure de-nitrification catalyst (NOx removal catalyst) to the Japanese market. Subsequently, following the strengthening of NOx regulations in various countries, the company has offered NOx removal catalyst manufacturing technology licenses to companies in the EU, the US, and South Korea. By removing more than 80% of NOx, which causes photochemical smog and acid rain, honeycomb structure de-nitrification catalysts contribute to maintaining the safety of ecosystems.

In recent years, environmental awareness has grown in China and caused a sharp rise in demand for de-nitrification catalysts. In response, JGC Catalyst and Chemicals has begun offering technology licenses for NOx removal catalyst manufacturing to Chinese manufacturers. The company also offers technology licenses for manufacturing the raw materials of de-nitrification catalysts in China. It has also established a sales company in Beijing to distribute these materials and started its sales activity.

In the coming years, NOx removal catalysts manufactured under license of JGC Catalyst and Chemicals are expected to come into widespread use at power plants in China as the country's standard, and to broadly contribute to the curbing of China's NOx emissions.

## Development of Titanium Paste for Dye-Sensitized Solar Cells

Solar cells, which convert solar energy into electricity, are power generation devices that require no oil, coal, natural gas, or other fossil fuels. Solar cells have attracted increasing attention and come into widespread use in recent years as a solution to energy problems and a means of protecting the global environment.

Although several types of photovoltaic materials are used for solar cells, dye-sensitized solar cells are being heralded as a next-generation material. Dye-sensitized solar cells are made using a photovoltaic material that consists of a thin nanoparticle titanium dioxide layer uptaking with a special dye on a glass or plastic plate. These solar cells possess characteristics such as the following:

- They offer good reactivity to comparatively faint light energy such as artificial light
- They have high photoelectric conversion efficiency even with diffused light
- They require no special costs for manufacturing equipment because high-vacuum manufacturing processes are not necessary

- They come in a variety of colors, and are easy to fabricate.

An international accreditation organization (NREL: National Renewable Energy Laboratory) has confirmed that the light harvest efficiency of dye-sensitized solar cells, and even modules, outpaces that of amorphous silicon-based solar cells. Dye-sensitized solar cells are expected to come into widespread use also because of other advantages they hold over conventional solar cells. For example, they have demonstrated durability in actual use under temperatures as high as 80°C.

Two factors affect the performance of dye-sensitized solar cells. One is the preparation technique used to control the size of nanoparticles to the optimum value of 0.4 microns in nanoparticle titanium dioxide, the material that creates the light-encapsulating effect. The other factor is the preparation of a paste forming an evenly thin layer of titanium dioxide particles in exactly the same form as it is staged by the industrial level. The JGC Group member JGC Catalysts and Chemical has been developing paste preparation technology using optimum particle size and has already refined this technology to an industrial standard level. JGC Catalysts and Chemical is now improving the technology with an eye toward commercialization.

### Development and Industrial Application of High Strength and High Thermal Conductivity Silicon Nitride Substrate for Power Devices

As we move toward a low-carbon society, technology such as hybrid cars, solar photovoltaic power generation, wind power generation, fuel cells, etc., become more and more prevalent. As key components in energy efficient and energy saving technology, power semiconductor devices are now in full development.

Because semiconductor elements used in power semiconductor devices handle higher voltages and currents than common semiconductor elements, they generate a large amount of heat, and must be kept at a suitable temperature for satisfactory operation. Consequently, their substrate materials must have excellent heat dissipation properties, and excellent mechanical performance and weather resistance.

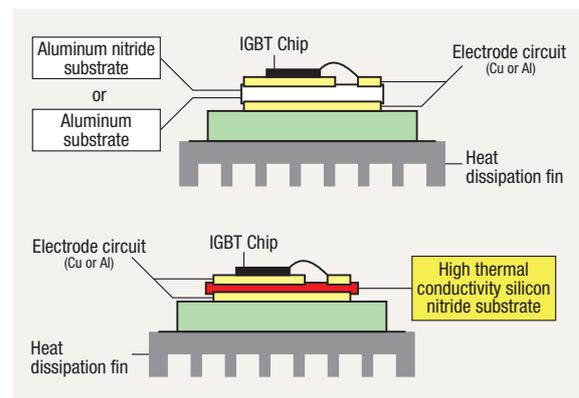
Using technologies and know-how accumulated through the manufacturing of ceramics, the JGC Group member Japan Fine Ceramics Co., Ltd. is engaged in the development of silicon nitride substrate with a high level of durability and high thermal conductivity for power

devices, for industrial application. This material has the excellent mechanical characteristics and high thermal conductivity necessary to make energy savings possible.

This development, carried out at Japan Fine Ceramics, has been adopted as an Innovation Promotion Project by the New Energy and Industrial Technology Development Organization (NEDO) for fiscal 2009.

**Characteristics of the high strength and high thermal conductivity silicon nitride**

- (1) Strength and toughness make for durability and excellent reliability
- (2) Strength of the material makes it possible to increase thermal conductivity through thinner layers
- (3) Excellent weather resistance



Heat-dissipating structure of a power device (example)

### Manufacturing of Bactericidal Enzyme Filter

Air filters do not only collect airborne dust, they also trap microorganisms such as bacteria. However, conventional filters carry risks because microorganisms trapped inside may remain alive, and proliferated bacteria and fungus may cause a secondary contamination after an outflow from the drain.

The Bactericidal Enzyme Filter developed and manufactured by Nikki-Universal Co., Ltd. has a bactericidal action on microorganisms trapped in the filter. This is why many medical facilities, food and beverage factories and pharmaceutical production plants use it as an efficient measure against microbiological contamination. By preventing secondary contamination of filters in air conditioning equipment, Nikki-Universal contributes to the safety of the air.

# Social

## Social Dimensions of Sustainability

As a professional engineering company, the JGC Group offers its employees the opportunity to improve their skills, and considers it an essential social responsibility to use these skills to give back to society at large. As a good corporate citizen, we also aim to build prosperous societies by proactively committing to technology licensing and human resources cultivation for the next generation.

**Social prosperity and the development of our business are inextricably linked.**

**Always giving consideration to its coexistence with society, the JGC Group engages in diverse activities to fulfil its social responsibility.**

### **Establishing client satisfaction and social trust, and developing our business through coexistence with society**

The above words are taken from the “Principles of Business Conduct of the JGC Group,” which was formulated to guide JGC on the path to being an enduring company that constantly achieves new development. Recognizing that our business development is inextricably linked with social prosperity, we always give consideration to our coexistence with society.

In fiscal 2011, the JGC Group formulated a new CSR Basic Policy, and systematically organized the social contribution activities it has implemented so far based on this policy.

### **The Four Priorities of the Social Contribution Activities**

#### **1. Environment:**

To actively contribute to environmental conservation

#### **2. Education:**

To support the education of the next generation of qualified professionals

#### **3. Science and Technology:**

To support science and technology that will form the foundation of sustainable development

#### **4. Local Contribution:**

To contribute to the sustainable development of the areas where we do business

In this section, we cover specific examples of activities in the fields of Education, Science and Technology, and Local Contribution.

# Personnel Development and Communication with Employees

As an engineering company, JGC's sustained growth depends upon its people. Therefore, the JGC Group focuses on personnel development and communication with its employees.

## Personnel Systems

JGC's fundamental policy for personnel systems is "autonomous development and creation of new value." In 2001, we introduced a personnel system to enable employees to autonomously develop their professional skills, while sharing the strategic direction of the company, and offering new value and contributions to customers and society. In subsequent years we have worked to firmly establish the system.

## Personnel Development at JGC Techno College

In 2001, JGC founded the JGC Techno College as a place where motivated personnel can voluntarily participate in continuing education courses. Senior staff members with long-term technical experience act as instructors at the college and organize and run the sessions, to help pass on their skills and experiences to younger employees. In addition to offering conventional in-house technical courses, the college holds sessions periodically inviting prominent experts in various fields from Japan and foreign countries. In 2010, JGC held 12 Techno College sessions and more than 1,500 officers and employees attended its courses and lectures.



JGC Techno College

## Educating Future Engineers (Piping School)

Expecting a shortage of technicians skilled in plant piping layout, the JGC Group company JGC Plant Solutions Co., Ltd has opened a Piping School in April 2007 to train students for this field. Located in Morioka, Iwate Prefecture,

the school hires high school graduates from the area with an interest in mathematics and design. After two years of intensive training in basic design techniques at the school, they refine their skills through on-the-job training (OJT) in the Yokohama area. Forty-six students that graduated by 2011 are already accumulating experience through this OJT system.

Since JGC intends to establish a design center in Morioka City in the coming future, this initiative has also attracted attention within the city because it provides young people with the stable job of designing plants, in Morioka, for projects in which the JGC Group is involved worldwide.



Practical training using drafters

## JGC Family Day (Bring-Your-Child-To-Work Day)

On August 23, 2010 JGC held JGC Family Day, to allow children from primary school grades four through six to observe their parents' workplaces. Twenty-one children of JGC employees participated in the event, the purpose of which is to develop children's social awareness and foster the concept of work and occupation. They exchanged handmade business cards with JGC Chairman Keisuke Takeuchi and employees, in addition to observing work and meetings in the actual company office. We hold this event every year to raise employee awareness of the importance of a healthy work-life balance.



Employees and children participating in JGC Family Day

# Corporate Social Responsibility

The JGC Group is keenly aware of its social responsibility as a corporate citizen. We seek a harmonious coexistence with society and aspire to contribute to local communities and society at large through our business activities.

## KAUST Industry-University Collaboration Program

In Saudi Arabia, JGC is a member company of the KAUST Industrial Collaboration Program (KICP), an industrial collaboration program at King Abdullah University of Science & Technology (KAUST), which opened in 2009.

KAUST is a graduate-studies level university established by an initiative of King Abdullah to serve as a research base in advanced technology fields including resources development, energy, water and environmental studies, biological and life sciences, catalyst- and nano-technology, and computer science. With support from the Ministry of Economy, Trade and Industry (METI), JGC has already been working for three years on academic and cultural exchanges between Japan and Saudi Arabia. However, as a member of KAUST/KICP, JGC is now providing the technologies and know-how it has accumulated over years in the field of plant construction. By this means, JGC supports the creation of next-generation technology and training of personnel that will contribute to both Saudi Arabia and the international community.

In September 2010, Japanese instructors offered 12 “Japan Courses” to present the technology and culture of their country. In total, 335 persons participated in this program, which was highly praised by many of the students and teachers who participated in the courses.



The staff of KAUST

## Building of Road Drainage Channel in Front of an Elementary School

The island of Mindanao in the southern Philippines has a tropical rainforest climate. Heavy rains cause severe flooding at an elementary school situated close to a nickel refining plant construction site on the island, to the point that children have difficulty commuting to and from

school. Therefore, JGC personnel involved in construction work at the plant conducted road improvement work on a volunteer basis to better protect the road from flooding.

The builders received a Certificate of Appreciation from the local community for the 50-m long drainage channel they built in front of the school as a service to the community. In addition to the road improvement work, an ambulance vehicle used by personnel who work on the plant construction site has also been made available to local people in the event of an emergency. A wide range of other volunteer contributions were also made to the local community, including repair of broken school desks and chairs before the beginning of the school term, re-painting of school buildings, etc.



Left: The Certificate of Appreciation from the local community  
Right: The drainage channel built at no charge

## Work Experience for Junior High School Children

The Environmental Science Laboratory (Yokohama) of the JGC Group company Japan NUS Co., Ltd. is certified to the ISO 14001 Environmental Management Systems standard. As part of its activities to present the environmental efforts of the company in the environmental field, the laboratory is providing work experience to students and offering internships. In fiscal 2010, work experience was provided to two students from Hama Junior High School, Yokohama. This year is the fifth year that the laboratory has been accepting students from this school.

Learning about marine ecosystems, the children used a microscope to observe eggs and larval fish collected by a research ship. They also performed biological analysis to determine species based on their morphology, and genetic analysis to determine species based on DNA extracted from piece of fish muscle. Using the Internet, they collected accurate information on relevant environmental

problems such as sick building syndrome and dioxins. They also studied the purpose and role of ISO 14001.

Although the two children looked nervous on the first day, they concluded the hands-on activities of the second day with a promising message, commenting that from now on they would “think more about the environment.”

### Participation in “Exciting Children’s Classes”

In September 2010, four employees of JGC Catalysts and Chemicals participated as instructors in “Exciting Children’s Classes” held at the Akasaki Community Center, Wakamatsu-ku, Kitakyushu. They presented their company and scientific experiments (paper chromatography with a water-based rollerball pen, freezing with liquid nitrogen, creation of slime) to 20 children from elementary schools of the area. Even though disinterest in science among children is a recent social concern, these classes conveyed the wonders of science to children through fun experiments and exchanges with the employees.



Freezing flowers with liquid nitrogen

### JGC-S Scholarship Foundation: Support for the Next Generation

Through the JGC-S Scholarship Foundation, JGC contributes to the cultivation of scientists and the advancement of science and technology in Japan and overseas.

The foundation was established in March 1968 with an endowment by JGC founder Masao Saneyoshi. Its principal undertakings include provision of educational loans to Japanese university and graduate school students majoring in science and technology fields, grants

to foreign students studying in Japan, and research funding assistance for young researchers.

Up to 2010, the foundation has provided educational loans to a total of 13,354 students, educational grants to 4,846 students, and research funding assistance to 1,986 researchers. Annual disbursements have reached 351 million and 650 thousand yen. To help universities (designated by the foundation) that suffered extensive damage during the Great East Japan Earthquake of March 11, 2011, the foundation has also established a special framework by significantly extending the normal framework through which grants are provided, to support students affected by the disaster.

In addition, over the course of this year, the foundation has completed the procedures to become a public interest incorporated foundation. Having received government accreditation, it has made a new start on April 1, 2011.



Investiture of scholarship loan recipient eligibility certification for fiscal 2010

### Grants to social welfare activities by the JGC Social Welfare Foundation

The JGC Social Welfare Foundation develops and provides welfare equipment for persons with physical disabilities, as well as funding for support groups and volunteer organizations for senior citizens and persons with disabilities in Kanagawa Prefecture. Since its establishment in March 1994 until fiscal 2010, the foundation has made 514 contributions to support groups, 335 contributions to volunteer organizations, and 25 contributions to other groups. In fiscal 2010, the foundation made 39 contributions to support groups, 21 contributions to volunteer organizations, and two contributions to other groups.



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