Toyo Engineering Corporation

Safety and Environmental Report

2011

Editorial Policy

- **Purpose of the report**

  This report has been prepared to present information about Toyo and its group Companies' (TOYO) safety and environmental activities to stakeholders of TOYO.

- **Reference guideline**

  This report has been prepared with reference to "Environment Guideline (2007)" of Japan's Ministry of the Environment.

- **Period**

  The report covers the activities for fiscal year 2010 (from April 1, 2010 through March 31, 2011). The data overseas cover those for calendar year 2010 (from January 1, through December 31, 2010), but also include some activities continuing from year 2010.

- **Scope**

  The report covers the activities of all the Divisions and Departments of TOYO as well as the domestic and overseas construction sites, i.e., "Global Toyo".

- **Next report**

  The next issue is scheduled for August 2012.

- **Prepared by**

  Safety, Quality and Environment Management Division / HSE Management Department (Phone 81-47-454-1678, Fax 81-47-454-1833)

Contents

Top Management Message

Aiming to be a Corporation trusted not only by Clients, but also by the Local and International Communities.

Toyo offers condolences to near and dears of those who lost their lives in Tohoku Earthquake and hope for earliest possible recovery and restoration of the affected regions. Toyo will continue its support and assistance to all extent possible, to improve the situation.

During this time of disaster, when importance of safety and reliable living is stressed, Toyo reaffirms the mission of Toyo Engineering Corporation Group which is "Engineering for Sustainable Growth of the Global Community". This is based on our global first-rate engineering capabilities by which we wish to contribute to the realization of a "Sustainable Global Community".

In the process of engineering, we consider it our Corporate Social Responsibility to satisfy the Quality and HSSE (Health, Safety, Security and Environmental) requirements in society.

Especially in safety, we place the highest priority on it, implementing a multifaceted approach. However, in the process of business solution, such as plant construction, loss of valuable human life must be prevented by all means. Our efforts, time and expenses to respect human life must take precedence over all other things. Thinking about safety every time is basic thing and by spreading the activated safety culture, we plan to impart education to all employees, because safety must be effort by one and all and not only by the people in construction.

While providing specialized services, Toyo employs energy and resource saving designs and implements minimization of environmental impact by detoxifying, reducing and recycling waste and preventing pollution by paying utmost attention to environmental concerns in plant construction. We will act as a Corporation trusted not only by our Clients, but also by the Local and International Communities.

Toyo completed 50 years since its inception in 1961. We will greatly appreciate if our endeavor to fulfill the commitment will be supported by Clients. We aim to become the most trusted and long-term partner to our Clients by offering know-how for problem solving from the Client's perspectives.

We would be highly obliged if you could give your valued views on the activities in this "Safety and Environmental Report 2011".

August 2011

Yutaka Yamada
President and Chief Executive Officer

Corporate Profile and Global Toyo

Corporate Profile (As of March 31, 2011)

- **Corporate name** : Toyo Engineering Corporation
- **Established** : May 1, 1961
- **Representative** :Yutaka Yamada, President and Chief Executive Officer
- **Paid-in capital** : 18.2 billion yen
- **Number of employees** : 3,956 (consolidated)
- **Business activities** : Engineering, Procurement and Construction for Industrial Facilities
  - R&D support, design, engineering, procurement, construction, commissioning and technical assistance for industrial facilities:
    oil, gas, petrochemicals, chemicals, water treatment, transportation systems, power generation, nuclear power, advanced production systems, pharmaceutical, fine chemical, distribution systems, biotechnology, environmental and others
  - IT engineering services and system software supply

Global Toyo

"Global Toyo" is a globally networked Corporate entity in which the group Companies around the world collaborate with each other while maintaining close relationships with their respective local markets and Clients, carry out work for all Clients worldwide in the most efficient manner based on common work standards.

Through Global Toyo, we accumulate and share information on topics such as market, human resources and technology, thereby enabling us to offer solutions and professional services that meet the Clients' needs precisely and promptly.

Worldwide Network

〈Global Toyo Companies〉

Toyo-Japan	: Toyo Engineering Corporation
Toyo-Korea	: Toyo Engineering Korea Limited
Toyo-China	: Toyo Engineering Corporation, China
Toyo-Malaysia	: Toyo Engineering & Construction Sdn. Bhd.
Toyo-India	: Toyo Engineering India Limited
SATEC	: Saudi Toyo Engineering Company
Toyo-Europe	: Toyo Engineering Europe, S.A
Toyo-Canada	: Toyo Canada Corporation
Tri Ocean	: Tri Ocean Engineering Limited
Toyo-U.S.A.	: Toyo U.S.A., Inc.
Toyo-Venezuela	: Toyo Ingenieria de Venezuela, C.A.
Toyo-Brazil	: Toyo do Brasil-Consultoria E Construcoes Industriais Ltda.

〈Group Company〉

Toyo-Thai	: Toyo-Thai Corporation Public Company Limited

Basic Policies
on
Health, Safety, Security and Environmental (HSSE) and Quality

Toyo Engineering Corporation and its group companies (hereafter TOYO) recognize that satisfying the HSSE and quality requirements called for by our clients and society is an indispensable prerequisite for us to conduct business activities and to fulfill social responsibilities, and abide by the following eight basic policies.

1 Continuously confirm and share the consensus that "Safety takes precedence over all other considerations", and realize and maintain safe, sanitary conditions in all workplaces.
2 Strive to complete all jobs with no accidents and no harm to people by enforcing preventive safety measures.
3 Endeavor to provide our personnel with work environment and opportunities that enable them to maintain and improve their mental and physical health.
4 Ensure information security, and take appropriate safeguards against threats and risks to business assets.
5 Minimize environmental burden by saving resources and energy, detoxifying, reducing and recycling waste, and by preventing pollution during the course of our work duties.
6 Provide high-quality products and services that meet the HSSE requirements of our clients and society.
7 Comply with all relevant laws and regulations, the requirements agreed upon with the clients, and our in-house rules relating to HSSE and quality.
8 Establish and continuously improve the effectiveness of management systems, including objective setting, hazard identification, risk evaluation, determination of countermeasures, execution control and review, and education and training, in line with management's firm belief that the securement of HSSE and quality is a prerequisite for business continuity.

These policies shall apply to all staff members of TOYO in any region and country. TOYO will also share the spirit defined by these policies with clients, business partners, and other related parties, and cooperate with them to achieve these objectives.

September 1, 2009

Yutaka Yamada
President and Chief Executive Officer

Safety

Safety Message

The premises of a Corporation trusted by the community include paying sufficient attention to safety.

TOYO is confident about its efforts and initiatives, time and expenses to respect human life which must take precedence over all other things. Loss of valuable human life must absolutely be prevented in the process of our business evolution, such as plant construction.

With the recognition that "safety takes precedence over all other things," TOYO will continuously implement safety education programs for all its employees to spread awareness of the Safety Culture.

"Safety" is the prime brand of TOYO. In order to boost the brand value, we are strongly promoting many safety measures and actively strive to consolidate a firm Safety Culture.

• • • Clients' Commendations for Safety • • •

Our mission is to hand over superior facilities to our Clients through construction work completed without any accidents or injuries. For this purpose, the Head Office and construction site members, together with Clients and Partners, conduct safety management activities in a planned and positive manner, with an established Health, Safety, Security, Environment (HSSE) management system.
Toyo received commendations from Clients for construction work continuing without lost time injuries.

Qatar Shell GTL, Mr. M. Noor, HSE Manager (Left) and THC, Mr. Yanagi, Consortium Leader (Right)

<Message from QATAR SHELL GTL >

THC's (Toyo Hyundai Consortium) safety performance on Pearl GTL project has been a fantastic journey, where learnings were consistently incorporated leading up to excellence in safety performance. 2007 was the year to commence construction, and the challenge was to satisfy the minimum required HSE readiness prior to starting the work. At peak construction in 2008, the work site has seen many challenges from a safety perspective. It was the time when THC senior management made a very clear commitment that they will visibly step in and personally drive HSE performance. It was a time when they committed to taking full personal accountability for the safety of every person on site.
The start point was an agreed statement - "We want to keep everybody safe everyday". It was realized early that "Safety Ownership" and "Safety Leadership" are the foundation to build a solid safety culture which is the best investment for safety performance.

THC launched many classroom and site initiatives for training and coaching. They were ultimately designed so that people are equipped with the right technical and safety skills. Leadership training for different levels was a key, and it enforced the concept that "Safety is a line responsibility".
Active visibility on site and stimulating safety conversation with workers and supervisors made a difference by sending strong safety message and setting clear expectations. It encouraged and empowered everybody to speak up and intervene in unsafe acts and to report through the channels as safety observation. All the observations are collected and analyzed to show the trend and then getting the senior and discipline managers to take actions to ensure observation made today are not left to develop into incidents tomorrow.

Safety communications, award programmes, safety walk downs, dedicated inspections, health and welfare activities and many others were part of a big health and safety programme implemented by THC.
As a result of all that, and since 15th of Feb 2009 THC did not experience any serious injury. THC has achieved over 28 million man-hours without lost time injury, and the frequency for small injuries was considerably reduced. It is a world class performance proved by all the leading and lagging indicators. Well done THC.
2011 is the year for completion and it is a challenging year for THC - and everybody else on site - to maintain safe progress and the advice is to keep the "planning" and "communication" on top of the agenda. It is one more occasion for THC to test the safety leadership and commitment, and I expect success.

February 2011

**Members of Dalian Sumika Jingang Chemicals Co., Ltd.
Mr. Mitsuaki Yamada(4th from right) Managing
Director (at that time) and Project members**

<Message from Dalian Sumika Jingang Chemicals Co., Ltd.(Sumitomo Chemical Local Joint Company)>

Construction started in April 2010, and is continuing with record, 1,591,493 hours without lost time incidents, which is appreciated. Our project members were much concerned about safety and quality of construction because of location of construction site in China. However now we are confident about Toyo's integrity with effectiveness in experience and know-how in China.

Construction work in Dalian, located in north-east area in China has severe condition such as cold weather, however management of safety is excellent. Safety meeting of all workers is held in the beginning of every month to improve safety efforts, such as intensive action of 3S(seiri-ordered, seiton-neat, seiketsu- cleanliness). In addition, we should follow many points in plant operation such as implementation of commendation for safety, improving motivation of construction workers etc.

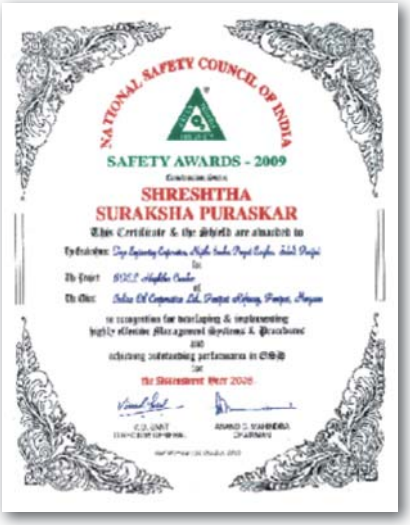
Until completion of plant construction, we expect to keep quality and safety in higher level.

March, 2011

Toyo has received letters of appreciation from the Clients listed below, in addition.

Commendations for Safety (March, 2010 – March, 2011)

Year and month	Reason for commendation	Client	Description
Oct. 2010	No lost time incidents	Taiyo Oil Company, Ltd.	Construction completed without lost time incidents at project for C3 splitter unit, etc. Japan
Oct. 2010	No lost time incidents	NSCI (National Safety Council of India)	Receipt of Silver Safety Award in 2009 for completion of Ethylene Project in India for no lost time incidents
Aug. 2010	No lost time incidents	Osaka Petrochemical Industries Ltd.	Construction completed without lost time incidents at project for Osaka Petro Chemical Industries Ltd. Japan
July 2010	Engineering Award 2010	Engineering Advancement Association of Japan	Evaluation of project safety performance in Ethylene Plant for Singapore Shell Corp.
Mar. 2010	No lost time incidents	Nippon Petroleum Refining Company (new: JX Nippon Oil & Energy Corporation)	ETBE and MEROX project (Japan) without lost time incidents



Commendation certificate from NSCI

Letter of appreciation from Taiyo Oil Company, Ltd.

• • • Efforts for Safety • • •

■ Safety Record

Toyo's safety record 2007 – 2011 (2011partially included) is as follows.

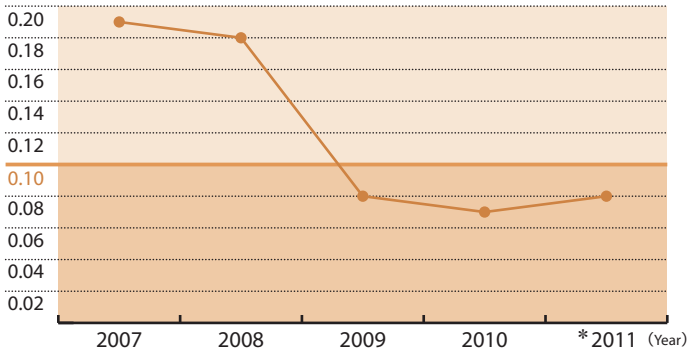
Both LTI rate and TRI rate show downward trend. LTI rate of under 0.1 is recognized as safety level for world's top class engineering companies.

Safety record over the past 5 years

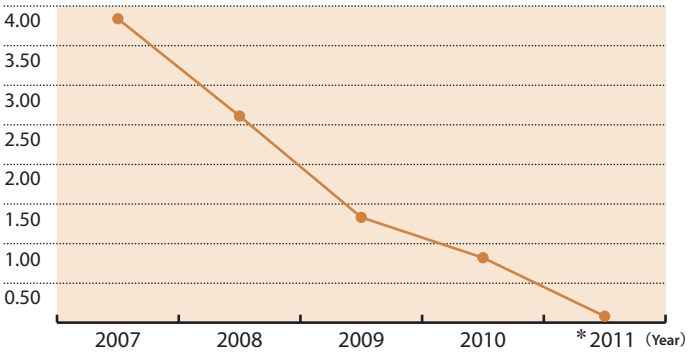
Year	Employee Worked (Man-Day)	Employee Hours (A)	Number of Incident					LTI Rate *1	Total Recordable Incidence Rate *2
			Fatalities	Lost Time Incident	Medical Treatment (No Lost Time)	LTI Total (B)	Recodable (C)		
2007	9,012,650	89,334,017	1	16	326	17	343	0.19	3.84
2008	9,685,066	96,925,454	3	14	236	17	253	0.18	2.61
2009	10,524,345	104,229,724	0	8	131	8	139	0.08	1.33
2010	5,866,408	57,652,883	1	3	43	4	47	0.07	0.82
*3 2011	1,230,328	12,114,123	0	1	0	1	1	0.08	0.08

*1: Lost time incidence (LTI) rate = (B) x 1,000,000 / (A)
*2: Total recordable incidence (TRI) rate = (C) x 1,000,000 / (A)
*3: Figures for 2011 are up to the end of April.

Lost time incidence (LTI) rate



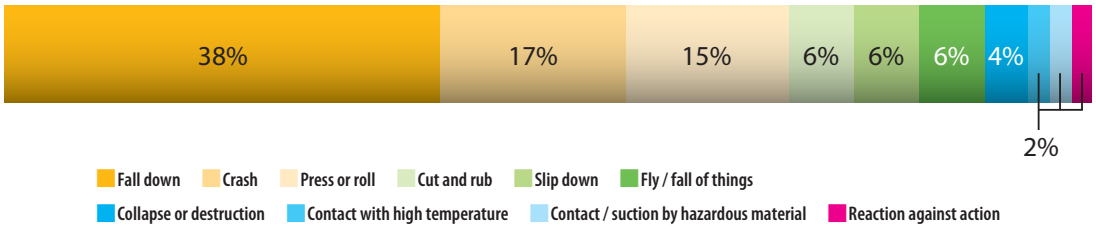
Total recordable incidence (TRI) rate



■ Number of injuries according to categories of incidents

The number of injuries from 2007 up to 2011 (figures for 2011 are until end of April, 5 fatalities and 42 injured with lost time incidents, total 47) are divided in accident categories, 38% of the injuries were due to fall down accidents. Therefore, the implementation of safety management and preventive measures for elevated work places is essential.

Injuries by category of incidents (2007～2011)



■Safety in Construction : Ammonia and Urea Plant Project, Venezuela

Project awarded by Petroquimica de Venezuela S.A. (PEQUIVEN) in Venezuela, for constructing ammonia and urea plant with ancillary facilities. The project is executed by a consortium of Toyo, Ferrostaal A.G.(Germany) and Y&V Ingeniería y Construcción, C.A., (Venezuela). Plant is located in Morón, Carabobo State, 150 km west of Caracas. Under the firm commitment of the Client and Toyo's top management - "Safety takes precedence over all other things," Toyo has been working at the site without any accidents or injuries, achieving a high-level safety standard.

Emergency Training

Construction personnel wearing gas mask during poison gas leakage from neighboring plant. Periodical emergency training is conducted with sub contractors.

Several sensors and safety alarms are located along the fence around site.

Prevention of Traffic Accident

Driving technique is being evaluated, by inviting specialist to site.
A prevention of traffic accident, burglar and kidnapping, Global Positioning System (GPS) is installed in every car for detecting its location and speed in real time at office.

Safety Commendation

Supervisors and workers during award ceremony. TOYO's rule of safety commendation and penalty is applied in consortium.

■Safety in Construction : China Polycarbonate Resin Production Project

Project awarded by Ling You Engineering-Plastics (Shanghai) Co., Ltd. who is joint venture company comprising of Mitsubishi Gas Chemical Company, Inc. and Mitsubishi Engineering-Plastics Corp., to construct polycarbonate resin production facility. Toyo's scope of work includes engineering, procurement, construction and supervision of commissioning. The production will begin in 2012.

At the plant site, located in Shanghai Chemical Industry Park about 50 km to the southeast from Shanghai, the construction work is in peak, and safety standards are in place to cope with new risks that may emerge in commissioning.

Organized Storage

In material storage area in shelter, piping parts such as elbow are kept in order on rack on the concrete floor.

Same base of Safety and Quality

Welding of prefabricated piping is being performed in temporary shelter, avoiding influence of rain and wind, by which welding defect ratio is reduced.

■Global Toyo HSSE Activities

TOYO has established Global Toyo HSSE Standard to ensure that safety management is implemented at the same level in all countries and regions. We promote Global Toyo HSSE activities for thorough implementation of these standards.

To promote Global Toyo HSSE activities, the persons in charge of HSSE maintain close communication through internet and video conferencing. They gather twice a year to exchange views and address the improvement of safety management activities.

Global Toyo HSSE Meeting

- Toyo-Japan
- Toyo-Korea
- Toyo-China
- Toyo-Malaysia
- Toyo-India

■Continuous Effort toward Improving Safety Culture

●Promotion of safety education

Toyo Japan is conducting safety education programs for all executives and regular employees, to enhance the safety awareness at corporate level. These are conducted from March 2011 as second session with effective period of 5 years.

Toyo group Companies also conduct safety education programmes.

Safety education in Toyo group Company

Safety education in Toyo Japan

●Safety Campaign

It was the first year that Toyo group Companies together held "Safety Campaign" in 2010, to harmonize with national safety week in Japan, for one month starting from July 1st. Not only people in construction site but also executives and regular employees in office participated in safety campaign, because of importance of national awareness.

Major Program of Safety Campaign

- Boarding of message of top management
- Simulated Experience of crackup car
- Cinematographic show
- Introduction of campaign in Toyo group Companies
- Briefing session of project HSE
- Radio gymnastic exercise
- Safety management activities at site
- Rescue training

Notice of Campaign Poster in front of reception in Toyo

Meeting at construction site during national safety campaign

Rescue training in group Company

●Feedback from completed project

Which activities contributed to big record of no lost time incidents (39.87 million hours) in Singapore Ethylene Project? Briefing session of HSE project was held on July 2010 to share the information with all employees of Toyo and prepare them for other projects.

Top management leading safety activities at site, introduced health and safety management activities, safety education in 6 national language, commendation and penalty rules, risk prediction activities by small group, a skit by professional actor and evaluation for each construction area by manager and supervisor.

It was emphasized that top management's efforts and its active participation to explain importance of safety, resulted in excellent safety performance.

Meeting for Reporting of HSE management in Singapore Ethylene Project

●Operating "Hiyari-Hatto" System

Hiyari-Hatto (near loss) is an incident that was prevented just in time before it occurred. At construction sites, people sometimes experience potentially dangerous Hiyari-Hatto. Repeated Hiyari-Hatto may lead to a serious accident. The Hiyari-Hatto data management system, developed by Toyo, has been employed since January 2008 at domestic construction sites. Hiyari-Hatto data at construction sites is collected and analyzed at the Head Office, then fed back to the group Companies and construction sites. In the following report, 1579 incidents from January, 2008 to May, 2010 are analyzed.

(1) Summary of Hiyari-Hatto System analysis results (indicating the top three items)

Items \ Order		No. 1	(%)	No. 2	(%)	No. 3	(%)
Time of occurrence		In the morning	49.6	In the afternoon	38.2	Early morning	6.8
Cause	Material	Fly or fall	57.6	Landslide	9.3	Fire	9.0
	Person	Stumble or slip down	32.7	Crushed	18.1	Tumble or fall down	17.8
Reason for occurrence	Person	Confirmation not made	21.0	Inappropriate reaction	11.0	Hurry for the work	8.8
	Work	Default of KYK	28.2	Work by a single person	20.9	Lack of examination	7.2
						Mistake plan	7.2
	Material	Lack of safety protection	23.0	personal protective equipment or tool insufficient or not used	16.7	Unstable scaffold	14.3

(2) Countermeasures based on analysis

Purple marking in list means remarkable data comparing to previous analysis in October 2009.

The following measures are taken to prevent the recurrence of "hiyari-hatto."

1) Measures in view of frequent occurrence in the morning
- Be sure to implement morning meeting, KYK(note 1) and TBM(note 2) and confirm work procedures before morning work.
- Let all workers see round the work places to identify the conditions before work.

2) Measures in view of frequent fly and drop accidents as well as stumbles and fall accidents
- Smarten up workplace every day and take care and measures for hazardous places.
- Give education referring to instances of accidents and "hiyari-hatto."

3) Measures against insufficient KYK by referring to potential causes of accidents
- Give education to KYK members in accordance with in-house manuals.
- Implement one-person KY(note 3) using KY cards.

(Note 1) KYK stands for "Kiken Yochi Katsudou"(risk prediction activity), or activities for predicting work-related risks before the work is started.
(Note 2) TBM stands for "Tool Box Meeting," or activity to briefly discuss the contents, methods, arrangements, and problems of the work of the day before starting the work at the workplace.
(Note 3) One-person KY means KYK that each worker carries out immediately before starting work using the "KY cards" (self-questioning cards for risk prediction).

Lessons Learned from Accidents

Accident due to Lack of Oxygen

A fatal accident occurred at site, there is accident due to lack of oxygen caused by inert gas (no color no smell) such as nitrogen and argon gas used for welding work, leak test, gas holding for preservation of equipment at construction and used for replacing by nitrogen gas at commissioning.

Accident due to lack of oxygen is one of 3 major fatal accident, in line with accidents due to falling down and electrification. It is very unfortunate but accident due to lack of oxygen has occurred in the group Companies. Then lessons learned from past accidents were introduced for prevention.
One breathe of inert gas caused immediate lost of consciousness. It may be too late to escape when breathe is deep. Inert gas is the same as poison gas. To prevent accident, it is required to have safety knowledge and also need to educate repeatedly the importance of action to comply with rule when an emergency arises.

Case - 1

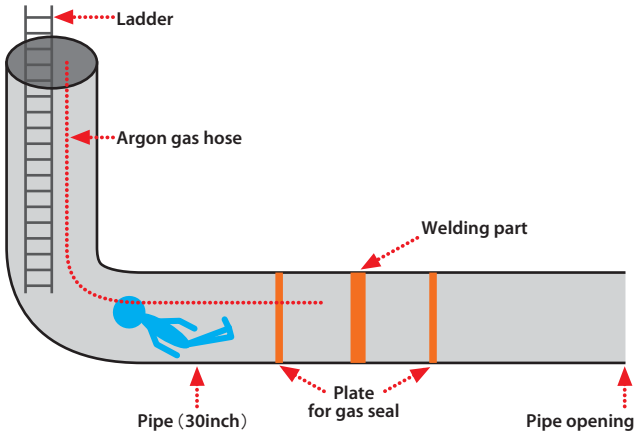
Situation	Causes	Countermeasures
After completion of hydrostatic test for pipeline (28inch), draining out of remaining water from pipe, pig flashing (Note1) was done but pig was stuck in the pipe. Air compressor specified in procedure was not available, so the stuck pig was decided to be moved by the pressure of liquid nitrogen. Again worker entered pipe to push pig back but he lost consciousness. Two workers tried to help the worker and entered pipe but they also lost consciousness. Out of 3 workers, two workers recovered in hospital but one worker died. **(Note1) Pig is being moved inside pipe for cleaning up and for removing dusty substances**	▶Lack of oxygen by residual nitrogen gas ▶Lack of knowledge about risk of nitrogen gas as inert gas ▶Permission not obtained for entering the pipe, nor no check inside pipe by gas detector was carried out.	(1) To be carried out at the construction site ▶Prohibit moving of pig by liquid nitrogen under pressure and increasing number of Danger Signs for caution ▶A general meeting to explain about compliance of rule and procedure ▶Education to supervisors and workers about risk of nitrogen gas (2) To be carried out at the Head Office ▶The accident shall be immediately reported to all project sites to promote safety awareness and to prevent similar accidents from occurring. ▶Instruct communication procedure when construction procedure is revised

Place of Accident

Whole picture of place of accident

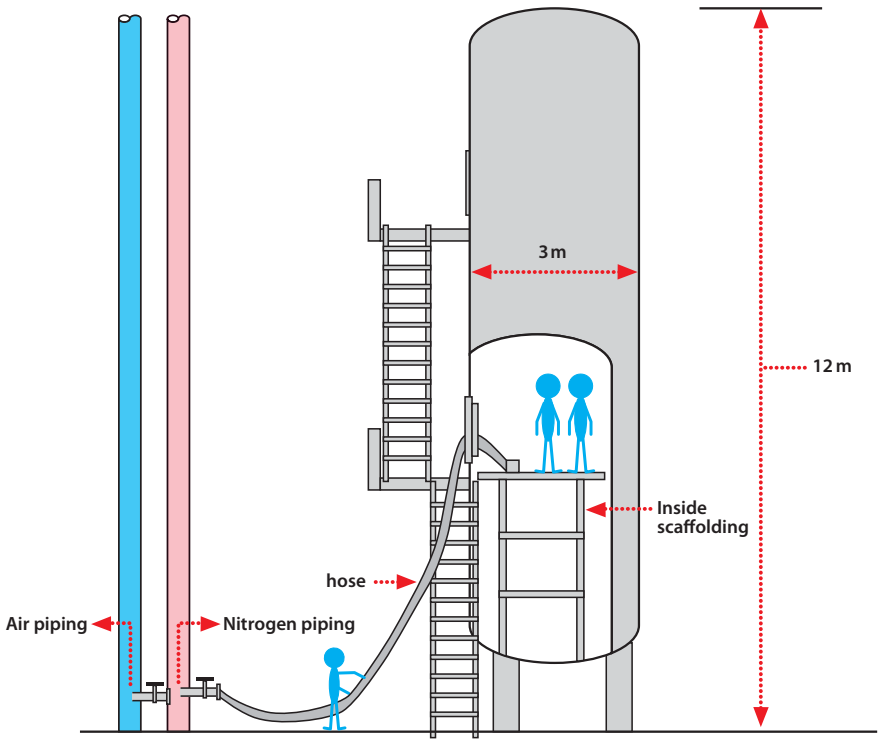
Case - 2

Situation	Causes	Countermeasures
A team of total 4 workers, two welders, one helper and one safety inspector, were performing welding work from outside of pipe. Welding procedure specified to fill the pipe to be welded by argon gas. At intermediate work stage, one welder entered pipe inside to check welding condition (not specified in procedure). Several minutes later, safety inspector called out but received no response, and then safety inspector took out the welder using rope. After emergency medical care, took him to hospital but the welder died.	▶Lack of oxygen by residual argon gas ▶Lack of knowledge about risk of argon gas as inert gas ▶Permission not obtained for entering the pipe, nor no check inside pipe by gas detector was carried out.	(1) To be carried out at construction site ▶Increasing numbers of Danger Signs for caution ▶A general meeting to explain about compliance of rule and procedure ▶Education to supervisors and workers about risk of argon gas (2) To be carried out at the Head Office ▶The accident shall be immediately reported to all project sites to promote safety awareness and to prevent similar accidents from occurring.



Case - 3

Situation	Causes	Countermeasures
Maintenance work during plant shut down, by a team of 3 persons, one supervisor and two workers. At first 2 workers entered vessel for cleaning and removing welding spatters. To provide the necessary air supply, supervisor connected hose to nitrogen pipe instead of air piping by mistake, he then entered into vessel to do his work. A worker of other team working near by, noticed something odd and looked inside vessel from manhole and found 3 persons lying down on top plate of scaffolding inside. He took them out and carried to hospital but they were confirmed dead.	▶ Lack of oxygen by residual nitrogen gas ▶ Identified nitrogen piping instead of air piping by mistake ▶ Permission not obtained for entering to vessel, nor no check vessel inside by gas detector	(1)To be carried out at construction site ▶ Add identification of hose and piping by color and tag. ▶ One safety inspector shall be present during carrying out for internal work. ▶ Education to supervisors and workers about risk of nitrogen gas (2)To be carried out at the Head Office ▶ The accident shall be immediately reported to all project sites to prevent recurrence and instructed to identify hose and gas piping by color and tag.



Environment

Message on Environment

Since its inception, Toyo has been providing solutions backed by comprehensive integrated engineering technologies, high tech application capabilities and project skills in project execution.

Through such execution, Toyo promotes development, introduction and improvement of technologies, offering following features: -Approaches to new and clean energy, -CO_2 reduction and energy conservation, -Recycle technologies of wastes and waste water, -Technologies for eliminating hazardous/toxic substances, -Construct plants to reduce environmental impact. Toyo's site construction work realizes following objectives: -Reduce environmental impact, -Prevent pollution, -Proper management of construction wastes.

Toyo, as Global enterprise company, fulfills social responsibilities of domestic and international Clients on basis of accumulated knowledge and experience, by offering technologies that contribute towards conservation of environment.

Project applying technologies, contributing to environmental conservation

Toyo applies integrated management to each project with cut –edge technologies of our proprietary and licensed processes for providing solutions to Clients. Toyo completes the project satisfying the expected purpose and target, in terms of quality, healthy, safety, security and environment.

Followings are some projects which apply technologies contributing to environmental conservation especially for technologies for clean energy, CO_2 reduction and saving energy.

Application of Technology for Clean Energy

Gas to Liquids (GTL)

GTL is a process that transforms natural gas or associated gas into a clean diesel fuel or naphtha containing less impurities than petroleum-derived products.
Since November 2007, Toyo has been developing a compact, cost efficient Micro-GTL process jointly with Velocys Inc., and MODEC, Inc. Because of the compactness, the Micro-GTL plant can be installed not only onshore but also onboard a ship. Early commercialization of on-board GTL (floating GTL) is expected to be effectively developed and utilized because it will allow development of deep-sea natural gas that has not been easily exploited.

Micro-GTL development schedule

2007	2009	2011	2013
Stage-1	Stage-2	Stage-3	Commercialization
			
●Process development ●Small-scale verification test	●Fabrication of practical-size reactor	●Construction and operation of demonstration plant ●Establishment for technology for commercialization	●Deployment to floating GTL

The module was fabricated in Thailand and reached PETROBRAS' refinery plant in Foltaleza city, Ceara state, Brazil in May, 2011. The project aims to achieve commercialization by 2013, after constructing and operating a demonstration plant.

1 **Module of Micro-GTL demonstration plant being assembled in Thailand**

2 **Module of Micro-GTL demonstration plant being loaded on ship in Thailand bound for Brazil**

3 **The Module was off-loaded in Brazil**

●Mid-Scale Electric –Motor –Driven LNG Plant

Toyo and Hitachi, Ltd. together are cooperating and executing front end engineering and design for Eastern Star Gas Limited, an Australian gas development company, for mid-scale electric-motor-driven LNG plant to be constructed in Newcastle, New South Wales, Australia.

The electric-motor-driven, mid-scale technology for LNG plant offers advantages in terms of environmental conservation, because applying electric motor instead of gas turbine in compression process, offers high reliability, high energy efficiency, low environmental impact, a small footprint and low noise.

It also has advantages of flexibility in production capacity to expand as required, and is suited for development of coal bed methane and mid-small gas fields which is not developed because of economic and geographical location.
Mid-scale Electric-Motor-Driven LNG plant is expected to expand market in future in middle and small gas field application.

Image of Mid-Scale Electric-Motor-Driven LNG Plant

Application of Technology for CO_2 Reduction

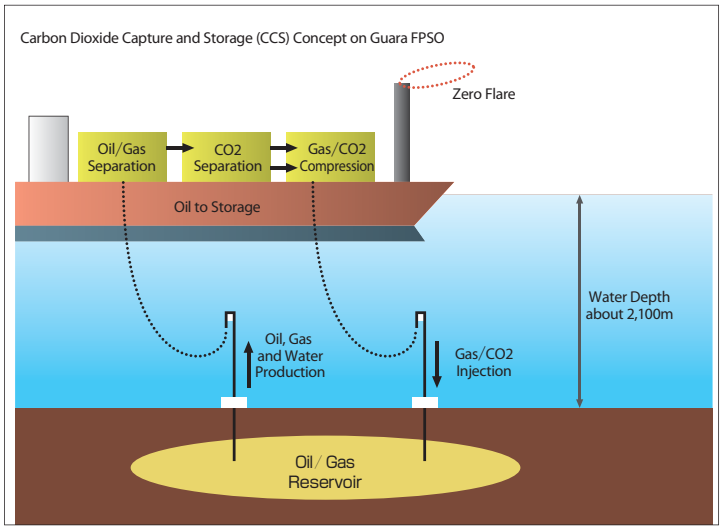


Image of FPSO system

● Floating Production, Storage and Offloading (FPSO) system utilizing Carbon Dioxide Capture and Storage (CCS) Technology

MODEC and Toyo Offshore Production Systems Pte. Ltd. (MTOPS), a joint company created by Toyo and MODEC, Inc. and established in Singapore, received contract from MODEC for a topside processing facilities to be installed on a FPSO system.

This FPSO will be delivered to offshore Brazil and used to develop the Guara offshore area for Petrobras, national oil company in Brazil. This facility uses the environment-conscious CCS technology that dissociates CO_2 in the produced gas and returns it to the oil/gas reservoir.

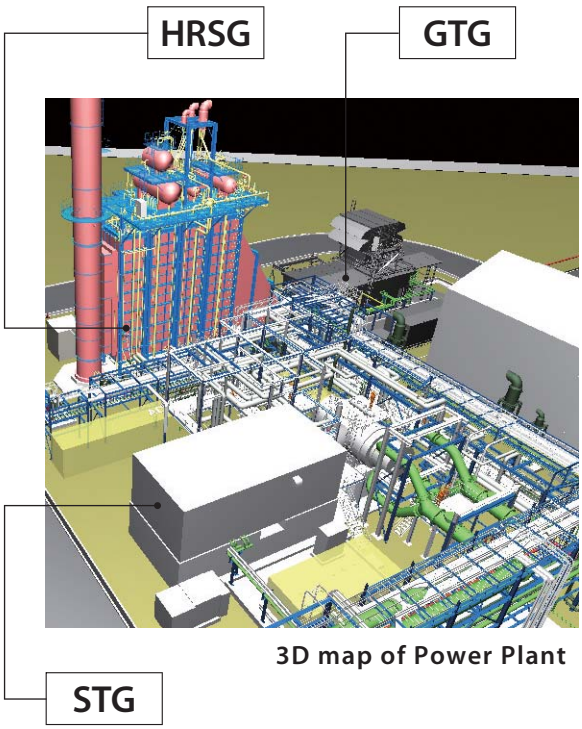
Application of Technology for Save Energy/Reduce CO_2 Emission

● Higher Efficiency Combined Electric Power Generation Plant

Toyo and Mitsui & Co., Ltd. have contracts with special purpose company (SPC) wholly owned by Gulf JP Co., Ltd. (Gulf JP). Gulf JP is an independent power producer in Thailand whose main owner is Electric Power Development CO., Ltd. in Japan. According to the contract, cogeneration gas turbine combined cycle power plants are to be constructed at seven sites in the suburbs of Bangkok (six 110MW and one 120MW,total generation capacity 780MW).

Toyo will be responsible for supply of equipment and materials and Mit-Power (Thailand) Ltd., a SPC of Mitsui in Thailand, will undertake the construction work.

Electric power generation facilities supplied by Toyo is a type of combined power generation consisting of heat recovery steam generation (HRSG), gas turbine generator (GTG) and steam turbine generator (STG). Because of applying high efficiency type of power generation turbine, the efficiency of 49% and higher can be realized.



3D map of Power Plant

The project began in October, 2010 and is schedule to be completed by October 2013. As of March 2011, major purchase orders for equipment and materials were issued, and design and fabrication work is in progress. Ground preparation work was started in construction site and piling work was commenced in a part of site.

Piling in Construction Site
Nong-kae industrial area located in 90km north from Bangkok、30km north-east from Ayutaya world heritage

Photo of Ayutaya, world heritage in Thailand

●Energy saving urea process（ACES21®）

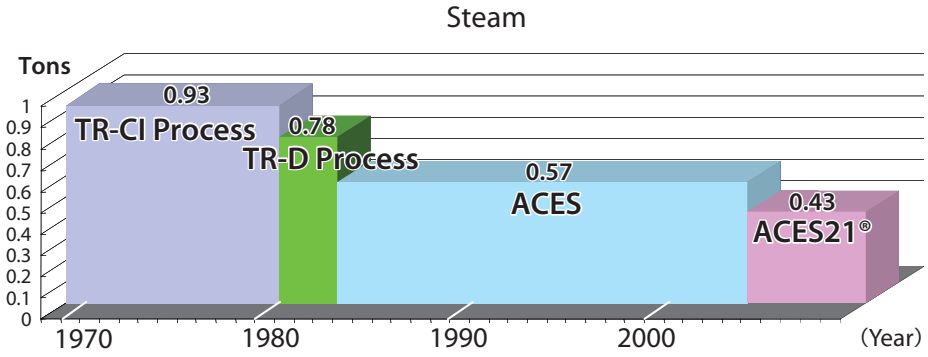
Since its establishment in 1961, Toyo has been a leader in urea technologies worldwide, designing, engineering, constructing, and commissioning over 100 urea plants based on its own process.

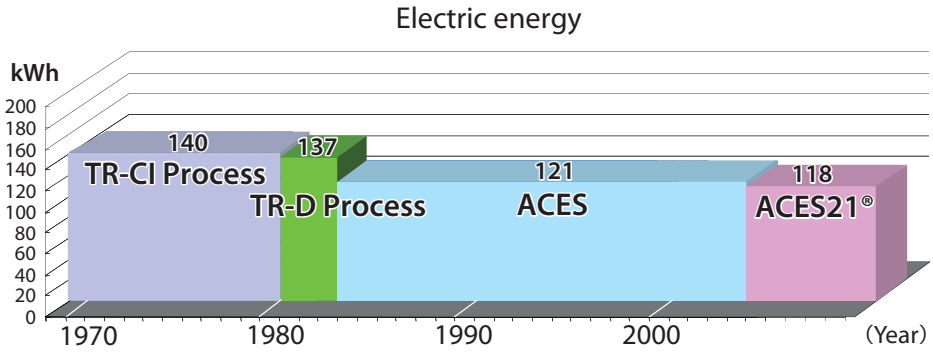
The history of urea plants is the history of energy conservation. While producing one ton of urea required 0.93 tons of steam and 140kWh of electric power in the past, the newest process ACES21® requires only 0.43 ton of steam (54% less) and 118kWh electric power (16% less) to produce one ton of urea which greatly contributes to energy conservation and CO_2 reduction.

ACES21® P.T. Pupuk Kujang, Indonesia

Urea product

Energy consumption per ton of urea





Efforts for Environment

Office[*1] Activities for Energy and Resource Saving

*** 1:Office means Toyo's Head Office and Engineering Center**

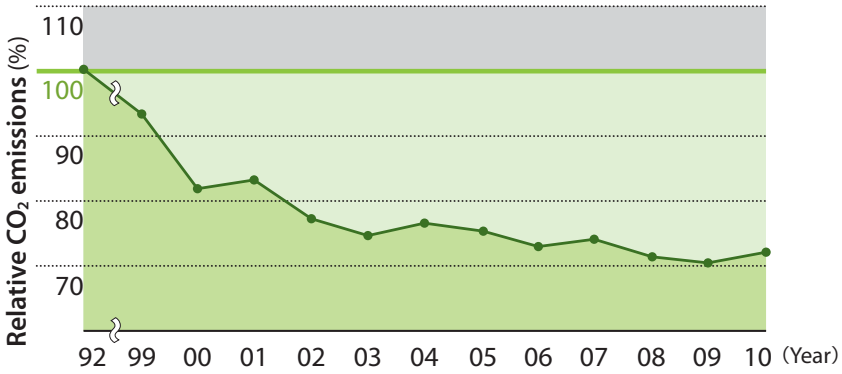
Reduction of CO_2 emissions

CO_2 emissions from office are calculated from electricity consumption, urban gas consumption, and consumption of fuel oil A used for emergency power generation.

Toyo launched energy-saving activities in 2000 with office lights being turned off during lunch breaks and unnecessary lights removed. In 2001, Toyo made energy saving investments, such as installing lighting inverter stabilizers, which produced positive results in 2002 and after.

CO_2 emissions in 2010 were reduced by30% from the 1992 level.

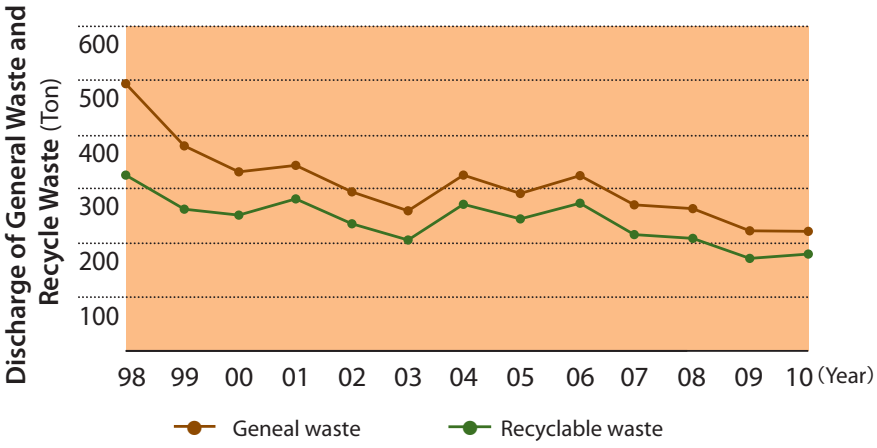
In wake of earthquake disaster and to overcome shortage of electric supply this summer in office, we implement emergency measures to save electricity, such as removal of lights, raising temperature of air conditioning, closing blinds on windows, switching off lights, limiting operation of number of elevators, etc.



Reduction of general waste and recycle waste[*2]

Discharge of general and recyclable waste has decreased gradually over the year and each waste is reduced to 221 ton and 179 ton respectively in 2010 which is the same level of 2009.

***2:Recycling waste is the recyclable general waste including paper output from personal computer and photo-copy machine, newspaper, glass bottle and can.**



■Construction Waste Gross Discharge

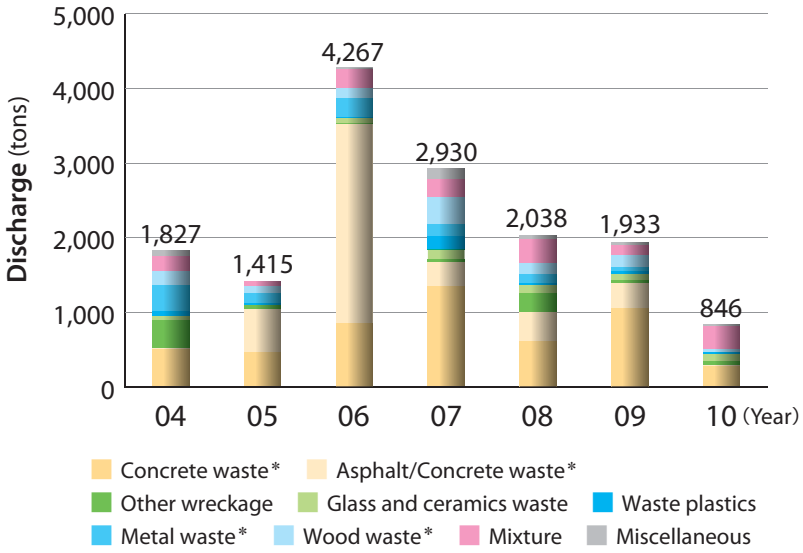
●Domestic construction sites

(1) Percentage of construction waste by category

The figure to the right shows the weight of construction waste and its categories in proportion. The weight of construction waste discharge from domestic construction sites in 2010 was 846 ton, about 1,087 ton less than that of discharged in 2009.

Toyo implements various kinds of construction and percentage of waste by category tends to be different in each year.
The four categories of waste marked with (*) an asterisk are recyclable.

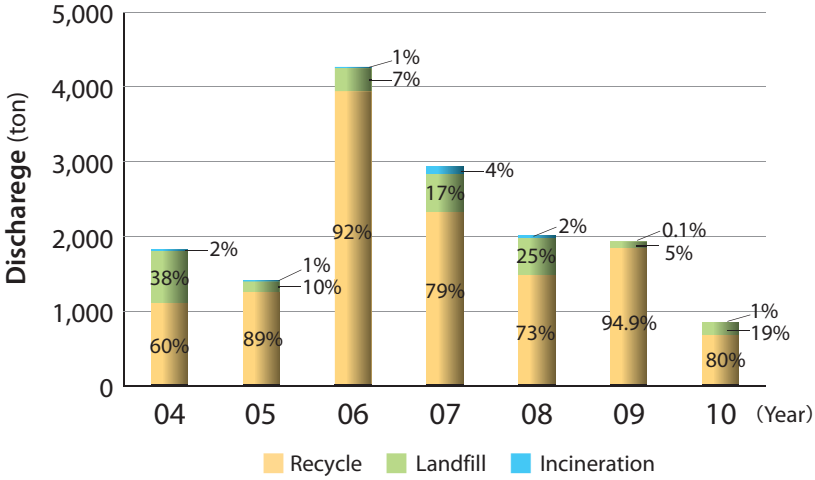
Percentage of construction waste by category (domestic)



(2) Percentage of construction waste by disposal methods

Percentage of construction waste by disposal method (recycle, landfill, and incineration) is shown in the figure to the right, that is, 80% recycled, 19% landfill and1% incinerated in 2010. As the mix of construction waste increased, the recycling rate decreased to 80% from 94.9% in 2009.

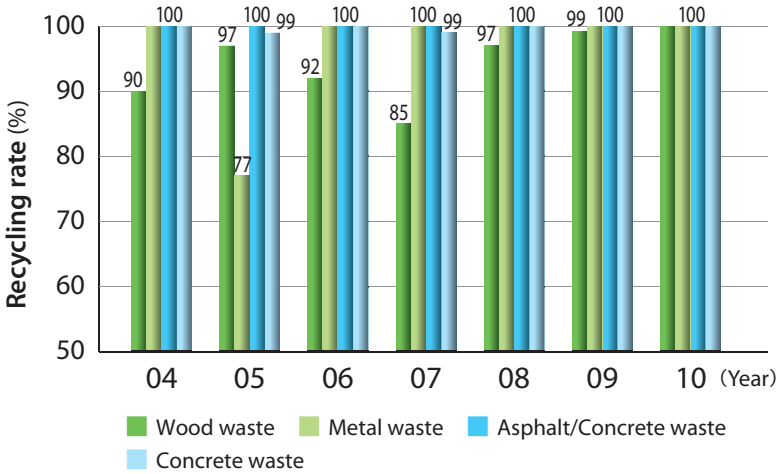
Percentage of construction waste by disposal method (domestic)



(3) Recycling rates of four items specified by the Construction Material Recycling Act

The recycling rates of four items specified by the Construction Material Recycling Act are illustrated to the right.
The recycling rates for wood waste, metal waste, asphalt/concrete waste and concrete waste have been kept to 100%.

Recycling rates of for four items specified by the Construction Material Recycling Act.(domestic)



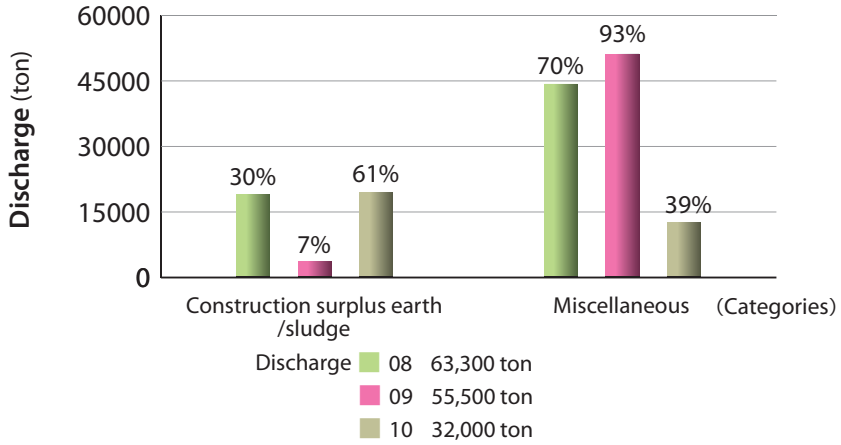
●Overseas project sites

Weight of construction waste discharge and percentage by category

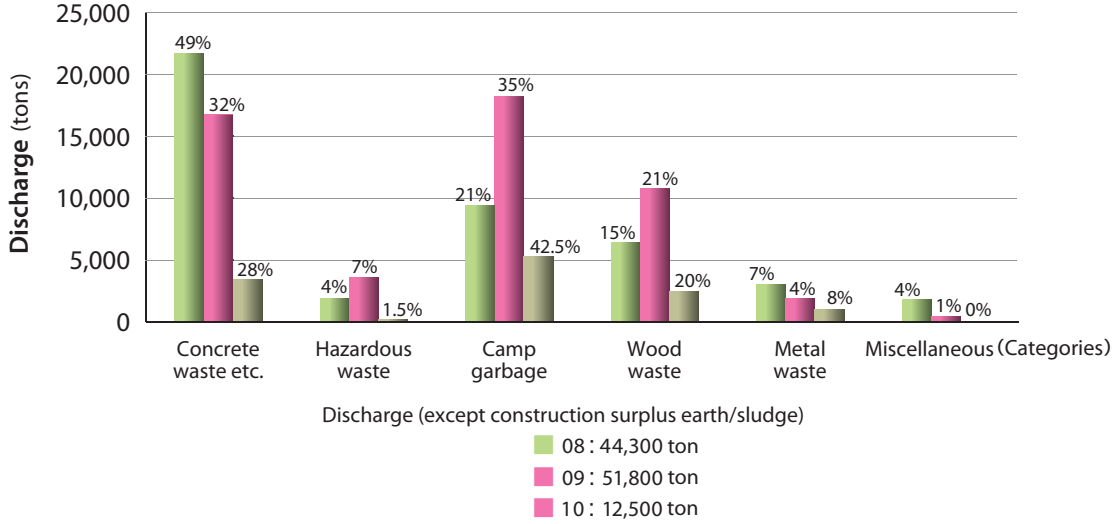
The total discharge weight in 2010 (Jan. to Dec. 2010) was 32.0 thousand ton, about 50% decreased from 2008 and 42% decreased from 2009.

The reason of increase of construction surplus earth/sludge in 2010 was discharged to outside from site instead of using backfill in 2009 in Venezuela project.

Weight of construction waste discharge and percentage by category
Comparison between construction surplus earth/sludge and miscellaneous
(Proportions of individual waste categories to the total discharge weight in each year shown as percentage)



Weight of construction waste discharge and percentage by category
(Proportions of individual waste categories to the total discharge weight except construction surplus earth/sludge in each year shown as percentage)



Toyo implements various kinds of construction method and percentage of waste by category tends to be different in each year. The weight of construction waste discharge in 2010, except construction surplus earth/sludge was 12.5 thousand ton decreased 76% from 2009.

■Activities for Reducing Environmental Impact in Engineering, Procurement and Construction

●Engineering activities

Toyo makes efforts to reduce the environmental impact in plant operation. These efforts start in engineering stage. Based on ISO 14001 and ISO 9001, Toyo reduces the environmental impact that occurs in plant operation, through the following work processes:

(1) Clarification and confirmation of Client requirements (environmental specifications)
(2) Design review
(3) Design verification
(4) Design validation

Toyo makes efforts to reduce environmental impact in design work through "Eliminate 3M - Principle" (Eliminating *Muri* (overdoing), *Muda* (wasting), and *Mura* (irregularity)) , while striving for efficient design work and methodology as an environmental target.

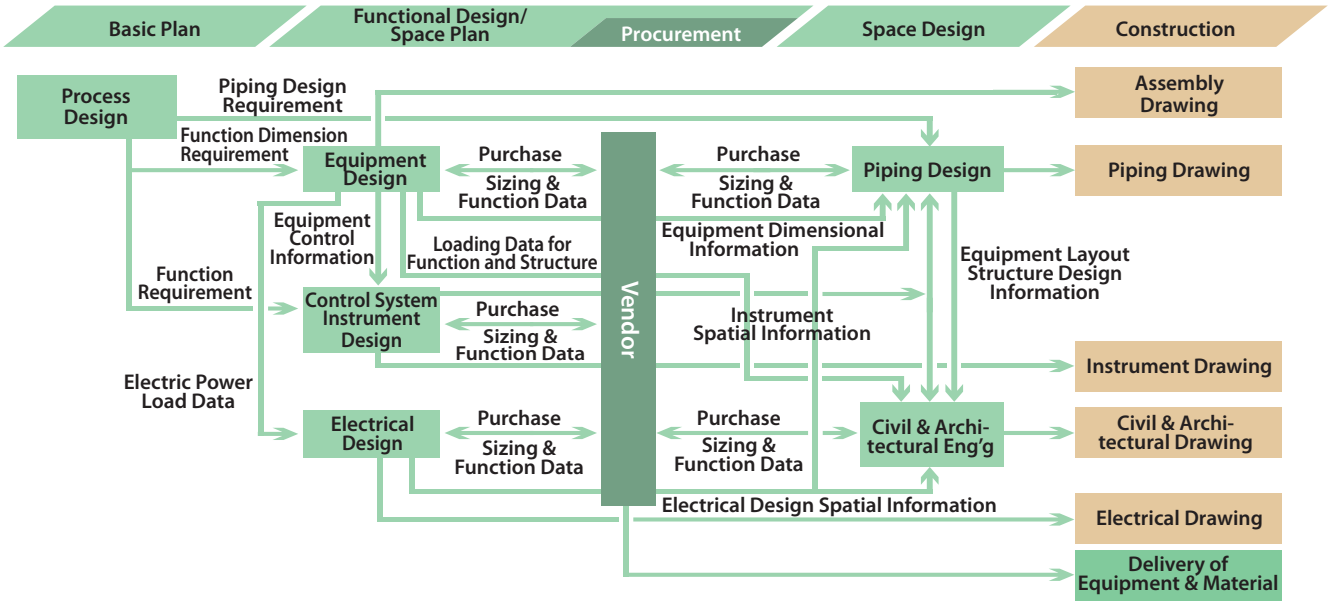
Case (1)

In design stage of processes, it is proposed to Client to set design pressure lower from experience and knowledge/know-how. As a result, design pressure was set lower, and type of pumps applied smaller one contributing reduce of electric consumption and saving resources.

Case (2)

In piping design stage, eliminating wastage and reducing re-do work were set as target for environment. Then it is realized reducing of revised work and saving energy by proper using of work check sheets and implementing periodical model review (design verification on screen by using of 3D computer soft).

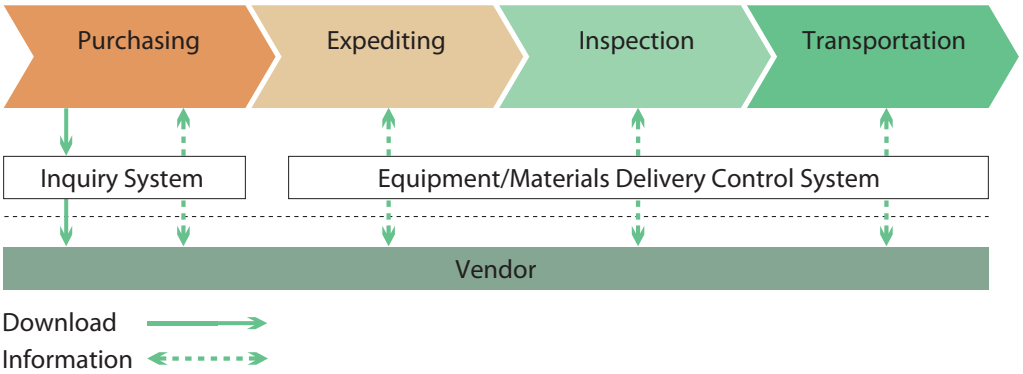
Flow of engineering



●Procurement activities

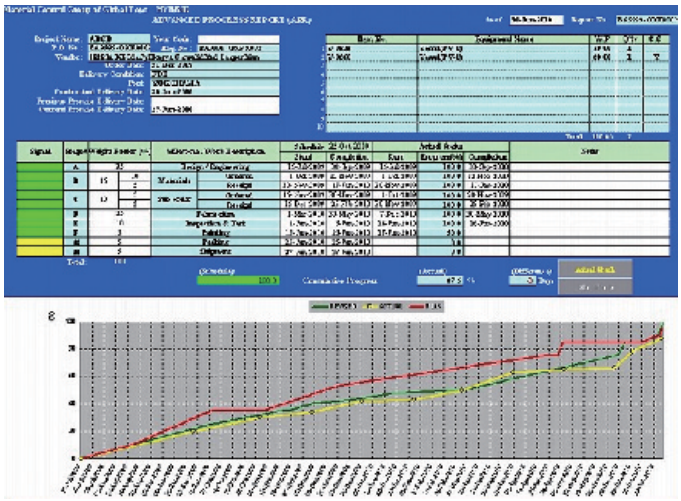
In purchasing activities, "Inquiry System" is applied and used for selection of vendors investigating efficiently vendor's data such as purchase order records in past project and their fabrication capability. Also "Inquiry System" is paperless system that can be accessed by vendors for getting inquiry document package.

Procurement Material Control System



"Delivery control system of Equipment and Materials" is applied for expediting, inspection and transportation activities after ordering the equipment. This system can be commonly used in Toyo's Head Office, Global Toyo's procurement office, and at construction site by sharing progress of manufacturing and delivery status. This enables to work efficiency by sharing information.

Screen showing equipment and material name, fabrication start and finish date, and delivery date



Screen sample showing fabrication progress

●Construction activities

Among Toyo's business activities, site construction work creates the largest environmental impact. At construction sites, the following environmental targets are set and efforts are made to reduce the impact on environment:

(1) Appropriate treatment of construction waste
- waste control by manifest and ledger
- monitoring waste disposal agency by regular patrol

(2) Appropriate treatment of chemicals (paint, etc.)
- preparation and implementation of procedures for waste treatment
- education of workers by Material Safety Data Sheet (MSDS)

(3) Environmentally conscious construction method
- Regular inspection and its records for storage of construction machines
- Stopping construction work during night

(4) Environmentally conscious material transportation
- Regular inspection and its records for storage of transportation vehicles
- Control of dust emission by spraying water on road and pavement

(5) Turbid water treatment and oily water separation
- Sedimentation separation and oil separation from water using tank with notched plate

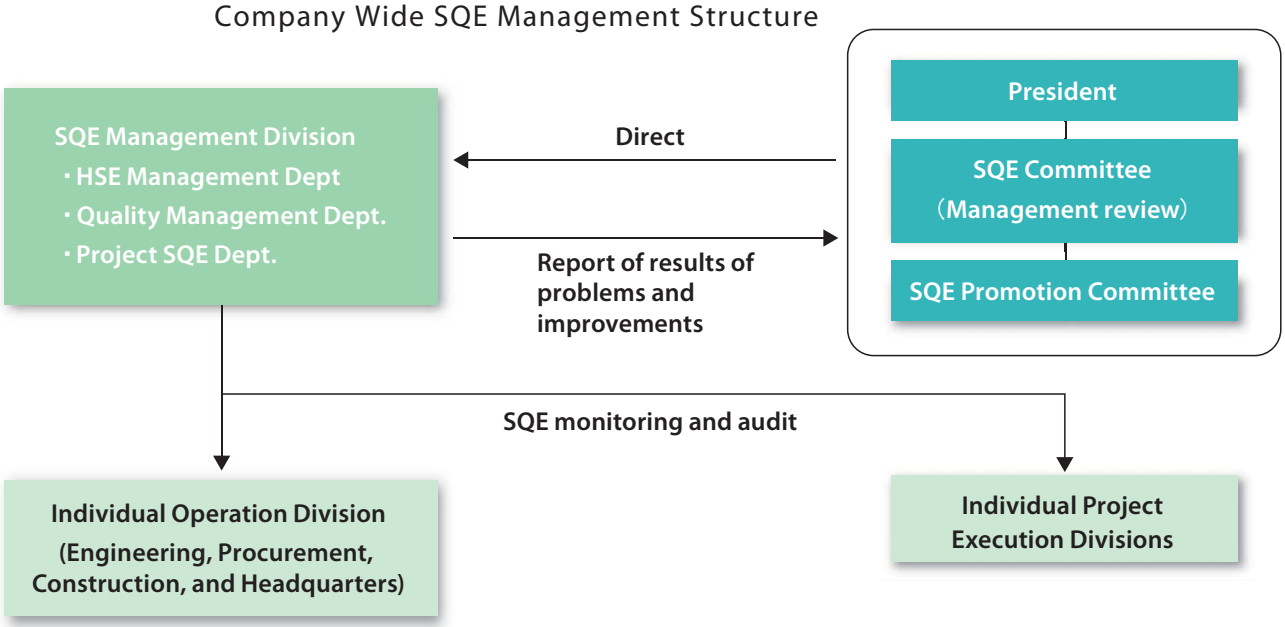
Baby of sea turtle in Venezuela site

SQE Management Promotion Structure

Safety, Quality, and Environment (SQE) Management Structure

In Toyo, the axis of SQE Committee is directly connected to the management, through co-operation of SQE Promotion Committee. SQE Management Division systematically implements the Plan-Do-Check-Act (PDCA) cycle upon the Individual Operating Divisions and Individual Project Execution Divisions for continual improvement of the SQE management system and performance.

Company Wide SQE Management Structure



SQE Committee	To review companywide SQE management activities reporting directly to the President, and to establish the operating policies and assess and approve the results of SQE activities.
SQE promotion Committee	To promote companywide activities in line with the basic policy of the SQE committee, and also to promote specific SQE activities of Individual Operating Divisions and Individual Project Execution Divisions.
SQE Management Div.	To monitor the SQE activities performed by Individual Operating Divisions and Individual Project Execution Divisions and by conducting internal audits, to support and promote the activities. To report the audit results to the SQE Promotion Committee and to the SQE Committee

ISO Approval

Toyo, in March 1994, acquired Quality Management Standard ISO 9001:1987 certification from the United Kingdom Accreditation Service (UKAS) and the Japan Accreditation Board for Conformity Assessment (JAB). After that year and now, Toyo passed the Transition Assessment for ISO 9001:2008.

ISO 9001 Certificate of Approval

In October 2004, Toyo obtained Environmental Management Standard ISO 14001:1996 certification, which covers the Head Office and domestic construction sites. After that year and now, Toyo passed the Renewal Assessment for ISO 14001:2004.

ISO 14001 Certificate of Approval

Toyo, in March 2006, obtained the BS 7799 Certificate of Approval for the Information Security Management System. After that year and now, Toyo passed the Renewal Assessment for ISO/IEC 27001:2005.

In activities not related to ISO certification, Toyo follows OHSAS 18001, an international occupational health and safety management system specification.

• • • SQE Education • • •

Toyo's SQE education includes "TEC Special Course: HSSE and Quality Management" held regularly and "Internal Safety, Quality and Environmental Auditor Training Course," in addition to in-house education for each of Safety, Quality, and the Environment. All employees are obliged to attend the in-house education. In addition, project HSE manager and project quality manager who control and manage project HSE and Quality are educated and trained.

■ TEC Special Course: HSSE and Quality Management

TEC Special Courses cover a wide range of engineering and management fields for the purpose of "promptly educating young employees as professionals" and "complementing intra-division education and extending peripheral knowledge" by in-house instructors. "HSSE and Quality Management" has been added to the series of TEC Special Courses to implement education on Safety, Quality, and the Environment.

■ Internal Quality and Environmental Auditor Training Course

Selected candidates for internal Quality and Environmental auditors are trained by an external auditor in training institute.

■ Education and Development of Manager for Project SQE

Due to the needs of project HSSE manager and project quality manager, special department is set up to educate and train selected candidates in-house and in external institute. So that they qualify to take up the responsibility.

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