# TOYO TIMES

TOYO COMMUNICATIONS

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TOYO ENGINEERING

UP TO DATE
TOYO COMMUNICATIONS

# TOYO's Subsea Oil & Gas Field Development

## Working in Collaboration with World-leading Contractors to Provide Subsurface and Surface Integrated Engineering

The recovery of energy resources from sea areas, which cover around 70% of the Earth's surface, is gaining significance globally for sustainable growth of human beings. This issue focuses on the evolution of TOYO's business model, which is expanding its coverage of services from onshore "subsurface and surface integrated engineering" to subsea areas through a collaboration with world-leading engineering companies. Hiroshi Sato, Unit Director of the Energy Business Unit, talks about TOYO's subsea energy recovery business, which has been updated to serve the diversified needs of clients in the industry.

**Hiroshi Sato**
Senior Executive Officer
Unit Director, Energy Business Unit

## Building Collaborations by Combining Strengths

**■ Now, almost all subsea energy recovery projects are executed as national projects, or by oil majors. Under these circumstances, what is the situation regarding TOYO's current operations in this business field?**

In February 2015, TOYO started a collaboration for the subsea energy recovery business with Baker Hughes Incorporated, a major U.S. subsurface oil & gas field services company, and Aker Solutions ASA, a Norwegian world-dominant producer of subsea production systems. This collaboration aims to enhance each company's core technologies in oil & gas recovery fields such as TOYO's overall project and facilities planning, Baker's subsurface energy recovery services, and Aker's design and fabricating of subsea production facilities. The collaboration quickly yielded results—for example, TOYO was awarded feasibility study work for production facilities used for subsea oil field development.

Japan is a maritime nation surrounded by ocean. TOYO believes this collaboration is now opening up the new area of subsea energy recovery by showing the overall view of projects that apply high quality subsea production technologies and facilities. We hope this collaboration can contribute to global energy and industrial development through widening possibilities regarding subsea energy recovery for potential clients.

## Strategies for Raising Added Value

**■ TOYO's subsea energy recovery strategy focuses on the integrated execution of high quality subsurface and surface services by applying durable facilities to fields.**

Subsea projects are completely different from onshore and ocean surface projects, especially from an operation and maintenance point of view. This is due to the location of the facilities. Maintenance is difficult to perform on subsea projects because the maintenance crew cannot directly access the facility. Even for minor maintenance, the entire facility needs to be lifted and transferred to the workshop, and specialized machinery needs to be sent to the seabed. This means that, even for minor maintenance, the field operator must incur high maintenance costs as well as reduce or suspend operations during the maintenance period. High quality, durable facilities require less maintenance, thereby reducing these problems. One of TOYO's roles in our three-company collaboration involves procuring such facilities.

Conventional facilities are assembled from equipment and materials that were designed separately. But to recover oil and gas from seabed reservoirs, a comprehensive concept is crucial. Our three-company collaboration can provide such service to oil companies because we take into consideration the feasibility of the overall operation costs, not only procurement costs.

**■ What response has there been to TOYO's initiatives in subsea energy recovery?**

In October of last year, TOYO exhibited our work in integrated subsea energy recovery at Techno Forum 2015, held by Japan Oil, Gas and Metals National Corporation (JOGMEC). We focused on our collaboration with Baker and Aker, and the many visitors from major oil companies and key government members from oil-producing countries were very pleased that our proposals met their expectations. At the Symposium on Subsea Technology held in December 2015, TOYO again spoke about our distinct three-company collaboration and energy recovery in Japan's coastal waters. Through our participation at these events, we recognize that interest from governments and private companies is increasing faster than before.

Taking advantage of this momentum, TOYO held the "Collaborating for Japan Workshop" in Tokyo along with Baker and Aker in February 2016. The workshop welcomed over 100 participants, showing that Japanese companies are very interested in subsea oil & gas recovery. TOYO is encouraging entry into the field by all companies with advanced technology, not just those from Japan.

**■ At present, methane hydrate is attracting attention as an energy source inherent to Japan.**

Methane hydrate deposits in Japan's coastal waters are estimated at around six trillion cubic meters—around 100 years' worth of domestic natural gas. The commercial viability of methane hydrate would completely change Japan's energy situation, which traditionally has relied on the import of oil, LNG and other energy sources. It would lead to the consolidation of energy security.

The Plan for the Development of Marine Energy and Mineral Resources was released by the Japanese


TOYO provides subsurface and surface integrated engineering through a collaboration with Baker and Aker, with each company leveraging their field of expertise.

Ministry of Economy, Trade and Industry in December 2013. It outlined a plan for large-scale methane hydrate commercialization with a goal of commencing production within 10-15 years from offshore deposits located in Japan's Exclusive Economic Zone (EEZ). To achieve this goal, Japan Methane Hydrate Operating Co., Ltd., was formed in October 2014, and was invested in by 11 domestic private companies, including ours. TOYO will contribute the know-how and technology we have accumulated through oil & gas recovery projects. As this is a Japan-based energy recovery project, TOYO hopes to invite participation from a wider range of Japanese industries.

**Personnel with high expertise and strong systems for business promotion are critical to expanding the energy recovery business, particularly with subsea projects. What system is TOYO creating?**

The Energy Business Unit is comprised of more than 50 experts in oil & gas recovery technologies, and is composed of the Energy Supply Chain Division, the Energy Project Division, and the Energy Technology Division.

The Energy Technology Division, which accounts for around half of the overall unit, takes a central role in technology aspects and functions in a wide range of capacities—designing strategic technology plans and providing solutions for clients' technology issues. About half the members of this division are subsurface engineers and the other half are production and facility operation planning engineers. The Energy Supply Chain Division focuses on clients' business operations as a whole and works to offer the best proposals considering the economic evaluation of investments. Finally, the Energy Project Division strives to further improve initial plans and conducts project implementation while improving the added value of assets. By continually increasing value through these improvements, TOYO has developed the client support business that we have provided to the same clients for over ten years.

Upstream Business in TOYO involves primarily "soft" services, so all members assigned to the Energy Business Unit first undergo intensive training in the Energy Technology Division, acquiring knowledge about oil & gas recovery methods and know-how learned from previous projects. And our training system broadens members' capabilities through on-the-job training.

## TOYO's Strength: Integration of Subsurface and Surface Engineering

**What competitive edge does TOYO have in the oil & gas business?**

TOYO's strength is our ability to conduct comprehensive engineering from subsurface to surface. We can optimize subsurface and surface systems for each stage of the production method by comprehending changing subsurface conditions and predicting future conditions. This allows TOYO to provide the client with the highest level of expert service at every stage of oil & gas recovery, from initial planning to the close of operations.

TOYO entered the oil & gas field development business in the mid-1980s, initially under an EPC* business model. However, we shifted our focus to providing services after concluding contracts with national oil companies in Saudi Arabia and Kuwait. In this business, TOYO found it necessity to provide sufficient know-how not only for surface systems but also for subsurface mechanisms in order to be a good partner

to the field owner. This discovery prompted TOYO to form an integrated subsurface and surface engineering business model, which has been highly appreciated by energy companies globally, particularly those in oil-producing countries. This has led to gaining our clients' trust. Currently, TOYO has concluded service contracts with over 20 international and national oil companies.

*EPC: Engineering, Procurement and Construction

### What is your outlook on future trends in the oil & gas market and TOYO's business strategy?

It appears that the oil & gas market will remain unpredictable for a while. Due to the drop in oil prices, investor sentiment has decreased in oil-producing countries. On the consumption side, the future of emerging economies is still unclear. However, now is the right time for clients to utilize TOYO to find the optimal solution. Recently, we've had an increase in inquiries regarding secondary and tertiary enhanced oil recovery methods where production levels have declined. TOYO is also receiving requests for assistance in optimizing operations from clients with which we have concluded service contracts. Our collaboration with Baker on the integration of subsurface and surface engineering is effective for solving these sorts of problems. When we added the challenge of subsea field engineering, we were able to form a three-company collaboration with Aker, who can cover areas where TOYO and Baker did not have adequate experience. Through providing a wide range of solutions for energy recovery, TOYO contributes to stabilizing energy supply and demand, and creates new possibilities for the energy business.

## TOYO's Value: Providing "Priceless" Services

### Lastly, do you have a message for our readers?

Since first joining TOYO, I have been dispatched overseas many times. This gave me the opportunity to work at the forefront of the energy business. Being involved in joint projects in a different culture outside Japan allowed me to learn a wider perspective and gave me a clearer understanding of the overall picture together with a down-to-earth perspective. I believe that this combination is the key to ensuring success throughout the lifespan of an oil & gas field project. Also, it remains indispensable in all of TOYO's endeavors—not just in the energy business. Our young members are the future of TOYO. In order to help them grow and evolve, they are actively given an opportunity to work in multicultural situations to broaden their viewpoints. We hope that this will assist them in continuing our corporate culture into the future.

I believe that added value to clients is defined as the things they receive beyond the contract price. In other words, simply carrying out the contract is the duty of a contractor, and that benefits TOYO and our stockholders. The real added value to clients comes from the higher quality of deliverables, wider knowledge in execution, and better solutions to issues faced during project execution. This is where clients truly recognize value, and this is what I mean by "priceless." I believe that providing this is a key part of TOYO's value. I look forward to seeing TOYO continue to move ahead together with our clients, propose excellence, and provide value to clients by forging a path to the future.

**PROFILE**

**Hiroshi Sato**
Unit Director, Energy Business Unit

Hiroshi Sato joined TOYO in 1981, and since then has been involved in the oil & gas recovery business. He was on loan to an American oil company for five years, and then gained further experience working on projects in the Middle East and Western Siberia. He also experienced working in a harsh natural environment during construction of an oil & gas recovery facility in the Russian Arctic Circle. In the 2000s, he learned about the latest execution methods of service contracts for oil & gas recovery in the U.S. In 2002, he applied this knowledge to service work on optimizing and sophisticating oil fields in Saudi Arabia and Kuwait (service contract continues today). Mr. Sato continued to lead TOYO's energy-related business, becoming General Manager of the Oil & Gas Engineering Business Department in 2005, and Division Manager of the Energy Business Division in 2009. In 2011, he became an Executive Officer, and in 2013 was appointed the Unit Director of the newly created Energy Business Unit. Since 2014, he has been acting as a Senior Executive Officer and Unit Director. He says, "The oil & gas business requires a solutions provider in every respect. I like to keep challenging myself to create new business models in engineering fields."

# Ongoing Global Major Projects (as of February 2016)

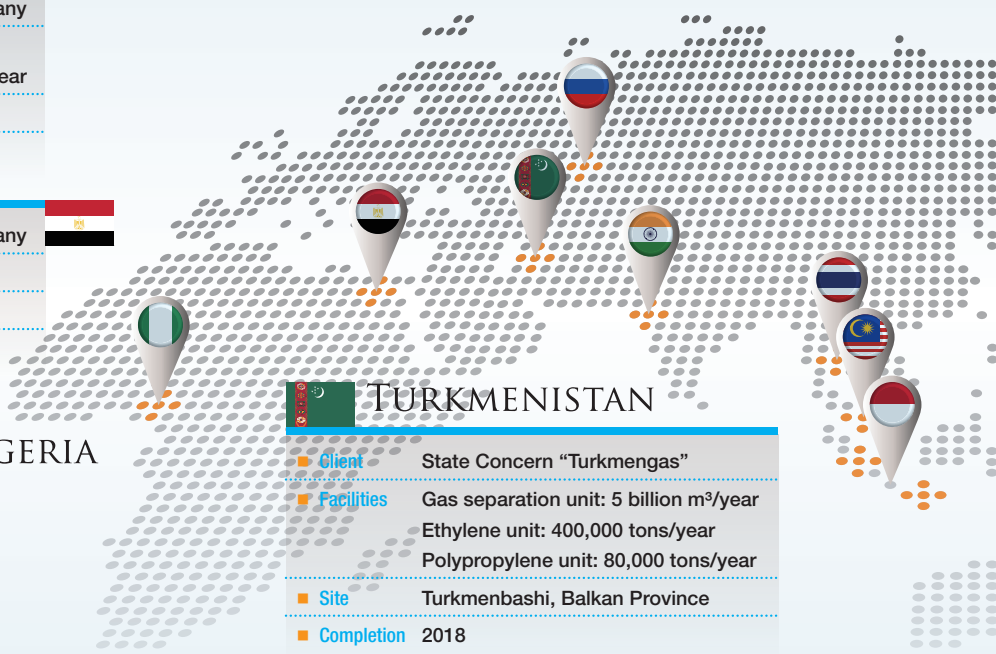
## EGYPT

- Client: Egyptian Ethylene and Derivatives Company
- Facilities: Ethylene plant: 460,000 tons/year
  Butadiene extraction plant: 20,000 tons/year
- Site: Ameriya District, Alexandria
- Completion: 2016

- Client: Egyptian Ethylene and Derivatives Company
- Facilities: Polyethylene plant: 400,000 tons/year
- Site: Ameriya District, Alexandria
- Completion: 2016

## RUSSIA

- Client: TAIF-NK
- Facilities: Heavy Residue Conversion Complex (VCC process): 3,700,000 tons/year
- Site: Nizhnekamsk, Tatarstan
- Completion: 2016



## TURKMENISTAN

- Client: State Concern "Turkmengas"
- Facilities: Gas separation unit: 5 billion m³/year
  Ethylene unit: 400,000 tons/year
  Polypropylene unit: 80,000 tons/year
- Site: Turkmenbashi, Balkan Province
- Completion: 2018

## NIGERIA

- Client: Indorama Eleme Fertilizer and Chemicals Limited
- Facilities: Ammonia plant: 2,300 tons/day
  Urea plant: 4,000 tons/day
- Site: Port Harcourt, Rivers State
- Completion: 2016

## THAILAND

- Clients: Joint ventures owned by Gulf Energy Development Company Limited and Mitsui & Co., Ltd.
- Facilities: Twelve natural gas fired cogeneration power plants: six 120 MW, two 125 MW and four 130 MW
- Site: The suburbs of Bangkok
- Completion: From 2017 to 2019

## MALAYSIA

- Client: PRPC Refinery and Cracker Sdn. Bhd.
- Facilities: Ethylene plant: 1,290,000 tons/year
  Pyrolysis gasoline plant: 660,000 tons/year
  Butadiene extraction plant: 185,000 tons/year
  Benzene separation plant: 175,000 tons/year
  Methyl tertiary butyl ether plant: 550,000 tons/year
- Site: Pengerang, Johor
- Completion: 2019

## INDIA

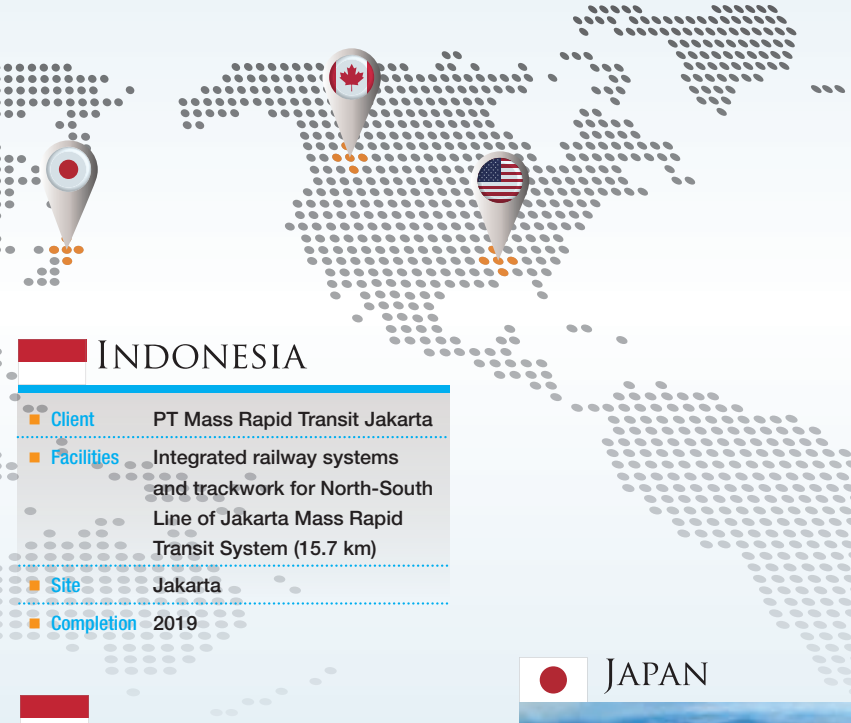
- Clients: ① Petronet LNG Limited ② GSPC LNG Limited
- Facilities: LNG regasification plants
- Sites: ① Dahej, Gujarat ② Mundra, Gujarat
- Completion: ① 2017 ② 2016

## CANADA

- Client: Japan Canada Oil Sands Limited
- Facilities: Bitumen production by SAGD*1 technology / Central processing facilities and utilities & infrastructure: 20,000 bpsd
- Site: Hangingstone area, Alberta
- Completion: 2016

## USA

- Client: Shintech Inc.
- Facilities: Ethylene plant: 500,000 tons/year
- Site: Plaquemine, Louisiana
- Completion: 2018



- Client: Sasol
- Facilities: Linear low density polyethylene plant: 450,000 tons/year
- Site: Lake Charles, Louisiana
- Completion: 2017

## INDONESIA

- Client: PT Mass Rapid Transit Jakarta
- Facilities: Integrated railway systems and trackwork for North-South Line of Jakarta Mass Rapid Transit System (15.7 km)
- Site: Jakarta
- Completion: 2019

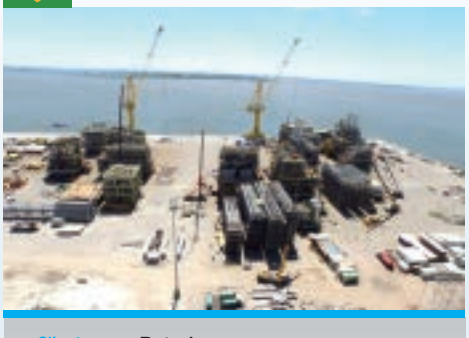
- Client: PT. Synthetic Rubber Indonesia
- Facilities: Synthetic rubber plant: 120,000 tons/year
- Site: Cilegon, Banten, Java
- Completion: 2018

- Client: PT Pupuk Sriwidjaja Palembang
- Facilities: Ammonia plant: 2,000 tons/day Urea plant: 2,750 tons/day
- Site: Palembang, South Sumatra
- Completion: 2016

## JAPAN

- Clients: ① Special purpose companies of Pacifico Energy K.K. ② Setouchi Future Creations LLC
- Facilities: Five large-scale solar photovoltaic power plants, total: 458 MW
- Sites: ① Okayama (×2), Miyazaki, Miyagi ② Okayama
- Completion: ① From 2016 to 2018 ② 2019

## BRAZIL

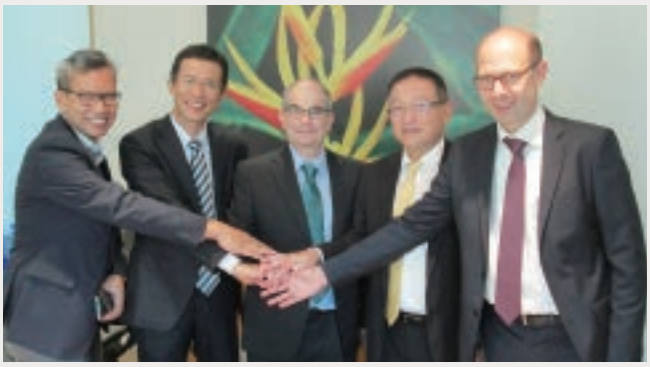


- Client: Petrobras
- Facilities: FPSO*2 (P-74): 150,000 bpd
- Site: Franco 1 area, off the coast of Rio de Janeiro
- Completion: 2017

- Client: MODEC, Inc.
- Facilities: FPSO*2 (MV27): 100,000 bpd
- Site: The Carioca area, off the coast of Rio de Janeiro
- Completion: 2016

*1. SAGD: Steam Assisted Gravity Drainage
*2. FPSO: Floating Production Storage and Offloading

## TOYO Awarded Synthetic Rubber Plant Project in Indonesia


Signing ceremony

Toyo-Japan and PT. Inti Karya Persada Tehnik (IKPT) have been awarded a contract for a synthetic rubber plant project with a production capacity of 120,000 tons per year in Cilegon in the western part of Java, Indonesia, from PT. Synthetic Rubber Indonesia, a joint venture between major tire manufacturer Michelin, France, and leading private petrochemical company PT. Chandra Asri Petrochemical Tbk. (CAP), Indonesia. This plant will produce Solution Styrene Butadiene Rubber (S-SBR) and Polybutadiene Rubber (PBR) utilizing technology licensed by Michelin, and will utilize butadiene feedstock produced by PT Petrokimia Butadiene Indonesia, a subsidiary of CAP. The synthetic rubber produced will be used primarily to manufacture tires. Toyo-Japan is in charge of offshore supply, and IKPT is handling detailed engineering, local procurement, and construction. The target for completion is in 2018.

TOYO was awarded a butadiene plant project in 2011 and an ethylene plant expansion project in 2013 from CAP. The Indonesian market, with a population of approximately 250 million, is experiencing rapid economic growth, and is showing fast-rising demand for tires along with a sharp increase in automobiles and motorcycles.

## Large-Scale Fertilizer Project in Indonesia Completed


Completed plant


Handover ceremony

TOYO has completed a large-scale fertilizer project for the state-owned Indonesian fertilizer company PT Pupuk Kalimantan Timur (Kaltim) in Bontang, East Kalimantan. Commenced in 2011, this project was to construct one of the largest fertilizer plants in the world, with a production capacity of 2,500 tons per day of ammonia and 3,500 tons per day of urea as well as its utilities facilities. TOYO's proprietary ACES21® urea process technology and urea granulation technology was applied in the urea plant. The project was challenging because it was for the largest single train fertilizer plant constructed by TOYO, and was conducted in collaboration with Toyo-Korea and PT. Inti Karya Persada Tehnik (IKPT) through multi-office project execution. After overcoming many obstacles, the project was completed in 2015. In November, a grand handover ceremony was held, with the attendance of Joko Widodo, President of Indonesia, and his cabinet members.

## Ethylene Plant Expansion Project in Indonesia Completed

Completed plant

*FEED: Front End Engineering Design

TOYO, jointly with PT. Inti Karya Persada Tehnik (IKPT), completed a plant expansion project of an existing naphtha cracking plant for PT. Chandra Asri Petrochemical Tbk. The plant is located in the suburbs of Cilegon on the western tip of Java, Indonesia. The project is to expand ethylene production capacity from 600,000 tons per year to 860,000 tons per year for an existing plant built by TOYO in the 1990s based on the ethylene technology of Lummus Technology Inc., U.S. TOYO had been providing FEED* services since July 2012, and continued on to project execution in the summer of 2013. The construction work to install the expansion facilities started in October 2015, during a shutdown period at the plant. The shutdown work was completed in early December, ahead of the schedule set in the contract. After carrying out commissioning, the plant was accepted by the client in January 2016.

## Completion of Nonwoven Textile Project in China

Product warehouse

Toyo-China completed a 60 million square meter per year nonwoven textiles project in the end of December 2015—one month ahead of the original schedule—for Bonar High Performance Materials (Changzhou) Co., Ltd., in the New District of Changzhou, Jiangsu Province, China. The project was awarded to Toyo-China in May 2014 and completed after start-up commenced in September 2015 for the fleecing line and in December 2015 for the spinning line. Bonar, Netherlands, is the client's parent company and is a subsidiary of Low & Bonar Plc., UK, which specializes in high performance technical textiles. Total investment is estimated at U.S. $50 million.

The design concept, plant equipment and installation process for textile plants differ greatly from that of petrochemical and chemical plants, where TOYO is richly experienced. Toyo-China developed the basic and detailed designs in close communication with the client, which was key to successfully completing the project to meet the client's objectives in a new field for TOYO. Toyo-China also improved the HSE*1 procedure to meet strict HSE requirements. The project was successfully completed through a detailed constructability study and comprehensive site construction schedule control without LTI.*2

*1. HSE: Health, Safety, Environment
*2. LTI: Lost Time Incident

## Cogeneration Power Plant Project in Thailand Gets Under Way

Construction on the first plant, started February 2015

At the end of November 2014, TOYO and TEC Project Services Corporation (TPS) concluded a contract with special purpose companies jointly established in Thailand by independent power producer Gulf Energy Development Company Limited (GED) and Mitsui & Co., Ltd., for a project to build twelve cogeneration power plants. Work on the sixth plant began in December 2015. TOYO and TPS started the first power plant project in February 2015, and since then the companies have been receiving orders and commencing work on the plants in sequence approximately every two months as planned. The project involves the construction of twelve natural gas-fired combined cycle cogeneration power plants near Bangkok (six 120 MW, two 125 MW and four 130 MW, total generation capacity 1,490 MW). Construction on the seventh plant is scheduled to begin in June 2016, and subsequent plant construction will resume commencing approximately every two months. Construction on the twelfth plant is scheduled to begin in April 2017, and all twelve plants are to be completed by July 2019.

## TOYO Awarded Large-Scale Photovoltaic Power Plant Project in Japan

TOYO has been awarded a large-scale photovoltaic power plant project in Osaki City, Miyagi Prefecture, Japan, by Pacifico Energy Furukawa G.K. The plant will have a power generating capacity of 56.87 MW (DC) and is scheduled for completion in the end of 2016. All power generated will be sold to the Tohoku Electric Power, Co., Inc.

TOYO is now executing several construction projects for large-scale photovoltaic power plants in Setouchi, Okayama Prefecture (230 MW), Miyazaki, Miyazaki Prefecture (96 MW), Mimasaka, Okayama Prefecture (42 MW), and Kumenan, Okayama Prefecture (32 MW) in Japan. The total power generation capacity of all these photovoltaic power plants, including the Osaki plant, will exceed 450 MW.

Construction site (panels are an artistic rendering)

## Completion of Non-Revenue Water Reduction Project in Yangon, Myanmar

Handover ceremony

The Japan Consortium Limited Liability Company (JC), which was established by TOYO and TSS Tokyo Water Co., Ltd. (TSS), a supervisory body under jurisdiction of the Bureau of Waterworks, Tokyo Metropolitan Government, recently completed a Non-Revenue Water (NRW) reduction project at a pilot area in Mayangone Township, Yangon City for the Yangon City Development Committee in Myanmar. This project made use of the Grant Assistance for Grassroots and Human Security Projects (GGP) program, offered by the Ministry of Foreign Affairs of Japan. Equipment and materials such as water meters and leak detection equipment were supplied to the pilot area in order to reduce the amount of NRW. Also, flow surveys, leakage detection, and supervision of repair work have been executed. Results included a reduction in the NRW rate, which had at times reached as high as 77%, to 32%. Also, the pilot area gained daily access to water, compared to only every other day of water supply before the project.

In October 2015, a handover ceremony was held in Yangon, with the attendance of Japan's Ambassador to Myanmar. A rapid population increase in Yangon City has required the development and expansion of water infrastructure. At the ceremony, the mayor of Yangon expressed his gratitude to JC for sharing its knowledge and experience regarding NRW and the remarkable results produced by this project.

## Construction of Highly Potent API Plant Completed in Japan

Plant overview / Safety cabinets

In September 2015, TEC Project Services Corporation (TPS) completed construction of a highly potent API (Active Pharmaceutical Ingredients) plant for Chitose Hamari Chemicals, Ltd. The plant will manufacture highly potent APIs, including certain peptides, which are gaining attention in a broad range of medical fields, such as treatments for cancer, diabetes mellitus / metabolic disease, infectious disease, and cranial nerve disease.
The Hamari Chemicals Group is planning to enter the highly potent peptide API market, which is expected to grow globally. In line with this policy, the group established this plant—their first of its kind—at Chitose Hamari Chemicals in Chitose, Hokkaido, Japan. As construction of the manufacturing facility was carried out inside an existing building, the rooms and barriers were arranged within limited space and the existing air conditioning system was modified to meet the requirements for both primary and secondary containment for highly potent APIs. The client's appreciation of TOYO's advanced containment technology and extensive track record led to the award of this project. By closely coordinating the construction sequence in order to minimize interfering with existing facilities, plant completion and handover to the client were carried out according to the original schedule. Currently, the client is carrying out commissioning.

## Validation Plant for New Process to Produce Feedstock for Functional Resin in Japan

A ceremony for safe construction

TEC Project Services Corporation (TPS) was awarded a contract for the construction of a validation plant planned by Asahi Kasei Chemicals Corporation* (Asahi Kasei) for its Mizushima Works. The facility will have an annual production capacity of 1,000 tons, and is scheduled to start operations in January 2017.

The newly developed process will produce diphenyl carbonate (DPC)—a monomer used as the feedstock to manufacture polycarbonate (PC)—via dialkyl carbonate (DRC). The process will use a proprietary catalyst developed by Asahi Kasei to obtain DRC from $CO_2$ and alcohol in the first step, with DPC obtained from DRC and phenol in the second step. This production method is revolutionary because it does not rely on ethylene oxide (EO), which is used as the feedstock in Asahi Kasei's current non-phosgene PC process, thus allowing for greater freedom in selection of plant location. With fewer process steps, the new process is also more energy-efficient, enabling production costs to be reduced substantially.

This project is an example of the solutions that TPS provides in order to help clients quickly realize their new technologies.

*Asahi Kasei Chemicals Corporation was merged into its parent company, Asahi Kasei Corporation, in April 2016.

TOYO ENGINEERING

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