

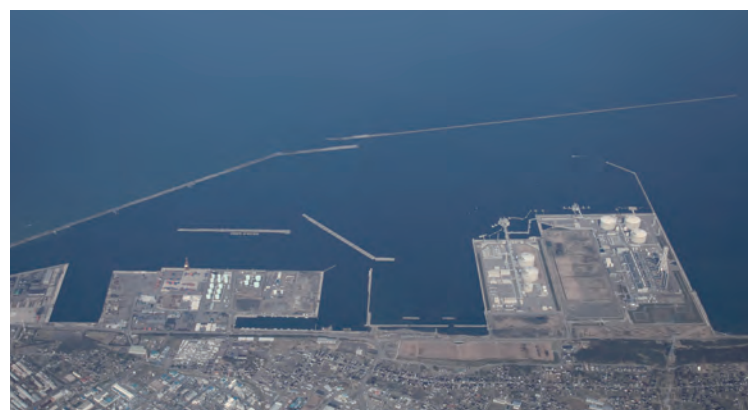
Aiming for greater heights with a more robust gas supply chain



INPEX's business in Japan started with the operation of gas fields and transportation of gas through long-distance pipelines, and has since expanded to midstream and downstream-business. Along with business expansion, securing a stable gas supply also became important, so operations greatly evolved to cover all processes in the gas supply chain, including overseas gas field production and operation, liquefaction, shipping and unloading from LNG carriers, and finally regasification of the LNG. Each phase in the gas supply chain is creating value to the business, and the aim is to develop this model further to complement the business as a whole.

Preparing for the strong demand of natural gas construction of an LNG receiving terminal

In January 2010, INPEX carried out a plan to source gas from LNG which began to be received from the Shizuoka Gas company via the Shizuoka pipeline. This LNG sourced from the Pacific Ocean side of the country, combined with the domestic gas operations on the Sea of Japan side, meant INPEX could secure gas from two different sources, and this improved its ability to utilize the full pipeline network and create a stable supply of gas. Meanwhile, the demand for natural gas as an environmentally-friendly energy source was expected increase significantly due to global warming. However, there was a limit



Panoramic view of Naoetsu Harbor (March 2017)
Photo: Port Development Division, Bureau of Transportation Policy, Niigata Prefectural Government

to how much demand that could meet when relying on Japanese gas field deposits and LNG from Shizuoka Gas alone. INPEX frantically searched for the supply of LNG from other companies in order to ensure a third and fourth source of gas but things did not go as hoped. After various studies, in 2005 the conclusion was reached that an LNG receiving terminal should be constructed for the supply of LNG from overseas. This construction project was the start of a long journey involving a huge amount of capital investment.

Construction of the cherished Naoetsu LNG Terminal

(1) Acquisition of the Naoetsu Site

As the potential locations for LNG terminals are limited to seaside areas, investigations targeted existing harbors near the Sea of Japan between Niigata and Toyama. Naoetsu was considered to be the optimal location in relation to the INPEX pipeline network, plus the area is being developed as the leading energy harbor near the Sea of Japan. However, the completion of a landfill project in Naoetsu led by the prefectural government was still a long way off and it was not possible to find suitable land in the harbor area that was not being used. Then, there was a major turning point. After hearing INPEX's intention to construct an LNG receiving terminal, the government of Niigata prefecture and Joetsu city realized the importance of the business and how the construction would stimulate the region. A decision was made to conduct a study to bring forward the land reclamation in the Naoetsu harbor. After many discussions, INPEX made an official request to Niigata prefecture and Joetsu city in September 2007 to cooperate with the construction of the Naoetsu LNG receiving terminal and an agreement was formalized. This memorandum stated the prefecture would change the harbor plans and land would be reclaimed for the terminal construction at the Arahama wharf in Naoetsu harbor. It also stated that INPEX would acquire that site and in cooperation with Joetsu city would endeavor to realize the construction plans for the LNG receiving terminal. The cooperation from Niigata prefecture along with the understanding of many stakeholders including Joetsu city and the Hokuriku Region Development Bureau propelled this project forward.

(2) Acquiring the know-how for optimal facility construction

In August 2008, the LNG Receiving Terminal Construction Division was established and the construction plan was made official. The plan included a berth for massive LNG carriers, two 180,000 kiloliters above-ground tanks, regasification equipment and heat adjustment facilities on a 25 hectare site. However, as INPEX did not have the expertise and experience to construct LNG facilities, it started by visiting LNG terminals at major electricity and gas companies to acquire knowledge. INPEX considered outsourcing the construction work, but as the terminal is near the Sea of Japan and as they had their own ideas for the plan, they decided to construct the terminal themselves to avoid potential issues from suspending the operation. Meanwhile, Tokyo Gas Engineering (now Tokyo Gas Engineering Solutions Corporation) was appointed as technical adviser to carry out the project smoothly. The groundbreaking ceremony was held in July 2009 and construction began the following month. Construction progressed well and the facility took shape when two dome-shaped LNG tank roofs were lifted in September 2011. Meanwhile, due to various external factors during construction, flexible measures had to be taken on site to revise the facilities and plans. Thorough safety management was needed with 1,200 employees per day at peak construction. In July 2013, the extensions of the Naoetsu and Shin Nagaoka pipelines were completed and connected to the LNG Terminal. In August 2013, the first LNG carrier docked into the harbor and in December of the same year, four years and four months after the commencement of work, Naoetsu LNG Terminal was complete, without any major accidents or difficulties and one month ahead of schedule. It started operation following the completion ceremony.



(From right) Joetsu City Mayor Masayuki Kiura, Niigata Prefecture Governor Hirohiko Izumida and Teikoku Oil President Masatoshi Sugioka shaking hands after signing a written memorandum ahead of construction of the LNG receiving terminal (September 2007)



LNG carrier arriving at the completed Naoetsu LNG Terminal

Completion of a major gas supply chain

During the construction of the LNG receiving terminal emphasis was put on creating a terminal that never stops. The only INPEX LNG receiving terminal is in Naoetsu, no others exist, so if the terminal stops operation so too will the supply of natural gas. Among the policies to avoid potential suspension of operations was the inclusion of duplicate piping, preparation of spare equipment such as pumps, and various schemes to combat the changing climate and marine conditions near the Sea of Japan. As for the control system, in addition to having a DCS (decentralized control system) that allows control of the terminal remotely with the touch of a button, leveraging from their operational experience INPEX added a system that controls the operations on site. As a security measure, access to the DCS is limited to the personnel who have sufficient knowledge to use the system. Employees gain valuable experience through

the daily use of the system, including techniques for the safe and smooth berthing, unloading and departure of LNG carriers. As of 2018, more than four years after the start of operation, everyone at Naoetsu LNG Terminal is brimming with confidence after acquiring lots of experience in this regard.

At Naoetsu LNG Terminal, approximately 900,000 tons of LNG per year will be received from Ichthys. This LNG, combined with domestically produced natural gas and the LNG from Shizuoka Gas Company, will ensure sound gas sources that will support the business in the future. INPEX has finished business integration and has drawn close to the day when the central idea behind business development—to supply Japan with the natural gas it developed overseas—becomes a reality. In October 2018, the first LNG tanker loaded with LNG from Ichthys arrived into Naoetsu Harbor to the keen interest of local colleagues. With this, the development of a robust gas supply chain was finally completed.



First receipt of LNG at the Naoetsu LNG Terminal LNG unloading operation (left); closely watched by the central control room (right)



Five mountain tunnels drilled despite being hampered by hard bedrock and flooding (total length of approximately 12.6 kilometers)



Laying pipeline underground with the Tateyama mountains in the background (Asahi, Toyama Prefecture)

Cultivating new demand: Construction of the Toyama Pipeline

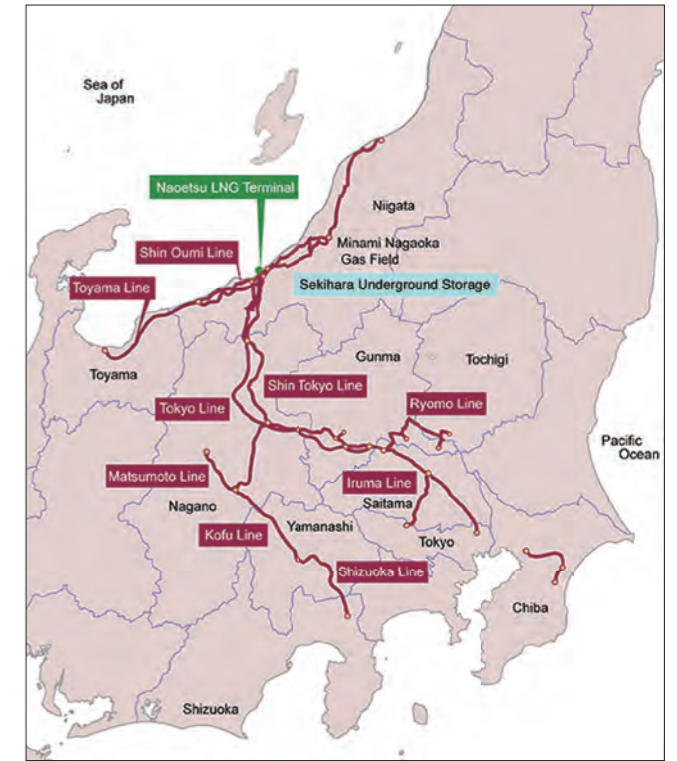
By building its own LNG receiving terminal, INPEX secured a new source of gas leading to a stable supply to meet the strong demand. However, this also proved to be the start of a new challenge. In order to cultivate demand for natural gas, it is essential to be competitive and increase the number of customers beyond the current level. A strategy to extend the pipeline network to new regions was developed to achieve cost competitiveness. This strategy continued after the integration of the businesses, where “expanding the scale of the natural gas business in Japan” became a business target, which includes an LNG supply chain that incorporates overseas gas assets. This strategy was carried out and the Toyama pipeline was born. Nihonkai Gas Co, which developed an urban gas supply business in Toyama prefecture, informed INPEX about the need for the supply of natural gas through a pipeline. In 2008, the decision to construct the Naoetsu LNG Terminal was made official, then the completion of the Shin-Oumi pipeline came into view in 2009 and an opportunity to construct a pipeline toward Hokuriku appeared. INPEX began a full-scale evaluation in the autumn of 2010. Despite the challenges of construction in mountainous areas and uncertainty about economic viability, more detailed studies were conducted and a decision was made to construct the Toyama pipeline in May 2011. The pipeline extends approximately 103 kilometers from the end of the Shin-Oumi pipeline in Itoigawa, Niigata prefecture, through to Toyama city, Toyama prefecture, and construction began in 2012. There was little familiarity with gas pipelines in this region, plus there was a heightened awareness of safety in Japan due to the nuclear power issues brought by the Great East Japan Earthquake that occurred the year before,

so considerable time was devoted to gaining the understanding of local residents about the safety of the pipeline. Construction work for this project was even more difficult than previous projects in terms of topography and geology. The pipe was laid along the coast which brought construction difficulties as there were many points where it crossed rivers both large and small, plus the line was obstructed by steep terrain with hard bedrock and debris, and there were many cases of flooding. Furthermore, the project required advanced techniques including the construction of mountain tunnels and the use of shielding and jacking method on traffic-prone urban roads as well as rivers. At its peak, there were 1,000 workers at more than 100 on-site locations.

As a result of difficulties in construction and certain unavoidable route changes, the construction period was extended by 18 months. Construction was eventually completed in June 2016, and after partial initiation the opening ceremony was held in October of the same year and natural gas was supplied to Nihonkai Gas. With the completion of the Toyama pipeline, the huge INPEX pipeline network reached a total length of more than 1,500 kilometers.

New business opportunities due to gas deregulation

With the start of operation of the entire Toyama pipeline, the sales volume of natural gas as of March 2018 reached approximately 2.11 billion cubic meters in combination with an increased supply to gas thermal power stations. The annual sales volume exceeded two billion cubic meters. In the 2012 Medium- to Long-term Vision, INPEX announced a strengthened gas supply chain as a growth target with the long-term aim of a domestic gas supply volume of three billion cubic meters per year. The aim of achieving 2.5 billion cubic meters by the mid-2020s was also stated, and INPEX has already drawn close to this amount. In April 2017, the revised Gas Business Act was enacted, which entirely deregulated participation in the gas retail market. As a result, following the deregulation of electricity retail the previous year, it was predicted that lowering the barriers to competition between energy businesses would lead to greater competition through participation of other industries and measures for diversified services. However, INPEX will take flexible measures to meet the various needs of wholesale city gas businesses that are proactively developing business. This has led to a business opportunity to increase the volume of gas sales, expand into new regions and develop new services. The Domestic Energy Supply & Marketing Division was therefore established in April 2017. The objectives of this division include enabling the Company to be flexible and respond to the changing business environment, to build stronger partnerships through enhanced cooperation, and to make new plans and proposals for urban gas suppliers and related companies. The gas supply chain that plays a role in the further growth of INPEX is not only about the stable supply of gas in Japan but also the start of a new challenge toward the full scale deregulation of the gas retail market.



Natural gas pipeline network (as at August 2018)