deugro

Case Study

Irkutsk Polymer Plant (IPP) Project

Industry
Petrochemical

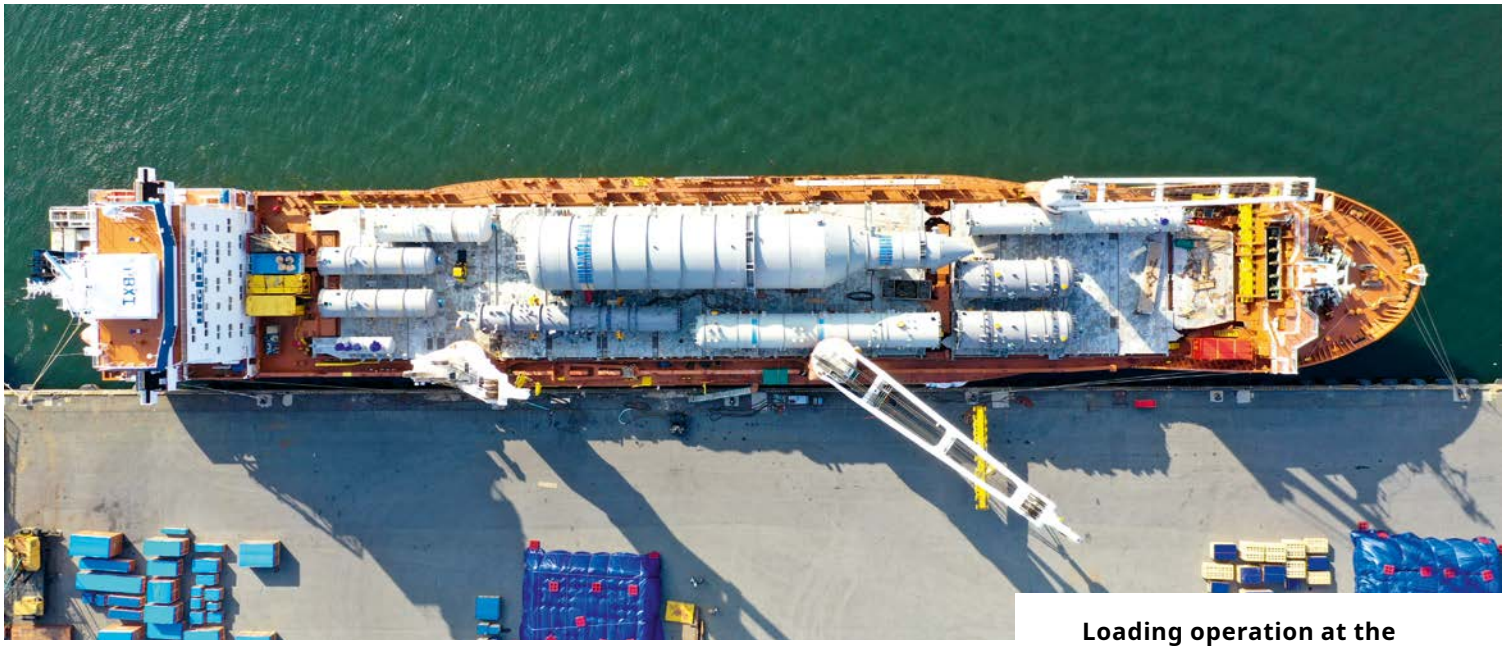
Cargo Highlights
81.93 m ethylene fractionator;
597 MT reactor

Volume
35,541 FRT of industrial cargo

Timeline
Limited navigation period of max. three months

Route
Northern Sea Route from South Korea via Tiksi to Ust-Kut, Russia

Coordination
High number of interfaces, barge voyages and overland trips



Loading operation at the Port of Masan, South Korea

Case Study: Irkutsk Polymer Plant (IPP) Project

In close and precise cooperation between the offices in Japan, Russia and Korea, deugro transported 35,541 freight tons of cargo simultaneously on two fully chartered heavy lift vessels for an ethylene and polypropylene plant. The cargo was moved from the cargo marshalling yard in Masan, South Korea via Tiksi in the Arctic Ocean to Ust-Kut, Russia. The heavy lift vessels, which have the Finnish/Swedish ice class 1A, were accompanied by the nuclear ice breaker *Yamal* for the Northern Sea Route (NSR) passage to ensure a safe delivery of the valuable cargo at the Port of Tiksi. The total distance from Masan to Tiksi and the subsequent barge transport across the Lena River to Ust-Kut was over 6,450 nautical miles.

The cargo contained 45 oversized and heavy lift (OSHL) pieces, including a 597-metric-ton reactor with dimensions of 44.5 x 11 x 10 meters and an ethylene fractionator weighing 357 metric tons with dimensions of 81.93 x 8.1 x 6.9 meters.

Due to the transport via the NSR and critical draft conditions of the Lena River, the navigation period was limited to a maximum of three months and required precise timing and coordination between all parties involved.

The barge delivery across the Lena River had to be completed according to schedule. Due to historical draft issues, contingency planning for the barge's guarded temporary storage sites was provided in case the draft of the Lena River would not have been sufficient.

» At first sight, the transport seemed almost impossible ... «

Project preparation

The first feasibility study was performed back in 2014. At first sight, the transport seemed almost impossible due to the short navigation times, uncertain weather, ice conditions and draft of the Lena River. In addition, only two kilometers of the nine-kilometer overland route to the construction site were passable via a federal highway, and the rest of the route needed to be constructed in a mountainous landscape.

However, these factors were no match for deugro. In close cooperation with our client, we found a way to make this project a success.

The first joint study with the client took place in 2016, whereby deugro experts prepared a survey and supported the project owner in determining the right location for the construction of the jetty on the Lena River. deugro presented the initial concept and preliminary schedule of transportation, which were generally confirmed at a later stage.

deugro conducted several route and infrastructure surveys and identified 45 OSHL units that needed to be delivered via Tiksi and the Lena River. To complete all deliveries in one navigational period, deugro and the client planned extensively to ensure the timely cargo readiness as well as vessel and barge arrivals at the Ports of Masan and Tiksi. Because most of the OSHL cargo came from South Korea and the transit time to Tiksi via the Bering Strait was the fastest, the cargo was consolidated at the Port of Masan.

deugro calculated and prepared a detailed transportation schedule; contacted the river barge operator, the ice-breaker operator and the Port of Tiksi authorities; and gathered information about the water level on the river. Based on these studies, deugro and its client scheduled the loading dates in Masan and chartered two heavy lift vessels for simultaneous loading operations and sea transportation. The method statements for loading, unloading, stowing and securing as well as transportation were reviewed by dteq Transport Engineering Solutions, a company of the deugro group.

For the Russian route from Tiksi to the job site in Ust-Kut, including barge transportation, transshipment at the jetty and last-mile transportation, all engineering work was monitored by deugro Russia's engineering department. All required documents prepared in the Russian language were issued timely with the authorities to obtain the permits for river and inland

Project challenges

- 45 OSHL pieces, including a 597 MT reactor and an 81.93 m, 357 MT ethylene fractionator
- The transport via the Northern Sea Route and the critical conditions of navigation on the Lena River, with a limited navigation period of max. three months, required precise timing.
- The high number of interfaces, barge voyages and overland trips required precise coordination.

» Timing, coordination and teamwork were key to successful delivery. «

transportation as scheduled.

Loading in Masan, South Korea

According to the sea voyage via the NSR, two vessels with ice class 1A (Finnish/Swedish ice class rules) were chartered and motion response analyses were conducted to determine the effects of any accelerations on the cargo during the voyage. Both vessels arrived in Masan according to the schedule.

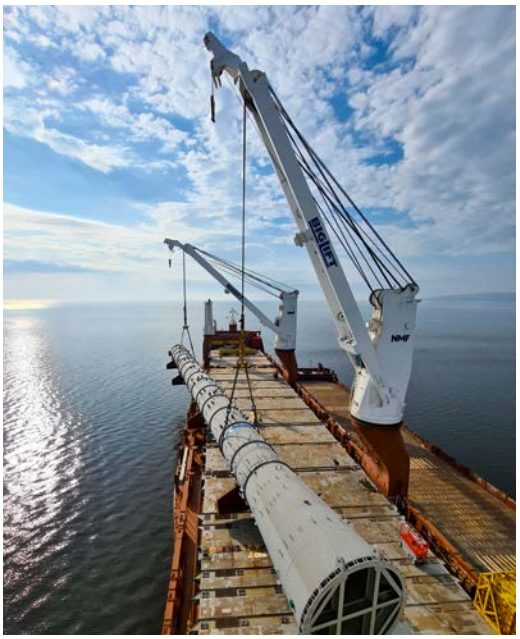
To avoid any unnecessary double handling of the cargo and to save costs, 17 OSHL units from China and Japan were loaded onto the same heavy lift vessel to Masan, which had already been chartered. Stowage plans and loading sequences were decided well in advance according to the barge stowage and discharging sequence onto the barges at Tiksi. All loading and seafastening plans were checked by dteq, and all the cargo was loaded according to plan, personally supervised by deugro Korea. After loading was completed, the heavy lift vessels were ready for their voyages through the NSR to their destination in Russia.

Transloading in Tiksi, Russia

After 4,500 nautical miles, both heavy lift vessels arrived punctually at the anchorage points in Tiksi, so transloading of cargo from the vessels to nine separate barges could be executed according to schedule within six days. Because there was no handling equipment in Tiksi, all the necessary equipment was carefully planned and assembled beforehand and delivered to Tiksi on barges from Yakutsk. Each step of the operation was supervised and coordinated by deugro, a stevedoring crew, transport engineers and the insurance company.

The transshipment in Tiksi was executed outside the port area due to a low draft at the Port of Tiksi. The sensitive cargo units were

Loading operation at the Port of Masan, South Korea



Transshipment in Tiksi, Russia

discharged simultaneously from the heavy lift vessels by using on-board cranes with a combined lifting capacity of up to 800 metric tons.

Two river ice-breaker tugs with the corresponding M-SP 3.5A class of the River Register were assigned to each heavy lift vessel to ensure a stable position of the barges during discharge operations from the vessels onto the barges. Additionally, they provided power supply to the welding machines. The shunting tugs moved the empty barges over 35 nautical miles from Bykov Mys, the mouth of the Lena River, to the loading point in Tiksi. Each time three barges were loaded, one tug towed them back to the mouth of the river where they waited for further transportation.

The loading operation was executed in one approach according to the pre-designed loading sequence. As a result, the barges did not have to be shifted once they had commenced

receiving cargo. The transport as well as the seafastening operation on the barges were coordinated with the Russian River Register.

River transportation

After discharge was completed in Tiksi, the barges, which are certified for an exit to the sea, started their voyage to Ust-Kut. The voyage of each barge took about 24 to 26 days per barge.

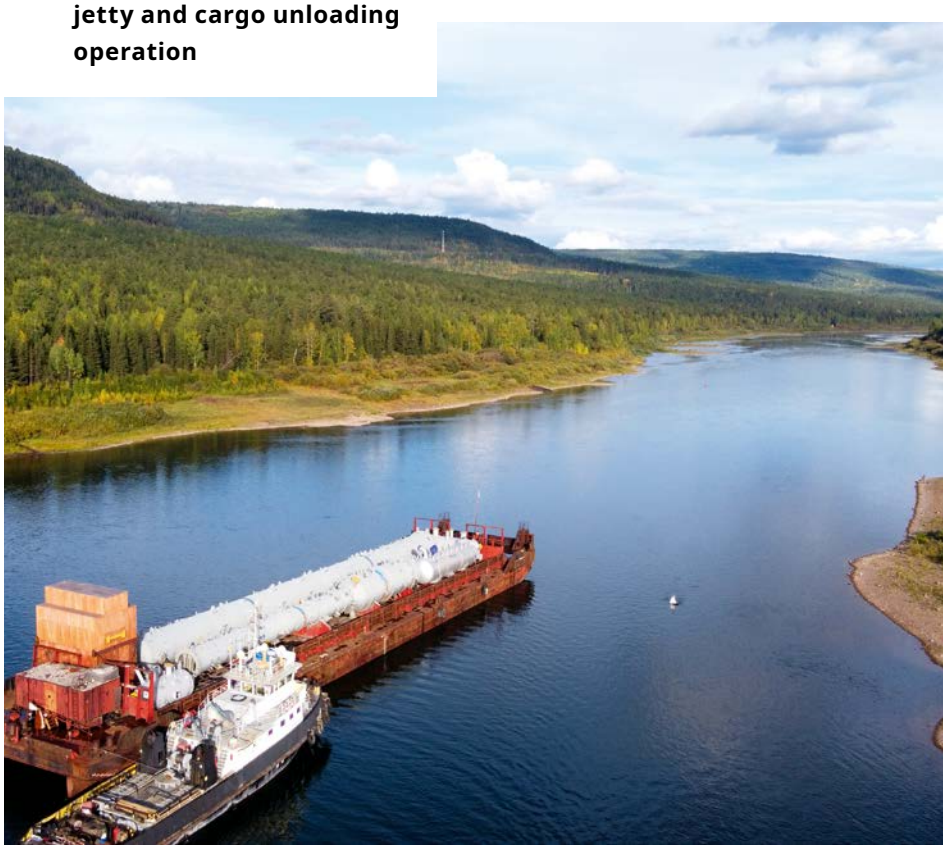
OT-2000 pusher tugs moved each two to four connected barges from Tiksi to Yakutsk/Peleduy. From Yakutsk/Peleduy to Ust-Kut, the towage was executed by RT-600 and RT-400 pusher tugs as well as a SK-2000K bulker/pusher.

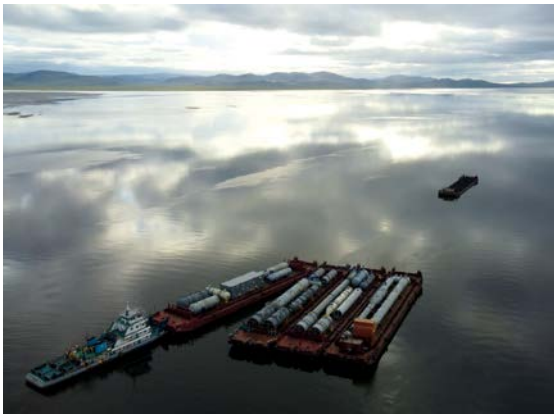
With a large number of rifts, where depths can merely be 115 to 130 centimeters during mid-August to mid-September, the most challenging part of the river was Peleduy/Ust-Kut. Therefore, the main objective was to execute the barge movements through the rapids section of the river and to deliver all of them to Ust-Kut prior to a possible falling of the water level. Thanks to professional planning and operation, the delivery was executed according to plan.

Transshipment from the barges onto road transport at the Ust-Kut jetty

The final destination for the barges was the Ust-Kut jetty, where the discharge operation for road transportation started. The jetty was designed in accordance with the technical solutions from deugro Moscow and constructed by the project owner. All units with a length of over 40 meters or a weight of over 220 metric tons were unloaded in tandem lift by two LR-1750 crawler cranes with a

Barges on their river voyage to the Ust-Kut jetty and cargo unloading operation





combined lifting capacity of up to 1,500 metric tons.

According to a precise schedule, the first day involved the berthing of the barge to the jetty, obtaining permission from customs for discharge operations, transshipment operations and fastening of the cargo on the vehicle, preparation for the road transport, and unloading of the remaining cargo from the barge.

The overland transportation started in the early morning of day two, when the next barge berthed at the jetty.

Road transportation from the jetty to the job site

The distance from the jetty up to the job site was about nine kilometers, including about two kilometers on the Viluy federal highway. The rest of the distance was covered on a separate road that was built especially for this

» It took a great deal of time for planning and required the concentration of the best effort of all concerned parties until the completion of this project. The best collaboration brought this successful result, which has been recorded as the one of the biggest shipments that has ever made its way up the Lena River to the Irkutsk region, and the first transportation for Toyo through the Northern Sea Route «

said Jung-Ah Kang, Lead transportation coordinator, Toyo Engineering Corporation.

purpose in accordance with the technical requirements and under the control of deugro Moscow. The maximum inclination was approximately 6%.

The OSHL units were moved by Self-Propelled Modular Transporters (SPMTs) assembled from four-axle and six-axle modules.

The 81.7-meter-long fractionator was moved by SPMT with turning tables, the 60 to 200-metric-ton units by non-self-propelled multi-axle THP trailers, and units under 60 metric tons by three to six-axis semi-trailers.

After the loading of the vehicles was completed, daily convoys from one to three road trains were formed and information on the convoy's structure, including unit numbers, were transferred to the relevant department of the project owner. Accompanied by escort cars and cars of the traffic police, blocking the traffic on all sections of the federal highway, the convoys started early in the morning during daylight. Applications with the parameters of the road trains and the project for organizing the transport were submitted by deugro to the local road administration and the traffic police in advance, who issued special permits and determined the transportation conditions.

To ensure smooth road transportation, the road was prepared according to the requirements of the cargo. This was based on the extraordinary dimensions and weights of the fractionator and reactor. Basic parameters to be considered were the turning radius of the axial lines on curves, the height of upper constructions, the longitudinal slope of the road or axle loading weight. The transportation took seven to nine hours for the SPMTs and three to four hours for the THPs.

Once the convoy arrived at the construction site, the unloading of the SPMTs was performed by jack-down of the cargo onto elephant legs without using cranes, and the unloading of the THPs and semi-trailers with the use of mobile cranes by the project owner. The storage areas were designed by the owner in accordance with the technical requirements of deugro Moscow.

Considering the scope of the whole project and the high number of interfaces, barge voyages and overland trips, preparation, timing, coordination and teamwork were key to successful project delivery. Teamwork and the full support of the client, project owner and all subcontractors made this project an operational and HSE success even during the COVID-19 pandemic.

From the jetty to the job site: Overland transportation of the 81.7 m, 357 MT fractionator and further OSHL units

Project video
Experience the complete transportation—watch the project video on YouTube!