

Case Study

Yamal LNG

Engineering for extremes

2020





Overview

In April 2014, TechnipFMC, in a joint venture with Japanese companies JGC and Chiyoda Corporation, won the contract for the Engineering, Procurement, Supply, Construction and Commissioning (EPSCC) of one of the world's largest LNG plants located in the Yamal Peninsula in the Russian Arctic. The pioneering Yamal LNG project is a remote complex that produces liquefied natural gas and gas condensate. It was built in three phases, each featuring a 5.5 Mtpa process train. The facility was completed at the end of 2018 and produces a total of 16.5 Mtpa of LNG and up to 1.2 Mtpa of gas condensate, which will be shipped to Asia-Pacific and European markets. The project was executed for JSC Yamal LNG, a consortium owned by Novatek, Total, CNPC and Silk Road Fund.

Contract: EPC

Award: 2014

Delivery: 2019

Client: Novatek, Total,
CNPC and Silk Road Fund

Location: Russia



3 LNG trains



10 fabrications
yards



75,000 people
with subcontractors



1 construction site



480,000 tonnes
of modules



Operating
centers in
7 countries

Challenge

As with any project, the main challenge was to complete on time a plant that produces LNG in the quantities and to the quality specifications required by the contract.

In the case of Yamal LNG, the project was faced with the extreme weather conditions and remoteness of the facility. Temperatures can drop as low as -57°C with an annual average of -10.5°C . The polar night lasts from November to February. And the region typically is ice-bound for nine months of the year.

Dealing with the extreme weather conditions and isolation, TechnipFMC and its partners confronted a variety of design challenges, including material selection, plant preservation, permafrost and ground stability. Special HSE measures had to be developed and implemented to protect the thousands of construction site workers laboring in frigid conditions



Technologies

Regarding LNG train configuration, for the first time at Yamal the refrigerant compressors were driven by twin GE Frame 7 gas turbines in a 2 x 50% arrangement. The two parallel and identical drive shafts each have three compressor casings and represent more than 100MW of power.

Yamal wellhead gas is mainly methane with some hydrocarbons heavier than pentane that have to be removed to avoid freezing in the cryogenic section of the plant. Technip Energies' Cryomax® process ensures trouble-free operations in the fractionation and delivers other advantages, including accelerated start-up.



TechnipFMC and its partners confronted the site's freezing and isolated conditions by choosing a modular construction approach, contracting with 10 Asian fabrication yards to build 142 modules and 365 pre-assembled pipe racks weighing more than 480,000 tonnes. Yamal LNG became one of the largest modular construction projects in the world.

To ship the modules to Russia, Technip Energies developed an ambitious logistics plan using a fleet of 20 vessels, including two specially built Arctic-class heavy transport vessels that journeyed from Asia to Sabetta by two different routes. The vessels travelled a western route through the Suez Canal and a northeast passage through the Bering Strait.

The modules were positioned and installed on more than 60,000 piles that were drilled 20 to 40 meters into the permafrost. The ground temperature was calculated at different depths to determine the best layers of insulation thickness. Thermosyphons were installed to chill the ground during winter to help balance the heat output from the facility.

Solutions

Because of the hostile and isolated environment of the Yamal Peninsula, it was important to identify the potential risk of critical onsite system failures such as the power supply. To that end, a thorough identification and assessment study was performed to develop a risk profile at the massive LNG complex and ensure all potential problems could be efficiently and safely mitigated.

These potential risks were objectively evaluated and analyzed from the early stages of the project. Mitigation plans required numerous studies

and use of the latest design and innovation management tools to achieve a safe plant startup and continuous operations under the extreme weather conditions.

Special HSE measures had to be developed and implemented to protect the thousands of construction site workers laboring in icy conditions. This was accomplished through strong management support and individual and team commitments to a safe environment with the overall goal of zero safety incidents.



Results

Yamal LNG began exporting LNG from its first train in late 2017 and from the second and third trains in 2018, ahead of schedule. This project has in many ways taken engineering practices well beyond traditional boundaries. The challenges of constructing and operating in such harsh Arctic conditions required innovation and adaptation of proven designs to the environment to push the usual industry solutions to new levels of success.

A challenging project from the outset, Yamal LNG was a triumph on many fronts, inspiring technological advances in engineering in extreme conditions as well as improved processes, organization and management tools.

First LNG train start-up: 2017

Second LNG train start-up: 2018

Second LNG train start-up: end 2018

A new benchmark in the industry for large projects

