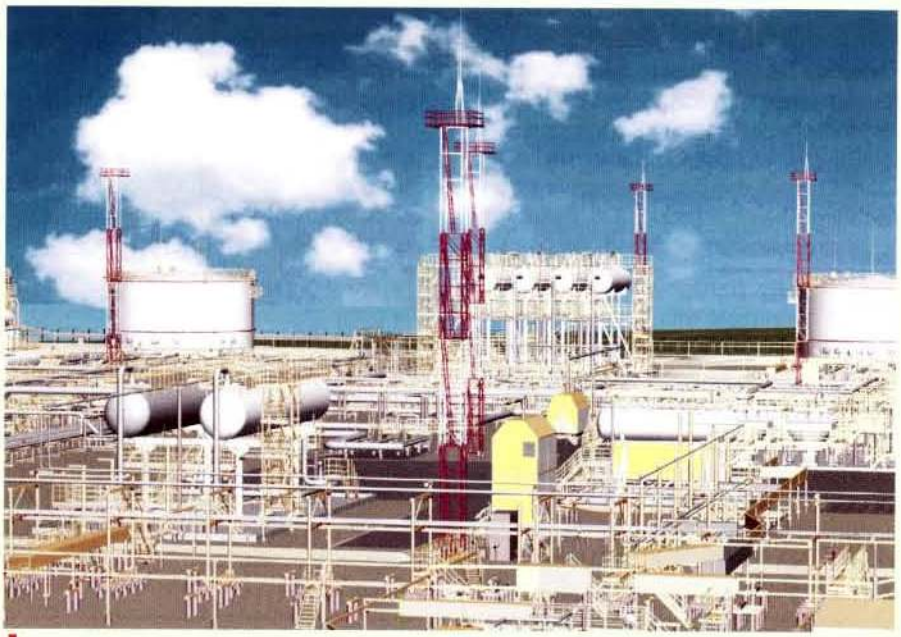
Sustainable Oil-Field Development Supports Thriving Community in Siberia

Specialists working in parallel on the same objects accelerated design time, reduced mistakes, and improved quality



If Khanty-Mansiysk were a country, it would be a world leader in oil production — second only to Saudi Arabia. This autonomous district of the Russian federation is located in a remote region of Siberia, where oil and gas production fuels 7.2 percent population growth. The 60,000 hearty citizens who live and work in subarctic conditions more than 3,000 kilometers from Moscow earn three times the national average salary. Families who settle in the region benefit from a rich infrastructure funded by social partnerships with the oil companies.

The St. Petersburg Times reports that in the past decade, the district capital has been transformed from a town of two-story wooden buildings to a thriving city with high-rise apartment complexes, schools, a university, scientific research institute, museum, concert hall, skating arena, and ski center. Though skeptics question the wisdom of encouraging economic growth in Russia's hinterland, those who have lived in Khanty-Mansiysk say improving life in Siberia is a worthy goal.

At the center of the district economy is the Priobskoye oil field, which borders both banks of the Ob River about 65 kilometers east of the capital city, also called Khanty-Mansiysk. Three-quarters of the 5,466-square kilometer field is controlled by the state-owned oil company Rosneft, which now owns the Yuganskneftegaz operating company. Yuganskneftegaz began production at the oil field in 2000 and expects to reach peak production of about 500,000 barrels per day by 2010. Experts predict the field will support peak production for up to 20 years of its 45-year life.

The infrastructure required to develop oil production in Western Siberia is built by leading design and research institutes such as Giprotyumenneftegaz. Founded in 1964 and located in historic Tyumen, the first Russian town in Siberia, Giprotyumenneftegaz performs integrated projects for more than 20 oil companies among other clients. With 500-plus engineers representing various specialties, Giprotyumenneftegaz designs optimal solutions for pumping oil and gas under severe climate conditions.

One project now under construction at the Priobskoye oil field is a $300 million booster pump station with a preliminary water discharge facility. The construction site is situated on the Ob River floodplain in an area crisscrossed by streams and old river beds. This complex project involved the design of several connected facilities including the process site, industrial zone, administrative and common buildings, and engineering facilities. Specialists from many different disciplines took part in the design, including surveyors, technologists, architects, sanitary engineers, electrical engineers, and specialists in CAM and telecom.

Giprotyumenneftegaz used Bentley software at all stages, from the engineering survey to functional design, plot planning, physical design, and estimate documentation. Use of Bentley's 3D solutions allowed different specialists to work in parallel on the same objects, which accelerated design time, reduced mistakes, and improved the technical quality. Given the high volume of projects undertaken by the design institute, the improved productivity has helped Giprotyumenneftegaz become much more competitive in the region.

"The annual volume of work we perform has increased eight times in the past four years," said Sergey Sokolov, general director of Giprotyumenneftegaz. "Our productivity has increased six times with the same number of personnel."

Photorealistic decision support

The project team used photorealistic object models to visualize the design and configuration of the pump station and discharge facility. The facilities perform water-oil emulsion and gas separation; preliminary discharge, treatment, and pumping of formation water; emulsion transport; and gas processing and transportation to a compressor station. The team also designed auxiliary systems for gas flare, water treatment, chemical and methanol injection, gas processing, and frost protection. Special design considerations included grouping elements in functional zones, arranging process units in accordance with harmful emissions class and fire hazard

category, and optimizing accident prevention and maintenance for all facilities.

Using base data provided by Yugansknefteqaz, the project team calculated basic production streams, then chose appropriate equipment, developed process diagrams, and analyzed pipeline strength under static and dynamic loads. During 3D design, more than 90 object plot plans were developed. With the great number of objects under design, the digital information content included about 6,000 files such as engineering survey maps, models, drawings, general explanatory notes, estimates, and equipment specifications all totaling more than 30 gigabytes. The integrated information field within the 3D model facilitated information exchange between different design stages. The work of several groups, including Russian and foreign subcontractors, was combined in the 3D model, which was used to generate drawings, sections, and elevations.

The 3D technologies for designing complex objects reduced the number of mistakes during design documentation and automated labor-intensive processes such as collision detection, specification, and estimate development. As a result, design time was reduced by 1.5 to 2 times, and design costs were reduced by about 25 to 30 percent. Giprotyumenneftegaz performs all large projects as 3D models deliverable to the customer. Using these visualization tools at the early stage of design enables the team to make decisions about the physical configuration that result in more elegant technical solutions for the client.

At the giant Priobskoye oil field, this single project is designed for an oil production rate of 9,163 million tons per year, with a maximum liquid quantity of 19,182 tons per year. The booster pump station with preliminary water discharge facility was designed to accommodate potential site expansion and construction in stages, so the facilities will perform as a unified whole when production peaks.

Looking to the time when the Priobskoye oil field is depleted, the governor of Khanty-Mansiysk district has said he envisions a vibrant high-tech industry as the new economic engine. Using oil money to fund higher education and scientific research facilities today is part of the government's plan to provide a better life for tomorrow's citizens of this isolated region. ❑

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