Offshore platforms still populate the Cook Inlet of Alaska, U.S.A. The Cook Inlet Basin contains onshore production and offshore platforms, with numerous oil and gas pipelines running around and under the inlet. The natural gas supplies all of south-central Alaska's residential, commercial and industrial demand, including liquefied natural gas (LNG), which is exported.

COMPRESSION HELPS NATURAL GAS DELIVERABILITY AT COOK INLET, ALASKA

NGC Compression Solutions Builds Reciprocating Compressor Packages to Boost Pressure in Beluga River Field

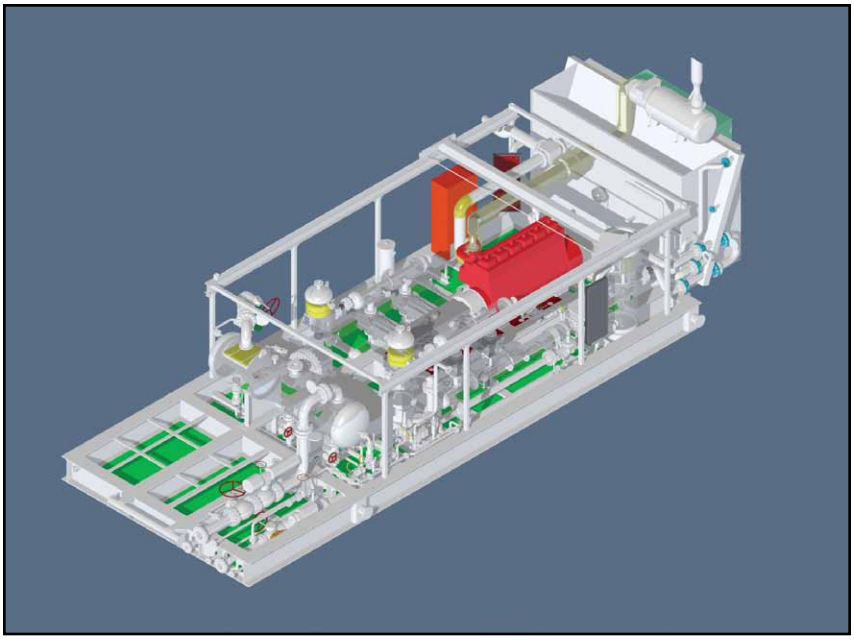
By Neil Purslow

Natural gas production from the Beluga River field in Alaska, U.S.A., has been declining since 2004 and may not be sufficient beyond 2012 to meet the heating and electrical demand of the Cook Inlet region, including Anchorage, Alaska.

In June of last year, in response to that decline, ConocoPhillips Alaska awarded NGC Compression Solutions of Calgary, Alberta, Canada, a contract to provide compression equipment for the field, on the upper west shore of the inlet.

"We are fabricating nine reciprocating compression packages that will be deployed at various well sites in that field," said Greg Nelson, account manager for NGC. "These units use a unique design that we developed specifically for this project."

ConocoPhillips indicated in its bid package that they wanted to reduce on-site construction costs by placing items on the skid that are not usually included on compressor packages. This included a remote electrical/instrumentation module (REIM) that would manage the on-site external



This image shows the 740 hp (550 kW) reciprocating compressor package in 3-D. Each unit includes an Ariel JGH/4 compressor driven by a Waukesha F3514GSI natural gas-fueled engine. An area was constructed on the skid base (front left) to include a remote electrical/instrumentation module (REIM) building. The module is used to manage the external electrical equipment, such as heat tracing and motor starters, for the on-site pumps and fans.

The 740 hp (550 kW) skid, with a total length of 56.5 ft. (17.2 m), required extra heavy-duty 24 in. (610 mm) steel I-beams to address package deflection. All critical skid welds were ultrasonically tested to ensure their integrity.

electrical equipment, such as heat tracing and motor starters for pumps, fans and other equipment. The bid also indicated that the packages should be as compact as possible to reduce transportation costs to Alaska.

NGC incorporated those requirements with the compression needs and developed a long, narrow (compact) design with all of the equipment on a single skid. The packages were sized so they could be trucked as a single unit from Calgary to Seattle, Washington, U.S.A., and then barged to Alaska, as opposed to the normal approach of building three-piece skids, dismantling and shipping them on the Alaska Highway in five or six truckloads per package.

In another example of how transportation costs are saved, the concrete ballast will not be installed in the skid base for the first seven packages until the units arrive in the Anchorage staging area. Once the concrete is poured and the units are staged, the skids will be barged to the Beluga River field. Other areas of the packages' design were also optimized for weight and size.

"Even though the skids are compact, they are not small," stated Nelson. "They are physically larger than most 1500 hp [1120 kW] skid packages built for Western Canada." The first seven units are 740 hp (550 kW) each and are 56.5 ft. (17.2 m) x 20 ft. (6.1 m) x 13 ft. 6 in. (4.1 m). The last two packages are 400 hp (300 kW) each and are 48 ft. (14.6 m) x 19 ft. (5.8 m) x 13 ft. 6 in. (4.1 m). The packages are slightly higher after the silencers are installed on-site.

Consideration for local seismic activity was incorporated into the design because of earthquakes and

The packages use a long, narrow (compact) design with all of the equipment on a single skid. The packages were sized so they could be trucked as a single unit from Calgary, Alberta, Canada, to Seattle, Washington, U.S.A., and then barged to Alaska. The total shipping weight (excluding concrete) for the 740 hp (550 kW) units is approximately 174,000 lb. (78,925 kg).

Each package is designed to use single-stage compression that is two-stage capable. This means that when wellhead pressures drop, larger first-stage cylinders can be installed to make better use of available horsepower or the packages can be retrofitted to use two-stage compression.

nearby volcanoes. As well, the buildings were constructed to handle the wind and snow loads of the Cook Inlet area. NGC reviewed the final design and layout of the packages with ConocoPhillips' engineers and operations staff. The review process was performed numerous times through video conferencing. With this technology, operators in Alaska were also able to see the packages in 3-D and complete a virtual walk-through to gain an understanding of the units and provide their input before the designs were finalized.

"It is interesting to see how these packages will be deployed," stated Nelson. "On three separate locations two 740 hp [550 kW] units will be installed, a single 740 hp [550 kW] package will be used at another site, and the 400 hp [300 kW] units will be installed at separate locations. The idea is to mix and match the units to best meet the compression requirements of each well."

The 740 hp (550 kW) packages include Ariel JGH/4 reciprocating compressors. The compressors are driven by Waukesha F3514GSI natural gas-fueled engines that deliver 740 hp (550 kW) at 1200 rpm. The 400 hp (300 kW) packages include Ariel JGJ/2 reciprocating compressors driven by Waukesha F18GSI natural gas engines providing 400 hp (300 kW) at 1800 rpm. Silencers, catalytic converters and air-fuel ratio controllers have been used to ensure Alaska's stringent emissions and noise regulations are met. All units will be used in sweet gas service.

The design and layout for both package sizes are similar, including the use of single-stage compression that is two-stage capable. This means that as the wellhead pressures continue to drop, the units can easily be converted. NGC sized the 740 hp (550 kW) packages so that larger first-stage cylinders can be installed to make better use of available horsepower or retrofitted to use two-stage compression.

The packages are fully automated, using two separate PLC systems. The first is the Spartan Controls REMVue system, which is used to control the engine, compressor and all process and equipment shutdowns. The second PLC is a sophisticated fire and gas detection system that was developed by General Monitors to meet Alaska's rigorous fire protection requirements. The UPS battery backup system for both panels is in the REIM. The REIM is a separate building on the same skid as the compression equipment. It is protected from the inlet separator by two firewalls, and uses electric heat so that natural gas does not enter the building.

ConocoPhillips requested that all equipment and piping be rated ANSI Class 600, which means that the units can handle up to 1200 psi (83 bar). Using a single-stage configuration, gas is boosted to about 360 to 470 psi (25 to 32 bar) discharge. High quality and reliability is required because the gas is used for heating and for fuel for the natural gas turbines at the Beluga River power plant. Inlet separation and discharge coalescing filters have been installed in each package to meet gas quality requirements.

An overhead crane is included inside the building, even though the skid is compact with low-eave height. The crane is used to maintain the engine and the compressor. The discharge coalescing vessel has been lowered so that the bottom of the vessel is below the package floor. This provides additional room for the crane bridge to move along its track without interfering with the vessel.

The aerial heat exchangers are supplied by Air-X-Changer and are used to service the engine's jacket water, lube oil and turbo operation, and cool the compressed natural gas. The coolers are sized to handle both single- and two-stage compression, and pressure relief valves are used to protect the suction, discharge and fuel gas systems from over-pressurization.

Large, self-contained, HVAC systems are included in each building. They control all air changes, such as managing the air required for ventilation, building heating and cooling requirements. The buildings are heated by natural gas catalytic heaters and they, along with the HVAC systems, are controlled by the fire and gas detection system.

The suction and discharge lines, fuel gas line and inlet separator drain lines enter and leave the packages

at one location behind the REIM. Because of the skids' length, extra heavy-duty 24 in. (610 mm) steel I-beams were required to address package deflection. All critical skid welds have been ultrasonically tested to ensure their integrity.

Construction of the first unit began in November 2010, and all nine packages are expected to be completed by summer 2011. The pressure vessels and process piping are manufactured in NGC's ASME-certified "U" stamp fabrication facility, and the skids are built and the equipment is brought together in the assembly plant. Both facilities are located in Calgary.

All of the pressure vessels and process piping were manufactured in NGC's ASME-certified "U" stamp fabrication facility, with the skids built and the equipment brought together in the assembly plant. Both facilities are located in Calgary.

NGC's primary business segments continue to be compression optimization and reconfiguration (using the company's proprietary OptiFit technology), fabrication and packaging, and field service for reciprocating and screw compression units of all sizes. In addition to the manufacturing facilities and head office in Calgary, NGC has field service and parts distribution branches in Medicine Hat, Drumheller and Stettler, Alberta; as well as in Fort St. John, British Columbia, Canada.

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