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Oooguruk Offshore Arctic Flowline Design and Construction

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Abstract

The Oooguruk offshore Arctic flowline system design, construction and operation satisfy the unique conditions presented by this shallow water Beaufort Sea location. The bundled 3-phase 12 x 16-inch pipe-in-pipe production flowline, 8-inch water injection, 6-inch gas lift/injection and 2-inch diesel fuel flowlines were installed along with power and communications cables offshore the North Slope of Alaska during 2007. The maximum water depth along the flowline route was only 7 feet but the location immediately offshore the Colville River Delta presented challenges with the flowline loading conditions, thermal interactions with the local environment and construction procedures. Key features of this flowline system include addressing flow assurance requirements for combined offshore/overland sections, strudel scour, subsea permafrost thaw consolidation, upheaval buckling, limit state design for bending, winter construction procedures and flowline leak detection systems. The subsea power cables consisted of separate cables for each conductor in order to be compatible with trucking all materials to the remote site. The dual fiber optic communications cables are being utilized with a distributed temperature sensing system to monitor the flowline burial conditions and supplement the multiple flowline leak detection systems.

Introduction

The Oooguruk oil field is located 6 miles offshore the North Slope of Alaska, in the Beaufort Sea. The site is partially sheltered from the more severe sea ice and wave conditions of the Arctic Ocean by its shallow water depths and a series of barrier islands offshore of eastern Harrison Bay. However, the field's shallow water location near the Colville River Delta provides its own challenges for the safe design, construction and operation of a flowline system to support the offshore field development. The flowline system transports 3-phase produced fluids, gas, water and diesel fuel and includes power and communications cables. Conventional pipeline design requirements must be integrated with the complex thermal interactions of the Arctic environment and the unique offshore arctic loading conditions.

Pioneer Natural Resources Alaska, Inc. is developing the Oooguruk Unit along with partner, Eni Petroleum Co. Inc. on state leases in the Beaufort Sea, west of Oliktok Point (Hall, 2008.) Oil wells are being drilled from an artificial gravel island (Oooguruk Drill Site or ODS), located in four feet of water and tied back to new onshore facilities (Oooguruk Tie-in Pad or OTP) near drillsite 3H, within the Kuparuk River Unit (KRU.) Existing KRU facilities will process the produced fluids and transport the oil 40 miles further east to the Trans Alaska Pipeline System. KRU will also supply injection water and injection/fuel gas to Oooguruk.

The Oooguruk flowline design needed to be cost effective and installed on a schedule matching Pioneer's field development plans. Flowline safety and minimizing impact to the fragile Arctic environment are fundamental project requirements for all North Slope field developments. Oooguruk follows BP's Northstar project as the second Beaufort Sea oil field to be developed using subsea pipelines (Lanan, 2001.) Additional planned Beaufort Sea field developments applying subsea pipelines include Eni Petroleum's Nikaitchuq oil field and other future projects.

Flowline Project Schedule

INTEC Engineering evaluated the Oooguruk flowline system conceptual design, constructability and costs for Pioneer in 2004. Front End Engineering Design (FEED) and detailed design were performed in 2005 and 2006. Pioneer awarded the installation contracts in 2006 while the project line pipe was being manufactured and coated. Preliminary construction activities were performed during 2006 including a winter test trench excavation, pipe double jointing and a flowline bundle