

Gas and Water Handling Constraints On Alaska's North Slope

Excerpts from Articles and Reports, 1989-2011

Background Information

1989 Revenue Sources Book

Alaska Department of Revenue

"The vast majority of Alaska production will continue to come from the now declining Prudhoe Bay field ... The decline in Prudhoe Bay production is now expected to be much more rapid than assumed in our Spring forecast. This reflects a more serious gas handling constraint. As more and more gas is produced with each barrel of oil, the amount of gas which must be re-injected back into the Prudhoe Bay field has increased substantially. Since it is anticipated that there will need to be more production downtime due to field and TAPS maintenance, the gas handling constraint will limit the ability to keep average annual oil production from falling. Installation of additional gas handling equipment, GHAX1 (gas handling and expansion 1), is scheduled to start late in 1990. A second expansion is in the planning stages. Once in place, the ability to re-inject up to 5.1 bcf/day of gas production will slow the rate of decline in oil production."

A Production Optimization System for Western Prudhoe Bay Field, Alaska

By D.A. Barnes, K. Humphrey, and L. Muellenberg of BPX America

Paper prepared for presentation at the 65th Annual Technical Conference and Exhibition of the Society of Petroleum Engineers held in New Orleans, LA, Sept 23-26, 1990.

"For almost a decade the Prudhoe Bay field on the North Slope of Alaska has produced at a yearly average offtake rate of 1.5 million stock tank barrels of oil per day. As the reservoir depletes and field gas-oil ratios (GORs) increase, gas handling constraints make it difficult to achieve oil rate targets."

With Prudhoe Bay in Decline, What's Next for Alaska?

By James M. Davis (Senior Vice President for Exploration and Land) & Jerry R. Pollock (Manager, Prudhoe Bay Engineering) of ARCO Alaska, Inc.

Oil & Gas Journal, August 3, 1992

"By any definition, Prudhoe Bay is declining and will continue to decline ... To accountants, Prudhoe decline began during 1988 when the field was no longer able to make its maximum allowable rate of 1.5 million b/d of oil. To engineers, the decline

began long before that ... Unfortunately, adding more wells can't keep the oil production rate up forever. We're already past the point where drilling can stave off a falling oil rate ... As the field matures, the production facilities reach their maximum capacities to handle produced water and gas. Wells with falling oil rates and increasing produced water or gas volumes have to be shut-in. Total field oil production drops."

Prudhoe Bay: Development History and Future Potential

By D.J. Szabo, BP Exploration (Alaska) Inc. and K.O. Meyers, ARCO Oil and Gas

Paper prepared for presentation at the SPE 1993 Western Regional Meeting, Anchorage, AK, 26-28 May 1993.

"Prudhoe Bay is seen by many as a mature oil field on an inevitable and irreversible decline ... The field's oil production capacity dropped below 1.5 MMSTB/D in 1988 *officially* signaling the start of decline. The onset of decline was a direct result of limited gas handling capacity as opposed to limited oil production capacity."

Alaskan North Slope Focus Shifts from Wildcarts to Cutting Production Costs

Oil & Gas Journal, June 6, 1994

"Liquids production at Prudhoe Bay is constrained by the ability of field operators to process and reinject associated natural gas. Since 1988, the field's production has declined to 1.1 million b/d from 1.6 million b/d of hydrocarbon liquids. Installation of additional gas handling capacity will temporarily stem the decline in the near term and slow the rate of decline in the years ahead."

Prudhoe Bay Field: Facility Consolidations Pave the Way for an Economic Future

By K.D. Eager, BP Exploration; M.D. Briscoe, ARCO Alaska; R.A. Bolduc, Exxon

Paper prepared for presentation at the 1998 SPE Annual Technical Conference and Exhibition held in New Orleans, LA, 27-30 Sept 1998.

"The Prudhoe Bay Field on Alaska's North Slope has produced for twenty-one years. Prudhoe's gas and water production rates are at historic highs, but the oil production rate has declined to less than one-half of the peak rate achieved in the 1980s. As a result, significant excess oil treating capacity exists, with water and gas handling capacity constraining the current oil production rate. The owners of the Prudhoe Bay Unit developed a major facility consolidation plan in 1997 designed to rationalize this excess oil treating capacity while preserving existing gas and water handling capacity. The reconfigured facilities are expected to provide sufficient capacity at a lower cost to

accommodate projected oil, water and gas production rates over the remaining life of the Prudhoe Bay Field."

Optimization of Production from Mature Fields

By P. Wang & K. Aziz of Stanford University and M.L. Litvak of BP, USA

17th World Petroleum Congress, September 1 - 5, 2002, Rio de Janeiro, Brazil

"Oil production in the Prudhoe Bay and Kuparuk River fields is constrained by the gas handling limits of the surface facilities."

2003 Oil and Gas Report (for the period ending December 31, 2002)

Alaska Department of Natural Resources (Tom Irwin, Commissioner)

Division of Oil and Gas (Mark Myers, Director)

"From the beginning of Prudhoe Bay production, dissolved gas and water were separated from the crude oil and injected back into the reservoir. Over time the reservoir's proportion of both gas-and-water to oil increased. Eventually, oil production was constrained by the rate at which the separating plants could process gas and water."

North Slope of Alaska Facility Sharing Study

Prepared for Division of Oil & Gas, Alaska Department of Natural Resources

By Petrotechnical Resources Alaska, May, 2004

"The North Slope processing facilities have specific design capacity limits, indicating the amount of oil, water and gas which can be handled by the facility. If the handling capacity of one of these streams is reached for a given facility, it limits the overall production output from that facility. While some facilities may be producing below capacity for oil, they are often limited due to capacity constraints on total water production or gas production."

Alaska Oil Forecast Shaky

By Kristen Nelson, Petroleum News

Week of November 18, 2007

"While new oil is an issue in maintaining production levels, there are also issues at existing fields, where [Dudley] Platt said facilities expansion may be needed. He said the large facilities are 'maxed out on how much gas they can handle and they're getting

close to being maxed out on how much water they can handle. ... If they don't expand their facilities to handle that, the oil production will continue to go down.”

Optimized EOR Design for the Eileen West End Area, Greater Prudhoe Bay

By M.N. Panda, SPE, Petrotechnical Resources of Alaska; J.G. Ambrose, BP Alaska; G. Beuhler, TNK-BP; and P.L. McGuire, BP Alaska

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“Eileen West End (EWE) initially was developed in the same style as Prudhoe Bay. To accomplish this, excess produced gas from Prudhoe Bay was injected into the EWE gas caps with a hope that the reservoir would produce with effective gravity drainage in a manner similar to that of Prudhoe Bay. Conductive faults and shale barriers, however, led to unexpected early gas breakthrough. High gas/oil ratios reduced the oil production rate, leading to a reduced recovery factor from the field.”

New Developments in Upstream Oil and Gas Technologies

Hearing before the Committee on Energy and Natural Resources, United States Senate

Testimony by Kevin Banks, Director, Division of Oil and Gas, Alaska Dept of Natural Resources

May 10, 2011

“With the exception of development of heavy oil resources known to exist around the Prudhoe Bay, Kuparuk, and Milne Point fields, and potential resource plays (like the Bakken in North Dakota) that may exist on the North Slope on State controlled lands, the natural field declines cannot be replaced without access to production from Federal lands and the OCS. There are no known conventional resources on State or Native lands that are likely sufficient to replace the decline in the existing production rates.”

Memo to Senator Joe Paskvan

From DNR Division of Oil and Gas

Re: North Slope Facilities Expansion

June 8, 2011

“... it is our belief that additional gas and water handling capacity investments will be necessary in some cases for continuing operation of maturing fields, development and expansion of satellite reservoirs, and to allow for facilities sharing with other new developments outside of current Units.”