

Prudhoe Bay Unit Facility Information

General

The PBU consists primarily of two major processing operations:

- The Initial Participating Areas (IPA) facilities that service the IPA (which produces the main Prudhoe field) and several PBU participating areas formed to produce satellite fields.
- The Lisburne Production Center (LPC) that services the Lisburne Participating Area and certain nearby Participating Areas, which produce to that facility.

To date, these two major processing operations have been essentially independent of each other in so far as oil and gas processing operations are concerned. However, in the first quarter of 2004, a field optimization project is planned for start-up that will allow some of the Pt. McIntyre production to be processed at IPA facilities. This change will not result in excess capacity at either field but will further optimize use of the processing capacity.

Within the IPA facilities, there are six separate major production processing centers that are operated in a coordinated manner with a central power station, a central gas processing facility, a central compressor (injection) facility, and a central sea water treatment plant. These IPA facilities operate as an integrated "system" and changes or constraints in any one part of the system generally affect operations in nearly any other part. In other words, the processing capacity of a particular facility is dependent not only upon the specific wells/production being processed by that facility, but also by the wells/production being processed by the other facilities at the same time.

Basic Facility Description

This section provides a description of the IPA and LPC facilities and production process.

The major facilities in the Initial Participating Area (IPA) of the Prudhoe Bay Unit, and their general functions, are shown in figure 1 and outlined as follows:

- **Drill Sites and Well Pads:** There are 42 production drill sites and well pads in the PBU along with three injection pads near the gas plants. Drill sites are located in the Eastern Operating Area (EOA) and well pads (analogous to drill sites) are located in the Western Operating Area (WOA). Each of the production drill sites and well pads contain as many as 60 producing and injection wells with associated manifolding to gather production into large diameter production flow lines which deliver production for processing to the six central processing facilities called Gathering Centers (GCs) or Flow Stations (FSs).

PBU Facility Description

- **Gathering Centers (GCs) and Flow Stations (FSs):** The three GCs and three FSs separate the raw crude oil production from the PBU drill sites into oil, water, and gas components. These processing centers process oil to meet pipeline quality specifications and transfer the processed oil to Pump Station 1 (PS1). Produced gas is dehydrated and roughly 10% is used for fuel and artificial lift; the remainder is sent to the Central Gas Facility (CGF). Produced water is either injected into the producing reservoirs for pressure maintenance and secondary recovery or into the Cretaceous formation for disposal.
- **Central Power Station (CPS):** The CPS is the electric power generation facility for IPA and PBU satellites.
- **Central Gas Facility (CGF) and Central Compression Plant (CCP):** The CGF is a propane refrigeration plant that processes all the gas handled by the processing centers (with the exception of fuel and artificial lift, noted above). The CGF extracts Natural Gas Liquids (NGLs) and manufactures Miscible Injectant (MI). Roughly 80 mbpd of NGLs are sent to PS1 to be blended with the PBU crude oil or are delivered to the Oliktok Pipeline for transport to Kuparuk or Milne Point for use in enhanced oil recovery operations. The MI is distributed to the drill sites and reinjected into the reservoir for tertiary recovery. Some residue gas from the CGF is used for fuel gas in PBU facilities, with most of the remaining residue gas compressed for injection into the gas cap at the three gas injection pads through compressors located at both the CGF and CCP.
- **Seawater Treatment Plant (STP) and Seawater Injection Plant (SIP):** The STP processes seawater and sends it to the SIP, which boosts the delivery pressure for injection down Prudhoe Bay and Pt McIntyre injection wells. The water is injected into the oil legs of the reservoirs as part of the secondary and tertiary recovery operation, and into the Prudhoe Bay gas cap under the Pressure Support Initiative. Water from the STP is also used in the grind and inject operations that dispose of drilling muds and cuttings.
- **The Lisburne Production Center (LPC):** The LPC is a standalone plant that performs nearly all of the functions described above for the IPA GCs / FSs, CPS and CGF / CCP. The LPC processes the gas and liquid produced from Pt. McIntyre, Lisburne, North Prudhoe Bay, West Beach and Niakuk. Processed oil from the LPC is sent to PS1. Produced gas is dehydrated and then refrigerated to extract NGLs and MI. The NGLs are blended with the crude oil before it is shipped to PS1. The MI is shipped to the Pt McIntyre drill sites and injected for tertiary recovery. The remaining gas is injected into Lisburne and other reservoirs. The LPC also generates electric power, which can be tied into the Prudhoe power grid for two-way transfers.
- **Crude Oil Topping Unit (COTU):** The COTU processes a portion of crude oil from FS2 to produce diesel or jet fuel.

Basic description of the production process

Oil Train Processing

- The typical FS has three separation trains and the typical GC has four separation trains that can be used in either High Pressure (HP) or Low Pressure (LP) service. HP trains usually operate at 650+ psig, while LP trains operate between 140 and 170 psig. Usually, at least one separation train at each facility is dedicated to HP service and another is dedicated to LP service. Most facilities process crude from their surrounding drillsites; with exceptions noted below.
 - A large portion of GC3's oil and gas processing train has been decommissioned. The result is that GC3 sends its partially processed fluids ("fizzy oil") to FS3 for final processing. GC3 ships none of its crude to PS1 directly.
- The LPC has two separation trains; however, there is a single slug catcher (inlet separation vessel), and both trains must operate at the same pressure, which is currently about 400-450 psig.
 - In order to debottleneck high commonline pressures at Pt. McIntyre when flowing to LPC, an out-of-service seawater pipeline between drill site PM2 and GC1 will be commissioned to transport some of the produced fluids from Pt. McIntyre's drill site 2 (PM2) to GC1 in early 2004.
- Crude oil allocation metering occurs at each of the FSs and GCs with the custody transfer meter located at the PS1 terminal. These meters are also used for pipeline leak detection.
- Each drill site and well pad has a test separator to estimate individual well production capability.
- The pipeline specifications for the oil delivery to PS1 are as follows:
 - Maximum basic sediment and water (BS & W) content of 0.35%
 - Minimum delivery temperature of 105° F to prevent paraffin deposition
 - Maximum delivery temperature of 142° F
 - Maximum True Vapor Pressure of 14.2 psia

Water Processing

- Heat, gravity separation and electrostatic precipitators accomplish separation of water from oil as part of the process of treating the oil to meet pipeline specifications. Most of the water is separated in the 1st stage LP vessels, or slug catchers. Interstage crude heaters are, in some cases, used to facilitate further water breakout in subsequent separation vessels. Final water separation to meet BS&W specs occurs in the treaters/dehydrators.

PBU Facility Description

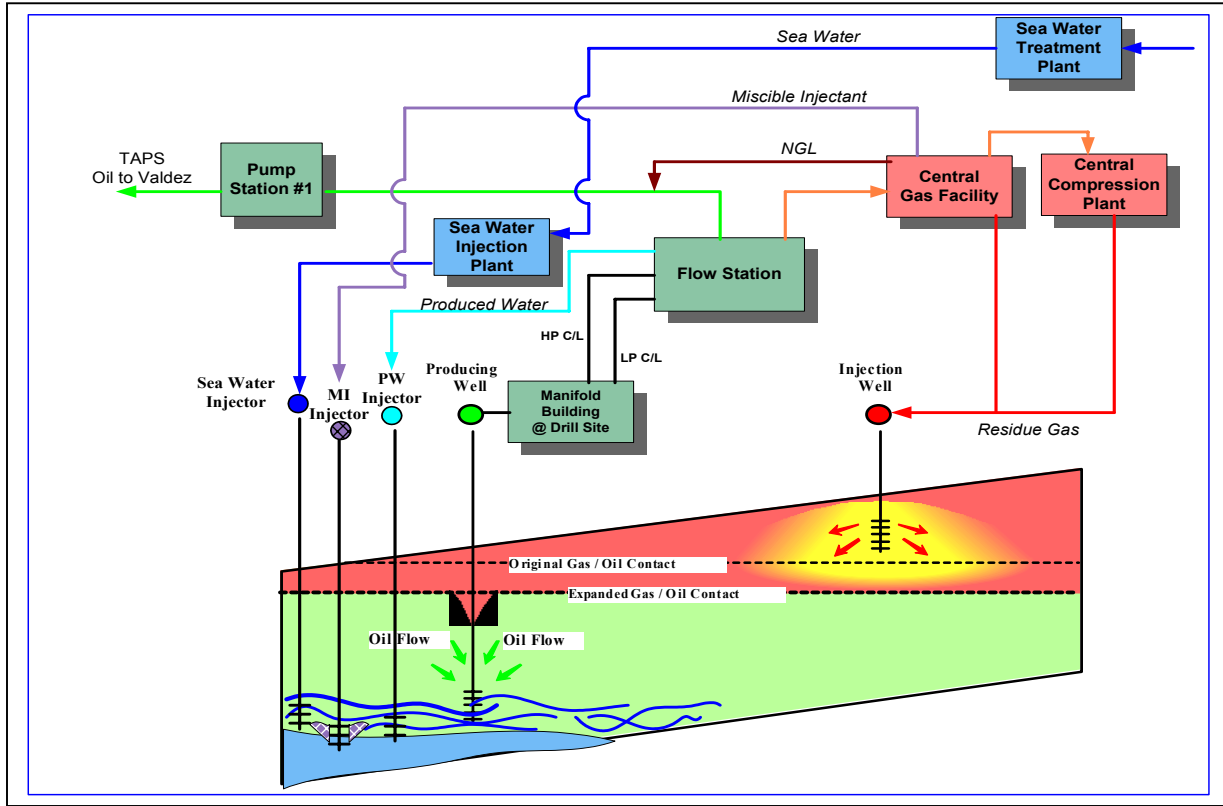
- Produced water is further treated by removal of oil from the water in large settling tanks at all facilities. Hydrocyclones are used at FS3 and LPC.
- Most processing centers have sand-jetting capabilities to keep the slug catchers operating efficiently.
- The produced water is boosted to injection pressure (2000 - 3000 psi) at each processing center with large electric motor or turbine driven pumps.
- Production fluids are generally treated with corrosion inhibitor (based on the fluids and corrosion rates at each particular facility), scale inhibitor (depending on the scaling tendencies of produced fluids) and emulsion breakers as necessary.

Gas Processing

- Low Pressure (LP) gas at the FSs and GCs is compressed up to High Pressure (HP) pressure by large 35,000 hp compressors and combined with gas from the HP trains. Each FS and GC has two 35,000 LP gas compressors.
- The combined gas is treated to reduce water content before shipment to the CGF/CCP or use as gas lift gas. The FSs, GCs and LPC dehydrate their produced gas via TEG (Tri-Ethylene Glycol) contractors. The glycol is regenerated at each facility.
- Artificial lift (AL) gas compressors are located at FS3 and GC1 to supply lift gas to the IPA and satellite wells. GC1 has roughly twice the capacity of FS3. A pipeline distributes the AL gas to the drill sites and well pads. AL gas at the LPC is taken from the discharge of its re-injection compressors for distribution to each GPMA drill site.

PBU Facility Description

Figure 1: Prudhoe Bay processing Schematic



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