# OIL & GAS SUCCESS STORY

## Centrifugal Compressor Seal Oil De-gassing Emissions Recovery

## BP Prudhoe Bay, Alaska (North Slope)

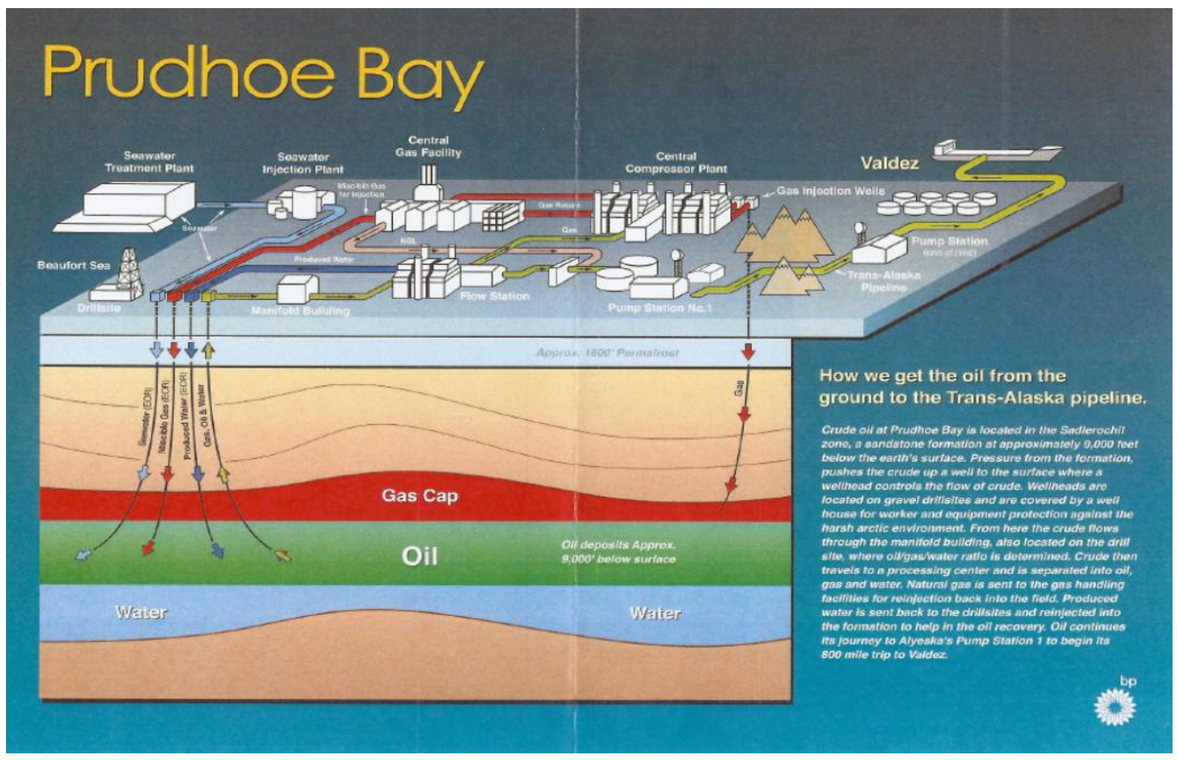
### OVERVIEW OF OIL & GAS TECHNOLOGY :

On Alaska's North Slope in the United States, BP's Prudhoe Bay facilities perform oil and natural gas production, gas processing and gas re-injection. The company operates wet seal centrifugal compressors with seal-oil/gas separation systems that route the separated gas to recycle, high and low pressure fuel gas use, and/or flare purge. These systems reduce emissions from seal-oil degassing and are an alternative to using/installing dry seals. Estimated emissions reductions achieved by this configuration are approximately 113 million standard cubic feet (scf) per year per compressor[1] (2 seals at 108 scf/minute each), which equates to approximately 3.2 million cubic meters ($m^3$) per year per compressor (2 seals at 3 $m^3$/minute each).

**ESTIMATED ANNUAL EMISSION REDUCTIONS: 45,900 $TCO_2E$ per compressor**

## TECHNOLOGY DETAILS

**Emission Source:** Centrifugal compressors require seals around the rotating shaft to prevent gas from escaping where the shaft exits the compressor casing. These seals may use oil, which is circulated under high pressure between three rings around the compressor shaft, forming a barrier against compressed gas leakage. Very little gas escapes through the oil barrier, but considerably more gas is entrained in or absorbed by the oil under high pressures at the "inboard" (compressor side) seal of the oil/gas interface, thus contaminating the seal-oil. Seal-oil is purged of the entrained/absorbed gas (using heaters, flash tanks, and degassing techniques) and then, recirculated. The purged gas, including methane, is commonly vented to the atmosphere. Methane emissions from wet seals typically range from 40 to 200 standard cubic feet per minute (scfm) for dual wet seals, depending on the size and pressure of the compressor.

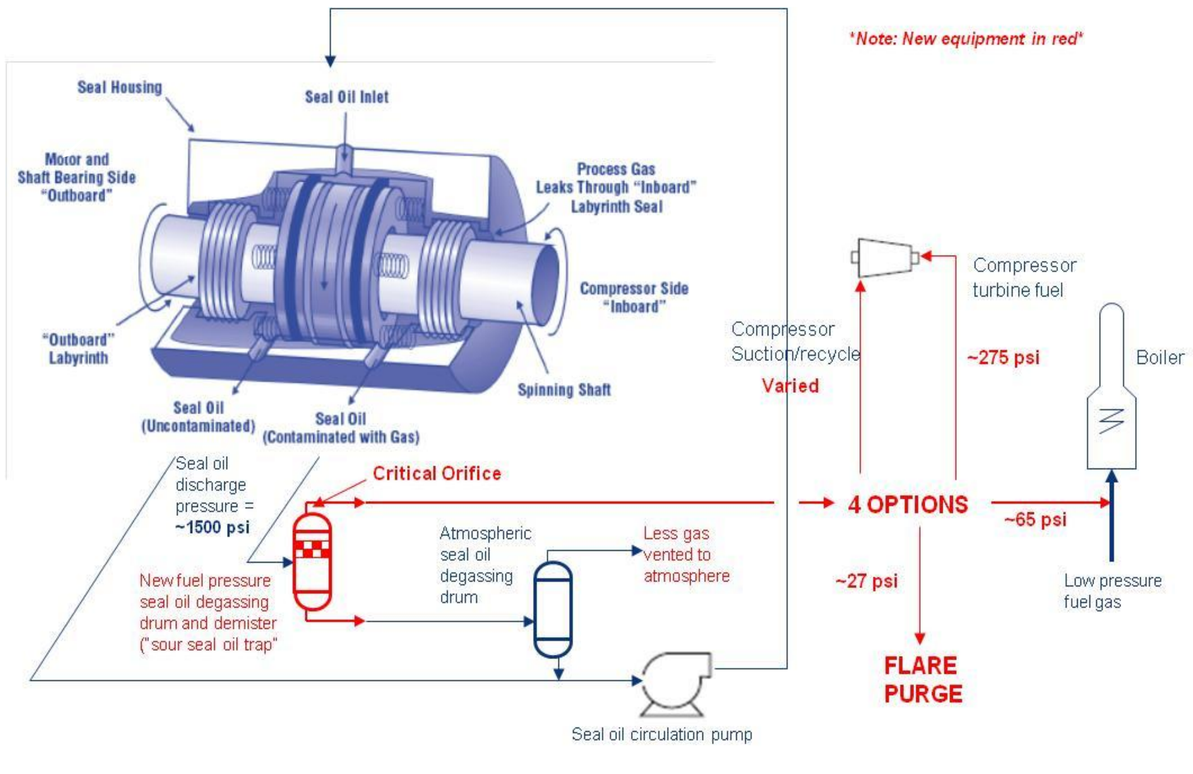



**Applicable Technology:** Centrifugal compressor seal-oil separation and recovery systems capture gas at seal-oil pressure, for recycle to fuel gas, compressor suction, or other uses. Gas utilization is increased and methane emissions are nearly eliminated. Seal-oil contaminated with gas that is typically routed to an atmospheric degassing tank is instead degassed at a new separator operating at seal-oil pressure with an outlet, controlled by a critical orifice and choke flow physics, to a lower pressure (e.g., fuel gas) system. The seal-oil then flows to the final degassing stage where a small amount of residual gas is degassed to the atmosphere and the regenerated seal oil is recirculated to the compressor.

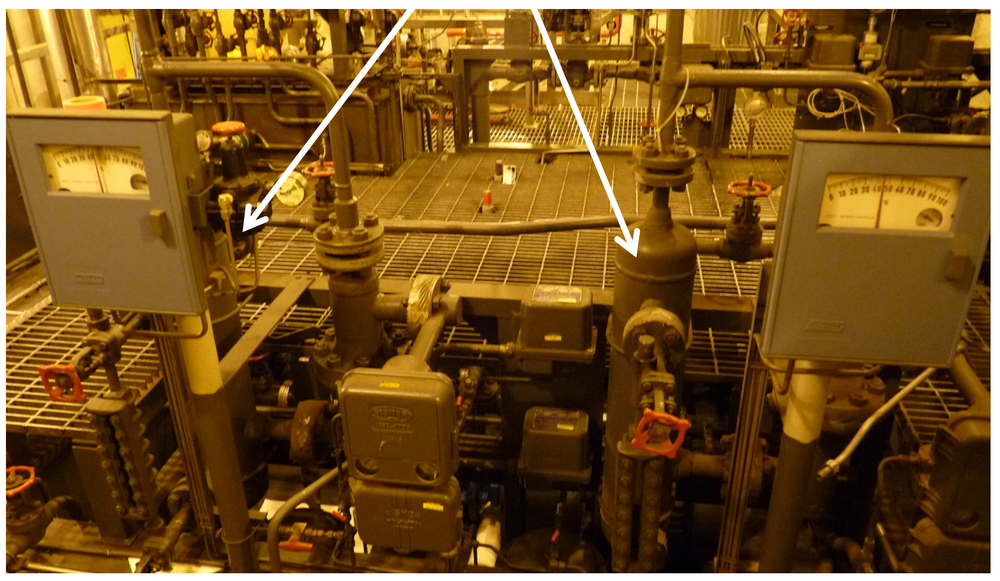
**Site/Equipment Requirements:** Implementing this technology requires a small seal-oil/gas separator to separate the seal-oil and gas, an outlet/use for the recovered gas, and piping modifications. Additionally, the flash gas stream from the new seal-oil degassing separator will entrain small amounts of seal-oil, requiring a demister/filter or fuel gas knock-out vessel to remove this entrained oil and yield an acceptable fuel gas specification.

*[1]The volume of gas recovered is based on tests of one high pressure and one medium pressure compressor. Please note that these are very large compressors operating at high pressure and the quantity of gas entrained in the seal-oil may not be indicative of other wet seal centrifugal compressors.*

# PROPOSED TECHNOLOGIES




## Seal Oil Degassing Pots



## PROJECT DEVELOPMENT PLAN

- **Existing Installations:** BP's Prudhoe Bay facilities
- **Timeline:** Retrofit with a seal-oil/gas separation and recovery system would require minimal downtime as opposed to significant downtime associated with dry seal retrofit on an existing centrifugal compressor.
- **Reliability:** The seal-oil degassing and recovery systems at BP's Prudhoe Bay facilities have been in operation for more than 30 years with no failures.

## PROJECT FINANCES

- **Projected capital and installation costs**: The BP compressors were installed with the seal oil degassing separators/systems as original equipment and incremental costs are not known. EPA estimates that installing these separators and related piping on existing wet seal compressors will cost approximately US$22,000. This assumes a typical seal oil flow rate of 14.20 liters/minute or 3.75 gallons/minute
- **Projected operation and maintenance costs for fully implemented project:** Minimal

## ECONOMIC ANALYSIS/BENEFITS

- **Gas saved:** ~100 MMSCF/Year (2 seals @ 108 scf/min each)

| Gas Price per mscf | $2.5 | $3.0 | $3.5 |
|---|---|---|---|
| Value of Gas Saved | $250,000 | $300,000 | $350,000 |
| Payback Period in Months | 1 | <1 | <1 |

## FOR MORE INFORMATION

**BP**
Gordon Reid Smith
Environmental Advisor
501 WestLake Park Blvd.
Houston, Texas 77079
United States
Tel: (281) 366-7515
Fax: (281) 366-2912
E-mail: gordon-reid.smith@bp.com