

## FACT SHEET

Proposed Issuance of Underground Injection Control (UIC) Area Permit AK-11004-A for the Continued Operation of Class I Non-Hazardous Industrial Waste Injection Wells at Pad 3 of the Eastern Operating Area of the Prudhoe Bay Unit on the North Slope of Alaska

U.S. Environmental Protection Agency, Region 10  
Ground Water Protection Unit, OW-137  
1200 Sixth Avenue  
Seattle, Washington 98101

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### Introduction

ARCO Alaska, Inc. has submitted an Underground Injection Control (UIC) permit application to continue operating three Class I non-hazardous industrial waste injection wells at Pad 3 of the Eastern Operating Area of the Prudhoe Bay Unit on the North Slope of Alaska. These wells were originally permitted for injection by EPA on August 20, 1989, and the current permit expires on August 20, 1999. ARCO's application for another ten-year permit was submitted to EPA on February 18, 1999. In response, EPA has reviewed the permit application and prepared a draft permit for public review and comment. The public comment period will remain open until August 16, 1999, as described later in this fact sheet.

The 10-year term UIC permit would allow ARCO to continue injecting non-hazardous waste fluids into naturally saline intervals of the Sagavanirktok Formation at about 2000 feet below the land surface. Injection of non-hazardous waste would continue through the existing wellbores into the same perforated intervals, and under terms very similar to the current permit.

EPA generally favors the underground injection of those fluid wastes on the North Slope which cannot be feasibly recycled. Underground injection, below all fresh water aquifers through properly constructed and operated wells, is an environmentally sound and efficient disposal practice which serves to prevent waste discharges to the land surface or surface water bodies.

ARCO estimates that the Class I injection wells at Pad 3 have received about 36,500 truckloads of non-hazardous waste over the past 10 years, and notes that these wells have injected just over one-third of the total volume of fluid waste allowed under the current UIC permit. The Class I wells at Pad 3 have functioned almost flawlessly, and are the only underground injection wells which can be legally used at Prudhoe Bay for some types of non-hazardous waste disposal.

## **Public Comment**

Peer review comments were sought from the Alaska Department of Environmental Conservation (ADEC) and the Alaska Oil and Gas Conservation Commission (AOGCC) in the development of the draft permit and this fact sheet. EPA is now requesting public comment prior to issuing the permit. Persons wishing to comment on the draft permit may do so in writing by August 16, 1999. All comments should include the name, address, and telephone number of the person making comment, a concise statement of the exact basis of any comment, and the relevant facts upon which it is based. All written comments and requests should be submitted to EPA at the above address to the Manager of the Ground Water Protection Unit or via electronic mail to [partee.grover@epa.gov](mailto:partee.grover@epa.gov). After August 16, 1999, EPA may finalize the permit as drafted if no substantive comments are received during the public notice period.

## **Regulatory Framework**

The Underground Injection Control (UIC) program is authorized by Part C of the Safe Drinking Water Act for the principal purpose of protecting Underground Sources of Drinking Water (USDWs) from contamination by injection through wells. The UIC regulations (see 40 CFR 144.3) broadly define USDWs as any aquifer capable of supplying a public water system with water of less than 10,000 milligrams per liter (mg/L) total dissolved solids (TDS).

Primary responsibility for regulation of injection wells through the UIC program is split in Alaska between EPA and the Alaska Oil and Gas Conservation Commission (AOGCC). The AOGCC has UIC program primacy for the regulation of Class II wells, and EPA directly regulates the other four classes of injection wells in Alaska. Class II wells are defined (see 40 CFR 144.6) as those wells used for injection in order to: 1) dispose of fluids brought to the surface from oil and gas production operations, 2) enhance the recovery of oil or natural gas, or 3) store liquid hydrocarbons underground. Class I non-hazardous industrial waste wells may be used to inject fluids eligible for Class II injection, and any other non-hazardous waste. Most waste fluids generated at the Prudhoe Bay Unit and other North Slope oil and gas fields can be legally injected into Class II wells. However, some must be injected through Class I wells.

Underground injection needs to be conducted in a manner which ensures the protection of USDWs. However, based upon available information, EPA has determined that there are most likely not any aquifers beneath the permafrost in the Pad 3 area which are fresh enough (less than 10,000 mg/L TDS) to qualify for protection as USDWs. Under these circumstances, the Director may authorize injection with less stringent requirements than would otherwise be required (see 40 CFR 144.16). EPA intends to grant several waivers requested by ARCO which are described under the Geologic Setting and Injection Issues portion of this fact sheet.

## **General Project Overview**

The Prudhoe Bay Unit is located along the Beaufort Sea about 250 miles north of the Arctic Circle on Alaska's North Slope. Most of the crude oil flowing through the Alaska pipeline is produced from the unit, which is operated as a single business entity with co-owners sharing the

costs and production. Operation of the field is governed by an agreement executed between the lessees and the State of Alaska. ARCO Alaska, Inc. is the operator of the eastern half of the unit, where the Pad 3 Class I injection wells are located.

The three Class I injection wells at Pad 3 are located about 50 feet from one another. Fluids are brought to Pad 3 by tanker trucks and injected into one well at a time. Most of the waste fluid injected to date has been split between two of the three wells. Each load of waste is manifested, and injected under the supervision of a trained operator. Injection rate and pressure are continuously monitored and recorded.

To date, almost 12 million barrels (462 million U.S. gallons) of waste fluid have been injected at Pad 3. ARCO estimates that another 12 million barrels will be injected over the next 10 years. This projected cumulative total of about 24 million barrels (924 million U.S. gallons) is approximately two-thirds of the volume (34.8 million barrels) allowed under the ten-year permit issued by EPA in 1989.

The most commonly injected waste fluids are sea water and brine, fresh water, drilling mud, gel (generally a bentonite and water mixture), crude oil, produced water, stimulation fluid, cement contaminate, diesel, contaminated snow, methanol, line pigging material, and boiler water. The types and volumes of fluid injected at Pad 3 from January through March of 1998 are listed below to illustrate the typical amounts and proportions of each waste. This information is from one of the quarterly reports submitted to EPA by ARCO.

*Prudhoe Bay Oily Waste Facility  
Total Injection From January–March of 1998*

<u>Component</u>	<u>Barrels (42 U.S. gallons)</u>
Boiler Water	1,865.15
Cement Contaminate	4,585.94
Cement Rinsate	151.25
Contaminated Gravel	55.94
Contaminated Snow	3,059.35
Corrosion Inhibitor	4.02
Crude Oil	10,644.52
Drill Cuttings	122.50
Developer and/or Fixer	12.00
Diesel	4,178.19
Dirt	83.50
Drilling Mud	13,141.92
Film Processor	57.00
Frac Sand	43.65
Fresh Water	44,665.16
Gel, Water/Diesel	11,594.39
Glycol	555.62

Gray Water	391.62
Hydraulic Fluid	1.66
Hydrocarbons	226.11
KCl	296.95
LCM	23.00
Line Pigging Material	1,928.80
Lubricating Oil	21.24
Methanol	2,417.92
Pit Rinsate	211.00
Processor Effluent	62.00
Product Vessel Sludge/Sand	33.20
Produced Water	8,770.81
Production Chemicals	36.37
SSAP	19.55
Sea Water/Brine	78,654.15
Soap	41.50
Source Water	235.00
Spent Acid	704.54
Spent Caustic	9.29
Stimulation Fluid	7,949.18
Xylene	0.03

ARCO has not applied for a hazardous waste injection well permit. Therefore, any listed hazardous wastes will need to be collected, stored, and transported to a RCRA-permitted hazardous waste treatment or disposal facility. Those wastes which are hazardous only because of a characteristic (such as ignitability, corrosivity, toxicity, etc.) may be treated to remove that characteristic and then injected as a Class I non-hazardous waste fluid. The permit does not allow injection of radioactive wastes, as defined in the UIC regulations. Naturally occurring radioactive material (NORM) from sludge or pipe scale (a mineral precipitate formed during production) may be injected.

### **Geologic Setting and Injection Issues**

The proposed permit would allow the continued injection of non-hazardous waste fluids into the already perforated intervals of the three existing wellbores, which are within about 50 feet of one another. The injection wells were drilled to 2200 feet in 1973 to study permafrost thaw and its impact upon well casing. They were later converted to oily waste injection wells, and permitted as Class I non-hazardous industrial waste wells by EPA in 1989.

Fluids are injected through perforations in the casing from 1978 to 2093 feet below the land surface. The receiving zone sediments, which are interpreted to be of fluvial deltaic origin, consist of thinly bedded shale, siltstone, sandstone, and gravel within the Tertiary-age Sagavanirktok Formation. The injection interval is overlain by low permeability shale and siltstone arresting and confining zones up to about the base of the permafrost, which is approximately 1800 feet below the land surface at Pad 3. The injection zone within the Sagavanirktok Formation dips to the

northeast at less than 100 feet per mile. The stratigraphic interval is unfaulted and terminates up dip (to the southwest) against the permafrost.

Analysis of geophysical borehole logs by ARCO suggests that the injection zone contains some extremely porous and permeable intervals, perhaps as high as 30-40 percent porosity and 1-2 darcies of permeability. Overall, the injection zone is estimated to originally have had a 25 percent average porosity and a composite permeability of 200 to 500 millidarcies. However, pressure fall-off tests indicate that extensive formation damage has occurred near the wellbore from the injection of large volumes of “dirty” fluids which contain particulate matter. Yet injection has not been impeded. Instead, it has continued successfully by the propagation of horizontal fractures developed through the extensively damaged near-borehole area.

ARCO estimates that the waste plume now extends radially about 820 feet from the injection wells. Pressure increases within the injection zone about 1000 feet from Pad 3 are now estimated at about 40 pounds per square inch (psi), and are likely to be about 70 psi above background pressure if injection continues as planned for another 10 years.

There are 24 wellbores within the area of review (AOR). The AOR is a circle with a radius of 2.5 miles around Pad 3 where the construction of all wellbores was evaluated prior to EPA’s issuance of the current UIC permit. The 24 wells are located at drill site 6, and they intersect the injection zone at a horizontal distance from Pad 3 which ranges between 600 and 1400 feet. These oil production and enhanced recovery injection wells are all perforated several thousand feet below the Pad 3 waste disposal injection zone, and their surface casing appears to be properly cemented. Therefore, the risk of fluid movement into these wellbores is nil, and the risk of fluid movement upward along the casing-formation interface is considered to be slight.

EPA determined as part of the 1989 UIC permit issuance that there are no USDWs beneath the Pad 3 area. This determination was based upon the review of geophysical borehole log analysis conducted by ARCO. Since the existing wells do not inject below a USDW, EPA may allow less stringent requirements for area of review, construction, mechanical integrity, operation, monitoring, and reporting than would otherwise be required by the UIC regulations (see 40 CFR 144.16). EPA has waived some standard UIC program requirements for the existing permit. Likewise, the proposed permit would also include the following waivers.

Compatibility of Formation and Injectant: Based upon the applicability of past injectability studies and injection practices, EPA intends to waive the requirements of 40 CFR 146.12(e) and 146.14(a) which require sampling and characterization of formation fluids and matrix in order to determine whether or not they are compatible with the proposed injectant.

Injection Zone Fracturing: Class I injection wells are prohibited from injecting at pressures which would initiate new fractures or propagate existing fractures within the injection zone. The draft permit instead allows hydraulic fracturing within the injection zone so long as new fractures are not initiated nor existing ones propagated within the upper confining zone. As described earlier, the propagation of horizontal fractures within the injection zone is needed to emplace fluids beyond the extensively damaged near-borehole area.

Ambient Monitoring Above the Confining Zone: EPA intends to waive the requirement to monitor the strata overlying the confining zone for fluid movement (see 40 CFR 146.134). The principal purpose of this requirement is to protect overlying USDWs, which are not present in the Pad 3 area. Also, most of the overlying strata and their pore fluids are frozen; permafrost extends to about 1800 feet below the land surface. Rather than monitoring strata above the confining zone, the proposed permit would require an external mechanical integrity test (MIT) each year to assess the extent of upward fluid movement along the outside of the casing..

### **Summary of Proposed Action and Permit Conditions**

EPA has primary enforcement authority in Alaska for Class I injection wells as they are regulated by the UIC program, which is authorized by Part C of the Safe Drinking Water Act. EPA Class I injection well permits are granted to ensure that waste fluids are safely injected for disposal beneath any existing USDWs and remain below the confining zone. EPA proposes to grant a permit to ARCO for the continued operation of three Class I non-hazardous waste injection wells at Pad 3 within the Eastern Operating Area of the Prudhoe Bay Unit.

Based upon available information, EPA has determined that there are no USDWs beneath the Pad 3 area. Considering the absence of USDWs, EPA proposes to grant ARCO a waiver of the UIC program regulation which prohibits hydraulic fracturing of the injection zone during operation (40 CFR 146.13). This waiver is necessary to enable the continued injection of fluid wastes which contain a fraction of solid material, and is authorized by the UIC program regulations under 40 CFR 144.16a.

The draft permit contains general legal provisions common to all EPA UIC program permits, specific technical requirements which apply to all Class I injection wells, and particular technical requirements for the Pad 3 injection operation. EPA contacts for further information are Grover Partee at (206) 553-6697 or Jonathan Williams at (206) 553-1369.