

STATE OF ALASKA
ALASKA OIL AND GAS CONSERVATION COMMISSION
333 West 7th Avenue, Suite 100
Anchorage, Alaska 99501

Re: THE APPLICATION OF) **Area Injection Order No. 34**
PIONEER NATURAL)
RESOURCES ALASKA, INC. for) **Oooguruk Field**
an order authorizing underground) **Oooguruk Unit**
injection of fluids for enhanced oil) **Oooguruk-Nuiqsut Oil Pool**
recovery in the Oooguruk-Nuiqsut)
Oil Pool, Oooguruk Unit, Beaufort) **April 11, 2008**
Sea, Alaska)

IT APPEARING THAT:

1. By letter and application dated December 20, 2007, and received by the Alaska Oil and Gas Conservation Commission (Commission) on December 21, 2007, Pioneer Natural Resources Alaska, Inc. (Pioneer), in its capacity as Unit Operator and on behalf of the working interest owners of the Oooguruk Unit (OU), requests an order from the Commission authorizing the injection of fluids for enhanced oil recovery in the Oooguruk-Kuparuk and Oooguruk-Nuiqsut Oil Pools. Pioneer's request regarding the Oooguruk- Kuparuk Oil Pool is addressed in Area Injection Order No. 33.
2. Notice of a public hearing was published in the ANCHORAGE DAILY NEWS on January 8, 2008.
3. On January 24, 2008, the Commission received a request for a hearing. No other requests or comments were submitted to the Commission during the 30-day public comment period.
4. The Commission held the public hearing on February 14, 2008. During the hearing, the Commission requested additional information from Pioneer, and left the hearing record open until February 22, 2008.
5. On February 19, 2005, the Commission requested further technical information from Pioneer.
6. Pioneer submitted written responses to the Commission's requests on February 21, 2008. The hearing record closed February 22, 2008.
7. On March 19, 2008, the Commission received a letter from Pioneer correcting clerical errors in the legal description for the proposed affected area.

FINDINGS:

1. Operator: Pioneer is the operator of the leases in the area proposed for development.
2. Project Area Pool and Formations Authorized for Enhanced Recovery: Enhanced recovery injection is proposed within the Oooguruk-Nuiqsut Oil Pool, which is defined in Conservation Order No. 597. The target injection zone is the Oooguruk-Nuiqsut Oil Pool, which is correlative to the interval between the measured depths of 6,354' and 6,472' on the

Dual Laterolog/Micro Laterolog recorded in the Kalubik No. 1 exploration well (see Figure 1).

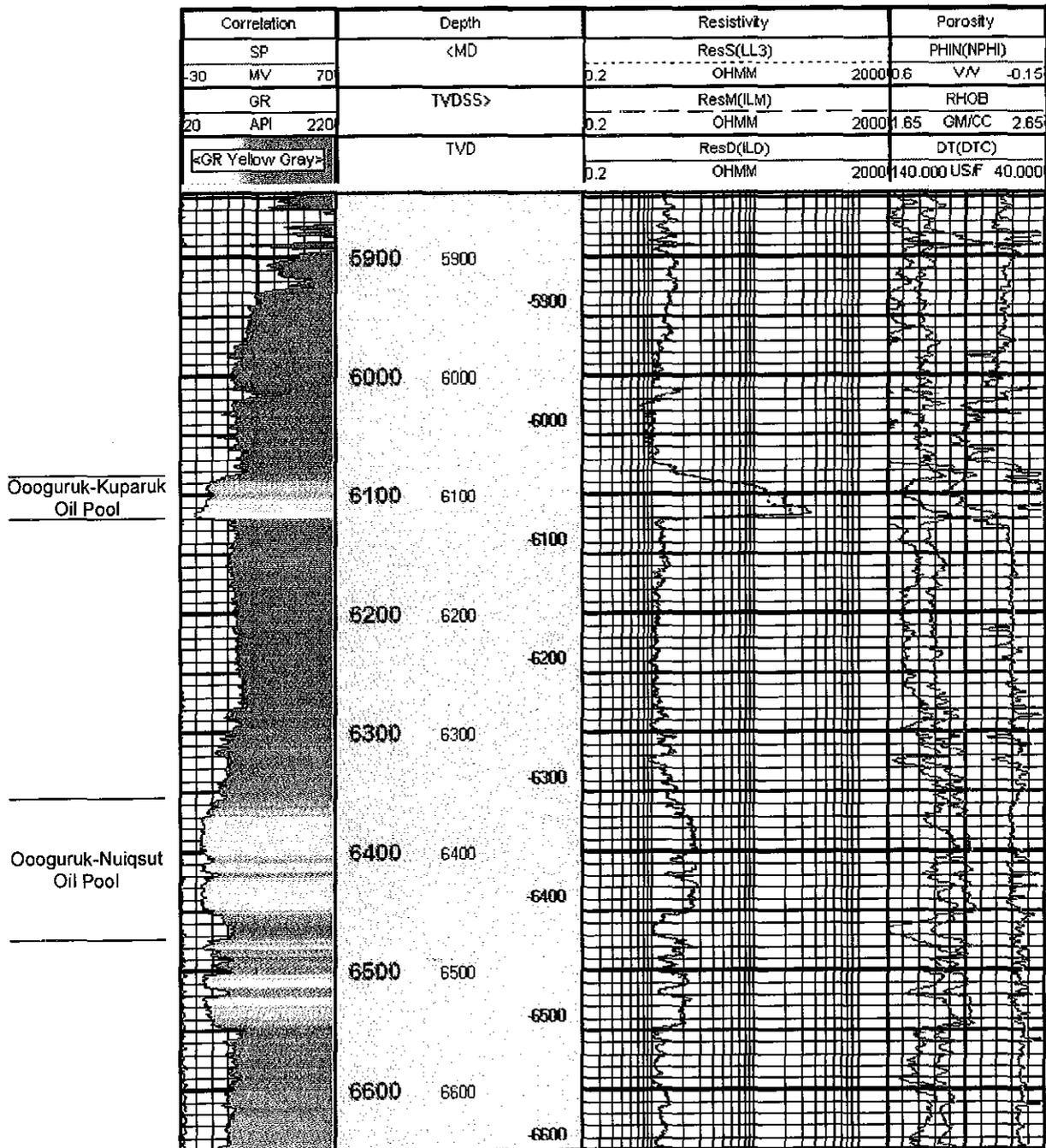
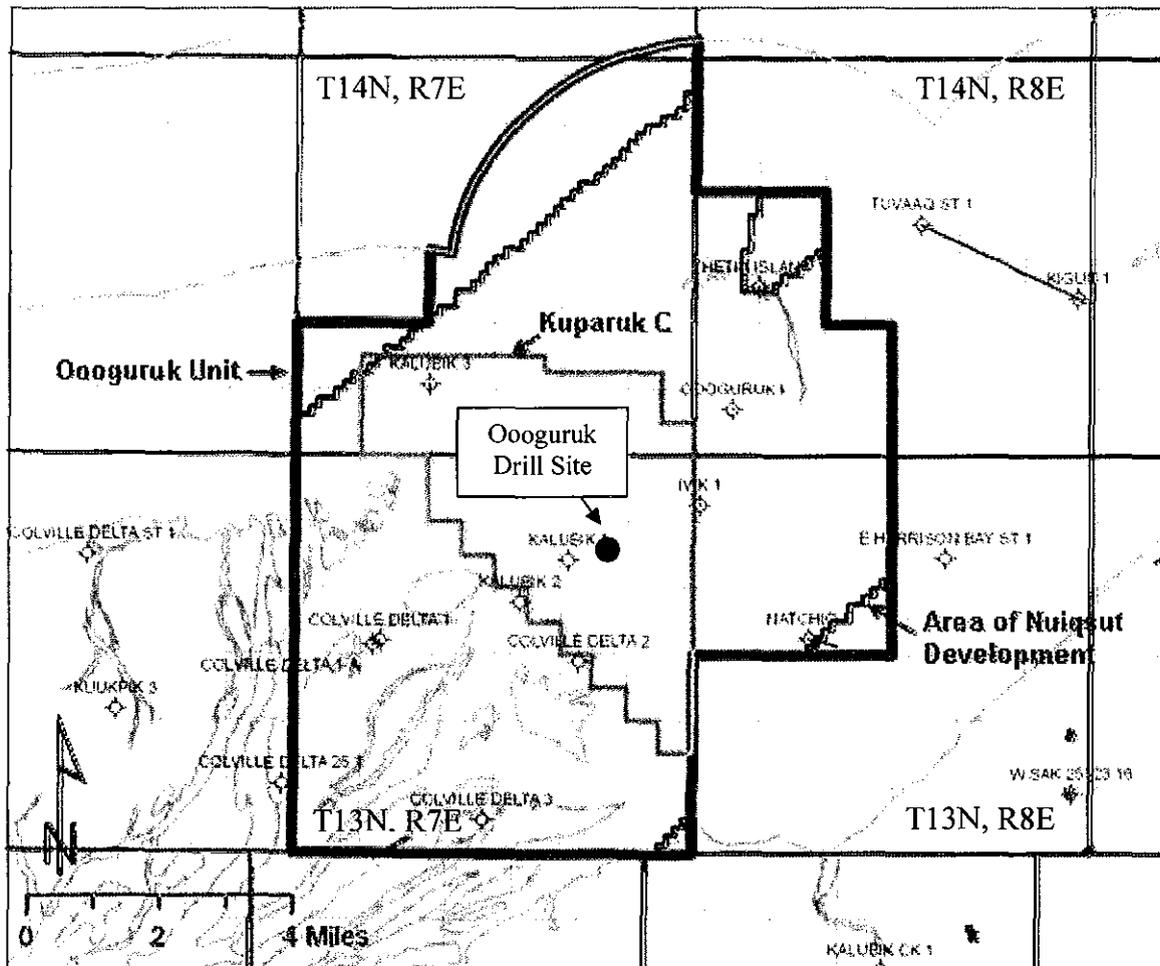


Figure 1. Kalubik No. 1 – Type Well Log for the Oooguruk-Nuiqsut Oil Pool¹

¹ Figure 1 is presented for illustration purposes only. Refer to the Dual Laterolog/Micro Laterolog recorded in the Kalubik No. 1 exploratory well for the precise representation of the Oooguruk-Nuiqsut Oil Pool.

3. Proposed Injection Area: Pioneer requested authorization to inject fluids for the purpose of enhanced recovery operations on lands in the OU. The proposed injection area includes portions of Township (T) 13N, Range (R) 7E; T13N, R8E; T14N, R7E; and T14N, R8E, Umiat Meridian (see Figure 2, below).



**Figure 2. Proposed Development Area for Oooguruk-Nuiqsut Oil Pool²
(outlined in black)**

4. Operators/Surface Owners Notification: All lands within the proposed development area are leased and lie within the OU. Two companies hold working interests in the proposed Oooguruk-Nuiqsut Oil Pool: Pioneer and Eni Petroleum US LLC (Eni). The only affected landowner and surface owner is the State of Alaska, Department of Natural Resources. The affected operators are Pioneer, operator of the OU, and ConocoPhillips Alaska, Inc., operator of the Kuparuk River Unit (KRU), which lies immediately to the southeast of the OU. Pioneer provided a copy of the application for injection to all operators and surface owners within a one-quarter mile radius of the proposed injection wells.

² This map was provided by Pioneer, and it is presented here for illustration purposes only. Refer to the legal description for the precise representation of the affected area.

5. Description of Operations: The Oooguruk-Nuiqsut Oil Pool will be developed with 30 to 39 horizontal wells, with a producer-to-injector ratio of about 1:1. The production and injection wells will range in length to 9,000' within the pool. Production and injection wells will be parallel to one another in an alternating arrangement to form a line-drive flood pattern. Individual wells will be spaced 1,500' to 1,700' apart.

The pool will be developed utilizing an under-saturated water-alternating-gas (US-WAG) injection as the enhanced recovery mechanism. Water injection is scheduled to begin in early 2008, with gas injection planned when gas becomes commercially available. Production from this pool will be commingled on the surface with produced fluids from other pools within the OU prior to shipment to the Kuparuk River Unit drillsite 3H for processing.

Annualized peak production rate for the Oooguruk-Nuiqsut Oil Pool is expected to be between 9,000 barrels of oil per day (BOPD) and 20,000 BOPD. Annualized waterflood injection rates are expected to peak between 15,000 barrels of water per day (BWPD) and 30,000 BWPD. Gas injection rates are expected to peak between 3 million standard cubic feet per day (MMSCFPD) and 20 MMSCFPD depending on gas availability.

6. Hydrocarbon Recovery: Estimates of original oil in place and recovery (in units of one million stock tank barrels or MMSTB) within the Oooguruk-Nuiqsut development area are:

Hydrocarbon Volume	Low Estimate (MMSTB)	High Estimate (MMSTB)
Original Oil in Place (OOIP)	250	300
Primary Recovery (4% to 10% of OOIP)	10	30
Primary + Waterflood (16% to 30% of OOIP)	40	90
Primary + Waterflood + US-WAG (18% to 34% of OOIP)	45	102

7. Geologic Information:

- a. Stratigraphy: The Oooguruk-Nuiqsut Oil Pool encompasses a late Jurassic-aged interval of reservoir sandstone beds that were deposited within the inner portion of a marine shelf environment, possibly as offshore sandbars. In general, the Oooguruk-Nuiqsut reservoir interval thickens from 20' in the northeast, near Thetis Island, to about 170' at the southern boundary of the OU, but the reservoir interval has been removed by erosion from the northwestern portion of the unit. Net sand ranges from 40' to 110' in the development area. The Oooguruk-Nuiqsut Oil Pool is not in hydraulic communication with the overlying Oooguruk-Kuparuk Oil Pool.

Within the OU, the Nuiqsut zone consists of very fine- to fine-grained, quartz-rich reservoir sandstone with up to 15% siderite and glauconite. Evidence of burrowing and bioturbation is abundant, suggesting relatively low rates of sedimentation. Nuiqsut zone porosity ranges from 10% to 20% and averages about 15%. Permeability ranges from 0.1 millidarcies (md) to 50 md, and averages

approximately 15 md. Estimated water saturations for 1 md and 10 md rock are 60% and 40%, respectively.

- b. Structure: Within the Oooguruk-Nuiqsut development area, the structure at the Nuiqsut level is a portion of a broad, southeast-plunging anticline nose centered in the southeastern portion of the OU, between the Colville Delta No. 1 and the Kalubik No. 1 wells. The crest and flanks of this structure are cut by northwest-trending, syndepositional, normal faults that are generally downthrown to the northeast. These faults range up to 200' in vertical displacement.
 - c. Trap Configuration: Well log and seismic information indicate that the oil in the pool is trapped by both structural and stratigraphic elements. The trapping mechanisms for oil within the Nuiqsut reservoir are erosional truncation to the west, northwest, and north; structural dip to the east; and stratigraphic pinch-outs into very fine-grained, non-reservoir rock to the east, southeast, south, and southwest.
 - d. Confining Intervals: The Oooguruk-Nuiqsut Oil Pool is overlain by about 150' to 350' of shale assigned to the Miluveach Formation, which separates and isolates the Oooguruk-Nuiqsut Oil Pool from the overlying Oooguruk-Kuparuk Oil Pool. The Oooguruk-Nuiqsut Oil Pool is separated from the underlying Nechelik interval by an 8-foot- to 15-foot-thick shale that is laterally persistent throughout the Oooguruk development area.
8. Well Logs: Logs of injection wells will be filed with the Commission according to the requirements of 20 AAC 25.
9. Mechanical Integrity and Well Design of Injection Wells: The casing programs for all injection wells will comply with 20 AAC 25.030.

Pioneer requests a waiver from the requirements of 20 AAC 25.412(b) so that packers may be located more than 200' measured depth (MD) above the top of the injection zone to facilitate the completion and long-term operation of the well. However, packers will not be set above the confining zone. Tubing or other equipment will be designed and installed in accordance with 20 AAC 25.412.

Cement-bond logs will be run to demonstrate isolation of injected fluids to the Oooguruk-Nuiqsut reservoir as required by 20 AAC 25.412(d). Mechanical integrity tests will be performed in accordance with 20 AAC 25.412(c).

10. Type of Fluid / Source: Fluids requested for injection are:
- a. source water from the Kuparuk sea water treatment plant;
 - b. injection water provided by the Kuparuk River Field;
 - c. produced water from the Oooguruk-Kuparuk and Oooguruk-Nuiqsut Oil Pools;
 - d. small amounts of the following fluids: fluids from reverse osmosis water treatment units, sumps, and hydrotests; rinsate from washing mud hauling trucks; excess well-work fluids; and treated camp waste water. These fluids will usually be injected into the ODS Class I disposal well, but may be blended with the fluids described in a, b, and c above, if necessary. The volume of these fluids is expected to be less than 0.1%, and is not expected to affect the efficiency of recovery from the oil pool; and

- e. natural gas from the KRU Central Processing Facility 3 (CPF-3) gas lift system.
11. Water and Gas Compatibility with Formation: Pioneer conducted special core analyses on a limited number of core samples from the Kalubik No. 1 exploratory well. Pioneer reports that Nuiqsut core samples are insensitive to formation and injection brine salinities and flow rates, and that fines did not migrate to impair permeability. Injection of gas was performed on one Nuiqsut core sample, and no degradation of permeability to gas was detected.
12. Injection Rates and Pressures: Injection rates will be adjusted to manage voidage for the reservoir. The maximum expected injection well rate is 6,000 BWPD, and the average injection well rate is expected to be 1,500 BWPD. For gas, the maximum expected injection well rate is 8 MMSCFD, and the average injection well rate is expected to be 2.5 MMSCFD.
- Water injection pressures are expected to range from approximately 1,800 psi to 2,000 psi at the wellhead. Injection will be managed to try to match voidage on an instantaneous basis. Gas injection pressure is expected to be approximately 3,800 psi at the wellhead.
- Original pressure of the Oooguruk-Nuiqsut reservoir was measured at about 3,200 psi at 6,350' true vertical depth subsea, and the bubble point pressure was determined by laboratory analysis to be about 1,900 psi. The proposed project will be operated to attempt to maintain the average reservoir pressure in the Oooguruk-Nuiqsut Oil Pool within about 500 psi of original pressure. Average reservoir pressure will be maintained above the bubble point pressure.
13. Fracture Information: Although normal water injection pressure will be close to the Oooguruk-Nuiqsut reservoir rock parting pressure, computer modeling indicates that, provided injection pressure is maintained below 2,900 psi, fractures will propagate to, but not into, the shale beds that bound the pool above and below. Therefore, injection fluids will remain within the Oooguruk- Nuiqsut reservoir.
14. Absence of Underground Sources of Drinking Water: According to the August 18, 2006, findings and conclusions of the U.S. Environmental Protection Agency (EPA), portions of the aquifers beneath the ODS that lie within a one-half mile radius of two potential Class I waste disposal candidate wells to be drilled from the ODS, do not qualify as underground sources of drinking water.³ Formation water salinity calculations by the Commission using log data from four exploratory wells and methods compatible with the R_{wa} method endorsed by the EPA confirm that there are no aquifers within the Affected Area that could serve as underground sources of drinking water.⁴
15. Mechanical Condition of Adjacent Wells: The Kalubik No. 1, Colville Delta No. 2, Ivik No. 1, and Oooguruk No. 1 exploration wells all penetrate the proposed Oooguruk-Nuiqsut injection interval within the Affected Area. All of these wells have been plugged and

³ Letter dated August 18, 2006 from Michael A. Bussell, Director of the Office of Compliance and Enforcement, U.S. Environmental Protection Agency, Region 10, to Mr. John Hellen of Pioneer Natural Resources Alaska, Inc., submitted by Pioneer to AOGCC as Attachment 1 to the Application for Proposed Oooguruk-Kuparuk and Oooguruk-Nuiqsut Oil Pools, Oooguruk Unit, North Slope, AK, on January 8, 2008.

⁴ Colville Delta 1, Colville Delta 2, Kalubik 1, and Thetis Island 1 log data were analyzed using techniques consistent with EPA guidance document "Survey of Methods to Determine Total Dissolved Solids Concentrations," KEDA Project No. 30-956, prepared by Ken E. Davis Associates in 1988 and revised in 1989.

abandoned. All four of these wells have sufficient mechanical isolation to confine injected fluids to the target reservoir and prevent cross flow into other intervals.

CONCLUSIONS:

1. The application requirements of 20 AAC 25.402 have been met.
2. Injection of water and gas will significantly improve recovery.
3. There are no underground sources of drinking water beneath the proposed Affected Area.
4. Increasing the distance between the packer and top of the injection zone will not compromise well integrity, so long as the top of the production casing cement is at least 300' measured depth above the packer.
5. The proposed injection operations will be conducted in permeable strata, which can reasonably be expected to accept injected fluids at pressures less than the fracture pressure of the confining strata.
6. Injected fluids will be confined within the appropriate receiving intervals by impermeable lithology, cement isolation of the wellbore and appropriate operating conditions.
7. Seawater and injection water provided by the Kuparuk River Field, produced waters from the Oooguruk-Nuiqsut and Oooguruk-Kuparuk Oil Pools, and injection gas will be compatible with the Oooguruk-Nuiqsut reservoir.
8. Compatibility has not been demonstrated for mixtures of waters or the following fluids: fluids from reverse osmosis water treatment units, sumps, and hydrotests; rinsate from washing mud hauling trucks; excess well-work fluids; and treated camp waste water.
9. Reservoir pressure will be maintained above bubble point.
10. Reservoir and well surveillance, coupled with regularly scheduled mechanical integrity tests, will demonstrate appropriate performance of the enhanced oil recovery project or disclose possible abnormalities.
11. Sufficient information has been provided to authorize injection of water and gas into the Oooguruk-Nuiqsut Oil Pool for the purposes of pressure maintenance and enhanced oil recovery.

NOW, THEREFORE, IT IS ORDERED that:

The underground injection of fluids for pressure maintenance and enhanced oil recovery is authorized in the following area, subject to the following rules and the statewide requirements under 20 AAC 25 (to the extent not superseded by these rules).

Affected Area:

Umiat Meridian

<u>Township, Range</u>	<u>Sections</u>
T13N, R07E	01 to 35: ALL 36: NE/4; NW/4 NE/4 SE/4; NW/4 SW/4 SE/4; NW/4 SE/4; W/2
T13N, R08E	04 to 08: ALL 09: NE/4; N/2 SE/4; N/2 S/2 SE/4; SW/4 SE/4 SE/4; S/2 SW/4 SE/4; W/2 16: W/2 NW/4 NE/4; NE/4 NW/4 NE/4; NW/4 NW/4 SW/4; N/2 NW/4; W/2 SE/4 NW/4; SW/4 NW/4 17: N/2; N/2 SE/4; NW/4 SE/4 SE/4; SW/4 SE/4; SW/4 18: ALL
T14N, R07E	01: E/2 NE/4 SE/4; SE/4 SE/4; S/2 SW/4 SE/4 11: SE/4 SE/4 NE/4; E/2 SE/4; SW/4 SE/4; SE/4 NW/4 SE/4; S/2 SE/4 SW/4 12: E/2; SW/4; E/2 NW/4; SW/4 NW/4; SE/4 NW/4 NW/4; 13: ALL 14: E/2; SW/4; E/2 NW/4; SW/4 NW/4; E/2 NW/4 NW/4; SW/4 NW/4 NW/4 15: NE/4 SE/4 NE/4; S/2 SE/4 NE/4; E/2 SE/4; SW/4 SE/4; S/2 NW/4 SE/4; NE/4 NW/4 SE/4; E/2 SE/4 SW/4 SW/4 SE/4 SW/4; SE/4 SW/4 SW/4 21: SE/4 NE/4 NE/4; SE/4 NE/4; SE/4 SW/4 NE/4; SE/4; E/2 NE/4 SW/4; SE/4 SW/4; E/2 SW/4 SW/4; SW/4 SW/4 SW/4 22 to 28: ALL 29: E/2 NE/4 NE/4; SW/4 NE/4 NE/4; SE/4 NE/4; E/2 SW/4 NE/4; SW/4 SE/4 NE/4; SE/4; E/2 SW/4; SW/4 SW/4; SE/4 NW/4 SW/4; SE/4 SE/4 NW/4 30: E/2 SE/4 SE/4; SW/4 SE/4 SE/4 31: E/2 NE/4; SW/4 NE/4; S/2 NW/4 NE/4; NE/4 NW/4 NE/4; S/2; SE/4 NE/4 NW/4; SE/4 NW/4; S/2 SW/4 NW/4 32 to 36: ALL
T14N, R08E	17: SE/4 SE/4SE/4 18: N/2 NE/4; N/2 S/2 NE/4; SW/4 SE/4 NE/4; S/2 SW/4 NE/4; W/2 NE/4 SE/4; NW/4 SE/4 SE/4; W/2 SE/4; W/2 19: W/2 NE/4; SE/4; W/2 20: E/2 NE/4; SW/4 NE/4; SE/4 NW/4 NE/4; S/2; E/2 SE/4 NW/4; SW/4 SE/4 NW/4 28 to 33: ALL

Rule 1 Authorized Injection Strata for Enhanced Recovery

Authorized fluids may be injected for purposes of pressure maintenance and enhanced recovery within the Oooguruk-Nuiqsut development area into strata that are common to, and correlate with, the interval between the measured depths of 6,354' and 6,472' on the Dual Laterolog/Micro Laterolog recorded in the Kalubik No. 1 exploration well.

Rule 2 Well Construction

To facilitate wireline access, packers in injection wells may be located more than 200' MD above the top of the Oooguruk-Nuiqsut Oil Pool; however, packers shall not be located above the confining zone. Production casing cement volume must be sufficient to place cement a minimum of 300' MD above the planned packer depth. Production casings must be cemented to a minimum of 500' MD above the Oooguruk-Kuparuk Oil Pool.

Rule 3 Authorized Fluids for Enhanced Recovery

Fluids authorized for injection are:

- a. source water from the Kuparuk sea water treatment plant;
- b. injection water provided by the Kuparuk Field;
- c. produced water from the Oooguruk-Kuparuk and Oooguruk-Nuiqsut Oil Pools;
- d. tracer survey liquid to monitor reservoir performance; and
- e. natural gas provide by the KRU CPF-3.

The injection of any other fluids, or mixtures of the above fluids, shall be approved by separate administrative action.

Rule 4 Authorized Injection Pressure for Enhanced Recovery

Injection pressures must be maintained such that the injected fluids do not fracture the confining zones or migrate out of the approved injection stratum.

Rule 5 Monitoring Tubing-Casing Annulus Pressure

The tubing and casing annuli pressures of each injection well must be monitored at least daily, except if prevented by extreme weather conditions, emergency situations, or similar unavoidable circumstances. Monitoring results shall be documented and made available for Commission inspection.

Rule 6 Demonstration of Tubing/Casing Annulus Mechanical Integrity

The mechanical integrity of an injection well must be demonstrated before injection begins, and before returning a well to service following a workover affecting mechanical integrity. A Commission-witnessed mechanical integrity test must be performed after injection is commenced for the first time in a well, to be scheduled when injection conditions (temperature, pressure, rate, etc.) have stabilized. Subsequent tests must be performed at least once every four

years thereafter (except at least once every two years in the case of a slurry injection well). The Commission must be notified at least 24 hours in advance to enable a representative to witness mechanical integrity tests. Unless an alternate means is approved by the Commission, mechanical integrity must be demonstrated by a tubing/casing annulus pressure test using a surface pressure of 1500 psi or 0.25 psi/ft multiplied by the vertical depth of the packer, whichever is greater, that shows stabilizing pressure and does not change more than 10 percent during a 30-minute period. Results of mechanical integrity tests must be readily available for Commission inspection.

Rule 7 Well Integrity and Confinement

Whenever any pressure communication, leakage or lack of injection zone isolation is indicated by injection rate, operating pressure observation, test, survey, log, or other evidence, the Operator shall notify the Commission by the next business day and submit a plan of corrective action on a Form 10-403 for Commission approval. The Operator shall immediately shut in the well if continued operation would be unsafe or would threaten contamination of freshwater, or if so directed by the Commission. A monthly report of daily tubing and casing annuli pressures and injection rates must be provided to the Commission for all injection wells indicating well integrity failure or lack of injection zone isolation.

Rule 8 Notification of Improper Class II Injection

Injection of fluids other than those listed in Rule 3 without prior authorization is considered improper Class II injection. Upon discovery of such an event, the operator must immediately notify the Commission, provide details of the operation, and propose actions to prevent recurrence. Additionally, notification requirements of any other State or Federal agency remain the operator's responsibility.

If fluids are found to be fracturing the confining zone or migrating out of the approved injection stratum, the Operator must immediately shut in the injection wells. Injection may not be restarted unless approved by the Commission.

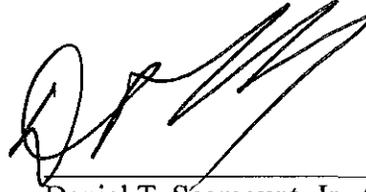
Rule 9 Other Conditions

The Commission may suspend, revoke or modify this authorization if injected fluids fail to be confined within the designated injection strata.

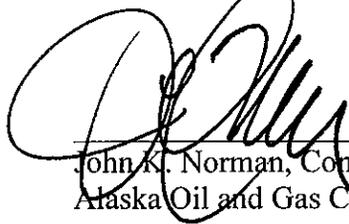
Rule 10 Administrative Action

Upon proper application, or its own motion, and unless notice and public hearing is otherwise required, the Commission may administratively waive the requirements of any rule stated herein or administratively amend this order as long as the change does not promote waste or jeopardize correlative rights, is based on sound engineering and geoscience principles, and will not result in an increased risk of fluid movement into freshwater.

ENTERED at Anchorage, Alaska, and dated April 11, 2008.



Daniel T. Seamount, Jr., Chair
Alaska Oil and Gas Conservation Commission



John K. Norman, Commissioner
Alaska Oil and Gas Conservation Commission



Cathy P. Foerster, Commissioner
Alaska Oil and Gas Conservation Commission

RECONSIDERATION AND APPEAL NOTICE

As provided in AS 31.05.080(a), within 20 days after written notice of the entry of this order or decision, or such further time as the Commission grants for good cause shown, a person affected by it may file with the Commission an application for reconsideration of the matter determined by it. If the notice was mailed, then the period of time shall be 23 days. An application for reconsideration must set out the respect in which the order or decision is believed to be erroneous.

The Commission shall grant or refuse the application for reconsideration in whole or in part within 10 days after it is filed. Failure to act on it within 10 days is a denial of reconsideration. If the Commission denies reconsideration, upon denial, this order or decision and the denial of reconsideration are **FINAL** and may be appealed to superior court. The appeal **MUST** be filed within 33 days after the date on which the Commission mails, **OR 30** days if the Commission otherwise distributes, the order or decision denying reconsideration, **UNLESS** the denial is by inaction, in which case the appeal **MUST** be filed within 40 days after the date on which the application for reconsideration was filed.

If the Commission grants an application for reconsideration, this order or decision does not become final. Rather, the order or decision on reconsideration will be the **FINAL** order or decision of the Commission, and it may be appealed to superior court. That appeal **MUST** be filed within 33 days after the date on which the Commission mails, **OR 30** days if the Commission otherwise distributes, the order or decision on reconsideration. As provided in AS 31.05.080(b), "[t]he questions reviewed on appeal are limited to the questions presented to the commission by the application for reconsideration."

In computing a period of time above, the date of the event or default after which the designated period begins to run is not included in the period; the last day of the period is included, unless it falls on a weekend or state holiday, in which event the period runs until 5:00 p.m. on the next day that does not fall on a weekend or state holiday.