

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

Re: THE APPLICATION OF Union Oil) Disposal Injection Order No. 28A
Company of California for disposal)
of Class II oil field wastes by) Deep Creek Unit
underground injection in the Tyonek) NNA No. 1 Well
Formation in the Deep Creek Unit)
NNA No. 1 Well, Section 11, T2S,) Originally Issued December 7, 2004
R13W, S.M.) Corrected and Amended

June 14, 2005

IT APPEARING THAT:

1. By correspondence to the Alaska Oil and Gas Conservation Commission (“Commission”) dated October 1, 2004 and received on October 4, 2004, Union Oil Company of California (“Unocal”) requested authorization to allow the underground injection of non-hazardous Class II oil field waste fluids into the Tyonek Formation within the Deep Creek Unit NNA No. 1 (“NNA #1”) well bore. The well is located on the Kenai Peninsula approximately 6 miles east of the city of Ninilchik;
2. The Commission published notice of opportunity for public hearing in the Anchorage Daily News on October 8, 2004 in accordance with 20 AAC 25.540;
3. The Commission did not receive any protests to the application, comments, or requests for a public hearing;
4. A hearing was held on November 9, 2004, at which Unocal provided sworn testimony addressing engineering and geologic considerations in support of the NNA #1 disposal injection order application. The record was held open to allow Unocal to provide supplemental information about the confining lithologies isolating injected waste fluids from shallow freshwater aquifers as requested by the Commission; and
5. Unocal provided supplemental information addressing fluids eligible for disposal into NNA #1 in a letter dated November 24, 2004.
6. Disposal Injection Order No. 28 was issued on December 7, 2004.
7. The Commission is providing this Disposal Injection Order No. 28A to supersede and replace Disposal Injection Order No. 28, clarifying the fluids authorized for injection.

FINDINGS:¹

1. Location of adjacent wells (20 AAC 25.252 (c)(1))

NNA #1 is a near-vertical well that is located approximately 272 feet from the south line and 510 feet from the west line of Section 11, Township 2 South, Range 13 West, Seward Meridian. There are no wells within ¼ mile of NNA #1;

2. Notification of Operators/Surface Owners (20 AAC 25.252 (c)(2) and 20 AAC 25.252 (c)(3))

Unocal is the only operator within ¼ mile radius of the proposed disposal operation. The sole surface owner within a ¼ mile radius of NNA #1 is Ninilchik Native Association, Inc. Unocal provided evidence that a copy of its application for disposal injection in NNA #1 was sent by certified mail to Ninilchik Native Association, Inc., on October 1, 2004;

3. Geologic information on disposal and confining zones (20 AAC 25.252 (c)(4))

Unocal proposes to conduct disposal into the Tyonek Formation (“Tyonek”) between the measured depths of 6,182 ft and 9,278 ft. Individual sand intervals within the Tyonek Formation were perforated after drilling to test for natural gas; no commercial gas rates were achieved. Disposal operations in NNA #1 will not impact adjacent production from the Happy Valley field as the nearest development wells are approximately 2 miles away;

Geologic information provided by Unocal notes that the Tyonek Formation consists of interbedded conglomerates, sandstones, siltstones, shales and coals deposited in fluvial, lacustrine, alluvial, and terrestrial systems. Sandstones within the proposed disposal interval have estimated porosities up to 22%, permeabilities in excess of 20 millidarcies, and can approach 40-ft in thickness (average 20 ft). Unocal has provided evidence that the numerous coal beds ranging in thickness from 6 inches to 30 ft, as well as tight carbonaceous and impervious claystone beds provide vertical confinement for injection into the Tyonek.

The Beluga Formation is several thousand feet thick and occurs at depths greater than 2,000 ft in the Deep Creek Unit. This formation is comprised of thinly laminated sandstones, siltstones, shales and coals. Individual sandstone beds within the Beluga Formation are generally less than 30 ft thick, resulting in a heterogeneous sequence of rocks with very poor or no vertical connectivity or permeability. In the area considered for disposal injection, the top of the Beluga Formation is at a depth of approximately 2,400 ft and marked by locally continuous, 75-ft thick shale.

¹ All depths noted in this Order are measured depth (“MD”) referenced to NNA #1 and are substantially equivalent to true vertical depth (“TVD”) below ground level in this near-vertical well.

Supplemental information provided by Unocal on November 17, 2004 identifies more than 1,000 ft of confining lithologies between the aquifer exemption depth (1,800 ft per AEO No. 11) and the depth of uppermost injection perforations (6,182 ft);

4. Well Logs (20 AAC 25.252 (c)(5))

Well logs from NNA #1 are on file with the Commission;

5. Demonstration of Mechanical Integrity and Disposal Zone Isolation (20 AAC 25.252 (c)(6))

Drilling records show that Unocal ran 7" casing and cemented it with 172-barrel lead and 66-barrel tail cement slurries. An Ultra-Sonic Imaging Tool (USIT) was run in the well 4 days after cementing 7" casing to evaluate the cement sheath in the vicinity of the disposal intervals, focusing specifically on the interval from 5,700 ft to 6,182 ft. Analysis of the USIT results indicates competent cement around the 7" casing below 5,860 ft, isolating the uppermost injection interval with approximately 320 ft of cement. Unocal conducted a successful 3000-psi mechanical integrity test of the tubing-casing annulus in NNA #1 on August 24, 2004. The pressure test was performed in accordance with 20 AAC 25.412(c);

6. Disposal Fluid Type, Source, Volume and Compatibility with Disposal Zone (20 AAC 25.252 (c)(7))

The primary disposal fluid planned for this well is formation fluid from the Happy Valley Field as well as approved Class II fluids from other Unocal operated fields. Specific wastes include drilling, completion, production, and workover fluids; stimulation fluids and solids; tracer materials; rig wash fluids; glycol dehydration wastes; drilling mud slurries; naturally occurring radioactive material scale slurries; precipitation accumulating within containment areas; tank bottoms; and other fluids brought to surface and generated in connection with oil and gas development activities.

Unocal estimates a maximum of 3,000 barrels per day of fluid will be injected in NNA #1;

7. Estimated Injection Pressure (20 AAC 25.252 (c)(8))

Unocal estimates average surface injection pressure will be 2,200 psig and the maximum surface injection pressure will be 4,000 psig;²

² Maximum injection pressure clarified in public hearing record for DIO 28 (November 9, 2004), pgs 9-10

8. Evaluation of Confining Zones (20 AAC 25.252 (c)(9))

The potential to fracture through the confining lithologies at NNA #1 was modeled by a Unocal consultant. Included in the consultant's analysis was experience from observed behavior of Beluga-Tyonek fracture treatments in the region. The goal of this evaluation was to predict the expected upward fracture growth for cuttings disposal at NNA #1 using worst-case assumptions. The simulation assumed continuous 2-day injection of 8,000 barrels of slurry in 10 equal events separated by 59.5-barrel sweeps with clean fluid. Slurry make-up was assumed to have a 12 percent solids concentration with 30/50-mesh sand distribution and density of 10 pounds per gallon. Injection rate for the modeling work was 2.5 barrels per minute. Only the uppermost perforated interval (6,182 ft – 6,222 ft) is assumed open.

In this worst-case model, the critical factor is vertical fracture propagation, with a critical limit being the log-derived top of cement in the production casing annulus (5,860 ft, or 322 ft above the top of perforations). The fracture analysis indicates that coal intervals overlying the injection interval tend to impede the fracture height growth within the Tyonek Formation. Modeling shows the fracture height is not expected to grow beyond the top of cement. Unocal further notes that the injection assumptions included in the modeling work significantly exceed maximum estimated fluid injection per day;

9. Standard Laboratory Water Analysis of the Disposal Zone (20 AAC 25.252 (c)(10))

A laboratory analysis of formation water sampled from one of the Tyonek sands in NNA #1 identified total dissolved solids greater than 7,000 ppm;

10. Aquifer Exemption (20 AAC 25.252 (c)(11))

Pursuant to a separate proceeding, an aquifer exemption has been granted, in Aquifer Exemption Order No. 11, for depths greater than 1,800 ft covering 3 specific areas within the Deep Creek Unit:

- A ¼ mile radius around NNA #1;
- All of Section 22, which includes the Happy Valley pad and associated wells;
- The southeast one-quarter of Section 15; and
- All of Section 21, which will cover a new drillsite and associated wells planned by Unocal for the Deep Creek Unit; and

11. Mechanical Condition of Wells Penetrating the Disposal Zone within ¼ Mile of NNA #1 (20 AAC 25.252 (c)(12))

There are no wells penetrating the disposal zone within ¼ mile radius of NNA #1.

CONCLUSIONS:

1. The application requirements of 20 AAC 25.252(c) have been met;
2. Mechanical integrity of the tubing-casing annulus to a depth of 6,097 ft has been demonstrated in NNA #1 by pressure test. Competent cement has been demonstrated in the casing annulus to 5,860 ft. NNA #1 has been cased and the casing cemented in a manner that will isolate the disposal zone and protect oil, gas, and freshwater sources;
3. At NNA #1, there are approximately 180 ft of confining lithologies between the top of cement in the 7" casing annulus and the uppermost perforations. While other confining lithologies are documented, the Commission does not recognize these as effective confining zones since the uncemented annulus above 5,860 ft provides a communication path for fluid migration up hole should the 180-ft net thickness be compromised;
4. Worst-case fracture modeling confirms that waste fluids will be contained within the receiving intervals by the confining lithologies within the Tyonek Formation, cement isolation of the well bore and operating conditions;
5. Disposal injection operations in NNA #1 will be conducted at rates and pressures below those estimated to fracture through the confining zones. Therefore, oil field wastes will not enter freshwater strata; and
6. Supplemental mechanical integrity demonstrations and surveillance of injection operations are appropriate to ensure waste fluids are contained within the disposal interval. Included are mechanical integrity testing, temperature surveys, monitoring of injection performance (pressures, rates), and analysis of the data for indications of anomalous events.

NOW, THEREFORE, IT IS ORDERED THAT this Disposal Injection Order No. 28A supersedes Disposal Injection Order No. 28, and that the following rules are adopted:

RULE 1: Authorized Injection Strata for Disposal

Injection of authorized fluids for purposes of underground disposal of oil field wastes is permitted into the Tyonek Formation below 6,000 ft in NNA #1. The Commission may immediately suspend, revoke, or modify this authorization if injected fluids fail to be confined within the designated injection strata.

RULE 2: Authorized Fluids

This authorization is limited only to Class II waste fluids as follow: produced water, drilling, completion, production and work over fluids (including stimulation fluids and solids, and tracer materials), rig wash, drilling mud slurries, NORM scale, precipitation

accumulating within containment areas, tank bottoms, and glycol dehydration wastes. The Commission may authorize the disposal of additional fluids not identified above on a case-by-case basis if the Commission determines they are suitable for disposal in a Class II well.

RULE 3: Demonstration of Mechanical Integrity

The mechanical integrity of NNA #1 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 NNA #1, 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 1,500 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 4: Well Integrity Failure 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 indicating well integrity failure or lack of injection zone isolation.

RULE 5: Surveillance

The operator shall obtain a baseline temperature log and a baseline step rate test prior to initial injection. A subsequent temperature log must be performed 1 month after injection begins to demonstrate the receiving zone of the injected fluids. Additional temperature survey requirements will be based on the results of the initial and follow-up temperature surveys.

An annual report for the calendar year evaluating the performance of the disposal operation must be submitted by July 1 of each year. The report shall include pressures, fluid volumes (disposal and clean fluid sweeps), fluid make-up, injection rates, an assessment of fracture height growth, and a description of any anomalous injection results. During the first year of injection, a monthly evaluation of injection monitoring results must be provided to the Commission with an emphasis on fracture height growth.

RULE 6: Notification of Improper Class II Injection

The operator must immediately notify the Commission if it learns of any improper Class II injection. Additionally, notification requirements of any other State or Federal agency remain the operators' responsibility.

RULE 7: Administrative Action

Unless notice and public hearing is otherwise required, the Commission may administratively waive or amend any rule stated above 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 fluid movement outside of the authorized injection zone.

RULE 8: Conditions

It is a condition of this authorization that operations be conducted in accordance with the rules set out in this order, with AS 31.05, and (unless specifically superseded by Commission order) with 20 AAC 25. Failure to comply with an applicable provision of AS 31.05, 20 AAC 25, or these rules may result in the suspension or revocation of this authorization.

DONE at Anchorage, Alaska and dated June 14, 2005.

John K. Norman, Chairman

Daniel T. Seamount, Jr., Commissioner

Cathy P. Foerster, Commissioner

AS 31.05.080 provides that within 20 days after receipt of written notice of the entry of an order, a person affected by it may file with the Commission an application for rehearing. A request for rehearing must be received by 4:30 PM on the 23rd day following the date of the order, or next working day if a holiday or weekend, to be timely filed. The Commission shall grant or refuse the application in whole or in part within 10 days. The Commission can refuse an application by not acting on it within the 10-day period. An affected person has 30 days from the date the Commission refuses the application or mails (or otherwise distributes) an order upon rehearing, both being the final order of the Commission, to appeal the decision to Superior Court. Where a request for rehearing is denied by nonaction of the Commission, the 30-day period for appeal to Superior Court runs from the date on which the request is deemed denied (i.e., 10th day after the application for rehearing was filed).