

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

**Re: THE APPLICATION OF Union) Disposal Injection Order No. 35
Oil Company of California for)
disposal of Class II oil field wastes) Sterling Formation
by underground injection in the) Ivan River Unit Well 13-31
Sterling Formation in Ivan River)
Unit Well 13-31, Section 1, T13N,) December 9, 2008
R9W, S.M.)**

IT APPEARING THAT:

1. Union Oil Company of California (Union), a wholly owned indirect subsidiary of Chevron Corporation, requested that the Alaska Oil and Gas Conservation Commission (Commission) issue an order authorizing underground disposal of Class II oil field waste fluids into the Sterling Formation through Ivan River Unit (IRU) Well 13-31. The application was received by the Commission on September 8, 2008.
2. In accordance with 20 AAC 25.540, notice of opportunity for a public hearing was published in the ANCHORAGE DAILY NEWS on September 11, 2008, on the State of Alaska Online Notices on September 9, 2008, and on the Commission's Web site on September 9, 2008. The scheduled hearing date was October 21, 2008.
3. The Commission did not receive any comments, protests or requests for a public hearing.
4. The public hearing was vacated on October 20, 2008.
5. The Commission requested clarification of certain items on October 20, 2008. Union responded on November 3 and November 8, 2008 with clarifications.
6. The information submitted by Union and public well history records for IRU wells are the basis for this order.

FINDINGS:

1. Location of Adjacent Wells (20 AAC 25.252(c)(1))

IRU Well 13-31 is a gas development well drilled in 1992 to a total depth of 8167 feet true vertical depth (TVD) (11,575 feet measured depth (MD)). The surface location is in Section 1, Township 13N, Range 9W, Seward Meridian (S.M.) (682 feet from south line, 699 feet from east line). The bottom hole location is in Section 31, Township 14N, Range 8W, S.M.. IRU Well 13-31 penetrates the injection zone within Section 1.

Six wells were constructed to develop gas reserves within the IRU; all wells are active except for one plugged and abandoned well. Two IRU wells penetrate the proposed injection zone within a ¼-mile radius of IRU Well 13-31.

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

Union is the only operator and the State of Alaska is the only surface owner within a ¼-mile radius of the proposed disposal well.

3. Geological Information on Disposal and Confining Zones (20 AAC 25.252(c)(4))

The proposed disposal injection interval lies within the Sterling Formation, and it extends from 4272 feet to 4681 feet TVD (5544 feet to 6183 feet MD) in IRU Well 13-31. This interval consists of a series of very fine- to coarse-grained sandstone and conglomerate beds that are generally rich in metamorphic and igneous lithic grains and commonly contain tuffaceous matrix. The proposed disposal interval is divided into three major members that are each about 125 true vertical feet thick. These members are separated by intervals of interbedded tuffaceous mudstone, sandstone, and coal have an aggregate thickness of about 20 true vertical feet.

Upper confinement for the disposal injection interval is provided by a stacked sequence of siltstone, mudstone, and coal that extends from approximately 4254 feet to 4272 feet TVD (5515 feet to 5544 feet MD) (*i.e.*, about 20 true vertical feet thick). Lower confinement is provided by a sequence of coal, mudstone, claystone, and siltstone. This sequence extends from 4681 feet to 4696 feet TVD (6183 to 6207 feet MD) (*i.e.*, about 15 true vertical feet thick). Additional upper confinement is provided by the thick sequence of mudstone and siltstone between 3469 feet and 3643 feet TVD (4290 and 4560 feet MD) (*i.e.*, about 270 true vertical feet thick). The thick coals and abundant mudstone beds of the lowermost Sterling, between 4824 feet and 5220 feet TVD (6435 and 7030 feet MD) (*i.e.*, about 400 true vertical feet thick), will provide additional lower confinement.

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

The injection of drilling mud and slurried cuttings will require pressure sufficient to fracture the formation. Union used fracture modeling to predict fracture behavior for IRU Well 13-31 disposal injection. The results were included in the disposal injection order application. Rock property information used in the fracture model was obtained from log data generated

during the drilling of IRU 13-31 and other nearby IRU wells. The fracture modeling included a base case run with the expected injection rate, slurry density, injected volume, and injection operating practice. Numerous model runs were performed – including runs simulating extreme conditions – by varying the injection rate, slurry density, and injected volume to test the sensitivity of these parameters on fracture geometry. The fracture modeling predicts maximum fracture heights up to 100 feet true vertical thickness and a maximum half-length up to approximately 1000 feet. Using injection rate, slurry density, and injection volumes that are expected to occur in IRU 13-31, Union’s fracture modeling predicts a fracture height up to 60 feet true vertical thickness and a fracture half-length up to nearly 800 feet.

Commercial gas production at IRU occurs from the Tyonek, Beluga, and Lower Sterling Formations. The shallowest gas production occurs from the lowermost Sterling Formation in IRU Well 44-36. The shallowest productive strata lie about 200 true vertical feet deeper than the base of the proposed injection interval in IRU Well 13-31.

5. Standard Laboratory Water Analysis of the Formation (20 AAC 25.252(c)(10)); Aquifer Exemption (20 AAC 25.252(c)(11))

The Commission issued Aquifer Exemption Order (AEO) 6 on July 23, 2001 and amended it as AEO 6A on December 5, 2008. AEO 6A extends the approved aquifer exemption depth interval to include portions of the freshwater aquifers between 2340 feet and 4202 feet TVD (2500 feet and 5435 feet MD) in, and within a ½-mile radius of, IRU Well 14-31, which is the reference well for AEO 6 and AEO 6A. The equivalent depth range in IRU Well 13-31 is from about 2365 feet to 4681 feet TVD (2530 feet to 6183 feet MD). IRU Well 13-31 disposal injection will occur within the aquifer exemption area established in AEO 6A.

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

Log data from IRU Well 13-31 are on file with the Commission. Union provided a type log for IRU Well 13-31 illustrating the proposed injection and confining zones.

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

IRU Well 13-31 produced 14.3 billion cubic feet of gas before it was shut in December 2007. The well is constructed as follows: 20-inch conductor casing driven to 166 feet TVD (166 feet MD); 13-3/8-inch surface casing set at 866 feet TVD (866 feet MD); 9-5/8-inch intermediate casing set at 2938 feet TVD (3460 feet MD); 7-inch production casing set at 7352 feet TVD (10350 feet MD); and 5-inch liner installed from 7113 feet to 8167 feet TVD (10,028 feet MD to 11,575 feet MD). The well’s plug-back depth is 5435 feet TVD (7400 feet MD).¹ Union will perform a well workover to pull the production tubing and packer, install a casing patch across a leaking casing collar, and reinstall the tubing and packer. The injection completion will consist of 3.5-inch tubing run to 4260 feet TVD (5525 feet MD)

¹ A slickline survey of the well in June 2008 found fill above the tubing plug-back at a depth of 4770 feet TVD (5561 feet MD).

and permanent packer installed at 4212 feet TVD (5450 feet MD), thereby establishing the Sterling Formation as the intended zone for Class II waste disposal injection.

Union reports that the 7-inch casing in IRU Well 13-31 is cemented from surface to the 9-5/8-inch casing shoe at 2938 feet TVD (3460 feet MD), and from 3925 feet to 7352 feet TVD (5000 feet to 10,350 feet MD). Cement bonding in the 7-inch casing section opposite the injection and confining layers was not evaluated during well construction. The reported cement top of 3925 feet TVD (5000 feet MD) was calculated from the volume of cement pumped and an assessment of the cement placement operation. Union plans to run a bond log from 2340 feet to 4710 feet TVD (2500 feet to 6250 feet MD) to evaluate the cement integrity adjacent to the upper confining, injection and lower confining zones prior to installing tubing and packer.

A mechanical integrity test will be performed before injection commences and, after injection is begun, as required by the Commission. Union indicates it will comply with the Commission's requirements for testing, monitoring, and reporting waste slurry injection activities.

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

IRU Well 13-31 will be the second active waste disposal well located on the IRU drillsite. Union intends to use IRU Well 13-31 to dispose of drilling, production, completion, workover wastes, and other associated wastes that are intrinsically derived from primary field operations. Union projects the injection volume into IRU Well 13-31 could be as much as 1,135,000 barrels of Class II wastes over the expected life of the well. Union expects the injection to occur in daily batch volumes averaging 155 barrels and not exceeding 1000 barrels, with rates up to 4 barrels per minute. Fracture modeling evaluated the effect of injection rates up to 4 barrels per minute, injected batch volumes up to 2500 barrels per day, and fluid densities up to 10.1 pounds per gallon.

No compatibility concerns relating to the injected fluids and in-situ formation fluids have been identified by Union in connection with the injection of a similar waste fluid stream into the Sterling Formation at the nearby IRU Well 14-31. To date, Union has injected more than 45,500 barrels of Class II wastes into IRU Well 14-31.

9. Estimated Injection Pressures (20 AAC 25.252(c)(8))

Union estimates that the average surface injection pressure will be between 1800 psig and 2800 psig. The maximum surface injection pressure could reach 5000 psig if sporadic plugging of perforations or fracture flow channels occurs.

10. Mechanical Condition of Wells Penetrating the Disposal Zone Within a ¼-Mile Radius of IRU Well 13-31 (20 AAC 25.252(c)(12))

IRU Well 14-31 and IRU Well 44-36 penetrate the Sterling disposal injection zone within a ¼-mile radius of IRU Well 13-31. Union's review of well construction records shows that

both wells are cased and cemented to prevent the movement of injected fluids beyond the well's confinement zones. Records documenting the drilling, casing, cementing, and testing of these wells are in the Commission's files.

CONCLUSIONS:

1. The 20 AAC 25.252 requirements for approval of an underground disposal application are met.
2. The Sterling disposal zone is approximately 400 true vertical feet thick. Upper confinement is provided by a stacked sequence of siltstone, mudstone and coal that is laterally continuous throughout the affected area. Lower confinement is provided by a sequence of coal, mudstone, claystone, and siltstone that is laterally continuous across the affected area. No significant faults are present in the vicinity of the proposed operations. Although these confining intervals are relatively thin, well log correlations indicate they are laterally continuous throughout the affected area. Additional upper confinement is provided by an overlying, 270-foot thick sequence of mudstone and siltstone, and additional lower confinement is provided by about 400 feet of underlying coal and mudstone in the lowermost Sterling.
3. AEO 6A exempts from underground sources of drinking water freshwater aquifers between 2365 feet and 4681 feet TVD (2530 feet and 6183 feet MD).
4. Commercial gas accumulations are sufficiently separated and isolated from the proposed injection zone that IRU gas production should not be adversely affected by the proposed IRU Well 13-31 disposal operations.
5. Injected fluids should be compatible with the lithology and resident water of the injection zone. This conclusion is based on operating experience and data from disposal injection within the Sterling Formation at IRU Well 14-31 involving similar materials and performance parameters (e.g., pressures, rates, and volumes). There have been no reported compatibility issues associated with disposal injection into the Sterling Formation at other fields in the Cook Inlet area.
6. Based on the fracture modeling results, including the extreme case sensitivities considered for injection into IRU Well 13-31, reasonable grounds exist to conclude that waste fluids should be contained within the receiving interval by the confining lithologies within the Sterling Formation, cement isolation of the well bore, and operating conditions.
7. Modeling predicts a zone of influence (*i.e.*, waste plume area) for injected materials equal to a fracture domain potentially extending up to 1000 feet laterally from the well. An area of review within a ¼-mile radius of IRU Well 13-31 is appropriate given the fracture modeling results. The wells penetrating this area have sufficient mechanical integrity to prevent the migration of fluids from the proposed IRU Well 13-31 injection zone.

8. Disposal injection operations in IRU Well 13-31 as described and modeled are not expected to fracture through the confining zones. Therefore, oil field wastes injected into IRU Well 13-31 should be confined to an isolated zone within the Sterling Formation.
9. Supplemental mechanical integrity demonstrations and the surveillance of injection operations—including baseline and subsequent temperature surveys, monitoring of injection performance (*i.e.*, pressures and rates), and analyses of the data for indications of anomalous events—are appropriate to ensure that waste fluids remain within the disposal interval.

NOW, THEREFORE, IT IS ORDERED THAT disposal injection is authorized into the Sterling Formation within Ivan River Unit Well 13-31 subject to each of the following requirements:

RULE 1: Injection Strata for Disposal

The underground disposal of Class II oil field waste fluids is permitted into the Sterling Formation within IRU Well 13-31 in the interval from 4272 feet to 4681 feet TVD (5544 feet to 6183 feet MD). The Commission may immediately suspend, revoke, or modify this authorization if injected fluids are not confined by the upper and lower confining zones.

RULE 2: Fluids

This authorization is limited to Class II oil field waste fluids generated during drilling, production or workover operations.

RULE 3: Injection Rate and Pressure

Disposal injection is authorized at (a) rates that do not exceed 4 barrels per minute and (b) surface pressures that do not exceed 5000 psig.

RULE 4: Demonstration of Mechanical Integrity

The mechanical integrity of IRU Well 13-31 must be demonstrated before injection begins and before returning the 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 IRU Well 13-31. That test must be performed when injection conditions (temperature, pressure, rate, etc.) have stabilized. Subsequent mechanical integrity tests must be performed at least once every two years after the date of the first Commission-witnessed test. The Commission must be notified at least 24 hours in advance of each such test to enable a representative to witness the test. Unless an alternate means is approved by the Commission, mechanical integrity must be demonstrated by a tubing/casing annulus pressure test that meets the following conditions: (1) uses a surface pressure of either 1,500 psig, or 0.25 psig/ft multiplied by the vertical depth of the packer, whichever is greater; (2) shows stabilizing pressure; and (3) does not change more than 10 percent during a 30-minute period. The results of all mechanical integrity demonstrations and Union's interpretation of those results shall be provided to the Commission and be readily available for Commission inspection.

RULE 5: Well Integrity Failure and Confinement

Whenever any pressure communication, leakage or lack of injection zone isolation is indicated by the injection rate, an operating pressure observation, a test, a survey, a log, or any other

evidence, the operator shall notify the Commission by the next business day and submit a plan of corrective action (on Form 10-403) for Commission approval. The operator shall immediately shut in the well if continued operation would be unsafe or 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 IRU Well 13-31 indicating any well integrity failure or lack of injection zone isolation.

RULE 6: Surveillance

The operator shall run a baseline temperature log and perform a baseline step-rate test prior to initial injection. A subsequent temperature log must be run one month after injection begins to delineate the receiving zone of the injected fluids. Surface pressures and rates must be monitored continuously during injection for any indications of anomalous conditions. Results of daily wellhead pressure observations in IRU Well 13-31 must be documented and available to the Commission upon request. The conduct of subsequent temperature surveys or other surveillance logging (*e.g.*, water flow; acoustic) will be based on the results of the initial and follow-up temperature surveys and injection performance monitoring data.

A report evaluating the performance of the disposal operation must be submitted to the Commission by July 1 of each year. The report shall include data sufficient to characterize the disposal operation, including, among other information, the following: injection and annuli pressures (*i.e.*, daily average, maximum, and minimum pressures); fluid volumes injected (*i.e.*, in disposal and clean fluid sweeps); injection rates; an assessment of the fracture geometry; a description of any anomalous injection results; and a calculated zone of influence for the injected fluids.

RULE 7: Notification of Improper Class II Injection

The operator must immediately notify the Commission if it learns of any improper Class II injection. Complying with the notification requirements of any other local, state or federal agency remains the operator's responsibility.

RULE 8: Administrative Action

Unless notice and public hearing are 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 9: Compliance

Operations must be conducted in accordance with the requirements of this order, AS 31.05, and (unless specifically superseded by Commission order) 20 AAC 25. Noncompliance may result in the suspension, revocation, or modification of this authorization and other penalties.

ENTERED at Anchorage, Alaska, and dated December 9, 2008.



Daniel T. Seamount, Jr., Chair

John K. Norman, Commissioner

Cathy P. Foerster, Commissioner

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.