

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

RE: THE APPLICATION OF UNION OIL ) Storage Injection Order No. 3  
COMPANY OF CALIFORNIA ) Swanson River Field  
("Unocal") for an order authorizing the ) Swanson River Unit Well KGSF #2,  
underground storage of hydrocarbons ) (Re-drill of SRU #12-27)  
by injection into the Tyonek Formation ) June 5, 2002  
in proposed well Swanson River Unit )  
KGSF #2. )

**IT APPEARING THAT:**

1. By application dated March 6, 2002 and received by the Alaska Oil and Gas Conservation Commission ("Commission") on March 7, 2002, Union Oil Company of California ("Unocal") requested an order from the Commission authorizing the underground storage of hydrocarbons by injection into the Tyonek Formation of the proposed Swanson River Unit ("SRU") KGSF #2 well. This proposed well is a 500-foot long, lateral re-drill of existing well SRU #212-27, which is located in Section 27, Township 8 North, Range 9 West, Seward Meridian.
2. Unocal proposes to inject gas into SRU KGSF #2 for storage during summer months and produce back the gas for sales during winter months to meet peak demand.
3. Notice of opportunity for public hearing was published in the Anchorage Daily News Anchorage Daily News on March 22, 2002 in accordance with 20 AAC 25.540.
4. By letter dated March 25, 2002 and received by the Commission on March 28, 2002, Unocal requested well SRU KGSF #2 be a re-drill of existing well SRU #12-27 instead of well SRU #212-27.
5. The Commission received no comments concerning the application or requests for a public hearing.
6. By Commission request, a hearing concerning Unocal's application was convened in conformance with 20 AAC 25.540 at the Commission's offices, 333 W. 7th Avenue, Suite 100, Anchorage, Alaska 99501 on April 30, 2002. Concurrently, the Commission heard testimony concerning proposed injection of gas into well SRU KGSF #2.

**FINDINGS:**

1. Unocal is the operator of the Swanson River Field.
2. Unocal proposes to drill a 500-foot lateral extension to the existing well SRU #12-27, rename the well SRU KGSF #2, and utilize the lateral extension for the proposed storage injection program.
3. The gas storage project is intended to provide a certain stored volume of gas to meet peak rate requirements during seasonal high demand periods. The design is intended to put a large volume into a reservoir at relatively high injection rate and withdraw the gas at a relatively high rate during peak demand periods.

4. Well SRU #12-27 and Unocal's proposed lateral extension lie within Federal lease A-028406. The U.S. Department of the Interior is the owner of the subsurface rights.
5. There are no other operators within a one-quarter mile radius of the proposed SRU KGSF #2 well.
6. Unocal has given notice of its application by certified mail to the surface owners within a one-quarter mile radius of the proposed SRU KGSF #2 well.
7. 40 CFR 147.102(b) provides that aquifers below 1700 feet from the surface and within a 1/4 mile of the Swanson River Field are exempted in accordance with 40 CFR 144.7(b) and 40 CFR 146.4.
8. Unocal proposes to conduct dry gas storage injection within the proposed SRU KGSF #2 well in the 62-5 sand of the Tyonek Formation. Unocal describes this sand as lying between 6233 and 6253 feet MD in offset well SRU #212-27.
9. Two other wells lie within one-quarter mile radius of the proposed SRU KGSF #2 well: SRU #212-27 and SRU #314-27. These wells penetrate the 62-5 sand in the proposed gas storage area. Offset well SRU #21-27 lies slightly more than 1/4 mile northeast of KGSF #2, and it also penetrates the 62-5 sand.
10. Upper confinement of the 62-5 gas sand is provided by 13 feet of impermeable claystone, which is overlain by 10 feet of coal, and then approximately 50 feet of water-bearing sandstone. Lower confinement is provided by about 19 feet of impermeable siltstone and claystone that is underlain by 21 feet of water-bearing sandstone.
11. Calculated porosity for the 62-5 sand ranges from 24 to 30 percent. Average water saturation is estimated to be between 45 and 55 percent. Well SRU #212-27 was drilled from the same pad as SRU #12-27, and its surface location lies 211 feet to the southeast. At the top of the 62-5 sand, the well bores are approximately 260 feet apart. During September of 1997, the 62-5 sand was perforated in SRU #212-27 from 6237 feet to 6254 feet MD, and put on gas production. By February of 2001, the 62-5 interval no longer flowed gas, and it was abandoned.
12. Initial reservoir pressure in SRU #212-27 was 2841 psia at 6078' TVDss (Attachment 6). This is equivalent to 2852 psia at 6245' MD and TVDss in the SRU #212-27 well.
13. Reservoir pressure was depleted to about 800 psi after producing 2 BCF based on the material balance P/Z versus cumulative plot presented in the application.
14. Material balance analysis of historical production and injection indicate an original gas in place of 2.9 BCF in the 62-5 sand. Produced volume corresponds to 69% recovery as of May 2001. Material balance analysis supports the contention that the interval proposed for gas storage covers a limited area and is isolated from other strata.
15. Well records indicate the 62-5 sand in the SRU #12-27 and #212-27 wells is adequately protected by casing and cement. Perforations in the 62-5 sand within the SRU #212-27 well have been properly abandoned.
16. Well records indicate the 62-5 sand in well SRU #21-27 is covered by 7 inch production casing, but is not protected by cement. Unocal interprets the 62-5 sand in SRU #21-27 as being separated by a permeability barrier from the 62-5 sand of the proposed injection area that surrounds SRU #12-27.

17. Surveillance of offset wells and storage well operating parameters will be necessary to ensure gas does not move out of the storage sand.

18. The fluid proposed for injection is predominantly dry methane produced from a liquid extraction plant for produced gas from the Hemlock Formation in the Swanson River Field and from the Trading Bay Unit. Specific gravity of the injected gas is expected to be 0.59 (air = 1.0).

19. Estimated maximum daily injection volume is 10 MMSCF/D, and expected average wellhead injection pressure is 2700 psi. Proposed maximum injection pressures will be maintained less than compressor outlet pressure of 3000 psi[jdh1].

20. Formation fracture gradients measured in shallower and deeper formations ranged from .8 psi to 1.03 psi per foot. The Tyonek Formation did not have any direct fracture gradient determined. Calculated fracture gradient for sandstones with 25 percent porosity and gas saturation range from .6 to 1.0 psi/foot at the depth of the Tyonek 62-5 sand.

21. If the maximum injection pressure is limited to a wellhead pressure of 3000 psi, fractures will not be propagated in the sandstone or confining strata. This limitation is equivalent to a pressure gradient of [SFD2].54 psi[jdh3]/foot to the Tyonek Formation 62-5 sand at 6245 TVDss.

22. The Operator will demonstrate the mechanical integrity of SRU KGSF #2 according to the provisions of 20 AAC 25.252(d) prior to initiating gas injection and storage operations.

## **CONCLUSIONS:**

1. The project as described and proposed meets the requirements of 20 AAC 25.252.
2. Mechanical integrity of SRU KGSF #2 must be demonstrated according to the requirements of 20 AAC 25.252(d) prior to initiating gas injection and storage operations.
3. The proposed injection of natural gas into the SRU KGSF #2 well for the purpose of storage will not cause movement of hydrocarbons into sources of freshwater.
4. The proposed storage of natural gas in SRU KGSF #2 will not cause fluids to move behind casing beyond the approved storage zone.
5. The proposed storage of natural gas in well SRU KGSF #2 will not propagate fractures through the confining zones.
6. The proposed injection of natural gas into the SRU KGSF #2 well for the purpose of storage will not cause waste, jeopardize correlative rights, endanger freshwater, or impair ultimate recovery.
7. Surveillance of operating parameters on the storage well and offset wells will aid in preventing stored gas from moving out of the formation where it is intended to be stored.

**NOW, THEREFORE, IT IS ORDERED** that the following rules, in addition to statewide requirements under 20 AAC 25, apply to the underground storage of hydrocarbons by injection in the SRU KGSF #2 well.

## **RULE 1: STORAGE INJECTION**

The Commission approves the injection for storage of natural gas into the 62-5 sand of the Tyonek Formation within the SRU KGSF #2 well bore. The Operator shall report disposition of production and injection as required by 20 AAC 25.228, 20 AAC 25.230, and 20 AAC 25.235.

## **RULE 2: CONTINUED MECHANICAL INTEGRITY**

This approval is conditioned on the operator's demonstrating the mechanical integrity of SRU KGSF #2 in accordance with 20 AAC 25.252 (d), (e) and (f).

## **RULE 3: MAXIMUM INJECTION PRESSURE**

The maximum wellhead injection pressure shall be limited to 3000 psi or a formation pressure gradient of .54 [SFD4]psi per foot[jdh5].

## **RULE 4: MONITORING PROGRAM**

Operating parameters including injection rate, injection pressure, and annulus pressures (for both the injection well and offsets within 1/2 mile) must be monitored and reported to the Commission on a monthly basis. Significant changes in pressure must be immediately reported to the Commission. An annual report evaluating the performance of the injection operation must be submitted in conjunction with the annual material balance calculations described below.

## **RULE 5: ANNUAL MATERIAL BALANCE**

The operator shall annually provide to the Commission material balance calculations of the gas production and injection volumes to provide assurance of continued reservoir confinement of the gas storage volumes. This information shall be submitted no later than 60 days after the beginning of each calendar year.

## **RULE 6: EXPIRATION OF APPROVAL**

As provided in 20 AAC 25.252(j), if storage operations are not begun within 24 months after the date of this order, the injection approval will expire unless an application for extension is approved by the Commission.

## **RULE 7 ADMINISTRATIVE ACTION**

Upon request or its own volition, the Commission may administratively revise and reissue this order or any of its rules upon proper showing that the change is based on sound engineering and geoscience practices, will not allow stored fluids to escape from the injection zone, and will not cause waste.

**DONE** at Anchorage, Alaska and dated June 5, 2002.

Cammy Oechsli Taylor, Chair  
Alaska Oil and Gas Conservation Commission

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