



6. Disposal injection, if required, will occur into the Ivishak Sandstone of the Sadlerochit Group, which is wet in this area of the North Slope.
7. The Ivishak disposal zone in the Tarn area appears to have at least 60 feet of sandstone with porosity greater than 15%, and can be defined in the Sinclair Colville #1 well at a depth of approximately 8500 feet subsea.
8. Approximately 1800 feet of shale in the Kingak Formation overlie the Ivishak Sandstone.
9. AAI does not intend to dispose of Class II fluids into the Ivishak Sandstone until it conducts adequate modeling of the process to establish appropriate operational constraints.
10. The Tarn oil pool is composed of a sequence of discontinuous, generally low permeability sandstone and interbedded mudstone found in the interval between 4376 feet and 5990 feet measured depth ("MD") in the AAI Bermuda #1 well. Tarn oil pool sands are fine to very fine grained with shale laminations and interbeds. Reservoir sands are locally developed, generally lobate to linear in form, and separated from other reservoir sands by mudstone and shale.
11. The proposed casing program for Tarn wells will be similar to that used in the Kuparuk River Unit. Conductor casing will be set below 75 feet. Either 9-5/8" or 7-5/8" surface casing will be set below the base of the West Sak Formation. Production casing will vary in size from 7" to 3½".
12. The mechanical integrity of injection wells will comply with the requirements specified in 20 AAC 25.412 prior to initiating injection operations.
13. The operator will comply with the requirements of 20 AAC 25.402 (d) & (e) to monitor tubing-casing annulus pressures of injection wells periodically during injection operations to ensure there is no leakage and that casing pressure remains less than 70% of minimum yield strength of the casing.
14. All existing wells drilled within the proposed project area have been constructed in accordance with 20 AAC 25.030. All wells abandoned in the proposed project area have been abandoned in accordance with 20 AAC 25.105.
15. Simulation studies show injection of a relatively large slug (20% pore volume) of MI followed by a lean gas flush is the most efficient recovery plan for the Tarn oil pool, with a potential yield of 30% of the original oil in place.
16. Laboratory core floods using synthetic formation brines of the Tarn reservoir indicate these lithologies are susceptible to formation damage related to fine migration when contacted with water.
17. The viscosity of water is generally too high to serve as an effective injectant in the Tarn reservoir due to the reservoir's low permeability and discontinuous nature.
18. Aquifer support for Tarn oil pool production is anticipated to be minimal.

19. The MI planned for Tarn EOR will be the same as that used in the KRU's Large Scale Enhanced Oil Recovery Project. The MI is manufactured at CPF-1 or CPF-2 by blending KRU lean gas with natural gas liquids from the Prudhoe Bay Unit.
20. Injection rates are expected to range between 30 to 50 MMSCFPD. Maximum MI injection pressures will be 4,400 psi. Wellhead pressures will vary, and are expected to range between 2,700 psi and 3,700 psi.
21. The high leak off coefficient and low viscosity associated with gas injectant precludes any possibility of propagating fractures significant distances into or above the Tarn oil pool.
22. There is no evidence from laboratory core flood experiments or compositional studies to indicate any compatibility problems between EOR fluids and either the Tarn formation or overlying confining strata.
23. The U. S. Environmental Protection Agency ("EPA") exempted all aquifers lying  $\frac{1}{4}$  miles beyond and directly below the Kuparuk River Unit under 40 CFR 147.102 prior to the Commission taking primacy of UIC Class II operations in Alaska. The development area for the Tarn reservoir lies within the Kuparuk River Unit aquifer exemption area approved by EPA.
24. AAI estimates the Tarn oil pool holds about 136 million barrels of original oil in place ("OOIP"). Primary production is expected to recover 10% of OOIP in the Tarn Oil Pool.
25. AAI estimates about 42 million barrels of oil ("MMBO") or about 31% of OOIP will be recovered using proposed EOR methods.
26. Compositional analysis of crude oil from the Tarn Oil Pool indicates 37 degree API gravity with a solution gas-oil ratio of 70 scf/stb based on analysis of recombined separator oil and gas.
27. The average Tarn reservoir air permeability measured from conventional core in the AAI Tarn #2 well is 9 millidarcies.

#### **CONCLUSIONS:**

1. The application requirements of 20 AAC 25.252 and 20 AAC 25.402 have been met.
2. An Area Injection Order is appropriate for the project area under 20 AAC 25.460.
3. The proposed injection operations will be conducted in permeable strata that can reasonably be expected to accept injected fluids at pressures less than the fracture pressure of the confining strata.
4. The proposed injection operations are for the purpose of enhanced recovery operations.
5. There is currently insufficient information upon which to grant approval for Class II disposal operations.

6. Well mechanical integrity is demonstrated by compliance with the requirements of 20 AAC 25.412 prior to initiation of injection operations.
7. The mechanical integrity of each injection well is ensured by a testing schedule of at least every four years after the initial test.
8. Weekly monitoring of tubing-casing annulus pressure and injection rates will disclose possible abnormalities in operational conditions.
9. An Area Injection Order for the project area will not cause waste nor jeopardize correlative rights and will improve ultimate recovery.

**NOW, THEREFORE, IT IS ORDERED THAT** Area Injection Order No. 16 is issued for the Tarn oil pool with the following rules governing Class II injection operations in the following affected area:

UMIAT MERIDIAN

T9N R7E Section 1, 2, 3, 4, 5, 8, 9, 10, 11 and 12.

T10N R7E Sections 13, 14, 15, 16, 21, 22, 23, 24, 25, 26, 27, 28, 29, 32, 33, 34, 35, and 36.

T10N R8E Sections 18, 19, 30 and 31.

Rule 1 Authorized Injection Strata for Enhanced Recovery

Within the affected area, fluids may be injected for purposes of pressure maintenance and enhanced recovery into strata defined as those which correlate with and are common to those found between the measured depths of 4376 feet and 5990 feet in the AAI Bermuda #1 well.

Rule 2 Authorized Injection Strata for Disposal

Class II disposal may not be conducted within the affected area until AAI conducts adequate process modeling to establish appropriate operational constraints and the commission has received sufficient information to authorize disposal.

Rule 3 Fluid Injection Wells

The underground injection of fluids must be through a well permitted for drilling as a service well for injection in conformance with 20 AAC 25.005 or through a well approved for conversion to a service well for injection in conformance with 20 AAC 25.280.

Rule 4 Monitoring the Tubing-Casing Annulus Pressure Variations

The tubing-casing annulus pressure and injection rate of each injection well must be checked at least weekly to ensure there is no leakage and that it does not exceed a pressure that will subject the casing to a hoop stress greater than 70% of the casing's minimum yield strength.

Rule 5 Reporting the Tubing-Casing Annulus Pressure Variations

Tubing-casing annulus pressure variations between consecutive observations need not be reported to the Commission unless accompanied by a greater than 10% increase in injection rate, indicating possible tubing and casing leaks.

#### Rule 6 Demonstration of Tubing-Casing Annulus Mechanical Integrity

A schedule must be developed and coordinated with the Commission that ensures that the tubing-casing annulus for each injection well is pressure tested prior to initiating injection, following well workovers affecting mechanical integrity and at least once every four years thereafter. A test surface pressure of 1500 psi or 0.25 psi/ft. multiplied by the vertical depth of the packer, whichever is greater, but not to exceed a hoop stress greater than 70% of the minimum yield strength of the casing to be used. The test pressure must show a decline of less than 10% in a thirty-minute period following thermal stabilization. The Commission must be notified at least twenty-four (24) hours in advance to enable a representative to witness pressure tests.

#### Rule 7 Well Integrity Failure

Whenever operating pressure observations or pressure tests indicate pressure communication or leakage of any casing, tubing or packer, the operator must notify the Commission on the first working day following the observation, obtain Commission approval of a plan for corrective action, and obtain Commission approval to continue injection

#### Rule 8 Plugging and Abandonment of Injection Wells

An injection well located within the affected area must not be plugged or abandoned unless approved by the Commission in accordance with 20 AAC 25.105.

#### Rule 9 Tarn Oil Pool Annual Reservoir Report

An annual Tarn Oil Pool surveillance report will be required by April 1 of each year subsequent to commencement of enhanced oil recovery operations. The report shall include but is not limited to the following:

- a. Progress of the enhanced recovery project and reservoir management summary including engineering and geological parameters.
- b. Voidage balance by month of produced fluids and injected fluids.
- c. Analysis of reservoir pressure surveys within the pool.
- d. Results and where appropriate, analysis of produced logging surveys, tracer surveys and observation well surveys.
- e. Results of any special monitoring.
- f. Evaluation of well testing and allocation.
- g. Future development plans.
- h. Review of Annual Plan of Operations and Development.

#### Rule 10 Administrative Action

Upon request, the Commission may administratively amend any rule stated above as long as the operator demonstrates to the Commission's satisfaction that sound engineering practices are maintained and the amendment will not result in an increased risk of fluid movement into an USDW.

**DONE** at Anchorage, Alaska and dated July 20, 1998

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David W. Johnston, Chairman  
Alaska Oil and Gas Conservation Commission

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Camillé Oechsli, Commissioner  
Alaska Oil and Gas Conservation Commission

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).