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United States Department of the Interior

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U-024316
(UT-066)

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DIV. OF OIL, GAS & MINING

FEB 10 1997

Pamela Grubaugh-Littig
Permit Supervisor
State of Utah
Division of Oil, Gas and Mining
1594 West North Temple Street, Suite 1210
Salt Lake City, Utah 84114-5801

Re: Mine Plan Amendment, Federal Lease U-024316 Tank Seam Addition, Co-op Mining Company, Bear Creek Canyon Mine, ACT/015/025

ACT/015/025 #2

Dear Ms. Grubaugh-Littig:

We have received the subject mine plan amendment and have reviewed the resource recovery and protection (R2P2) portion of the plan for compliance with the mineral leasing laws and regulations. In addition, we have evaluated the pillar stability contained in the mining plan as to possible subsidence concerns as expressed by the Manti-LaSal National Forest. Our comments follow:

In 1989, Co-op applied to add Federal coal leases U-024316 and U-024318 to the Bear Creek Canyon Mine Permit. We sent our recommendation for approval of the R2P2 in July of 1990. The approval was for mining of two seams of coal (the upper Blind Canyon and the lower Hiawatha seams) north from the existing mine on fee coal. Permit issuance was delayed because of various issues. As Co-op mined north in the Blind Canyon Seam and approached lease U-024316, coal thicknesses decreased rapidly down to less than minable height. Exploration holes drilled later determined no Blind Canyon Seam coal of minable thickness in the lease. However, this and other exploration holes showed minable coal in a third seam above the Blind Canyon Seam, named the Tank Seam. Co-op has been mining in the Tank Seam in the fee property to the south and now wants to extend mining into U-024316.

We have reviewed the amended mine plan for compliance with the mineral leasing regulations and the lease terms and conditions. The plan for the Tank Seam shows a logical approach to mine the reserves by room-and-pillar methods with continuous miners. Much of the northern portion of the lease has low coal and no mining is anticipated in the Tank Seam in the northern end of the lease. Most of the minable coal in the lease is in the southwest portion of the lease and Co-op has an adequate plan to mine the recoverable reserves. Another purpose of mining on the lease in the Tank Seam is to provide access to reserves on the other side of the Bear Canyon Fault. Co-op plans to mine a set of main entries north along the outcrop of the west side of Bear Creek Canyon. These mains are situated in a small fault graben that is sympathetic to the large Bear Canyon Fault which forms the canyon. The mains will be used as an access route for the coal on the east side of the Bear Canyon Fault as Co-op has plans to cross the Bear Canyon Fault in the Tank Seam and ramp down to the Hiawatha Seam on the other side of the

fault. These main entries are critical to the access of additional coal to the north and east. They also run under the escarpment of the west side of Bear Creek Canyon. As per the lease stipulations, the BLM has analyzed these main entries for stability to protect the escarpment from subsidence-induced failure. The following is our stability analysis:

Co-op plans to mine five main entries north/north-east into Federal coal lease U-024316 in the Tank Seam. These entries would be mined between the outcrop to the east and a sympathetic fault to the west which separates this main entry access corridor from the main mining panels to the west. These entries would be under the west escarpment of Bear Creek Canyon. The design of the entries and pillars are for long-term use with dimensions of 60- x 60-foot pillars and we find they will be stable as verified.

We have used an excepted methodology to substantiate that these pillars will remain stable and that no subsidence should take place under the escarpment which would satisfy the special lease stipulation. From Rock Mechanics and the Design of Structures in Rock, by Obert and Duvall, a design equation for the average pillar stress is:

$$Sp = \frac{Sv}{1-Ra}$$

Sp = average pillar stress (lbs./sq. in.)
Sv = average vertical stress (lbs./sq. in.)
Ra = recovery rate (%)

An estimation of the vertical stress has been shown to approximate the gravitational force on the amount of rock above the opening. Hence:

$$Sv = T\,h \div 144 \text{ sq. in./sq. ft.}$$

T = density of the overburden (lbs./cu. ft.)
h = height of overburden (ft.)

This assumption is accepted by industry and rock mechanic experts, though exact vertical stresses are complex due to changes in geologic structures. For simplicity, the density of the overburden is 160 lbs./cu. ft., which is a reasonable average of the various rock (sandstones and shales) strata above. Hence, the vertical stress is nearly a direct relationship to the amount of overburden. The overburden in the area of question ranges from 400 feet in the south to 1000 feet in the north. Using a 44 percent recovery rate for the proposed entry and pillar design (60- x 60-foot pillars on 80-foot crosscut and entry centers), the stress on the pillars (Sp) will range from about 800 to 2000 psi.

The strength of the pillar to resist the vertical stresses can be estimated by compressive tests on the core samples of the coal. The Tank Seam has been tested at about 3,500 psi. If the vertical stress on the pillar is greater than the strength of the pillar, failure will occur. Hence:

$$F = \frac{Cp}{Sp}$$

F = factor of safety
Cp = strength of the pillar
Sp = vertical pillar stress

Factors of safety greater than 1 will reflect stability. We calculate a safety factor for the proposed main entry pillars under the Bear Creek Canyon escarpment to range from 1.8 to 4.4. This substantiates the assertions of Co-op that the pillars will remain intact and no subsidence under the escarpment will occur. This is in harmony with known observations and experiences in this coal region. This pillar plan is a standard design used in many main entries and has stood over time. We know of no instances where main entries with these dimensions have failed.

In summary, Co-op's mining plan will not affect the escarpment along the west side of Bear Creek Canyon and the pillars will remain stable. The mining plan to add Federal coal lease U-024316 to the existing Bear Creek Canyon Mine Permit meets the requirements of the Mineral Leasing Act of 1920, as amended, the regulations at 43 CFR 3480, the lease terms and conditions, and will achieve maximum economic recovery of the Federal coal. We recommend the R2P2 be approved and the permit issued.

If you have any questions or need further information, please contact Stephen Falk of my staff at 636-3600.

Sincerely,

Richard L. Manus
Field Manager

cc: UT-921, Utah State Office
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