I 70-3(2)251 Unit 2
Idaho Springs Tunnels

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TUNNEL LINING AND BOLTING

The following recommendations, for lining and bolting of our proposed tunnels east of Idaho Springs, are an opinion of the writer based on discussions and suggestions involving BPR, Bureau of Mines, Department Geologist and others. Your comments will be appreciated in order that we might proceed with revision of plans.

There is approximately 303 feet of cover above the profile grade of the south tunnel near Sta. 176+ and approximately 309 feet of cover over the profile grade of the north tunnel at Sta. 176+.

1. LINING (ESTIMATED QUANTITIES FOR PLANS)

   a. North Tunnel - Recommend 200 feet of lining at West end (to extend beyond fault) and recommend 40 feet of lining at East end.

   b. South Tunnel - Recommend 150 feet of lining at West end (to extend beyond fault). Portal of South tunnel is approximately 61 feet East of portal for North tunnel. Also recommend 40 feet of lining at East end of South tunnel.

   c. Recommend approximately 50 feet of additional lining in estimate and plans for possible bad areas that may be encountered. A quantity Tunnel Enlargement Excavation is also to be included in plans for bids.

2. ROCK BOLTING AREAS

   a. Sta. 173+ to 173+50 - Shattered Material. Rock bolts in pillar side only. Bureau of Mines will investigate and make recommendations for rock bolting on floor of tunnel at West end to protect against apparent possibility of heave due to bad foliation.

   b. Sta. 173+50 to 174+00 - Estimate scattered rock bolting for temporary support before lining is placed. No mesh required in lined sections. Rock bolts in pillar side.

   c. Sta. 174+00 to 175+ - Fault area. Rock bolts in pillar side. Bolting of Roof not recommended - section to be lined.

   d. Sta. 175+ to 179+80 - Entire tunnel section to be rock bolted (except floor). Chain link fence also to be placed over entire bolted section and secured under rock bolt nuts and washers.

2. ROCK BOLTING AREAS (Cont'd)

e. Sta. 179+80 to 180+20+ - Lined section. No rock bolting except for pillar side.

f. Estimate some rock bolting on hillsides at both portals. Bureau of mines states that loose areas can be well protected by bolting.

3. ROCK BOLT DETAILS

a. Specify 1" diameter slotted wedge type 6 feet long. End to be threaded 8 inches (Std. bolt is threaded 4"). Minimum 60,000 lbs. tensile strength per square inch. Anchor type bolts are not recommended since they require constant tension to keep in place. They are hard to install and if nut becomes loose, they are ineffective especially in hard rock.

b. Require minimum 200 foot pounds of torque on Bolts. Maximum allowable torque to be 300 foot pounds.

c. Use 6"x 6" square washer - 3/8" thick. Extra washers and nuts required for every other bolt in full bolted tunnel section. This will permit placement of V mesh fencing.

d. Require 9 gage chain-link fencing under bolts in fully bolted section. Fencing at bottom can be placed horizontally with balance to be placed circumferentially. Probably a 54 inch wide mesh would be most suitable.

e. Bolting in tunnel to be on 4 foot centers with first row approximately $2\frac{1}{2}$ feet above floor. Bolting need not be staggered. This requires 17 bolts per ring.

f. Bolting to progress to face of work after each section of tunnel is blasted.

g. Where bolting of pillar only is required use 3 rows high on North Tunnel and 4 rows high on South Tunnel.

h. Chain link fence inside tunnel may be bolted to every other bolt with extra washer and nut. Balance of bolts can then be installed and the single washer and nut will suffice with fencing underneath.

i. Bolting on hillsides at portals, where required, to be at 7 foot horizontal spacing and 10 foot vertical spacing. Provide 8 foot wide 9 gage chain link fence.

j. Bolt holes in tunnel to be as near as possible vertical to the face. Bolt holes on hillsides should be a few degrees down to prevent coming out if loosened. This will also keep bolt in shear support in case it should become loose.

k. Wedge of bolt to be lubricated with grease if necessary. May be required in the softer rock areas.

4. BOLT RETENTION TESTS

a. Tests conducted by the Bureau of Mines gave resistance results from 3,000 lbs. to 18,000 lbs. The 3,000 lb. areas are not too suitable, but they state bolting is very feasible and highly recommended.

5. REVISION OF PLANS:

We will proceed to revise plans in accordance with the above outline unless you are not in agreement. Your comments and recommendations will be appreciated. The Bureau of Mines will submit their report sometime after January 15, 1960.

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