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Docket No. 40-8084

MEMORANDUM FOR: Jeffrey L. Kotsch
Uranium Recovery Licensing Branch

FROM: Ted L. Johnson
Uranium Recovery Licensing Branch

SUBJECT: RIO ALGOM CORPORATION - REVIEW OF DIVERSION DITCH DESIGN FOR PMF

I have reviewed the subject report, "Report of Additional Geotechnical and Hydrologic Evaluation, Containment of PMF Series Within Tailings Disposal System, Lisbon Operations", dated March 4, 1981, and specifically reviewed the diversion ditch to determine if the Probable Maximum Flood (PMF) series can be safely accomodated. Based on this review, I conclude that the diversion ditch would fail during an occurrence at the PMF. The ditch has adequate capacity, but the slope of the ditch is very steep, causing high flow velocities to occur. These high velocities will cause erosion of the ditch, flood waters will enter the tailings ponds, and the lower embankments will be overtopped.

Attached are additional questions and comments to be submitted to the licensee. These questions and comments represent the additional information and analyses which will be needed in order to fully complete the hydrologic review.

Original signed by

Ted L. Johnson
Uranium Recovery Licensing Branch
Division of Waste Management

Attachement:
As stated

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Rio Algom Hydrologic Engineering Questions
Diversion Channel Design
Docket No. 40-8084

1. Your recently-constructed diversion channel is not acceptable to prevent flood water from entering the tailings impoundment. As designed, the channel is subject to high-velocity flood flows, which could produce enough erosion to allow surface water to enter the ponds. These high velocities are caused principally by the overall steepness of the channel, and floods much smaller than the PMF can produce erosion and damaging velocities.

   If credit is taken for the channel in diverting flood flows, we require that erosion protection be provided for the right side (looking downstream) of the diversion channel, to assure the stability of the right bank. The side slopes should not be steeper than 1 Vertical on 2 Horizontal. The erosion protection will generally be required at those locations where the channel is cut in overburden soils, and particularly where an embankment has been constructed to confine flood flows. This erosion protection should be designed in accordance with Corps of Engineers EM 1110-2-1601, "Hydraulic Design of Flood Control Channels", and the gradation should be in accordance with ETL 1110-2-120, "Additional Guidance for Riprap Channel Protection". The alpha method (as discussed in EM 1110-2-1601) should be used to compute the design velocity, rather than use the average channel velocity. To account for turbulence, standing waves, and eddies, the factor of safety (also called non-uniform flow factor) should be at least 1.5 in those areas where the channels have transitions in width and changes in bottom slope. The riprap on the outside of channel bends should also be properly designed to account for increased shear forces at those locations.

   The water surface profiles (which determine the depth and velocity of flow at various points along the channel) should be computed by standard gradually varied steady flow analyses rather than by slope-area methods. This is important especially where the width and bottom slope of the channel change. In addition, hydraulic jumps should be located (if applicable) and the "stilling basin" areas properly designed.

2. Provide the rating curve, and the basis for its computation, for the earth channel spillway from Bisco Lake to the diversion channel. It appears that the maximum outflow with three feet of head on the crest should be greater than 68 cfs. Discuss the effects of submergence on the rating curve. If the flow in the diversion channel is deeper than in the spillway channel, water could back up the spillway channel, drowning the control at the spillway crest, thereby lessening its capacity.

3. Provide the flood routing computations for Bisco Lake.

4. Provide an analysis showing the peak PMF flows that occur at various points along the diversion channel as a function of drainage area, inflow tributaries, etc. It is evident that the flaw will not be the same along the entire length of the channel, and any increases or reductions in flow along the channel may be important in designing erosion protection and other hydraulic structures. Was the spillway flow from Bisco Lake added to the diversion channel flow?

5. Provide the flood routing computations for the upper tailings pond. Provide the rating curve for the CMP overflows and the basis for its computation.

6. At those locations where a road crosses the diversion channel, provide details of the bridge or culvert that will be used. In addition, a hydraulic analysis should be provided which determines the effects of the road crossing on the water surface profile. Backwater effects, in particular, are important because of potential overflow of the channel banks into the reservoirs.

7. In general, the use of the formula $Tc = \left[\frac{11.9L^3}{H}\right]^{.385}$ is acceptable for computing the time of concentration of peak flow during a precipitation event. However, the formula is normally used in general applications where tributary stream slopes are relatively flat. In the site area, this formula may not be conservative and the time of concentration may be considerably less than 43 minutes. This is due to the existence of several well-defined steep stream channels which exist in the upper portion of the drainage basin and flow generally northward toward the diversion channel. For cases such as this, the staff suggests that the time of concentration be computed using the "stream hydraulics" method found in the same reference that was used. Using this method, the actual velocity of flow in the watercourse should be computed. It is evident that the stream channels in the vicinity of N 607,000 E2,642,200 have an approximate slope of 3-5%; velocities in these streams will likely exceed 15-20 ft/sec during the PMF. Revise your calculations accordingly.

8. Provide the basis for the design of the erosion protection at the entrance and outfall locations of the CMP spillway pipes. Provide the thickness and the gradation of the rock to be used.

9. Provide your proposed site reclamation plan. If a diversion ditch is chosen to divert floods away from the abandoned tailings pile, the ditch must meet the same hydrologic criteria as the ditch used

during operation. It may be practical to design the same channel for both operation and reclamation. Any other diversion ditches must also meet the PMF criteria.