SYSTEMATIC RISK BASED DEACTIVATION AND STABILIZATION:  
THE KEMESS MINE POWERLINE DEACTIVATION PROGRAM

Scott Davidson, M.Sc., P.Geo.

Kemess Mines Ltd.
Box3519Smithers, BC
VOJ2NO

ABSTRACT
Kemess Mine is an open-pit gold-copper mine located in northern British Columbia. A 380 km long, 230 kV powerline built for the project provides electricity to the minesite. Deactivation of the access roads and the tote roads along the powerline corridor were initiated in 1998 and were completed in 2001. This paper outlines the systematic risk-based approach to the deactivation program and some of the considerations that were incorporated into the deactivation program.

INTRODUCTION
Kemess Mine is an open-pit gold-copper mine located 10 kilometres east of Thutade Lake, in the northern Omineca Mountains of north central British Columbia. The minesite and study area are approximately 300 km northwest of Mackenzie, B.C. Power to the site is supplied by a 230 kV transmission line that originates at Windy Point and traverses approximately 380 km to the site. The powerline generally follows the alignment of mainline logging roads to the minesite. Figure 1 shows the mine location and the powerline route.

Kemess Mines Ltd. holds a License of Occupation for the powerline corridor as issued by the BC Ministry of Environment, Lands and Parks (now the Ministry of Water, Land and Air Protection).
In addition, the company holds three (3) Special Use Permits (SUP's) for access roads issued by the BC Ministry of Forests (MOF). A total of 126 km of roads are contained within the SUP's and 377 km of tote road within the License of Occupation.

In 1998, Kemess Mine initiated road deactivation and slope stabilization efforts along the powerline corridor as required in the Special Use Permits issued by the Ministry of Forests (MOF) to cover the access road to the corridor. The road deactivation and slope stabilization efforts were completed during the 2001 field season. The deactivation and stabilization efforts in 1998 and 1999 focused on high priority sites that were identified as areas representing the greatest potential risk. During these years some other deactivation on access and tote roads along the corridor was completed. During the 2000 field season, efforts focused on the deactivation and stabilization of the northern portions of the powerline in conjunction with the preparation of site specific prescriptions. In 2001, the remainder of the SUP roads requiring deactivation were addressed along with inspections of work conducted previously. Professional prescriptions required along the corridor were prepared in-house by Kemess staff during the 2000 and 2001 deactivation programs. Tyhee Forestry Consulting Ltd. (Tyhee) of Smithers, BC prepared the majority of the remaining deactivation prescriptions and oversaw the field programs.

GOVERNMENT JURISDICTION

The powerline corridor access roads are under Ministry of Forests Special Use Permits while the tote road for the powerline was under the jurisdiction of the Ministry of Energy and Mines. Both the access and tote road deactivation plans were reviewed by the Ministry of Environment, Lands and Parks (currently known as WLAP) prior to implementation. Deactivation requirements for the powerline access and tote roads were required to conform to the requirements under the Forest Practices Code of British Columbia.

POWERLINE SECTION PERMITTING AND GENERAL INFORMATION

Sections 1 through 5 of the Kemess Transmission Line originates at the Kennedy Siding Substation (PI 1000), located near the Parsnip River on the south-west end of Williston Lake, and runs north-west to the Blackwater Creek crossing (PI 1020), near km 75 of the Finlay Forest Service Road. There are 57 access roads covered under Special Use Permit #22376 which total approximately 39 km in length, in addition to 94 km of powerline corridor.
Sections 6 through 13 of the Kemess Transmission Line run from the Blackwater Creek crossing (PI 1020), near km 75 of the Finlay Forest Service Road, to the Lower Lay Creek crossing (PI 1063), near km 55 of the Tenakaihi Forest Service Road. There are 135 access roads covered under Special Use Permit #22414 which total approximately 88 km in length, in addition to approximately 182 km of powerline corridor.

Sections 14 through 18 of the Kemess Transmission Line run from the Lower Lay Creek crossing (PI 1063), near km 55 of the Tenakaihi Forest Service Road, to the Kemess Mine site. There are 32 access roads covered under Special Use Permit #22412 which total approximately 20 km in length, in addition to approximately 101 km of powerline corridor.

ACCESS LEVEL CONSIDERATIONS

During the initial planning of the powerline, an Access Management Plan was prepared to show existing road access in addition to tenure information. This information was updated during 2000 and 2001 based on consultation with Abitibi Consolidated, Slocan Forest Products and the MOF to allow for planning and preparation of deactivation prescriptions. Where multiple permit holders for a road were identified, the other permit holder(s) were consulted as to their access requirements prior to implementation of works.

The Access Management Plan was refined during 2001 to include information on which towers were accessed by each access road to allow for emergency access plans to be developed. Larger stream crossings which could potentially limited access, had skid bridge spans stored adjacent to the site for emergency access. Where skid bridge spans were not already available, the length of bridge required to permit emergency access was determined.

TIMING OF DEACTIVATION WORKS

The timing of field works was dependent on receiving approval from government review agencies. The field deactivation programs were generally limited from July to the end of September due to the length of the powerline corridor, variable ground conditions, and the relatively short snow-free period. The northern sections which are generally higher elevation have later melt than the sections closer to Mackenzie which resulted in the progression of deactivation works from south to north.
Tyhee, during 2000, conducted detailed road assessments to determine the work priority of untreated roads and assess the need for further works on previously treated areas based on the need to streamline the overall approval process to begin works. By preparing the majority of the prescriptions for the remaining access and tote road sections during 2000 it was possible to initiate works along the corridor in a more timely manner during the remainder of the program.

During 2000, to assist in the planning and implementation of in stream works along the majority of the powerline corridor, MELP provided a document outlining measures for instream deactivation efforts such as woody debris removal, culvert removal, and skid bridge removal. The document also outlined revised fisheries windows for in stream works in areas with Spring and Fall spawners based on empirical evidence.

INSPECTIONS

During each year of the deactivation program, field inspections were conducted by members of MEM and MOF to assess the results of ongoing deactivation and assess the results of previous year's works. Where areas of concern were identified by government inspectors, these were directed to Tyhee and Kemess staff to implement quick response.

An aerial inspection of the powerline corridor is typically conducted during early to mid-July each year to determine whether any areas require immediate response. This inspection is typically conducted with personnel from MEM, MOF, and Kemess Mine staff. Kemess Mine also conducts annual ground based road inspections to determine whether there are any further works required on the access or tote roads. These inspections are typically carried out during the month of July when the corridor is free of snow and vegetation has had a chance to start growing. This is part of the long term maintenance program for the powerline access roads to minimize environmental impacts.

RISK BASED ASSESSMENT AND PRIORITIZATION

To prioritize the road sections for deactivation it was first necessary to assess the risk of each road section. Risk was determined using the simplified risk formula shown below.

\[
RISK = HAZARD \times CONSEQUENCE
\]
Five areas of concern were identified as potentially high risk and during the first two years of the deactivation program, efforts were primarily focused on these areas where slope instability or erosion control problems existed. Following the treatment of the potentially high risk areas, the remaining access and tote road sections were systematically deactivated from south to north to allow for the later spring breakup in the north.

DEACTIVATION OF LOW TO MODERATE RISK ROADS

The majority of the access roads and tote road sections along the powerline corridor were rated as having potentially low to moderate risk due in most cases to gentle terrain and a lack of stream crossings. These areas were addressed using standard deactivation techniques dependent on the level of deactivation being conducted (permanent versus semi-permanent). Deactivation measures included culvert removal, cross-ditching, water barring, minor pullback, breaching of windrows and berms, and grass seeding.

HIGH RISK SITES

Five areas of potential high risk were identified during the initial phases of the powerline deactivation with three areas requiring professional prescriptions. Other areas deemed to be high risk or to require more detailed works during 2000 and 2001 were addressed through site specific prescriptions on an "as required" basis. Discussion of these five main high risk sites is contained below.

i. Frog Pond Road

A steep section of hillslope was impacted by loss of water control near the top of the hillslope. Loss of drainage control had resulted in erosion along the base of a tower and tote road, and had directed water down the hillslope assisting in the destabilization of the slope adjacent to the mainline.

During 1999 works completed at this site included re-direction of the water at the top of the slope that had resulted in the erosion, some minor pullback, and excavation of material from the mainline ditch. The 2000 field season works were conducted to address remaining drainage issues along the tote road that accessed the top of the hill in this section of the powerline. The works completed included removal of the tower at the top of the hill, re-contouring of the entire tote road that traversed the hillside and drainage control to direct surface flows into natural drainage paths. Seeding of exposed soils was also completed during the 2000 field season.
During 2001, the program focused on the stabilization of unstable road cutslopes to maintain 4wd access. Works completed included excavation of sloughed material from the road and ditchlines, buttressing of the cutslope using blast rock, widening of the road to move the road centerline approximately 1 m further from the slope, and installation of buried French dram/drainage culverts to assist in drainage of the problem section of road. Figure 2a and Figure 2b show the after conditions at this site.

![Figure 2a. Reclaimed tote road](image)

![Figure 2b. Stable Frog Pond Mainline](image)

ii. Manson River

The Manson River site was identified as having drainage structures with insufficient freeboard. As a result there was potential for washouts or for jamming of the channel with debris resulting in greater potential environmental impact. One bridge on a side channel of the Manson River was noted to be of primary concern with less than 0.6 m of freeboard.

During 1999, works completed at this site included the removal of the bridge over the Manson River side channel in addition to the removal of six other bridge structures in the nearby area. All disturbed areas were seeded using grass seed mixed with Sitka Alder.

iii. Nation River Site

The Nation River site is a section of the powerline that traverses steep gullied terrain. Silly sand soils with clay were encountered in cuts along access and tote road sections. Sloughing of materials and filling of ditchline resulted in a loss of water control and the potential for slope instability.

During 1999 works completed on this section of the powerline included pullback of sidecast materials, installation of waterbars and cross ditches, beaching of berms and windrows, and grass seeding.
iv. **Omineca Camp Slide**

The Omenica Camp Slide occurred October 1998 at approximately Km 32 on the Ostlinka Mainline. An avulsion of a stream upslope of the powerline corridor resulted in the steam flowing down through an old channel to the powerline tote road and below. The flows did not return to the main channel until just upslope of the Mainline where the water was unable to re-enter the channel as a result of berms in the ditchline. This resulted in the water flowing down the Mainline for approximately 600m before flowing across the road. Where it flowed down a private driveway resulting in significant erosion of fine-grained glaciofluvial materials.

Works conducted during 1999 on the site included the diversion of flows back to the natural drainage in addition to re-establishment of the tote road and drainage. During 2001, Kemess Mine implemented a final prescription at this site which included removal of deposited channel material at the site of the avulsion and the construction of flow intercept ditching and deflection berms through excavation of materials from the floodplain. Figure 3a and Figure 3b show the interception ditching and deflection berms constructed during 2001.

> Figure 3a. Interception trench and berm protecting powerline tower
> Figure 3b. Deflection berm by main channel at site of the 1998 avulsion

v. **Wayne's Hill**

The Wayne's Hill site is a bridge crossing site located in Section 14-1. This site had oversteepened cut slopes on either approach to the bridge. The hillslopes immediately adjacent to the stream had excessive amounts of woody debris which was a concern for slope instability.
During the 1999 field season the bridge was removed and the approaches were pulled back and seeded. To alleviate the woody debris problem and potential for materials reaching the stream, hand crews bucked woody debris into manageable lengths and then skidded the logs from the hillside to a nearby stable disposal area. Photographs showing the before and after conditions at this site are shown in Figure 4a and Figure 4b.

![Figure 4a. Wayne's Hill Pre Treatment](image1)

![Figure 4b. Wayne's Hill Post Treatment](image2)

**SUMMARY OF DEACTIVATION EFFORTS**

During the four years of active deactivation a total of 377 km of tote road and 123 km of access road were treated at a total cost of approximately Si.3 million dollars. The removal of drainage structures was a major undertaking during the deactivation program. A total of 671 culverts and 165 bridge crossings (comprised of 295 individual spans) were removed. The culverts were transported to 10 MEM approved storage areas while the majority of skid bridges were placed close to their original site for emergency access or sold to forestry companies. Summary of the deactivation program are given in Table 1 below.

Revegetation efforts since 1999 has involved the application of over 6,800 kg of grass seed. Areas of special concern were also treated with Sitka alder seed and willow shoots to enhance revegetation on an "as needed" basis. Grass seeding continues as part of the annual inspections conducted on the line where it is deemed necessary.
### Summary of Tote Road Deactivation by Section

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<tr>
<th>Deactivation Level</th>
<th>Sections 1-5</th>
<th>Sections 6-13</th>
<th>Sections 14-18</th>
<th>Total (km)</th>
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<tr>
<td>Permanent</td>
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### Summary of Access Road Deactivation by Section

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<th>Sections 14-18</th>
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<tr>
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<td>Total (km)</td>
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### Summary of Culvert and Bridge Structures Removed by Section

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### Summary of Deactivation Program Costs by Year

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<td>2000</td>
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### CONCLUSION

Kemess Mine used a systematic risk based approach to complete deactivation efforts on access and tote road sections along the 380 km powerline providing power to the site. The initial two years of the deactivation program focused on five potentially high risk sites with some additional deactivation efforts being conducted during these years. The final two years of the deactivation program focused on the deactivation of remaining access and tote road sections according to an overall Access Management Plan for the corridor. The program took four years and $1.3 million dollars to complete.