VARIS
SMART UNDERGROUND COMMUNICATIONS

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Dear Governor:

Our sincerest condolences to the families of the miners who lost their lives at the Alma #1 and Sago mine disasters.

In response to calls by US legislators for improved safety through improved communication for underground miners Varis would like to review the current options available for implementation.

Underground communication can be achieved through any or all of the following:

- Mobile two-way radio over Leaky Feeder antenna system
- Mobile one-way text messaging over ULF (Ultra Low Frequency) through-the-earth transmission
- Stationary telephone or pager (mine phone) systems
- Stationary networks delivering voice, video and data
- Mobile two-way wireless VOIP (Voice over Internet Protocol) provided by WLAN Access Points tied to stationary fiber/twisted-pair network

The criteria we use to compare these options include:

- Worker Mobility — Can the worker move freely around the underground workings while remaining in contact?
- Effectiveness — Does the communication network enable discussion and confirmation of each party's status, needs and intentions?
- Network Survivability — Will a fire, explosion or roof collapse render the communications inoperable?
- Cost — What is the cost to implement, maintain and expand the network?

Option	Worker Mobility	Effectiveness	Network Survivability	Cost
Leaky Feeder	High	High	Low	Low
ULF	High	Medium	Medium-High	Low
Telephone	Low	High	Low	Low
Fiber network	Low	Medium	Very High	High
VOIP	Medium	High	High	High

In Varis' opinion the most important consideration is the effectiveness of the communication system. Two-way radio is the network of choice for dispatching, coordination and emergency response. Multiple voice channels blend private and broadcast communication. Two-way is the key as it allows confirmation that instructions were received, understood and agreed-to. Compare that to the one-way nature of ULF text messaging. The sender of the message does not know if the recipient was in range, had an operational receiver or was able to understand or act upon the message. Wireless VOIP is still in its infancy and the biggest impediment to its widespread use is the cost and difficulty to provide contiguous coverage throughout the underground workings while maintaining Intrinsic Safety protection. There are also no MSHA approved WVOIP handsets.

The only option that will withstand any disaster is a redundant fiber optic network. Providing access to this network every 1000' however requires a significant number of devices and energy to power them which runs counter to Intrinsic Safety requirements for underground coal mines.

Telephone, Pager Phone and Leaky Feeder networks cannot be made redundant and thus will fail at the point where the cable is melted or crushed. ULF systems can be damaged by lightning, fire or roof collapse; however since the ULF signaling cable is one level only it is more likely to survive than a Telephone, Pager Phone or Leaky Feeder network.

With no perfect single solution mines must make important decisions. Ideally multiple systems can be implemented to provide redundancy and to take advantage of their specific benefits. We advocate that a Leaky Feeder system be the first choice as its mobile voice communication provides improved safety during day-to-day operation as well as during emergencies. A ULF text messaging system provides an improvement to the survivability component and would be used only during emergencies. A redundant fiber optic network should be implemented to control and monitor stationary equipment so that conditions for rescue operations can be determined.

Sincerely for
Varis Mine Technology Ltd.

Matt Ward, P.Eng.
Managing Director

About Varis
Dedicated to mining communications since 1996, Varis has created effective solutions for underground wireless communication, personnel and vehicle tracking and equipment monitoring and control. Product and contact information available at www.varismine.com.