Obviously, the signal position on the time axis is subject to jumps if a signal originates from a so-called "intelligent transmitter." When an intelligent transmitter shifts the position of its transmit pulses in time in order to avoid overlap, the signal edges from such transmitter will no longer fit any existing chain at the receiver, and thus they will be considered emanating from a new transmitter. So focusing on a specific transmitter in a multiple-burial situation becomes next to impossible. To this author, it looks like "intelligent transmitters" are not an intelligent thing at all, since they affect the signal that is best suited for handling multiple-burial situations.

MARKING

With the above scheme, the marking of a transmitter can never lead to double markings as stated in [2], since a single transmitter will be marked only, based on some chain-specific icon on the display.

COMPATIBILITY

[2] also concludes that beacons that provide signal timing analysis and marking features are not downwardly compatible with the existing base of avalanche transceivers. As we have shown in this paper, this is not necessarily the case. If proper algorithms are used for signal analysis, the problems arising from some properties of the older beacons can be taken care of quite well. We have run many field tests and not noticed a particular loss in performance when searching for older beacons.

Transceivers with large deviations from the 457 kHz standard transmitter frequency do not affect compatibility in terms of multiple-burial resolution algorithms. However, as has been shown in [6], they do pose a problem since they require that receiver bandwidths be relatively large in order to accommodate their frequency offset. This in turn has a negative influence on the achievable range when searching for such beacons.

BEACON STANDARD MODIFICATION

We agree with [2] regarding the following items to be considered for the next overhaul of the EN 300 718 [5]:

Beacon pulse periods should be randomized to some extent. This would greatly reduce the probability of long duration overlap situations. It does not affect backward compatibility.

Beacon pulse width should be limited to e.g. 200 ms, since longer pulses increase the probability of overlap. Backward compatibility would not be affected.

The tolerance for the transmitter frequency should be tightened, e.g. to ± 50Hz. This requirement can be met with today's components without an undue increase in cost, and it would permit the construction of better receivers (see [6]). However, since narrowband receivers would then receive signals from transmitters with a larger frequency offset, backward compatibility with old beacons exhibiting a large frequency offset would be affected. A possible approach to this problem may be the introduction of a transition period of several years, similar to the one declared when concentrating on the 457 kHz beacons and abolishing the 2.275 kHz variety.

CONCLUSIONS

Some of the modifications to the standard EN 300 718 as suggested by [2] would really help to handle multiple-burial situations by good receiver algorithms.

"Intelligent Transmitters" play havoc with multiple-burial resolution algorithms, since they affect the must useful signal feature that can be used for classification.

Contrary to [2], we believe that even in case of signal overlap multiple-burial situations can be resolved properly in most of the cases by applying suitable feature extraction and classification algorithms.

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Above: Material retrieved from the misfire site.

Left: The balloon that contains the sensitizing compound for the bulk of the cast shot was found about 30 feet from the blast crater. Notice the striations left from the rubber band.

Right: The thawed out cap/fuse assembly clearly shows the end of the blasting caps where they are crimped to the fuses as well as at least an inch and a half of the cardboard tube detonator wells – showing that the detonators were properly installed.

Snowmass Misfire Incident

Two incidents prompt in-depth review

Story and photos by John Brennan

On December 18, 2007, the Snowmass Ski area experienced a misfire with an Austin Powder White Cap cast booster. Better understanding how this explosive is manufactured will lead to knowing how this misfire occurred.

Basically, the bulk portion of this precast booster is not sensitive to detonating from a blasting cap. The mixture is a blend of TNT with various other compounds which likely are PETN, RDX, or HMX. To generalize, a mixture of TNT and RDX forms a common military explosive called Composition B. Some explosive manufacturers use reclaimed military explosives in their products. Because the White Cap's mixture alone cannot be detonated by a blasting cap, a sensitizing component is used.

Austin Powder uses a small balloon filled with PETN for the job. PETN, which can be ignited with blasting caps, is typically the core load in detonating cord. PETN is also used in an approximate 50/50 ratio with TNT to form the cap-sensitive cast explosive called Pentolite. The balloon is held in place between the cardboard detonator wells by a rubber band. While it is uncommon for the sensitizer balloon to somehow relocate itself, it is not unheard of. This is what occurred in the booster that resulted in the misfire at Snowmass.

Fernie Alpine Resort in Canada had a misfire with White Cap boosters on April 11, 2006. In his excellent article in the Summer 2007 *Canadian Avalanche Association Journal*, Fernie Ski Patrol Director Mark Vesely describes the event. Two individually primed White Cap boosters were taped together and used in an aerial cableway application. "First, the bomb tram failed to transport the shot out to its standard placement, Then, upon detonation, the two boosters separated, displacing one of the primed explosives into the blaster safety area, where it then detonated." While no serious injuries occurred, the potential for tragedy was immediately recognized, and an in-depth review of the accident was quickly and thoroughly conducted.

For a complete copy of Mark's article, or to further discuss explosive topics and concerns, please contact me at: jbrennan@aspensnowmass.com.

John Brennan is an avalanche tech at the Snowmass Ski Area and the Rocky Mountain rep for the AAA. He has also been a member of the International Society of Explosive Engineers for over a decade and sits on the NSAA Explosive Committee and the Artillery Users of North America Committee. His company, Avalanche Mitigation Services, aims to find long-term solutions to the explosives issues that face our industry.