

# USE OF RECCO SYSTEM TO LOCATE BURIED ROADS IN A WINTER ENVIRONMENT

By Mike Stanford, Avalanche Control  
Washington State Department of Transportation

P. O Box 98  
Wenatchee WA. 98831  
Tel. (509) 664-1257 Fax. (206) 973-2402

## ABSTRACT

Each winter, Stevens Pass, the North Cascade Highway, and other Washington state highways which pass over the Cascades, are covered with a blanket of snow. When enough snow falls on some of them to create a threat of avalanching onto the road and a danger to the public, they are closed for the season. When the spring opening is begun, there can be an average of 10-15 feet of snow on the road (flat snow), and where the road is effected by slides, there can be upwards of 100-150 feet (avalanche debris).

To test the practicality of using the RECCO rescue system for the purpose of locating a road in a winter environment, one hundred twenty six RECCO tabs were placed on three of these passes. On the North Cascade Highway, they were placed on key guardrail locations, and culverts that have been in the past a problem to find in the spring. Tabs were also embedded into the road just outside the fog line where the avalanche debris has a history of being deep, (100-150 feet on the average), and also where the location of the road is critical due to the narrowness. Tabs were also placed on two other mountain passes, Stevens Pass, and Chinook Pass. This paper will depict the results of our experiments with the RECCO system in a winter highway application.

## HISTORY

In 1974, the Royal College of Technology in Stockholm Sweden, developed the RECCO Rescue System. The system was developed for the ski industry, and the back country enthusiasts who sometimes become lost, or caught in avalanches. The system is simple. The public wears a small locator on their body, and if they, for some reason need to be found, they can be located with a microwave beam bounced off of their locator. The idea however, had what some like to call the "chicken or the egg" syndrome when it came to the marketing of the product. That is, no one wanted to buy the receiver unless there were a lot of locators in use, and no one wanted to buy the locators unless there were a lot of receivers in use. So as a consequence, the first generation of the RECCO has gone the way of the dinosaur. It has however been replaced by a third and fourth generation unit.

## TECHNICAL DATA

The receiver transmits a narrow banded microwave signal at a frequency of 915 MHz at about 5 watts peak power. The receiver section is tuned to 1830 MHz and incorporates a filter which suppresses signals at 915 MHz. The locator is a small, thin transponder (approximately 5" x 1" x 1/8") weighing about half an ounce. It contains a foil aerial and diode which receives a 915 MHz signal from the detector, doubles it to 1830 MHz and returns it to the detector antenna. When the detector receives a signal at 1830 MHz, the operator hears an audible response through earphones provided as part of the detector. Signals at any other frequency, including those at 915 MHz reflected back off rocks, ect; are not heard.

Since it's conception, the RECCO system has gone through several stages of technology update. The unit that was first introduced in the mid 1980s did, like all new products, have it's problems as far as reliability and durability. We are now on the third generation of the system, and have been informed by the company that a lot the problems with the first unit have been worked out and they are very excited about the future. The system is a directional beam. This means that you either have a signal or you don't. Therefore, the accuracy is quit good, about 4 inches in the tests that we have conducted.



*The unit comes self contained in a semi shock resistant backpack. Total weight of the unit is less than twenty pounds. Enclosed rechargeable battery is good for about 1.5 hours depending on temperature.*

### **COST**

The cost of the RECCO system at the present time is \$14,000 to \$15,000 U.S. As stated before, the marketing of the system has been in a severe slump as far as it's use by back country travelers, and alpine skiers in the U.S. We were able to secure a unit for \$ 7,000 dollars. The tabs are priced at about \$10.00 a pair.(less with quantity). At first glance the price did seem high, but when compared to the cost of replacing guardrail over the course of several years, and the time saved knowing where the road was before any snow was removed, it seemed that there may be a net savings to the state.

### **REASONING**

One of the many questions that were asked by the people in the district and state headquarters was" Why?". Why did we need something to help us find the road now when we have been finding it every spring for years? Our answer was this. Yes, we have been finding the road every year, but for the most part it has been done totally by guess work. Admittedly it was at times very good guess work but it was guess work just the same. If the person was wrong or even just off a bit, the resulting problem always had the possibility of becoming a real headache for someone. When dealing with 150 feet of avalanche debris, if the initial cat road is two feet off by the time you reach the road you are left with a 150 foot wall of snow that you now must deal with. Our feeling was that if we could eliminate the guess work of knowing where certain things or points were under the snow, we would be able to save not only money but also headaches and gray hair.

### **TESTING**

The first testing of the system was done in October of 1992 with a first generation system that we borrowed from the local Ski Area. To test the practicality of the system a number of things were done. First, twenty six RECCO tabs were placed on the North Cascade highway. Sixteen of them on key guardrail locations, four on culverts, and six in monuments which are located in the center of the road. The locations selected during that first winter were places that had a consistently deep snow pack, or where the location of the road was critical due to it's narrowness. A few tabs were also placed on culvert locations on Stevens Pass where we knew the snow would be deep. This was done so that we could check the system during the winter. We then waited for it to snow.

On March 3, 1993, five months and uncountable storms later, a test of the RECCO system was conducted on Washington Pass. The test was conducted by myself, Dale Keep (Maintenance Specialist for the Department of Transportation), and Jerry Holmen (Maintenance Supervisor, Washington Pass D.O.T). The RECCO unit was supplied, and demonstrated by James Ellis, who was at the time the North American representative for the RECCO system. The snow pack was not as deep as we had hoped, but with the given depth of the snow at the time, (about ten feet), the feeling was that a good reliable test could still be conducted. We also tested the reliability of the system to work through different types of materials commonly used by maintenance personal on the highway. These included a two part epoxy used to adhere reflectors to the asphalt, and cold mix, which is used to repair pot holes in the asphalt. Tests were conducted with different depths of these materials to determine the reliability of the system with workable amounts.

*Tab are embedded 6-10 inches outside of the fog line. hole is then filled with two component epoxy.*



The first test was to see if the system would pick up the tabs that had been placed in the monuments. Because of the thickness of the steel cover, it was found that the system would not reliably locate the tabs. Next was to see if we could locate the tabs we had placed on the guard rail and culverts. Both applications seem to work well. The system was able to locate the tabs easily through an average snow depth of seven feet, and from a distance of about 150 feet. We then took the tabs that had been embedded in 1 1/2 inches of epoxy and cold mix, and buried them under three feet of snow. The system was able to locate the tabs with ease, and was very accurate. A test of distance was done. The system could pick up a reliable signal above the snow from 250 feet. It was the general consensus of the group that the first initial test was a success, and that further involvement and experimentation was warranted.

## THE SECOND WINTER

After the initial success during that first winter, A RECCO unit was purchased by the Washington State D.O.T., with two districts sharing the cost. The work of installing the tabs on three of our passes was put into motion.

On **Stevens Pass**, seventeen tabs were buried in the asphalt just outside the fog line. The situation on Stevens is that the highway runs through the middle of the ski areas parking lot. When the road is covered with a layer of compact snow, it is impossible to know the exact location of the fog line. Therefore, there were many a busy Saturday when the ski area traffic was parked well into the road. With the RECCO system, we are able to mark the location of the fog line with orange marking paint eliminating any guesswork.

This task is accomplished by one of our crew in the early morning hours every Saturday and Sunday. It takes about 30 minutes. The Washington State Patrol has found this to be very helpful in their discussions with motorists trying to park closer to the ski slope. They also have found it a very useful tool in court when asked to prove that the fog line was where they said it was. They are currently looking at other locations on the pass where the system may be helpful to them.

**Washington Pass** was given a total of sixty-two additional tabs. The majority of these were buried in the asphalt just outside of the fog line. The tabs in the road are embedded into the asphalt by chipping out a small groove, and then filling it with the two part epoxy we had experimented with. Where avalanche debris was going to be deposited onto the road, tabs were placed every 100 feet. This way, if for some reason we were unable to get a good signal through the debris itself, we would be able to get a mark on either side of the path and then put a person on the top of the debris and line them up with the other two marks.. The tabs which had been placed on the culverts and guardrail seem to withstand the rigors of the first winter well, so they were left untouched.

**Chinook Pass** was given seventeen tabs. Our goal on Chinook was two-fold. We wanted to aid the maintenance crews in locating the road and also try to avoid damage to expensive rock work that is being build as part of a federally funded face lift. Near the summit of Chinook pass the road takes a long sweeping turn. The terrain above this stretch of highway is mostly all avalanche prone. During a normal year the resulting snowfall and avalanching can fill in the road cut completely to the point of having a smooth slope from the top of the path to the bottom. After hearing a story from one of the "old time" maintenance workers about how the pioneer road was 30 feet laterally outside of the actual road one year, the possibility of aiding the crew was obvious. Both Chinook and Washington Pass are designated scenic highways, and are closed during the winter months.



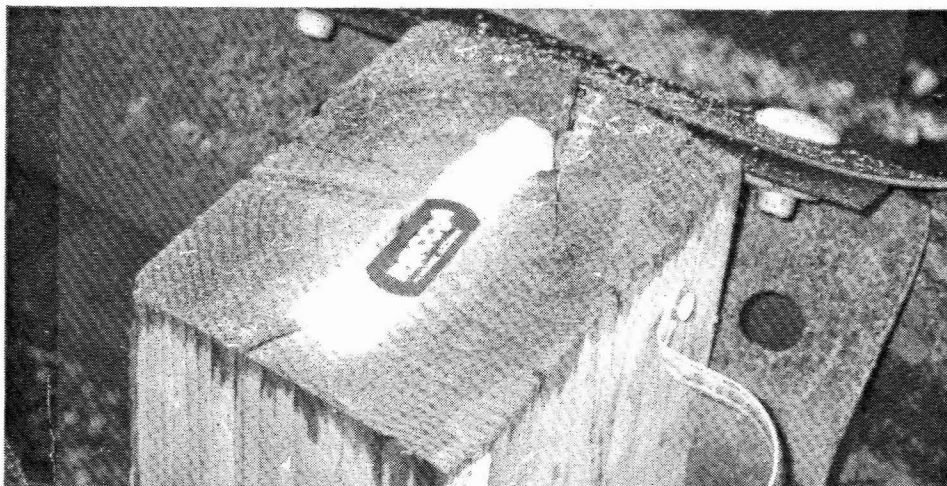
*Fog line is marked with orange spray paint every 100 feet on both sides of the highway.*

### CONCERNS

Up until this point, we have talked only about the good things the system has to offer. There are however, a few problems with the system. One of the things that were found during the experiments was that when we were trying to locate the tabs that were buried in the actual slide path section of the highway, some trouble was encountered pinpointing the exact location. We concluded that this was caused by the slope of the debris. We came to this conclusion because the tabs buried between the individual slide paths can be pinpointed very accurately, and the only difference other than the depth is that one is flat snow and the other is convex snow. The theory is that the operator is picking up a signal at different points around a radius. We had anticipated that this may be a problem, thus the reason for putting tabs on either side of the debris zone.

Another problem that we have encountered is the fragile nature of the unit. Care must be taken by the user not to damage the antennas, or the detector. We have been in contact with the parent company as recent as October 1 1994, and have been told that new advances in development should help to eliminate this concern. The cost of course, is also of some concern. The feeling is that this will come down with time and development.

The only other thing that really has become a topic of discussion during the past two years is the fact that it did take some practice to get accustomed to the art of pinpointing the tabs. To alleviate this problem, we have designated one person to run the unit most of the time. All team members are however, trained in it's use because of the rescue applications.



*Groove is routed out of the top of a guardrail post, and then filled with epoxy. Location can then be marked with orange flag.*

## THE FUTURE

Like the title of the presentation states, the RECCO system has so far only found a place during the winter months. It has proved it's contribution to be a valuable one for part of the year, and should continue to do so. We are currently in the process of replacing and adding tabs on all three passes. Our continuing goal now is to find a use for the system during the rest of the year.

Some of the other benefits to any D.O.T. that have become possible applications are:

1. **Road location-** The tabs can be embedded in up to 2 inches of epoxy or 12 inches of cold mix at any location of the highway and that location could be reliably found.
2. **Culvert / Drain location-** Tabs can be placed on any drain or culvert, and can be located under up to 20 feet of flat snow. (note; The depth would most likely vary depending on the water content of the pack).
3. **Guard rail-** Guard rail ends, or specific points on guard rail runs can be quickly located under up to 20 feet of snow.
4. **Power / Communication lines-** Tabs could be located on junction boxes, splices, or at specific points along the line, and could be found under at least one foot of earth.(Note; The depth of dirt that the RECCO system can work with may very well be much more. Further tests would be needed to determine the maximum depth).
5. **Avalanche rescue-** The tabs could be used in addition to rescue beacons for all maintenance personnel working on the states mountain passes
6. **Equipment-** The location of lost radios, or expensive pieces of equipment is a proven benefit of the system.

If anyone would like more information about our use with the RECCO rescue system, please feel free to contact the Washington State Department of Transportation at phone (509) 644-1257. or fax (206) 973-2402 We will be happy to help in any way possible.

Inquires can also be made to the company itself at, RECCO AB Box 4028 S-181 04 Lidings Sweden. Phone 46-8-731 59 50 or Fax 46-8-73105 60.