New Long Range Control Methods

Marty Schmoker and Mike Stanford
Washington State Department of Transportation
Avalanche Control, P.O. Box 98, Wenatchee, WA 98826
Telephone: (509) 664-1257, Fax: (206) 973-2402

Key Words: Howitzer, Recoilless Rifle, Tank

ABSTRACT

With the depletion of 105, and 75 mm recoilless ammunition over the last few years, and the recent accident involving the 106 recoilless rifle ammunition causing a general uneasy feeling among gunners, it has become clear that new, reliable methods for controlling destructive snow slides is still needed. Some areas have been able to augment their control with increased hand routes, Gazex, Locats, or Avalunchers. There are some places however that still do require the use of an accurate, long range delivery system to control avalanche paths.

Over the last few years, the Washington State Department of Transportation Avalanche Control division has been conducting tests with several different options. The 105mm howitzer, the S.S.E. LoCAT, and the M60A3 tank. Given the many considerations an agency has when adopting a new control method, no one system will most likely stand out as the tell all answer to everyone's problem.

It is our intention, to relay our findings concerning the M1A1 105 Howitzer, and the M60A3 Tank. Having gone completely operational with the Howitzer, we have been able to work through most of the problems someone may encounter. In addition, having the M60A3 tank in place and firing under control conditions, we are confident that most of the main concerns with it's operation have also been addressed. Topics covered are, maintenance, storage, availability, blind firing capabilities and reliability, range, training concerns, and winter time operation.

INTRODUCTION

The use of artillery to create snow slides is not a recent idea or practice. Text found in ancient China tell of avalanche control, p. 288

perimeters for research. Each side of the program were kept separate but cooperation was encouraged with each other by passing information and data between the controller's and researchers.

From this program the North West Avalanche Center was formed along with the first fuel/air gas exploder (the fore-runner to GazEx), ground placed snow disrupters (didn't work), rapid expansion air bags (didn't work), polyvinyl starting zone covers (worked too well), and the establishment of an artillery program.

The weapon of choice for years has been the 105mm recoilless rifle. As we all know ammunition is at critical levels for this weapon system. The next logical step was adapting 106mm recoilless rifle to replace the aging 105s. Ammunition supplies are plentiful and more up to date. Adaptability was not hard and we felt our mobile long range control needs were met for the next 20 years.

Not knowing if our goals would be achieved with 106mm recoilless rifles we also requested a 105mm howitzer be obtained for field evaluations. We knew from Rogers Pass experience with this weapon system that it should prove reliable for inducing snow slides, however our firing locations were not set up for this weapon system and a learning curve would be needed to become familiar with it's capabilities.

Shortly after the introduction of the 106mm recoilless rifles in avalanche control an incident involving a 106mm rifle resulted in a death of a technician, putting the future of the recoilless rifles in question.

Washington State DOT discontinued using 106mm recoilless rifles in avalanche control and concentrated on the howitzer and a more recent development the M60-A3 Main Battle Tank, for our attenuated long range artillery needs.

Research into 105mm howitzers available in the United States has led us to 3 models, M101-A1 currently available, M102 becoming available, and the M119 not available at this time through army assets. Each model has attributes making it desirable under certain circumstances.

When planing the replacement of recoilless rifles we looked at weapons that could not only match the rifles capabilities but exceed them in range and accuracy.

Recoilless rifles are mounted on towers throughout Washington to conduct avalanche operations. In most cases each tower controls one or two snow areas consisting of several paths. Because of the howitzer's capabilities we planed to consolidate several towers into one fire base. Range to impact areas would increase from 1,800 yards to 5.5 miles. This new location gives a more suitable window for howitzer operation using it's long range capabilities.

Evaluations on the howitzer were conducted on Washington Pass in the North Cascades. This location was selected because of its remoteness, high angle slopes, deep
snow pack, long range from fire base to a variety of starting zones, angles and aspects, and a positive control over traffic and public entering the area.

Washington State National Guard provided gunnery training. Our approach to training was, acquire every thing we could about the howitzer, how it functions, target acquisition methods, sighting methods, and so on, and adapt it to our situation. Initially training was very intense trying to absorb an incredible amount of information. It helps to have a background in mathematics to understand angles and survey results in order to lay the weapon on targets that have never been fired on before that lay beyond the range of the direct sight or over mountains out of site of gunners.

As procedures were learned, modification from a 5 person crew to a 2 person crew were adapted, however at no time did modification to procedures compromised safety issues.

Evaluations covered several areas, each directly or indirectly relating to long term reliability of the weapon system. Areas of concern: cost, weather condition affecting weapon and ammunition, locations of targets, personnel training, ammunition availability and reliability, mainte-

nance, storage, public impact or perception, and government regulations.

Lessons learned from the recoilless program could be adapted to howitzers to a certain extent. Due to the size and weight differences between weapon systems, new transportation methods had to be developed. Also the howitzer could not be mounted on towers designed for recoilless, so trail pockets had to be designed, built and installed at the site.

Unlike recoilless, howitzers move or displaced when fired. This displacement had to be kept to a minimum to insure accurate blind firing data. After 3 rounds were fired, trails were set into the pocket and further displacement was not encountered. Using this method, the weapon could not be moved because exact placement was not insured rendering firing data inaccurate. Methods have been developed so the weapon can be removed after each mission retaining accurate blind fire data.

Target location and shot placement does not present a problem. Howitzers are capable of firing over several mountain ridges hitting reverse slopes of starting zones. During high angle firing flight times for rounds are around 40 seconds, reaching apogee elevations of 30,000 plus feet before coming back down.

High explosive ammunition has been distributed all over the world. Current stocks are over 1,000,000 rounds available for avalanche control. The recommended fuzing for this round proved unreliable during our evaluation. A dud rate of 30 percent was not uncommon while testing the M739 point detonating fuze. Inquires into why it did not function properly under snow conditions reviled nothing. Alaska DOT avalanche control conducted tests with the same fuze under similar condition with like results. An older M557 was ordered and new tests conducted in the same area with 100% detonation while using this fuze. This fuze also happens to be the same fuze used on the high explosive recoilless rifle round with a historical dud rate of less than 1%. Because howitzer ammunition is semi-fixed type and susceptible to water, care must be taken to ensure powder bags are kept dry. A small portable “A” frame enclosure was constructed to assemble ammunition at the fire base.

The first few years we stored the weapon at a local national guard unit near our complex. This facility didn’t have covered storage so it had to stay out in the hot sun.
Avalanche Control, Rescue and Education

and rain during the summer months. Because of this the original cover has rotted away forcing us to build a new cover. We now store it in our snow camp inside under cover. During winter it stays at the fire base. This presented a problem when new snow cover exceeded the height of the weapon. There were times when we would not have found the weapon if we would have not known where we put it to begin with.

Public perception does not seem to be any different than that of recoilless rifles. Not many people know of its winter location and local public are use to seeing strange weapons being pulled by DOT vehicles.

Governmental regulations dictate security measures for weapon and ammunition. All hazardous material handling procedures are adhered to when transporting ammunition. Special training has been given to gunners to comply with local, state and federal regulations. It is our finding that the howitzer will take the place of recoilless rifles in most cases. Accuracy for both short and long range is exceptional. Over snow mobility is cumbersome. Skis had to be constructed in order to transport the weapon to remote locations by snow cat. The high explosive ammunition must be fired with the M557 fuze to ensure reliable detonation. Gun crews have little difficulty adapting firing commands from rifles to howitzers. It's important to completely understand gunnery before this weapon system can perform to its designed capabilities. Ammunition must be kept dry and assembled at the time of use. Do not pre-assemble ammunition prior to control mission use. Gun crew safety is enhanced due to the lack of back blast however, recoil of the gun tube is violent and capable of severe damage to body parts. Preparation to fire takes more time than rifles because of snow removal around weapon and ammunition house. By the time weapon has been cleared by the gunner, the loader has the ammunition assembled and ready to go, so time is not wasted.

In the period we've evaluated the howitzer, no major repairs to carriage or gun tube have been required.

North Central Region Avalanche Control has completed preliminary testing on the M60-A3 tank and C518 HEP-T ammunition.

Preliminary evaluation results:

- All rounds functioned as designed. Ammunition seems to detonate close to snow surface.
- Sighting systems are redundant and extremely accurate. Able to acquire targets very accurately using established did-hit-data. Several firing and sighting systems were made to fail without affecting outcome of mission.
- All power and computers were turned off. Did not observe any difference in accuracy or mission time.
- Enclosed area provides favorable work environment during inclimate weather. Less fatigue on crew.
- Noise levels during firing appear to be much lower than recoilless rifles or howitzers. Only foam inserts were needed, very comfortable when firing.
- Speed in target acquisition appears to be greater than recoilless or howitzers. Several minutes can be saved on each control mission.
- Unlike gun towers, removal of vehicle during off season is favorable to Forest Service for aesthetic reasons.
Automotive systems performed when desired, batteries stayed charged throughout winter. Vehicle does not have to have power to provide stable firing platform.

MAJOR COMPONENTS

General:
The tank is divided into three sections. The front section contains the driver’s compartment with all controls and instruments necessary to drive the tank. The center section contains the turret which houses the controls and instruments used to traverse the turret, elevate and depress the main gun, sight and fire the main gun. The rear section contains the engine, transmission, fuel tanks, and related automotive equipment.

Turret:
The turret is operated by the gunner and loader. Manual and power controls are provided for operation of the gun elevating and turret traversing system. The 105mm gun is mounted to the 360-degree rotatable turret.

Sighting and Fire Control:
Two types of sighting equipment are provided to lay on targets. The first type, called conventional, is used in daylight. The second type is called passive. Passive sights or tank thermal sights (TTS) electronically increase dim light and are used for night viewing. Also included is a laser rangefinder to provide accurate range data for the ballistic computer. The computer increases first-round-hit probability by compensating for the effect of gravity, drift, cross-wind, horizontal target motion, altitude, air temperature, gun wear, trunnion cant, and gun sight parallax.

Pre Authorization Planning
Before permission was granted by DOT headquarters a meeting was held with state legislators and representatives on the feasibility of a tank for avalanche control and the public perception of such a vehicle being held by the DOT.

It was first thought avalanche control was going to run up and down the road blasting away as we went. (Not a good impression on the public.) However, after explaining the tank would be placed at a fixed site, at the latest possible moment in the Fall, used from this site during the winter, and removed the first possible time in the Spring, they now understood the project.

During this same time concerns whether the vehicle would operate with our environmental factors were also voiced. In anticipation of such questions we asked personnel who had either worked on or were part of tank crews in cold regions, if the vehicle would operate in a snowy winter type condition. They described to us that the vehicle and gun would perform to our standards in these conditions, however they did express a good maintenance program would enhance the reliability of the gun and vehicle.

Breaking down these problems, and addressing each concern in a maintenance plan, we felt a vehicle could be brought into top shape over time, our operating conditions would be very easy on components. The tank would not maneuver in rough dusty terrain driving 7 miles in the Fall and 7 in the Spring, on paved highways and under cover during off seasons.

As other equipment breaks, TACOM has granted permission to cannibalize 30 tanks slated for targets. We can have anything that can be removed prior to hauling them down range. A finite amount of parts but enough to keep us in stock for many years. Engines and trans-
missions continue to be used in a bridge layer still in production, so packs will be available for years to come, however they may have to be bought at market price of $100,000.00 per unit.

**EVALUATION PARAMETERS**
This evaluation applied to ammunition reliability, vehicular mobility, serviceability, sighting systems, safety for crew and public, security, and maintenance of weapon and carrier.

During testing care was taken to address the following factors:
- How cold of temperature would the engine start without trouble?
- Would cold temperatures affect sights and related equipment?
- Could the turret traverse with snow between the hull and deck?
- Would heat changes within the tank produce condensation and if so what affect would the condensation have on vital equipment?
- Define what maintenance is critical to gun operations and vehicle.

Sighting systems were purged before leaving the training center. We had acquired a valve to purge the systems if it became necessary during the season. After several storms had passed we found a lot of condensation on the inside of the turret, dripping on sights and other components, but we never had a problem with water or condensation in the sights. They were always clear with no fogging.

**Placement**
A ramp was constructed by placing ground cloth on level ground providing a barrier to capture oil or fuel in event of spillage, with fill dirt 15 feet wide and 4 feet high and 20 feet long. Just enough to give elevation to upper starting zones. If area permits, the same can be accomplished without building ramps by moving vehicle back until proper elevation is achieved.

**Comparison consideration**
Our primary weapon for the 95/96 season was a M101-A1 105mm howitzer with recoilless rifles as a backup system. We felt if primary control efforts continued with recoilless rifles our ammunition would be exhausted in relatively short time, without knowledge of howitzers at this location.

A fire base was constructed in front of ramp built for the tank. Both weapon systems at same location also provided valuable information for logistical comparison between our eventual primary weapon and the tank.

Our intentions were to fire howitzer and tank rounds during actual control conditions throughout the season. This would prove reliability between point detonating HE howitzer ammunition and base detonating HEP-T tank ammunition under similar snow pack conditions.

Consultations with fuze manufactures disclosed military specification calling for reliable detonation when contacting 9 inches of plywood. They questioned reliability in snow condition. Fuzing is similar to other base detonating ammunition with some modification. We explained ammunition and weapon types we currently use, along with muzzle velocities, (Recoilless rounds are around 1120 ft/s, HEP-T tank rounds are 2300 ft/s).

They felt reliability would be considerably improved over HEP-T ammunition currently used based on two factors:
- Age of tank ammunition compared to recoilless.
- Muzzle velocity increase over recoilless.
Considerable attention towards security was expressed by all concerns. At the top of everyone’s mind was a misfortunate incident taking place in California involving a stolen tank, a freeway, and several smashed cars. A security plan had to address DOD concerns of a recurrence. We designed a five-point plan to make it difficult to start, operate, or access the vehicle or weapon systems. By exceeding DOD requirements for storage of tanks they approved security proposal.

In many respects securing a tank is easier than recoilless rifles, especially 75mm. Recoilless rifles can be easily transported without notice in a pickup. Unlike a tank .... someone will see it!

One stigma we had to overcome was, “a tank, a weapon of war, what will the public think?” I think recoilless rifles had the same growing pains, now they are accepted. If it’s acknowledged as an obsolete weapon being used for protection of life and property, it will gain acceptance. These vehicles are being dumped into the ocean by the thousands. Discarding unessential multi-million dollar vehicles by this approach doesn’t seem like wise use of tax dollars.

Implementation of weapon test
Our intentions from the inception of this project was augmentation of recoilless rifles. Many areas in Washington State can not support an other type of weapon without modification to terrain or widening of roads, both extremely expensive. If annual recoilless ammunition consumption could be cut by using other types of weapon systems in area that could accommodate, it would prolong recoilless ammunition for critical operational areas.

We’ve been comfortable with 105mm ammunition’s reliability in stabilizing snow slides. Implementation of howitzers has added to this confidence. When the tank idea first came to mind we were thinking of weapon system. It just happened the weapon came on tracks. For this reason vehicle performance was secondary to overall weapon and ammunition performance.

Redundant information had been confirmed through many independent sources before testing took place, but we still wanted conformation of questions and proof of concept.

Avalanche Control, Rescue and Education

AREAS OF VERIFICATION OR ESTABLISHMENT:
- Ammunition function (high order) in altra-soft environment such as snow
- Sighting systems be redundant in the event of power loss or inoperable power source
- Adaptation of “did hit data” to accurate blind fire tables
- Fire weapon without primary power using established firing tables in simulated night conditions
- SOP of weapon, fire control computer, and related range finding equipment as pertaining to avalanche control
- Maintenance of systems and how they relate to functions of weapon/vehicle
- Maintain Army or establish new firing procedures that will not compromise safety for crew or public in any way.

Prepare to fire
Advisors recommended a fixed procedure for “prepare to fire”. Tank guns and sights are designed to be extremely accurate over long distances. Because of this several mechanical, hydraulic, and electrical systems have been built into the firing system. One or all can fail and the weapon can still sustain fire, however accuracy will diminish. How much accuracy diminishes?

At distances over 2.5 miles we witnessed no change in shot placement, hitting another tank in the same hole repeatedly. The prepare to fire examines key aspects between fire control systems and weapon.

We have modified this procedure examining elements that are critical to avalanche control needs and what method of engagement are being used. When utilizing blind fire data prepare to fire concentrates on recoil compensator operation, breach function, azimuth indicator is zeroed on proper reference point, and gunners quadrant end for end test This takes less than 5 minutes to accomplish.

Sighting
Primary site for weapon is the passive 105-D sight. This sight is similar to recoilless and howitzer sights with a few exceptions. In this sight several range lines are shown corresponding to each type of ammunition the gun can fire.
If distances are known to targets place range line on target and fire. If not known, use laser to acquire range, place range lines on given range and fire.

*It's important to remember, laser beam of the laser rangefinder can be dangerous and cause blindness if it enter the eye, either directly or reflected from a flat mirror-like surface. To minimize the possibility of any such accident, you must have had laser safety training prior to operation of the laser.*

The Tank Thermal Sight (TTS) can acquire targets but is coupled to fire control computer and laser for pin-point accuracy. TTS work well at night when not snowing, and can be used while snowing light to moderate but harder it snows the less you can see. It’s based on thermal differential, any temperatures with 4 degrees difference from 270 degrees F and up will be displayed.

**Firing weapon system**

Unlike recoilless rifles or howitzers breach operations on tanks are much easier, however if fingers or gloves are in way of breach closing you will lose them. When loading, place tip of round in breach, make fist with right hand, and throw round into chamber. When round comes in contact with closing mechanism breach slams closed.

At end of recoil, breach automatically opens ejecting empty shell casing on turret deck. The shell hitting deck actually makes more noisy than gun firing. **Do not** pickup empty casing with bare hands, it’s extremely hot and will burn you.

**Stevens Pass weapon/ammunition testing**

By placing on a ramp we had concerns the tank would displace when fired moving it down the ramp or at least rocking and not returning back to original orientation making accurate blind firing impossible.

Several rounds were fired at lazed targets with ranges, elevation, and azimuth recorded to build blind fire tables. Selected targets were at different elevations and ranges to document affect of divers tub angle and orientation on tank movement.

Using blind fire data we shot targets again. Our objective was to achieve accuracy comparable to recoilless or howitzer’s.

We encountered much improved accuracy over any weapon system we have ever used even under simulated night blind firing. Target acquisition was faster than crewing recoilless or howitzer with three people, cutting down overall mission time.

**Mobility**

Planned movement from Tye Valley to summer storage area was to take place as soon as snow cover was favorable for transit. Five feet of snow was near summit, small patches of snow covered ground at firebase.

Tank didn’t have trouble being mobile in these conditions. Climbing over slide debris easy, not a problem. Near the summit we began dragging the under-side of the hull but didn’t slip or spin a track.

**Cost of M60-A3 tank project**

Washington State DOT has not incurred any cost outside of time and labor for DOT employees. WAANG has absorbed cost of preparing, transporting, ammunitions, and training under our agreements.

It is our intention to use the tank operationally for the 96/97 season. This will provide valuable facts on direct operational cost and problems.

DOT has inquired into the possibility of reduction in price per round of ammunition. Currently market price is $176.00/round. We hope this will be reduced substantially.

It’s difficult to estimate cost for this vehicle until it’s used under our environmental factors. Too many variables differ between use as a battle tank with hard utilization and an avalanche control device that task the unit very little. Also, under what circumstances would it operate under? If it’s to remain parked and never moved, the pack can be removed. If power can be supplied to the tank, a heater could be placed in turret to keep equipment warm and condensation to a minimum. A converters from 110vac to 24vdc would provide power for normal turret operations.

**Ammunition availability**

At this time 80,000 rounds of C518 HEP-T are being held in reserve for the new advanced gun system. Congress pulled all funding for this new system with no plans to reenact the project in the future.

Tank gun systems no longer fire HEP-T ammunition because it will not defeat modern heavily armored vehicles.