Angela Minahan
Matt Anderson
ENGL 394-1001
December 3, 2002

Final Report:

I pledge on my honor that I have not given nor received any unauthorized assistance on this assignment.

Matthew L. Anderson Angela K. Minahan

Recommendations for Improving Body Armor Worn by the Maryland State Police and the University of Maryland, College Park Department of Public Safety

By

Matthew L. Anderson

&

Angela K. Minahan

Date: December 3, 2002
To: Chief Kenneth Krouse, Director, University of Maryland Department of Public Safety
From: MPO Matthew L. Anderson ID191, Angela Minahan
Re: Proposal for Improving Body Armor Products for UMDPS

Enclosed you will find our recommendation report which concludes that you should provide threat Level 4 vests to your officers. After analyzing research, surveying patrol officers, interviewing police administrators, and studying recent events and media reports, we have found that the bullet-resistant body armor currently used is not adequate considering today's levels of danger to police officers.

Our research has revealed that there are vests on the market that provide a much higher level of protection than the PointBlank threat Level 2A vest currently issued. We are all well aware that if the "sniper" had attempted to assassinate a UMDPS officer, the officer's vest would have been no match for the sniper's .223 "armor piercing" rounds. However, if UMDPS provided officers with the option of wearing a threat Level 4 vest during high-risk situations, the officer would have had a much better chance of survival.

A recent media report detailed the story of the NYPD, who tested their PointBlank brand ballistic-resistant vests and had 900 of them fail. PointBlank workers claim that PointBlank does not have high quality manufacturing practices. We also recommend that you replace all PointBlank vests with another brand.

An interview with your Squad Patrol Commander showed that he is willing to entertain the idea of issuing safer vests. A survey of more than half of your patrol officers revealed that they are willing to wear more protective vests, even if they are a little less comfortable or if they had to help pay for some of the costs associated with purchasing them. Because budgeting is a concern, we have explained how the Bullet Proof Vests Partnership Act allows police agencies to be eligible for funding for up to 50% of the costs of buying ballistic-resistant vests for officers.

You will see that MSP is mentioned in the report. Our recommendation is for both UMDPS and MSP, and we hope that by reading about how an update in equipment would also benefit another agency with which you work closely, you will be more convinced of our argument. Please read the enclosed report for more detail.

University of Maryland Department of Public Safety
#003 Rossborough Lane
College Park, MD 20740
December 3, 2002

Superintendent David Mitchell
Maryland State Police
1201 Reisterstown Road
Pikesville, MD 21208

Dear Superintendent Mitchell,

Enclosed you will find our recommendation report which concludes that you should provide threat Level 4 vests to your officers. After analyzing research, surveying patrol officers, interviewing police administrators, and studying recent events, we have found that the bullet-resistant body armor currently used is not adequate considering today's levels of danger to police officers.

Our research has revealed that there are vests on the market that provide a much higher level of protection than the threat Level 2 vest currently issued. We are all well aware that if the "sniper" had attempted to assassinate an MSP officer, the officer's vest would have been no match for the sniper's .223 "armor piercing" rounds. However, if MSP provided officers with the option of wearing a threat Level 4 vest during high-risk situations, the officer would have had a much better chance of survival.

An interview with First Sergeant Runk showed that he is willing to entertain the idea of issuing safer vests. A survey of more than half of the patrol officers of a local police department revealed that they are willing to wear more protective vests, even if they are a little less comfortable or if they had to help pay for some of the costs associated with purchasing them. Because budgeting is a concern, we have explained how the Bullet Proof Vests Partnership Act allows police agencies to be eligible for funding for up to 50% of the costs of buying ballistic-resistant vests for officers.

You will see that UMDPS is mentioned in the report. Our recommendation is for both MSP and UMDPS, and we hope that by reading about how an update in equipment would also benefit another agency with which you work closely, you will be more convinced of our argument. Please read the enclosed report for more detail.

Thank you for your time,

MPO Matthew Anderson
University Police Officer

Angela Minahan

Table of Contents

Executive Summary

This project team recommends that the Maryland State Police and the University of Maryland Department of Public Safety upgrade their ballistic-resistant armor to Level 4 (according to the NIJ standards for ballistic threat levels). The recent sniper case has prompted law enforcement agencies all over the country, particularly here in the Washington, D.C. metropolitan area, to take a serious look at the safety of their communities and their personnel.

The snipers were using .223 caliber ammunition when they attacked more than a dozen people in Maryland, D.C., and Northern Virginia. The current body armor that MSP and UMDPS use is not adequate protection against these high-velocity bullets. Our research has led to the following discoveries:

- Criminals are much more heavily armed than expected.
- Current body armor for both departments is insufficient.
- Funding is available to defer some of the cost of improved equipment.
- Personnel seek safer vests for their own protection.

As a result of our research, we have made some initial recommendations, which are as follows:

- The Maryland State Police and the University of Maryland Department of Public Safety should make threat level 4 vests available to their officers for high-risk activities.
- The University of Maryland Department of Public Safety should not continue to use PointBlank brand ballistic-resistant vests. Media reports have shown that a wide range of PointBlank's vests are of questionable quality.

Demographics of the Police

The Maryland State Police (MSP) is the statewide police agency charged with enforcing all state, criminal, and traffic laws. Officers patrol national, state, and local highways, and their primary duties in the metropolitan area include traffic enforcement, commercial vehicle enforcement, accident reconstruction and investigation, and dignitary protection. Its jurisdiction includes the entire state of Maryland (except within the city limits of Baltimore) - a total population of 4,645,332 people (15). MSP has 1,589 sworn police officers and 773 civilian employees (7).

The University of Maryland Department of Public Safety (UMDPS) is a full-service police

department responsible for the safety and security of all property owned, leased, and operated by the University of Maryland, College Park campus. With 74 sworn officers, 30 full-time civilian employees, and a contingent of 60 student employees who work part-time in the Auxiliary Services Unit, UMDPS is responsible for enforcement of all traffic, criminal, and University regulations on campus and in certain areas of the city of College Park. The department serves a jurisdiction of approximately 4 square miles and a campus which hosts approximately 35,000-40,000 faculty, staff, and students on a daily basis. Approximately 8,400 students live on campus full-time for 9 months of the year (2).

Recent Events

On October 2nd, 2002, the D.C. metropolitan area was horrified when a "sniper" began a three week rampage of Maryland, D.C., and Northern Virginia. An unknown person or persons began terrorizing the metropolitan area by randomly shooting area citizens with a high-powered rifle and bullets that are commonly used by law enforcement and military snipers. The .223 caliber bullets were lethal more often than not. Unfortunately, for almost the entire duration of the incident, no one knew how the sniper was able to commit such heinous acts without being noticed at the scene or while leaving the area. As the terror continued over several days, law enforcement officials positioned themselves at every major intersection and on key exit routes from the city. The officers were prepared to shut down all traffic and search each car one at a time at a moment's notice. Officers were on posts at schools because the sniper had shot and critically wounded a teenager at a school in Bowie, Maryland. Law enforcement knew that no one was immune from being a target of this killer.

One group who was certainly not safe was the law enforcement officers themselves. As an unprecedented task force was mobilizing to identify and apprehend the sniper, the average police officer was on the street guarding the community. Protected by what looks like a thick-padded hunting vest, officers of the Maryland State Police and the University of Maryland, College Park Department of Public Safety stood guard over the campus and the highways of the local area. These officers knew that the "bullet-proof" vests they were wearing were no match for the .223 caliber rifle bullets that the sniper (s) was using on the victims, because the sniper's bullet was so fast that it was classified as "armor-piercing." Nevertheless, they maintained a constant vigil over College Park and the surrounding metro areas. The officers needed protection, as did the communities under their watch. The sniper case

demonstrated to local law enforcement that the protective vests worn by the patrol officers were not adequate protection; a higher level of bullet-resistant protection was necessary. But what level of protection would be adequate? Could the Maryland State Police and the University of Maryland Department of Public Safety afford to equip its officers with the proper vest? And finally, would the officers themselves wear such a vest? These are the questions that must be answered before we can make an educated recommendation as to what types of protective measures are necessary.

Bullet-Resistant Vests

Bullet-resistant vests, also called personal body armor, are commonly thought to be impenetrable by bullets. A common misconception is that all body armor is the same, and the officer will always survive if shot while wearing a vest. Technology is always changing and new innovations emerge to make bullet-resistant vests more effective, comfortable, and affordable; however, a 100% survival rate is not even close to the reality.

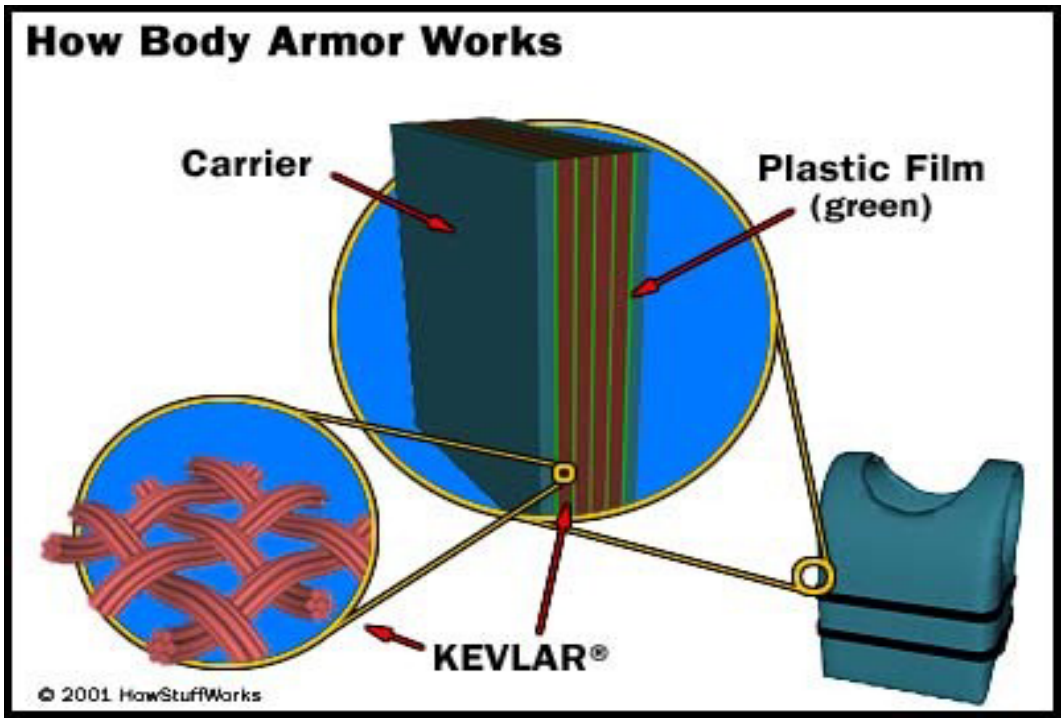
The most frequently used material for constructing police bullet-resistant vests is a man-made fiber called “Kevlar.” Kevlar armor systems are designed to protect people and equipment from ballistic threats, which are classified into military and non-military types. Military ballistic threats (such as shrapnel, rifle bullets, flechettes, and fragments from explosions) can cause serious injury or death because the projectiles have very high velocities. Law-enforcement agents usually encounter what are considered non-military ballistic threats, such as bullets from handguns and the ballistics of personal assassination, riots, and the like. Accordingly, body armor is designed differently for these two different types of threats.

Body armor used to be made of metal (hard armor); however, new synthetic fibers that use metals, ceramics, fabrics and fiber-reinforced composites (such as Kevlar) have been more popular in recent years. For ballistic fragments with velocities below 3000 feet per second, Kevlar can provide equal protection to an officer with equal weight and lower cost than hard armor. Presently, soft body armor is usually designed as a vest (as opposed to a jacket or a shirt) to protect a person’s torso and can be worn either under or over regular clothing (10).

Figure 1: Suit-Style Vest (Courtesy of www.bulletproofme.com)

Extensive research by Aerospace Corp., U.S. Army Edgewood Arsenal and Natick Laboratory, Law Enforcement Assistance Administration (LEAA), National Institute for Law Enforcement and Criminal Justice (NILE/CJ), National Bureau of Standards, Lawrence Livermore Laboratory and the DuPont Corporation has influenced the design, manufacture, and construction of bullet-resistant vests, resulting in today's technology of layering multiple plies of flexible fabrics stitched from ballistic fibers (10). Figure 2 illustrates the design and composition of the ballistic-resistant vest. This technology is influenced by national standards for the manufacture of all ballistic vests, and the National Institute of Justice (through the Office of Law Enforcement Standards) develops the standards all manufacturers strive to meet.

Figure 2: How it Works (Courtesy of www.howstuffworks.com)



NIJ Standards and Threat Levels

The National Institute of Justice's standard 0101.04 is called "Ballistic Resistance of Personal Body Armor," and it "establishes minimum performance requirements and test methods for the ballistic resistance of personal body armor designed to protect the torso against gun fire" (1). Due to continual updates in ballistic resistant materials and changing ballistic threats, this standard is under constant revision (6). Technically, this standard is voluntary, and manufacturers are not required to adhere to it (5). However, police departments rely on this standard to ensure that they vests they issue their officers will provide protection (14). As a result, vest manufacturers often follow the guidelines to keep the police department's business.

Standard 0101.03 recognizes that there is not one vest that is suitable for everyone and their various safety needs. The standard includes the requirements for 6 different safety levels (threat levels) of vests, with each increase in threat level meaning an increase in safety.

1. Level 1 vests have become almost useless for law enforcement today due to the regular use of more powerful weapons, however Level 1 vests protect officers from .22 caliber pistol rounds or

long rifle rounds (40 grams of lead solid traveling up to 1450 ft/s.), and .38 caliber bullets (158 grams of lead round nose at a speed up to 900 ft/s).

2. Level 2A is one of the most commonly worn threat levels of vest and is designed to be very thin and easily concealable. Level 2A vests protect the officer from all Level 1 threats, 9mm bullets (124 gram full metal jacket bullets with a velocity up to 1140 ft/s), and 357 magnum bullets (158 gram jacketed soft point bullets traveling up to 1300 ft/s).
3. Level 2 vests are concealable but can also be worn in conjunction with a hard plate, making it more noticeable. Level 2 vests protect the officer from the same types of bullets to which Level 2A vests are resistant, except in this increased safety level vest, the bullets can travel at greater speeds and the officer can still be protected. 9mm bullets with velocities up to 1225 ft/s and 357 magnum bullets with velocities up to 1445 ft/s are no match for a Level 2A vest.
4. Officers who wear Level 3A vests cannot easily conceal the vests because their protective panels are very thick and heavy; this is the highest protection level for soft body armor. Level 3A vests protect from all threats in the lower safety standards, but also 9mm bullets with velocities up to 1400 ft/s (machine gun speed), and .44 caliber bullets and .44 magnum bullets with speeds up to 1400 ft/s.
5. Level 3 is the first level of vest that mandates the use of a heavy, bulky hard plate with the soft body armor to protect the officer from rifle bullets. The soft armor is used to absorb some of the blunt trauma to minimize injury to the officer. This level vest must withstand 6 shots from a 7.62 x 51 NATO ball that travels up to 2800 ft/s.
6. Level 4 vests are also hard body armor and are designed to protect an officer from one shot from an “armor piercing” projectile (30.06 AP M2 166 gram bullet traveling up to 2900 ft/s) (13).

Figure 3: Levels of Protection (Information courtesy of www.nlectc.org)

	Hard/soft	Type of bullet	Bullet speed
Level 1	SOFT	.22 pistol or LR .38 bullets	1450 ft per sec. 900 ft per sec.
Level 2a	SOFT	9 mm 357 magnum bullet	1140 ft per sec. 1300 ft per sec.
Level 2	SOFT	SAME	1225 ft per sec. 1445 ft per sec.
Level 3a	SOFT but THICK, HEAVY	9mm .44 magnum	1400 ft per sec. 1400 ft per sec.
Level 3	SOFT & HARD	7.62 x 51 NATO Ball (6 shots)	2800 ft per sec.
Level 4	HARD	"armor piercing"	2900 ft per sec.

Current Equipment

The body armor used today by the University of Maryland Department of Public Safety is threat Level 2 armor made by PointBlank. This armor was purchased when the agency was still utilizing Sig Sauer 9mm pistols. Since changing to the .40 caliber pistol, the vests have not been upgraded but are rated as adequate protection against a .40 caliber bullet. The reason this is significant is because the golden rule in law enforcement for body armor is that the vest must be rated to resist the bullets in the officer's gun. This is for the unlikely situation that the officer's weapon should ever be used against him or her.

Troopers of the Maryland State Police currently wear Level 2A body armor made by P.A.C.A. This armor is also rated to be resistant to the bullets carried by the troopers: .40 caliber rounds. While the vests worn by the two agencies are rated for the same level of ammunition, the manufacturers are different, which means different manufacturing techniques and different in-house compliance testing. The state police S.W.A.T. team, however, wears a much more protective vest.

According to First Sergeant Keith Runk, a member of the S.W.A.T. team, all troopers on the team wear threat Level 3 vests made by P.A.C.A., known as "Smart Vests." He said these vests are much bulkier than the Level 2 or 2A vests and reduce the range of motion for the officers. Runk did add that the Level 3 vests are still not adequate protection for .223 and .308 caliber rounds commonly used by snipers. The Level 3 vest does, however, have a hard trauma plate not found in lower level vests (Figure 3). This plate drastically increases the protection to the officer, particularly in the chest area where the heart and lungs are located (9).

PointBlank Manufacturers

In the beginning of September 2002, an Army survey of PointBlank's "Interceptor" model ballistic-resistant vest worn by American troops in Afghanistan found flaws in the manufacturing of the vest, according to *Defense Week* (3). In the end of the same month, the New York State Labor Department conducted an investigation regarding the New York City Police Department's (NYPD's) PointBlank bullet-resistant vests and tested them to ensure their effectiveness. At least 900 of the vests tested by the Labor Department proved to be defective "and one vest did have full penetration from a single gunshot," according to the report. As a result, more than ¼ of all the vests worn by NYPD officers are being returned to PointBlank.

When interviewed, Rhonda Graves, the Chief Operations Manager for PointBlank, claimed that she does not sell bullet-proof vests, rather, her company sells bullet-resistant and stab resistant-armor, and her company would never cut corners in the manufacturing of such safety devices (8). This contrasts a written statement from Umberto de la Cruz, a PointBlank shipping clerk, who claimed that PointBlank workers were told to overlook problems, use inferior grade materials to pass off as high-quality armor, and insert incorrect sizing labels into vests. Officials at PointBlank countered these accusations by saying the employee was unfamiliar with how the vests were manufactured and he did not know about

"quality assurance inspections" for each vest. (3).

Rhonda Graves said that the testing done by the New York State Labor Department must have been done improperly for the vests to "fail." The President of the New York Police Benevolent Association, Pat Lynch, disagreed, saying that the testing was done properly and that the defective vests were not resistant to the types of bullets they were designed to stop. The two are negotiating replacing the "defective" vests (8).

Police Administration

To answer the question of whether or not the departments would be receptive to the idea of buying safer vests for their officers, we sought out administrators from MSP and UMDPS. First Sergeant Keith Runk is an assistant barrack commander at the Waterloo barrack in Jessup, MD. He has more than fifteen years service with the department and is a high-ranking member of the S.T.A.T.E. team. In speaking to him recently, he said that the issue of ballistic vests varies depending on the tasks of the officers. What is practical and effective for the patrol officer on the street is insufficient for the officer on the S.W.A.T. team making entry into a dangerous area. He indicated that he wants to issue the most effective vest available to his officers. When asked what he felt about officers complaining about having to change equipment, he said, "If you don't like it, find another job." This is of concern because one of the most common traits among all law enforcement officers, particularly those who are seasoned, is their resistance to change (9).

Major Paul Dillon, a fifteen year veteran of the UMDPS, is the commander of the police services bureau. He is responsible for the operations of all patrol squads as well as major incidents on campus. He is also the current public information officer - the person who speaks to the press regarding official police business. Major Dillon is responsible for the safety of his officers and the equipment they use. He is very receptive to the idea of getting new equipment for the officers. He points out, however, that the state's current financial crisis is a major factor in deciding whether or not purchasing new vests for his 74 sworn officers is feasible. Additionally, the new vests would have to be comparable in size and weight, and any increase in price would have to be justified by an increase in safety. Despite his hesitations, safety is his top priority (4)

Officer Surveys

In order to establish that the patrol officers of UMDPS would be willing to wear a vest in a higher threat level, we administered a survey to them through the department's email system and received 26 total responses. Considering that the total number of patrol officers for the department is only 45, we are confident that our survey of more than half of the patrol officers will adequately reflect the views of the 6 patrol squads as a whole. The three questions we asked were:

1) Would you be willing to wear a more protective vest?
2) What if the vest was a little more uncomfortable?
3) What if you had to pay a portion of the increased cost for buying the vest?

96% of the officers (all but one) said that they would be willing to wear a more protective vest. None were undecided. 73% of the officers would be willing to wear a less comfortable vest and 11% had not decided. 38% were willing to help pay for the vests, and 30% had not decided. Please see Figures 4-6 for a graphical representation of these statistics (11).

Figure 4: What Would You Wear?

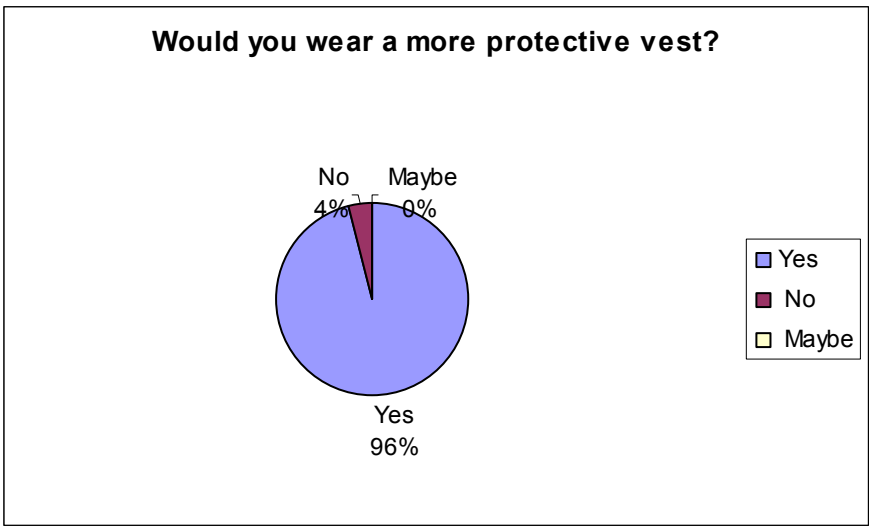


Figure 5: Comfortability Survey

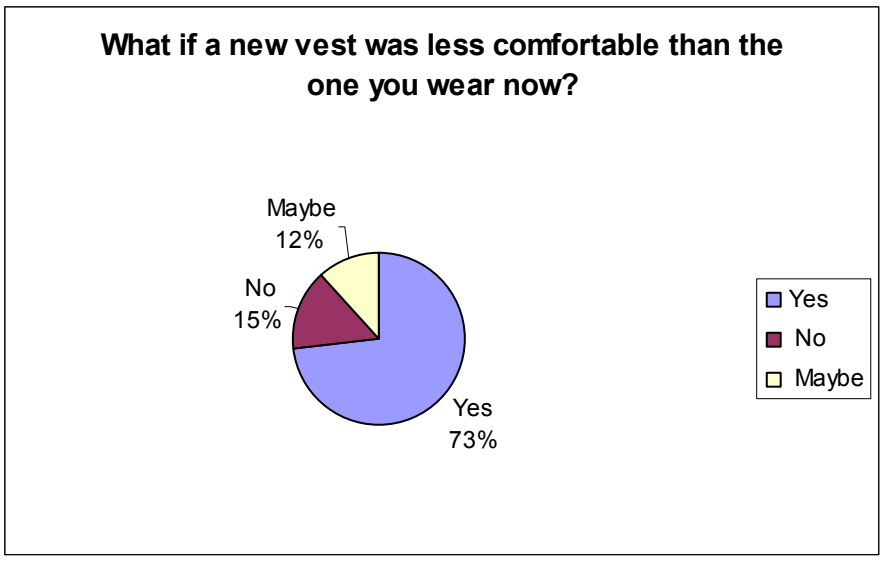
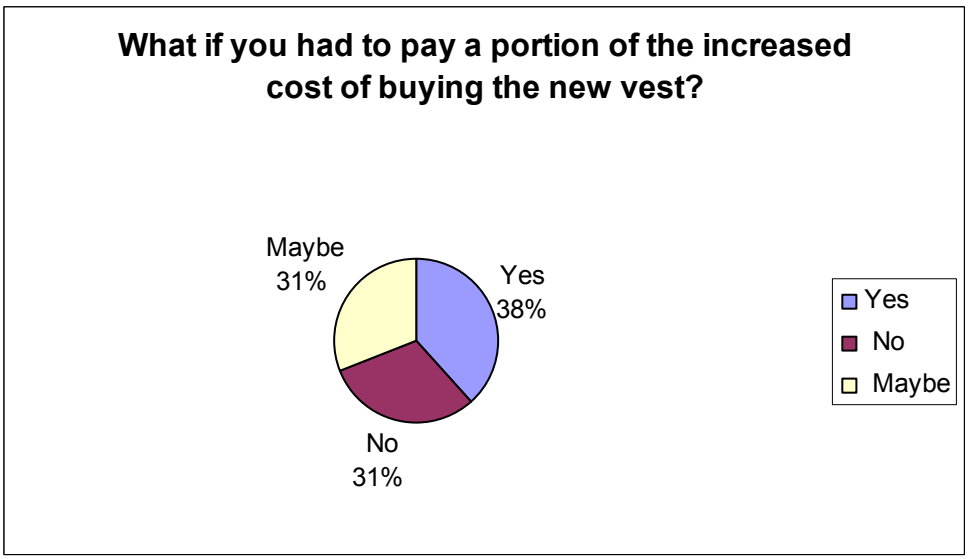


Figure 6: Would you pay for it?



Budgeting and the Bulletproof Vest Partnership Act

Understandably, cost is of great concern to police administrators. The United States Department of Justice, the Office of Justice Programs, and the Bureau of Justice Assistance are aware of this, and in 1998 they issued The Bulletproof Vest Grant Act. This act grants federal funding to any federal, state, or local law enforcement agency on U.S. soil (including the American Samoa, Guam, and Native American Tribes' police departments) to help defray the costs of ballistic-resistant and stab-resistant vests. Funding priority goes to departments with jurisdictions with a total population less than 100,000; these departments will receive 50% of their total vest costs. Funding for police departments with larger jurisdictions will received up to 50% of their total costs, depending on remaining funds. According to

the Grant's website, Maryland State Police is allotted $8,048.49, allowing them to buy 412 vests. The University of Maryland Department of Public Safety is not listed (14).

Recommendation

As shown by the above stated recent events, research, analysis of current equipment, interviews, media reports, and officer surveys, the protective gear worn by officers of the Maryland State Police and the University of Maryland Department of Public Safety is inadequate for today's risks. Recent events have proven that officers face threats at unprecedented levels, and so the body armor of the past is invariably insufficient. Accordingly, we make the following recommendations:

1. The Maryland State Police and the University of Maryland Department of Public Safety should make threat Level 4 vests available to their officers. Because Level 4 vests are hard body armor and heavier than the currently issued vests, we propose that Level 4 armor be issued to personnel for specific events where they are more likely to be targeted than during their normal patrol shifts. The vests currently used are appropriate for everyday work. However, for riots, static posts during sniper sprees, or tactical maneuvers, Level 4 vests are necessary and should be available.
2. The University of Maryland Department of Public Safety should not continue to use PointBlank brand ballistic-resistant vests. Media reports have shown that a wide range of PointBlank's vests are of questionable quality. There are many other vest manufacturers in the market at comparable prices who have not had their equipment fail field tests as PointBlank's vests did. Examples of such brands include P.A.C.A., Alpine Armoring, and American Body Armor.

Summary

Recent events have proven to us that the soft body armor worn by police officers in the state of Maryland is insufficient to protect them from today's criminals and their powerful weapons. There are more protective vests available than the ones currently in use that police administrators could issue to their officers. High-ranking department officials have said that they are willing to change equipment (if feasible), officers have said that they would like to be better protected, and the federal government has allowed for funding for police departments to buy vests. To the best of our knowledge, it would only be beneficial to both departments to begin implementing our recommendations.

Glossary

Ballistic = Refers to the activity of bullet that is in motion

Flechettes = A small projectile that is part of a larger one.

Ft/s = Feet per second. This is the unit of measurement for the velocity of bullets.

Full metal jacket = Refers to the full metal casing that encompasses the projectile of the bullet.

Jacketed soft point = A soft point, or projectile made of a rather soft metal, encompassed by a full metal jacket casing.

Kevlar = DuPont fiber used to construct ballistic vests

Magnum bullets = Magnum refers to a heavy grain load creating more velocity for the bullet.

NATO Ball = A high velocity rifle bullet used in fully automatic weapons

Round = Another term for bullet.

Shrapnel = Remnants of metal objects.

S.T.A.T.E. = Acronym for the Maryland State Police S.W.A.T. team

S.W.A.T. = Acronym for Special Weapons And Tactics

Troopers = Sworn officers of the Maryland State Police

Endnotes

1. "Census Bureau Homepage." Accessed: December 2, 2002. www.census.gov

2. Phone conversation with Personnel Department of the Maryland State Police Headquarters in Pikesville, MD on December 2, 2002 at 10:00 a.m. 410-486-3101.

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6. Anonymous. "NIJ Gives Assessment of Ballistic Armor." *Crime Control Digest*, Vol. 34, Issue 51. Fairfax: December 22, 2000, 4.

7. Mandelblit, Bruce D. "The New Role of Body Armor for Security." *Security.* Vol. 36, Issue 12. Troy: December 2001, 45-46.

8. Hoffman, John. "Body Armor Improvements." *Law & Order*. Vol. 48, Issue 4. Wilmette: April 2000, 90-94.

9. "Bulletproof Vest Partnership Program." Accessed: November 15, 2002. www.vests.ojp.gov/index.html

10. Ballistic Resistance of Police Body Armor (NIJ Standard 0101.03)." Accessed: October 29, 2002. www.nlecte.org/txtfiles/BodyArmorStd/NIJSTD010103.html

11. Runk, Keith. Personal Interview on November 9, 2002 at 1:00 p.m. at Byrd Stadium, College Park. 410-799-2101.

12. Danner, Patrick. "Union Raises PointBlank Safety Charge." Miami Herald: September 13, 2002, 3.

13. Ross, Brian, Rhonda Schwartz and David Scott. "Tests find some 'Bulletproof' Vests to be Defective." World News Tonight with Peter Jennings broadcast. ABC News: October 1, 2002.

14. Danner, Patrick. "Union Raises PointBlank Safety Charge." Miami Herald: September 13, 2002, 3.

15. Ross, Brian, Rhonda Schwartz and David Scott. "Tests find some 'Bulletproof' Vests to be Defective." World News Tonight with Peter Jennings broadcast. ABC News: October 1, 2002.

16. Runk, Keith. Personal Interview on November 9, 2002, at 1:00 p.m. at Byrd Stadium, College Park. 410-799-2101.

17. Dillon, Paul. Personal Interview on November 5, 2002, at 1:30 p.m. in BLDG 003, Rossborough LN, College Park. 301-405-5762.

18. Email survey of UMDPS patrol officers, conducted by Matthew Anderson on November 6, 2002.

19. “Bulletproof Vest Partnership Program.” Accessed: November 15, 2002. www.vests.ojp.gov/index.html

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7. Danner, Patrick. "Union Raises PointBlank Safety Charge." Miami Herald: September 13, 2002.

8. Dillon, Paul. Personal Interview on November 5, 2002 at 1:30pm in Bldg. 003, Rossborough Lane, College Park. 301-405-5762.

9. Email survey of UMDPS patrol officers, conducted by Matt Anderson on November 6, 2002.

10. Hoffman, John. "Body Armor Improvements." *Law & Order* Vol. 48 Issue 4. Wilmette: April 2000. pages 90-94.

11. Mandelblit, Bruce D. "The New Role of Body Armor for Security." *Security* Vol. 38 Issue 12. Troy: December 2001. pages 45-46.

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