

**House Report 107-532 - DEPARTMENT OF DEFENSE
APPROPRIATIONS BILL, 2003**

ADDITIONAL VIEWS OF THE HONORABLE MARTIN OLAV SABO

While the bipartisan spirit with which the Committee has developed a wise and workable future Army artillery program gratifies me, I remain deeply concerned over the Defense Department's determination to terminate the Crusader next-generation artillery program.

Three Defense Secretaries, three Secretaries of the Army, and three Army Chiefs of Staff have testified before Congress that the lives of U.S. soldiers are at risk due to the Army's outdated artillery.

Twelve nations outrange the Army's existing Paladin artillery cannon, including the so-called 'axis of evil.' Twenty-eight nations are now developing artillery that will outperform the Paladin, which was first designed in the 1950s. Under the Administration's proposal to cancel Crusader, Paladin would continue in service until at least 2032--at which time its basic design will be 80 years old.

The Army has expressed deep concern that the Paladin chassis cannot perform for this long, or be modified satisfactorily to fire the precision munitions now being developed that the Administration places so much faith in. Further, the Paladin's lack of mobility and range is a handicap for the Army's transformation strategy based on speed and more widely dispersed forces.

The Crusader program was on track to give the U.S. one of the world's fastest and most accurate artillery systems in order to support and protect U.S. troops in battle. Its prototype gun and automatic reloading system has already fired over 6000 rounds in the Arizona desert demonstrating the capability of firing ten rounds a minute out to a range of 40 kilometers compared to 30 kilometers for Paladin.

When completed, Crusader would have moved twice as fast as Paladin, had three times its rate of fire, and sixty percent fewer crewmembers. At \$10 million per system, Crusader would have cost less than one Blackhawk helicopter or two M1-A2 Abrams tank upgrades.

The Department's desire to terminate Crusader seems to stem from a view that artillery warfare is obsolete, and that air-delivered precision weapons and the development of new precision artillery shells to be fired by Paladin are adequate substitutes.

However, for certain artillery missions, such as suppression of enemy forces and denial of terrain, a high volume and rate of fire are more important than precision. Our soldiers also tell us of the limitations of close air support that have little to do with better precision--weather, timing, availability of aircraft, target identification, munitions loading and reloading, air-ground communications, smoke and confusion, imperfect intelligence and modern surface to air missiles. The Army has argued convincingly that our soldiers still need cannons, like Crusader, to provide lifesaving close support on a minute's notice, 24 hours a day, in all weather.

In lieu of Crusader, the Department proposed to accelerate development of precision weapons such as Excalibur, NetFires, and Guided MLRS. However, that recommendation was not accompanied by thorough cost and capabilities analysis of these high-risk programs. To make matters worse, there is serious risk that relying

solely on these alternatives would cost far more than Crusader, without providing equal capability.

In the case of Excalibur, the physics of putting sensitive guidance systems in an artillery shell are extremely challenging, and there is no guarantee that the technical hurdles can be overcome. Excalibur is currently projected to cost \$220,000 per round for the first 9,000 rounds. The Guided MLRS is projected to cost between \$55,000-\$65,000 per round. These costs compare to about \$250 to buy a standard 155mm high explosive artillery round. NetFires is still in a very early conceptual stage of development, and the projected per unit cost for its munitions is roughly \$125,000.

Despite the breezy optimism we have heard that these technical risks and costs can be overcome, the Pentagon's record of fielding new technology on schedule and on budget is horrendous.

Recognizing the importance of maintaining a robust Army artillery development program, the Committee has worked hard to provide more money to accelerate and transfer the best elements of Crusader artillery technology to Objective Force Artillery and Resupply systems for the Future Combat System program, while accelerating the development of a range of compatible precision munitions and related technologies.

Under this plan, the Army will develop and field, by 2008, a first-rate artillery system to protect U.S. combat troops. To achieve this goal in this short period, the Committee recognizes that more money and a strict program schedule will be required. In addition, it will be critical to retain the fine technical team that produce the artillery technology breakthroughs under the Crusader program.

It is my hope that the Department will join the Committee in promoting this Non-Line of Sight artillery solution as the best course to transform the Army and protect American soldiers in combat in the near term.

MARTIN O. SABO.

ADDITIONAL VIEWS OF HON. NORMAN D. DICKS AND HON. CHET EDWARDS

THE GAMBLE ON CRUSADER

The Administration's recent decision to terminate the Crusader artillery system is a decision fraught with risk. Risk that we hope will not end up costing soldiers' lives.

The Crusader self-propelled howitzer has been under development for the last eight years. This program is running under budget and on schedule with fielding of the first new howitzer set for 2008. The Crusader has been considered by the Army to be its highest priority acquisition program, because it would rectify the one glaring operational weakness that endangers the Army's battlefield success--heavy artillery support.

Currently, our Army is outgunned in heavy artillery by at least 12 different countries (including all 3 countries in the so-called `Axis of Evil')--a situation the Crusader would rectify. It is estimated that as many as 40 countries could soon have artillery systems that out-range the Army's current howitzer--the Paladin--and that 28 countries are developing artillery-delivered high precision munitions to complement these systems. Clearly, most other countries around the world plan on making high performance heavy artillery a mainstay of their military force for some time to come.

Last month, the Administration took the highly unusual step of deciding to cancel the Crusader program in the middle of the budget cycle. This action was taken without consultation with the Army's military leadership, and over their strong substantive objection. This decision will fundamentally alter the role that U.S. heavy artillery will play in future battles, yet we have seen very little evidence of any serious analytical effort to support this radical departure from the Army's accepted doctrine.

The Administration has essentially made a giant strategic bet on behalf of our land forces that the combination of future advances in precision cannon and rocket munitions (as distinguished from precision bombs and missiles) combined with hoped for perfection of real time target identification and selection technology (based on ubiquitous `24/7' all weather surveillance capabilities) will supplant the need to replace the Army's outdated Paladin howitzer with a system that shoots farther and faster.

This decision depends upon unproven technology and unproven tactics--betting that more traditional lethality and combat overmatch capabilities can be replaced by precision and speed. It is a decision that--as the Army's vaunted 'Crusader talking points' said--'could put soldiers' lives at risk' if the Department's hypothetical assumptions about how and where future wars will be fought turn out to be wrong.

What is somewhat puzzling to us in that the Army's artillery upgrade plan that the Secretary of Defense has now rejected calls for improvements in both areas--lethality and precision. The Army's Crusader plan that was devised in the last Administration and endorsed in the first two Bush Administration budgets called for fielding the new world-class Crusader howitzer by 2008 giving the U.S. Army an artillery system that is operationally and technologically superior to any artillery system in the world. The second part of the Army's plan was to perfect and field the GPS-guided Excalibur projectile to shoot from the Crusader within 3 to 5 years after the Crusader was in the force. The combination of Crusader and Excalibur would give the Army a truly devastating capability to support its soldiers--combining unprecedented accuracy with vastly superior rate of fire and range.

The Army had a prudent and affordable plan that recognized the possibility that developing precision-guided cannon projectiles and rocket systems is a difficult task that may end up falling short of expectations. Contrary to popular wisdom, precision-guided cannon and rocket systems are not perfected yet. Shooting sensitive high-tech precision guidance systems out of cannons exerts several hundred times the G-forces exerted on air-delivered precision-guided bombs and missiles such as JDAM or Tomahawk, and the cost that contractors propose charging to overcome these factors is very high at the current time. For instance, the Army's published plans call for paying \$222,000 per round for the first 9,417 Excalibur projectiles when and if they are perfected. This is 7 times greater than the Secretary of Defense' target price of \$33,000 per round, and many experts question whether this target price will ever be achieved. It seems the Army had a very prudent plan--both from a warfighting perspective and from a development and cost risk perspective--that the Secretary of Defense summarily and unilaterally rejected.

So what is the Army left with under the Administration's new plan? In essence, the Army will be left with the outdated Paladin howitzer that sits on a 40-year-old chassis design that has already been upgraded six different times. The Paladin of the future will continue to shoot standard 155mm ammunition at low rates of fire and at substandard ranges as well as the new Excalibur precision projectile if it can be perfected, if the Paladin chassis can be shown to withstand the additional forces generated by firing this new round.

Whether the Excalibur works or not, the Administration now plans on keeping the Paladin in the force until 2032 when the Future Combat System will finally phase it out.

The Administration explains that the risk of keeping the Paladin is acceptable because the greater precision and range of Excalibur rounds and the projected availability of fire support systems such as Guided MLRS and air-delivered precision munitions can cover the existing indirect fire support shortfall. Aside from the issues of bad weather, responsiveness, and ability to support the close fight, this new plan discounts many of the traditional roles of artillery that depend upon volume of fire over accuracy--such as fire to suppress enemy attacks, and cover fire to protect friendly troop movements or to protect sectors of a battlefield. Rate of fire is completely discounted as a priority under the new plan.

It does not overstate the case to say that Army military leaders do not support this plan--they see too much risk. While the Administration points to skirmishes in Afghanistan to support its bet on precision, many of our military leaders worry about the potential major battles that could erupt in Korea or other theaters where mechanized forces will determine the outcome. A high level Defense Department official echoed these exact concerns just 3 months ago when discussing the Crusader:

Unless we want to have no new artillery facing North Korea's artillery, we need something. We have to remember, it's not just a matter of fighting on horseback with satellites and B-52s as we did in Afghanistan. We still face Kim Jung-II in North Korea. We still face Saddam Hussein in Iraq. We face others who use conventional weapons and the question then becomes do you want to modernize those or do you not- Dov Zakheim, Comptroller, Department of Defense. Comments on The News House With Jim Lehrer March 18, 2002.

The Crusader decision also signals a troubling change of direction about how we will equip and fight our future force. Over the last several decades there has been a consensus that we should take maximum advantage of America's Scientific and technological strength to field military systems and devise military strategy and tactics to achieve decisive 'combat overmatch' capabilities against any potential opponent. General Michael E. Ryan, former Air Force Chief of Staff, succinctly summed up the combat overmatch philosophy as follows:

I'm not interested in fair fights. What I'm interested in is a 100 to nothing score, not 51-49.

This philosophy has proven its worth--not only does it save American lives on the battlefield, but it is an effective way to win the peace. Our vastly superior military capabilities cause potential adversaries to think twice before confronting us or our allies militarily, which contributes significantly to world

peace and stability. This was not always the case, and we must continue to work at keeping this edge.

Of all the military services, it is perhaps most important for the Army to continue with the philosophy of 'combat overmatch' through superior technology. Unlike the Air Force and the Navy, we have a small Army compared to other countries. Currently, eight other armies in the world outnumber our Army. We make up for this with superior people, superior leadership, and superior technology, but numbers still matter if we let our technological edge slip.

It is disturbing that the Defense Department seems willing to rest on the laurels of past administrations and go back to a philosophy of 'just enough.' The Crusader would provide US military personnel with the best technology in the world that meets a known deficiency of a military service that American industry has shown it can deliver on time and on budget. The Crusader system is a state-of-the-art heavy artillery system that has already produced 7 new patents from its new technology. Over 6,000 test rounds have already been fired and the system is meeting or exceeding range, rate-of-fire, and reliability requirements by all accounts.

It is simply hard to understand why a system that meets the biggest Army warfighting deficiency is being scrapped.

If the President persists in demanding the termination of the Crusader, the weaknesses of the outdated Paladin (with or without the Excalibur projectile) make it imperative that we expedite the development and fielding of the Objective Force next generation artillery system. American soldiers do not deserve to continue to endure the risks of substandard artillery support. This deficiency must be eliminated as quickly as possible.

We therefore support the Committee position of adding \$173 million to the \$195 million budget request for development of the Objective Force artillery system in order to field a new system by 2008. This would accelerate the Army's old schedule by four to six years. This acceleration is possible only if the Army uses the existing Crusader engineering team and leverages the technology advances garnered with the Army's \$2 billion investment that has already been spent on Crusader development.

Following are some of the detailed answers received from DOD to our specific questions on the Crusader that have been raised in the course of this debate.

1. How does the Crusader compare to other top foreign systems? Why don't we simply buy one of those systems?

A comparison of the most advanced artillery systems in the global marketplace available to our allies shows why the Army believes the Crusader is a superior artillery system. The Crusader delivers more firepower

is more mobile, protects its crew better weighs less, uses fewer crewmembers, and is the only system that can be fully networked on the battlefield.

COMPARISON OF MODERN SELF-PROPELLED HOWITZERS

	Paladin (U.S.)	G6 (S. Africa)	AS90 (U.K.)	Crusader (U.S.) PzH2000 (Germany)
Max Range (km) *	30	30	37.4	40
Max Rate of Fire *	Indefinitely	4/minute for 3	3/minute for 3	10 to 12/Minute.
Crew Size (howitzer + resupply veh)	4 + 4	6+resupply crew	5+resupply crew	3 + 3
Curb Wt. (ton)	27	52	46.3	40
Combat Wt. (ton)	32	55.6	50.7	50
Horsepower	440	520	660	1500
Projectile Qty.	39	45	58	48
Accuracy	232m@30km	Unknown	246m@30km	96m @ 30km
Simultaneous rounds on target (MRSI Capability)	N/A	Unknown	Unknown	200m@km
Highway Speed (km/hr) *	60	85	52	4-10 rounds
X-Country Speed (km/hr) *	27	30	25	2-6 rounds
NBC Macro Protection	No	No	No	67
Resupply Vehicle	Yes/Manual	No	No	62.5
U.S. Command & Control	Yes/Not All	No	No	48
				Yes
				No

2. How Much Does Crusader Cost?

A two-vehicle Crusader system (howitzer and resupply vehicle) could be procured for about \$10.01 million (recurring production costs, FY 01 constant dollars) which is about 70% of the cost of one Army Blackhawk helicopter. In budget terms, the total procurement cost of \$7 billion for 480 systems (another \$4 billion is for development) is substantial in and of itself, but in terms of the total Defense budget the Army's planned average appropriation

level of about \$1 billion per year represents about one percent of the Army's annual budget, and about 3 tenths of one percent of the annual Defense Department budget. The total cost of the entire Crusader procurement is less than one year's worth of research for the missile defense program.

3. How much are the new Excalibur and guided MLRS munitions expected to cost, and how does that compare to standard 155mm ammunition?

Excalibur. The latest February 12, 2002 Army estimate pegged the future Excalibur program acquisition cost for the first 9,417 unitary projectiles at \$222,000 per round, or a total cost of \$2.1 billion. The Army could purchase nearly half of the entire Crusader fleet (209 out of 480 systems) for the cost of the first 10,000 rounds of Excalibur ammunition. The Administration's target unit cost for Excalibur unitary is \$33,000 per round for 200,000 rounds, a seven-fold decrease compared to the current price, for a total cost of \$6.6 billion. In addition, the Administration plans on buying an additional 40,264 Excalibur sensor-fused (infra-red sensing skeet bomblets) projectiles at \$96,000 per round, for a total cost of \$3.9 billion. The past Army track record in precision/smart munitions programs (SADARM, MSTAR, BAT, WAM, Copperhead) does not support this cost reduction assumption. But assuming the Army can attain these 'best cost' estimates, the cost of the first 200,000 rounds of Excalibur unitary and 40,000 rounds of Excalibur sensor-fused projectiles would cost \$10.5 billion, more than one and half times the total cost of the Crusader procurement (\$7 billion). If the \$33,000 'best cost' estimate for Excalibur unitary cannot be reached and the price can be reduced by only 50% to say, \$100,000 per round, the total cost for Excalibur unitary projectiles skyrockets to over \$20 billion in order to attain the Army's initial 200,000-unit inventory objective. In any case, it would require annual appropriations of well over \$1 billion per year in order to finance the Excalibur production rate efficiencies used as the basis for the target cost estimate--something that is unprecedented for one type of round of Army ammunition. It is also expected that the Army Excalibur inventory objective over time would increase well above 200,000 units.

Guided MLRS. The latest Army estimates peg the expected cost of Guided MLRS unitary rockets at \$65,000 per unit. Assuming that the Army would fire a minimum of two rockets per target, the cheapest 'kill' cost for a truck or a tank using guided MLRS would be \$130,000. Each salvo of 12 MLRS rockets would cost \$780,000 for unitary warheads (equivalent to the cost of 3,250 155mm projectiles).

Non-precision 155mm HE ammunition. The Army's most recent purchase of M107 HE 155mm projectiles was \$240 per round for 155,000 rounds. M795 HE rounds are estimated to cost between \$500 and \$770 per round.

Inventory. The Army has an inventory of over 4.2 million 155mm HE rounds already paid for. There are no Excalibur projectiles or Guided MLRS rockets in the current inventory.

4. The Army has the best tank, the best infantry fighting vehicle, and the best attack helicopter in the world. Why has the Army operated so long with an inferior heavy artillery system?

During the late 1970's and 1980's the Army introduced new families of fighting systems that included the Abrams tank, Bradley fighting vehicle, air defense systems and helicopters such as Apache and Blackhawk. Due to fiscal constraints and diverging priorities in the mid 80's, the field artillery was forced to skip a generation of cannon modernization.

During that time period, the Army developed the Multiple Launch Rocket System (MLRS) to satisfy its deficiency in deep attack and Paladin was developed as an interim solution for its cannon deficiencies. Consequently, Paladin was a simple product improvement to the old M 109 that lacked mobility, lethality, and survivability. Because of the limitations of the chassis, Paladin lacks the potential for significant product improvement.

5. Can indirect cannon fire support missions be accomplished by greater investment in other systems--aircraft, missiles, and rockets?

U.S. ground forces have traditionally required a mix of rocket, missile and cannon systems to meet their fire support requirements. Cannons have historically provided close support to the maneuver arms on a 24-hour all weather basis. Although the unique characteristics that made cannon systems ideal for this mission are becoming less distinct as the capabilities of precision and smart munitions are improved, several distinct characteristics are likely to remain.

Flexibility and responsiveness. Flexibility and responsiveness are probably the cannon's hallmark. The close combat environment demands the ability to rapidly accommodate change. Cannon systems are more responsive to rapidly changing battle conditions because they carry a readily available quantity and variety of munitions and can rapidly change from one type of munition to another as required. Cannons reload by individual rounds vice pods for rockets/ missiles. Rocket/missile pods can only accommodate one type of munition at a time. Often, the type of rocket/missile pod loaded may not be the optimum munition required for the specific target. Fires and effects coordinators then face what can be a dilemma. They must either search for launchers loaded with the correct munition, fire the launcher loaded with the less than optimum munition, or direct reload. Launcher reload operations can take approximately 7-20 minutes, making them less than ideal in a time critical situation. Aircraft carry limited amounts and types of munitions and must land to reconfigure or replenish their load. Aircraft reload cycles are generally much longer than missile and rocket systems. Army data indicated that a Crusader battalion could provide 130 tons of munitions in one hour, and 900 rounds in close support before the first aircraft sorties arrives on station.

Continuous Fires. Cannon systems are more capable of providing continuous fires (fires without gaps over a period of time) than are rocket/missile launchers and aircraft. With an actively cooled cannon, and fully automated rearm and resupply provided by Crusader resupply vehicles, the capability to provide continuous fires is greatly enhanced. Cannons have the capability to shift from target to target quickly--a matter of seconds in many cases. While launches do well in providing massed fires, there can often experience unacceptable gaps for reloading operation in sustaining fires.

Employment in Proximity to Friendly Forces. Providing fires in close proximity to friendly forces is an essential fire support task in the close fight. The minimum safe distance as measured by bursting radius is considerably smaller for cannons compared to existing rocket/missile systems. Final protective fires and 'danger close' missions end up placing fires extremely close to friendly forces. The smaller bursting radius of cannon munitions enables the 'echelonment of fires' whereby the infantry uses a succession of cannon and mortar systems interchangeably to maximize the coverage of fires until they must be shifted or lifted. Close fires require accuracy, responsiveness, timely delivery, and 'controlled' (or limited) effects (burst radius), to reduce risk to supported forces. Cannon artillery can be employed much closer to our forces and is an absolute necessity in the close support role since it can be employed in all weather, in all terrain, day or night. Weather can severely hamper close air support. For instance, during the Kosovo air campaign, 56% of sorties were aborted due to weather. Of those sorties executed, 33% were adversely affected by weather, resulting in less than half of the targets being effectively engaged.

Sustainability. Accordingly to the Army, the logistical footprint for cannons is generally smaller than for rocket/missile launchers based on ammunition weight and cube size.

Cost of Munitions. Cannon munitions have historically been less expensive than rockets or missiles on a per-unit cost basis, and they provide a larger family of munitions to select from the deal with battlefield dynamics. Compared to the expected range of cost for new precision guided cannon and rocket munitions, the cost per round of non-precision 155mm cannon projectiles is cheaper on the order of 140-925 to one (see #3 above).

6. Will there be a void in indirect fire support with out Crusader?

Possibly. According to the requirement that was developed by the Army and approved by the Joint Requirements Council of the Joint Chiefs of Staff, the Paladin was judged to be not mobile enough to keep up with our mechanized force in a maneuver-dominated fight. The Army is also concerned that the Paladin's range and rate-of-fire limitations prevent it from providing the required counter-fire 'umbrella' for our forces. In addition to the significant increase in mobility, range, and rate-of-fire, Crusader provides the responsive, continuous fires and mobility required for fast moving close

combat operations. Its automated ammunition handling and resupply system combined with an actively cooled cannon provide accurate sustained fires where needed in the required volume. Crusader interoperability with Joint and all Army command and control networks assures that effects are delivered when needed; providing direct link capability to any platform on the battlefield.

7. How old is Paladin and how much longer would it need to be in the force if Crusader is cancelled? Can Paladin be upgraded to meet many of the Crusader requirements?

The M109 series howitzer design began in the mid-1950s and entered service in 1961. Paladin is the sixth modification to the M109 design--no Paladins are new howitzers. While maintaining virtually the same chassis, engine, transmission, and basic suspension, the Paladin's weight has grown by one third from 24 tons to 32 tons. The armament system has grown from a 24 caliber cannon with a range of 14 kilometers to a 39 caliber cannon with a range of 30 kilometers.

The Crusader was planned to remain in the force beyond 2032. If Crusader is not available and the M109 series howitzer must be continued in its place, it is probable that it too would be in the field in 2032. This would mean that the M109 series howitzer would be in the field 70 years after it initially entered service. The soldiers in 2030 could be fighting with the same howitzer used by their great grandfathers.

The Army evaluated the prospect of improving Paladin during the Cost and Operational Effectiveness Analysis completed for Crusader's Milestone 1 decision and the Congressional report delivered in December 2000. The analysis shows that to attain Crusader's rate-of fire (10-12 RPM), cross country mobility (39-48 KPH) and firing range (40-50 KM), Paladin would require an automated ammunition handling system, increased horsepower, improved suspension, and a cooled 56 caliber cannon. Paladin lacks sufficient growth capacity in the chassis to allow these improvements. To strengthen the chassis to withstand these stresses would require replacing or significant design changes in the hull structure, hydraulics, engine, transmission and suspension sub-systems.

8. Is Crusader rate of fire oversold because it can't be resupplied at high enough rates? What is the logistical plan to resupply Crusader during maximum rates of fire?

Ammunition resupply has been an issue that has plagued artilleryman for years. Because Crusader has a fully automated resupply system, it allows a 300% improvement

in resupply operations. The key to successfully achieving this new resupply requirement will be the fielding of fully automated resupply vehicles (RSVs)

that can rearm a Crusader howitzer with 48 rounds and refuel it in 10 minutes--a 50% improvement. One technique employs two resupply vehicles (RSV's) per howitzer battery in the vicinity of the firing area to conduct rearming and refueling, two RSVs in hide areas with full loads of ammunition, and two RSVs uploading at the Logistics Resupply Point. Other methods may be employed, depending on the individual tactical situation, and considerations of distances that have to be traveled between the locations. The introduction of the wheeled RSV gives the commander enhanced flexibility to conduct resupply operations depending on the threat. For example, when facing a high counter fire threat, the commander could deploy the tracked resupply vehicles forward providing maximum protection for the crew while using the wheeled vehicles to upload and transport ammunition in the less vulnerable rear positions and transfer the ammunition to the tracked carriers. In a low counter fire threat, the commander could also deploy the wheeled vehicles forward maximizing throughput of ammunition. The automatic resupply and cannon autoloader capability is a major technological leap forward for the Army, which has never had this capability before.

9. What force structure was sacrificed in anticipation of fielding Crusader? Will structure be added back if Crusader is terminated? What will that cost?

In anticipation of the increased firepower and productivity of the Crusader system, the Army reduced force structure in both maneuver and fire support units by 25 percent in the mid-1990s. The Army reduced Paladin and all other cannon battalions from three batteries of eight howitzers (3x8) to three batteries of six howitzers (3x6). MLRS battalions were also reduced to 3 batteries of 6 launchers each (down from 8 or 9 launchers each). At the same time, Army tactics were changed to take full advantage of the speed of its tanks, Bradley fighting vehicles, the Crusader, and other situation awareness capabilities, increasing the planned battle space for Army forces by over 200 percent. Termination of the Crusader will necessitate a reexamination of Army force structure, tactics, techniques, and procedures.

10. What are remaining development and cost risks of the Crusader?

The Army has testified that it rates the Crusader program a moderate to low risk for technical performance, cost, and schedule. The software build for Crusader is on schedule and within cost estimates. The range and rate-of-fire key performance parameters are being demonstrated with the first prototype vehicle at Yuma Proving Grounds and the resupply and mobility are on schedule for demonstration in 2002. Over 6,000 test firings have shown the Crusader to be 142% more accurate to date than Paladin. Accuracy improvements come from:

- A new projectile tracking system that removes meteorological errors;
- Precision pointing with electric drives;

Thermal management
 Muzzle velocity management;
 On-board projectile weighting;
 Inertial reference unit coupled to GPS to null out position errors.

The program has been focusing significant effort on building the reliability of the system in order to remove soldiers from the technical and manual operational aspect of fighting a weapon system.

11. How much does the Crusader weigh and what can carry it?

The Crusader howitzer was redesigned several years ago to reduce its weight from 60 tons to 40 tons. Under the Army's current plan, Crusader artillery would be either prepositioned or moved by sea as part of a counterattack corps. If needed, Crusader systems could be airlifted on C-17 or C-5B aircraft. Deployments by airlift would most likely entail a battery of 3 Crusader systems to meet special contingencies. Crusader airlift ranges would be:

	Nautical
	Miles
C-17:	
2 howitzers (84 tons)	2,276
1 howitzer and 1 resupply vehicle (w) (73 tons)	2,782
C-5B:	
2 howitzers (84 tons)	3,200
1 howitzer and 1 resupply vehicle (w) (73 tons)	3,500

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