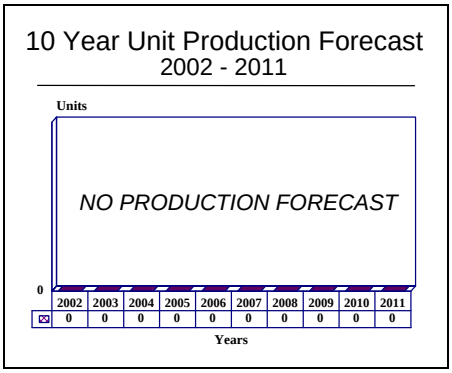
XM2001 Crusader 155 mm Self-Propelled Howitzer and XM2002 Self-Propelled Crusader Resupply Vehicle - Archived 3/2003

Outlook

- The Crusader was the United States Army's designated follow-on to the M109A5/A6
- Technical problems related to the now-abandoned liquid-propellant technology and other areas delayed the program
- Procurement objective was 480 units for complete system
- Size, weight, and.price, along with the fact that this was a Cold War weapon, did not fit into new, more deployable US Army and doomed it



Orientation

Description. A tracked, 155 millimeter self-propelled artillery system including ammunition/resupply vehicle.

Sponsor. The development of the Crusader (formerly the Advanced Field Artillery System-Cannon) was being sponsored by the United States Department of Defense through the US Army. The executive agency was the Armament Research and Development Center at Picatinny Arsenal, New Jersey.

Contractors. Although the definitive production contract was never awarded, United Defense Limited Partnership/Armament Systems Division, Minneapolis, Minnesota, was the designated prime contractor for this enhanced self-propelled artillery system. Subcontractors included Alliant Techsystems, Applied Dynamics, Architecture Technologies, Ascent Logic, Boeing, Digital Pilot Corporation, General Dynamics Land Systems Division, General Dynamics Defense Systems, General Electric Power Systems/Honeywell, Honeywell Defense Avionics, Kollmorgan, Lynx, MPC Products, Rational Software, Raytheon, Perkins Engines Limited, Zahnradfabrik Renk, Saunders, Simplex Technologies, Technovative Applications, Teledyne Continental Motors/Vehicle Systems, Textron Marine & Land Systems, Upper Mohawk and Vector Research.

Licensees. None

Status. When it was canceled in May 2002, the Crusader program was in the concept demonstration and validation phase. While the development of the previously favored XM300 regenerative liquid-propellant cannon and XM47 propellant technology is continuing on a technology base level, it was decided in March 1996 to use the new XM297 cannon and its Modular Artillery Charge System on the Crusader. Several US Army agencies are still pursuing these development programs. In May 1991, (then) FMC Corporation was awarded a contract to fabricate the Advanced Technology Transition Demonstrator for the Advanced Field Artillery System-Cannon development program. This vehicle was delivered and is undergoing tests with both the contractor and user. The first preprototypes of the XM2001 Crusader fire unit and XM2002 resupply vehicle have been delivered and are undergoing firing (XM2001) and automotive (XM2002) tests which will soon wind up. The major goal of the system redesign was to reduce the weight. At the time

of cancellation, a wheeled version of the resupply vehicle, based on the M1075 truck from Oshkosh, was in development.

Total Produced. At the time of termination in May 2002, two preprototypes of the XM2001 Crusader fire unit and two preprototypes of the XM2002 resupply vehicle had been fabricated. The first XM2002 ammunition resupply vehicle is not fitted with the ammunition storage and handling equipment.

Application. Mobile medium- to long-range artillery support for the field army.

Price Range. At the time of termination, knowledgeable sources estimated the unit price of the Advanced Field Artillery System-Cannon at $11.003 million in Fiscal 2002 dollars. The tracked XM2002 resupply vehicle unit price was $9.756 million.

Technical Data

Design Features. The Crusader was the first combat vehicle under development for the Army's digitized battlefield of the 21st century. As the restructured program was envisioned, the system would have incorporated an advanced-design conventional cannon, state-of-the-art computerized fire control, and other advanced electronic components. Ammunition upload and transfer from the XM2002 resupply vehicle, as well as loading in the XM2001 fire unit, were to be fully automated. The vehicle would have incorporated drive-by-wire technology.

Crew. A main design criterion was a reduction in the number of personnel required to operate the system as compared with the M109. A three-man crew in the XM2001 and a three-man crew in the XM2002 were specified.

Muzzle Brake. The XM297 cannon is fitted with an integrated pepper-pot muzzle brake.

Recoil System. The XM297 cannon uses a hydropneumatic (Schneider-type) modular design recoil system.

Breech Mechanism. Although the details are unknown at this time, the breech assembly of the XM297 cannon is a multi-lug sliding type.

Ammunition. The Crusader was to be compatible with all United States/NATO-standard 155 millimeter ammunition, including the latest technology rounds now in development. The Crusader was to carry a total of 60 projectiles in two 30-round magazines and 63 propellant charges in two magazines. The XM2002 Crusader resupply vehicle would have held 130 rounds and XM231/XM232 modular charges.

Dimensions. Other than the planned use of a 56 caliber cannon, the dimensions for the proposed Crusader system were never released. The original desired weight was 49.89 tonnes (55 tons), but in a program initiated in late 1999, the system was redesigned in order to reduce this figure to around 36.28 tonnes (40 tons).

Performance. No definitive performance requirements have ever been released, other than that the system was to be able to outrange the comparable threat systems and have a range of 50 kilometers (54,680 yards). A sustained firing rate of three to six rounds per minute was desired, as was a burst rate of 12 to 16 rounds per minute for five minutes. Further details are provided below. Regarding the automotive performance, the maximum speed on a metaled road was expected to be 67 kilometers per hour (41.61 miles per hour), and the cross-country speed was expected to be 48 kilometers per hour (29.81 miles per hour).

Engine. Various engine options were proposed for both vehicles of the new Crusader self-propelled artillery system – ranging from the 8V-71T and VTA-903 diesels to the diesel (Cummins) and vehicular gas turbine (General Electric) contenders for the Advanced Integrated Propulsion System, to other automotive gas turbines such as a derivative of the AGT 1500. The power ratings were equally diverse. A General Electric LV100 vehicular gas turbine mounted in the front of the vehicle powers the automotive test rig that was developed and tested in relation to this program.

In January 1995, United Defense announced that the Perkins Engines Limited Condor CV12 diesel engine had been selected for the Crusader vehicles. This 12-cylinder supercharged diesel engine, which powers the British Challenger and Challenger 2 tanks, is rated at 1,118.6 kilowatts (1,500 horsepower) for the Crusader application. The Caterpillar firm was to manufacture the engine under license and would be involved in the integration and product support of the Condor engine for the Crusader requirement.

In late 1999, a different engine was investigated to reduce the weight of the system. This was related to a re-engining program for the M1 Abrams tank with the program called the Abrams-Crusader Common Engine. The US Army evaluated a variety of industry proposals for such an engine, and in November 2000, it selected the General Electric Power Systems/Honeywell LV100

vehicular gas turbine for this requirement. At the time of cancellation, this integration was ongoing.

Gearbox. At one time, the advanced-design HMPT 1250-EC automatic unit supplied by General Dynamics Defense Systems had been chosen for use in the Crusader. Subsequently, developmental problems in the HMPT 1250-EC program prompted a review of the selection decision. In late 1997, United Defense reviewed the options, and in March 1998 it officially sought alternative sources – Allison, Twin Disc, and Renk. In July 1998, the Army received $5 million to test the Renk HSWL 295 automatic gearbox with five forward and three reverse gear ratios. As of mid-1999, the Renk gearbox seemed to be the preferred solution for the XM2001 and XM2002, but the decision in late 2000 to integrate the LV100 engine changed this.

Suspension and Running Gear. An unspecified externally mounted hydropneumatic suspension system was to be used on the Crusader vehicles. A lighter version of the T158 track, the T158LL, was to be used.

Fire Control. Although system details were never released, the Crusader would have used an advanced computer-based system, which is a component of the US Army's digitization effort. The fully automated fire control system would had included an integrated command and control component, an advanced navigation and position system, a ballistic computer, and a gun-laying system. Fully embedded decision and training aids were to be incorporated into the system.

Variants/Upgrades

Variants. As the program has been canceled, this is not applicable. The XM2002 ammunition resupply vehicle would have been based on the chassis and automotive components of the XM2001 Crusader.

In an effort to reduce program costs, it was decided in 1999 to use a new wheeled chassis for about half of the XM2002 ammunition resupply vehicle requirement. The development of this vehicle, based on the widely used M1075 from Oshkosh, has been terminated along with the rest of the program.

Modernization and Retrofit Overview. Although the Crusader never entered serial production, and at the time of cancellation was undergoing a major redesign, there was already a plan for an Improved Crusader. This system – the M2001A1/M2002A1 – would have integrated further enhanced electronics in the fire control and communications suites, enhanced (possibly active) armor defense, and possibly a new engine and an electro-thermal cannon. Further out, the M2001A2/ M2002A2 was planned – this system would have incorporated further advanced electronic components, redesigned crew positions, new gun control equipment, further advanced protection, and possibly robotics technology. However, the re-alignment/redesign decisions that were put in place for the program in late 2000 effectively putting these plans on hold while the program was restructured.

Program Review

Background. Since the US Army's adoption of the M109A6 Paladin as its next self-propelled howitzer, the following efforts to develop new self-propelled howitzer technology have been terminated: the old Enhanced Self-Propelled Artillery Weapon System, the Division Support Weapon System, and the Howitzer Extended Life Program and Howitzer Improvement Program. Even though the A6 version of the M109 is significantly advanced over earlier versions, it is quite apparent that the basic M109 design is somewhat long in the tooth with little room left for further improvement. By the late 1980s, the Army realized this, stating that the M109A6, a modification program as far as it was concerned, was an interim system to partially fill the performance and numerical gap between United States/NATO self-propelled artillery and the systems developed by the Soviet Union.

Even before the M109A6 was type classified, the Army had embarked on a major development program for a totally new self-propelled artillery system for the 21st century. The new program, initially designated the Advanced Field Artillery System-Cannon, was renamed Crusader in late 1994, and was pre-type designated the XM2001 in 1997 for the artillery system and XM2002 for the ammunition-resupply vehicle. The Crusader program was to be the culmination of the US Army's long-standing effort to develop and field a true self-propelled artillery system.

Design Criteria. Two major design criteria were being incorporated into the Advanced Field Artillery System-Cannon design. Above all, the Army wanted to reduce the personnel-to-weapon-system ratio, a significant reduction of the five- and six-man crews of the M109 and other similar systems. The other criterion

was a quantum leap in the overall crew/system survivability when compared to the M109A6 and similar systems. Of course, a greatly increased range capability and rate of fire was also desired. The Army had requested the following:

1. A range better than the comparable threat systems, and of over 40 kilometers (43,744 yards) with a 50 kilometer (54,680 yard) range.
2. A burst rate of 12 to 16 rounds per minute for three to five minutes, and a sustained firing rate of three to six rounds per minute for an indefinite period of time.
3. Ability to send off the first round within 25 seconds after coming to a halt.
4. A minimal launch/firing signature.
5. Integration of the latest detection and countermeasures technology into the system to reduce its overall signatures and avoid enemy acquisition.
6. Totally autonomous operation including self-location, computation of fire control data and the fire control solution. The ability to correct and maintain accurate fires, even in non-standard meteorological conditions, was required. The autonomous operation capability was to be three to five days less than the fuel and ammunition requirements. The system was expected to be able to operate up to 72 hours in a nuclear-, biological-, and/or chemical-contaminated environment without a degradation to the system's or crew's performance.
7. Ability to fire on the move.
8. A 43.36 to 49.9 tonne (50 to 55 ton) weight with air portability in C-5, C-141, and C-17 aircraft.
9. Unrestricted rail transport.
10. A design that allowed a lightweight version to be developed, with the ability to be transported underslung by intra-theater helicopters or delivered by low-altitude parachute extraction or low-velocity air drop.
11. A modular design with maximum commonality in chassis and other components.
12. Maximum use of composite materials.
13. A design that integrated explosive reactive and/or reconfigurable armor technology in order to be tactically flexible at a minimum weight penalty.
14. System mobility equal to that of the maneuver forces it was supporting.
15. Use of unspecified advanced technology to enhance the system's survivability against "smart" munitions.
16. Self-diagnostic and self-repair capability.
17. Integration of the latest human factors and safety engineering technology to enhance overall performance. A three-man crew for both the XM2001 fire unit and XM2002 resupply vehicle was mandated.

Research Programs. Several US Army technology demonstrator programs contributed to the overall Advanced Field Artillery System-Cannon/Crusader development. The Human Factors Howitzer Test Bed program, run by the Human Engineering Laboratory, was designed to reduce the amount of crew operations while aiding crew performance by enhancing the work environment.

The second program, a longer term effort called Integrated Smart Artillery Synthesis, was run by the Fire Support Armament Center. This program investigated the potential for a crewless self-propelled artillery system. Of special interest was the robotic ammunition handling and loading system, which was mounted in a modified M109.

The third program was the Advanced Technology Transition Demonstrator, begun in May 1991. This program, run by United Defense, fabricated a technology-demonstration system for the Advanced Field Artillery System-Cannon using a surrogate vehicle supplied by FMC Corporation (now United Defense) integrated with the new ordnance, which was supplied as government-furnished equipment. This program was aimed at reducing the developmental and integration risk of the various components of the new self-propelled artillery system before the fabrication of the definitive prototypes was begun. Other firms involved in this effort were Armored Vehicle Technologies Associates, General Motors/Delco Electronics, Dynamics Research Corporation, LB and M Associates, Rheinmetall, Vector Research Incorporated, and (then) Wegmann.

Exotic Technology? Other than stipulating the 155 millimeter caliber, the US Army was quite lenient in the actual artillery (gun) technology that it was willing to consider for the Advanced Field Artillery System-Cannon program. In addition to enhanced conventional artillery technology, other exotic technologies such as liquid propellants and even electro-thermal and electro-magnetic launchers were considered. Most observers originally expected that this enhanced gun system would employ the new unicharge technology being developed by the US Army and several independent

firms. This new modular-type propellant system had long been in development by the US Army. In late 1991, senior Army officials decided that the regenerative liquid-propellant technology would be used in the then-designated Advanced Field Artillery System-Cannon. Nevertheless, the development of the unicharge technology was continued in case the liquid-propellant technology failed, as well as to avoid technological surprise.

The new regenerative liquid-propellant cannon system was designated XM300. The new cannon used a monopropellant, designated XM46, composed of oxidizer, fuel, and diluent. Concurrent to the development of the liquid-propellant technology was the development of the XM773 multi-option artillery fuze.

Why Liquid Propellant? For years, the United States Army has been investigating the use of liquid propellants for artillery and other medium- and large-caliber cannon. The principal advantages of liquid propellants in cannons are as follows:

- Requires a smaller storage area in the combat vehicle than conventional ammunition. One 250-liter container of liquid propellant is equivalent to the 34 propellant charges carried on a M109A2.
- Easier handling on the combat vehicle.
- Increased safety on the combat vehicle, especially if the vehicle is hit.
- Significantly reduced associated logistical support.

Liquid-propellant technology has now evolved into three distinct areas:

- Bulk Loaded – the simplest form of liquid-propellant technology for cannons, but somewhat difficult to control, especially when varying amounts of charge are needed.
- Regenerative – this form starts with some standard amount of propellant, then pumps additional propellant into the chamber as the combustion process proceeds. Therefore, the system achieves control over the amount of propellant, but is mechanically complex.
- Traveling Charge – this, the least developed concept to date, is mechanically complex but offers the potential for very high velocities. As of late 1995, some sources felt that this technology was 15 years off in terms of fielding.

Under a $42 million contract awarded in 1986, General Electric developed a 155 millimeter regenerative liquid-propellant cannon called Defender. This cannon was installed on an M109 for testing. As of 1992, the Defender had performed above expectations. Development was continued by Martin Marietta, which had acquired General Electric's armament business in 1994. Subsequent development was by Lockheed Martin, which absorbed Martin Marietta, and more recently by General Dynamics Armament Systems, which purchased the armaments business from Lockheed Martin.

Up to 1996, the Army had desired that the Crusader use the XM300 regenerative liquid-propellant system, the technology developed for the Defender cannon. In the XM46 regenerative liquid-propellant, the propellant composition is as follows:

- 60.8 percent hydroxyl ammonium nitrate, the oxidizer
- 20 percent water, the diluent
- 19.2 percent triethanol ammonium nitrate, the fuel

In addition, a colorant and odorant are added to the above composition for safety purposes. More recently, the XM46 liquid propellant was "ruggedized" so that it remained useable and fully effective when contaminated by dirt.

Development Troubles. The Crusader program had technical problems related to the regenerative liquid-propellant technology. This is not unusual in the development of any new sophisticated military technology. However, by late 1995, these technical problems were threatening the postponement of the regenerative liquid-propellant technology for the Crusader, or outright cancellation in favor of the conventional technology as described above.

The following is a list of the problems that reportedly were encountered, some of which may have been later corrected:

- Excessive overpressure when firing to the desired ranges of the Advanced Field Artillery System-Cannon program. This could cause problems in man-rating the system.
- Excessive temperatures in the gun tube. This could affect the rate of fire, as well as the dispersion characteristics of the system.
- Vibrations when firing the cannon. These could be caused by uneven burning of the propellant, which in turn could be caused by the injection system. This problem could affect sensitive electronic fuzes and ballistic performance.
- Problems encountered during operation in cold weather.

- Uneven ignition performance, misfirings, and other chamber-related problems.
- Problems relating to the durability of the cannon components.

A 1994 explosion of a test cannon led to a delay in the program, as tests were suspended pending the outcome of an investigation. Although the tests were resumed, another explosion occurred in August 1995; this failure was traced to a fatigued filling hose. The problem was corrected and test firings were resumed later in 1995.

It was finally decided that the technical risks and additional time required to fully develop and man-rate the XM300 liquid-propellant weapon would seriously affect the Crusader schedule. On March 15, 1996, it was announced that the advanced XM297 cannon and the new modular charge solid-propellant system (the XM231 and XM232 charges) would be used on the Crusader. However, liquid-propellant charge technology continued to be developed but at a very slow pace.

The New Armament System. In light of the March 1996 announcement, the new XM297 56 caliber cannon and XM200 mount were to be used on the Crusader. The XM297 cannon is an advanced-design weapon that employs several unique features, including an active cooling (the integral midwall cooled) system that allows for unprecedented high rates of fire, longer barrel life, and a greater degree of accuracy.

The coolant is a combination of ethylene glycol and water. In addition, the chamber and bore of the XM297 cannon are chrome plated. The XM297 is fitted with an advanced-design pepper-pot muzzle brake and multi-lug sliding breech assembly. A new laser ignition system that requires no primer component is used. The Schneider-type recoil system is modular in design. The new Modular Artillery Charge System (the XM231 and XM232 charges), designed to replace the current bag-charge system, eliminates the need to dispose of unused bag charges. The Modular Artillery Charge System uses insensitive munitions technology and consists of two charge components, with the zone number equivalent to the number of charges. The Low Zone (1 and 2) component is the XM231. It is used for Zone 1 ranges (3,400 to 7,900 meters) and Zone 2 ranges (5,600 to 11,900 meters). The High Zone (3 through 6) component is the XM232. It is used for Zone 3 (7,900 to 10,200 meters), Zone 4 (10,400 to 24,700 meters), Zone 5 (15,800 to 30,500 meters), and Zone 6 (19,000 to 40,000+ meter) ranges.

Panzerhaubitze 2000 Turret an Option? In mid-1996, stories began circulating that options to the Crusader were being considered due to the escalating cost of the program. The option most often suggested was one that integrates the new Panzerhaubitze 2000 turret, with its 52 caliber cannon, with the Crusader chassis. The Panzerhaubitze 2000 entered service in Germany in 1999, and had been selected by three other nations. This program, covered in a separate report in this section, is also generating a good deal of interest in the international market. Another option was the British-made Artillery System 90 fitted with a 52 caliber cannon. However, despite continued calls for another re-evaluation of the Panzerhaubitze 2000, the US Army remained committed to the Crusader prior to its cancellation in May 2002.

The XM2002 Crusader Resupply Vehicle. The XM2002 Crusader Resupply Vehicle was being developed as a component to the Crusader system, which has a crew of three. Based on the same chassis and many other components of the XM2001 Crusader fire vehicle (a 60 percent commonality was claimed), the XM2002 Crusader Resupply Vehicle was to fill essentially the same role that the M992 Field Artillery Ammunition Supply Vehicle does for the M109 system. The ammunition-resupply system was totally automated. The XM2002 backed up to the XM2001 fire vehicle, and the ammunition was automatically transferred to and positioned in the fire vehicle. The XM2002 Crusader Resupply Vehicle was to carry a total of 130 projectiles and charges. The goal was to re-arm the XM2001 Crusader fire vehicle at a rate of 60 rounds in 12 minutes. In addition, the XM2002 Crusader Resupply Vehicle was to be able to refuel the XM2001 Crusader fire vehicle when necessary.

The first prototype of the XM2002 Crusader Resupply Vehicle was completed in early 1999. It does not have the ammunition loading/transfer equipment. At the time of cancellation, this vehicle was undergoing extensive automotive tests and would have eventually be brought to the full XM2002 configuration.

Program Cut. Following General Eric Shinseki's famous speech on October 12, 1999, redirecting the US Army toward a more deployable force, many observers believed that the Crusader 155 millimeter self-propelled artillery system was in for some changes. As it turned out, the changes mandated six weeks later were even more drastic than observers expected. The procurement was slashed by more than half, from an original 1,138 systems to 480. The XM2002 ammunition-resupply vehicle, a tracked vehicle based on the chassis of the howitzer, was also changed. Although it would have still been procured on a one-for-one basis, half the 480 resupply vehicles would have been on a wheeled chassis based on the Oshkosh M1078 Palletized Load System vehicle. Although these changes were certain to

impact the program, nothing is cast in stone, and additional changes were expected in the years ahead.

Weight Reduction Program, New Engine. Since 1999, the US Army had become increasingly concerned over the weight (and deployability) of the Crusader system. These concerns coincided with the release of General Shinseki's plan discussed above. In effect, the US Army told the contractor, United Defense, to put the Crusader on a diet – to lower the weight of the system to 36.28 tonnes (40 tons). The contractor began redesigning the system to meet this specification. For a long time, the most promising option was thought to be the switch from the Perkins diesel engine to a vehicular gas-turbine powerplant. This concept was further developed by the US Army in conjunction with a re-engining program for the M1 Abrams tank – the Abrams-Crusader Common Engine program. Following an evaluation of both diesel and vehicular gas-turbine engine alternatives, in November 2000 the General Electric Power Systems/Honeywell LV100 vehicular gas turbine was selected as the common engine. At the time of cancellation in May 2002, the contractor United Defense was integrating the LV100 engine in conjunction with its redesign of the Crusader. Still, many knowledgeable observers believed that United Defense had a tough row to hoe to meet the desired weight. Some have stated that a 36.28 tonne (40 ton) weight would be impossible to achieve unless some of the other parameters of the system were modified.

First Live Firing. On February 22, 2000, the XM2001 Crusader 155 millimeter self-propelled howitzer passed a major milestone with its first live firing. The live-fire test was conducted at the Kota Range at the US Army's Yuma Proving Ground. This first fire was conducted with a M107 inert projectile with a Zone 1 XM231 modular charge. The achieved range was 7,130 meters (7,797 yards). During the next 15 months an additional 1,800 rounds were fired at all the available zone combinations at various ranges. These firings were to establish system reliability, performance, and other factors, and to establish the firing tables. Several significant milestones were passed in the test firing program in November 2000, including a firing rate of 10 rounds per minute, and the first multiple-round, simultaneous impact mission.

Funding

At the time of program cancellation, funding was only minimal. The Army had allocated $1.7 billion for the demonstration and validation phase of the Crusader development program. These funds were used primarily to develop the XM300 regenerative liquid-propellant cannon and the XM46 propellant.

In 1999, a US Army source stated that the total cost (design, development, and procurement) of the XM2001 Crusader program (then 824 systems) would run to over $12 billion.

The following is the funding profile for the Crusader at the time of its cancellation in May 2002.

US FUNDING

Research and Development	FY91	FY92	FY93	FY94
PE#0603645A				
Project D409[a]	59.8	358.5	132.0	55.1
PE#0603854A				
Project D505[b]	-	-	-	-

Research and Development	FY95	FY96	FY97	FY98
PE#0603645A				
Project D409[a]	112.8	135.7	-	-
PE#0603854A				
Project D505[b]	-	0.0	229.6	298.0

Research and Development	FY99	FY00	FY01	FY02
PE#0603645A				
Project D409[a]	-	-	-	-
PE#0603854A				
Project D505[b]	311.3	282.9	120.5	TBD

All funding amounts are in millions of dollars. TBD = to be determined.

The data above and below are from the Fiscal 1999 through 2002 documents.

[a] Armored Systems Modernization, Project D409 – Advanced Field Artillery System/Crusader, Advanced Development. This effort was listed before the 1991 demise of the Armored Systems Modernization program as such. Because the Crusader program is now the only effort in the Army's overall armor modernization effort, the project number is no longer used.

[b] Artillery Systems – Demonstration/Validation. Project number D505 is for the continued development of the Crusader and the armored resupply vehicle.

In addition, a number of other projects in various program elements have supported the development of the Advanced Field Artillery System-Cannon and the Crusader.

Recent Contracts

In 1994, FMC merged with BMY Combat Systems to form United Defense Limited Partnership. United Defense is expected to be awarded the definitive development contract for the system.

The contracts specifically related to the Advanced Field Artillery System-Cannon awarded to FMC Corporation (and, since mid-1994, United Defense Limited Partnership) are as follows. The list is current to early 2000.

Contract	Date	Amount	Procurement
DAAA21-91C-0038	1991/05/10	$66,878,891	Fabrication of Advanced Technology Transition Demonstrator; completed in January 1995.
DAAA21-94C-0084	1994/09/09	$7,500,000	Increment of a $9.5 million contract for the preparation of the proposal for the Advanced Field Artillery System-Cannon.
DAAE30-95C-0009	1994/12/29	$22,000,000	Increment of a $62.13 million contract for the analysis and component maturation efforts related to the Advanced Field Artillery System-Cannon.
DAAE30-95C-0009	1995/09/05	$34,325,115	Modification to contract for the analysis and component maturation efforts related to the Advanced Field Artillery System-Cannon.
DAAE30-95C-0009	2001/09/27	$665,211,918	Modification to contract for the redesign of the Crusader system.
DAAE30-95C-0009	2001/09/27	$1,784,160,842	For continued development and support of long lead procurement.

Program Canceled. On May 8, 2002, the Crusader program was officially terminated by the Department of Defense. Secretary of Defense Donald Rumsfeld made the announcement at a Pentagon press briefing, and stated that it was a case of balancing the resourcing needs of fighting the current War on Terrorism with what is required for national military strategy in the future. In commenting on the cancellation, Deputy Secretary of Defense Paul Wolfowitz said that the Crusader still was not light enough, and it was not precise enough in delivering indirect fires. The projected price of the system was also a growing concern. But in the final analysis, the heavy and expensive Crusader simply did not fit into the new lighter, more deployable US Army now being developed.

Timetable

Month	Year	Major Development
	1979-1988	Various programs to enhance M109 funded
	1983-1989	Human Factors Howitzer Test Bed and Integrated Smart Artillery Synthesis programs developed
	1987	Advanced Field Artillery System-Cannon program initiated
	1987-1996	Various technologies for Advanced Field Artillery System-Cannon developed
May	1991	Advanced Technology Transition Demonstrator contract awarded

Month	Year	Major Development
Late	1991	Decision made to concentrate on liquid-propellant technology for Advanced Field Artillery System-Cannon
December	1994	Advanced Field Artillery System-Cannon named Crusader
March	1996	XM300 liquid-propellant armament system portion of Crusader canceled and replaced with XM297 advanced conventional charge cannon
	1997	Crusader pre-type classified XM2001, with resupply vehicle type classified as XM2002
July	1999	First XM2002 prototype completed
Late	1999	Planned procurement cut, design of fire unit to a lower weight begun, design of wheeled resupply vehicle begun
February	2000	First live firing
November	2000	Several firing records achieved
Early	2002	Development and redesign of system technology ongoing
May	2002	Program canceled

Worldwide Distribution

Export Potential. At the time of cancellation, the Crusader had not been developed to the point that its export potential could be determined. One drawback to export of the Crusader would have been its high unit price.

Countries. Preprototypes of XM2001 firing unit and XM2002 resupply vehicle in **United States**.

Forecast Rationale

During the past several years, the Crusader program underwent several major changes that were still impacting the program at the time of its cancellation in May 2002. As we predicted it would in a prior issue of this report, the Bush administration canceled the program following a review of defense programs. The Crusader was determined to be a true Cold War relic that simply did not fit into a lighter, more deployable US Army.

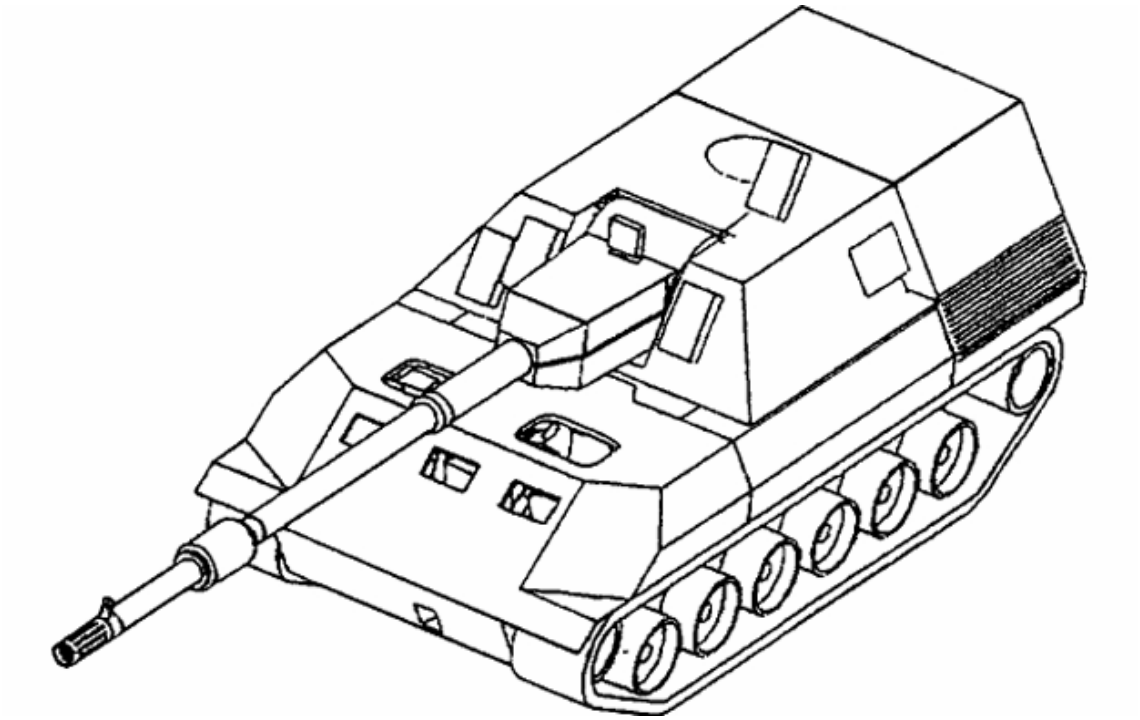
While opponents of the cancellation are still clamoring to reverse the decision, all the evidence indicates that the Crusader program is dead. Of course, we will continue to monitor the program, as some of the Crusader's technology could be incorporated into the next self-propelled artillery program developed by the US Army.

Ten-Year Outlook

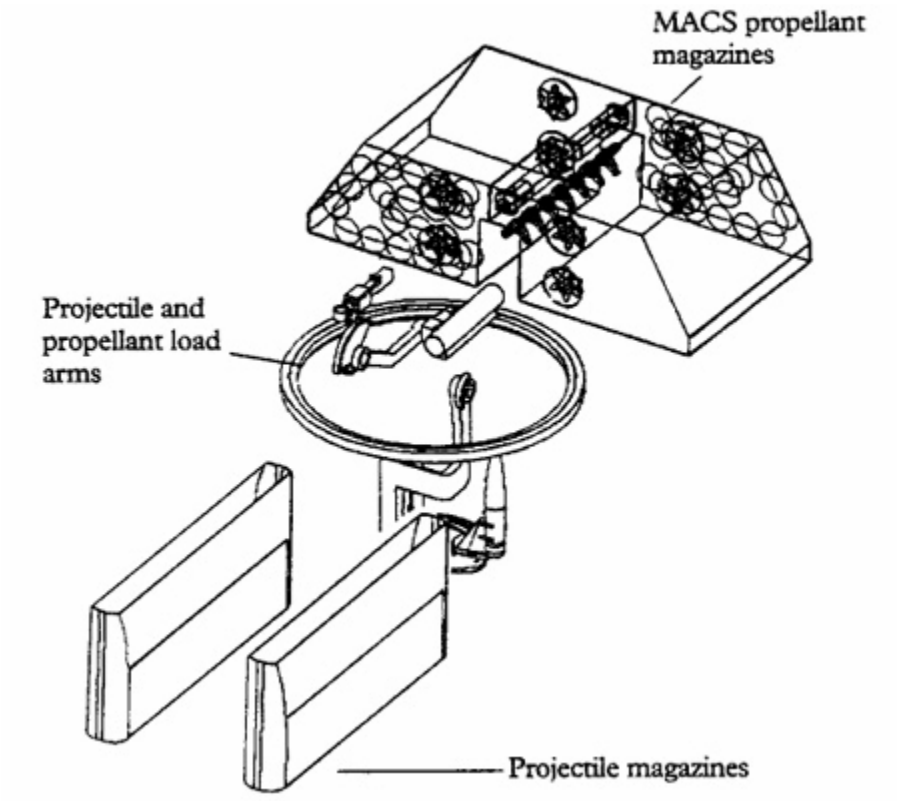
ESTIMATED CALENDAR YEAR PRODUCTION

			High Confidence Level				Good Confidence Level			Speculative			
Ordnance	(Engine)	through 01	02	03	04	05	06	07	08	09	10	11	Total 02-11
UNITED DEFENSE LIMITED PARTNERSHIP													
XM2001 CRUSADER (a)	LV100	1	1	0	0	0	0	0	0	0	0	0	1
XM2002 RESUPPLY VEHICLE (b)	LV100	1	1	0	0	0	0	0	0	0	0	0	1
Total Production		2	2	0	0	0	0	0	0	0	0	0	2

(a) The production through 2002 is for the first preprototype and prototype for the initial firing tests and system integration tests. This program was canceled in May 2002.
(b) Production through 2002 is for the initial developmental prototype tracked systems used for automotive and system integration tests. The ammunition-handling equipment for these vehicles was incomplete. The entire Crusader program was canceled in May 2002. This line is for the tracked XM2002 system only.

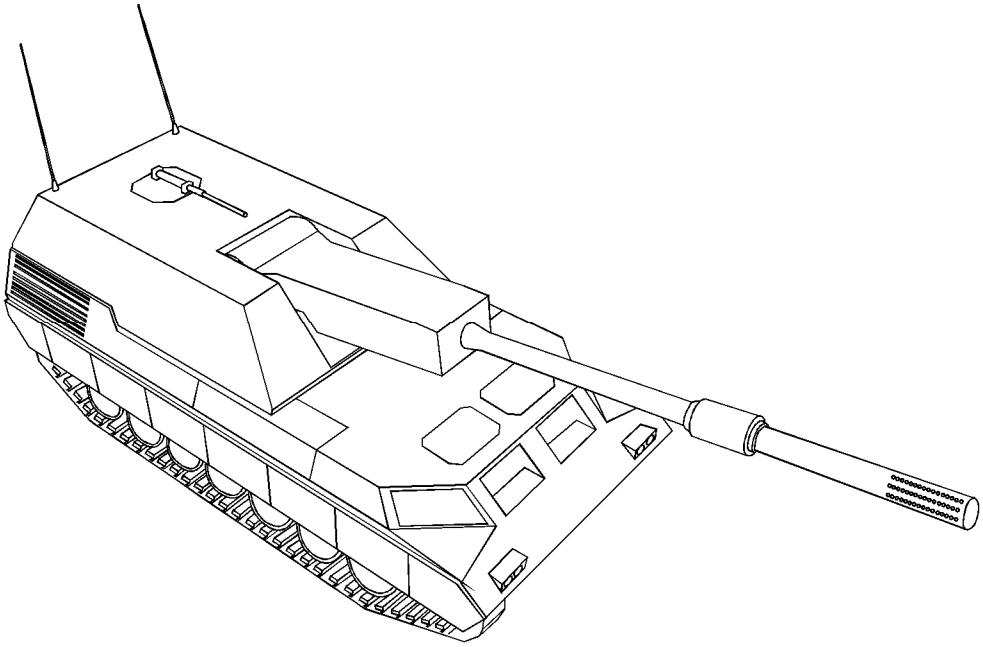


Source: United Defense



Crusader Loading System

Source: US Army



CRUSADER 155 mm Self-Propelled Howitzer

Source: US Army