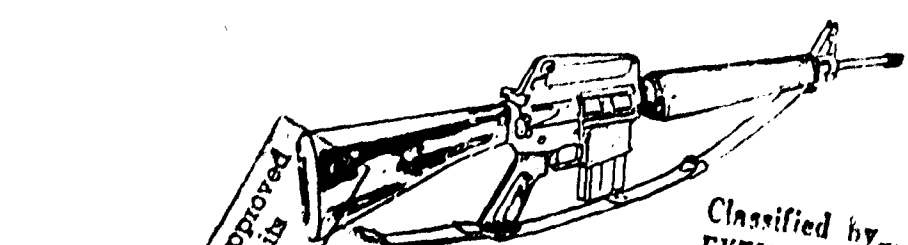
AD NUMBER
ADA953120
CLASSIFICATION CHANGES
TO: unclassified
FROM: confidential
LIMITATION CHANGES
TO: Approved for public release, distribution unlimited
FROM: Distribution authorized to U.S. Gov't. agencies and their contractors; Administrative/Operational Use; 01 JUN 1968. Other requests shall be referred to Department of the Army, Attn: Public Affairs Office, Washington, DC 20301.
AUTHORITY
D/A ltr, 9 Apr 1984; D/A ltr, 9 Apr 1984

APPENDIX 10

REPORT OF THE M16 RIFLE REVIEW PANEL



1 JUNE 1968

THE ARMY SMALL ARMS PROGRAM

DEPARTMENT OF THE ARMY
OFFICE OF THE DEPUTY CHIEF OF STAFF
FOR RESEARCH, DEVELOPMENT, AND ACQUISITION
WASHINGTON, DC 20310

REPLY TO ATTENTION OF

DAMA-WSW

1 FEB 1994

MEMORANDUM FOR THE RECORD

SUBJECT: Declassification Action - Report of the M16 Rifle Review Panel (U) dated 1 June 1968. [redacted]

1. The Report on the M16 Rifle Review Panel dated 1 June 1968 was prepared for the Office of the Chief of Staff of the Army, by the Office of the Director of Weapons System Analysis. The Ground Combat Systems Division, Office of the Director of Weapons Systems, Office of the Deputy Chief of Staff for Research, Development and Acquisition, is the successor to the originator of the report.

2. This office has completed a review of subject report and appendices 1 through 11 and has determined classification of Confidential is no longer needed. The report is now Unclassified. Selected extracts of the report are at Enclosure 1.

3. Notification of this declassification will be forwarded to all distribution addressees and a declassified copy will be forwarded to the Defense Technical Information Center, Cameron Station, for file.

1 Encl
as

WILLIAM D. COOMER
Colonel, GS
Chief, Ground Combat Systems
Division

[redacted]

Appendix 10

THE ARMY SMALL ARMS PROGRAM

1 June 1968

[redacted]

[redacted]

Appendix 10

THE ARMY SMALL ARMS PROGRAM

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Index to Appendix 10 Continued

Appendix 10

THE ARMY SMALL ARMS PROGRAM

A. Introduction

On 26 January 1968, the Assistant Chief of Staff for Force Development (ACSFOR) published the Army Small Arms Program (ARSAP)--a comprehensive document detailing, with funding and priority citation, nearly 50 tasks to meet the Army requirements for small arms in the immediate, mid-, and long-range time frames. This document also established a management structure to provide for coherent execution of the multiphased, multifaceted program. It was the formal response to an October 1966 Chief of Staff decision [1/] to draw together under unified management the various activities of small arms developments. (A draft program had been published in July 1967). The decision, in turn, was an outgrowth of several years of study and analysis of small arms development in the U.S. Army. The stated purpose of the program is to assure that the U.S. Army will have the necessary small arms weapon systems at the time they are needed. One of the key points of the small arms program is that it is not a rigid, final work plan, but rather an assemblage of tentative tasks and efforts amenable to redirection, expansion, restriction, and execution in order to provide the data, technology, and systems when and where needed, and to ensure that at each step the necessary fundamental work has already been accomplished.

1. The decision was announced 26 October 1966 at a meeting of Army Staff principals, and formalized in CSM 66-485, Army Small Arms Weapon System, 7 November 1966 and in CSM 67-96, Army Small Arms Program, 8 March 1967.

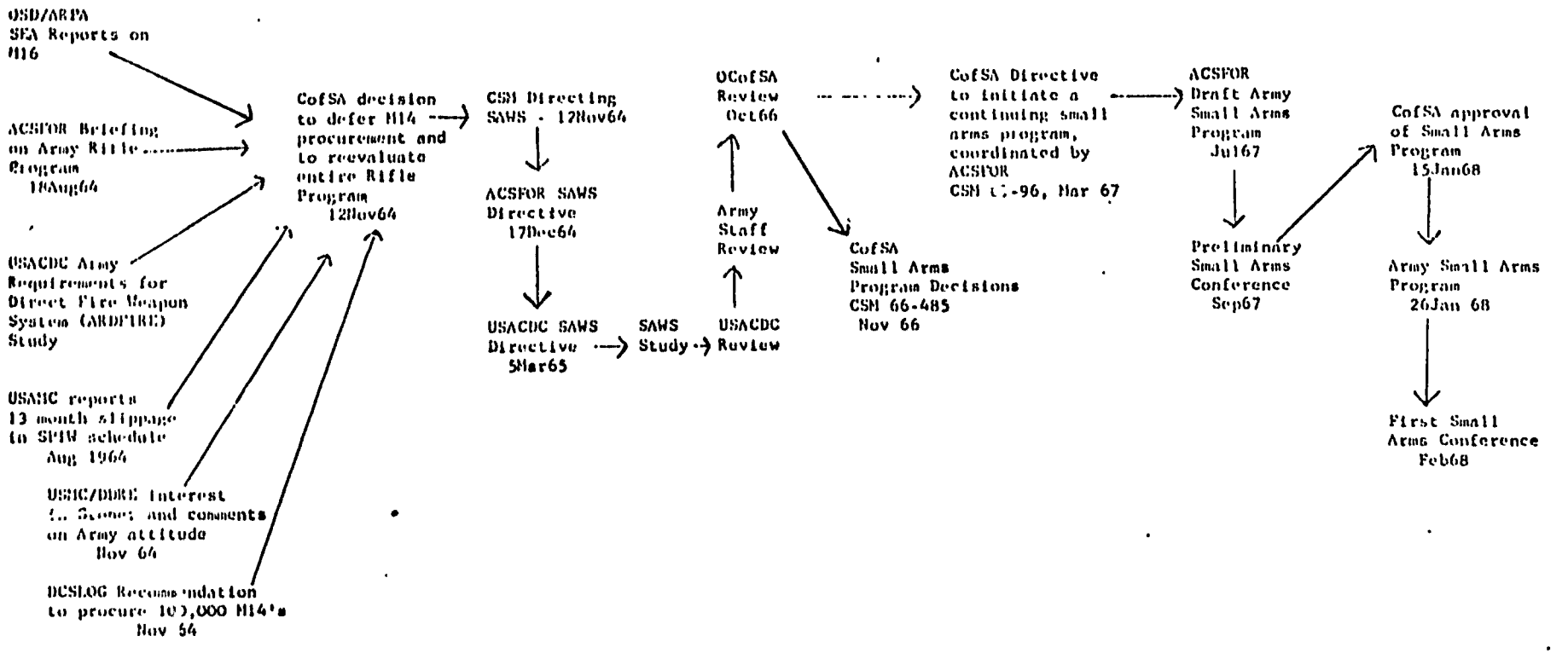
It is the purpose of this discussion of the Army Small Arms Program to describe and evaluate the program, and to offer constructive suggestions for its future development. The discussion begins with the Army's rifle program as it stood in 1964. The factors leading to the worldwide, two-year Army Small Arms Weapons Systems (SAWS) Study are described, as is the analysis of that study in the Office of the Chief of Staff, an analysis that brought about the development of the Army Small Arms Program in its present form. (For a schematic outline of the history of the Army Small Arms Program, see Figure 10-1).

The Special Purpose Individual Weapon (SPIW) held a dominant position in the Army small arms and rifle programs between 1962 and 1966. Accordingly, Inclosure 1 discusses the SPIW program in detail.

Appendix 9 presents an audit trail of the Chief of Staff's involvement with and influence on the Army small arms program in general, and the M16 rifle program in particular.

Figure 10-1 SCHEMATIC OUTLINE OF THE DEVELOPMENT OF THE ARMY SMALL ARMS PROGRAM

August 1964 - February 1968



B. Background

Small Arms in July and August 1964

On 7 July 1964 the Under Secretary of the Army wrote the new Army Chief of Staff, who had taken office on 3 July, that he and the Secretary would like to review the Army's rifle program with particular emphasis on two questions:

> (1) If it became necessary in the near term to place new orders, would we resume M14 production, increase M16 production, or some combination of the two; (2) What is the status of current planning for the SPIW? To what extent are we considering other weapons. such as the M16 with its available attachments or the Stoner system, in lieu of the SPIW?[2]

The Staff position was forwarded by summary sheet a week later to the Chief of Staff. He approved on 21 July the joint Assistant Chief of Staff for Force Development (ACSFOR) and Deputy Chief of Staff for Logistics (DCSLOG) briefing on rifles, provided that improved oral rationale and appropriate viewgraph slides were presented to support the position taken. The Army position should

2. The SPIW was designed to be lightweight, hand-held, small arms weapon that would fire both area- and point-target ammunition to ranges up to 400 meters, and that could combine the more desirable features of a high-velocity, small-caliber rifle and the M79 40mm grenade launcher. The rifle (for point-target firing) was to be capable of selective automatic, semiautomatic, and controlled-burst fire. The projectile assembly was to have a 10-grain fin stabilized flechette capable of inflicting a fatal wound at 400 meters on personnel wearing standard body armor and helmets. The launcher (for area-target firing) was to fire high-explosive grenade cartridges and was to be semi-automatic in action.

be based upon (1) applicable concepts of the U. S. Army Combat Developments Command (USACDC) Army Requirements for Direct Fire Weapons Systems (ARDFIRE) study; (2) weapon and ammunition system lethality; (3) basic input data to the Deputy Chief of Staff for Military Operations (DCSOPS) study of 9 January 1963, "Rifle Evaluation: A Comparative Evaluation of the U.S. Army Rifle M14, the Armalite AR 15, and the Soviet Rifle AK47"; and (4) an explanation of the purpose and functional role of the rifle as an Army weapon. The ACSFOR-DCSLOG briefing was revised accordingly and subsequently was approved by the Chief of Staff on 4 August 1964.[3]

Significant points in that briefing presented on 18 August 1964 to the Secretary of the Army were:

1. If procurement of rifles were authorized in the immediate future, the Army should resume production of M14's rather than M16 production or a combination of M14 and M16 production. Additional M14 procurement would allow the Army to reduce further the logistical problems associated with multiple caliber ammunition requirements for small arms.

> At this point in time, prior to the availability of a quantum improvement in individual weaponry, the Army Staff believes the M14 rifle to be the best weapon acceptable for general use.
>
> The M14 is the only U. S. rifle which fires the 7.62mm NATO standard ammunition. Unless there is

3. 4 August 1964, Notation on ACSFOR Addendum to Summary Sheet, 31 July 1964, The Army Rifle Program.

a quantum improvement in individual weaponry, it is desirable from a logistical point of view that all units planning for deployment to Europe be equipped with basic weapons firing NATO standard ammunition.

2. There were not enough M14's to equip and support the entire active Army. All units not having special mission requirements for weapons should be equipped with M14 rifles.

3. The then-current procurement of 85,000 M16 rifles satisfied the entire requirement for this type of light-weight, small caliber weapon. The light weight was considered to be of overriding importance for airborne, air assault, and special forces units which were being equipped with these rifles. M14's should not be replaced with M16's in any other type of unit.

4. The SPIW should be the standard individual weapon to replace the current rifles, provided that the forthcoming evaluation of the program resulted in approval of a SPIW weapon. In the meantime the Army was continuing to examine several small caliber rifles as possible standard replacements for the then standard weapon. The object of the SPIW program was to equip the combat infantryman with a weapon significantly better in hit probability than the current military rifle. Upon approval of such a weapon for procurement, the standard rifle in all combat units would be replaced; the new weapon would be phased into the system as rapidly as possible.

5. The SPIW development schedule was:

December 1965[4/]	Type classification of the selected weapon
January - June 1966	Pilot line production
June - December 1966	Troop tests with the first thousand weapons
January - June 1967	Initiation of large scale procurement

6. The Remington caliber .223 round common to all of the 5.56mm systems was considered inferior to the 7.62mm NATO standard round in all respects except that of weight.

The 18 August 1964 staff briefing for the Secretary of the Army reviewed briefly the purpose of the rifle, based upon the Combat Developments Command ARDFIRE study, and quoted an ARDFIRE conclusion.

> Direct fire weapons are principally used in the battle area extending 1,000 meters in both directions from the line of contact between opposing forces. They are the primary weapons of the close combat arms, infantry and armor. A close combat element is . . . trained, organized, and equipped to operate in direct contact with the enemy . . . . It employs fire and manuever to close with the enemy in combat, to destroy or capture the enemy, seize, control or deny terrain to the enemy. The direct fire weapon (which for the infantry is the rifle) of a manuever force is usually the only weapon that can be employed effectively at the crucial point of the land battle, i.e., the moment of closing . . . Accurate and effective aimed rifle fire is delivered from point blank range out to about 400 meters(which distance) is

4. On 1 June 1964, DCSLOG had reported SPIW on schedule with a type classification date of June 1965. By November 1964 the SPIW type classification target date had slipped to December 1967.

> selected as the maximum effective range of the average rifleman. However, well-trained riflemen can deliver effective rifle fire at greater ranges . . . . The selection of an individual weapon which will best fulfill the need of the infantry in accomplishing its mission must depend on military judgment of the relative value of the weapon characteristics available . . . . (to include) range, accuracy, lethality, penetration of common materials, hit probability, signature effect, reliability, durability, transportability, ease of training, and cost.
>
> The ARDFIRE study concluded that the SPIW offered the greatest advantage to the infantryman but that pending its availability the Army should continue to rely on the M14.

Throughout 1964 and 1965 SPIW had the dominant role as the successor small arms or close combat weapon system. The failure of SPIW to meet its development schedule was a significant factor in the decision to initiate an explicit, articulated small arms program.[5] Three other weapons, or systems, had been considered in 1964 as primary candidates to succeed the M14 rifle.[6]

The M16 or AR15. This was the first of the caliber .223 weapons to be tested. It was being procured on a one-time basis for special forces, airborne, and air assault units only. After the Army's contract expired, Colt's developed certain attachments and modifications such as a belt feed mechanism for a machine gun

5. Because of the singular impact of SPIW on the considerations and development of the Army rifle program, an inclosure to this appendix discusses the history of the SPIW program in greater detail.

6. The following subparagraphs, describing and giving the status of the development of these weapon systems, are based on the 18 August 1964 Army Staff briefing for the Secretary of the Army.

version of the rifle and a 40mm grenade launcher attachment (later known as the XM148). These were to be offered for Army evaluation along with a number of other grenade launching devices developed in conjunction with the SPIW program. The belt feed mechanism, however, would not be evaluated by the Army because it was said that a caliber .223 weapon did not satisfy the qualitative materiel requirements for a machine gun.7/ Results of an evaluation of a modification to permit firing a 2-shot controlled burst were to be published in the SPIW test reports.

The Stoner 63 System. The Stoner 63 weapon system is a development, which the Marine Corps considered in 1964 as a second generation weapon, configured to fire the same caliber .223 ammunition fired by the M16. The system has six configurations: a fixed machine gun; tripod and bipod mounted machine guns; an automatic rifle; a carbine; and a rifle. All six are fabricated from one basic component group with the same operating parts; the proper barrel and stock are selected to build a particular weapon. A brief description of each weapon follows:

1. The Stoner rifle is a gas-operated, air-cooled, shoulder-fired weapon fed by a 30-round magazine from the bottom of the receiver. It fires semiautomatic or full automatic from the closed bolt, with the bolt remaining open after the last round is fired.

7. In particular, it did not have an effective range of 1,100 meters, essential; 1,500 meters, desirable.

2. The Stoner carbine has the same characteristics as the rifle except tnat it has a shorter barrel and a folding stock.

3. The Stoner automatic rifle is fed by a 30-round magazine located on top of the receiver and has a heavier barrel than the rifle. It fires from an open bolt (the bolt is open at the initiation of each firing cycle) and has only the full automatic fire capability.

4. The Stoner machine gun is a gas-operated, air-cooled weapon. It can be mounted on a bipod with a stock or on a tripod with or without a stock. It can be equipped with a solenoid and trigger linkage and fired remotely. It is belt-fed and fires from an open bolt.

The Army had conducted engineering tests of the Stoner 63 weapon system for the Advanced Research Projects Agency (ARPA) earlier in 1964. At the time, it was undergoing U. S. Marine Corps testing and was not in procurement.

The AR18. The AR18 rifle is a gas-operated, air-cooled, magazine fed shoulder weapon, and fires the same ammunition as the M16. It is capable of either semiautomatic or full automatic firing. A hinge-type mechanism allows the buttstock to be in a firing position or in the folded position. It is provided with a charging handle for aid in loading, unloading, and clearing of malfunctions. Sheet metal pressings (stampings) and automatic screw machine

operations have been used wherever possible. Milling operations have been held to a minimum. The metallic components have been fastened together by spot welding wherever practicable. Armalite, the manufactuer, had pushed the development of this weapon because its simplified production engineering led the company to hope that it could be produced at low cost in developing nations.

Prelude to the SAWS Study

In response tc the analysis presented in the briefing on 18 August 1964, the Secretary of the Army directed that a study be prepared, aimed at supporting a proposal to the Secretary of Defense that M14 rifle procurement be resumed.[8/] Chief of Staff Memorandum (CSM) 64-341 on 21 August assigned responsibility to DCSLOG and ACSFOR for resumption of limited production using one production facility, and citing the advantages to be gained in terms of readiness and cost and the renewed availability of M1 rifles for the Military Assistant Program (MAP). The study was also to include a discussion of arguments that might be used against this course of action.

On 12 August 1964, the Commanding General, U. S. Army Materiel Command (USAMC) informed the Chief of Research and Development (CRD) that in his view the type classification date for the SPIW would slip from December 1965 to January 1967. The CG, USAMC based his opinion upon the most recent performance of the test prototype

8. CSM 64-341, 21 August 1964, The Army Rifle Program.

weapons, which had indicated a high malfunction rate and an unacceptably high noise level, and upon the yet unfulfilled need for a workable muzzle brake.[9] The Chief of Staff was informed of the SPIW slippage on 21 August 1964.

On 2 September 1964, ACSFOR submitted a fact sheet to the Chief of Staff with a description of the Stoner 63 weapon system and its current status, noting the limitations of the system cited by the U. S. Army Weapons Command (USAWECOM). These limitations were insufficient barrel life, belt pull too light, stock breakage while launching grenades, insufficient operating energy under adverse conditions, and unreliable tracer functioning in the machine gun.

In November 1964 a DCSLOG study of M14 rifle procurement in response to CSM 64-341 concluded that, as a minimum, procurement of M14 rifles was necessary to fill the expected deficit at the end of fiscal year 1970 and to initiate a commercial hot base. In the event of further slippage in the schedule of the SPIW, procurement of M14 rifles to equip the Selected Reserve might become necessary. DCSLOG recommended approval of procurement of 100,000 M14 rifles in the fiscal year 1966 budget.[10]

On 6 November the Deputy Director of Defense Research and Engineering (DDRE) expressed to the Chief of Staff the Department

9. CRD Summary Sheet to the CofSA, 21 August 1964, Cancellation of NATO SPIW Demonstration. The summary sheet was approved by the Acting VCofSA, 27 August 1964.

10. DCSLOG Summary Sheet, November 1964, Study on Procurement of M14 Rifles, withdrawn, 12 November 1964.

of Defense view that the Army was resistant to the Stoner weapon family, had a closed mind about it, and had been dragging its feet with respect to the system. The Chief of Staff replied that the Army has a basic doctrinal problem: "We must first determine what is the purpose of the rifle and then what do we want it to do." Following this exchange, the Chief of Staff ordered that directives be prepared to the Army Staff, U. S. Continental Army Command (USCONARC), USACDC, and USAMC to include the following: (1) tighten the doctrinal bases for the rifle and machine gun; (2) establish the QMR, and follow it by the military characteristics needed; (3) concurrently conduct a thorough test of the Stoner weapons family in order to get the data needed in advance to measure against the military characteristics, which will be determined later.[11/]

On 10 November 1964 the Chief of Research and Development acknowledged[12/] that the "not invented here" (NIH) problem was a real one and was recognized as such by the Army Staff. However, it was his expressed opinion, despite allegation and inference to the contrary, that NIH was not the real reason behind the Army's position or actions with regard to the Stoner and AR15 rifle systems. It was rather that in these cases the Army had real

11. SGS Memo for Record, 6 November 1964, The Army's Rifle Program.

12. CRD Memo for the VCofSA, 10 November 1964, Army Opposition to Outside Proposals. This memo expanded on the CRD's comments at a 7 November 1964 meeting on small arms.

doubt about the wisdom of developing and buying the proposed item or system for one or more of the following reasons: (1) no valid requirement existed; (2) design capabilities of the proposed design system were dubious; (3) test results had been unsatisfactory; (4) item or system was not compatable with Army doctrine and other existing systems.

Because the Secretary of the Army was to be briefed on the Stoner weapon system by the Marine Corps on 12 November and because of recent activity concerning the Army small arms weapon program, the Chief of Staff wrote the Secretary on 11 November:

> I believe that it would be useful for me to bring you up to date on what has transpired and also to make my views known prior to the time that you hear the (USMC Stoner) presentation. The Vice Chief of Staff had met with appropriate members of the staff to discuss the Army rifle program generally and specifically how we intend to cope with what was beginning to shape up as an all out effort by the Marine Corps to sell the Stoner system. After the Marine Corps had briefed Mr. Vance (then Deputy Secretary of Defense) on the Stoner system, the Deputy DDRE asked to see me on the subject. I met with him on 6 November. The essence of his remarks was that the Department of Defense considers that the Army has a closed mind on the Stoner system and has been dragging its feet. You will remember that after you were briefed on the Army rifle program on 18 August, you asked the staff to study the overall rifle situation in order to determine whether a limited procurement of the M14 rifles in FY 66 could be justified. DCSLOG has completed its study, and I cannot recommend that we buy in 1966. As a matter of fact it now looks as though our assets vs requirements picture remains good through FY 1967.

> In summary, I believe that we can and should completely re-evaluate our small arms weapons program, starting with a review of doctrine. Our posture is such that we can afford to take this action over the next year or two with a minimal risk. Only by such a deliberate and thorough approach will I be confident that our small arms weapons program reaching into the 70's will be on firm footing. I am hopeful that the Marine Corps will subscribe to this approach, will monitor our efforts as they habitually do, and will not attempt to precipitate an early decision which could prejudice the future combat effectiveness of both the Army and the Marine Corps. General Greene has given me oral assurance that he does not intend to pursue a course that diverges from that of the Army at this point. 13/

The SAWS Study

The complete re-evaluation of the Army's small arms program that the Chief of Staff, Army (CofSA), had recommended to the Secretary of the Army on 11 November was formalized the next day. CSM 64-484 directed the Army Staff to initiate a review and evaluation of the Army Small Arms Weapons Systems (SAWS), to include study of doctrinal employment and desired characteristics, test and evaluation of existing weapon systems, and analytical evaluation of weapons under development or feasible within the time frame, 1965-1980. The object was to develop the necessary analytical background upon which to base a program for replacement of existing stocks of small arms as the inventory dropped below requirements, or replacement of the inventory with weapon families of demonstrated superiority over all other families,

13. CofSA memo for the Secretary of the Army, 11 November 1964, Army Small Arms Weapons Program.

based upon cost effectiveness considerations. The memorandum further stated that the review must not be limited by present commitments, agreements, or doctrinal dogma, but must be of sufficient breadth and comprehensiveness to serve as a basis for the re-establishment of an Army position on small arms families. "It must be based on a dispassionate analysis of those factors which can be quantified, coupled with unbiased judgment applied to those factors which cannot be quantified."

Army Staff responsibility was assigned to ACSFOR, whose first task was publication of a detailed directive. This directive, CSM 64-555, provided the following additional guidance:

> Wherever current doctrine of the tactical employment of small arms would seem to rule out consideration of a particular small arms weapon system, it will be carefully re-examined and if necessary new doctrine applicable to the particular system developed.
>
> The comparison of small arms weapon systems must be based on both technical and tactical considerations which exploit fully the special characteristics peculiar to each system. It is conceivable that new and improved doctrine for the employment of small arms will have as much influence on the choice of a small arms weapon system as the technical characteristics of the weapons themselves.

The Small Arms Weapons System (SAWS) Study was conducted by USACDC with the assistance of USAMC, USCONARC, and major overseas commands. Overall responsibility for conduct of the study -- to include the development of feasible alternative

courses of action that the U.S. Army could pursue, together with a description of the implications of each course of action, and recommendation to the Chief of Staff of the course of action which promised to accomplish best the Army mission -- was assigned to the United States Army Combat Developments Command Infantry Agency (USACDCIA) at Fort Benning, Georgia.[14] USACDCIA tasked appropriate agencies for the following:

1. Engineering and Service Tests: United States Army Test and Evaluation Command (USATECOM).

2. Troop Tests: USCONARC; United States Army, Europe; United States Army, Pacific; United States Army, Southern Command; and United States Army, Alaska.

3. Field Experimentation: United States Army Combat Development Command Experimentation Command (USACDCEC).

4. Computer Simulation of SAWS: Combined Arms Research Office (CARO).

5. Weapon Systems Data: Ballistic Research Laboratories.

6. Procurement and Cost Data: USAWECOM.

These substudies and USACDCIA locally generated inputs, such as doctrinal and organizational considerations, were synthesized into the USACDCIA main study and annexes. USACDCIA accepted the Essential Elements of Analysis (EEA) developed by DA as a basis for structuring its final report. All EEA were not explicitly addressed by empirical

14. USACDC SAWS Directive, 5 March 1965.

testing or quantitative analysis because some were not amenable to such treatment; but all were at least subjectively addressed in the course of the study.

Consistent with the directive to consider hardware and prototype weapon systems and feasible designs for such systems, the Infantry Agency conducted hardware (engineering and service test) evaluations on the XM16E1, Stoner, Armalite AR18, and Harrington and Richardson caliber .223 rifles; the Colt and Stoner automatic rifles; the Colt submachine gun (now designated the XM177E1); the Stoner carbine; the Stoner, M60 and M73 machine guns; and the M14 and M14E2 rifles. Computer and parameter design analysis evaluated the Springfield Armory and AAI SPIW and universal machine gun (UMG) systems; the 13mm and 20mm Gyrojet systems; the AVROC 5-20, 8-20, and 25-40 systems; and parametrically designed 0.65 lb-sec, 1.2 lb-sec, and 2.6 lb-sec impulse weapon systems. 15/

The scope of the SAWS Study was described in broad terms as:

1. A comparison of small arms weapon systems by characteristics and performance.

2. A doctrine study of the way infantry uses small arms at platoon and squad level.

3. An analysis of the relationship of small arms weapons to organization at squad, platoon, and company level.

15. USACDC SAWS Study, August 1966.

4. The impact on training of the candidate system.

5. The impact of the candidate system on the individual load of the combat infantryman.

6. An analysis of the advantages and disadvantages of commonality of parts and ammunition in a small arms weapon family.

7. A comparison of the effectiveness of weapon families and selected feasible mixes of weapon systems at squad and platoon level.

8. A cost and logistical comparison of the candidate weapon systems.

9. An analysis of the political and psychological impacts of the adoption of a new weapon family.

10. An analysis of feasible alternative courses of action which the U.S. Army might pursue to accomplish the Army mission.16/

USACDCIA developed its study recommendations by placing primary reliance on the CARC computer simulation, the assumed availability of SPIW in 1970, the 1965 Army Materiel Plan (AMP) assets-requirements balance, and a concept of "selective modernization." The policy of selective modernization envisaged replacing one-third of the total small arms inventory every seven years, with priority for allocation of new weapons going to combat units. The principal USACDCIA recommendations of the SAWS Study were:

1. Procure no additional rifles beyond those XM16E1 rifles currently on order until SPIW becomes available in 1970.

16. USACDC SAWS Study, August 1966, Section I, pages 3-4.

2. Initiate a program of selective modernization by procuring SPIW, when available, in sufficient quantities to replace rifles, automatic rifles, and grenade launchers for infantry maneuver units only (approximately 192,000).

3. Retain the M60 as the future infantry machine gun until the universal machine gun is developed, about 1972.

4. Improve the effectiveness of SPIW in the automatic rifle role or adopt the UMG with a bipod mount to this role.

5. Continue development of the UMG to make it at least as effective as the M60, while preserving the weight-saving of the current conceptual UMG design, and then in 1972 replace all machine guns with the UMG.

6. Initiate and fund a vigorous research and development program for the purpose of (a) developing caseless ammunition by 1976 with improved projectiles for use in a redesigned SPIW with a further improved area fire capability; and (b) discovering or developing a new lethal mechanism permitting design of radically different small arms systems.

7. In 1976 continue the program of selective modernization by procuring 500,000 SPIW redesigned to utilize caseless ammunition. About half of these would have the area fire capability and half would not.

The secondary recommendations of the SAWS Study were:

1. Develop a method of measuring in actual test firing the combat effectiveness of platoon weapon mixes. In particular, assess the interrelations between different types of weapons in a conventional mix and assess the value of fragmenting rounds in comparison with conventional ball projectiles.

2. Establish a program to develop a comprehensive and detailed computer simulation model for evaluation of two-sided small arms engagements more accurately than was possible with the computer model used in the current study.

3. Procure and issue 7.62mm duplex ammunition to complement the M80 cartridges already in the inventory.

4. Reduce the cost of small arms ammunition of current and conceptual systems.

5. Monitor rocket-type small arms systems continually to permit exploration of any inherent military potential.[17]

Behind these recommendations was the substantive conclusion that among weapons currently in the inventory, the 5.56mm weapons were better for use in low intensity warfare, such as that encountered at the time in Vietnam, whereas the 7.62mm weapons were more effective in high or mid-intensity warfare, such as that which would be encountered in Europe. This conclusion was mainly derived from the computer simulation.

A study review by Headquarters, USACDC modified the Infantry Agency's study recommendations in several instances.

Rifle Procurement. An increase in stockage objectives or significant decrease in assets by combat loss or wear-out, requiring an additional buy of rifles before 1970, should be satisfied by purchase of XM16E1 weapons.

Adoption of SPIW. Final decision to adopt and field SPIW must be contingent upon results of further experiments and tests. It is understood that some difficulty is being experienced

17. USACDC SAWS Study, August 1966, Volume I, Main Report, pages 9-11.

in current SPIW comparative evaluation testing by U. S. Army Materiel Command. To be acceptable, SPIW should essentially equal the theoretical capabilities used in this study.

Automatic Weapons. The need for an automatic weapon in the squad is recognized. This recommendation does not exclude from consideration weapons other than the UMG and SPIW.

General. While the 7.62mm systems do provide advantages over the 5.56mm systems against materiel targets, the intensity of conflict is not a sound basis for a clear choice between two weapons. An environmental distinction, giving due consideration to terrain, existing built-up areas, and estimated equipment resources of the enemy offers a better basis for choice. This minor advantage offered by the 7.62mm system does not, of itself, warrant the maintenance of two different small arms weapon systems in the inventory. It is the position of this command that the total SAWS Study does indicate that the 5.56mm rifle offers the most promise for improved capability for the money spent . . . the concept of selective modernization is an excellent idea whereby the Army takes deliberate advantage of progressive improvements in small arms. Every reasonable effort should be made to insure that Army units are equipped with the best possible weapons. To this end, the indicated timing must not become a constraint; advances in the state-of-the-art must be taken advantage of as they occur.[18]

The variance between the recommendations of USACDCIA study and those of Headquarters, USACDC resulted in part from the USACDCIA assumption of the availability of SPIW in 1970, whereas USACDC, indicated a need for some caution regarding such an assumption. USACDCIA had to employ the 1965 Army Materiel Plan for requirements and asset guidance, although the plan was necessarily

18. USACDC Letter to ACSFOR, 30 August 1966, Army Small Arms Weapons Systems (SAWS) Program; which transmitted the USACDC SAWS Study.

somewhat outdated at the end of the study. There also were unresolved questions about the effectiveness and cost measures emphasized or employed by USACDCIA in its report. On effectiveness, only the Combined Arms Research Office computer simulation and the USACDCEC field experimentation attempted to define and employ measures of operational effectiveness. These two efforts arrived at divergent conclusions, and USACDCIA relied mainly on the results of the computer simulation.

The SAWS Study was submitted to the Army Staff 30 August 1966 and reviewed by the Staff and by the Force Planning and Analysis Office (FPAO) within the Office of the Chief of Staff, Army.

The Small Arms Program, 1964-1965

During the two-year period following the decision in November 1964 to undertake the comprehensive SAWS evaluation, the SAWS Study dominated all discussion of the Small Arms Program. SPIW development continued during this period (see Inclosure) and the M16 continued in procurement. M16 product improvement actions were of major concern, as was expanded weapon and ammunition production capability. A 30 August 1965 Office Chief of Staff Memorandum responded to the Chief of Staff's request that a review be conducted of the Inspector General's investigation resulting from allegations made concerning the M16 (AR15) and M14 comparative evaluation conducted in 1962-63. The review was to provide information on the

comparative evaluation and the decision to procure the M14 and M16, the factors leading up to the Inspector General's Investigation, results of the investigation, and significant events subsequent to the investiagation which would bear on a decision to procure additional M16 rifles.[19] At this same time ACSFOR was conducting a study to determine requirements for future M16 procurement.[20]

Analysis of the SAWS Study

The Force Planning and Analysis Office conducted an extensive review and evaluation of the Small Arms Weapons Systems Study with particular attention devoted to the source documents.

The SAWS Study recognized[21] that the candidate small arms weapons differed in degree of development, design concept, physical and operational characteristics, projectile types, and terminal effects, and that the adaptability of a particular weapon system or weapon family to a battlefield role would be influenced chiefly by the engineered capability of each weapon. This capability in itself should not be the sole determinant of the combat effectiveness of the system or family. "Knowledgeable authorities agree that there are interactions between weapon

19. OCofSA memo for the CofSA, 30 August 1965, Review of M16 Inquiry of 1962-63.

20. ACSFOR Summary Sheet, 21 April 1965, Army Requirements for the M16 Rifle.

21. USACDC SAWS Study, August 1966, Section I, page 1.

technological features, user physiological limitations, and tactical use and support of the weapon system which, when grouped with other weapons in a tactical unit, determine the overall combat effectiveness of a weapon system or family." Further, adoption of any new weapon system that may appear technically favorable, without examination of these interactions and without comparison with the capabilities of other candidate weapon systems, could have a detrimental effect on the operations of the United States Army.

While the SAWS Study had provided much needed information and a sound basis for some decisions on current small arms weapon alternatives, FPAO's review of the SAWS Study revealed that (1) there were gaps in the Army's basic knowledge on small arms which could be remedied by additional fundamental research work; (2) the Army research and development effort to provide successor small arms weapons needed to be broadened, to be continuous, and to be deliberate; (3) a better interface between USAMC and USACDC at the technical and systems management levels was required.[22/]

The SAWS Study amassed large quantities of data, most of which were left unanalyzed or only partially analyzed. Thus it was, that while providing much valuable information on which

22. See CSM 67-96, 8 March 1967, Army Small Arms Program.

significant decisions could be based, the SAWS Study did not, in fact, develop the necessary analytical background upon which to base a program for replacement of existing stocks of small arms as the inventory dropped below requirements, or for the introduction of weapon families of demonstrated superiority over all other families, based upon cost-effectiveness considerations in the time-frame up to 1980. Nor did the study provide for an evolutionary program for small arms oriented toward improvement of current systems and development of new systems against future requirements, together with improved evaluation criteria and methods, and more complete analytical data upon which to base future decisions. SAWS was a first effort in this direction, and left the next step in the development of the Army Small Arms Program to subsequent action.

The Chief of Staff's Decision on the SAWS Study

In October 1966 the Chief of Staff reviewed the USACDC SAWS Study, the DA Staff position, and the FPAO review and evaluation. The Chief of Staff's decisions were discussed with Staff principals on the 26th of October, and were formalized in two memoranda -- CSM 66-485, published 7 November 1966, and CSM 67-96, published 8 March 1967.

CSM 66-485, containing the immediate time-frame directives, stated:

> The XM16E1 rifle will be adopted as the standard Army rifle and will be reclassified as Standard A. The M14 and M14A1 rifles will remain Standard A initially. The Authorized Acquisition Objective (AAO) for rifles and automatic rifles will be computed on the XM16E1, rather than on the M14 and M14A1.
>
> Pending the completion of . . . field experimentation . . . the XM148 grenade launcher will be issued as the companion grenade launcher for units armed with the XM16E1 rifle. Concurrently, action will be taken to improve the design of the XM148.
>
> The Colt carbine/submachine gun will be adopted in lieu of the XM16E1 rifle in those cases where use of the XM16E1 rifle is impractical as the individual weapon.
>
> A companion automatic rifle will not be adopted.
>
> The M60 machine gun will be retained until an improved machine gun is developed and adopted. Evaluation of the 5.56mm machine gun will continue.
>
> The development cycle of the SPIW will be reoriented to the status of exploratory development and become a part of a broadened small arms research and development program for the future.
>
> The overall procurement objective is a single-family (rather than a multifamily) small arms weapons inventory based on the Colt 5.56mm individual weapons and, for the present, the M60 machine gun; and the first objective will be eliminate at an early date the caliber .30 family of infantry weapons.
>
> Product improvement . . . will be incorporated in the new production of XM16E1 rifles and 5.56mm ammunition.

The 7.62mm duplex ammunition will not be produced for other than development purposes at this time.

The purpose of CSM 67-96 was to provide guidance for the formal establishment of the Army Small Arms Program and for future small arms weapon development. CSM 67-96 called for:

Improvement in design and performance of the Army's current small arms system, within existing technology, to increase effectiveness.

Continuous investigations and/or development of new techniques, machines, procedures, and/or materials which will provide a reduction in the unit cost of small arms ammunition and grenades.

Studies, field experimentations, tests, and evaluation to establish, validate, or develop small arms data, doctrine, or concepts which are required to improve effectiveness or utilization of current small arms systems and to provide a more valid basis for the development of new systems.

Research and development effort designed to identify new approaches or lethal mechanisms which could be more effective than conventional approaches in fulfilling the role of small arms systems.

C. The Army Small Arms Program

On 26 January 1968 the Assistant Chief of Staff for Force Development wrote the Army Staff, USAMC, USACDC, and USCONARC:

> . . . the Army Small Arms Program . . . is hereby established as a means to direct and coordinate the research, development, and product improvement efforts of the Army in the small arms area, as well as investigative efforts as to qualitative requirements for small arms weapons or weapon features, and to provide a coordinated system of priorities of effort with corresponding budgetary allocations and planning figures. 23/

The Army Small Arms Program (ARSAP) coordinates by means of periodic conferences and compilation of task resumes, the research and development, procurement, and product improvement of all small arms, caliber .60 or smaller, shotguns, and infantry grenade launchers.

The objectives of the ARSAP are in consonance with, and seek to make explicit with reference to small arms, the general objectives of the Army Strategic Plan (ASP), the Army Force Development Plan (AFDP) and the Combat Developments Objective Guide (CDOG). The ARSAP objectives are divided into four categories: (1) short-range objectives, directed toward product improvement of current systems and the introduction of equipment within the next five years to meet currently identified requirements; (2) mid-range objectives, aimed at development of systems to meet the projected threat five to ten years hence

23. ACSFOR Letter to the Army Staff and others, 26 January 1968, Army Small Arms Program.

(the Army in 1975); (3) long-range objectives, the development of systems to meet the projected threat ten to twenty years hence; and (4) continuous objectives, the continuous research, evaluation, study, and experimentation required to identify and resolve data gaps, reduce ammunition cost, increase effectiveness, and develop new lethal mechanisms.

The Army Small Arms Program will establish a more deliberate and coordinated effort for the improvement and development of small arms systems. The program requires an immediate effort to identify gaps in data essential to future development, followed without delay by a data collection plan to fill the gaps. On the basis of the broad data base thus developed a plan for research, experimentation, and computer simulation studies will be required to determine trade-offs associated with interrelated weapon system characteristics in terms of combat effectiveness. A clear understanding of the trade-offs involved will facilitate updating the Qualitative Materiel Development Objectives (QMDO's) and Qualitative Materiel Requirements (QMR's) and will provide more timely guidance for product improvement or further development efforts. New gaps in data uncovered during this process will initiate another cycle of data collection, trade-off determination and successive revision of the QMDO's and QMR's. Such successive

reviews should insure that requirements documents reflect the most current thinking, based on the best factual data and the most accurate estimates of the state-of-the-art in small arms weaponry.

The Army Small Arms Program directs the review of small arms matters in the form of a standard recurring analysis cycle, made explicit by establishment of a semi-annual small arms conference.

It assigns specific tasks to be accomplished by major commands, indicates the estimated timing for accomplishment of assigned tasks, and identifies the funding required and programmed for accomplishing these tasks.

The central portion of the program is the compilation of tasks, presented by time-oriented objective with priorities and funding levels.

Short Range Objectives

Product improvement tasks are directed for evaluation of multi-part caliber .38 and caliber .45 pistol rounds; M16A1 weapon system components, to include muzzle brake compensator and two-round burst control device: M60 machinegun redesign as the M60A1, improvement of M198 7.62mm duplex ammunition production engineering, lethality of the M80 7.62mm ammunition, and range effectiveness of the M62 7.62mm tracer ammunition; re-evaluation and definition of the QMRs for machineguns on armored

vehicles, especially with respect to the M73 7.62mm tank mounted machinegun; grenade launcher attachment development, alternative methods of launching grenades, advanced development of a 40mm disposable barrel cartridge area target ammunition (DBCATA), development of a family of 40mm cartridges, and consideration of special purpose weapon systems, currently low noise-level weapons, shot-guns, and sniping equipment.

Tactical and technical studies are included to address the requirements for sniping as a contribution to combat effectiveness, and data on hit probabilities using "quick kill" techniques for close range - short exposure targets. Experiments, evaluations, and simulations will address analysis of the tactical value of machine guns in squads and platoons equipped with automatic rifles, the effectiveness and utility of the SPIW and of automatic rifles, the effectiveness and utility of the SPIW and of automatic 40mm grenade launching systems.

Mid Range Objectives

Research and exploratory development effort is devoted to a serially-fired, fin-stabilized projectile rifle (the SPIW prototypes), to a serially-fired, spin-stabilized projectile rifle, to a multiple-projectile, fin-stabilized rifle, and to flechette cartridge producibility.

Tactical and technical studies are scheduled to investigate human response to pulsing auditory inputs of both potentially hazardous and non-hazardous types, to collect data on target suppressive effects as a function of miss distance and on target acquisition by the rifleman as a function of range and activity, and to evaluate standards, controls, and criteria for the reliability and effectiveness of small arms.

Long Range Objectives

The Army Small Arms Requirements Study (ASARS) I will establish measures of effectiveness, and the importance of small arms relative to supporting weapons in casualty production, and will identify types of weapon mixes applicable to the Army in 1985. A follow-on study, ASARS II, will relate data on the contribution of small arms weapon characteristics to overall combat effectiveness. The stated purpose is to permit valid assignment of relative importance values to each characteristic in a set of QMR's for a future follow-on small arms weapons (oriented toward the Army in 1985). A computer simulation will be accomplished only if a valid model can be established.

Continuous Objectives

Research and exploratory development efforts on a continuing basis are included in the current Army Small Arms Program for the following items: rifles pistols; machine guns; grenade

launchers; individual components of small arms systems, such as barrels, springs, ammunition, projectiles, and muzzle devices; interactions of small caliber weapons and their mounts; interior ballistics; exterior ballistics; wound ballistics and improved lethality, and anti-materiel penetration; tracer studies; development and application of improved testing techniques and equipment; and evaluation of unsolicited proposals.

Continuous tactical and technical study effort is directed toward systems analysis for the small arms program and collection of data on foreign and free world small arms development. Other continuous tasks address the dissemination of procurement information, industry orientation meetings, and updating the small arms QMDO's and QMR's.

D. The First Small Arms Conference

By letter to the Department of Army Staff, USAMC, USACDC, and USCONARC, the Assistant Chief of Staff for Force Development (ACSFOR) announced that the First Small Arms Conference would be held at Fort Benning, Georgia, 26 - 29 February 1968, under the chairmanship of an ACSFOR action officer.[24/] This meeting was the first in the series of semi-annual conferences, called for by the ARSAP for the purpose of providing coordination of Army small arms activities. The specific purposes of the February 1968 meeting were to review and refine task descriptions and funding requirements. The discussions and decisions of the First Small Arms Conference are reflected in the revised edition of the Army Small Arms Program, which was published on 19 April 1968, and in the assessment of the ARSAP in the next section.

24. ACSFOR Letter to the Army Staff and others, 8 February 1968, Army Small Arms Conference.

E. Assessment of The Army Small Arms Program

With the promulgation of the Army Small Arms Program (ARSAP) in January 1968, the Army has established a formal, integrated, and thorough program to direct and coordinate the research, development, procurement, and product improvement of small arms weapon systems. The program is established, but, like other programs, will not eliminate nor solve future problems, until it becomes truly viable in each command and at each echelon, which of necessity requires time.[25] Assessment of the ARSAP is split into three parts: orientation, management, and component tasks. The component tasks portion is, in turn, directed toward the major decisions announced by the Chief of Staff on 7 November 1966 in CSM 66-485: the M16A1 rifle, 5.56mm machine gun development, the M73 machine gun, grenade launcher evaluation, and basic user data collection.

Orientation

The basic philosophy underlying the ARSAP is that weapon development must be a continual effort. Weaponry state-of-the-art

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25. For example, not until fiscal year 1970 will it be possible for the research and development funding portion of the ARSAP to be in phase with the normal budgetary cycle.

makes moderate advances, and only rarely, can significant technological breakthroughs be accomplished. To be prepared to meet threat contingencies and to exploit technological developments as they occur, the United States Army must continually monitor technical improvements for its weapon systems. At the same time, effective weapon systems must be in the hands of troops. Such systems represent the successful integration of various component parts, each fully developed to the point of production, not just engineering, prototypes.

The ARSAP approaches this requirement, in practical terms, by specifying tasks for accomplishment with respect to short-, mid-, and long-range time frames, where the short-range time period is the immediate present, and the long-range is ten to twenty years into the future. Such an expression of time-frame oriented objectives allows for the smooth transition from long-range to short-range objective of a given task with the passage of time. Overlapping the time-frame orientation is a group of tasks, called continuous objectives, directed toward continuing exploratory development of weapon system components, small arms systems analysis, and evaluation of requirements statements and doctrine.

Of fundamental importance, as evidenced by the interrelated history of the SPIW and the M16A1 programs, is the absolute necessity

to maintain the time-frame flexibility represented by the initial version of the Army Small Arms Program. No future development should look so tempting that the Army fixes solely, or even primarily, on it, to the detriment of the development of other systems or concepts. Similarly, the ARSAP must not become geared to arbitrary conceptulization of target dates (such as the Army in 1975 or 1985) for the introduction of future systems. The expression of its objectives must remain dynamic. Also, the longer range objectives must not be overlooked. These generally will be less well defined than those nearer at hand, but they will have just as great a need for funding and laboratory support, because without investment in the long-range research of today, tomorrow's advances cannot be made.

Management

Management represents the principal problem area in the Army Small Arms Program. Basically, the program is managed by funding authority, but this is indirect management. There are also the problems of management continuity and funding priority. The stated scope of ARSAP uses the phrase "manages, by means of periodic conferences.[26/] However, in the absence of daily, direct line authority, it would be more appropriate to use the term "coordinates." The periodic conferences provide for user

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26. The Army Small Arms Program, 1 December 1967, page 1.

and developer interface, allo[illegible]ion of funding priorities, coordination of development effor[illegible] identification of required research activity. Yet, the need for these is continual, not just semi-annual. The program does not assure interface between Army components between conferences. This fact makes the job of the ARSAP chairman (the ACSFOR representative) especially fundamental, as he must be the link between all participants in the small arms program. The ACSFOR representative is, in effect, the Department of Army small arms action officer. On the other hand he is a single action officer with other responsibilities. Like other Army Staff officers, he is subject to frequent reassignments: The workload of other activity and the potential for discontinuity in the ARSAP chairmanship highlight the fragile nature of the ARSAP management structure.

Funding limitations also threaten coherent execution of the Army Small Arms Program. In time of fund restrictions, a natural inclination is to discount the future effect of curtailed activity, by maintaining 100 percent funding of near term projects and approaching zero percent funding surplus, such an approach invites atrophied long-term effort. With careful analysis, the near-term and far-term benefits must be weighed on a realistic basis, whenever choices are to be made among task and funding priroties. In the ARSAP the choice between near-term and far-term objectives is

made in the listing of priorities, together with guidance for adjusting ARSAP activity when other priority efforts preclude or slow an assigned task. The provision for time-phased development is one of the significant accomplishments of the ARSAP. Any change in the time-phasing of a sub-task affects the overall task and program, and therefore, should be reported to ACSFOR in order to avoid delays and wasted effort. However, there is no requirement to report the ARSAP task revision to the ACSFOR coordinator.

Component Tasks

The content of the Army Small Arms Program is the compilation and publication of the task statements. The following paragraphs assess the major tasks formulated in response to the Chief of Staff's guidance at the time formulation of the ARSAP was directed.[27] These tasks are the M16A1 rifle, the 5.56mm machinegun, the M73 machinegun, grenade launcher evaluation, and basic user data collection.

M16A1 Rifle. Four prototype stock drawings with a cavity for rifle cleaning equipment have been developed. Based on design drawings, two have been selected. These drawings are being combined into one drawing from which prototype stocks for field testing in June 1968 will be produced. Another ARSAP task addresses M16A1 product improvement in general.

27. See CSM's 66-485 and 67-96.

5.56mm Machine Gun. Despite the direction in CSM 66-485 to continue development of a 5.56mm machine gun, there has been little or no activity by Army agencies. The U.S. Marine Corps has continued interest in the Stoner 63A weapon system, and together with the Army launched an evaluation of the light machine gun in January 1968.[28] The ARSAP in February 1968 said of a new small bore light machine gun only

> Conduct feasibility studies of a 5.56mm, or smaller, successor for the M60 machine gun. Employ new concepts to eliminate sensitivity to variables inherent in normal ammunition production. Explore appropriateness of 5.56mm destructive potential, including possible use of heavier projectiles, in comparison with lethality required for Light Machine Gun successor.[29]

No money was programmed for this effort in the fiscal year 1968-71 time period. Yet, two sub-tasks involving feasibility studies of a 7.62mm successor to the M60 machine gun were programmed for $40,000 in fiscal year 1969, and $80,000 in fiscal year 1970. The U.S. Army Ballistic Research Laboratories, however, have a small program in the preliminary stages directed, in part, toward the use of heavier 5.56mm projectiles to obtain greater ranges of effectiveness.

The 19 April 1968 revision of the ARSAP includes a task resume for evaluation of contender 5.56mm machine guns. The assumption is that the primary mode of employment will be with the rifle

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28. CofSA letter to Commandant, USMC, 3 January 1968, Stoner Weapon System Evaluation.

29. The Army Small Arms Program, as revised at the First Small Arms Conference, 26 - 29 February 1968, Appendix 35.

squad as a supporting weapon to the M16A1 rifle. The 5.56mm machine gun is not expected to replace the 7.62mm M60 machine gun at conventional machine gun ranges. $1,000,000 is listed as required in fiscal year 1969, but no money is programmed until fiscal year 1970.

M73 Machine Gun. The major share ($35,000 out of $60,000) of fiscal year 1968 funds allocated in the February 1968 ARSAP to machine guns were programmed for a kinematic analysis of the M73 and M73E1 tank mounted 7.62mm machine guns, including a study of breech and cartridge compatibility to determine the causes for cartridge case stretch and rupture. Another M73 machine gun sub-task is to conduct exploratory development in order to determine whether to initiate an M73 product improvement or a replacement program. This task is being conducted significantly after the Chief of Staff's 1966 decision to provide a satisfactory replacement for the M73 fixed machine gun. The April 1968 revision of the ARSAP still lists these three objectives:

1. Conduct kinematic and dynamic analysis of the M73/M73E1 machine gun to provide foundation for further product improvement.

2. Initiate development of a replacement for the M73/M73E1 machine gun to provide a simpler more reliable weapon, utilizing the current family or product improved 7.62mm ammunition.

3. At an early date, select preferred course of action, i.e., redesign of M73/M73E1 or continuing development of a new weapon for early replacement.[30/]

30. ARSAP, Change 1, 1 April 1968, Task V-A-3-a.

Grenade Launcher Evaluation. On 8 March 1967 in CSM 67-96, the Chief of Staff directed investigation and test of alternative methods for launching 40mm grenades. He specified consideration of grenades launched from the muzzle as complementary or as an alternative to the then current XM148 grenade launcher attachment and the M79 separate weapon launcher. Nearly a year later, the Army Small Arms Program has five grenade launcher tasks among its short-range objectives. The highest priority is accorded the grenade launcher attachment development (GLAD) program, with completion scheduled for the fourth quarter of fiscal year 1970. Related to the GLAD program is the advanced production engineering for the disposal barrel cartridge area target ammunition (DBCATA). Product improvement of existing systems (the M79) and development of a family of 40mm cartridges is a continuous effort. Granted a second priority, with no funds scheduled until fiscal year 1970 and with a projected completion date of the fourth quarter of fiscal year 1971,[31] is the investigation of alternative methods for launching grenades. It is noteworthy that the studies leading to the selection of the optimum system of grenade launching will not be completed until after the attachment and separate weapon alternatives are fully developed. Meanwhile, no attention is directed toward the possibility of launching 40mm, or similar, grenades from the muzzle of the M16A1 rifle.

31. The same date as the completion of the DBCATA program, and one year after the GLAD program completion.

Army Small Arms Requirements Study (ASARS) I. ASARS I is described as the study to put the entire ARSAP in perspective. It responds to the Chief of Staff's direction to identify and fill in data gaps where they exist. The objective of ASARS I is to determine the importance of small arms in combat relative to supporting weapons in casualty production, and to determine, establish, and define effectiveness criteria against which to measure small arms. The starting date for ASARS I is the first quarter of fiscal year 1970, because of a fund shortage. If ASARS I is to be as fundamental in the Army Small Arms Program as its objective indicates, it should be initiated as soon as possible. An alternative is to review Vietnam data and the numerous USACDC and other Army studies already completed, such as the SAWS study, to obtain the same information that ASARS I seeks. One should not rely on the yet-to-be-initiated ASARS I as the single effort to put the Army Small Arms Program in perspective from the user's point of view.

Summary

The Army Small Arms Program is formally established. The year ahead will be a crucial period as the execution of the time-integrated tasks is initiated. Care must be taken to assure that the stated task objectives remain flexibly responsive to requirements and technological developments on the one hand, while on the other being specific enough to result in engineering and production prototypes at the time of need.

The management structure and procedures must be reviewed to assure that an integrated small arms development effort is maintained. Also, sufficient personnel resources must be made available to manage the program, lest it split into disconnected sub-programs.[32]

Certain tasks need to be expedited to meet the need for analytical evaluation of weapon alternatives prior to hardware development and to be responsive to the Chief of Staff's directives in CSM 66-485 and CSM 67-96.

32. As of May 1968, ACSFOR was identifying additional personnel resources to work on the ARSAP.

F. Conclusions

1. Throughout 1964 and 1965 SPIW had the dominant role as the successor small arms or close combat weapon system.

2. The failure of SPIW to meet its development schedule was a significant factor in the decision to initiate an explicit, articulated small arms program.

3. During the period 1962-1966, the SPIW program virtually constituted the Army's small arms research and development program.

4. USACDCIA developed its study recommendations by placing primary reliance on the CARO computer simulation, the assumed availability of SPIW in 1970, the 1965 Army Materiel Plan (AMP) assets-requirements balance, and a concept of "selective modernization."

5. Behind the USACDCIA SAWS recommendations was the substantive conclusion that the 5.56mm weapons were better for use in low intensity warfare (Vietnam), whereas the 7.62mm weapons were more effective in high or mid-intensity warfare, (Europe or Korea).

6. In the SAWS Study only the Combined Arms Research Office computer simulation and the USACDCEC field experimentation attempted to define and employ measures of operational effectiveness.

7. The SAWS Study amassed large quantities of data, most of which were left unanalyzed or only partially analyzed.

8. The SAWS Study did not, in fact, develop the necessary analytical background upon which to base a program for replacement of existing stocks of small arms as the inventory dropped below requirements, or for the introduction of weapon families of demonstrated superiority over all other families, based upon cost-effectiveness considerations in the time-frame up to 1980.

9. The SAWS Study did not provide for an evolutionary program for small arms oriented toward improvement of current systems and development of new systems against future requirements, together with improved evaluation criteria and methods, and more complete analytical data upon which to base future decisions.

10. With the promulgation of the Army Small Arms Program (ARSAP) in January 1968, the Army has sought to establish a formal, integrated, and thorough program to direct and coordinate the research, development, procurement, and product improvement of small arms weapon systems.

11. The basic philosophy underlying the ARSAP is that weapon development must be a continual effort. The effective execution of the Army Small Arms Program is therefore dependent on the assumption of regular funding support over a significant period of time (Appendix 10, pages 10-29 and 10-30).

12. Of fundamental importance, as evidenced by the interrelated history of the SPIW and the M16A1 programs, is the absolute necessity to maintain the time-frame flexibility in the Army Small Arms Program.

13. The ARSAP must not become geared to arbitrary conceptualization of target dates (such as the Army in 1975 or 1985) for the introduction of future systems.

14. The longer range objectives must not be overlooked, even though they generally will be less well defined than those nearer at hand.

15. Management represents the principal problem area in the Army Small Arms Program.

16. Funding limitations threaten coherent execution of the Army Small Arms Program.

17. Studies leading to the selection of the optimum system of grenade launching will not be completed until after the attachment and separate weapon alternatives are fully developed. Meanwhile, no attention is directed toward the possibility of launching 40mm, or similar, grenades from the muzzle of the M16A1 rifle. Such a course, although not desirable, is reasonable, since a valid requirement has been established in Vietnam for the Over-Under concept.

18. If ASARS I is to be as fundamental in the Army Small Arms Program as its objective (to determine the importance of small arms in combat relative to supporting weapons in casualty production; and to determine, establish, and define effectiveness criteria against which to measure small arms) indicates, it should be initiated immediately (not in fiscal year 1970).

19. The year ahead will be a crucial period for the ARSAP as the execution of the time-integrated tasks is initiated.

20. The ARSAP management structure, funding, and procedures must be reviewed to assure that an integrated and balanced small arms development effort is maintained.

21. Certain ARSAP tasks need to be expedited to meet the need for analytical evaluation of weapon alternatives prior to hardware development and to be responsive to the Chief of Staff's directives in CSM's 66-485 and 67-96.

The Special Purpose Individual Weapon
Program

I. Introduction

The Special Purpose Individual Weapon (SPIW) has held a dominant position in the Army small arms and rifle programs since March 1962, when the Chief of Ordnance initiated a project for its development. The dominance of the flechette-firing SPIW was such that in July 1966, when the SPIW type classification was being delayed by developmental problems and the ammunition production and cost feasibility had not been demonstrated, the USACDCIA recommended no further rifle procurement until the SPIW should become available in 1970.[33/] Further, the Army Materiel Plan (AMP)[34/] implied that the SPIW had been selected as the successor system to the M14, at a time when no comparative effectiveness evaluation had been conducted with hardware copies of the proposed SPIW. Because of the significance of the SPIW developmental program, both because of its impact on the Army's thinking vis-a-vis the small arms program and because of the interest in the combined point-area fire capability, this separate review and discussion of SPIW is presented as an inclosure to the discussion of the Army Small Arms Program.

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33. USACDC SAWS Study, August 1966.

34. DCSLOG, Army Material Plan, September 1966.

II. History of SPIW

Origin of the SPIW and Flechette Concept. Since World War II, the Army has had for one of its objectives the development of a small arms weapon system that would increase the combat effectiveness of the infantryman and at the same time reduce both the number of types and the weight of small arms weapons and ammunition. During the 1950's extensive studies of wound ballistics and ammunition effectiveness were made, and research on small-caliber, high-velocity rifles, liquid propellants, flechette ammunition, multiple-bullet ammunition, and antipersonnel hand-held weapons was carried out. Much of this work was sponsored by the Office, Chief of Ordnance (OCO), and carried out by such agencies as the Operations Research Office (ORO), the Ballistic Research Laboratories (BRL), and the Chemical Research and Development Laboratories (CRDL).

In one of its studies,[35/] ORO stated that the hit probability of individual rifle fire on human targets was low, estimating that the Army had issued 10,000 rounds, or 660 pounds, of infantry ammunition for each hit realized in World War II. The study found that the most important cause of such inaccurate shooting was that, during combat, the soldier's idea was to shoot first, without taking time to aim accurately, and, since the weapon was

35. USAMC, October 1964, Technical Information Report 27.1.1.1, Development of Special Purpose Individual Weapon (SPIW) System.

not aimed accurately, it was only by chance that a projectile hit a target. To compensate for the aiming errors common to various modes of fire, ORO suggested the use of controlled dispersion. The study also found that the infantry fought most of the time at ranges of less than 300 meters, and that the opportunity for aimed fire against visible enemy personnel was extremely limited. It stated that a rifle smaller than caliber .30, with a projectile of correspondingly increased velocity, offered possibilities for obtaining: (1) greater wounding power; (2) improved ballistic characteristics; (3) reduced single-shot and cumulative recoil effects; (4) a lighter and shorter cartridge; and (5) some reduction in the weight of the weapon.

In November 1952, to carry out and evaluate ORO's conclusions, OCO initiated Project Salvo,[36/] which was an organized and concerted effort by a number of Army agencies to improve the combat effectiveness of the man-rifle combination. As defined by ORO Salvo signified the "instantaneous" or successive projection or discharge of several missiles by a single trigger pull. This rapid delivery of multiple missiles, such as pellets, darts, or bullets, was to be accomplished by a shoulder-fired weapon with a moderate-to-high rate of fire, and discharge was to be achieved by a single aim and a single trigger pull. Project Salvo, therefore, proposed the

36. USAMC, October 1964, Technical Information Report 27.1.1.1, Development of Special Purpose Individual Weapon (SPIW) System.

rapid projection of several shots in a dispersion pattern adjusted to obtain optimum hit and optimum incapacitation probabilities under battlefield conditions.

Prototype weapons and ammunition were fabricated and tested to determine their technical and military feasibility, with emphasis on the study of controlled dispersion and how it might improve hit probability for the ordinary rifleman in combat. The first major field test of the Salvo Project was conducted at Fort Benning, Georgia, in June and July 1956.[37]

Previously, effectiveness studies made by BRL[38] had indicated that, in automatic fire, the number of hits per trigger pull for a flechette-firing weapon would be from 10 percent to 270 percent higher than for the M14 rifle, at ranges between 50 and 300 meters and in bursts of from 3 to 5 rounds. In semiautomatic fire, the flechette-firing weapon would produce about three times as many casualties as the M14 rifle. Although the incapacitating probabilities per trigger pull were about the same for the two weapons, the flechette-firing weapon would produce 20 percent more casualties in the same period of time. The hit probability per trigger pull for the flechette-firing weapon in semiautomatic

37. Operations Research Office, ORO-T-378, June 1959, SALVO I Rifle Field Experiment, and ORO-T-397, May 1961 SALVO II Rifle Field Experiment.

38. BRL Technical Note 1482, December 1962, Comparative Effectiveness Evaluation of M14 and Other Rifle Concepts.

fire at ranges of from 100 to 300 meters would be between 12 percent and 18 percent higher than for the M14; in automatic fire, the flechette-firing weapon would be about twice as effective as the M14. On the basis of effectiveness per round of ammunition fired, therefore, the flechette-firing weapon would be about seven times as effective as the M14.

Increasing evidence of the effectiveness of flechette ammunition came from a study of the wound ballistics of high-velocity flechettes by CRDL. It reported in October 1961[39/] that, in terms of wounding power, the short 10-grain flechette was highly effective.

Initiation of the SPIW Program. The Army's experience with the weapons and ammunition developed in Project Salvo during the 1950's and analyses of the research, studies, and investigations carried out during the same period -- particularly those indicating the increased hit probability, wounding capability, and lethality of flechette-type ammunition -- led the Ordnance

39. CRDL Report 3091, October 1961, Wound Ballistics of High-Velocity Flechettes for Hand-Held Weapons.

Corps to the conclusion that a single weapon, capable of selectively firing small-caliber, high-velocity, point-target ammunition or area-target ammunition not only would greatly increase the effective firepower of the individual soldier but also would reduce significantly the number of different weapons to be supported logistically. As a result, in March 1962 the Office, Chief of Ordnance initiated a project for the development of such a weapon, to be called the special purpose individual weapon (SPIW).[40/] A requirement for such a weapon was stated in the Combat Development Objectives Guide prepared by USACDC:

> To be lightweight, hand-held, small arms weapon that will fire both area- and point-target ammunition to ranges up to 400 meters, SPIW is to combine the more desirable features of a high-velocity, small-caliber rifle and the M79 40mm grenade launcher. Its weight, loaded with 60 rounds of point-target and 3 rounds of area-target ammunition, is not to exceed that of an M14 rifle loaded with 20 rounds of 7.62mm ammunition. It is to be no more than 40 inches long, but it is not to be so short as to preclude three-point support when the user fires from the prone position, and the sight is to be such that, if the target can be seen at night with the unaided eye, the weapon can be aimed at the target. The sight for the rifle is to require but one setting for ranges from zero to 400 meters, and the sight for the launcher is to have range graduations in 25-meter increments from 50 to 400 meters. A soldier wearing complete arctic equipment is to be able to use the weapon.

40. Ltr, OCO to Ordnance Technical Committee, 31 January 1962, SPIW -- Initiation of Project and Recording of Approved Military Characteristics.

The rifle (for point-target firing) is to be capable of selective automatic, semiautomatic, and controlled-burst fire; when it is fired automatically in controlled bursts from the prone position with the weapon mounted on a bipod, 80 percent of the rounds fired to a range of 300 meters are to strike within an area 3.5 feet high and 5 feet wide. The projectile assembly is to have a 10-grain flechette capable of inflicting a fatal wound at 400 meters to personnel wearing standard body armor and helmets. The maximum ordinate of the projectile is to be no more than 10 inches at ranges up to 400 meters. Smoke and flash are to be reduced to a minimum, but smoke reduction is more important than flash reduction. A flash suppressor may be used if necessary.

The launcher (for area-target firing) is to fire high-explosive grenade cartridges and is to be semiautomatic in action. It is to be provided with the integral safety features necessary to prevent accidental firing and dangerous malfunctions. The minimum arming distance for the fuze of the grenade is to be sufficiently far from the user to preclude any danger to him, and the fragmenting grenade is to be lethal out of 4 meters from the point of burst; beyond 20 meters, the number of incapacitating fragments is to decrease to nearly zero. Although at first the standard 40mm grenade is to be used, it is hoped that one of smaller caliber but equal lethality can be developed.[41]

Prototype Production. In October 1962 manufacturers were informed of the OCO decision to develop SPIW and were provided with the information necessary for preparing designs and cost estimates.[42] A briefing was held for representatives of all interested companies, and the proposals submitted were studied

41. Combat Development Objectives Guide Paragraph 237a(5). The SPIW requirements are compared with those for the M16A1 Rifle in Table 10-1.

42. Project Manager-Rifles, July 1966, Special Purpose Individual Weapon Newsletter Number 5.

Table 10-1 — COMPARISON OF THE SPIW AND THE M16A1 WITH THE SMALL ARMS REQUIREMENTS (As Expressed for the SPIW in 1963)

Characteristic	1963 Technical Requirement	1966 SPIW	1966 XM16E1
Weight	Not more than 10 lbs loaded with 60 rds of point fire ammo, 3 rds area fire ammo	AAI - 14.6 lbs Springfield - 15.5 lbs	13.7 lbs with XM148 attachment
Rifle only with 60 rounds		AAI - 9.7 lbs Springfield - 10.3 lbs	8.87 lbs
Length	Not more than 40 in.	40 in	39 in
Mode of fire	Fire semiautomatic, full automatic, and controlled-burst automatic	As specified	Has controlled burst capability, but not procurred with it.
Lethality	For a controlled burst at 100m, P_k = 0.5	0.82 (3rd burst)[a/]	0.76 (2 rds)[a/]
	at 300m, P_k = 0.1	at 400m, .22 (3rd burst)[a/]	.22 (2 rds)[a/]
	Single round P_{hk} (30 sec def criteria) at 400m to be not less than 0.7	.7[b/]	.6[b/]
Penetration	At 400m penetrate standard body armor and steel helmets	as specified	as specified
Semiautomatic Accuracy	1.0 mil standard deviation	.80 mils[a/]	.17 mils[a/]

1/ Based on BRL Technical Note 1542, August 1964, Summary of Test Data and Effectiveness Evaluation of SPIW.

2/ Based on BRL Technical Note 1482, December 1962, Comparative Effectiveness Evaluation of M14 and Other Rifle Concepts.

and evaluated during December 1962. Contract negotiations were begun the following month. In February 1963 the following organizations were each commissioned to submit ten models in February 1964 for comparative testing: (1) Aircraft Armaments Inc., (AAI); (2) Harrington and Richardson, Inc; (3) Springfield Armory; and (4) Olin Mathieson Chemical Company, Winchester Western Division.

Contracts were awarded to the three corporations and a work order was issued to the armory because of the potential effectiveness, producibility, maintainability, and general design feasibility of the weapons they had proposed. Each company and the armory had a different design approach. The Harrington and Richardson weapon was based on the principle of the simultaneous launching of three projectiles, which was one of the ideas that came out of the Salvo project. Olin Mathieson's entry used the soft recoil principle, in which successive projectiles were launched before the barrel and the barrel extension completed their full travel to the buffer; it was believed that this system would tend to reduce the effects of recoil on accuracy. Springfield Armory's weapon used conventional cartridges and a conventional gun mechanism that operated at a cyclic rate lower than that of the model submitted by AAI. The AAI model had a high-cyclic-rate mechanism designed to reduce dispersion of a controlled burst; in addition, it was designed to use a new type of ammunition,

a piston-primed cartridge. This cartridge contained a piston that was rigidly positioned to prevent any forward movement unless the piston was struck by a firing pin. When the piston was struck by a firing pin, igniting the primer mix and the propelling charge of the cartridge, pressure developed by the burning propellant forced the piston rearward in the cartridge. As it moved rearward, the piston was in contact with the firing pin and forced it to the rear also. The movement of the piston was checked by the cartridge case, but the firing pin continued on, driving the bolt rearward to unlock and open it. This action eliminated the need for gas mechanisms like those of the M1, M14, and other conventional gas-operated rifles.

The 1964 Re-Orientation. In November 1964 in a briefing to the Commanding General, U.S. Army Materiel Command, the Army Weapons Command reported on the then current current status of the SPIW program and on five possible approaches to continued development leading to type classification of SPIW. In this briefing, eight problems were discussed:

1. Three-Shot Semiautomatic Grenade Launcher. No satisfactorily functioning prototype was available, and it was doubtful that such a launcher could be developed without exceeding the then maximum weight requirement for the SPIW system.[43] The considerable bulk of any three-shot launcher also presented difficulties.

43. The prototype was to be of no greater weight than the M14 or M14E2 with 100 rounds of ammunition.

2. Sabot Hazard. Limited tests of the ammunition indicated that sabot fragments were slightly hazardous as far as 20 feet from the muzzle. The technical characteristics required that the fragments be nonhazardous beyond 15 feet from the muzzle.

3. XM110 Type Cartridge. This piston-primer cartridge was suffering from a number of deficiencies: high cost, low level of performance reliability, questionable safety, long-term storage failures, and interior ballistics problems.

4. Sabot Manufacturing Costs. The sabot is the most expensive and difficult to manufacture of all the components of the point-target ammunition.

5. Noise. All of the SPIW weapons (and the M16 with muzzle brake compensator) produced peak sound pressures far in excess of 159 decibels. Sound pressures were high enough to produce permanent damage to the hearing of as many as 20 percent of the personnel equipped with these weapons.

6. Flash. Only one (the Springfield Armory version) of the SPIW weapons exhibited acceptable flash suppression.

7. Stripper. The maximum demonstrated life of the device to strip the sabot from the projectile was reported as 2,000 rounds.

8. Tracer. The stated user requirements[44] were reported to be beyond the then present state-of-the-art within the design parameters of the current flechette.

USAWECOM presented five possible approaches to continued development leading to SPIW type classification. All of these approaches revolved around the AAI and Springfield SPIW prototypes. The Olin Mathieson model had technical problems of such magnitude as to eliminate it as a contender. The Harrington and Richardson model had been eliminated in earlier developmental stages.

The program being followed in November 1964 was presented as a 14-month accelerated development effort, with type classification scheduled for the end of the third quarter of fiscal year 1966 (March 1966). However, it was described as an "extremely high risk alternative" and the "plan least likely to result in an entirely satisfactory weapon at the time of type classification.[45]

44. The WECOM proposed revisions to the USACDC tracer requirements were: change the final visibility of trace at night from a minimum of 850 to a minimum of 500 meters; change the final visibility of trace in daylight from a minimum of 850 to a minimum of 300 meters; and change the lethality requirement from "comparable with ball projectiles at all ranges" to comparability at ranges out to 500 meters.

45. November 1964 USAWECOM briefing to Commanding General, USAMC.

Following this approach would necessitate continuing the development of only the AAI version, as there would be insufficient time to exploit the advantages of the Springfield design.

Other alternative courses of action called for 20-, 26-, 35-, and 50-month development efforts with type classification under these alternatives scheduled for the first quarter of fiscal year 1967, the third quarter of fiscal year 1967, the second quarter of fiscal year 1968, and the third quarter of fiscal year 1969, respectively.

USAWECOM recommended the 35-month development effort as a course of action which would assure satisfactory completion of the engineering and service tests, provide for type classification a system with the highest reliability and fewer manufacturing start-up problems; have no unsolved technical problems with the piston-primer type cartridge, and provide a tracer cartridge at the time of the engineering and service tests that would meet the USAWECOM-proposed relaxed characteristics.[46]

The USAWECOM recommendation was accepted, and thus late in 1964 the SPIW program was reoriented toward continued development of two prototype versions of the SPIW and solution of the identified problem areas. On 18 August 1964 ACSFOR had informed the Secretary

46. November 1964 USAWECOM briefing to Commanding General, USAMC.

of the Army that the selected SPIW weapon would be type classified in December 1965.[47] Further on 12 August the Commanding General, USAMC, had informed the Chief of Research and Development (CRD) that the SPIW type classification date would probably be January 1967.[48] Yet three months later in November, USAWECOM recommended, and the Commanding General, USAMC, approved, a revised SPIW time schedule that would set the time of type classification at the end of the second quarter of fiscal year 1968 (December 1967).[49] Nor was this to be the last USAWECOM slippage in the SPIW schedule before the virtual termination of the developmental effort in 1966-67.

Approval of the 35-month development program for the SPIW was granted by Department of the Army (DA) on 9 February 1965.[50] Work on this program commenced 1 March 1965 with further development of both the Aircraft Armament Inc., and the Springfield Armory concepts.

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47. Army Rifle Program Briefing for the Secretary of the Army, 18 August 1964 (see pages 10-6 and 10-7).

48. CRD Summary Sheet, 21 August 1964, Cancellation of NATO SPIW Demonstration.

49. USAWECOM briefing for CG, USAMC, November 1964, Briefing on the status of SPIW.

50. Project Manager-Rifles, July 1966, Special Purpose Individual Weapon Newsletter Number 5.

The 1966 Reorientation. The 35-month SPIW development program, initiated in March 1965, had a type classification target date of February 1968. (The slippage from December 1967 was due to delay in DA approval and initiation of revised milestone schedule.)[51/] Essentially this program was divided into two phases of research and development effort. In Phase I, the two developers, AAI and Springfield, working in direct competition, were to spend 14 months in the development and fabrication of 10 complete weapon systems each. In Phase II a comparative evaluation would be made of the two competing designs and a selection of the single, most promising system for further development. The delivery of 10 weapon systems from each developer for competitive testing had been extended for 90 days as reported in the July 1966 SPIW Newsletter.[52/] Accordingly, the type classification date had slipped to May 1968. By August 1966, the type classification objective had become June 1968.[53/]

51. Project Manager-Rifles, July 1966, Special Purpose Individual Weapon Newsletter Number 5.

52. Project Manager-Rifles, July 1966, Special Purpose Individual Weapon Newsletter Number 5.

53. Minutes of (informal) Project Manager-Rifles meeting with CG, USATECOM, 23 Aug 66.

In a briefing for the Commanding General, USATECOM, on 23 August 1966, the Project Manager-Rifles discussed the status of the SPIW development program. In general the developmental effort was still encountering many of the problems and delays that two years earlier had necessitated total revision of the milestone schedule, In particular, the engineering design tests were just beginning, and until operational data were accumulated, it would be impossible to tell how closely the QMR's for weapon and ammunition could be met. The development activity up to that time indicated that the weight would be closer to 11 than 10 pounds,[54] and that the (unchanged USACDC) tracer requirements would not be met. The essential problem areas of the development program were:

1. A potentially serious cook off vulnerability problem with the AAI version because of the unsupported primer-piston.

2. Heat buildup at the muzzle end of the barrel which had not been expected by the designer. This might be resolved by special steels. Some limitation on barrel life and cyclic rate not originally predicted might exist, but this could not be related to requirements. In any event, considerable redesign would be required.

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54. The SPIW system weights as of 30 July 1966 were: AAI version with grenade launcher, 12.9 lbs., 7.9 lbs. without launcher; Springfield version with grenade launcher, 13.6 lbs., 8.4 lbs. without launcher.

3. Unresolved waterproofing of the cartridge. This could be a problem operationally due to rain, or condensation. Long-term storage could be accommodated by packaging.

4. The extremely unlikely desire to achieve durability of parts to a 10,000-round life. The likelihood of firing 3,000 rounds without a weapon-ascribed malfunction was reported as optimistic.

5. Propellant for both cartridges, but especially for the AAI cartridge. Solution of this problem would probably require selectivity and quality control not normally exercised with military propellants.

6. Limited tracer performance, both in ignition reliability and in visibility.

7. Grenade launcher adaptation. Utilizing the present 40mm ammunition, the SPIW grenade launcher was bulky, and the weight was undesirably distributed.

8. Penetration of hard targets. Except for aluminum the SPIW flechette did not penetrate hard targets as well as current 7.62mm bullets. It was not required to penetrate more than vests and helmets at 400 meters, which it could do.

9. Rough handling and transportation-vibration. This might be a problem and would be strongly influenced by the manner of packaging the SPIW, including magazines.

10. Excessive launcher trigger pull force with the Springfield system (26-36 pounds) and somewhat less with the AAI (15-23 pounds). This was due to incapatible design mating of the rifle and launcher and was considered resolvable. It presented however, a serious operational problem for immediate test purposes.

In Chief of Staff Memorandum (CSM) 66-485, dated 7 November 1966, the Chief of Staff directed the Army Staff to reorient the development of the SPIW to the status of exploratory development. The SPIW was tc become part of a broadened small arms research and development program for the future, for which further guidance was issued in CSM 67-96, dated March 1967. The latter memorandum established continued SPIW development as part of the Army Small Arms Program.

The Chief of Staff decision on the SPIW was the result, in part, of reports of the problems being encountered in the SPIW development and of the diminished urgency for an M14 successor, since procurement of the M16A1 had been recommended.[55/] There was also a need to reopen the small arms program and research and development activity rather than continue to focus principally, or solely, on one particular design concept -- the SPIW. The effect of the Chief of Staff's decision was to terminate the dependence of rifle program planning up on the availability of SPIW, to eliminate SPIW from consideration as a nearly guaranteed

55. FPAO Review and Analysis of the SAWS Study, 18 October 1966, and CofSA guidance.

and immediate successor of both the M14 and the M16A1 rifles, and to assure that SPIW development would proceed in an orderly fashion, with the objective of producing a substantially improved final product.

III. Current Status of the SPIW Program

When the Chief of Staff directed reorientation of the SPIW effort to exploratory development in November 1966, SPIW was undergoing engineering design tests at Aberdeen Proving Ground and Fort Benning. The Project Manager-Rifles on 16 November 1966 terminated further testing and directed submission of a final report to cover all subtests either partially or fully completed. The available data from these engineer design tests and the previous SPIW developmental activities, which represented the expenditure of about $19 million, were assembled and reviewed by Project Manager-Rilfes. Since its reorientation to the status of exploratory development in November 1966 SPIW development has been considered within the context of the broadened and expanded small arms research and development effort. SPIW has become an integral part of the Army Small Arms Program (ARSAP). In March 1968 it is more accurately considered to be in the engineering development phase of the research and development cycle, because SPIW activities are funded by RDTE 6.31, rather than 6.21 funds.[56/]

56. Army Small Arms Program, 1 April 1968.

SPIW field experimentation is one of the short-range tasks in the Army Small Arms Program. The two-fold objective is to determine whether the full automatic mode (as contrasted with the 3-round controlled burst mode) of fire should be maintained as an essential requirement in SPIW specifications, and to determine by analysis of data collected in field experiments under tactical conditions whether a SPIW-equipped basic infantry element has significantly increased fire effectiveness over a like-size element equipped with another candidate mix of weapons, based upon the Phase I results of the Infantry Rifle Unit Study - 1975 (IRUS 75).

Two tasks among the mid-range objectives of the Army Small Arms Program continue the development of the flechette-firing SPIW weapon. The general objective of the first task is to investigate a weapon and ammunition system capable of firing a low impulse high velocity, small caliber single or multiple projectile cartridge with increased effectiveness; to conduct exploratory investigations and experiments to identify effective parameters and establish relationships between them, and to fabricate hardware for tests of four competitive concepts. More specifically, SPIW efforts, cited in the January 1968 ARSAP and at the first Army Small Arms Conference at Fort Benning, Georgia in February 1968, include:

1. work to determine barrel erosion problems,

2. work to define design parameters of the projectile assembly and to measure ballistic dispersion. Case design is limited to the 7.62mm configuration, in order to conserve financial resources.

3. staffing of Small Development Request (SDR) for a weapon mount program.

4. continued development of a sabot.

Preliminary sabot activity was accomplished under contract with Honeywell, Inc. and with FMC Corporation. FMC could not develop a manufacturing process to produce a sabot importing the required velocity to the projectile. Honeywell developed a manufacturing process that produced a sabot having the required break-up, providing the desired projectile velocity, and, after several process modifications, meeting the accuracy and chamber pressure requirements. However, the accuracy and chamber pressure of the modified sabot have not been verified by firing at Frankford Arsenal. By enlarging the front face, a sabot was obtained that did not require a stripper at the end of the gun barrel to remove it from the projectile. This greatly improved the entire system. Honeywell is designing a manufacturing process for such a sabot.[57]

The second mid-range SPIW task in the ARSAP is flechette cartridge producibility. The Department of Defense has approved

57. Army Small Arms Program, as revised at the 26-29 February 1968. Small Arms Conference.

$1.81 million in the fiscal year 1967 budget to establish the producibility of flechette point fire ammunition for the SPIW system at a reasonable cost. Prior to February 1968, $777 thousand, from fiscal year 1964 funds, had been spent on advanced production engineering of the components of SPIW point fire ammunition.

Significantly, SPIW does not represent the only advanced development effort for individual weapons in the Army Small Arms Program. Investigation of serially-fired, spin-stabilized projectiles and of multiple-projectile, fin-stabilized (flechette) projectiles are rifle tasks accorded the same priority as the SPIW activity. The principal efforts for the serially-fired, spin stabilized rifle system are to define an optimum caliber to include selection of bullet weight, remaining velocity as a function of range, and number of rounds per burst in automatic fire and to determine the production feasibility of a lethal small caliber ball projectile, capable of being fired at a high velocity from a high cyclic rate weapon. The principal effort on the multiple-flechette projectile system is to conduct feasibility and concept design studies.

IV. Analysis

Discussion of the history of the SPIW program up to November 1966 is a pertinent part of any consideration of the Army Small Arms Program, or even of the M16 rifle program. The significance of SPIW is essentially twofold.

The acronym, SPIW, has come to stand for a particular weapon-ammunition configuration, but one that incorporates a significant number of design advances. The SPIW concept might be considered the greatest advance in rifle weaponry since the end of muzzle-loaders -- this because of the fin-stabilized flechette projectile, the high-cyclic rate, controlled-dispersion burst pattern, and the combined point and area fire capability for the individual infantryman. True, these features of the system have yet to be demonstrated operationally. But progress has been made in the direction of the solution of technical problems, and the progress continues. Thus, in a sense, the SPIW program (1962-66) constituted the Army's small arms research and development program. The interesting and unique design rifle and ammunition concepts considered within the state-of-the-art, or nearly so, were incorporated in the various SPIW prototype designs, and development was carried on in the context of the SPIW program.

Other competitor programs received significantly less attention in the Army laboratories and in the procurement programs.[58] The SPIW had evolved from the theoretical analyses of the 1950's as the weapon-ammunition concept providing the most appreciable effectiveness benefits. Official optimism kept cost statements sufficiently low and technical advances sufficiently frequent

58. Table 10-2 presents a comparative chronology of the SPIW and M16A1 systems, which points out the special emphasis accorded the SPIW.

TABLE 10-2 - COMPARATIVE CHRONOLOGY OF THE SPIW AND THE M16A1

Date	SPIW	M16A1
May 1958		Infantry Board evaluates Armalite AR15.
March 1962	Chief of Ordnance initiates SPIW project.	
August 1962		ARPA Field Evaluation in Vietnam.
November 1963		Procurement of 85,000.
June 1964	To be type classified, June 1965.	
August 1964	To be type classified, December 1965.	
August 1964	To be type classified, January 1967.	
November 1966	SAWS Study Directed. Program Re-Oriented. To be type classified, December 1967.	SAWS Study Directed.
December 1965		USARV Request, results in procurement of 327,405.
July 1966	Infantry Agency recommends no other rifle procurement until SPIW becomes available in 1970	
August 1966	SAWS Study Completed. To be type classified, June 1968.	SAWS Study Completed
November 1966	Program re-oriented to exploratory development.	To be standardized.
January 1967		SECDEF approves expanded production base.
February 1967		M16A1 type classified Standard A.
March 1968	Still in basic development.	Production nearing 40,000 per month. A third production facility approved.

to make the SPIW appear competitive with all proposed candidate systems. Successive schedule revisions punctured this balloon, but not until after other programs had suffered the effects of neglect. The M16 was introduced as a limited-procurement item. Then because of suddenly increased Southeast Asia requirements, the M16 had to be procured beginning in December 1965 for more than a third of the active Army. The XM148 grenade launcher attachment received little developmental attention. After one-third the grenade launcher Authorized Acquisition Objective (AAO) had been provided for in the procurement budget, its major developmental test was conducted in Vietnam. The XM148 failed this test, and the program was terminated.

The SPIW program provides an example of a developmental system concept that came in practice to be considered as the Army rifle research and development program. The entire Army establishment geared for the introduction of SPIW, and in so doing, failed to anticipate the need for thoroughly developed alternatives. There is, and always will be, the risk that the chosen system may not enter the procurement and distribution cycle in time to meet the need. This happened to the SPIW. Consequently the Army is now undertaking a broadened research and development effort as part of the Small Arms Program. This program also includes M16 corrective actions requiring immediate attention, because they were not addressed two years ago, or more.

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