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RIOT CONTROL WEAPONS FOR THE VIETNAM WAR

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(U) Introduction

One of the advantages of the use of chemical weapons in warfare, according to a frequently-propounded adage of the Army Chemical Corps, is the degree of flexibility they afford. While ever more potent lethal agents competed with other systems as weapons of mass destruction, incapacitating chemicals were in a distinctly less awesome class, and more irritants of the tear gas variety were so far over to the other end of the military spectrum that by the 1960's they were no longer classed as war gases at all but given a category of their own as riot control agents. Though they were anti-personnel weapons, they were hardly capable of producing casualties in the ordinary sense of the term, for when the victim of a weapon could be expected to recover spontaneously in a matter of minutes, he would hardly be considered a casualty. A non-casualty-producing antipersonnel weapon was something very close to a contradiction in terms in a traditional military context. Riot control agents, therefore, were regarded as no more than the term implied – weapons with which to disconcert and disorganize a civilian mob.

When concepts of "massive retaliation" began to give way to "flexible response" early in the 1960's, America shortly began to participate by degrees in a limited war in Vietnam, a conflict in which tactics and weapons were to be proportioned to the military irregularities of the situation. Combat was often urban in location and context, centering on guerrilla infiltration of villages and towns. Traditional battle lines were usually lacking. Unconventionality in tactics and flexibility in weaponry were evidently to be in demand.

The early 1960's found the Chemical Corps experimenting with the newly standardized riot control agent CS, which represented a substantial advance on the older tear gases in terms of rapidity of effect, degree of incapacitation, and speed of recovery. The Army began to study the possibility of using such an agent in combat rather than civilian situations, just at the time when its involvement in combat was increasing. When the decision was made, half way through the decade, to employ CS weaponry in Vietnam, neither standardized munitions nor developed concepts for such employment existed. Yet in succeeding months and years weapons were designed, produced, and shipped, concepts were evolved. and effective employment was attained.

This monograph undertakes to provide an account of the process by which these ends were achieved. To some extent, at least, that process might be regarded as one of many wartime logistics efforts to meet needs not clearly foreseen in prewar planning. More specifically it represented the first effort by an American force in half a century to develop and utilize a group of chemical weapons in actual combat. In this sense the experience had no direct parallel in the present generation. Whatever its ultimate significance, it added still another new and unfamiliar aspect to the unfamiliar kind of war America faced in Vietnam.

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CHAPTER 1

(C) PREPARATION FOR THE FIELD

(C) CS and Tactics, 1962–65

(U) The use of irritant agents on the battlefield preceded the introduction of chemical warfare proper by half a year. Tear gas, previously known as a police weapon, made a brief appearance on the Western Front in the first autumn of World War I, achieved no results, and was all but forgotten when lethal agents were brought into play in April 1915, which date was subsequently held to mark the beginning of chemical warfare. Forty years passed before anything more effective than the chloroacetophenone of the World War I era was added to the repertory of irritant agents – agents, that is, with no significant toxic hazard or persistent incapacitating effect. Then, in the mid-1950's, the British adopted orthochlorobenzalmalononitrile, a compound first prepared by two American chemists, B. B. Corson and R. W. Stoughton, over a quarter of a century earlier as a riot control agent and used it during civil disturbances in their colonies. The American Army Chemical Corps then made its own evaluation of the compound, called CS after its discoverers, and standardized it as the riot control agent of choice on 30 June 1959.[1]

(U) This rapid decision, achieved as the result of an expedited program nicknamed Black Magic, to upgrade the Army's riot control capabilities, included in the same formal action the standardization of four CS munitions, a smoke-type hand grenade M7A1, an explosive "baseball" grenade M25A2, a CS disperser M2, and CS capsules,together with a micronized form of the agent itself, CS1, devised for more effective grenade filling. The grenades and the disperser corresponded to existing riot control systems for utilizing tear gas; the capsules were for use in troop training.

(U) The new agent was a solid at ordinary temperatures, rather than a gas, and was produced as a white crystalline powder. In the CS1 form the powder was reground to a finer particle size and mixed with 5% silica aerogel to discourage agglomeration. Unlike the familiar tear gas chloroacetophenone, CS was almost irresistible even in concentrations of 2 parts per million of air or less. The reaction of the eyes and respiratory system to the agent was

[1] Chemical Corps Technical Committee (CCTC) Item 3581

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almost instantaneous, producing such acute sensations of lachrymation, coughing, and even nausea as to incapacitate its victims as long as they were exposed. Recovery after exposure, however, was a matter of minutes, with no after-effects, and the general toxicity of the compound was rated significantly below that of ordinary tear gas. This latter fact was of particular importance because the Army distinguished between riot control agents and toxic agents (chemical warfare agents, properly speaking), including not only lethal chemicals but any casualty-producing agent in the latter category.

(U) Black Magic and the systems that resulted from it were concerned with civil disorder only. The question of battlefield use of CS did not arise until the end of 1962, by which time the Armed Forces of the United States were involved in the hostilities in South Vietnam, though still in an advisory capacity. At that time Brigadier General Fred J. Delmore, newly-appointed head of the U. S. Army Chemical-Biological-Radiological Agency (CBR Agency) as Edgewood Arsenal was then styled, spent several months in Vietnam. While his principal concern was with the feasibility of chemical defoliation as an anti-guerrilla technique, he also made some suggestions as to the utility of the new riot control agent in the unconventional type of warfare then going on. His specific concern was for the safety of airborne troops as they landed and left their vehicles. After his return to Edgewood, a demonstration was arranged for representatives of Department of the Army (DA) General Staff, Continental Army Command (CONARC), and Combat Developments Command (CDC), indicating current capabilities in both riot control and smoke munitions.[2]

(C) The possibilities of CS as an effective battlefield munition seemed sufficiently realistic after this demonstration to warrant a full scale troop test. Such a test, with the code name Water Bucket, was accordingly arranged and carried out in June 1963 at Fort Campbell, Kentucky by the 101st Airborne Division. Water Bucket deployed troops in five situations: ambush of a foot patrol, ambush of a vehicle convoy, attack by a rifle company against a hostile assembly area, helicopter-borne attack on village, and enemy attack on a small outpost. These were all small-unit operations without mortars or artillery. Standard CS grenades were used, both conventionally and as submunitions in the 3.5-inch rocket launcher and an experimental vehicular-mounted grenade launcher system. For reasons of

[2] CBR Advisory Council: Minutes, Dissemination and Field Testing Cmte, 11–12 Jun 64

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safety, most of these were emplaced and statically fired in predetermined patterns. After observing the manner in which small, slowly-forming grenade-generated clouds of CS could be dodged by opposing troops, the test report concluded that while CS was in fact effective in offensive and defensive tactical situations, the available CS munitions were "totally inadequate for tactical operations."[3]

(C) A number of recommendations for upgrading CS weaponry were made by the Water Bucket report. Among these was a call for a CS disseminating system to enable a rifle company to lay down a CS cloud over an area of 200 x 500 meters almost instantaneously while in tactical march formation. Expendable multiple grenade launchers were suggested as a possible means of meeting this need. A vehicular-mounted munition system to accomplish the same result was also recommended, as were air-droppable munitions. An airborne CS aerosol dispenser for use by helicopters or Army planes was called for, and the use of CS in large area coverage types of dissemination for offensive use was suggested.[4]

(C) The Water Bucket report resulted in studies of appropriate munitions concepts for CS being undertaken by the Chemical Research and Development Laboratories (CRDL) at Edgewood Arsenal, where similar studies for incapacitating agents, properly so called, were already under way and to some degree applicable to CS. At the same time, CDC requested the Edgewood Arsenal Operations Research Group to conduct an analysis of proposed CS delivery systems which could assist in developing formal qualitative materiel requirements along the general lines of the Water Bucket report. This analysis, published in June 1964, declared that since most tactical applications of CS would involve close combat situations in which the agent would be used to flush out or momentarily incapacitate enemy personnel, rapid establishment of essentially continuous agent clouds over a substantial area was a basic requirement for effective use. This would involve using a fairly large amount of agent in an action, so that lightweight munitions systems would be especially desirable in small unit applications. A ground munitions system of this type would probably be expendable, rather than an adaptation to CS of a unit's organic weapons. Aerial delivery would be preferable, however, when circumstances permitted.[5]

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[3] Rept, Troop Test Water Bucket, Ft. Campbell, KY, Jul 63

[4] Ibid

[5] (1) CBR Advisory Council: Minutes, Dissemination and Field Testing Cmte, 10–11 Oct 63
(2) Opns Research Gp, EA, "An Analysis to Propose Characteristics of CS Munitions for Army Use" (ORG Special Pub 7), Jun 64

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(C) The Operations Research Group analysis also took account of the candidate munitions proposed by CRDL in the course of the munitions concepts studies in progress there. A group of nine design concepts for CS munitions had already been prepared for demonstration in field tests in December 1963 to illustrate what the CRDL exploratory program could produce in a few months. They included the following:

1. An expendable launcher – called a popgun – for ground emplacement, containing 96 small canisters filled with an agent-pyrotechnic mix for thermal dissemination. The 24 launcher tubes, each holding four canisters, were of cardboard, embedded in polyurethane foam. The whole launcher, contained in a canvas backpack, measured 18 x 14 x 8 inches and weighed about 30 pounds, of which about 1.7 pounds was agent. It was capable of disseminating enough agent in about 10 seconds to cover an area 25 meters wide by 50–200 meters deep.

2. A light infantry mortar tube and projectile. The projectile contained 21 CS pyrotechnic canisters, in three tiers, and a charge in its base. The expendable mortar was a light steel tube, four inches in diameter, with a fixed firing pin in the base. Range of the weapon was 60–200 meters.

3. A CS-loaded 115mm T238-type rocket. Banks of seven CS canisters were loaded in a rocket body, which could hold up to 11 banks for a total of 77 submunitions. Shoulder-launched with the M28 Bazooka motor, it had a 200-meter range that could be increased by launching from a rail with a more powerful motor. The submunitions contained 20 grams of CS each – a total of over three pounds for the munition – and dispersed over an area 30 meters wide by 200 meters deep.

4. An improved CS rifle grenade. This grenade, unlike standard CS grenades, was loaded with six 8-gram CS canisters as submunitions, providing a distribution of payload over a circular area with a radius as large as fifty meters, depending on the size of the burster charge. The range, using a standard rifle grenade launcher was 170–220 meters.

5. A 3.5-inch CS rocket warhead, designed to be launched from the standard Bazooka launcher. Containing 56 CS-loaded pyrotechnic canisters, the warhead disseminated something over half as much agent as the 115mm rocket. The dispersion area of the submunitions was about 25 x 50 meters; the range, at maximum, was 200 meters.

6. An adaptation of the popgun expendable launcher for helicopter mounting. A helicopter carrying two launchers on each side, mounted so as

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to fire submunitions ahead of and to the side of the aircraft, would cover a rectangular ground area up to 200 meters wide while flying at 200 feet. Firing of the launchers would be carried out electrically.

7. An airborne cluster unit containing rubber ball submunitions. The cluster consisted of a cardboard cylinder one foot in diameter and two feet long, containing a central burster tube and 40 rubber balls, 4 1/2 inches in diameter, loaded with CS-pyrotechnic mix. The effective amount of agent disseminated by the cluster was about six pounds, distributed over an area of one to two hectares. The munition was lanyard activated, with the expelling charge in the burster tube serving also to ignite the submunitions. It could be dumped from the cabin door of the carrying aircraft, or dropped from suspension lugs. The rubber ball concept for the submunition was carried over from a study designed to produce riot control munitions with a minimum likelihood of producing injury through the functioning of components.

8. A canister cluster for air drop delivery. This cluster was a metal tube 27 inches long and 8 inches in diameter, loaded with banks of CS canisters. Each bank contained 31 canisters, for a total of 248, with a total dissemination capability of about 4 1/4 pounds of CS. Four banks were expelled sequentially from each end of the cluster when the munition was fired, distributing canisters over an area of about one hectare. This cluster was also lanyard-actuated, and could be suspended from the carrying aircraft or dropped manually from the cabin.

9. A dispenser for use on high performance aircraft. The SUU-7 Dispenser utilized air pressure from high-speed flight to eject bomblets from its 19 tubes. The bomblet contained nine CS canisters together with a fuze and ejection charge. Each bomblet, set to function at 100 feet, distributed ignited canisters over a path 70 meters wide. Discharge of two fully loaded dispensers by a plane on a single run would extend the dispersion path to a length of 1300 meters, and disseminate over 85 pounds of CS.[6]

(C) From the point of view of the Operations Research Group's critique, these development items, though promising in some degree, were limited in efficiency of distribution and percentage of effective payload per pound of munition. The analysis also took note of the fact that casualty hazards and fire hazards from munition components in the proposed systems

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[6](1) ORG Special Pub 7, Jul 64 (2) Presentation, COL William G. Willmann, CO, CRDL, to EA Commander's Conference, 1 Nov 63

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would tend to preclude use in areas where friendly personnel might be affected. Consequently, it did not recommend immediate generation of requirements for any of them, but recognized that some of them might be called for as interim munitions.[7]

(C) To some degree the discussion at this stage was still theoretical, since the US forces in Vietnam were not authorized use of CS in combat. Though some instances of riot control grenades being employed were reported in the winter of 1964–65, this situation remained essentially unchanged until some months after the United States became fully involved in the conflict in the summer of 1965. Nevertheless more advanced development did proceed at CRDL on at least two of the concepts generated in 1963, the air drop cluster and the popgun expendable launcher. In subsequent years a number of new CS dissemination systems outside the original Water Bucket concepts were to be added.

(C) Early Development Efforts

(U) The first efforts of CRDL followed objectives and systems criteria laid down by the Commanding Officer of the Laboratories on 25 July 1963 just after the conclusion of the Water Bucket troop test. These included an area coverage per munition approximating one hectare with a concentration (attained from multiple sources) sufficient to prevent evasive action by the target forces, delivery from light aircraft or from ground-emplaced weapons light enough to be easily handled, and range, in the case of ground-emplaced weapons, to cover 50–200 yards.[8]

(U) The Weapons Research Division of CRDL utilized available research results covering the general principle of multiple point-source pyrotechnic submunitions dispersing an aerosol of CS in smoke. Three concepts emerged at this early stage: an air-drop cluster containing a large number of small cylindrical submunitions, a shoulder-launched rocket loaded with the same small cylinders, and an air-drop cluster holding a 4 1/2-inch rubber ball submunition. Both clusters were conceived as being suitable either for mounting on fixed-wing aircraft or hand launching from helicopters.[9]

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[7] ORG Special Pub 7, Jul 64

[8] CRDL Technical Rept 3332, Weapons Concepts for Delivery and Dissemination of Agent CS, by H. I. Carroll and M. J. Bessey, Dec 65, p. 7

[9] Ibid, p. 8

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(C) The cylindrical canister submunition intended for the first two of the above systems was already available as a design item. It was a 1 1/4-inch aluminum cylinder 2 1/2 inches long, containing 40 grams of CS-pyrotechnic mixture and a fuzing and ignition system providing for a 5–6 second delay in ignition after initial activation. Burning time after ignition averaged about 14 seconds. The whole canister weighed 58 grams, just over two ounces. After munition development was under way, the canister was identified as the E49.[10]

(C) The air-drop cluster of E49 submunitions was designed on the basis of aluminum modules holding 31 submunitions each, a concept which was introduced when an original plan to stack the E49's in cardboard cylinders with expelling charges proved inefficient. The aluminum modules, about 8 inches in diameter, and containing expelling charges of black powder under a wood pusher plate, were clustered in four pairs to provide a munition with a total submunition capacity of 248 canisters and an area coverage over one hectare in initial air drop tests. About four pounds of CS was distributed as an inhalable aerosol over the target area, just meeting the standard concentration, calculated to render 50% of the target troops ineffective within 30 seconds.[11]

(C) For use in a shoulder-launched rocket, such as the M28 bazooka, the E49 canisters were arranged in 10 aluminum modules containing 7 canisters apiece. The resulting warhead produced an aerosol dispersion equivalent to 1.5 pounds of agent over a 1-hectare area at a range of 50–200 yards from the firing point, indicating that multiple firings would be required to reach the necessary agent concentration. The loaded bazooka, as fired in tests, weighed about 22 pounds.[12]

(C) The rubber ball submunitions concept involved a 4 1/2-inch hollow sphere of latex rubber with a filling neck, capable of containing about 350 grams of CS-pyrotechnic mix and a burster unit. To provide better dispersion a miniature rocket motor was developed for insertion in the filling neck. A cluster containing 40 submunitions constituted the basic munition. The cluster, when tested, covered a 1-hectare area with submunitions which

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[10] AMCTC Item 4346, 3 Mar 66

[11] CRDL Tech Rept 3332, pp. 9–15

[12] Ibid, pp. 22–27

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disseminated about 6 pounds of effective agent aerosol, but the larger size of the individual point sources meant that this was probably below effectiveness levels desired.[13]

(U) In the course of the next two years the first of these three prototype munitions, the canister cluster, became the basis of the E158 and E159 clusters ultimately sent to Vietnam. The expendable launcher concept evaluated by the Operations Research Group developed into the E8 launcher. Two additional projects were also in development: the adaptation of a commercial sprayer into a back-pack unit for spraying CS into tunnels (the future M106 disperser) and a 40mm rubber-bodied cartridge, planned originally for riot control use, which could be fired from a hand-held tube. These will be discussed in greater detail in subsequent chapters, but collectively, by the end of 1965, they represented a range of potential weapons for CS well beyond the 1962 level.[14]

(C) CS Enters the War

(C) It was at this stage in the development of CS munitions that the probability of battlefield requirement became evident. Before the fall of 1965 CS was not authorized for battlefield use in Vietnam by the theater command, although American personnel had been authorized protective masks and CS grenades for use in self-defense. In September it was finally decided by the US Military Assistance Command, Vietnam (MACV) that CS ought to be used offensively and permission, at first temporary, was granted by the Department of Defense for this change in policy. By November the change had been made permanent, with the theater commander authorized to use riot control agents CS and CN at discretion. This authority was immediately delegated to field commanders, and CS grenades, the weapons then in stock, began to be actively used in operations.[15]

(C) Somewhat coincidentally a second troop test – Water Bucket II – was just getting under way in the latter part of 1965. As the first Water Bucket test had served to evaluate available standard CS munitions for combat use, the second was to consider the advances, if any, achieved by the new development-type weapons. The specific tests scheduled involved the E158/159 air-droppable canister clusters and the E8 launcher system for

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[13] Ibid, pp. 15–21

[14] AMCTC Items 3935, 16 Dec 65; 4346, 3 Mar 66; 5191, 6 Feb 67

[15] Rept, Ofc of Science Advisor, MACV, Employment of the Riot Control Agent CS in Vietnam, 30 Apr 68

35mm cartridges. They were conducted at Camp A. P. Hill, Virginia, on 6–13 December 1965 under the auspices of the Special Warfare Agency of Combat Developments Command. Each of the munitions systems was tested in various small unit (squad and platoon) combat situations. The E8 launcher was found to provide effective use of CS in attacking and defending fixed positions and in conducting and defeating ambushes of foot and motor columns. The E158/159 clusters, dropped from supporting aircraft, cleared hostile bases and villages and defeated ambushes of motorized columns and a helicopter landing zone. It was concluded that both types of weapon gave significant tactical advantages in a counterinsurgency operational environment. The weapons themselves were recommended for tactical use. Thus at the very period when the Vietnam theater command was beginning to employ CS in tactical situations, the lack of tactical CS munitions, the predominant factor limiting use of the agent hitherto, was being overcome. The following year was to be the first in which CS systems designed for battlefield use were put into production to meet Vietnam needs. Nor would there be further Water Bucket tests; subsequent operational evaluations of new weapons would take place on the battlefield itself.[16]

(U) In the meantime units in Vietnam were using standard riot control CS grenades as best they could, in order to take advantage of the agent's capabilities. Instances were reported early in 1966 of grenade dispensers being fabricated for aerial drop of grenades from helicopters. Two dispensers, made from 2.75-inch rocket containers, gave a helicopter a 400-grenade capacity. The grenades were dropped to flush enemy personnel from suspected positions or known entrenchments, discourage guerrillas from firing at helicopters, and reduce casualties when hunting Vietcong personnel in villages. Similar dispensers were reported to be useful in clearing helicopter landing zones under good weather conditions.[17]

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[16] Rept, Troop Test Water Bucket II, HQ, Test Director, Ft. Lee, VA, Dec 65

[17] Ltr, USA Cml Center and School to Distribution, 25 Apr 66, subj: Operations in Vietnam, with inclosures

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CHAPTER 2

(C) AERIAL MUNITIONS

(C) Canister Clusters

(C) The first airborne CS munitions to be developed for Vietnam use, and probably the most important during the late 1960's, were the E158 and E159 canister clusters. These weapons grew out of the canister cluster developed more or less speculatively in the latter part of 1963 following the first Water Bucket troop test, as described in the preceding chapter. By the end of 1965 they were sufficiently far along to be evaluated in Water Bucket II. The E158 was a cluster of 8 molded plastic modules, each containing 33 E49 cylindrical canisters loaded with 35 grams of CS-pyrotechnic mix each. It was rated at 50 pounds, though actually a little lighter. The total weight of CS agent carried approximated 8 pounds. The E159 cluster was a 130-pound munition containing two E158 clusters tied end to end by a hinged strongback assembly, with suspension lugs for mounting on low-performance aircraft (fixed wing or helicopter) utilizing outboard bomb racks. An explosive bolt, actuated upon drop, forced the constituent E158 clusters downward and triggered their actuating mechanisms. When the E158 cluster was activated, its modules were released and opened by an explosive charge which also ignited the fuze trains of the individual canisters. The canisters skittered and burned after falling to the ground, disseminating CS as an aerosol.[18]

(C) The Water Bucket II troop test of December 1965 indicated that the E158/159 cluster systems were effective CS munitions, temporarily incapacitating target forces for ten minutes or so, and functioning for the most part as planned, although a few function failures of submunitions were noted. A formal requirement under the new Army ENSURE program (expedited nonstandard urgent requirements for equipment) followed shortly thereafter. ENSURE was a method for putting weapons concepts desired by forces in Vietnam and approved by the Department of the Army through the engineering design phase as rapidly as possible and shipping limited quantities of the resulting munitions to Vietnam for field evaluation without waiting for completion of the standard research and development

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[18] EA Special Publication, Riot Control Agent CS, Munitions, and Dispersers, Jul 69, EASP 600-4

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cycle. The validation of the canister cluster systems as ENSURE items was approved late in January 1966. The E159, which was considered the end item, was type classified for limited production (LP) less than a month later, on 15 February 1966. Production engineering contracts were awarded to Aerojet-General and Brunswick Corporation in the following spring. A procurement contract with Aerojet-General was negotiated by mid-May 1966, calling for delivery of 788 E159 clusters between August and November of that year.[19]

(U) Meanwhile word from the field led to a review of the assumption that the E159 cluster, which could be handled only by aircraft equipped with external mounting racks, would be the only desired end item. When a demand appeared for a cluster which could be manually dropped from helicopters, the E158 was quickly redesignated as an end item also, and preparations were made in the spring of 1966 to revise plans for future cluster procurement to include both the E158 and the E159.[20]

(U) The E159, with the designation CBU-19/A, was adopted by the Air Force as a munition for its low-performance aircraft with mounting racks before the first production items were received. With the successful conclusion of First Article Testing in the summer of 1966, subsequent production of the E159 was planned for the Air Force only, in numbers in excess of a thousand. Follow-on Army requirements were planned only for the E158. Two new production contracts covering both clusters were negotiated with Aerojet-General and Brunswick before the end of 1966.[21]

(C) The relatively smooth progress of the canister clusters from development projects to production items was interrupted in January 1967 when an E158 cluster being tested as an end item at Dugway Proving Ground functioned prematurely, blowing apart before the pre-set time interval after leaving the aircraft. Investigation revealed the need for more engineering on the fuze and initiator systems used when the cluster was manually dropped. Production of E158's was halted for a time, until the E22R1 fuze was designed to replace the E22 used previously. The E63R2 initiator similarly replaced the E63 of the original cluster. The cluster, as modified with these components, was then designated E158R2, and

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[19] (1) AMCTC Item 4346, 3 Mar 66 (2) EA Weekly Significant Action Repts, Commodity Mgr, E159 Cluster, Feb–May 66

[20] AMCTC Item 6322, 5 Sep 68

[21] EA Weekly Significant Action Repts, Commodity Mgr, E159 Cluster, Sep–Dec 66

production was resumed. Testing under the suitability for issue test program (SITP) in the spring of 1967 validated the safety of the redesigned cluster. It was independently type classified as an end item for limited production in September 1968.[22]

(C) The canister clusters were in Vietnam before the middle of 1967, and reports of successful use began coming back. Targets included such installations as bunker complexes, trenchworks, and groups of buildings. The use of the E158R2 to neutralize helicopter landing zones and to precede assault on entrenched enemy positions became popular with field units. It was noted, however, that care had to be taken to avoid too low a level for cluster activation, and there was criticism of the performance of the initiator. But in general the clusters were highly valued. The 9th Infantry Division, for example, reported several incidents early in 1968 in which the E158 played a major role. On 8 February two Vietcong companies in heavily fortified bunkers resisted assault supported by airstrikes and artillery, but four E158 clusters, followed by artillery attack, silenced their fire and led to the position being overrun. The dropping of six E158 clusters on fortified Vietcong defensive positions along a wooded stream on 25 March caused the defenders to flee, exposing themselves to air, artillery, and infantry fire. Again on 11 April, after eight E158 clusters were dropped on fortified Vietcong positions, the defenders abandoned their bunkers and were swept from the area with heavy losses by infantry action.[23]

(C) The demand for E158 clusters by field elements in Vietnam quickly outran the supply. The original limited production authorizations were extended as requirements increased. By mid-1967 nearly 4000 clusters had been delivered, the greater number for inclusion in E159 munitions. In the succeeding twelve months over 6000 E158R2 clusters were accepted by the Army from contractors. The monthly rate of delivery reached 1500 in the spring of 1968, and exceeded 3000 in December of that year. The cumulative total at that time was over 20,000. Yet the demand for the munition was hardly satisfied. The available supply rate to units in the field was less than 40% of that recommended during 1967; it was increased to 75% in June 1968, reflecting earlier rises in production output. Consequently units had to ration their expenditure of clusters. Use of improvised CS grenade

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[22] AMCTC Item 6322, 5 Sep 68

[23] (1) Rept, Employment of CS, 30 Apr 68 (2) Final Rept, USARV Cml Conference, 20 May 68

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dispensers to accomplish over-target strikes with CS aerosol continued. In some instances E158 clusters and M7A3 grenades were dropped successively in the same mission. The Chemical Officer of the 1st Infantry Division, discussing operations in the period February–April 1968, noted drops of both E158 clusters and M7A3 grenades in locally devised airborne dispensers on different occasions, mentioning as examples the clearing of a defended village – where the presence of civilians prevented artillery preparation – after E158 clusters had been dropped, and the overrunning of a Vietcong base camp area after the use of air-dropped grenades. The report referred both to the very short supply of clusters and to the fact that some of those received failed to function properly.[24]

(C) While the increased production of E158 clusters in the course of 1968 tended to relieve the supply shortage to a degree, the question of unreliable functioning, as in the report mentioned above, remained to be disposed of. In August 1968 the Army Concept Team in Vietnam (ACTIV) completed an evaluation of the performance of the clusters in the field and issued an evaluation report. The team had difficulty determining the precise effects of CS aerosol clouds on targets but found that the clusters had general acceptance by field units, especially for preparatory fire prior to conventional fire and ground attack. Nevertheless the malfunction rate ran as high as 17% and was rated unacceptable The problem was attributed principally to the E63R2 initiator, one of the elements engineered as a safety improvement after the premature activation of a test cluster early in 1967. Improvement or no, it was now held to be unacceptable. The level of quality control in munition assembly was also criticized as marginal. While the doctrine and techniques for employment of the cluster were rated adequate, it was noted that, whereas the role of munition as an over-the-target source of large CS aerosol cloud had been justified by the relative immunity of aircraft from hostile ground fire when at the release height of 1000–2000 feet or so, more sophisticated enemy weaponry was increasing the vulnerability of aircraft and might eventually make over-the-target munitions impractical. The report recommended that, while the supply of E158 clusters to field units be maintained, effort be made by developers to improve overall reliability, reduce munition preparation time, and find a less complex means of cluster initiation than the E63R2. More training in

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[24] (1) Item acceptance records, Production Ofc, Dir Procurement and Production, EA (2) Ltr, USA Cml Center and School to Distribution, 28 Jun 68, subj: Operations in Vietnam, with inclosures

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coordinating other operations with use of the cluster was suggested for combat arms personnel, to be carried out in CONUS. Quality control standards in munition manufacture had to be improved, and storage of clusters in the theater had to be conducted with more concern for the deleterious effects of the tropical environment. Finally the report urged expedited development of a helicopter-launched stand-off weapon for aerosolized CS, in the form of a rocket system, against the day when over-the-target drops might have to be discontinued.[25]

(C) The ACTIV report prompted a formal request to Army Materiel Command (AMC) in September 1968 for such modification of the E158 as might prove feasible, while continuing the supply of clusters to the theater. The first steps taken by Edgewood Arsenal, as the AMC activity responsible, was to improve quality control in the procurement of the T5 timer mechanism which appeared to be causing most of the problems in the E63R2 initiator, and to negotiate a product improvement contract for the munition as a whole. An altogether new timing mechanism, the XM109 initiator, was already being evaluated in the fall of 1968. Further development integrated this timer into a new XM721 fuze which eliminated initiators in the fuze system, replacing them with a more reliable standard ignition mixture. With these improvements, the E158 cluster was redesignated XM15. (When doubled to produce the Air Force-type rack-mounted cluster assembly munition, the designation was XM165.)[26]

(C) Tests of the XM15 cluster were conducted during the early months of 1969 by the Test and Evaluation Command (USATECOM) as a support to engineering design. Shortcomings were noted but prompt corrective measures, especially involving moisture-proofing the cluster modules and protecting the timer from corrosion, enabled retesting to be carried out successfully by USATECOM's Deseret Test Center in mid-year. A Prototype Systems Characteristics review of the XM15 and the XM165 at Edgewood Arsenal late in July 1969 recommended early type classification for limited procurement of the XM15, with concurrent engineering and service tests of both munitions for eventual Standard A classification. It was the conclusion of the review session that a long-term requirement for over-the-target CS

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[25] ACTIV Final Rept, Project ACG-83-86.1/67I, 1 Aug 68

[26] AMCTC Item 7619, 27 Jan 70

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munitions remained, which would not be obviated by the development of CS stand-off aerial weapons. The recommended LP classification was accomplished in November 1969, making the XM15 cluster available as a procurement item for future supply to Vietnam.[27]

(C) Terrain Restriction from the Air

(U) Aerosolized CS such as that produced by the burning of a CS-pyrotechnic mix is a nonpersistent riot control agent, effective only at the time of dissemination, before its concentration in the surrounding atmosphere becomes too dilute. Micronized and mixed with an anti agglomerant, CS became CS1, which, when dispersed as a powder rather than burnt, was capable of producing the characteristic riot control effects of the basic agent for a matter of days, when encountered on foliage or on the ground.

(U) With the introduction of CS into the American armament in Vietnam toward the end of 1965, the use of bulk CS1 as a terrain denial, or at least terrain restriction agent, soon came to the fore. The first method of use was to spray the agent from an M3 disperser or an M106 back-pack disperser around a perimeter or along trails leading to a defended perimeter, so as to discourage covert approach by enemy personnel. In the course of 1966 a more wholesale method of contaminating terrain began to be employed – dropping 55-gallon drums of CS1 from helicopters. The 55-gallon drum contained 80 pounds of agent (ten eight-pound bags). In order to disperse the agent, the drum had to be exploded upon dropping, turning it into a simple form of bomb. Various field expedients were employed by using elements to convert drums into CS bombs. The usual system was to install an M4 incendiary burster in the drum, with a pull-wire firing device. A number of drums (30 in some instances) would be loaded on a helicopter and dropped off one at a time at treetop level or higher. The bursting drums created a cloud of finely-dispersed CS1 that settled downwind to form an effective barrier zone, difficult for unprotected personnel to use.[28]

(U) In the course of 1966 the 1st Infantry Division, which had been using such a field expedient, came to feel that an adjustable time fuze adapted for the use to which it would be put, was essential for dependable functioning of their CS1 bombs. The erratic burst results of the

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[27] Ibid

[28] (1) Ltr, USA Cml Center and School to Distribution, 18 May 67, subj: Operations in Vietnam, with inclosures (2) AMCTC Item 6747, 12 Nov 68

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field-assembled drum and the frequency of fuze damage by tree limbs upon dropping were among the problems being experienced. A requirement was promptly forwarded to AMC and thence to Edgewood Arsenal under the ENSURE program in the fall of 1966 calling for an optimum fuze and burster system for the 55-gallon CS drum.[29]

(C) The first effort at Edgewood in response to this ENSURE requirement was to check out the functioning of the field expedient combination of an M4 burster with the CS drum. It was found that the burster was not adequate for proper rupture of the drum and tended to cause agent flashing, so that significant amounts of the powdered CS burned instead of dispersing. A new burster was devised (by modifying an M15 burster unit). It consisted of a 1.69-inch paper and chipboard tube 32.2 inches long, filled with 2.29 pounds of a mixture of 75% cast tetryl and 25% TNT, and closed with steel caps. The fuze developed for actuating the burster was a version of the M15A1 mechanical time fuze, with an 18-foot lanyard to provide for arming the munition well away from the launching aircraft. The burster, designated XM52, and the fuze, designated XM921, together constituted the XM920 Fuze and Burster, which was the first new system tested by Edgewood early in 1967 in the course of its development effort toward meeting the ENSURE requirement. The test results were not altogether satisfactory. The XM52 burster turned out, after extensive trials, to have the same propensity for causing agent flashing which had been a major defect in its M4 predecessor. Additional development was undertaken on the burster, and a narrower tube (1.0625 inches in diameter) was substituted, fabricated of steel, and containing only 1.5 pounds of a new mix, designed to limit flashing; it consisted of 83.3% Composition B, 6.7% TNT, and 10% oxamide. This burster, designated XM55, joined with the XM921 fuze and a pre-punched drum lid ready to receive the burster tube, formed the XM920E2 Fuze and Burster system.[30]

(C) The XM920E2 was ready for testing by the spring of 1967. Although safety precautions were necessary, it was judged good enough by the latter part of the year to go into production for operational evaluation in the field. The rate of successful functioning was high and flashing appeared to be significantly reduced. The system provided a capability for exploding a CS drum in the air above a target zone, with variable fuze

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[29] AMCTC Item 6747, 12 Nov 68

[30] Ibid

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settings to control the height of burst, although test results indicated that at any setting considerable variation in actual height of burst was to be expected. By 1 March 1968 USATECOM recommended that despite deficiencies the XM920E2 be considered suitable for release to forces in Vietnam for operational evaluation; meanwhile efforts should be made to improve performance and test actual munition effectiveness. By that time the first production quantities were ready for shipment, after assembly at Edgewood from components procured on contract and bursters furnished by Picatinny Arsenal.[31]

(C) The initial reaction of troop units using the new XM920E2 system was favorable. There seemed little doubt that it was a great improvement on the field expedients it was meant to replace. But it was noticed that the time fuze was not very accurate as a means of predetermining height of burst. Some accounts later claimed that, between fuze errors and aircraft altimeter errors, perhaps 50% of the drums dropped were wasted. Before the end of May 1968 the theater suggested that the fuze and burster system would be more acceptable if it was fuzed to burst upon ground impact, a method which limited area coverage per drum (though not significantly) but seemed likelier to produce predictable results. The optimum air burst height, 35–50 feet above the ground, was far too narrow a range for the degree of variation found in XM920 E2 functioning; the expected deviation was estimated at 170 feet. At least one unit (the 196th Light Infantry Brigade) had rigged up its own impact-fuzed drums, using AN-M173A1 fire bomb fuzes, as early as the fall of 1967 after experiencing difficulty with home-made air-burst CS munitions and reported the results to be satisfactory.[32]

(C) Receiving the theater request through channels, Edgewood Arsenal also turned to the AN-M173A1 fuze as a potential improvement for the XM920E2. The fuze was modified by adding an adapter to fit the burster well and a 10-foot arming lanyard with safety wire, snap hook, and screw eye. The resulting fuze, designated as the XM923, when put into the XM920E2 as a replacement for the XM921 fuze converted the system to a new designation: XM925. As such it constituted a direct-arming, all-ways, impact-type fuze and burster system. Tests of the system in June 1968 by

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[31] (1) Ibid (2) Ltr, USATECOM (AMSTE-BG) to CO, EA, 1 Mar 68, subj: Safety and Suitability Evaluation of Fuze and Burster Bomb, XM920E2

[32] (1) AMCTC Item 6747, 12 Nov 68 (2) USACDC Summary, Debriefings of Vietnam Returnees, Sep 69, pp. 63, 125 (3) USACDC Quarterly Rept, Operational Rept–Lessons Learned, Aug 68, p. 4.6

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the Quality Assurance Directorate of EA indicated that functioning and safety were adequate for shipment overseas as an evaluation item. USATECOM concurred in this finding in August 1968 after running its own tests of the XM925. The system was accordingly recommended for standardization as a limited procurement item, with procurement authority for 24,000 systems (including those already assembled and 1020 XM920E2 systems to be converted). Type classification as requested was approved 25 January 1969.[33]

(C) Production was already under way, with the first XM925 systems shipped in August 1968 and about 14,000 assembled by mid-1969, despite delays caused by shortages of components and reports of nonfunctioning systems from the theater. This occurrence of duds led to a slowdown early in 1969 while efforts were undertaken to improve the quality of system components. An extension of the limited procurement status was authorized in September 1969. At the same time investigations of new system concepts were undertaken in the interests of product improvement.[34]

(C) While the use of air-dropped CS1, whether in jury-rigged field-expedient bombs or in drums with standardized fuze and burster systems, was steadily growing through the late 1960's, becoming the major expenditure method for CS as a means of forcing evacuation of enemy base camps, contaminating trails and blocking infiltration routes, a new persistent form of the agent was in the process of standardization. Development of this new type was initiated in 1966, not for airborne use but to meet requirements for a tunnel denial system. The line of approach was to increase the persistency of CS1 by increasing the fluidity of the micronized particles to the point where they would readily form a secondary aerosol when ground deposits were disturbed, while resisting the tendency to be damped down by moisture. Research efforts on anti-agglomerants dating back to 1964 were drawn upon, and before the end of 1966 a formulation which modified CS1 by the addition of 1% hexamethyldisilazane, a liquid silicone product,

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[33] (1) AMCTC Item 6747, 12 Nov 68 (2) Ltr, USAMC to OACSFOR, 29 Nov 68, subj: Classification of Fuze and Burster, Bomb: System, XM925 . . . , with 1st Ind, OACSFOR to USAMC, 25 Jan 69

[34] (1) Item and acceptance records, Production Ofc, Dir Procurement and Production, EA (2) Presentation, Mr Merl G. Ringenberg, Customer Relations and Commodity Mgmt Ofc, EA, to EA Commander's Conference, 23 Apr 69 (3) AMCTC Item 7212, 23 Sep 69 (4) R&A, EA, 1st Qtr FY 70, p. 12

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was determined upon. The new formulation produced a fluffy, free-flowing powder of particle size 5–10 microns, the particles having water-repellent characteristics. It was accepted as a development-type agent in February 1967 under the designation CS2. Evaluation of the agent both at test sites and in the field indicated a substantially increased persistency in terrain restriction effects as compared to CS1, with marked secondary aerosolization when personnel passed through contaminated areas several days after agent deposition. This not only tended to satisfy the requirement for an improved tunnel denial agent but attracted the attention of munitions developers in the area of terrain restriction by air drop of CS. Although no formal Army requirement had even been specifically stated for riot control agent in this form, which prevented testing against stated desired characteristics, the advantages of CS2 were sufficiently evident and proposed uses in tunnel and terrain denial sufficiently pressing to enable the agent to be type classified Standard A in April 1968.[35]

(C) The Air Force, which had already adapted a 350-pound napalm bomb for use with CS1 (the BLU-52 bomb), was ready to use the same munition with CS2, which meant that a munition capable of spreading 250 pounds of agent over 3000 square meters or more was already available. The immediate outlook for Army munitions was along other lines. By the early months of 1967, a year before CS2 was formally standardized, Edgewood Arsenal's Weapons Development and Engineering Laboratories (WDEL) were at work on a concept for dispersing CS2 in small packages from a helicopter-borne dispenser. This munition took shape as an oblong box dispenser containing 19 vertical bays which were loaded with about 2300 0.35-pound containers of agent. The container which offered the most promise for rapid development of the munition was a small paper bag which burst upon ground impact. The delivery system was accordingly nicknamed the Brown Bag Dispenser. Early tests, with the dispenser slung suspended from an Army helicopter like any other piece of heavy cargo, showed a terrain coverage capacity for a strip 1200 feet long by 200 feet wide. In operation the bags were released sequentially from the dispenser, beginning with the center bays and proceeding simultaneously toward either end in order to maintain the center of gravity.[36]

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[35] AMCTC Item 6007, 9 Apr 68

[36] (1) EASP 600-4, Jul 69 (2) Historical statement, WDEL, EA, 25 Jul 67

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(U) As finally fabricated for testing, the XM28 Dispenser consisted of a lightweight rectangular box fabricated from angular, load-bearing, aluminum alloy extrusions and aluminum alloy sheeting. Its 19 compartment subdivisions, when loaded, each contained a fiberboard carton filled with roughly 110 folded and stapled paper bags of CS2; the cartons were loaded by weight rather than by bag number. The cartons had bottom-positioned tear strips which were laced to the bottom doors of the compartments. The dispenser was constructed to be electrically actuated from the carrying helicopter; sequential firing throughout the system then caused the compartment bottom doors to fall away in predetermined order, each door tearing open the attached payload carton as it fell. The bags of CS then could fall freely on the target area, bursting as they impacted. The dispenser measured 95 inches long, 36 inches high, and 33 inches wide, but in flight a box-type tail fin configuration with four canvas vanes was bolted on for aerodynamic stability, increasing the overall length to 155 inches. Loaded and ready to fly, the munition weighed about 1025 pounds.[37]

(C) In the course of 1967 the helicopter-borne dispenser, with its 760-pound agent capacity, was tested by Deseret Test Center, using both paper bags and frangible spherical grenades also designed to burst upon impact. The paper bags showed a more consistent burst rate. A substantial development program for the dispenser was now authorized. By August 1967 a tentative ENSURE requirement had been expressed, and within the following months an initial evaluation lot of 16 dispensers was being fabricated at WDEL. At the same time a suggestion by Deseret Test Center that the agent to be dispersed be given a green dye camouflage was being followed up. Suitability-for-issue testing (SITP) was conducted with the 16 dispensers in the spring of 1968 with favorable results. The dispenser, by now designated XM28, was thought to have a coverage capacity for a strip somewhat longer and narrower than first estimated – roughly 1400 by 120 feet – at a release level of 1500 feet above the ground at typical air speeds. About two or three dispenser loads were estimated to be required for an effective barrier zone against unprotected personnel, with duration of effectiveness rated at up to ten days.[38]

(C) A program for fabrication of 40 more XM28 dispensers for evaluation in Vietnam followed the SITP tests. The first increment of ten

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[37] WDEL, EA, Supporting Data and Recommendations, XM28, 5 Aug 68

[38] (1) Presentations, COL Robert L. Andreoli, WDEL, to EA Commander's Conferences, 18 Oct 67; 17 Jan 68 (2) R&A, WDEL, 4th Qtr FY 68

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reached the theater in September 1968, with the remainder following during succeeding weeks. Early reports were favorable; the 4th Infantry Division felt that the 750 pounds of CS2 in the XM28 was more effective than 1600 pounds of CS1 in a drop of 20 drums since there was no agent flashing at all, and the new form of the agent was considered nearly twice as persistent as the old. The principal use was for restricting enemy lines of communication, a function in which the munition was successful to the extent that no perceptible movement occurred in the areas affected after the attacks. Effective terrain restriction to prevent enemy occupation of rallying points, assembly areas, or emplaced weapons positions was also accomplished with the XM28. One dispenser was used to contaminate a ravine which penetrated an American defensive perimeter, as part of the defense of the base camp. Overall effectiveness in the evaluation of the lot dispatched was judged to be about 67%, with one third of the remaining missions judged partially successful. Three dispensers did not function at all, for no immediately apparent reason; several others had defective electrical equipment which delayed functioning or bays which failed to open properly. An evaluation of the overall experience by ACTIV led to recommendations that the XM28 be considered an acceptable combat munition, provided that some mechanical improvements, principally in the electrical components, were made and tested.[39]

(C) Upon receipt of this evaluation in March 1969, Edgewood Arsenal proposed a fix program covering six months to bring the XM28 up to recommended standards. Delays in funding at higher echelons carried the proposal into the succeeding fiscal year without action,and increasing budgetary restrictions led eventually to a query to the theater as to whether the XM28 was still desired as a field munition. The US Command in Vietnam confirmed its requirement for follow-on supplies of the dispenser, and the necessary support funds were at last provided late in October 1969, allowing the program for component improvement to get under way.[40]

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[39] (1) R&A, EA, 1st Qtr FY 69, p. 14 (2) I Field Force Vietnam Tactical Notes, Nov 68 (3) ACTIV Rept, CS Munitions: Dispenser . . . XM28, ACG-83-86.7/67I, 18 Feb 69

[40] EA Weekly Significant Action Rept, Project Engineer for ENSURE 215, 29 Oct 69

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CHAPTER 3

(C) GROUND MUNITIONS

(C) Cartridge Launcher

(C) The concept of an expendable launcher, ground-emplaced but man-portable and firing enough CS submunitions to lay down an effective surprise cloud of agent over a sizable target area, dated back to the period following the first Water Bucket troop test in mid-1963. The first development efforts for a so-called "popgun" weapon were carried on under contract with Cornell Aeronautical Laboratories and involved a bank of tubes firing multiple submunitions from a prepared earth emplacement. Further development was encouraged by the issuance of a formal Small Development Requirement (SDR) by the Army in November 1964. By 1965 the basic configuration had been settled to include a rectangular bank of 16 tubes, each firing four cartridges loaded with 38 grams of CS-pyrotechnic mix apiece. The launcher, an expendable back-pack item approximately 19x15x9 inches in dimensions and weighing 33.5 pounds, included a firing platform which obviated the need for prepared emplacement. Its 16 tubes encased in polyurethane foam were formulated of kraft paper and embedded in epoxy resin to hold them in place in the baseplate. The cartridges, designated E23, were aluminum canisters 4 inches long by 1 1/4 inches across and containing a propellant cup, the CS charge, and a rubber diaphragm which produced a skittering effect when the canister was burning, increasing the area and uniformity of the agent cloud produced. The launcher, designated E8, was fired either manually, by pulling a lanyard, or electrically. The resulting impact pattern of cartridges was meant to cover an area 30 meters wide and 125–175 meters deep, starting 50 meters from the launcher. The range could be varied, however, by altering the launcher's angle of elevation, which was adjustable through 90 degrees. The burning E23 cartridges gave off a cloud of CS as an aerosol, using about two pounds of agent per shoot and temporarily incapacitating unprotected personnel throughout the target area as well as producing bonus effects downwind.[41]

(C) The E8 launcher was considered to satisfy most of the requirements specified in the SDR, except that it weighed about one-third more

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[41] (1) EA Customer Relations and Commodity Mgmt Ofc, Test and Evaluation Study, E8 Launcher, 6 Dec 65 (2) Rept of Evaluation, Launcher . . . E8, MC Landing Force Development Center, Marine Corps Schools, Jun 66

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than the 25 pounds indicated there as the upper limit. In consequence it was rated rather heavy and awkward for a back-pack item. Nevertheless it won approval in the Water Bucket II troop test in December 1965, as indicated in the first chapter, and an Infantry Board evaluation in November 1965 showed only minor deficiencies in the test items aside from the weight problem. Early in 1966 it was designated as a requirement under the ENSURE program for Vietnam. In view of this need for expediting new CS munitions to the field, the E8 launcher was type classified for limited production early in 1966, at the same time as the E159 canister cluster. A production contract for over 10,000 launchers was negotiated with Brunswick Corporation, and deliveries began arriving in the theater by the end of 1966.[42]

(C) Reaction to the new munition by using agencies was mixed. The 1st Air Cavalry Division considered them too heavy to carry very far but flew them to contact sites to fire CS into cave complexes and tunnels, something of a departure from original use concepts. The 1st Infantry Division also found them too heavy to manpack on infantry missions but used them to defend base camps and other static positions. However, the 25th Infantry Division reported that E8 launchers were carried by many of its units on search and destroy missions and declared it to be excellent for use against fortified positions.[43]

(C) During the Tet Offensive in early 1968, in the course of the hard-fought battle to clear Hue of the enemy, Marine units used the E8 launcher as preparatory fire before a successful assault on the Treasury building. Republic of Vietnam troops also used E8's successfully during the battle as a means of neutralizing buildings used as strong points before assault.[44]

(C) Though use of the E8 launcher in the field did not match employment of airborne CS munitions, continued requirements were expressed and the original LP status of the munition was repeatedly extended to permit additional buys. Nearly 40,000 had been procured by mid-1969, when the production rate approximated 1500 a month. The weapon was

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[42] (1) AMCTC Item 4346, 3 Mar 66 (2) R&A, EA, 2d Qtr FY 67, p. 10

[43] (1) Ltr, USA Cml Center and School to Distribution, 28 Jun 68, with inclosures (2) USACDC Operational Rept – Lessons Learned, Aug 68

[44] Rept, Employment of CS, 30 Apr 68

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perhaps only a substitute for a CS mortar round in its capacity to lay down an agent cloud at close range, yet it continued to be used. However, formal development toward classification as Standard A, though contemplated at the time the launcher was first designed, was not to take place. The progress of the research and development cycle toward this goal had been halted as early as June 1966, when production was just in preparation, by an Army decision to suspend further development work pending field evaluation. In this suspended state the development project for the launcher remained for over three years.[45]

(C) A formal evaluation of the E8 launcher was finally forthcoming in November 1968 in the form of an ACTIV report. The evaluating team found the launcher an effective munition when used in attacking hard targets, covering retreat, or defending static positions. It also found that potential uses for the weapon, such as in ambush situations or attack on targets including noncombatants, had not been taken advantage of in the field. The launcher was judged too heavy to be properly portable. The report recommended that operational quantities of the launcher continue to be supplied, and that it be re-engineered to reduce its weight before permanent type classification was undertaken. This evaluation might have appeared to be the signal for resumption of a development program, but the event proved to be the contrary. A request for guidance by AMC resulted, after some months delay, in a determination by the Office of the Chief of Research and Development, DA in November 1969 that no requirement for a standardized lightweight version of the E8 launcher existed in the Army and that therefore the development program for the launcher would be terminated, with the weapon retaining its existing LP status for the time being. This brought to a close any prospect for standardization of the E8, though current procurement and supply programs continued.[46]

(C) Cartridges

(C) A formal requirement for a 40mm CS round to be used with the shoulder-fired M79 grenade launcher was in existence from the days following the first Water Bucket troop test. A corresponding research and development task was established shortly thereafter in June 1964, at a time

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[45] (1) Item acceptance records, Production Ofc, Dir Procurement and Production, EA (2) AMCTC Item 4728, 13 Jun 66

[46] (1) ACTIV Rept, CS Munitions: Launcher . . . E8, Project ACG-83-86.4/67I, 6 Nov 68 (2) AMCTC Item 7454, 18 Dec 69

when CS was not yet authorized for battlefield use in Vietnam. The first product of this development effort, the E20 tactical CS cartridge, revealed a number of serious deficiencies in the area of accuracy and compatibility with the launcher in the course of testing in 1966. By this time the urgency of the requirement had increased with the introduction of CS into active tactical use, and the existing development task was supplemented by an ENSURE requirement validated in June 1966. The initial evaluation quantity requested was 20,000 cartridges.[47]

(C) It was to meet this ENSURE requirement that modifications were undertaken to make the E20 cartridge usable in the field. The modified version, redesignated XM651, had a new cartridge case cup seal which eliminated jamming in the launcher. Test results generated on SITP tests early in 1967 on the new cartridge were mixed. The XM651 functioned well against soft targets and in open terrain but experienced a 50% failure rate against hard targets barricades. It was safe to handle and fire from the M79 launcher, however. Investigation of the test results indicated that defective performance against hard targets was a function of fuze design, and a redesign of the fuze housing was accomplished in conjunction with the fuze contractor. The modified assemblage was identified as XM651E1. Renewed SITP testing of this version in mid-1967 indicated significant upgrading of performance. The cartridge was shortly thereafter released for evaluation in Vietnam, with the first increments of the 20,000 requested for trial arriving during the summer of 1967.[48]

(C) First reports from the theater were favorable. A military police detachment reported that the cartridge was invaluable in policing the base camp perimeter. Reconnaissance units used it for neutralizing hedgerows and other strong points encountered, taking advantage of its increased range as compared to hand grenades. Theater command indicated by January 1968 that the cartridge had operational capabilities not duplicated by other munitions and stated that it should be maintained as an urgent item of supply. Action was immediately taken to type classify the XM651E1 for limited procurement, with a first year production goal of 330,000 for

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[47] AMCTC 6249, 24 Jun 68

[48] (1) Ibid (2) EA, Dir Quality Assurance, Independent Safety and Reliability Assessment on Cartridge, 40mm: CS, XM651, 11 May 67

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Vietnam. (Additional production was scheduled for National Guard stockpiles.) The LP type classification action was approved in June 1968.[49]

(C) The newly classified XM651E1 cartridge consisted of a bullet-shaped 40mm aluminum cartridge case and projectile 4.56 inches long overall, weighing about 9 1/2 ounces. The blunt-headed projectile portion of the round had ridges that acted as rotating bands to produce fuze arming upon firing. It carried a payload of two ounces of CS-pyrotechnic mix and the modified XM581E1 fuze, and it functioned on impact. The cartridge case carried the propellant charge, percussion primer, and driver cup. Upon functioning, the rotating cartridge projectile armed its fuze within the first 30 meters of flight, which constituted the lower limit of range. Upon impact the fuze ignited the CS mix, which blew out the base of the projectile and emitted a CS aerosol cloud some 25–30 feet across within half a minute. The munition was capable of putting this aerosol cloud on a point target 200 meters distant, with a maximum range for area targets up to 400 meters. It could penetrate window glass or wood siding to release CS in an enclosed area, which augmented its effectiveness.[50]

(C) On the basis of the utilization of the original evaluated lots of the 40mm CS cartridge, it was rated as the preferred munition for getting CS into single bunkers, weapons emplacements and buildings. Fired through a window or bunker port, it made the occupants of the structure helpless or drove them into the open. Small units using it felt they had an organic CS capability against point targets, without dependence on supporting fire. Demand for the evaluation items outran supply, and there were instances of units raiding each other's stockpiles for the cartridge.[51]

(C) The XM651E1 went into full scale production in the latter part of 1968 to meet the limited procurement quantities authorized. Almost at the same time action was taken to extend the LP status and increase total quantities to nearly a million rounds. By the end of 1968 a second LP increase brought authorized procurement goals to over 1,300,000 cartridges. Actual deliveries against these requirements did not begin to

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[49] AMCTC Item 6249, 24 Jun 68

[50] (1) Ibid (2) EASP 600-4, Jul 69

[51] Rept, Employment of CS, 30 Apr 68

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gain momentum until 1969. Early production ran well behind schedule, as fuze and design problems and defective components complicated assembly. New component subcontractors helped bring production up in 1969. Over 350,000 acceptable XM651E1 cartridges had been delivered by the middle of that year.[52]

(U) The XM651E1 cartridge, when supplied in quantity to Vietnam, would have at least five roles in which it could be utilized, according to an ACTIV evaluation report: attack of hard targets, attack of troops in the open, reconnaissance by fire, defense of static positions, and counterambush. Units employing the cartridge when in close contact with the enemy could observe the effects of the munition; it either reduced enemy fire, forced abandonment of protected positions, or caused opposing troops to break contact. It permitted infantrymen to place CS accurately on target at stand-off distances greater than those attainable by the use of other CS hand munitions. The principal shortcoming observed was that the impact of the cartridge on very soft targets – the water or mud of rice paddy surfaces, for example – was sometimes insufficient to actuate the fuze. The report recommended that the cartridge continue to be furnished in operational quantities, and that consideration be given to improving reliability when fired into water or soft mud.[53]

(U) The XM651E1 cartridge was a weapon of war capable of perforating a wall and unquestionably hazardous to anyone in the target area. A nonhazardous CS cartridge conceived of primarily for riot control use was also produced and delivered to Vietnam for use wherever it might help, and especially as a substitute for the XM651E1 when that was in short supply. This was the E24 40mm CS cartridge, known familiarly as Handy Andy from its ability to be fired if necessary without using a grenade launcher. The basic development of the E24 was also an outgrowth of the effort to improve CS capabilities after the first Water Bucket troop test in 1963. A development effort for a riot control munitions concept ancestral to the E24 was authorized at the outset of 1965. The munition resulting from this effort was a 1 1/2-inch aluminum tube over 8 inches long, containing a propellant charge and a projectile in the form of a

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[52] (1) AMCTC Items 6425, 20 Sep 68; 6683, 21 Jan 69 (2) Presentation, Mr Herbert G. Fredericks, Dir Procurement and Production, EA, to EA Commander's Conference, 22 Apr 69 (3) Item acceptance records, Production Ofc, Dir Procurement and Production, EA

[53] ACTIV Rept, CS Munitions: Cartridge, 40mm: Tactical CS, XM651 and XM651E1, Project ACG-83-86.6/671, 1 Dec 68

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7-inch molded rubber cylinder weighing 200 grams, half of which was CS-pyrotechnic payload. While an adapter was provided for firing the cartridge from the M79 grenade launcher, the weapon could also be fired by striking the firing cap with the hand – hence the cartridge's nickname. When fired in this manner, its range was fifty yards or so; launched by the M79 its range was doubled. Ignition of the payload produced a CS aerosol cloud about 35 square yards in extent at the target point. The rubber projectile was too soft and too slow to inflict casualties, but it represented an extension of the range to be expected of a hand-thrown CS grenade.[54]

(C) By the beginning of 1966, with CS already in use in Vietnam, and no comparable munition ready for production, a requirement was expressed under the ENSURE program for the E24 cartridge, whose limited range was balanced by its capability of use against target areas which might include noncombatants. A preliminary evaluation of the E24 by CRDL shortly before had shown, however, that there were some deficiencies to be corrected and that hand-firing involved some risk of bruises to the operator and should be undertaken only when necessary and then by trained personnel. Accuracy of the hand-fired projectile also was questionable. From the point of view of Combat Developments Command, a new development project against more rigorous requirements was called for. This had the effect of discouraging plans to develop the E24 into a Standard A munition, but the existing requirement for LP quantities for Vietnam remained to be met. Design and engineering changes were undertaken to correct deficiencies and improve reliability. In the spring of 1966 reviews of progress indicated that much of this goal had been achieved. Engineering design tests showed that estimated agent return levels at the target were above the 50% desired and that function reliability was about 82%. This figure was believed to be improvable by corrective measures on components during pre-production engineering. On this basis AMC recommended LP standardization in July 1966. This action was approved by DA in December, with an LP production level of about 280,000.[55]

(U) In the meantime action was being taken to restore the status of the E24 as a development item to be continued in the research and development program as a candidate for future Standard A classification. With the

[54] (1) AMCTC 5191, 6 Feb 67 (2) EASP 600-4, Jul 69

[55] AMCTC Item 5191, 6 Feb 67

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understanding that the E24 would in any case be considered an interim munition, pending completion of development of a new 40mm riot control cartridge meeting USACDC's requirements (an event expected to occur in FY 1972), this step was recommended by AMC in October 1966 and approved by DA in January 1967.[56]

(U) Production of a sample lot of E24's for SITP testing was accomplished in the summer of 1967, but the tests themselves revealed problems that were to cause major delays in the program. The rubber projectiles tended to be produced with too wide a variation in size, causing oversize items to jam in the cartridge tube. Agent recovery also ran below the 50% minimum expected. Production delays ensued while actions were taken to improve projectile body tolerances by modifying the molds used in production and to identify and correct the source of the drop in agent recovery. The latter was held to be the result of a deficiency in igniter components, and the ignition system was redesigned. The hazard to the user in hand firing prompted development of a new and safer firing cap for the cartridge. The original LP production schedule had to be sacrificed as a consequence of these changes, but by mid-1968 the urgent ENSURE requirement was reaching the theater. The safety cap was not included on these first lots, and the shipment was therefore limited to use with the M79 launcher only.[57]

(U) By late summer of 1968 the LP production schedule was resumed, though deliveries continued to run behind. The modified E24 being turned out was redesignated XM674. The schedule shortfalls were largely due to an insufficient supply of acceptable components. Standardizing the characteristics of the pyrotechnic mix in the cartridge payload when dealing with the output of different producers also helped delay production. Before the end of the year, however, production began to pick up momentum. The greater part of the original LP quantity had been accepted for inventory before the middle of 1969. The production program continued under the impetus of successive LP extensions.[58]

(U) As the XM674 cartridge had retained its status as a development item, it pursued its way through the research and development cycle during 1968 and early 1969 while LP production was in process. The

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[56] AMCTC Item 5261, 3 Apr 67

[57] (1) R&A, EA, 1st Qtr FY 68, p. 10; 3d Qtr FY 68, p. 12; 4th Qtr FY 68, p. 14 (2) Presentation, COL Robert L. Andreoli, WDEL, EA, to EA Commander's Conference, 17 Jan 68

[58] (1) Item acceptance records, Production Ofc, Dir Procurement and Production, EA (2) Presentation, Mr Merl G. Ringenberg, Customer Relations and Commodity Mgmt Ofc, EA, to EA Commander's Conference, 23 Jan 69 (3) AMCTC Items 6482, 15 Oct 68; 6745, 18 Feb 69

occurrence of dud rounds in tests delayed the standardization schedule to the point where it was determined in mid-1969 that it was not far enough ahead of the next generation nonhazardous CS cartridge (the XM627 cartridge, in development since 1967) to justify further development effort, especially in the face of USACDC dissatisfaction with its capabilities. The decision made was to give the XM674 Standard B status without proceeding to engineering and service tests, establishing it as an interim item in Army supply but terminating existing development programs. Formal approval of this action came in December 1969.[59]

(C) Artillery and Mortar Rounds

(C) In the summer of 1966 an ENSURE requirement was validated for providing CS-loaded rounds for three major ground weapons: the 4.2-inch mortar and the 105mm and 155mm howitzers. The purpose was to provide tactical commanders with relatively large-scale CS weapons in attacking hard targets when air support was unavailable or impractical. Immediate design work was undertaken involving CS canisters to be incorporated, after the manner of smoke shell fills, in a base ejection shell, using existing illuminating projectiles as carriers. The canisters were to be loaded with CS-pyrotechnic mix at the rate of about one pound per canister for the smaller calibers and nearly two pounds for the 155mm weapon. A shell could be made to carry four (or five, in the case of the 155mm projectile) such canisters, which would be ejected at the target to burn on the ground, emitting a CS aerosol cloud.[60]

(C) The first of the three experimental CS shells to reach the field was the 4.2-inch mortar cartridge, designated XM630. This projectile, carrying four XM9 CS-pyrotechnic canisters and fuzed for airburst with an M548 fuze, was in the early test stages during the first months of 1967. The tests indicated that the accelerated development of the shell had not been a complete success. Test firings indicated that at least ten increments of propellant were needed to make the round flight safe, and one short round occurred even after this minimum had been established. Nevertheless it was decided in June 1967 by Test and Evaluation Command to give a conditional

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[59] (1) Presentation, LTC Sampson H. Bass, Jr., WDEL, EA, to EA Commander's Conference, 24 Jul 69 (2) AMCTC Item 7517, 20 Jan 70

[60] (1) EASP 600-4, Jul 69 (2) Presentation, Dr Bernard Berger, WDEL, to EA Commander's Conference, 18 Oct 66

safety release to the munition, with restrictions proposed by USAMUCOM as to the minimum number of propellant increments and a warning to alert friendly troops in line of fire that short rounds were possible. It was understood that acceptance tests of the first production lot (10,000 rounds for evaluation in the field) would also be conducted. These tests were satisfactorily conducted later in the summer of 1967, and the evaluation quantity was shipped to Vietnam in October 1967.[61]

(C) The XM630 mortar shell was used during the evaluation period mainly as a means of placing CS accurately on protecting positions so as to flush out enemy troops. Follow-up air and artillery strikes were thereby rendered more effective. An ACTIV evaluation of the munition, while noting occasional tumbling rounds, short rounds, and duds, was generally favorable, and troop reaction was also positive. By the spring of 1968 the Army was prepared to place an initial order for 243,000 rounds, or nearly a million XM9 canisters. An additional 200,000 rounds in the form of a follow-up order for the next fiscal year had been approved by the time formal type classification for limited production was accomplished in October 1968.[62]

(C) Production of the first year's increment of canisters was already under way. The major part of the requirement -- about 90% -- was placed on contract with Brunswick Corporation, but before the contractor's expected first delivery toward the end of 1968 Edgewood Arsenal began fabricating metal canister components and sending them to Pine Bluff Arsenal for filling. Some 120,000 canisters were produced in this manner in the fall of 1968.[63]

(C) The 4.2-inch CS mortar round had already proven itself in combat. One unit, for example, using shells from the evaluation lot in January 1968 prevented a Vietcong night attack from overrunning its position. Another fired 52 rounds to force enemy troops from bunkers, exposing themselves to punishing fire from American ground forces.[64] The CS shells were used

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[61] AMCTC Item 6481, 4 Oct 68

[62] (1) Ibid (2) USARV Chemical Conference, 20 May 68

[63] R&A, EA, 4th Qtr FY 68, p. 14

[64] 9th Inf Div, Cml Operational Repts, 5 Feb 68, 1 May 68

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in other instances to suppress enemy fire from built-up areas in villages. Late in April 1968 units of the 101st Airborne Division encircled a North Vietnamese battalion near the city of Hue and began air and artillery strikes against enemy fortifications. On 1 May CS clouds were initiated by air-dropped grenades and maintained by 150 rounds of 4.2-inch CS mortar shells mixed with conventional explosives. Enemy fire was suppressed and a successful paratroop assault ended the action.[65]

(C) The development of the 105mm CS round, XM629, began in the summer of 1966 at the same time as that of the 4.2-inch XM630 but proceeded somewhat less smoothly. Accelerated design of a CS-pyrotechnic canister, designated XM8, and intended for an existing base-ejection howitzer shell (M314A2E1 illuminating projectile) was completed in succeeding months. The resulting XM629 round, carrying four XM8 canisters, went directly into a Suitability for Issue Test Procedure, in the course of which a number of the shells lost their baseplates after firing. A higher standard of workmanship and materials was required; this was attained in lots manufactured for retests, and the improved round, which included heat-treated steel-grooved shear pins to prevent premature baseplate separation, was declared safe for issue in November 1967 – pending lot acceptance tests of the rounds actually produced for shipment overseas. When these tests were conducted, however, at the beginning of 1968, a number of instances of premature functioning occurred, and the trouble was traced to the XM8 canisters. Investigation revealed that the starter composition in certain lots of the canisters had been improperly compounded. Retesting with properly loaded canisters proved satisfactory. The defective lots were culled out, and the evaluation quantity of some 3000 rounds required under the ENSURE program was finally shipped to Vietnam in August 1968. An additional thousand rounds was shipped shortly thereafter. First reports from the field indicated that the XM629 shell was successful in giving the 105mm howitzer a CS capability in combat. A request for an additional 10,000 rounds was received by the end of 1968, and on this basis the XM629 was type classified for limited production in June 1969. By this time the XM8 canisters required for the approved order had already been produced.[66]

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[65] USACDC Operational Rept – Lessons Learned, Feb 69

[66] (1) AMCTC Item 7027, 20 Jun 69 (2) Historical statement, WDEL, FY 68 (3) Item acceptance records, Production Ofc, Dir Procurement and Production, EA

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(C) The development of the 155mm CS round, begun at the same time as the 4.2-inch and 105mm shells, proved to be the most troublesome of the three. Like the other two, the 155mm round, designated XM631, used an existing base-ejection standard shell (the M485 illuminating projectile) for which a CS-pyrotechnic canister, the XM7, was designed. The shell was loaded with five XM7 canisters, giving it a total payload of 9.4 pounds of CS-pyrotechnic mix. First tests of the design in 1967 resulted in the discovery that black powder was sifting out of the canister starter mixture into other portions of the projectile. The test schedule was suspended to allow for rework of the XM7's starter mixture characteristics and loading techniques. The SITP test stage was finally reached early in 1968, only to reveal instances of premature functioning. Investigation indicated that possible failure to press-load the mixes at high enough pressures might have been the cause, and the SITP lot was reworked under tighter quality control procedures. The tests were repeated in the fall of 1968, with results indicating that the projectile was not safe for use at maximum propellant charge. It was then proposed to release the round for field use with a restriction as to the limit of charge to be permitted (Charge 6) and new tests were run early in 1969 which verified the adequacy of the XM631 round under this limitation. However, work was already under way to redesign the XM7 canister for improved performance, and since longer range development of other 155mm CS rounds, based on different concepts for the agent-carrying canisters (submunitions) contained within the shell, was also proceeding, it was tentatively decided to continue the XM631 as a development program in competition with other approaches. In the course of 1969 the XM631, which continued to experience development problems, dropped out as a probable answer to the ENSURE requirement for a 155mm CS round, fulfillment of which was postponed until a competitive concept could complete development.[67]

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[67] (1) Historical statement, WDEL, FY 68 (2) R&A, EA, 3d Qtr FY 69, p. 12; 4th Qtr FY 69, p. 12

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CHAPTER 4

(C) CONCLUSION

(U) The CS weapons described in the preceding chapters were representative of the effort to provide the forces in Vietnam with a riot control agent tactical capability in the 1966–1969 period. The list of items mentioned therein is not exhaustive, however. Several field expedients were put into use from time to time to utilize CS with whatever means were available. A lightweight commercial agricultural duster-sprayer with a 450 cubic foot/minute axial-flow blower was adopted for military use as the M106 disperser and employed in blowing CS into tunnel complexes. Nicknamed Mity Mite (it weighed less than 40 pounds including fuel and 8 pounds of CS) it was standardized in 1965 at the outset of the period of riot control agent use in tactics and saw extensive use in the field.[68]

(C) Other CS weapons were still being developed for Vietnam use as the 1960's ended. Chief of these were two rocket warheads, one for aerial and one for ground employment. The aerial rocket began as a standard full-cycle development project in 1966 to meet a Qualitative Materiel Requirement for a tactical CS munition deliverable by Army aircraft at a stand-off distance. Feasibility studies by contractors led to the conclusion that a CS warhead for the 2.75-inch Folding Fin Airborne Rocket system (FFAR) would meet the requirement. The warhead was planned as a container for submunitions to provide multi-source area coverage capability; it had to function in flight by means of a relatively sophisticated remote setting electronic time fuzing system. As designed it consisted of a frangible aluminum outer shell carrying 32 CS canisters (XM100) arranged around a central steel tube. The expelling charge in the tube functioned upon fuze activation, breaking the warhead shell to disperse the submunitions. Development of the 2.75-inch warhead, designated XM80, proceeded through the late 1960's, with type classification estimated as attainable by the end of 1971 at the normal development pace. Early in 1969, however, actions were initiated to provide a version of the XM80 rocket to the Vietnam theater under the ENSURE program so as to bypass some of the remaining development schedule in the interest of rapid delivery to the field. The

[68] (1) AMCTC Item 3935, 16 Dec 65 (2) Ltr, HQ, 1st Air Cav Div to a member of Faculty, USA Cml Center and School, 19 Mar 66

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ENSURE requirement was validated on 25 April 1969, and the schedule worked out in consequence called for shipment to the theater of an operational evaluation quantity within eight months after the initiation of the program.[69]

(C) The ENSURE schedule could not be met by the XM80 rocket as it stood; the developers intended to satisfy the requirement by simplifying certain features, especially the fuzing system. A less sophisticated base ejection fuze and actuating system for the warhead was decided upon, and the weapon thus constituted was redesignated XM99. The required base ejection fuze was already available as an Air Force item. Contracts for production of 10,540 XM99 warheads for SITP tests and ENSURE needs were awarded in September 1969. First Article tests of the contractor's production, conducted at the end of 1969, indicated the need for redesign of the warhead casing to strengthen skin thickness. This involved some delay in the commencement of SITP testing, which did not get under way until the late winter of 1970. Delivery of the operational evaluation quantity of 10,000 XM99 warheads to Vietnam was not probable before the end of the following summer. Meanwhile the development of the original XM80 warhead was suspended, pending evaluation of the capabilities of the XM99.[70]

(C) A shoulder-fired CS rocket warhead entered the development scene late in 1968 in consequence of the successful adaptation of the LAW (lightweight antitank weapon) high explosive rocket system – a modern version of the bazooka, with a multi-shot capability – to the use of a new flame warhead. The prospect of producing a CS-loaded warhead for the same XM191 four-barrel rocket system resulted in an ENSURE requirement being formulated before the end of 1968. Once in development, some time was lost in determining an optimum ballistic CS match for the existing flame round. The first assumption was that a steel warhead casing would be desirable, but by mid-1969 tests had shown that an aluminum warhead had better performance characteristics. The design of this XM96 rocket system (the weapon had originally been designated XM74 in 1968) was sufficiently

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[69] (1) AMCTC Items 5491, 13 Jun 67; 5889, 13 Feb 68 (2) R&A, EA, 3d Qtr FY 69, p. 12; 4th Qtr FY 69, p. 12

[70] R&A, EA, 1st Qtr FY 70, p. 12; 2d Qtr FY 70, p. 12

established by the summer of 1969 for procurement efforts to be initiated. Procurement of an initial lot for SITP tests and operational evaluation to meet the ENSURE requirement began late in 1969, with First Article testing scheduled early in 1970.[71]

(U) Thus, as the decade of the 1960's came to an end, the effort to provide CS weapons systems for battlefield use begun in 1963 was still moving forward. Beginning with hand grenades and portable blowers, the means of agent dissemination provided to the field had progressed through improvised bombs and cartridge projectors to airborne linear dispensers and CS shells, with CS rockets in the offing. The development of CS2, with its capacity for effective secondary aerosolization after deposit, had contributed to the effectiveness of terrain restriction and tunnel denial techniques. The effort as a whole, marked by widely varying rates of progress, had succeeded in introducing and maintaining CS as a battlefield factor in Vietnam, the first time in half a century that a chemical irritant had figured as a significant tactical element in an active theater of war.

(U) Begun at a time when CS was not admitted to the battlefield, the development of CS weaponry proceeded at the traditional measured pace of military research and development during its first two years. The change of policy that late in 1965 brought CS into demand as a tactical weapon coincided almost exactly with the Army's ENSURE program to bypass standard development procedures to get new materiel into the theater of operations at the earliest practical moment. Within a year the first examples of CS tactical weapons had gone overseas; by the end of 1967 a number of new devices had been introduced to the field and units were becoming accustomed to the possession and use of CS materiel.

(U) As might be expected with weapons rapidly designed and produced, the new items often displayed shortcomings. Some of these, like the problems of component quality experienced in assembling the E24 Handy Andy cartridge, were familiar production difficulties encountered repeatedly in munitions manufacture. Others, like the excessive weight of the E8 launcher, or the unsatisfactory test performance of the XM7 canister, represented defects in design or engineering. In such cases the need for haste militated against the development of a completely

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[71] (1) R&A, EA, 2d Qtr FY 69, p. 13; 3d Qtr FY 69, p. 13; 4th Qtr FY 69, p. 12; 2d Qtr FY 70, p. 13 (2) Presentation, COL Andreoli, WDEL, to EA Commander's Conference, 23 Apr 69

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satisfactory munition. This was not unexpected; nevertheless the general level of results achieved by the end of 1969 was impressive. Within four years from the first demand from the theater, roughly a dozen CS weapons had been put into the field, not one of which had existed as a production item at the outset of the period. Most of them were being produced and shipped in large quantities and were in regular use on the battlefield.

(C) In entering the battlefield as a tactical factor, CS was meant to accomplish the following objectives:

1. Force the enemy into the open, exposing him to other munitions.
2. Disorganize enemy assaults.
3. Neutralize enemy defenses and suppress enemy fire against opposing assaulting forces.
4. Restrict enemy use of terrain, tunnel complexes, and other installations.
5. Permit use of selective munitions in populated or built-up areas to accomplish military objectives with minimum civilian casualties or destruction of property.

(U) Achievement of these objectives depended not only on the availability of CS munitions but also on their intelligent use, including allowing for peculiarities of weather or terrain and assuring proper exploitation of the agent's effects. The readiness of friendly forces to take immediate advantage of the temporary disorientation in an enemy unit upon contact with CS would often be a decisive factor in determining the success of a CS mission. The fact that the war in Vietnam so often involved contact with lightly-equipped irregular forces was another important factor, for these guerrilla units were not likely to have adequate eye and respiratory protection available when exposed to CS. Conversely possession of gas masks by friendly forces was essential if they were to use CS in combat. Frequent failure on the part of American troops to carry the relatively heavy M17 gas mask into the field tended to restrict utilization of CS at first; the outfitting of units with the new lightweight XM28 mask in 1969 was expected to increase the opportunities for use of CS weaponry.[72]

(U) In practice the record would seem to show that the new weapons were effectively employed. As a means of clearing villages before or during assault with a minimum of casualties, both aerial and ground employment

[72] Draft, Riot Control and Incapacitating Chemical Agents (CB Weapons and Defense Technical Data Source Book, Vol. 1 Part B), Deseret Test Center, Apr 69, pp. 97–100

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of CS gave positive results in most cases reported, with the targets being secured and enemy forces driven off or captured. Equally positive results were recorded for CS as a weapon in position defense, again with employment of either airborne or ground dissemination. The use of CS in attacking fortified positions such as bunkers or enemy base camps also seemed to be generally successful in forcing evacuation of positions or suppressing enemy fire during assault. The most frequent use of CS was in some form of terrain restriction, including contamination of base camps, agricultural or storage sites, river crossings, infiltration routes, and tunnel complexes. In this employment CS was used in a manner recalling the persistent contaminants of World War I tactics. Tunnel denial procedures, as reported, were effective in somewhat over half the cases cited: it was difficult to assess the actual effectiveness of other terrain restriction techniques. Where specific results were reported, they were generally positive. Successful use of CS weapons in clearing suspected enemy positions or hidden troop concentration points was also reported.[73]

(U) One uniform factor testifying to the battlefield utility of CS weaponry was the demand, which consistently outran supply. Evaluation lots of new ENSURE CS items were quickly exhausted in operational use and rapid resupply was usually sought. Available stocks of CS weapons were carefully rationed, and field expedients for the dissemination of the agent when weapons were in short supply (or not yet developed) were universally resorted to. Over 3000 tons of the agent itself were procured in the United States during the first three years (1966–69) of its wide-scale use. There seems to be good reason to assume that from the point of view of the troops themselves the program to devise tactical systems for CS was well conceived.[74]

(U) It would be reasonable to conclude, therefore, that the concept of bringing a riot control agent into the battlefield had been successfully realized, at least in the special circumstances of the war in Vietnam. Such a conclusion would not overlook the many delays, the individual design failures, the sometimes haphazard use concepts, and the supply difficulties which accompanied the CS program to a greater or lesser degree throughout its course. Nevertheless the new weapons had contributed materially to

[73] Ibid, pp. 188–197

[74] Ibid, pp. 197–198

American tactics in the field, expanding the resources of troops in both counter-insurgency and conventional battlefield situations, and exploiting the inferiority of the enemy in defensive and retaliatory capabilities. The effective use in warfare of an agent which in itself could not produce casualties could not have been inferred from the example or the doctrines of the past, in which lethality had been a major criterion of success in a weapon. But the prediction of the first Water Bucket test report in 1963 that a riot control agent could be a true tactical weapon if properly employed was borne out in the test of battle during the same decade. It is worth noting that the concept could be propounded, accepted, and embodied in new weaponry, and that these weapons could be produced and successfully employed in a distant and difficult theater of war, all within five years or so. Such an accomplishment might properly be termed a success. The value which may ultimately be accorded to CS and its weapons systems in the prosecution of the war in Vietnam, or in warfare generally, awaits a future reckoning.