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result of field tests during 1949, the optimum effectiveness of a clusterable bomb approximating the 10-lb. size was established as the most promising vehicle for G-agent dissemination and related data showed the advantages of GB over GA as a filling therefor. Military characteristics for this bomb were established as recorded in reference b. and are reproduced herewith as a matter of information and record:

- (1) The bomb should be designed for clustering in 1000-lb. size cluster adapters.
- (2) The bomb filled with GB or other G-series agent should be able to withstand storage without leaking or undue deterioration for a prolonged period of time.
- (3) The bomb should be capable of storage and use under all climatic conditions and temperature ranges consistent with the properties of the agent employed.
- (4) The bomb should be capable of release from aimable clusters dropped from altitudes varying from 5000 to 60,000 ft. and at speeds varying from 175 to 600 knots.
- (5) The bomb should be safe in storage, handling, and use by operating personnel.
- (6) A suitable fuze should be provided for the bomb in order to permit instantaneous functioning on impact with any surface under all operating conditions.
- (7) The bomb should be designed to give the most effective dissemination of the agent filling.
- (8) The bomb when clustered should not rupture when dropped onto concrete from a height of twenty feet.
- (9) The unarmed fuze should not function when dropped onto concrete from a height of twenty feet.
- (10) When released from aimable clusters the bomb should be stable in flight.
- (11) The method of functioning of the adapter should be such that there are no loose adapter parts or cluster debris in the air which will affect the releasing airplane or other airplanes in any tactical formation that may be flown.
- (12) The resulting clusters should have predictable and reproducible ballistic qualities.

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b. During World War II the standard size bombs and clusters were in the 100, 500, and 1000-lb. categories with weight and size being limited by the capacity of airplanes then available. With subsequent increase in plane capacity, the development of larger munitions to be carried therein was a logical step to increase combat efficiency. In order to meet the requirement for larger and more effective clusters, Project Bl2.3c, identified as reference c., was established just prior to VJ-Day. Military characteristics for these larger clusters and component adapters were established by CCTC Item 1782, 25 Sep 1947, and provided that the adapters would overcome deficiencies of wartime design and function so that there were no loose parts in the air that might damage the releasing airplane or any others in tactical formations that might be flown. Load factors used as design criteria were those established initially by the Bomb Subcommittee of the Aeronautical Board. Work conducted under this project resulted in development of water-proof, nose-ejection type adapters which could serve as shipping cases for the assembled munition without further packing or crating with the exception of shipping rings. With verification of the basic principles for a 10-lb. clusterable bomb and a suitable 1000-lb. adapter, the development of the complete G-agent cluster was the next step in the program. As a consequence, Project 4-04-15-022, 1000-lb. Cluster of GB Bombs, was established in the FY 52 program as recorded in reference d. This action recognized the new Air Force requirement for the family of 750-lb. bombs and clusters; however, the need for the subject 1000-lb. cluster was established in order to provide an interim munition pending development of the smaller counterpart. In order to provide a firm guide for this new end item, reference d. approved applicable military characteristics which are reproduced herewith with editorial changes as a matter of information and record:

- (1) The cluster shall be capable of installation and release under operational conditions from bomb bay designed for this class of bomb size.
- (2) The ballistics of the cluster shall be such as to permit the proper distribution of component(*) gas bomblets(**) on the target.
- (3) The component(*) gas bomblets(**) after release from the cluster at a suitable height shall be capable of efficiently disseminating nerve agents in an airborne state, under conditions consistent with the properties of the agent.
- (4) The overall functioning of clusters and bombs shall be not less than 95%.
- (5) Structurally, the clusters shall meet the following "g" requirements: +15 g, -9 g vertical, + 6 g fore and aft and + 2 g side.

(*) "Component" replaced "child" as recorded in CCTC Item 2456.
 (**) Terminology "bomblet" assigned as recorded in CCTC Item 2743.

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- (6) The cluster less fin assembly and fuze shall serve as its own shipping container and shall be water-proofed to withstand storage under conditions and for a period of time consistent with the properties of the agent fill.
 - (7) The preparation of the cluster for use should be as simple as possible and should not require any special tools.
 - (8) The cluster shall be capable of being jettisoned in an unarmed condition.

c. As the result of work conducted under Project 4-04-15-022 (reference d.) the prototype E101 1000-lb. Cluster was fabricated and subjected to preliminary tests. These resulted in modifications incorporated in the subject E101R3 and E101R5 Clusters which are covered by references e., f., and g. and consist of the components described below with notation of reference drawing, specification and type classification:

- (1) Cluster, Nonpersistent Gas Bomb, GB, 1000-lb. E101R3 (M34)
(C14-23-1080) (MIL-C-11781A) (Limited Standard)

As assembled for bomb bay installation the cluster includes all components noted below except shipping guards and is 68 $\frac{1}{2}$ " long by 19 $\frac{1}{4}$ " dia. (casing). For transport the cluster is 58-5/8" long with 23-3/4" diameter shipping guards. Fin, fuzes, cartridges and arming wires are separately packed.

- (a) Adapter, 1000-lb. Cluster, E43R1 (M29)
(D14-23-780) (MIL-A-11634A) (Standard)

This adapter consists of a 19-1/8" diameter x 50" long 1/4" steel casing designed for nose ejection of seventy-six (76) component E54R6 10-lb. Bombs by means of gas pressure generated at the tail assembly by four ejection cartridges. Six cluster bars and plates at each end support the four jointly strapped banks of bombs. The forward end is hermetically sealed by an C-ring and steel plate. The fin mounting assembly at the rear, with holes for cartridges, is covered during shipment by a gasketed plate. Standard suspension lugs, two at top and one below, are welded to the casing. The loaded adapter, identified as the cluster without fuzes, fin, and arming wire, is marked in accordance with drawing D14-23-1081 and includes the following data stencilled on a gray background: Nomenclature,

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Stock Number, Lot Number, Weight and Cubage, one 1" green band centrally located but not concealed, adapter nomenclature, number and nomenclature of bombs, and the Chemical Corps insignia.

- (b) Bomb, Nonpersistent Gas, GB, 10-lb. E54R6 (M125)
(D14-5-1369)(196-131-524A)(196-131-499)(Lim. Standard)

This bomb is 3-5/8" in dia. x 12" long, vacuum-filled through a rubber diaphragm at the rear which is solder sealed, and equipped with a parachute that is secured and packed under a cover at the tail of the bomb. The bomb weighs about 8 1/2 lbs. and includes 2.6 lbs. of GB filling. The assembled bomb less components described below is identified on drawing D14-5-1372, which indicates the recognized status of Type A (E14-5-1377) seamless steel cases with two brazed ends, and Type B (B14-5-1281) drawn tubes with one end brazed. Although about 400,000 Type A bodies have been produced and will be utilized, only Type B will be supplied in the future. In accordance with marking diagram C14-5-1350, each bomb is painted gray, has a single green band near the nose, and includes identification and filling data in green. Essential components of the bomb are the following:

1. Fuze, Bomb, E24R1 (M196)
(D14-15-515)(196-131-533)(196-131-534A)(Standard)

This is a 1-3/4" long x 1-11/16" diameter point-detonating fuze containing an Ordnance M15A2 Detonator. Arming is accomplished when the parachute decelerates the bomb and brings the detonator in line with the firing pin. This fuze is screwed into position at the nose of the bomb after insertion of the burster.

2. Burster, Bomb, E12R1 (M31)
(C14-15-532) (MIL-B-11485A) (Standard)

This consists of a plasticized paper tube encasing a 250-gram tetryl column 1.337" in diameter and 7.5" long.

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- 3. Parachute, 10-lb. Bomb, E4R1 (ML)
(C14-5-1331)(MIL-P-13342)(Standard)

This is a 14" diameter semi-hemispherical chute made of nylon or rayon with nylon shroud lines connected to the end of the bomb and covered by a special retaining cap. Types A and B parachutes are identified for use with the comparable bomb bodies and differ only in details of attachment. Only Type B parachutes will be procured in the future.

- 4. Delay, Bomb Parachute Opening, E1OR1 (ML)
(D14-32-3)(196-131-562A)(Limited Standard)

This is a metal tube 6" long x 7/16" in diameter containing ignition components and is secured around the bomb body by a 30.6" long 1/16" wire rope to retain the E4R1 Parachute under 60 to 90-lb. pressure by crimping a 5" steel-tubing-covered section of the wire. When the bomb is released from the cluster, a spring-operated mild steel arming bar releases a lock pin which allows a spring-driven pin to fire the M26 Primer. This burns in turn through first fire mixture FF-31 (MIL-STD-594), delay mixture (Formula B2.54) and black powder, exploding ignition powder and breaking the end of the body thereby releasing the wire and the cover over the parachute. A cotter pin through the arming bar maintains the delay safe until its removal during clustering.

- 5. Nonpersistent Gas, GB
(354310) (MIL-I-10758) (Standard)

This is the standard agent of the G-series of which 2.6 lbs. are used as the bomb filling. Although classified as a non-persistent agent because of intention to always disperse it in the aerosol form, inherent characteristics identify it as moderately persistent under temperate climatic conditions. In the E54R6 Bomb design is such as to achieve a relatively high percentage of nonpersistent dissemination; however, persistence is such that concentrations dangerous to unmasked personnel may exist for periods up to 24 hours.

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- (c) Fin, 1000-lb. Cluster, E6 (M13)
(C14-23-761) (196-131-571) (Standard)

This component is 20" long with a maximum width across the ends of 25 $\frac{1}{2}$ " which is bolted to the adapter prior to fuzing. It incorporates a round shroud, a short fin with a 10° boat-tail angle, and four blades of two thicknesses of 14 gage steel (.0747") spot-welded together. Two tail fuze adapters for the standard M152A1 Fuzes are fastened to the base of the cone. Shipped separately in a steel crate 17" x 19" x 19" in size.

- 1. Cord, Detonating, Type IV
(MIL-C-17124) (Standard)

Forty inches (40") of plastic-reinforced cord are interlaced in the fin to contact fuze wells and cartridge holders.

- (d) Fuze, Bomb Tail, Mechanical Time, M152A1
(R14-15-674) (MIL-F-1269) (Standard)

This is a standard tail fuze supplied by the Ordnance Corps. Two are required per cluster.

- (e) Wire, Arming, E11 (M22) (C22-128-1) (Standard)

Two 55" lengths of 0.035" brass wire from the tail fuzes are connected at a swivel loop retained between the suspension lugs. It is a Type B assembly on drawing C22-128-1 and specification MIL-W-10982A and is shipped 100 per wood box rolled on cardboard and enveloped.

- (f) Cartridge, Cluster Ejection, E8 (M3)
(C14-31-1) (MIL-C-13230) (196-131-532) (Standard)

This cartridge is similar in size to an 8 gage shotgun shell (2.68" x .923" dia.), with about 200 grains WCC 225 propellant powder. Four are required per cluster, 500 are shipped separately in a wood box.

- (g) Guard, Shipping, 1000-lb. Bomb Cluster, M1
(B14-17-290) (MIL-G-11395) (Limited Standard)

Three asphalt-impregnated wrapped paper rings 2-9/16" wide by 23-3/4" outside diameter are located at each end and in the center to protect the cluster during storage, shipment, and

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handling prior to assembly of fin and firing components. Eight 31-1/4" x 3/8" steel tie rods with lock nuts connect end guards to the center section which is strapped to protect the opening over the single suspension lug.

- (2) Cluster, Nonpersistent Gas Bomb, GB, 1000-lb, E101R5 (M34A1) (D14-23-1533) (Standard)

This cluster consists of the same components as the E101R3 Cluster with the exceptions noted below:

- (a) Bomb, Nonpersistent Gas, GB, 10-lb., E54R8 (M125A1) (D14-5-2184) (Standard)

This bomb is identical with the E54R6 Bomb except that in lieu of the E10R1 Delay it incorporates the

Delay, Bomb Parachute Opening, E10R2 (M1A1) (D14-32-24) (196-131-613A) (Standard)

The primary change in the delay mechanism is the redesign of the arming bar to improve functioning efficiency and safety. This spring steel component has a tab turned under to engage a shoulder of the modified firing pin and no lock pin is required.

- (b) Guard, Shipping, 1000-lb. Bomb Cluster, M2 (D14-17-1501) (196-131-628) (Standard)

This is an improved guard similar in construction to the M3 Guard provided for the M35 and M36 750-lb. Incendiary Clusters, and is used in lieu of the M1 Guard described under the E101R3 Cluster. The M2 Guard consists of four 90°, identically-molded, wood-fiber sections strapped with steel at each end and two central positions. This provides a 58-5/8" long x 24" diameter slatted case which protects the loaded adapter. Dimensions of the shipped adapter are 60-1/4" long x 24" diameter. Limited Standard M1 Guard may be used with this assembly.

- (c) The cluster is marked in accordance with drawing G14-23-1534 in a manner similar to the E101R3 but so that all markings are visible through the top central bars of the M2 Shipping Guard.

d. Functionally the E101-type Clusters operate through the following sequence after release from bomber aircraft in accordance with bombing tables: The cluster fuzes arm after vanes are released by the arming wires and rotated by air currents, the fuzes initiate simultaneously at the pre-set time for 5,000 feet, setting off detonating cord to the four cartridges and developing a pressure of about 5,000 psi

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within the chamber at the rear of the cluster; this deforms a bolt in the rear plate of the adapter releasing internal components and causing ejection of the bundle of bombs through the front of the casing under pressure; after about 4 seconds the delay mechanism on each bomb bursts to free the rear can and allow the parachute to assure axial stability and slow the bomb to a terminal velocity of about 75 feet per second to reduce ground penetration and obtain optimum dispersion; the fuze functions instantaneously on surface contact to disperse an aerosol of GB in lethal concentrations. On the basis of test reports cited above, a lethal dosage from one cluster covers 10,000 to 20,000 square yards in 30 seconds and 30,000 to 50,000 square yards in 2 minutes, depending upon meteorological conditions. Reference m. noted that although GB is classified as a nonpersistent, all Air Force missions flown showed only an 18% decline in the total amount of gas in the atmosphere per minute of exposure from the one-half to one hour sampling interval.

e. The inherent dangers of GB and mass production and testing of the E101R3 Clusters has been recognized, consequently appropriate safety procedures have been prepared and are identified as ref. q. This is a complete safety publication for use by all Army agencies concerned with the storage and handling of the subject cluster. In addition to a detailed munition description and discussion of GB and its properties, physiological effects, medical aspects, etc., ref. q., covers protective clothing and procedures; detection, decontaminating materials, equipment, and procedures; disposal, storage facilities, procedures, and quantity-distance factors; escort responsibilities, procedures, agreements, and mission of the Technical Escort Detachment; rail, motor, water and air shipment; and disaster planning to include responsibilities, alarms, and training drills. The Air Force is publishing a Technical Order to cover procedures to be used by USAF agencies. Surveillance procedures based on reference r. will be published as an SR in the 742-series for implementation by Cml C depot personnel to evaluate clusters in the supply system while in Army Control and also to provide for declustering to individual bombs. Reference s. identifies the interim procedure in effect until such time as the SR is available. Detailed technical data are provided and include visual inspection, leakage tests, functioning tests, special tests including sampling and chemical analysis, and serviceability requirements for all separately packed components.

f. Reference h. identifies the final engineering report of the development laboratories on testing of the E101R3 Cluster conducted for evaluation against the approved military characteristics and provide data for tentative munition expenditure requirements. Some results obtained jointly with the Air Force are incorporated in this report. Routine tests were conducted on (1) Rough handling, including transportation and drop tests onto concrete, (2) Surveillance, including storage of the E43R1 Adapters, E6 Fin and detonating cord, E54R6 Bombs, and assembled clusters in the climatic hangar at the Eglin Air Force Base, (3) Design efficiency, including tests for vibration, immersion, bomb bay installation,

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g-requirements, ballistic evaluation at Edwards Air Force Base, design adequacy and jettisonability, (4) Functional efficiency, including drop test at Eglin Air Force Base and agent dissemination of the E54R6 Bomb from drop tests of the agent-filled clusters at Dugway Proving Ground. As a result of all tests reported in reference h. it was concluded that the E101R3 Cluster satisfied the approved military characteristics reproduced in paragraph b. above in all cases except that it was noted that the evaluation with respect to characteristics (2) and (3) were not yet fully determined which was also the case for characteristic (7) of the component bomb reproduced in paragraph a. above. (Although 95% functioning may have been accomplished with development-type clusters, the functioning of production-type clusters has been of the order of 85%. In addition, characteristics (2) and (4) paragraph 2.a. are not considered to be completely satisfied because of limitation of time and aircraft capabilities.) As a result of all tests conducted and evaluated, reference h. recommended that the subject E101R3 Cluster be considered a satisfactory item to meet the stated requirement and suggested that an improved delay mechanism, subsequently accomplished, be developed to simplify cluster assembly and avoid possible premature firing.

g. Detailed reports of testing of the E101R3 Cluster at Dugway Proving Ground are covered in references i., j., k. and l.

(1) Of these, reference i. reported multiple drop tests to provide data for use in verifying cluster expenditure rates. Functioning of 32.7% component bombs from eight clusters was reported over 109,000 sq. yds.; estimated dosage-area coverages for an LD₅₀ of 100 mg-minutes per cubic meter in the C-15, C-30, C-120 second sampling periods were 44,000, 80,000 and 270,000 square yards, respectively. (Meteorological conditions for this test were wind speed - 4.4 mph., temperature gradient - slight lapse, air temperature at 2 meters - 53°F.)

(2) Reference j. reported tests conducted to determine the capabilities of the E101R3 Cluster for disseminating GB in physiologically significant concentrations over large areas and to provide information on the functionability of the munition and its component parts. Functioning of 85% of the E54R6 Bombs was reported with an average drop pattern per cluster of 8,000 square yards. Assuming uniform distribution, conclusions indicated that 209 clusters were required to provide a vapor dosage equal to 100 mg-minutes per cubic meter over 80% of a 1 square mile area within a 2-minute sampling period under lapse conditions. For inversion conditions, 74 to 94 clusters would be required. It was also concluded that the E101R3 Cluster was sufficiently aimable when dropped at 15,000 feet altitude for functioning at 5,000 feet above the terrain and that the parachute-opening delay device on the component bombs should be improved.

(3) Reference k. reported further tests conducted to determine munition expenditure rates, functionability of the cluster, and a comparison of the vapor effectiveness of the subject munition with a VT-fuzed, GB-filled, 500-lb., AF-M78 Bomb. Conclusions indicated that (a) A reliable determination of expenditure rates was not possible because vapor dosage data were inadequate, (b) A higher percentage of E54R6 Bombs

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functioned than in previous tests, (c) Vapor dosage data for the 500-lb. GB Bomb were valid for future use, and (d) Persistency of GB was greater when disseminated from air burst AM-M78 Bombs than from the E101R3 Clusters under the meteorological conditions of the test.

(4) Testing reported in reference l. was conducted to assess the operational suitability of the E101R3 Cluster in multiple cluster releases. From tests reported it was concluded, based on random distribution, that (a) The number of clusters required to produce vapor dosages equal to 100 mg-minutes per cubic meter over 1 square mile of open level terrain 2 minutes after dissemination of the agent was approximately 37 clusters for 50% target coverage and 83 clusters for 80% target coverage, (b) The extent of downwind travel of detectable GB was 1/2 mile to 3 miles, (c) Closed houses and slit trenches afforded some protection from the agent cloud and (d) Percentage functionality of the component E54R6 Bombs was comparable to that observed in previous tests. (These tests were conducted under the following meteorological conditions: wind speed - 8 mph, temperature gradient - slight inversion, air temperature at 2 meters - 51°F.).

h. Air Force operational suitability testing of the E101R3 Cluster is reported in reference m. which covers tests conducted to determine the conditions of multiple release at operational altitudes and airspeeds from high performance bomber aircraft. Tests reported were conducted as a joint effort by Air Proving Ground Command and this Corps with all phases of testing closely monitored and evaluated by the ARDC technical consultants on Project "Big Ben". Testing was subdivided under (1) The logistic phase, including transportation of 20 inert, simulant-filled and 40 GB-filled clusters from Rocky Mountain Arsenal to Lowry Air Force Base, Colorado, thence to Eglin AFB in C-124 type aircraft. Operations included appropriate provisions for the necessary security, detection, and decontamination procedures both on the ground and during flight. Unloading operations at Eglin AFB were similarly safeguarded and the munition placed in a suitable toxic gas yard facility. (2) Strike mission phase, in which night profile missions were flown in B-47 aircraft staging from Eglin AFB to the target area at Dugway Proving Ground, Utah. Plans for bombing operations required one dry run over the target for necessary information both aloft and from ground control stations. Four clusters from each of two aircraft were released from 35,000 ft. with a fuze setting of 50.33 seconds to function at 5,000 ft. above the target based on tentative bombing tables provided by this Corps. After each Dugway mission, the aircraft landed at either Tinker or Kirtland Air Force Base to refuel and return to Eglin. A total of 10 such missions was included in the test program. (3) Target description, providing a 6,000 ft. square superimposed on a circle 8,000 ft. in diameter with the square divided into 250 ft. grids. Family-type houses and a slit trench were located in the target area in which special vapor samplers, liquid samplers, and test pigeons were uniformly emplaced. Appropriate target illumination was provided since the tests were conducted at night. (4) Sampling analyses, in which quantitative analyses were carried out for all missions with GB-filled bombs with

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subsequent evaluation of results to determine the effectiveness of the agent as disseminated. Reference m. included detailed results and data from which the following conclusions were drawn:

(1) The E1C1R3 GB cluster cannot be considered operationally suitable for USAF employment until such time as compatible detection devices and protective equipment become available to using organizations. (S)

(2) The cluster can be dropped from high performance bomber aircraft (B-47) at high altitudes (up to 42,000 feet MSL) and high speeds (up to Mach .76) and is very stable in flight. (U)

(3) The ballistics of the E1C1R3 are satisfactory for area employment. (C)

(4) Use of the cluster to produce a lethal concentration of the agent under appropriate conditions is feasible. (S)

(5) The agent disseminated by this means penetrates temporary shelters and diffuses down into trenches. (S)

(6) No special loading equipment will be required in the bomb-up operation. (U)

(7) The main impact on an Air Force Wing upon the adoption of this munition-agent combination as a weapon for strategic employment is the requirement for a thorough G-series indoctrination and training of all personnel. (S)

(8) Facilities at a base of operation require a storage area, toxic gas yard, as outlined in T.O. No. 39B-15K-15. (S)

(9) The Air Weather Service and Air Intelligence will be required to give valid and "up to the minute" target information. (U)

(10) The E24R1, inertia-arming, point detonating fuze, is unsatisfactory for fuzing the E54R6 bomb. (C)

i. Based on the conclusions noted above, reference m. incorporated the following recommendations:

(1) An "all-ways" type fuze be developed and used in all GB cluster munitions of the future. (S)

(2) A requirement be made of the Chemical Corps for development of a more positive means of immediate detection of leakers. This might be:

(a) An instantaneous indicator, installed within

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the cluster, so that any leaking inside the cluster would be immediately detected or indicated. (S)

(b) Or an instantaneous area detector, portable and inexpensive. (S)

(3) An approved and tested operational method of disposing of a leaking munition be formulated. (S)

(4) A thorough study be initiated to formulate more pertinent safety criteria, especially for this agent. (S)

(5) The present bombing tables be redesigned to include true airspeed in ten knot increments, release altitude above the target in increments of 1,000 feet, and to permit use of "Q" factors for differential ballistic wind corrections. (C)

(6) A tank liner for the M3A2 power driven decontamination apparatus be developed that would be resistant to the corrosive action of the sodium carbonate solution. (U)

(7) Any future plans for the employment of this weapon be delayed until such time as compatible detection devices and adequate protective equipment are made available to the USAF. (C)

(8) Further research and/or study be initiated to improve the reliability of the fuze of the E54R6 bomb. (C)

j. In summarizing the overall results of the operational suitability testing, reference m. indicated that:

"2. Although the design of this munition fails to exploit the potential capacity of the bomb for agent fill (agent weight is less than 1/5 the total bomb*weight) the E10LR3 cluster will provide the Air Force with a nerve gas type anti-personnel munition compatible with high performance bomber aircraft. The cluster is ballistically stable from release altitude to the point of functioning of the cluster; however, since the component bombs are stabilized through the use of parachutes, the overall aimability is contingent upon allowance for the effect of vector wind from burst altitude to the surface. Within the condition postulated in this report, this munition can produce a lethal concentration on target. (S)

"3. In order for the Air Force to attain a capability to use munitions containing nerve gas, it is recommended that the E10LR3 cluster bomb, although not entirely suitable, be accepted as an interim weapon pending the development of a more efficient

* cluster weight

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munition. The using military units must be provided with adequate detection devices, protective equipment, and acceptable methods of decontaminating "leakers" prior to the issuance of this weapon. Further, most effective utilization of the weapon, is contingent upon development of the ability to accurately forecast meteorological conditions at distant points within enemy territory. (S)"

k. In view of the recommendation of reference m. that the subject cluster be accepted as an interim weapon, reference n. indicated that Air Force standardization proceedings were being initiated and requested appropriate action by the Chemical Corps which would include identification of those assemblies utilizing on-hand components which would be considered available as limited standard types and those considered standard for future procurement. As a result of informal coordination, reference o. indicated agreement that the ELOR5 Cluster, incorporating the ELOR2 Delay, should be the standard type selected for future procurement with the ELOR3 Cluster, incorporating the ELOR1 Delay, classified limited standard. Based on these acceptances and agreements, this report was prepared to incorporate the necessary information and effect the type classification desired.

1. Pursuant to the provisions of par. 17, SR 705-5-1 the following information is tabulated in connection with the subject action:

- (1) Using Agency - Air Force
- (2) Whether military characteristics were satisfied - Yes, except as noted in par. 2.f.
- (3) Whether user tests were waived - No tests were waived.
- (4) Expendability - Subject items are expendable, Class V items of supply.
- (5) Stock Status -

* (a) Procured: Total production of 23,700 clusters has been authorized from components originally stock-piled for 62,931 clusters. The data tabulated below indicates total quantities produced, scheduled for assembly, and on hand:

<u>1.</u> ELOR3 Clusters produced	- 13,600**
<u>2.</u> ELOR5 Clusters produced	5,600
	Scheduled 4,500

* Procurement authorized as recorded in reference p.
** 2700 are considered unserviceable.

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3. Components in storage:

E43R1 Adapter	43,000
E54R8 Bomb Bodies - Type A	362,000
Type B	2,488,000
E10R1 Delay	3,000,000
E10R2 Delay	228,000 *
E12R1 Furster	3,000,000
M1 Shipping Guard	13,020
E4R1 Parachute - For Type A Body -	309,000
For Type B Body -	2,546,000
E6 Fin	39,860
E11 Arming Wire	39,860
E8 Cartridge	159,700

*Sufficient for 3,000 clusters. Additional E10R2 Delays required for 1,500 clusters (114,000) will be supplied by modification of E10R1 Delays at a cost estimated at 65¢ each.

(b) On Hand - See above

(6) Estimated Cost: E10R3 - \$1750 E10R5 - * \$1800

*Including modification of delay mechanisms

- (7) Procurement Plans - The subject clusters are under current procurement to meet Air Force requirements. Future procurement is dependent upon the needs of the using agency.
- (8) Subject clusters are a completely new type of munition and do not duplicate any existing type in the supply system.
- (9) Sufficient facilities exist for peacetime and wartime production which will be accomplished by commercial procurement of metal parts with final assembly and filling operations conducted at Chemical Corps arsenals.

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- (10) Design insures maximum interchangeability and is suitable for mass production.
- (11) Transportation aspects - Necessary security guard with suitable individual protection, detection and decontamination equipment is required.
- (12) Strategic and critical materials involved - None. The GB filling, once considered critical, is now available in sufficient quantity.
- (13) Literature requirement - Subject clusters will be included in pertinent Cml C - Air Force technical publications and bombing tables.
- (14) Commodity classification - SCC Code 90-52
- (15) Subject item has completed limited environmental tests for conditions under which it was designed to operate.
- (16) Security classification - Subject item is now considered Unclassified in view of current interpretation of SR 380-5-6 (ref. t.) as interpreted by references u. and v. Detailed performance data are classified Secret.
- (17) Logistical data -

	<u>E101R3</u>	<u>E101R5</u>
Stock No. - - - -	311010	311015
Line Item No. - -	10629710	10629720

Packing - Cluster components are stored and shipped as follows:

- (a) Cluster (w/o components) 1130 lb. 19.1 cf*
(Adapter w/bombs & shipping guard)
- (b) E6 Fin ---- 1/steel crate 74 lb. 3.6 cf
- (c) M152A1 Fuze - 15/wood box 54 lb. 1.3 cf
- (d) E11 Arming Wire - 100/wood box 20 lb. 0.3 cf
- (e) E8 Cartridge - 500/wood box 30 lb. 0.7 cf

*When produced with M2 Shipping Guards 1300 lb. 20.1 cf

Color Marking - Gray body with one green band.

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m. In connection with this action, it is to be noted that the agent concerned, GB, is classified as a nonpersistent to indicate that its use would always be predicated on dissemination in an aerosol form to achieve maximum results from its very high lethality. As a consequence, the nonpersistent terminology is included in the designation of the cluster which is marked with one green band indicative of a non-persistent filling. Inherent characteristics of GB, however, are such that it qualifies as a persistent agent and is so indicated in basic documents like TB 3-215-1, Chemical Agents of the G-Series, 28 Jun 50, and TM 8-285 - NAV MED P-1328 - AFM 160-12, Treatment of Chemical Warfare Casualties, Aug 51. This is recognized in the precautions for manufacture and the procedures taken to accomplish decontamination which normally is not required for true nonpersistents. Previous recommendations submitted to the CCTC Subcommittee to recognize GB as a persistent agent were not approved, with similar action on suggestions that a 3-band marking (2 for inherent persistency and 1 for dissemination as a nonpersistent) be established for munitions like the subject clusters which, in reality, are persistent-filled munitions from the time of assembly until used in combat.

n. The foregoing paragraphs briefly review the requirement, development and testing of the subject clusters which are the first aerial munitions available for the dissemination of GB. Development of these bombs and clusters was initiated in postwar years as noted and was proceeding normally when the impetus of the Korean War established an urgent requirement for quantity procurement which was authorized as recorded in reference p. Due to the telescoping of procurement and development, certain problems resulted from the urgent effort to produce a satisfactory munition suitable for early production. Critical design features included the strengthening of the adapter, and the sealing, stabilizing and fuzing of the component bomb. These quite obviously affected assembly schedules which, as revised, will utilize all on-hand components in the most economical manner. Security classification of the subject clusters has been guided by the regulation of ref. t. which superseded the applicable postwar combined Chiefs of Staff directive. Although essential information on these GB munitions was originally Secret, downgrading actions recorded in references u. and v. have unclassified most pertinent data except production figures which are Confidential. Type designators (M numbers) listed herein have been coordinated with the Ordnance Corps to preclude any duplication of common item designations within the supply system. Appropriate recommendations to accomplish the action required at this time are noted below.

3. Recommendations:

It is recommended that:

- a. The E101R3 and E101R5 Clusters as described herein and in references e., f. and g. be redesignated
 - (1) Cluster, Nonpersistent Gas Bomb, GB, 1000-lb., M34 (E101R3)

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(2) Cluster, Nonpersistent Gas Bomb, GB, 1000-lb., M34A1 (E101R5)

and be classified as Limited Standard and Standard types, respectively to meet the corresponding requirement for internal carriage munitions.

- b. The M34 and M34A1 Clusters be further classified as essential, Class V(A) items of current supply.
- c. The Chemical Corps be assigned all Army responsibility for the subject items under SCC Code 90-52.
- d. The subject munitions be furnished to the Air Force in accordance with current interdepartmental agreements.
- e. The components of the complete rounds of the subject clusters listed in par 2.c. be redesignated with the "M" numbers indicated and type classified as noted.
- f. Consumption rates for the subject clusters be determined by the Air Force as the using agency.
- g. The subject clusters be considered Unclassified items with performance data classified in accordance with provisions of references t., u., and v.
- h. Drawings and specifications, stock records and all publications affected by this action be revised accordingly.

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Classification of the Clusters, Nonpersistent Gas Bomb, GB, 1000-lb., M34 (E101R3) & M34A1 (E101R5) as Limited Standard and Standard Types, Respectively

CONCURRENCE SIGNATURES

/s/R.N. Skaggs, Col, GS Dev & Test Sec, OCAFF	Subject to Security Resolution	/s/R.A. Murdoch BuShips, Navy Dept
/s/L.E. Fellenz, Col, CmlC Cml Sec, OCAFF	/s/R.C. Kinne Wright Air Dev Center	/s/A.L. Russell BuYds&Dks, Navy Dept
/s/C.M. Freudendorf, LtCol, Inf AFF Ln O, A Cml C, Md.	Concurred J.J. Hayes, Col, CmlC ACCmlO/BW	/s/W.G. Willmann, LtCol, CmlC Ind Div, Mat Comd
Concurred C. Lonerio, LtCol, MSC Army Medical Service	/s/L.D. Fothergill Scientific Adviser/BW	Concurred R.C. Morris, LtCol, CmlC Sup Div, Mat Comd
/s/T. Emmett Thomas Corps of Engineers	/s/Leo F. Walsh Mat Div, OCCmlO	/s/L.T. Fleming Transportation Corps
/s/H. Rackowski Ordnance Corps	/s/V.F. LaPiana, Col, CmlC R&D Div, OCCmlO	/s/D.H. Hale, Col, CmlC Dep Comdr, R&E Comd
/s/R. Raymond Quartermaster Corps	/s/M.L. Denlinger, LtCol, CmlC PT&I Div, OCCmlO	/s/E.H. Lewis, LtCol, CmlC P&E O, R&E Comd
Subject to resolution of Security Classification	/s/L.M. Swanson BuAero, Navy Dept	/s/B.H. Harris A/TCW, R&E Comd
/s/W.A. Martin, LtCol, USAF Air R&D Comd	/s/W.P. Swain BuOrd, Navy Dept	/s/J.C. Braxton, LtCol, CmlC Ln O, CmlC Tng Comd
Concurred H.C. Gilbert, LtCol, CmlC Inspec Div, Mat Comd	/s/J.H. Rothschild, Col, CmlC Chemical Corps Board	/s/J.A. Martin, LtCol, CmlC A/RW&NTM, R&E Comd

ACCEPTED BY THE CHEMICAL CORPS
TECHNICAL COMMITTEE, 9 Dec 1954:

/s/T. S. ECKERT
Secy, CCTC

APPROVED FOR THE CHIEF CHEMICAL
OFFICER, 9 Dec 1954:

/s/WILLIAM E. R. SULLIVAN
Colonel, Cml C
Chairman, CCTC

APPROVED BY ORDER OF THE SECRE-
TARY OF THE ARMY, 9 Dec 1954:

/s/DONALD H. BEHRENS
Major, GS
Office, Deputy Chief of Staff
for Logistics

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Report "AA"
Copy No. _____
(30 Pages)
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DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF CHEMICAL OFFICER
Chemical Corps Technical Committee
Army Chemical Center, Maryland

CMLWH

TSE/5190/af
4 Nov 1954.

SUBJECT: Consolidation of Chemical Corps CW R&D Program for FY 55.

TO: Chairman, Chemical Corps Technical Committee

1. References:

- a. CCTC Items 2703 (S-RD), Chemical Corps R&D Program for FY 54, approved by Item 2730, 11 Sept 1953.
- b. CCTC Item 2876 (S), Chemical Corps BW Program for FY 55, 29 Jul 1954.
- c. CCTC Item 2622 (S); Consolidation of 41 Projects in the FY 53 R&D Program, 5 Mar 1953.
- d. SR 705-5-1, Research and Development of Materiel, 10 Feb 1954.
- e. SR 705-20-1, Priorities for Research and Development Projects, 14 May 1952.
- f. ACofS, G-4, Index and Classification System for Research and Development Projects, 15 Jun 1953.
- g. RDB 102/19 (S), Planning Guide for Military Research and Development, 17 Sep 1952; (as revised).
- h. Letter, G4/F1-32014, 14 Jun 1954, Planned Obligations for the Army R&D Program FY 1955 (CCTC Item 2852).
- i. Letter, CMLRE-P-1 R&E Command, 1 Nov 54, CCTC Agenda Item: FY 1955 RECOM Program, to Chm. CCTC.

2. Discussion:

a. Reference a. identifies action of this Committee which reviewed the Chemical Corps R&D program for FY 54 and approved establishment or continuation of 195 projects covering the three major fields of Chemical Corps responsibilities. Subsequent action on other projects, together with the formation of the separate BW program as recorded in

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2.a. Discussion (continued)

reference b., resulted in a total of 127 projects currently approved which constitute the Chemical Corps FY 55 R&D Program for CW and RW. Of these, four (4) projects are in the RW area so that 123 projects constitute the current CW program.

b. Review of the FY 54 Program accomplished by reference a. noted above was conducted in accordance with provisions of reference d. which stipulates assignment of priorities in accordance with provisions of reference e., assignment of project numbers in accordance with basic fields and subfields as provided by reference f., and assignment of technical objectives as provided in reference g. These references provide the basic framework for all Army R&D project programming and classification and are considered to categorize individual projects most appropriately for necessary review and reporting purposes. This uniform system of Army project identification has been in effect since the present numbering system reflecting basic fields and subfields was established in 1947. Classification in accordance with reference f. results in assignment of four-section numbers consisting of eight digits which precisely identify a project among the 10 developing agencies, 92 basic fields, and 930 subfields for all purposes including electric accounting machine procedures.

c. During the current and preceding fiscal year Staff directives have suggested the desirability of over-all reduction in the number of Army R&D projects being reported on in order to simplify budgeting and necessary review procedures. Reference c. identifies action of this Committee which identifies initial effort directed toward program consolidation. This need for consolidating R&D programs was more recently covered in the correspondence identified as reference h. which included the Army R&D Review Board policy decision directing that (1) Additional effort should be made to consolidate similar or related projects into single projects and (2) Continuous effort should be made to clarify and simplify project titles. Reprogramming as the result of consolidation was encouraged provided it follows established policies and is authorized by Staff. In conformance with this directive, the Chemical Corps BW program was consolidated by action of this Committee as recorded in reference b. which approved a total of twenty-two (22) projects in the BW area for prosecution at Camp Detrick, Md. Because of the nature and status of the BW research and development, the consolidated program consists essentially of projects established in the normal manner with the minimum number of separate tasks to outline the work being done. The purpose of this paper is to effect similar consolidation of all projects in the CW program with more detailed identification of subprojects as required. Consolidation of RW projects in the same manner is the subject of separate action.

d. All currently approved projects are listed in Inclosure 1 herewith by project title, technical objective, priority and security classification and current action thereon. As transmitted by reference i., these were reviewed with a viewpoint to maximum consolidation in cor-

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2.d. Discussion (continued)

pliance with reference h. with the results indicated in Inclosure 2. In accomplishing this action Cml C offices concerned have reviewed similar efforts of the other Technical Services and noted the lack of uniformity in subproject and task identification which may be attributed to the lack of specific guidance since this is not covered in the pertinent regulations (ref. d.) and the problems involved are peculiar to each Service. All new or continued Chemical Corps projects will continue to be numbered in accordance with provisions of reference f. and it has been determined that all subprojects will be identified with the basic project number with a two-digit serial suffix in order to show the relationship of the subproject to the over-all group project. Renumbering of subprojects has been accomplished which provides in many cases different basic and subfields for projects previously identified. Similarly, certain technical objectives disappear in the process of consolidation as the consequence of reducing major R&D effort to subproject level without appropriate revision in pertinent regulations and basic concepts.

e. Based on the system outlined above, it is proposed that henceforth all reporting for over-all budgeting and programming will be done project-wise, however, detailed annual and technical reports will be submitted for each subproject separately identified. It is planned that all end item development will be accounted for by subprojects which will be submitted for approval by this Committee as required. Likewise, each of these will be accorded an appropriate technical objective, priority, and security classification as a means of proper identification within the consolidated project framework. Most subprojects being established at this time were previously approved and identified as projects; however, a few new subprojects are included based on other actions currently before this Committee or previously approved. Subprojects for end items not currently covered will be identified in subsequent actions.

f. The foregoing discussion reviews basic regulations and directives pertaining to Army R&D project establishment including numbering, approval of priorities, and assignment to technical objectives. In compliance with Staff directives to effect maximum consolidation of projects currently approved in order to simplify budgeting and programming review procedures, the 123 currently approved projects in the CW area have been reduced to 42 with separate identification of subprojects in accordance with provisions of reference d. The recommendations below incorporate the action required at this time to effect the subject consolidation.

3. Recommendations:

It is recommended that:

a. The 17 projects listed in Inclosure 1, identified with a (#), and recommended for cancellation, completion or otherwise terminated, be so approved and deleted from the subject program.

b. The 15 projects listed in Inclosures 1 & 2 without diacritical

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3. b. Recommendations (continued)

marking be continued without change.

- c. The 91 projects listed in Inclosure 1 for continuation as subprojects and identified with an asterisk (*) therein be so approved.
- d. The 27 new projects and 25 subprojects identified with a (%) in Inclosure 2 be established in the subject program.
- e. The technical objectives, priorities, and security classifications of all projects and subprojects listed in Inclosure 2, be approved.
- f. The forty-two (42) new and continued projects listed in Inclosure 2 with subprojects listed thereunder be considered to constitute the current CW Program for FY 55.

2 Incls:

- 1. FY 54-55 Project Summary
- 2. Consolidated FY 55 Program

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FY 55 CML C CW PROJECT PROGRAM SUMMARY

Project No. & Tech. Obj.	Title & Security Class. Thereof	Pri- o- rity	Sec. of Project	Current Action
* 4-04-06-004 CW-3	Basic Studies for Develop- ment and Improvement of CW Aerial Munitions (U)	2	S	Continue as 4-04-15-029-01.
- 4-04-14-010 BW-5	750-lb. Cluster Adapter for 1/2-lb. Biological Bomb (S)	1-B	S	Continue as is.
* 4-04-15-007 CW-3 (AW-4) (BW-5)	Dissemination and Exploi- tation of CW Agents (U)	1-C	S	Continue as 4-04-15-029-02.
* 4-04-15-009 CW-3	Special Problems, Munitions Division (U)	2	C	Continue as 4-04-17-020-06.
* 4-04-15-013 CW-3 (BW-5)	CW Warheads for Guided Missiles (U)	1-B	S	Continue as 4-16-16-020-01.
* 4-04-15-014 CW-3	GB Mortar Shell, 4.2-inch (C)	1-B	S	Continue as 4-04-15-023-01.
* 4-04-15-016 CW-3	750-lb. Cluster of GB Bombs (C)	1-B	S	Continue as 4-04-15-030-01.
* 4-04-15-017 CW-3	Kit for Conversion of Fire Bombs to Spray Tanks (U)	1-C	C	Continue as 4-04-15-030-02.
* 4-04-15-018 CW-3	HD Mortar Shell, 4.2-inch (U)	1-C	C	Continue as 4-04-15-028-02.
* 4-04-15-021 CW-3	Spray Tank for Jet Air- craft (U)	1-A	S	Continue as 4-04-15-030-03.
# 4-04-15-022 CW-3	1000-lb. Cluster of GB Bombs (C)	1-B	S	Record as Com- plete. Remaining work under 4-72- 05-015.

NOTE: (*) Identifies project converted to subproject,
(#) Identifies terminated project.

Incl 1

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Project No. & Tech. Obj.	Title & Security Class. Thereof	Priority	Sec. of Project	Current Action
* 4-04-15-024 CW-3	5, 6 & 8-inch Gas Projectiles (U)	1-C	S	Continue as 4-04-15-028-03.
* 4-04-15-026 CW-3	500-lb. Gas Bomb (U)	1-B	C	Continue as 4-04-15-030-04.
* 4-04-15-027 CW-3	Gas Artillery Shell (U)	1-C	S	Continue as 4-04-15-028-04.
* 4-04-16-006 CW-3	Fire Bomb for Jet Aircraft (U)	1-C	C	Continue as 4-04-16-022-01.
* 4-04-16-013 CW-3	750-lb. Cluster of 4-lb. Magnesium Incendiary Bomb (U)	1-C	C	Continue as 4-04-16-022-02.
* 4-04-16-014 CW-3	750-lb. Cluster of 10-lb. Incendiary Bombs, M74 (U)	1-C	C	Continue as 4-04-16-022-03.
* 4-04-16-015 CW-3	750-lb. Cluster of High Penetration Incendiary Bombs (U)	1-C	C	Continue as 4-04-16-022-04.
* 4-04-16-019 CW-3	Incendiary Munitions (U)	1-C	C	Continue as 4-04-16-022-05.
* 4-04-16-021 CW-3	Incendiary Burster for Improvised Munitions (U)	1-C	C	Continue as 4-09-06-004-01.
4-04-17-011 CW-3	750-lb. Cluster of Smoke Bombs (U)	1-C	U	Continue as is.
# 4-04-17-014 CW-3	Hand and Rifle Smoke Grenade (U)	1-C	U	Record as Complete. Remaining work under 4-72-05-015.
* 4-04-17-015 CW-3	5 & 6-inch Smoke Projectiles (U)	1-C	U	Continue as 4-04-17-020-01.

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Project No. & Tech. Obj.	Title & Security Class. Thereof	Pri- rity	Sec. of Project	Current Action
* 4-04-17-016 CW-3	Remote-Controlled Smoke Generator (U)	1-C	C	Continue as 4-04-17-020-02.
* 4-04-17-017 CW-3	Smoke Protective Device for Combat Vehicles (U)	2	C	Continue as 4-04-17-020-03.
4-07-06-001 CW-3	Persistent Gas Land Mine (U)	1-C	C	Continue as is.
* 4-08-01-003 CW-3	Basic Studies of Aerosols (U)	1-C	C	Continue as 4-04-17-020-04.
* 4-08-02-005 CW-5	Physiological Aspects of CW (U)	1-C	C	Continue as 4-08-02-019-01.
* 4-08-02-006 CW-5 (BW-5)	Biological Studies of CW Particulates (U)	1-C	S	Continue as 4-08-02-016-01.
* 4-08-02-007 CW-5	Toxicology of CW Agent Vapors (U)	1-C	S	Continue as 4-08-02-016-02.
* 4-08-02-009 CW-5	Biochemical Action of CW Agents (U)	1-C	S	Continue as 4-08-02-017-01.
* 4-08-02-010 CW-5	Neurological Action of CW Agents (U)	1-C	S	Continue as 4-08-02-018-01.
* 4-08-02-012 CW-5	Toxicological Action of CW Agents (U)	1-B	S	Continue as 4-08-02-016-02.
* 4-08-02-013 CW-5	Pathological Action of CW Agents (U)	1-C	S	Continue as 4-08-02-018-02.
* 4-08-02-014 CW-5	Biophysical Mechanisms in CW Wounds (U)	1-B	S	Continue as 4-99-02-002-01.

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Project No. & Tech. Obj.	Title & Security Class. Thereof	Priority	Sec. of Project	Current Action
*4-08-02-015 CW-5 (BW-1a)	Pharmacology of Toxic Compounds (U)	1-C	S	Continue as 4-08-02-019-02.
*4-08-03-001 CW-1a	New Compounds (U)	1-B	S	Continue as 4-08-03-016-01.
*4-08-03-005 CW-1a	G-Agents (U)	1-B	S	Continue as 4-03-03-016-02.
#4-08-03-006 CW-1a	Special Problems, Chemical Division (U)	2	C	Cancel - Specific tasks to be done under existing projects.
*4-08-03-015 CW-1a	Agent SS (U)	1-B	S	Continue as 4-03-03-016-03.
*4-08-04-005 CW-3	Devices, Methods & Techniques for Field Evaluation of CW Agents & Munitions (U)	2	C	Continue as 4-08-04-011-01.
*4-08-04-006 CW-3	Maintenance & Purchase of Field & Test Equipment, CCCRL (U)	2	U	Continue as 4-08-04-011-02.
*4-08-04-008 CW-4a	Chemical Agent Detector Kit (U)	1-C	S	Continue as 4-08-06-029-01.
*4-08-04-009 CW-4a (AW-5a) (BW-4a)	CBR Agent Sampling & Analysing Kit (U)	1-C	C	Continue as 4-08-06-029-02.
4-08-05-003 CW-3	Mechanical Irritant Gas Disperser (U)	1-C	U	Continue as is.
*4-08-06-004 CW-4c (AW-5c) (BW-4c)	Decontamination Methods & Materials for Toxic Agents (U)	1-C	C	Continue as 4-03-06-031-01.
*4-08-06-006 CW-4a	Field Alarm for G-Agents (U)	1-A	S	Continue as 4-08-06-030-01.

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