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THE ENGINEER SCHOOL THE ENGINEER CENTER AND FORT BELVOIR FORT BELVOIR, VIRGINIA

Proceedings of the Panel on the Tactical Aspects of Mine Warfare and Evaluation of the Research and Development Program convened at Fort Belvoir, Virginia, at 0800 on 11 February 1952.

1. References:

a. Letter, OCE, ENGOT, dated 19 December 1951, Subject: Tactical Aspects of Mine Warfare. (Incl 1)

b. Plan of Operation for the "Panel on the Tactical Aspects of Mine Warfare and Evaluation of the Research and Development Program", TES, dated 21 January 1952. (Incl 2)

c. Letter, OCE, ENGOT, dated 24 January 1952, Subject: Panel on the Tactical Aspects of Mine Warfare with 2 indorsements. (Incl 3)

2. Pursuant to reference 1 a above the panel was convened at Fort Belvoir, Virginia, at 0800 on 11 February 1952. The following representatives were present:

The Engineer School

Col Warren M. Underwood, CE, Panel Chairman
Lt Col H. J. St. Clair, CE
Lt Col Edwin R. Perry, CE

The Infantry School

Col Robert G. Sharrard, Jr., Inf.
Col John G. Schermertorn, CE
Capt Alfred B. Hallow, Inf.

The Armored School

Lt Col H. P. Schaudt, Armor
Capt Charles E. Alexander, Armor

The Command and General Staff College

Lt Col Glenn E. Wozniak, Inf.

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The Engineer Center

Col Douglas Brown, CE

Office, Chief of Ordnance

Lt Col James F. McCaslin, Ord.
(Sitting for Brig. General Leslie E. Simon)

Army Field Force Board No. 2

Lt Col Robert I. Dice, CE
Major E. E. Hollowall, CE

Office, Chief of Army Field Forces.

Lt Col John H. Elder, CE

3. The panel was addressed by the Deputy C. G. of The Engineer Center, Brig. Gen. Frank O. Bowman in the absence of Major General Scott. The background and need for the study were explained by The Engineer, AFF, Col. Robert J. Fleming, CE.

4. The panel was then organized by the chairman into three working committees as follows:

Committee No. 1 Doctrine

Membership:

Lt Col Glenn E. Muggelberg (Chairman)
Colonel Robert G. Sherrard, Jr.
Lt Col H. P. Schmitt
Lt Col John H. Elder,
Lt Col E. J. St. Clair
Lt Col Robert I. Dice

Mission: To prepare a study in tactical doctrine on land mine warfare. To evaluate existing doctrine and recommend changes in appropriate field manuals where such changes are found to be desirable. To study existing training publications and programs and to recommend changes which are found to be desirable.

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Committee No. 2 Technique

Membership:

Lt Col A. H. Perry (Chairman)
Capt Alfred B. Mallow
Capt Charles Alexander

Mission: To study existing techniques in the laying and clearing of mine fields. This study should include all methods of laying and clearing, both manual and by machine. The marking and recording of mine fields should be considered. The desirability and practicability of camouflage measures in the laying of mine fields should be carefully considered.

Committee No. 3 Research and Development

Membership:

Col Desloge Brown (Chairman)
Col John G. Scherzerborn
Lt Col James F. McCaslin
Major H. E. Hallowell

Mission: To investigate and evaluate the research and development program to determine what should be done to expedite the availability of adequate and satisfactory antitank mines, antipersonnel mines, fuzes and other equipment. Military characteristics should be carefully examined to determine whether they are practical and not too restrictive.

5. The panel then proceeded to an examination of the current status of tactical doctrine, technique, and research and development. The first presentation was given jointly by The C and GSC and The Engineer School, reviewing present doctrine. The presentation was made by Lt Col Muggelborg and Lt Col St. Clair. A copy of the presentation (less maps) is attached as Exhibit A. A thorough discussion by the panel and the audience followed.

6. The panel met at 0800 on 12 February 1952. A review of current projects relating to Mine Warfare under jurisdiction of Army Field Forces Board No. 2 was given by Lt Col Robert I. Dice, CE, of AFF Board No. 2. This presentation was followed by a discussion in which both panel members and audience took an active part. A copy of presentation is attached as Exhibit B.

7. Col Paschal E. Strong, CE, former Engineer, 8th Army in Korea, appeared informally before the panel and was questioned by the members on the applications of mine doctrine in Korea.

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8. Dr. Elia Johnson, Director ORO, appeared before the panel and made a presentation on the subject of "Tactical Factors affecting the Military Characteristics of Land Mines". Mr. J. W. Johnson, ORO, made a presentation on "Current Studies on Mine Warfare at ORO". A brief of his presentation is attached as Exhibit C. This ORO presentation was thoroughly discussed by the members and the ORO subjected to cross-examination on it.

9. The panel met at 0800 on 13 February 1952. A review of research and development in Engineer mine warfare materiel, including development being carried on by ERDL for Ordnance, was presented by Col Desloge Brown, CE, and others, of ERDL. This presentation covered the present status of projects as well as an actual demonstration of the materiel under development. A brief of the status of projects is included in Annex No. 3.

10. Dr. A. G. McNish of the National Bureau of Standards described and demonstrated the projects being investigated by that organization for Ordnance. These projects were thoroughly discussed by the panel members. The material covered by Dr. McNish is included in Annex No. 3.

11. Lt. Col Schmitt, Armor, was withdrawn from the panel by The Armored School at 1100 on 13 Feb 1952.

12. Col Emerson C. Itchner, CE, former Corps Engineer of I Corps in Korea, sat the panel in the evening and was questioned on mine warfare doctrine and techniques as practiced in combat in Korea.

13. The panel met at 0800 on 14 February 1952. A review of the present status of Ordnance Mine Warfare Materiel was presented by Col Albert C. Wells, Ordnance Corps, Office Chief of Ordnance and others. The presentation was thoroughly discussed by the panel members and audience. The material covered by Col Wells is included in Annex No. 3.

14. A presentation was made to the panel by Col William S. Triplet, GSO, of the office of the Assistant Chief of Staff G-4, Logistics, on the subject of the coordination and supervision of the research and development program. The presentation was thoroughly discussed by the panel members. A brief of the presentation is attached as Exhibit D.

15. The panel met at 0600 on February 15, 1952. A demonstration and explanation of current techniques in mine field laying, recording and breaching was presented by Lt Col Edwin R. Perry, CE, of the Engineer School with the assistance of the 91st Engineer Combat Battalion. The techniques used were as prescribed in FM 5-32, Land Mine Warfare, May 1949.

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16. Approval of the plan for the conduct of the panel was received from OCAFV this date (see Incl 3) except for that portion of par. 4a assigning vote to AFV Board No. 2. It was desired that AFV Board No. 2 not be assigned voting privileges on questions of doctrine and training. Accordingly Lt Col Robert I. Dice of AFV Board No. 2 was transferred from Committee No. 1 to Committee No. 2.

17. The first phase of the panel procedure was completed at 1500 on 15 Feb 1952 and the panel proceeded to work by committee, to meet again in committee-of-the-whole at 0800 on Wednesday, 20 February 1952, for the presentation of progress reports by the committees.

18. Lt Col Clark Webber, Armor, arrived at Fort Belvoir, Virginia on 17 February 1952. He was assigned to replace Lt Col Schmitt on Committee No. 1.

19. The panel met at 0800 on 20 February 1952 in committee-of-the-whole. The committees presented the results of their work to date for discussion by the entire panel. At 1500 on 21 February 1952 the panel resumed work, by committee to meet again in committee-of-the-whole at 0800 on 28 February 1952 for the presentation of progress reports by the committees.

20. The following consultants were examined by committees of the panel:

On 21 February 1952. Dr. Fred C. Lindvall and Dr. Thomas Lauritsen of Operation Vista.

On 25 February 1952. Mr. John R. Vogler of the Engineer Intelligence Division, OCE, and Messrs. Jack H. Abbott and William A. Adrian of Army Map Service.

On 26 February 1952. Col Francis H. Faulkner, CE, of the Joint Landing Force Board, Quantico, Virginia.

21. The panel met at 0800 on 28 February 1952, in committee-of-the-whole. The committees presented the results of their work to date for discussion by the entire panel. On the afternoon of 29 February 1952, Messrs. Floyd I. Hill and A. R. Vincent of the Ballistic Research Laboratories, Aberdeen, Md. presented a discussion on the evaluation of mines to the panel. The panel then at 1500 resumed committee work to meet again in committee-of-the-whole at 0800 on 10 March 1952, for the presentation of final reports by the committees.

22. The panel met in committee-of-the-whole at 0800 on 10 March 1952 to receive the final report of Committee No. 1 on Doctrine and Training. The full report of the committee is contained in Annex No. 1 of this report. The conclusions and recommendations of the committee are as follows:

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a. Doctrine.

(1) Conclusions. That existing mine warfare doctrine is substantially sound but requires expansion. Following paragraphs state the conclusions necessary to such an expansion of doctrine.

(a) The role of the mine in military operations.

1. The primary function of a mine is to provide an obstacle to enemy movement which will assist the user in gaining the time and economy of force necessary to permit tactical and/or strategic flexibility.

2. The casualty-producing effect of mines must be considered as secondary even though it is essential for the successful accomplishment of their primary function.

3. Existing doctrine on the function of mines is substantially correct, however, it requires expansion in order to ensure clear understanding on the part of all commanders.

(b) Evaluation of GHO Memo T-109. Examination of GHO Memo T-109 discloses little that can be classified as wholly new within the field of mine warfare doctrine. In the main, the concepts advocated in this document are extensions of existing doctrine. However, it should be studied carefully in connection with the extension of mine warfare training and in connection with the review of the research and development program.

(c) Authority of commanders. Commanders should restrict mine warfare activities of subordinate units only as necessary to ensure operational and administrative coordination.

(d) Marking, recording, and reporting.

1. Marking, recording, and reporting of mine fields, both friendly and enemy, is essential to ensure coordination in any operation.

2. Forms for recording and reporting of mine fields, both friendly and enemy, must be simplified to be practicable.

3. Commanders authorizing the installation of a mine field must insure that the field is properly marked, recorded, and reported.

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4. Units responsible for the installation of mine fields must mark, record, and report the location of emplaced fields, and, through supplemental reports, provide higher headquarters with records which will reflect the true current status of the mine fields.

5. Units planning the installation of a mine field must submit a report as to the planned location of that field.

6. All units must be responsible for marking, recording, and reporting enemy mine fields upon discovery.

(e) Terminology. Present mine warfare terminology is complicated and confusing and therefore should be simplified and clarified.

(f) Need for patterns. The proposed tactical and strategic employment of mines creates a need for both standard and nonstandard patterns, and random methods of laying, either of which may be applicable in a given situation.

(g) Staff responsibilities. Staff responsibilities as presently established are clear cut and valid. There is no requirement for change.

(h) Target selection for aurally emplaced land mines.

1. The ground commander concerned (normally field army or higher) must have final authority in designating targets within his present or proposed zone of responsibility against which aurally emplaced land mines are to be employed.

2. Either of two methods are acceptable (designation of a "no-mine line or area" or complete restriction without specific authority), but the ground commander must have the authority to designate which method will be used in a given tactical situation.

(i) Antiamphibious operations.

1. The Joint Amphibious Board should have the mission of determining service responsibility for development of antiamphibious doctrine and techniques.

2. The ground commander should be responsible for the installation of all types of underwater obstacles to include mines, up to a line generally defined as 6 feet (1 fathom) beyond low ebb.

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2. The Army should be responsible for research, development, and procurement of anti-airborne mines with the technical assistance of the Navy.

(j) Anti-airborne Operations.

1. There is a requirement for a mine field designed to counter an airborne attack.

2. There is a need for a mine capable of attacking aircraft and parachutists just prior to their landing if such a mine is found to be feasible.

3. The Army has primary interest in the development of doctrine and techniques for the planning for and installation of anti-airborne mine fields.

4. The Army has primary interest in the development of an anti-airborne mine.

(k) Sample logistical analysis. No complete logistical analysis can be made of this proposed doctrine by this panel, since a logistical analysis must be based on an actual situation to be valid. However, the logistical analysis contained in appendix E of Part One, Annex No. 1, indicates that the proposed doctrine is logistically feasible.

(l) New developments.

1. Doctrine developed in this study will not be adversely affected by foreseeable future developments in mine warfare material and equipment.

2. The proposed doctrine is capable of utilizing foreseeable future developments in mine warfare material and equipment to their maximum capability.

(2) Recommendations.

(a) That proposed changes to FM 5-32, 100-5, and 101-10 (appendices A, B, and C respectively of Part One, Annex No. 1) be tentatively approved and published for interim use and for comments and recommendations of all using agencies pending final publication.

(b) That agencies having Manual responsibility review the doctrine contained in appendices A, B, and C of Part One, Annex No. 1 with a view toward determining its effect on the publications for which they are responsible.

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(c) That agencies having Manual responsibility, continue review of land mine warfare doctrine and techniques in the light of new developments to determine the affect thereon.

(d) That the Army member of the Joint Tactical Air Support Board be directed to raise the question of aerially emplaced land mines and that he use Appendix K of Part One, Annex No. 1 for guidance on the Army position.

(e) That the Army member of the Joint Amphibious Board be directed to raise the question of anti-amphibious operations and that he use Appendix L of Part One, Annex No. 1 for guidance on the Army position.

b. Training

(1) Conclusions.

(a) Thorough, up-to-date, realistic mine warfare training for all commanders and staff officers is necessary if full advantage is to be taken of mine warfare to augment offensive and defensive capabilities.

(b) Developments in the field of mine warfare materiel and the probable increase in the practice of mine warfare both by ourselves and an enemy make it imperative that more complete and intensive mine warfare training be given both to all individuals and to mine warfare specialists.

(c) Mine warfare consciousness must be maintained at a high level by a continuing play of mine warfare in unit exercises, maneuvers, and map exercises and by continued refresher training.

(2) Recommendations.

(a) That all mine warfare developmental projects be accompanied by concurrent projects for development of training materiel.

(b) That as the probability of adoption of an item of mine warfare materiel in substantially its developmental form is recognized, Army Field Forces provide for the early issue of the item to Service Schools, as appropriate, for their early use in the formulation of doctrine and technique for its employment. Where minor deficiencies in the item appear to be the only bar to standardization, issues should be made of developmental prototypes.

(c) That maximum play of mine warfare be included in maneuvers, and in unit tactical exercises and map exercises in ATP's and school programs of instruction.

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(d) That the allocation of training hours and the training objectives indicated in Appendix B of Part Two, Annex No. 1 be approved for inclusion in FOI's and ATP's.

(e) That a mine warfare indoctrination program in three phases be undertaken and completed as expeditiously as possible. Phasing of the program to be as follows:

1. Indoctrination of senior commanders and staff officers. (Army, corps, and division commanders and selected staff officers.) It is recommended that this phase of the program be of 5 to 7 days duration and be conducted by the Army War College with the technical assistance of the Engineer School and the Aberdeen Proving Ground. This phase of the program must stress the need for careful integration of mine warfare plans with other plans at both the strategic and tactical levels. It must emphasize and demonstrate progress in research and development and the development of doctrine.

2. Indoctrination of instructors for Phase 3. The portion of this instruction dealing with doctrine should be conducted by an agency of service-wide interest with support in instruction on technique by The Engineer School, and in new mine-material development by the appropriate agency of the Ordnance Corps. The integration of mine warfare plans with other plans must be stressed.

3. Indoctrination of all personnel. This instruction should be based on new mine-warfare material and approved mine-warfare doctrine. It is recommended that this program be conducted at station or unit level and be about 8-hour duration for all officers and 4-hour duration for other personnel.

23. The Panel Chairman then took a formal vote on approval of the conclusions and recommendations of Committee No. 1. The results were as follows:

<u>Delegation</u>	<u>For Approval</u>	<u>Against Approval</u>
Command and General Staff College	1	
The Infantry School	1	
The Armored School	1	
The Engineer School	1	

The above conclusions and recommendations having been approved are therefore adopted and made a part of the conclusions and recommendations of the panel.

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24. The panel met in committee-of-the-whole at 1300 on 10 March 1952 to receive the final report of Committee No. 2 on Techniques. The full report of the committee is contained in annex No. 2 of this report. The conclusions and recommendations of the committee are, in summary, as follows:

A. Conclusions.

(1) Presently prescribed techniques for reconnaissance and for planning installations of mine fields are incomplete.

(2) Presently available mine warfare material provides sufficient variety of types of mines to permit reasonably effective installation of all the functional types of mine fields proposed by this panel.

(3) True randomness in laying mines is impracticable.

(4) The minimum acceptable density for antitank mine belts using pressure actuated mines laid to pattern is one mine per yard of front.

(5) Tactical requirements of functional fields as proposed by this panel will require judicious scattering of mines and laying mines to standard and nonstandard patterns.

(6) Extensive route mining of major highways is extremely time consuming when utilizing existing equipment and/or explosives.

(7) Present doctrine requires detailed recording for some mine field for which such records are not necessary.

(8) The recording of the location of individual antipersonnel and all activated mines is based on the accuracy of the measuring equipment. At this largely consists of the ability of the human eye to determine angles, records requiring accuracy to the foot over distances of 10 yards are not reliable.

(9) The degree of detail required in records is based on future tactical plans, the composition of the field and the methods of placement.

(10) Proper marking of mine fields reduces the recording requirements.

(11) Present marking equipment is satisfactory for all requirements except assault mapping.

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(12) Present methods employed in reconnaissance for mine field breaching are incomplete.

(13) Present methods employed in mine field breaching can be improved without the provision of new equipment.

(14) Camouflage of individual mines should be continued where practical. Where machine laying makes it impractical to camouflage the mine installation, areas not containing mines must be made suspect by marking similar to that made by machine laying.

(15) The specific purpose of an interdictory field, the type of mines and fuses used and the methods of installation all have a bearing on density. No particular density can be prescribed as standard, however, individual spacing of antitank mines may vary from about 15 yards to asymptotic detonation range and in general, anti-personnel mines should protect each antitank mine.

b. Recommendations.

(1) That revised techniques for reconnaissance and planning installations of mine fields as discussed in appendix A of Annex No. 2 and delineated in appendix B of Annex No. 2 be approved.

(2) That a density of one antitank mine per yard of trace of a mine belt be adopted as the minimum essential requirement for fields laid to pattern.

(3) That the pattern and drill discussed in appendixes C and E be adopted and standardized for use in those installations where standard patterns are required.

(4) That the principles to be observed for nonstandard pattern and scattered mine laying discussed in appendixes C and E be approved.

(5) That a method and/or equipment be developed to enable the rapid emplacement of large quantities of mines in major highways.

(6) That the forms for mine field records discussed and illustrated in appendixes B and E of Annex No. 2 be approved.

(7) That methods of mine field breaching reconnaissance discussed in appendixes D and F of Annex No. 2 be approved.

(8) That the methods of mine field breaching discussed in appendixes D and F of Annex No. 2 be approved.

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(9) That appendixes E and F of Annex No. 2 be approved as the basis for revising chapters 3 and 5 of FM 5-12.

(10) That as development equipment is adopted as standard agencies responsible for training literature publish information outlining the characteristics of that equipment and its effect on the approved mine warfare techniques.

(11) That if the revised mine installation and clearance techniques recommended herein be adopted, that sufficient training time be allotted and training inspections conducted to insure that the revised techniques are fully assimilated by troops.

25. The Panel Chairman then took a formal vote on approval of the conclusions and recommendations of Committee No. 2. The results were as follows:

<u>Delegation</u>	<u>For approval</u>	<u>Against approval</u>
The Infantry School	1	
The Engineer School	1	
The Armored School	1	
JF Board No. 2	1	

The above conclusions and recommendations are therefore approved and made a part of the conclusions and recommendations of the panel.

26. The panel met in committee-of-the-whole at 0830 on 11 March 1952, to receive the final report of Committee No. 3 on Research and Development. The full report of the committee is contained in Annex No. 3. The conclusions and recommendations of the committee are as follows:

a. Conclusions:

(1) General Policy Statements.

(a) Economy of the end item and not research cost should be a factor governing research effort. Cost of mass employment must be considered in the final evaluation of new weapons and equipment.

(b) Requirements for mine warfare equipment must be examined carefully to insure that the end items integrate into a balanced weapons system.

(c) The research and development program must be continually reviewed and evaluated by the using services in order that emphasis may be placed on the most urgent requirements and military characteristics kept realistic and current.

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(4) The results of the limited or fusion presented herein should in no way operate to prevent or discourage the continued application of imaginative research to improve and develop material.

(2) Mines and Fuzes.

(a) The suitability and availability of present standard antipersonnel and antitank mines is dangerously inadequate.

(b) Emergency stocks should be provided through accelerated domestic and overseas production of the conventional metallic and wood mines.

(c) The development program should be carefully guided toward the evolution of a balanced and integrated family of antipersonnel and antitank mines.

(d) The greatest urgency exists for the development of a suitable tank-killing mine through exploitation of the effects of shaped charges.

(e) Research and development should be initiated and continued to produce suitable special purpose mines for use against amphibious and river crossing operations and for the contamination or denial of areas.

(f) The most urgent requirement for new research is determination of the feasibility of aerial emplacement of antipersonnel and antitank mines by aircraft, artillery and other means.

(g) Further basic research and investigation is required to explore the possible use of flame mines, sensitive explosives in lieu of mines, chemically filled antitank mines, and the specialized use of mines against airborne targets.

(h) Greater emphasis is required on the timely evaluation of allied development in the mine program.

(i) All existing and new mines and fuzes should be tested as soon as developed to determine reactions to atomic explosion.

(3) Special Fuzes.

(a) The standard fuzes are effective with the standard mines but the possible combinations offer little hope of increased effectiveness.

(b) Several types of special fuzes are needed to fully exploit the capabilities of present and development mines.

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(c) Influence and effect fuzes are essential to the development of tank-killing mines and their development must be expedited.

(d) Delay arming is a required feature with the influence type fuze or other delicately balanced mechanisms and for machine laying of AP mines.

(e) Self-sterilization is a required feature for certain mines.

(f) Antidisturbance features should ordinarily not be incorporated in fuze mechanisms unless a means of self-sterilization is also provided.

(g) The development of controlled or command arming fuzes will greatly reassure commanders and encourage them to make the fullest use of mine warfare material.

(h) Numerous special fuzes of diverse characteristics are needed and should be developed for use with standard, development, and proposed items in order that US forces may make the fullest use of mine warfare material.

(i) General research projects with very broad and general military characteristics should be established to permit research which may develop new principles or techniques or will prove the feasibility of more specific ideas.

(j) A study leading to the design of a family of interchangeable mines and fuzes is required.

(k) A firm requirement exists for the following specific fuzes in the relative priority of listing:

1. Tilt or snap rod fuze for shaped charge or other tank-killing mines.

2. A family of effect fuzes of varying design types for tank-killing mines as in (1) above.

3. A family of influence fuzes of both single and multi-influence types for conventional and tank-killing mines as in (1) above.

4. A fuze incorporating delay arming and self-sterilization for use in AP mines.

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5. A nonmetallic antilift fuse for use with development T-18 and T-20 nonmetallic mines.

6. An antirailroad fuse of the influence type with an antidisturbance feature for use with guerrilla equipped mines.

7. A "Controlled" or "Command" arming fuse probably of the influence type with an antidisturbance feature for use with AT mines.

8. A blast proof, contact type fuse for use with conventional antitank mines.

9. A contact type fuse with adjustable or fixed counting for use with conventional antitank mines.

10. A vehicle proof antipersonnel mine fuse which will be actuated by the weight of a man but not by a vehicle. (Relaxing feature)

(1) No present programs or projects should be cancelled.

(4) Mine Detectors.

(a) Portable. Present standard mine detectors are inadequate. The requirement for portable mine detectors to meet revised military characteristics is firm. Revised military characteristics have been prepared. Present detector development has not attained the required goal. The AN/PRS-3 and AN/PRS-4 are satisfactory interim solutions but development must be continued. The need for anticountermeasure detectors and the miniaturized detector is not as urgent as further improvement of the basic portable detectors.

(b) Vehicular.

1. The AN/VRS-2 is an improvement over the AN/VRS-1 and meets current military characteristics.

2. The requirement for a vehicular detector for administrative vehicles other than the $\frac{1}{2}$ ton truck is not sufficiently important to warrant continued development effort.

3. There is a requirement for a tank mounted detector-eradicator, but since detection must precede eradication, and since the tank mounted detector alone has considerable value, priority in development should be given the detector.

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(c) Basic Research.

1. Research must be continued along unexplored approaches to mine detection since none of the present methods appear to offer probability to attaining the ultimate goal.

(d) Training. Intensive operator training can increase effectiveness of present detection equipment.

(5) Mine Clearing Devices

(a) Satisfactory methods of assault breaching of AP and AT mine fields have not as yet been developed. Present military characteristics for these items are essentially correct.

(b) Further improvements are possible in the snake and explosive cable devices.

(c) Rollers offer a feasible solution to the clearance of mine fields composed of pressure type mines. Mobility and flexibility of the rollers must be improved.

(d) Excavator type devices offer the best chance of success against the more complicated types of mines and fuzes which may be employed in the future.

(e) The jet mine clearing device is the most promising of all those yet investigated for the assault breaching.

(f) No additional development of specific equipment for route or area clearance is required.

(6) Related Equipment

(a) Firing Devices. A complete family of metallic and nonmetallic firing devices including pressure, pressure release, pull, tension release, tilt rod, delay and antidisturbance devices is required. The present family of metallic devices is satisfactory except for the tension release, pull friction and delay devices.

(b) Baby Traps. No material development especially for employment in field constructed baby traps is required. The family of firing devices proposed for this and other uses will be adequate. Design and production of prepared baby traps or dirty trick devices is necessary.

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(c) Marking Equipment.

1. Requirements for marking friendly fields are satisfied by the present mine field marking Set No. 2 and the developmental Set No. 1.

2. An unsatisfied requirement exists for a method of marking assault breaches.

3. The proposed development project for marking of assault gaps, currently suspended, should be reactivated.

(d) Warning Equipment. Present trip and ground activated parachute flares W48 and W49 are reasonably satisfactory but should be improved.

(e) Training Aids.

1. Implementation of the training program for mine warfare requires provision of a complete family of training and practice mines, fuses and firing devices. These training aids must be provided in quantity and as soon as possible after the standardization of the live item. Training charts are likewise necessary.

2. Mine detector training can be facilitated by the provision of dual head sets for detectors using audible signals and training charts giving details of operation. Training films are a training aid which has not been fully utilized.

3. Training in mine field breaching and mechanical mine planting can be facilitated by large scale training charts and by training films.

(f) Protective Equipment.

1. There are no suitable items of protective equipment for mine clearing personnel.

2. Antismoke shoes should be developed along lines other than reduced ground pressure.

3. Eye protective equipment of the British should be investigated.

(g) Mine Planters.

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(a) Mechanical planting of both antitank and anti-personnel mines is necessary to permit full utilization of the defensive potential of extensive mine fields.

(b) Present development efforts do not indicate the feasibility of a single device for planting both conventional and shaped charge antitank mines and antipersonnel mines.

(c) Planting of either shaped charge mine or the conventional mine by machine is practicable if disturbance of the ground is accepted.

(d) Priorities. Since most mine warfare development projects are assigned Department of the Army priorities no lower than 1-C, additional guidance must be given the development agency to insure that most urgent items are given maximum attention. A further grouping of items by relative priorities within the field of mine warfare is required.

(7) Procedures.

(a) Present assignments of responsibilities for development, procurement, storage, issue and maintenance for the various items of mine warfare materiel are satisfactory.

(b) The Army Equipment Development Guide fails to give adequate guidance to development in that it gives little indication of the proposed tactical employment of novel weapons and materiel.

(c) The Guide should be liberalized with respect to temperature limitations and acceptance of modifications of materiel.

(d) The military characteristics prepared for new development should be divided into those absolutely essential and those desirable. Details of tactical employment should be given.

(e) General research projects with liberal allocation of funds are required to determine feasibility of new ideas and perform basic research.

(f) Adequate consideration has not been given to the total weight which must be handled in packaging of mines. The ratio of the weight of boxing to the weight of the mines is intolerably excessive.

(g) Better security must be maintained on new materiel in order that the maximum benefit may be obtained from surprise when finally employed in combat.

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(h) The failure to mention any specific item in this study should not be interpreted to mean that no requirement exists. The available time did not permit an exhaustive review. There may be omissions and if found should be recognized as such rather than unfavorable consideration.

b. Recommendations

(1) General policy statements. It is recommended that:

(a) Economy of the end item and not research cost govern research effort.

(b) The research and development program be continually reviewed by the using services to keep it realistic and insure a balance of weapons.

(2) Mines and Fuzes: It is recommended that:

(a) Immediate action be taken to provide emergency stocks of interim mines through the following measures:

1. Finalize modifications needed and procure the T6 antipersonnel mine in lieu of the M2A3 mine.

2. Provide simplified design and expedite overseas manufacture of wood antipersonnel and antitank mines from indigenous resources.

3. Initiate production of the M6 antitank mine.

4. Develop and produce a standard explosive increment for the M6 mine.

5. Develop and produce the T27 heavy antitank mine.

6. Increase the production rate of the M14 antipersonnel mine.

7. Examine and accept if suitable, the United Kingdom No. 6 stick antipersonnel mine and the MK VII antitank mine.

(b) Highest priority be afforded the development of a tank killing mine with emphasis on use of the Hisseny-Shardin effect.

(c) The following development projects be accelerated to the maximum degree feasible, in the order listed, and second in priority to the foregoing items:

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1. A tank killing mine suitable for use with a mechanical mine layer.

2. A family of nonmetallic antipersonnel mines (including one suited for mechanical laying,) for use with special purpose fuzes.

3. The nonmetallic antitank mine T16.

4. A chemical mine for area contamination.

5. The nonmetallic general purpose mine T20.

6. Other members of the tank killing mine family including one suited for deep burial.

7. A suitable antibomb mine or family of mines for use against amphibious craft.

8. A floating mine for use against enemy bridges and river craft.

(d) The highest priority for new research be given to determining the feasibility of aerial means for emplacing antipersonnel and antitank mines by aircraft, artillery or other weapons.

(e) Basic research and investigation be established and continued to determine the feasibility of the following:

1. Providing a nonmetallic material which possesses fragmentation properties equal to metal.

2. Fabrication and use of flame (napalm) mines in lieu of improvised mines.

3. A special weapon or mine for attack of air landing troops while still in carrying aircraft.

4. Sensitive explosives for use in lieu of mines.

5. Chemical filled antitank mines.

(f) The military characteristics attached as Appendix F to annex 3 be approved and implemented to guide the development program.

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(e) All present mines and fuses and all developmental mines and fuses be tested, completely and by component, for the effects of atomic explosion when exposed under various burial conditions.

(h) Effective action be taken to insure that the new items developed under this program having a marked degree of superiority over conventional mines be secured against premature disclosure.

(3) Special Fuzes.

(a) General Recommendation: 1. It is recommended that:

1. The development of a suitable tilt rod fuze and the family of offset fuzes be vigorously pursued as offering the greatest possibility of securing immediate and items for use with tank-killing mines.

2. The program on influence fuzes be continued to utilize all feasible influences and in as many combinations as practicable.

3. A nonmetallic antilift fuze be developed for the present development nonmetallic mines.

4. The antidiisturbance fuze for use against RR be continued with emphasis on securing their functioning only under locomotives.

(b) Specifically. It is recommended that:

1. The development of the following items for which projects already exist be vigorously prosecuted:

a. Influence fuze family

b. Offset fuze family

c. Antirailroad mine fuze

2. Projects for the following items be immediately

initiated:

a. Tilt or snap rod fuze

b. Antilift fuze (nonmetallic) for use with nonmetallic mines T-18 and T-20.

c. Command arming fuze.

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feature.

1. Contact, pressure type fuse with counting

proof features.

2. Contact, pressure type fuse with blast

(Relaxing feature)

3. Vehicle proof antipersonnel mine fuse

2. Rose ran projects be initiated:

- a. To design delay arming and self-sterilizing mechanisms for employment in various types of fuses, particularly in small antipersonnel mine fuses.

- b. To determine the feasibility of an antipersonnel mine fuse that will not be actuated by vehicles.

4. No present programs or projects be cancelled.

(4) Mine Detectors

(a) Portable. It is recommended that:

1. Revisions be made in military characteristics for mine detectors as shown in Appendix P of Annex 3.

2. Correction of minor deficiencies and quantity procurement of the AN/PSS-3 be expedited.

3. The AN/PSS-4 be standardized and procured in limited quantity for training and use in Korea.

4. Development of the AN/PSS-5 be continued with a high priority.

5. Work on acoustic detectors be continued with relatively lower priority.

6. The AN/PSS-7 be continued with a relatively lower priority.

7. Development of an anticountermeasure detector be continued with a relatively lower priority.

(b) Vehicular. It is recommended that:

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1. Testing of the AI/VRS-2 be completed and the item standardized, and the AI/VRS-1 be classified limited standard.

2. Present service testing of the AI/VRS-3 be completed and the project closed without standardization of the item.

3. Development of the AI/VRS-4 Detector Eradicator be continued with primary emphasis on the detector element, and work on the eradicator mechanism be given a lower priority until success is in sight for the detector.

(c) Basic Research. It is recommended that:

1. Basic research be continued along any approach which offers some chance of success.

2. The Dog program be dropped after present contracts have been completed unless significant progress has been made.

3. The nuclear program be dropped upon completion of current contracts unless significant progress has been made.

4. Continuance of the Disturbed Earth Program is warranted.

5. The Atomic and Molecular Program be further developed if initial studies seem to warrant.

(d) Training. It is recommended that:

1. Training of mine detector operators be intensified.

(5) Mine Clearing Devices. It is recommended that:

(a) Development of mine clearing snakes be continued, investigating the use of horizontally directed linear shaped charges to be propelled by tanks or rockets.

(b) Development and production of satisfactory rockets for the projection of the HI AP mine clearing snake projected line charge and HI AP mine clearing coil be expedited.

(c) Development of mine clearing rollers be continued and expedited until one suitable roller, preferably self propelled, is perfected.

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(d) Development and testing of the rotary excavator continues.

(e) Development and testing of the plov continues.

(f) The Jet mine clearing device be given the highest priority until a suitable test item is completed and fully evaluated.

(6) Mine Planters. It is recommended that:

(a) The present project for one device to plant conventional and shaped charge antitank mines and antipersonnel mines be divided for the interim period into three projects, one for each type of mine.

(b) Present military characteristics be liberalized in accordance with revision included in Appendix V of Annex 3.

(c) Development work be expedited on at least two approaches toward the problem of planting the conventional mine and two for the shaped charge mine.

(d) The skip plov be service tested and if acceptable declared standard as an interim item but no further development of this partial solution carried out.

(e) The concept of British scoop attachment for the bulldozer be tested and evaluated.

(f) Development of a mechanical planter for AP mines be undertaken after significant progress has been made on the AT mine planter.

(g) A simple planting aid for digging holes for the M14 antipersonnel mine be developed.

(h) A terrain study be made of areas in Europe and Africa to determine areas of possible employment of mechanical mine layers.

(7) Related Equipment.

(a) Firing Devices. It is recommended that:

1. A development project be established for expansion of the present family of firing devices to provide improved tension release and delay devices, tilt rod and antidisturbance devices and nonmetallic versions of all devices.

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2. The present M1 Pull Friction device be declared obsolete.

(b) Booby traps. It is recommended that the appropriate agency develop and procure an assortment of small, prepared booby traps or dirty trick devices.

(c) Mine Field Marking Equipment. It is recommended that:

1. Mine field marking Set No. 1 be standardized.

2. The project for equipment for assault gap marking be reactivated using the military characteristics proposed by AFF Board 2 and attached in appendix F of Annex No. 3.

(d) Warning Equipment. It is recommended that:

1. The M39 fixed flare be modified to include activation by pressure.

2. The M48 parachute flare be improved in accordance with military characteristics as contained in appendix F of Annex No. 3.

(e) Training Aids. It is recommended that:

1. Each project for the development of a mine include a requirement for a training and a practice version concurrent with standardization.

2. Mines be supplied without explosive components for training.

3. Mine detectors using earphones be equipped with a jack for a second phone for training.

4. Training charts, and training films be prepared for all types of mine warfare material.

(f) Protective Equipment: It is recommended that further development of body armor, goggles, and antiskin ointment be undertaken to produce suitable and items of protective clothing for mine clearing work.

(g) Priorities. It is recommended that the priorities as outlined in Section IX of Annex 3, be followed by the development agencies to insure that proper coordination is effected between items being developed by different agencies and a balanced family of material is obtained.

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(9) Procedures. It is recommended that:

(a) No change be made in present assignments of development and supply responsibility for the various items of mine warfare material.

(b) The Army equipment Development Guide be liberalized in temperature requirements and policy on acceptance of changes.

(c) Military characteristics include a statement of proposed tactical employment and divide characteristics into those absolutely essential and those desirable.

(d) Weights of boxing or crates for mines be drastically reduced.

(e) Better security be maintained on newly developed material.

27. The Panel Chairman then took a formal vote on approval of the conclusions and recommendations of Committee No. 3. The results were as follows:

<u>Delegation</u>	<u>For approval</u>	<u>Against Approval</u>
The Engineer Center	1	
Office, Chief of Ordnance	1	
The Infantry School	1	
AGF Board No. 2	1	

The above conclusions and recommendations are therefore adopted and made a part of the conclusions and recommendations of the panel.

28. The panel met at 1300 on 12 March 1952 to consider the report on The United States viewpoint on mine field policy for presentation in connection with Standardization Study no. 10. This report was called for by 2nd Ind., dated 31 January 1952, to letter OCS, HZ207, dated 15 December 1951, Subject: "Reevaluation of Doctrine on Tactical Employment of Mines." The report is in accord with the conclusions and recommendations of the panel and after presentation of the report no panel member objected to it. The report is contained in Annex No. 4 of this report.

29. The panel at 1200 on 13 March 1952 adjourned.

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Inclosures:

1. Letter OCE, 19 Dec 1951
2. Plans of Operation, 21 Jan 1952
3. Letter OCE/1 & 2 Int., 24 Jan 1952

Exhibits:

- A. Presentation by Lt Colo Huggelberg and St. Clair
- B. Presentation by Lt Col Dice, AFF Board No. 2
- C. Presentation by Mr. J. W. Johnson, ORO
- D. Presentation by Col W. S. Triplet, GSC

Annexes:

- Annex No. 1 Doctrine and Training
- Annex No. 2 Technique
- Annex No. 3 Research and Development
- Annex No. 4 U.S. Viewpoint on Mine Field Policy

Harmon N. Underwood
HARMON N. UNDERWOOD
Col CE, TIS, Panel Chairman

Robert G. Starnes, Jr.
ROBERT G. STARNES, JR.
Col Inf. TIS, member

John G. Scherhorn
JOHN G. SCHERHORN
Col CE, TIS, member

Desloge Brown
DESLOGE BROWN
Col CE, TIS, member

J. F. McCaslin
JAMES F. MCCASLIN
Lt Col, Ord C. Office,
Chief of Ord. member.

Clark Weber
CLARK WEBER
Lt Col, Armor, 2 Arm S,
member

Glen E. Huggelberg
GLEN E. HUGGELBERG
Lt Col, Inf. GSC, member

Edwin H. Perry
EDWIN H. PERRY
Lt Col, CE, TIS, member

John H. Miller
JOHN H. MILLER
Lt Col, CE, AFF, member

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Robert I. Dice

ROBERT I. DICE
Lt Col, CE, AFF Bd. 2,
member

Harold J. St. Clair

HAROLD J. ST. CLAIR
Lt Col, CE, TES, member

Noel E. Farnsworth

NOEL E. FARNSWORTH
Major, CE, AFF Bd. 2,
member

Alfred B. Mallon

ALFRED B. MALLON
Capt. Inf, FIS, member

Charles E. Alexander

CHARLES E. ALEXANDER
Capt. Armor, T Armd B,
member

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MEMO

19 December 1951

SUBJECT: Tactical Aspects of Land Mine Warfare

TO: The Commanding General
The Engineer Center
Fort Belvoir, Virginia

1. References:

a. Letter, Department of the Army, G-3 476 (17 Oct 50), dated 6 June 1951, Subject: SOLOG - Standardization in the Design of Mine Fields and the Technique of Mine Field Laying (Study AAI6), which was transmitted to you by 1st Indorsement, 26 June 1951.

b. Letter from Office, Chief of Engineers, dated 4 October 1951, HECOG, Subject: Reevaluation of Doctrine on Tactical Employment of Mines.

2. It was the intent of the 1st Indorsement, 26 June 1951, referred to in paragraph 1a above, to give the Commanding General, The Engineer Center, the mission of developing the United States position on those features of mine warfare which were set forth as the scope of SOLOG Study AAI6.

3. It was the intent of the 4 October 1951 letter referred to in paragraph 1b above to:

a. Reaffirm the necessity of developing the United States position on those features of mine warfare which were set forth as the scope of SOLOG Study AAI6.

b. Assign to the Commanding General, The Engineer Center, the mission of preparing a study on all tactical aspects of land mine warfare, including doctrine, technique, training, equipment, and answers to the following questions presented by the Chief, Army Field Forces:

(1) What changes are desirable in our doctrine for the tactical use of mines?

(2) What changes should be made in training publications and in training programs to give additional emphasis to the defense in our use of mines? Are such changes desirable?

4. It is further desired that as an expansion of the directive included in the 4 October 1951 letter, you investigate and evaluate the research and development program to determine what should be done to expedite availability of adequate and satisfactory antitank mines, antipersonnel mines, fuses and other equipment. Incidental to your investigation answers to the

Encl. 1

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LESTO

SUBJECT: Tactical Aspects of Land Mine Warfare

following questions are desired: Are our military characteristics too restrictive? Are we striving for the ideal at the expense of the practical?

5. The study submitted by you under cover of letter dated 29 November 1951, Subject: Reevaluation of Doctrine on Tactical Employment of Mines has been submitted to Chief, Army Field Forces with OCE recommendations and remarks by letter LESTO, 15 December 1951, a copy of which was furnished you. Since the information needed for SOLOG Study AAL6 is dependent on the U. S. mine field doctrine developed as the result of study referred to in paragraphs 3b and 4, above, no further action directed solely toward SOLOG Study AAL6 need be accomplished until further directed.

6. To conform with a suggestion of the Chief, Army Field Forces, you are requested, when arranging meetings to prepare the study described in paragraphs 3b and 4 above, "to include in the conference representatives of the Chief of Ordnance and others interested in research and development of mine warfare equipment." It is understood that, on at least a small scale, you have initiated such a study.

7. A copy of an Army Field Force staff study pertaining to mine warfare has been furnished your headquarters under cover of OCE letter 14 December 1951, Subject: "Staff Study, Mine Warfare."

8. It is requested that with the use of your study and the enlarged panel referred to in paragraphs 5 and 6 above, you actively continue with the study referred to in paragraphs 3b and 4, above.

BY ORDER OF THE CHIEF OF ENGINEERS:

G. E. TUTOR
Brigadier General, USA
Assistant Chief of Engineers
for Military Operations

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THE ENGINEER SCHOOL
THE ENGINEER CENTER AND FORT BELVOIR
FORT BELVOIR, VIRGINIA

21 January 1952

Plan of Operation for the "Panel on the Tactical Aspects of Mine Warfare and Evaluation of the Research and Development Program in Mine Warfare Material".

1. Time and Place.

The Panel will be convened at 0900, 11 February 1952 in Room 210, Abbot Hall, Fort Belvoir, Virginia.

2. Panel Chairman:

Colonel Warren H. Underwood, O-16078, CE, is designated as Panel Chairman. His address is Department of Engineering, The Engineer School, Fort Belvoir, Virginia. His telephone is Temple 7400 Ext. 2127.

3. Mission.

The mission of this panel is to prepare a study on all tactical aspects of land mine warfare including doctrine, techniques, training and equipment, and an evaluation of the research and development program.

The above mission is comprehensive in scope and contemplates a thorough examination of the subject in all its phases. Neither any member of the panel nor any of its committees should interpret any of the terms of the mission as stated above or the missions of the committees as stated in par. 4 below, to be restrictive. In any study of this nature, if thoroughly conducted, unforeseen questions and avenues of investigation are encountered. If encountered in this study they are to be recognized and frankly explored and answered.

4. Participation

The following agencies will participate in the study and furnish the membership of the committees to the extent shown in paragraph 5 below.

Office, Chief of Army Field Forces (optional with OCAF)
The Command and General Staff College
Army Field Forces Board No. 2
The Infantry School
The Engineer School
The Armored School
Office, Chief of Ordnance
Office, Chief of Engineers

Incl. 2

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Each agency should furnish a separate officer for each committee on which the agency is represented. Representatives should be prepared to devote approximately 30 days to the study.

5. General Plan for Study.

The study will be made in three phases. Phase 1 will consist of a complete survey of our present status in research and development in doctrine and materiel. The survey will include detailed presentations on:

- a. An exposition of present Mine Warfare doctrine.
(To be presented by CAGSC and TIS).
- b. A review of present mine laying techniques.
(To be presented by TIS.)
- c. An exposition of current studies and research on Mine Warfare.
(To be presented by ORD).
- d. A review of the current status of requirements for research and development. (To be presented by JTF Board No. 2)
- e. An exposition of the present status of research and development in Mine Warfare materiel. (To be presented by OCE, OCO, and Bureau of Standards).

Each of these presentations should be followed by a discussion period of at least one hour. At the end of the first phase, the panel will be organized into working committees for the conduct of the studies. These committees will be:

- Committee No. 1 - Doctrine
- Committee No. 2 - Technique
- Committee No. 3 - Research and Development

The second phase of the work will consist of study and preparation of reports by the committees. Periodically during this phase the panel will meet as a committee-of-the-whole to receive progress reports from the committees and to discuss, as a committee-of-the-whole, the problems arising as each committee's work progresses.

The third and final phase of the study will consist of the presentations to the panel of the final reports of each committee. Based upon these reports, the panel should then formulate its report, including:

- (1) Conclusions
- (2) Recommendations

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Conclusions and recommendations should be specific in both committee reports and the final report of the panel. For example, where changes in doctrine are recommended the recommendations should include the specific changes to be made in the appropriate manuals. Where changes are recommended in military characteristics, the specific changes to be made should be included.

6. Voting.

For the purpose of resolving questions in the committee work as well as the panel when acting as a committee of-the-whole, voting privileges are assigned as follows:

a. On questions of doctrine and training

CAGSC	)	
AFV Board No. 2	)	
The Infantry School	)	one vote each
The Armored School	)	
The Engineer School	)	

b. On questions of technique

The Engineer School	)	
The Infantry School	)	one vote each
The Armored School	)	
AFV Board No. 2	)	

c. On questions of research and development

The Engineer Center (ERDL or TES)	)	
The Infantry School	)	one vote each
AFV Board No. 2	)	
Office, Chief of Ordnance	)	

It shall be the duty of the various committee chairman and the panel chairman to conduct the deliberations accordingly.

7. Report:

The report of the panel shall consist of three parts as follows:

a. The presentation on current status of doctrine, technique and research and development.

b. The committee reports.

c. The final conclusions and recommendations of the panel.

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8. Organization and Missions of the Committees

The panel shall be organized into three committees as follows:

Committee No. 1 - Doctrine and Training

Mission: To prepare a study on tactical doctrine on land mine warfare. To evaluate existing doctrine and recommend changes in appropriate field manuals where such changes are found to be desirable. To study existing training publications and programs and to recommend changes which are found to be desirable.

Membership: Will include representatives from:

Command and General Staff College
The Infantry School
The Armored School
The Engineer School
A77 Board No. 2

The chairman of the committee will be the representative from the Command and General Staff College.

Committee No. 2 - Technique

Mission: To study existing techniques in the laying and clearing of minefields. This study should include all methods of laying and clearing, both manual and by machine. The marking and recording of minefields should be considered. The desirability and practicability of camouflage measures in the laying of minefields should be carefully considered.

Membership: Will include representatives from:

The Engineer School
The Infantry School
The Armored School
A77 Board No. 2

The chairman of the committee will be the representative from The Engineer School.

Committee No. 3 - Research and Development

Mission: To investigate and evaluate the research and development program to determine what should be done to expedite the availability of advanced and satisfactory antitank mines, antipersonnel mines, fuses and other equipment. Military characteristics should be carefully examined to determine whether they are practical and not too restrictive.

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Memberships: Should include representatives from:

The Engineer Center
Office, Chief of Ordnance
The Infantry School
AFS Board No. 2

The chairman of the committee will be the representative of
The Engineer Center.

FOR THE COMMANDANT:

/s/ E. J. Peterson
E. J. PETERSON
Colonel, Corps of Engineers
Assistant Commandant

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DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON 25, D. C.

EX-37

24 January 1952

SUBJECT: Panel on the Tactical Aspects of Mine Warfare

TO: Chief, Army Field Forces
Fort Monroe, Virginia
ATTENTION: Engineer

1. As requested by Lt. Colonel Hinds, Engineer Section, GMAFF, there is attached a copy of the plan for the conduct of the panel on the tactical aspects of mine warfare to be held at The Engineer School, Fort Belvoir, Virginia.

FOR THE CHIEF OF ENGINEERS:

1 Incl
Panel on Tactical Aspects
of Mine Warfare

/s/ A. C. Welling
A. C. WELLING
Chief, Engr Orgn & Tng Division
Military Operations

ATTN 334 (24 Jan 52) 1st Ind
Subject: Panel on the Tactical Aspects of Mine Warfare

Office, Chief of Army Field Forces, Fort Monroe, Virginia

TO: Chief of Engineers, Department of the Army, Washington 25, DC

The plan for the conduct of the panel on the tactical aspects of mine warfare is approved, except for that portion of para 4a assigning votes to AFF Board No. 2. It is desired that AFF Board No. 2 not be assigned voting privileges on questions of doctrine and training.

FOR THE CHIEF OF ARMY FIELD FORCES:

1 Incl
-7/3

/s/ Owen Elliott
OWEN ELLIOTT
Colonel, AGO
Asst Adj Gen

Incl-3

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EMIST

2nd Ind

Office of the Chief of Engineers, Washington 25, D. C., 14 February 1952

TO: The Commanding General, The Engineer Center, Fort Belvoir, Virginia

Forwarded for your information.

BY ORDER OF THE CHIEF OF ENGINEERS

/s/ C. Melling

for C. MELLING

Colonel, Corps of Engineers

Chief, Engr Org & Tng Division

Military Operations

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"AN EXPOSITION OF CURRENT MINE WARFARE DOCTRINE"
by Lt Col H. J. St. Clair, CG, The Engineer School

INTRODUCTION

1. The joint presentation of current mine warfare doctrine by the Command and General Staff College and the Engineer School has been divided into two parts:

a. The Engineer School Representative will summarize US doctrine as given in FM 5-32 (Land Mine Warfare) and other DA Publications.

b. The Command and General Staff College Representative will describe the tactical employment of this doctrine as presented in problems given at the college.

2. At the time presentation of doctrine only that which appears in the field manual will be mentioned. Leaving discussion for a period following the course presentation.

3. Our current doctrine derives mainly from battle experience gained in WW II. Land minefields are considered to be obstacles, as a part of the complex which includes ditches and wire entanglements, wedded to natural obstacles such as mountains, forests and swamps.

DEFINITIONS

1. Terminology: The most common mine field terminology employed in our present doctrine follows:

a. A mine belt is a strip of ground containing mines laid in a straight pattern.

b. A mine station is part of a mine belt. Belts are divided into sections to facilitate laying and recording mines and to allow for change of direction.

c. A mine field includes an entire mined area. It may consist of one or more mine belts or may contain one or more mine belts.

d. A mine-free area is an area that may contain both mine belts and mine fields, the boundaries of which have not been accurately determined.

e. Mine density is the number of mines per yard of front. Normal mine density of mine belts is 10 mines per yard of front.

f. A mine-free line is a physical object of mine and marked so that it is safe for personnel and animals to travel safely through the mine field.

g. Clearing is the clearing of one or more lanes for vehicles and/or personnel through a mine field.

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D. Clearing a mine field includes recovery and collection and/or destruction of all mines over the whole field.

E. Types: Mine fields are classified as to types of mines and as to their tactical employment. The classification as to employment will be discussed in a latter paragraph. Following are 5 mine field types listed in TM 5-37. The classification is not consistent since mine type, mine purpose, and mine field location are all included in this classification.

F. Antitank: Antitank mine fields are entirely mined obstacles which can be established rapidly to hinder the enemy's attack or movement. They are effective supplements to other antitank weapons (antitank guns, artillery, rocket launchers) generally employed in antimechanized defense.

G. Antipersonnel: Antipersonnel mine fields are installed to harass and slow enemy foot troops, provide warning of enemy approach, and to prevent removal of AT mines.

H. Beach: Beach mine fields provide a means of denying free use of beaches to a landed amphibious enemy force.

I. Antiairborne: Antiairborne mine fields are installed to prevent the landing of an amphibious enemy force on a friendly beach.

J. Antiairborne: Antiairborne mine fields are installed in organized defense against enemy airborne forces. The purpose of these mine fields is to prohibit, by their casualty producing effect, the landing of enemy airborne units in certain areas, thereby restricting landing operations to less desirable areas.

K. Patterning: Mines normally are laid in patterns. The standard antitank mine field pattern, the drill for laying antitank mines, and the triangular pattern for antipersonnel mines, will be demonstrated by TEG in a subsequent period.

L. Marking: To prevent casualties to our troops, all mine fields, antitank, enemy mine fields and enemy mine fields that have been overrun by our troops or incorporated in our defense positions, must be marked in a manner known to all troops. Steps must be taken to prevent our troops from entering mine fields being installed and marked. Distance mine fields may or may not be marked.

M. Troops which lay a mine field are responsible for properly marking the field. Marking fences are maintained by troops occupying the area where the mine field is located.

N. All mine fields must not only be marked but also be marked as to the location of the field. Standard markings will be demonstrated by TEG.

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25. It also has standard methods of marking lanes through mine fields and of marking cleared tracks and of marking individual mines.

5. Recording and Reporting: Division, corps, and army engineers keep a special situation (barrier) map on which all essential information concerning friendly and enemy mine fields is continuously entered. This information is used to keep commanders, unit staffs, and troops in the mined areas accurately informed. Division, corps, and army engineers distribute overlays, to appropriate agencies of 1:100,000 to 1:25,000, of special situation (barrier) maps periodically. It is important, therefore, that newly installed mine fields be recorded and records be forwarded to the proper headquarters immediately.

6. Special Minefields: are recorded while being installed. Different classes of mine fields require different types of reports. There are two types of records - the detailed report and location report.

(1) Location Reports: This is an overlay type report which shows the location of the minefield and mine belts.

(2) Detailed Reports: This is a sketch or series of sketches which gives all information necessary to locate individual mines accurately. Accurate location of mines relative to a topographic marker is the key to this report.

7. Alterations: Changes or alterations made in mine fields are recorded and forwarded to interested headquarters.

8. Transfer of Responsibility: Whenever one unit relieves another, the unit commander of the relieving unit automatically assumes all the mine-field responsibilities formerly assigned to the commander of the relieved unit, unless otherwise directed by higher commander. The commander of the relieved unit furnishes the commander of the relieving unit all records and information concerning friendly and enemy mine fields in the area. He also supplies the necessary ground-combat personnel to insure continuation of all mine field information. All higher commanders are responsible for insuring that a proper transfer of information is effected.

9. Authority: The level of command which may authorize the installation of mine fields varies with the type of mine field. For example, only an army or separate task force commander may authorize the installation of a minefield mine field while a regimental commander may authorize the installation of unit mine fields. The commander who may authorize each type of minefield will be mentioned in the discussion of minefield types. Actually the authority and extent of delegation of this authority comply to the needs of the most contemporary concepts and current doctrine.

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7. Siting. Reconnaissance for siting of a mine field is of vital importance. Once laid, the mine field fixes the location of supporting weapons and controls future operations.

a. Considerations. When selecting a mine field site, reconnaissance personnel must consider the mechanical type of mines and the supporting troops and weapons.

b. Reconnaissance. In conducting a reconnaissance available maps and aerial photographs are studied to determine the approximate location of the field. Both ground and aerial reconnaissance is conducted, and proper use of forces are made to supplement the recommendations of the reconnaissance officer and to aid the commander in making his decision as to location of the field.

c. Coordination. Coordination is necessary between the organization installing the field and the unit responsible for guarding and protecting it. The mine field should be sited in terrain that can be covered effectively by protected anti-air, mortar, and antitank-gun fire.

d. Utilization of terrain. Effectiveness of a mine field is increased by laying it on terrain which the enemy either cannot observe or has difficulty in observing. Mine field location is restricted to the windows by making maximum use of natural obstacles and by restricting mine fields to terrain which can be covered effectively by defensive fire. To be effective, the mine field must be anchored to natural obstacles to prevent the field from being outflanked, or it must be sited so that bypassing the field would result in very work or be more hazardous than breaching the field.

e. Depth. The depth of a mine field varies with the terrain conditions and the fields of fire of supporting weapons. Maximum depth of a field is governed by the effective range of these weapons. Properly protected mine fields restrict enemy reconnaissance to the most forward mine belts of the field, leaving the rear belts as surprise obstacles to check any quick enemy thrust.

f. Mine Clearance. Mine clearance includes the location of detection and the removal and/or destruction of mines. The methods mentioned below will be demonstrated by TMS in a latter period.

g. Location. Mines are located visually, with mine detectors, or by probing.

(1) Visual: In a rapid advance visual inspection is necessary. It is effective in most types of ground.

(2) Mine Detectors: The electric mine detector is the most effective and safest way to locate individual mines; however, all detectors have their limitations.

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(3) Probing: Present standard mine detectors are not entirely satisfactory under all conditions. Heavy probing in suspected areas is necessary.

d. Removal: Mine removal is employed when the mine must be removed silently. Mine removal is safer and faster but it may cause destruction of activated mines.

e. Mechanical and Explosive Clearance: Many experimental devices have been developed to remove mines or destroy them in place. They are used principally in well-planned, coordinated attack operations. Such devices require special equipment and training, but may save time and lives.

5. USE OF MINE FIELDS. All existing mine fields, except uncharted mine fields, and all new mine fields, including anti-aircraft mine fields, must be covered by small arms, mortar, and antitank weapons (antitank weapons in the case of beach fields). Antipersonnel mine fields should be covered by small arms and mortar fire. Mine fields not covered by fire are susceptible to any method of breaching. Outposts or listening posts may be placed in front of mine fields or in a mine field itself to prevent enemy patrols from discovering the location of its forward edge, determining the direction and extent of the belts, and removing portions of the field.

10. TRAINING. Officers and enlisted men of all arms must have some training in mine warfare and enemy mine techniques. All combatant personnel must know how to employ mines effectively.

a. All Arms. Officers and enlisted men of all arms should know the common types of mines, how to find mines, reconnaissance procedure, standard markings, and laying and reporting of a unit mine field.

b. Specialists. Mine field specialists must be able to recognize and neutralize all R, S, and enemy mines, clear and mark lanes, and lay, mark and record mine fields.

c. Present A.P.'s: A summary of training required in all units has been prepared for the use of the panel.

11. CLASS. Mine fields were previously classified as AP, AE, beach, antipersonnel and antitank. However, they are very commonly classified as to their tactical employment. The sheet which you were issued entitled "Orders of U. S. Mine Warfare Policies", may be used to follow this classification.

a. Temporary Security. A temporary security mine field is a mine field constituted only of mines not laid to a specific pattern, that are put out for short periods of time to protect isolated units. The temporary security mine field is not marked, but must be guarded at all times. The only record made is a general location report which is retained by the unit. All mines must be removed when the laying unit leaves the area. This type of field may be ordered by a regimental or separate battalion commander and delegated to lower unit CPO.

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1. Unit. The concept type mine field we will discuss is the unit mine field. It is a protective mine field used to improve the defensive position of a unit. Basically this field is not very extensive in length nor is it laid in more than one belt. It may be ordered by the commander of any unit, but he must obtain clearance from division headquarters. It may be laid by any troops desiring it, however engineers may be called to supervise and help. The field is laid in a definite pattern, is marked, and recorded.

2. Divisional. The divisional mine field is used in large-unit defensive positions. It is extensive in length, laid in depth, and may include both enemy and friendly mine fields in the area. It is ordered by a division or higher commander. Unit engineers plan this mine field and normally engineers or specially trained troops will lay it although the defending troops may be called upon to assist in the operation.

3. Intimidation. A nuisance mine field consists of individual mines scattered in areas to give up to the enemy. It may be either antitank or antipersonnel. Authorization by an Army Commander is required to lay it because only he will know whether the area is to be abandoned permanently or whether the unit can sustain the losses involved in returning to the area.

4. Dummy. A dummy mine field is one having all the appearance of a mine field but without the mines. It is marked and recorded and the ground slightly disturbed to give the effect of mines in the area. Odd objects or signs may be placed in these spots to increase the effect. A division or higher commander orders this type of field placed.

5. Antipersonnel. Antipersonnel mine fields are installed only by engineers or other specially trained troops because of the hazardous nature of the work. They are used for defense of positions against foot troops, to provide warning of enemy approach, and to hinder reconnaissance and patrol parties in antitank mine fields. A division or higher commander orders their placement.

6. Booby Trap. A booby trap, of course, is not a mine field but a concealed mine or charge designed to inflict casualties on and destroy the ranks of enemy personnel by the movement of an apparently harmless object. It may be authorized by division or higher commander.

7. General. The actual employment of temporary security, unit, and divisional mine fields will be discussed by the Command and General Staff Courses in detail.

8. References: Army School Catalog, Training Manuals, Training Circulars, and Training Bulletins contain numerous references to mine fields. A compilation of these references has been prepared and issued as follows:

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SUMMARY

Current Mine Warfare doctrine has been summarized. There are many opinions as to its adequacy. If short comings did not exist in current doctrine there would be no need for convening this panel.

TACTICAL APPLICATION OF LAND MINE WARFARE

By Lt Col Glenn R. Engelbarg, Inf. The Command and General Staff College

INTRODUCTION

Gentlemen, I have been asked by the Engineer School to illustrate, through the medium of a few problems, the application of our present doctrine on land mine warfare. I'd like to point out that my presentation will be here or less off the cuff.

Other than at the general staff level the CGSC does not go into barrier planning or the installation of mine fields as such, in any great detail. Instead, we cover it generally from the general staff operational planning aspect.

With that general introduction, I will try within the next hour, to illustrate the possible uses of mine warfare based on our current doctrine in a position defense, a defense on a wide front, a retrograde action, and in an attack, in that order.

First, let us examine the position defense. You will note that on the blackboard I have schematically sketched a typical position defense for a division. If you will turn to page 44 of Field Manual 5-32, which you have in front of you, you will see illustrated the manner in which a battalion, as part of the battle position, protects itself with unit mine fields. I believe that this illustrates our basic doctrine quite well. However, let's tie in the battalion's plans with the plans of higher headquarters.

When we link a series of these battalion defense positions together, we begin to get a picture of the conventional defense as shown on the blackboard. When we link their unit mine fields with other obstacles, or adjacent unit mine fields, we have elements of the barrier plan of the higher units. Dependent upon the time and material available, the bands will be reinforced, deepened or extended. Bands to provide flank protection and to eliminate lateral movement will be installed. Army and corps will establish key bands in the rear areas to limit or hinder deep penetration.

We must also not forget our security elements. The covering force would protect itself with mine fields much in the same manner as would any force conducting delaying action, which I will explain later. The general outposts also could utilize division mine fields or as a very minimum, temporary security mine fields and road blocks. The combat outposts will in all probability use temporary security fields for their local protection. Further, depending on the location and depth of the key bands, combat outposts may be located within the key bands.

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Are there any questions on the use of mine in a position defense?

DEFENSE ON A WIDE FRONT

Gentlemen, before we get into a discussion of land mine warfare in a defense on a wide front, I would like to point out that the method of defense on a wide front, first is shown on the overlay before you. It is only one of the several methods that we have under consideration at the College. Actually our position relative to the best manner of organization for, and conduct of, defense on a broad front is not firm as of this date.

Now if you will refer to the Diagram - LUXEMBOURG sheet and Overlay 4 of subject 6041/2, which you have before you, I'll orient you briefly on the general situation. Aggressor is on the offensive. We have been fighting a delaying action. Aggressor's main effort is for to the north of our present position. First Army has been ordered to defend the line of the OUR-SAUER Rivers with minimum forces in order to permit the army group to concentrate sufficient forces to the north to stop Aggressor's main thrust. I Corps, a part of First Army, is using its 20th Armored Division to sugar the withdrawal of the remainder of the corps to the OUR-SAUER line. We are concerned with the status of the 20th Infantry Division which is shown on Overlay 4. In this instance the division plan calls for a defense by a series of battalion strong points which are located so as to deny Aggressor the critical terrain and to slow down and/or disorganize his attack to such a degree that counterattack with the forces we have available in mobile reserve will have a reasonable chance of restoring the position.

Now let's turn our attention to the antitank defense. The SAUER River is unfordable below the town of KONTZMACH. Note that in our antitank defense we strengthen that obstacle by mining the most likely crossing sites initially, and that units use antitank barrels to protect the battalion strong points. These barriers would include antitank mines, tank obstacles, both natural and artificial, and antipersonnel mines. Regimental and battalion antitank weapons are sited within the battalion strong points.

Initially barriers and mine fields between strong points are located to canalize Aggressor's forces and lead him into the intense antitank fires of the battalion strong points. Armor maintained under division control would be used primarily in a counterattack role.

We consider this organization minimum essential initially - As time, material and labor permit, mine fields and obstacles would be extended, improved and deepened until our barrier plan would have essentially the same characteristics as that of a position defense except that some areas would not be covered with effective small arms fire.

Security elements forward of the position would use mines back in the same manner as indicated in the position defense. Army and corps would also operate much the same as in the position defense.

any questions?

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RETROGRADE ACTION

Gentlemen, let's now discuss retrograde action. Please place Map B and Overlays 4 and 6, subject 104/2, on your desks. Also have available the sketch map for the same subject. You will note here we have a division which has been given the mission of protecting the withdrawal of the remainder of the corps. The corps is establishing a defense along the Rhine line. The division is at present occupying positions along the Moselle River which it intends to hold for a period of two to three days. Its most delaying position will be the line of the Moselle River. The overlay that you have before you, is the 20th Division's plan for a night withdrawal from its present position to the Moselle River position. If you would like to, take a few minutes to read the plan.

Especially we believe that the use of mines and other antitank and antipersonnel obstacles on the successive battle positions would be the soundest for any defense - dependent upon the width of front, time, material and labor available. Further, it would be dependent upon the time that we intended to hold the position.

Possibly the major point of interest here is the installation of antitank obstacles between the successive positions along the major routes of withdrawal or avenues of approach to the new position. These obstacles would be established under the supervision of the planned covering force as coordinated by G3. Coordination with withdrawing forces is also essential to insure that lanes are left open to permit their passage to the rear and that these lanes are closed upon completion of their passage. Engineer assistance is considered essential in a retrograde action. Possibly I would also be used as flank protection along the routes of withdrawal.

These flanks between the successive positions or in fact on the various positions, may include any or all types of mines and may or may not be covered with small arms fire, dependent upon the policy prescribed by the Army or separate force commander.

Any questions?

OVERLAY

Please place the THIRTEENTH SHOOT and Overlay 2 of subject 104/2 and the sketch map for that subject in front of you on your desks. Here we have a division of a corps which is planning an attack against a tactically superior force. Overlay 2 is the operation plan, in part, for that attack. Would you study it for a few minutes?

Offensively we state that barriers are used to:

- a. Provide flank security.

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b. Guard against surprise counterattacks.

g. Protect a section of the front that is not strongly held.

You will note that the 72nd Division plan of attack calls for Task Force A to make a demonstration along the Sauer River on the north to hold the enemy north and east of that river. Since we have occupied this position defensively, the mine fields and other obstacles in Task Force A's zone will be left in place to assist in the protection of that front which will not be very strongly held.

We intend to make our main effort along the SCHARBOLLIG ridge and to use the Sauer River which though fordable, has quite steep banks as an obstacle to protect the flank of our main effort regiment, the 58th Infantry. We will attack the 20th Recon Company and provide engineer support to assist our main effort unit in protecting its flank. We can further protect this flank by the use of a vision mine fields along the critical avenues of approach across the Sauer River. Another possible use of antitank and/or anti-personnel mines to protect our flank would be in the event we seized Objective 3 and turned our attack to the east prior to the time that the 72nd Division on the north had advanced to the general area of BIRLING. Again these fields may or may not be covered by small arms fires at all times and may or may not be removed as the division moves forward. This would be entirely dependent on the corps scheme of maneuver.

Temporary security mine fields could be used by units to prevent local enemy counterattack during the phase after seizure of any one of the objectives indicated.

SUMMARY

Essentially then we can sum up our present doctrine by stating that mines may be used in any way prescribed by the Army or Separate Task Force Commander. This policy is based on his future operational plans and his logistical ability to support his policy in regards to land mine warfare. He may prescribe his policy in SOP or in other published orders, indicating for specific operations approved deviations from the SOP or additional restrictions.

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~~RESTRICTION TO THE MINE WARFARE CELL~~
CURRENT STATUS OF RESEARCH NEEDS FOR RESEARCH AND DEVELOPMENT IN MINE WARFARE
BASED ON REVIEW OF RELATED PROJECTS
by Lt Col B. I. Dice, CE, AFF Board No. 2

1. ARMY EQUIPMENT DEVELOPMENT GUIDE. This guide is the basic source of all Army material requirements. Portions that pertain to mine warfare have been extracted and are appended hereto as Annex 1. The provisions of the guide with respect to mine warfare material are summarized below:

a. Urgent needs are listed as: improved land mines and explosives; development of mines, methods and equipment necessary for the rapid laying of mines and explosives as tank obstacles and provision of devices for the location and elimination of all types of enemy mines.

b. The eventual users are specifically given the responsibility for development of detailed characteristics in close collaboration with developing agencies.

c. Developing agencies are charged with investigation of all promising fields to meet requirements of users and concurrent development of countermeasures, counter-countermeasures and detection devices as continuing and general responsibilities.

d. When common requirements exist for several of the Armed Services, such requirements should be consolidated into one statement of military characteristics and one development item.

e. Developing agencies are required to determine and meet troop requirements for training aids.

f. Requirements are stated for metallic and nonmetallic antitank and antipersonnel mines. A basic antitank mine capable of immobilizing all vehicles, mine suitable for mechanical laying, a shaped charge antitank mine capable of deep burial, sensitive explosives to be used as mine substitutes, and fixed and bounding type antipersonnel mines are specifically listed.

g. Requirements are stated for obstacles against air, amphibious and land attack, and booby-traps for use with obstacles. A variety of fuzes and firing devices are included.

h. A requirement is stated for equipment for rapid laying of extensive mine fields.

i. Requirements are stated for metallic and nonmetallic mine detectors, miniature detectors, vehicular and tank mounted detectors, vehicular and tank mount detectors, detectors capable of locating horizontally directed shaped charge mines or similar lethal projection devices and a detection system capable of either ground or air location of mines.

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J. Mine clearing requirements include an urgent a tank mounted eradiator of individual mines and a method or rapidly gapping enemy mine fields. Requirements are listed for liquid explosives for mine field gapping, for a system for ground or air directed detonation or neutralization of mines.

K. Requirements are stated for body armor and antismine shoes for the protection of individuals against mines.

L. Marking equipment for safe passages through mine fields and capable of use with rapid mine clearing equipment is required.

M. There is a requirement for a system to remotely control a mine field by selectively arming, disarming or detonating the mines.

2. CLARIFICATION OF REQUIREMENTS. The brief statements of requirement for mine warfare materiel contained in the Army Equipment Development Guide are the basis for the preparation of detailed military characteristics which are designed to serve as the objectives for research and development projects. The concept of what the proposed new equipment is required to do is fundamental to the development of detailed military characteristics. In some instances the materiel requirement is directly related to established doctrine and the proposed service employment is adequately prescribed by the appropriate field manuals. Present mine warfare doctrine is contained in Department of the Army, FM 5-15, August 1949; FM 5-32, May 1949; FM 100-5, August 1949; FM 100-15, June 1950; FM 101-10, August 1949, and War Department FM 5-31, 1 Nov 43. This doctrine does not provide for the complete utilization of the capabilities of some types of required materiel developments, for example, the shaped charge antitank mine armed by an influence fuse. Consequently, the formation of some definite tactical concepts has been necessary in order to clarify some established mine warfare materiel requirements sufficiently to permit preparation of detailed military characteristics. The tactical concepts formed to fill in gaps and inadequacies in present mine warfare doctrine have disclosed additional materiel deficiencies and requirements.

3. TACTICAL CONCEPTS DEVELOPED TO CLARIFY MATERIEL REQUIREMENTS. Tactical concepts developed at AFF Board No. 2 indicate requirements for functional types of mine fields, various degrees of effectiveness of antitank mines and employment of certain related mine warfare equipment. Three types of desired damage to tanks as a result of antitank mine action are recognized: "Kill" - to damage an armored vehicle to the extent that it is eliminated from current operations, requiring base maintenance or replacement; "Disable" - to damage armored vehicles so that they are taken out of the current action, requiring field maintenance and removal from field of action for necessary repairs, and "cripple" - to damage armored vehicles so that they cannot continue action, but can be put back into action with organizational maintenance. The requirements for functional mine fields and related mine laying, detection, clearing and control equipment are generally as follows:

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a. Infiltrate Defensive Mine Fields which shall be lethal to armored vehicles, effective against foot troops, and suitable for reinforcing the fires of friendly troops and temporarily obstructing gaps between organized positions. These mine fields shall be capable of utilization in a col uar mine field installation.

b. Temporary Security Mine Fields which shall be capable of extremely rapid installation and be capable of crippling or disabling armored vehicles and effective against foot troops for close-in protection of friendly units. These fields shall not unduly limit the later maneuver of friendly forces.

c. Interdiction Mine Fields which shall be capable of crippling, disabling or killing armored vehicles and effective against foot troops and extremely difficult to breach and as nearly impossible to clear completely as can be achieved. These mine fields shall be suitable for contributing to other means of forcing the enemy into concentrations remunerative for attack or counter-attack by atomic weapons. Material is required for interdiction of areas to prevent probable hostile airborne operations.

d. Quiescence Mine Fields which shall be capable of rapid installation, including by aerial means, and of crippling, damaging, or killing armored vehicles. These fields shall be capable of maximum surprise and harassment through utilization of counting devices, selective or remotely controlled arming and disarming and undetectability. These fields shall be effective against personnel and shall incorporate effective booby traps capable of rapid installation and mass employment. Both ground and aerially installed anti-railway mines are required.

e. Offensive Mine Fields which shall be capable of crippling, disabling or killing armored vehicles and effective against foot troops. These fields shall be capable of aerial installation and reinforcement and of delayed or controlled arming or disarming. These fields shall be capable of isolation of the battlefield missions, and shall be suitable for use in coordination with atomic weapons.

f. Anti-Airborne Mine Fields which shall be capable of crippling, disabling or destroying small water craft, amphibious vehicles and landing craft up to 100 tons gross displacement. Free floating mines shall be also provided which shall be suitable, additionally, for defeat of hostile river crossing boats including bridging. These mines shall be capable of aerial installation, and shall be equally suitable for interdiction of inland waterways in hostile rear areas.

g. Submarine and Beach Head Devices which shall include all types of so-called "dirty tricks" devices and highly portable demolition kits. These components of previously mentioned anti-railway mines shall be suitable for sabotage use with bulk explosives.

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h. Mechanical Mine Laying which shall be capable of rapidly laying conventional or specially developed antitank and antipersonnel mines.

1. Mine Detection which shall be capable of reliable detection of metallic and nonmetallic mine buried under up to 3 feet of earth cover or up to 4 feet under water without excessive false indications. Facile disclosure of subsurface objects is ultimately required. Capability of incorporation in an effective integrated detection-eradication system is ultimately required.

1. Mine Clearing equipment shall be provided for three separate clearing requirements:

(1) Assault Breaching which shall be capable of rapid assault clearing as follows:

Depth:	1/2 inches
Width of Cleared Lane:	
Infantry:	2 feet
Vehicles:	12 feet
Trucks:	20 feet

(2) Route Clearing which shall be capable of rapid sustained clearing of relatively scattered mines along a route of march as opposed to assault breaching of numerous mines in a dense mine field.

(3) Area Clearing which shall be capable of complete operations of post war clearance of extensive mine fields.

1. Individual Mine Protection which shall provide protection against accidental mine activation for individuals engaged in dismounted manual clearing operations.

1. Assault Gap Marking which shall provide an offensive means of rapidly marking gaps made by mechanical mine field breaching devices in order to permit immediate use by following combat vehicles.

1. Control of Mine Fields to permit reliable remote selective arming, disarming and possibly firing of individual mines within friendly mine fields.

4. AVAILABILITY OF MATERIAL. The material to be available for the implementation of the foregoing tactical concepts can be examined in three general phases with respect to time:

Current
Short Range
Long Range

Up to June 52
July 52 - 1954
After 1954

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In general current material is existing standard equipment or new equipment now undergoing joint engineering-service test; short range material will be provided from other new equipment, currently under active development and reasonably certain to become available during the short term phase with the present equipment; and long range material will be provided from development of intermediate and short range material in ultimate form and from provision of equipment previously impossible of development pending technological advances.

a. Current Material. The mine warfare material presently or soon to be available for proposed tactical employment is:

(1) For Permanent Defensive Mine Fields:

(a) Antitank Mines:

1. M6, M7, and T27

11. UK M7 with breachproof Type "C" fuse or counters

(b) Antipersonnel Mines:

1. M3, M14, and T6

11. US Pressure Fuse M1A1 can be used to improve Schurzen type antipersonnel mines.

111. UK AP Mine No. 6 "STICK" mine.

(c) US Trip Flare M49

(2) For Temporary Security Mine Fields all of which mines must be used unburied, because of lack of self-sterilization and means of rapid buried emplacement during the current phase and are restricted to antitank types and flares only:

(a) Antitank Mines:

1. M7, M6, and T27

11. UK M7 with No. 4 or Type "C" fuses. (Note: No. 4 fuse is a simple pressure type.)

(b) US Trip Flare M49

(3) For Interdiction Mine Fields:

(a) Antitank Mines:

1. M6, and T27

11. UK M7 with Type "C" fuse or counters.

(b) Antipersonnel Mines:

1. M14, and T6

11. UK AP Mine No. 6 "Stick" mine

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(4) For Intelligence Mine Fields: Same as for Defensive Mine Fields less M3 Trip Mine 197, plus M5 "Butterfly" Bomb.

(5) For Offensive Mine Fields: Material available or to become available during the current phase probably will not be satisfactory for the installation of offensive mine fields, with the possible exception of the "Butterfly" Bomb.

(6) For Antiairship Mine Fields: The material available or to become available during the current phase will probably not be satisfactory for the installation of antiairship mine fields.

(7) For Sabotage and Booby Trap Devices: Standard pull, pressure, rel. seef pressure and release of tension firing devices.

(8) For Mechanical Mine Laying:

- (a) Tractor Attachment for shallow burial shaped charges mine, T28.
- (b) Skip Plow for digging holes only.
- (c) Continuously planting plow for conventional AT mine.

(9) For Mine Detection:

- (a) SCR 625 Metallic Detector
- (b) AN/PKS-3 Metallic Detector
- (c) AN/PRL-4 Metallic and Nonmetallic Detector
- (d) AN/VRS-2 Yeouliar Mounted Detector

(10) For Mine Clearing:

(a) Assault Breaching:

- 1. M3 Snake
- 11. World War II Plail
- 111. T1E8 Roller

(b) Route Clearing: T1E8 Roller

(c) Area Clearing: No method for area clearance other than detection and individual manual removal of mines or possible use of the T1E8 mine clearing roller are available during the current phase.

(11) Individual Mine Protection: No satisfactory protective equipment will be available during the current phase.

(12) For Assault Camouflage Marking: No material other than standard markers which must be placed by dismounted marking personnel is available for use during the current phase.

(13) For Remote Control of Mine Fields: Radio Sets AN/TRT-1 and AN/TRT-2 are available but unsuitable because of limited armed life of the receivers and susceptibility to hostile countermeasures.

b. Short Range Material. The mine warfare material required for short range use is:

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(1) For Defensive Mine Fields:

(a) Antitank Mines:

i. T16, T20, T23 (Shaped Charge for mechanical laying), T24 (shaped charge for deep burial), T25 (Shaped charge multijet), T26 (altern. 2. for T23) and Plate Charge Mine.

ii. Aerial anti-tank mines for reinforcement of ground installed fields.

iii. UK MK7 with Type "C" fuse or counters.

(b) Antipersonnel Mines:

i. M14, T6, and US unfindable AP mine.

ii. Aerial antipersonnel mines.

iii. UK shaped charge AP mine.

(c) Improved Flare.

(2) For Temporary Security Mine Fields:

(a) Antitank Mines:

i. T16 and T26.

ii. UK MK7 with No. 4 or Type "C" fuses

(b) Antipersonnel Mines: US anti-infiltration mine with self-sterilization.

(c) Improved Flare.

(3) For Interdiction Mine Fields:

(a) Antitank Mines:

i. T20, T23, and T24

ii. UK MK7 with Type "C" fuse or counter

(b) Antipersonnel Mines: MK7, T6, US unfindable AP mine and US anti-infiltration mine without sterilization, "Dingbat", and UK shaped charge AP mine.

(c) Improved US Flare.

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(4) For Defensive Mine Fields: Same as for Defensive Mine fields, land mine.

(5) For Offensive Mine Fields: Aerial antitank and antipersonnel mines.

(6) For Antitank Amphibious Mine Fields: Ground installed free floating and ground mines.

(7) For Sabotage and Roadby Trap Devices: No development has yet been proposed, except provision of antirailway mine fuses for railroad sabotage.

(8) For Mechanical Mine Laying:

(a) Continuously planting plow for conventional AT Mines.

(b) Improved mine layer for shaped charge mines.

(9) For Mine Detection:

(a) AN/PSS-4 Metallic and Nonmetallic detector

(b) AN/PSS-5 Metallic gradiometer type detector

(c) AN/VMS-2 24 volt vehicular mounted detector

(d) AN/VMS-3 12 volt vehicular mounted detector

(e) Tank mounted mine detector.

(10) For Mine Clearing:

(a) Assault Breaching:

i. H. Shocks

ii. Projected Line Charge

iii. Undercutting Flail (Rotary Hoe)

iv. Mine Clearing Plow

v. Jet Mine Clearing Device

(b) Route Clearing: TRES Roller.

(c) Area Clearing: No development has yet been proposed.

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(11) For Individual Mine Protection: No development has yet been projected.

(12) For Assault Gun Position: No active development has yet been initiated. The Rocket driven mine may prove suitable.

(13) For Remote Control of Mine Fields: The necessary technological advances have not been forgotten for this period.

c. Long Range Policy. Short range material will continue to be required with the following additional material to be made available:

(1) For Deliberate Defensive Mine Fields:

(a) Antitank mine both aerially and ground installed of increased lethality to include principles other than explosive and incorporating self-sterilization and counters.

(b) Antipersonnel mines both ground and aerially installed of increased effectivity need to include principles other than explosives and incorporating selective self-sterilization.

(3. (2) For Temporary Security Mine Fields: Self-burying and self-sterilizing antitank mines and sensitive explosives suitable for antipersonnel and antitank use without fuses or caps and incorporating self-sterilization and improved warning devices.

(3) For Interdiction Mine Fields: Same as for Defensive Mine Fields.

(4) For Guidance Mine Fields: Same as for Defensive Mine Fields but to include aerially installed sensitive explosives and with no requirement for self-sterilization.

(5) For Offensive Mine Fields: In addition to requirements for anti-tank and antipersonnel mines, one exists for reliable delayed timing and remote control.

(6) For Antiaircraft Mine Fields: Aerially installed free falling mines are required.

(7) For Sabotage and Sandb Traps Mines: A variety of devices for employment by sabotage and command forces are required.

(8) For Beach (Line) Mine Laying:

(a) Devices for automatic laying of antitank and antipersonnel mines are required and a means of rapid emplacement of mines in land surfaced, and bays.

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(a) Assault Breaching: Improved methods for breaching of armor and installation.

(b) For Mine Detection: Portable detection and integrated detection-communication systems are required.

(c) For Mine Clearance

(a) Assault Breaching: Improved mechanical methods for breaching.

(b) Route Clearance: Improved methods to include the tank-mounted detector-amplifier are required.

(c) Area Clearance: Systems for mine area neutralization or induced self-destruction are required.

(11) For Individual Mine Protection: Equipment which shall provide protection against accidental mine activation for individuals engaged in dismounted manual clearing operations is required.

(12) For Assault Bay Marking: Marking devices integral with breaching devices are required.

(13) For Remote Control of Mine Fields: Reliable remote control systems for arming and disarming of individual mines are required.

5. STATUS OF PROJECTS. Development projects for material to implement the tactical concepts outlined in paragraph 3 above fall into three categories: those active, guided by approved military characteristics; those projects not yet initiated, but for which characteristics have been proposed; and those for which satisfactory military characteristics have not yet been proposed. Approved and proposed military characteristics for mine warfare material are specified hereto in Annex 2.

Active Projects Guided by Approved Military Characteristics. These projects include the following:

(1) Mine, AT, RM, T18 & Disc, RM, T1202.

(2) Mine, G.P., RM, T20, & Disc, RM, T1205.

(3) Family of Chemically Filled AT Mines (Project active for feasibility study only).

(4) Family of Shaped Charge Mines

(5) Influence Mines for Antitank Mines

(6) Contact Fused Cable of Tank and Infantry Attack

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- (7) Mechanical Mine Layer ("Little Joe") (For shaped charge mines)
- (8) Mechanical Mine Layer ("Little Abner") (For conventional antitank mines).
- (9) Projected Line Charge.
- (10) Tank Mounted Mine Detector and Ejector ("Dixon")
- (11) Equipment for Assault Passage of Enemy Mine fields ("Rapid Razer").
- (12) Mine Clearing Device, Jet Type.

b. Proposed Military Characteristics for Which No Projects Have Been Initiated.

- (1) Aerial Antitank Mines (Air Force Projects are underway)
- (2) Aerial Antipersonnel Mines (Air Force Projects are underway)
- (3) Family of Ground Burst Antipersonnel Mines
- (4) Sensitive Explosives Employed as Mines
- (5) Air-Delivered Mine Distributors
- (6) Antiamphibious Mines
- (7) Antirailway Mines (Air Force Project may be underway)
- (8) Mine field Warning Flares
- (9) Assault Gap Marking Equipment

c. Material for Which No Satisfactory Military Characteristics Have Been Proposed.

- (1) Necessary training or practice versions of mine material.
- (2) Effective Booby Trap Mechanisms (and "Dirty Trick Devices").
- (3) Antipersonnel Mines.
- (4) System for Remote Control of Mines.
- (5) Mechanical Mine Layer for Antipersonnel Mines.
- (6) Protective Device for Individuals Engaged in Mine Clearing Operations.

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6. EXAMINATION OF REQUIREMENTS AND REVIEW OF MILITARY CHARACTERISTICS
The military characteristics listed in paragraph 5 above should be examined to determine whether or not they adequately prescribe equipment to meet actual requirements. If additional requirements to those expressed by the Army Equipment Development Guide or to those necessary to implement an effective mine warfare doctrine are disclosed, suitable military characteristics for material to meet such new requirements must be prepared. The requirements for the following developments are the most questionable and warrant the most careful examination and evaluation:

- a. Family of Chemically Filled Mines
- b. Mechanical Mine Layers
- c. Projected Line Charge
- d. Aerial Mines
- e. Air-delivered Mine Distributors
- f. Antirailway Mines
- g. Antiairborne Mines
- h. Protective Devices for Individuals Engaged in Mine Clearing Operations.

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SUBJECT: Presentation made to the Mine Warfare Panel, 12 February 1952 at Fort Belvoir, Virginia; title "Current Studies on Mine Warfare at QRO."

TO: Colonel Warren M. Underwood, GS
Chairman
Mine Warfare Panel
Fort Belvoir, Virginia

FROM: James V. Johnson
Chairman, Project ARMOR, QRO

INTRODUCTION: It is believed that the following purposes will be served by this presentation: To acquaint the Panel with written material now available bearing on the subject of the conference, and to suggest how best QRO may assist the conference in its deliberations.

QRO is an advisory agency only. Its studies are directed at assisting the Army in making decisions, doctrinal and on research and development. It also acts as a catalyst to encourage changes in Army tactical procedures when these appear to be advantageous militarily.

TECHNICAL MEMORANDUM, QRO-T-109, "Employment of Land Mines": This document, published in September, 1950 has been credited with providing the Army with reasons for reviewing its mine warfare program and capabilities, and for the increase in the allotment of Army funds to land mine warfare research and development. It was recently reevaluated by QRO and found to be essentially valid after a year and a half of testing. It may therefore be studied by the Panel for ideas and proof of doctrinal decisions.

The four points made in QRO-T-109 which are believed to be basic to all decisions in doctrine are:

- (1) The mine is a weapon (not an obstacle).
- (2) The mine, as a weapon, is part of a weapons system. (It follows that one is not seeking a one-weapon solution).
- (3) The mine has two direct functions: To damage or kill; and two indirect functions: To delay and canalize.
- (4) The employment of mines is a problem of tactics and strategy, to be determined by all the standard criteria in the estimate of the situation.

From the point of view of developing doctrine, Point (4) is the important one to remember. Anything which will limit the commander's decisions in the field will limit the effectiveness of mines in combat.

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The balance of this paper is directed at suggestions for assisting the commander in making the proper decisions.

THE FORT-TIME-COST RELATIONSHIPS: Consider that "Cost" is synonymous with "Effort". The introduction of land mines into the tactical problem is meant to increase the enemy effort, decrease his time advantage and increase his needs for reserves. At the same time, friendly force needs are reduced and time gained at the expense of the effort which goes into installing the field. The effort of installing is usually expended prior to the actual time of need and thus gives the friendly forces the advantage of effort "in the bank."

METHODS OF ASSISTING IN THE DEVELOPMENT OF DOCTRINE:

(1) The use of probability calculations giving at least partial indications of the effectiveness of mine fields is suggested. It might be advantageous to provide the commander with such tables in the Field Manual. ORO-T-109 provides a little data. The work of the Applied Mathematics Panel during World War II may help. ORO expects to continue work along these lines. For example, attention is called to the ORO publication CAVUL-5-77 by Atkins and Munson, which evaluates the relative effectiveness of fragmentation bombs and anti-personnel mines. (This document does not receive regular distribution, but could be made available to the Panel at the Panel's request).

(2) The use of exchange rate data may assist. Data is available in ORO-T-109 and in ORO-S-85 for World War II, and in ORO-R-1 (JEC) for Korea. It is evident that the general tactical situation plays a part as well as the nature of the terrain and the type of mines used and their employment. These exchange rate studies can give the commander an idea of what he may expect in a payoff under given circumstances.

(3) Game theory is a new analytical tool which may be valuable in determining the best methods to be used in mine warfare. ORO is attempting to establish the possibilities. However, ORO is reluctant to say at this time what the profit is likely to be.

HISTORICAL EXCHANGE RATES: In connection with (2) above, data on World War II and Korea was given. Also the pattern of average effectiveness has been evaluated. (Refer to documents mentioned above.) In World War II, on the average, 2000 mines accounted for each tank casualty, of which 50% were losses. In Korea, due in part to the terrain and the random use (rather than the pattern use) of mines, 80 to 100 mines are used by the North Koreans accounted for one US-UK casualty. Losses varied from 26% when the US-UK team was moving forward; in retreat, losses rose to 50% at times. It is interesting to note that the pattern of effectiveness of mines can be broken down rather well. In conditions of "normal contact" between two weapons

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systems which are reasonably similar (normal contact meaning minor give and take in territorial acquisition) mines caused 10-15% of the casualties due to weapons. Tanks attacking fortified positions experienced 30-40% casualties due to mines. When tanks move forward successfully, but rather slowly, 20% casualties due to mines have occurred rather persistently. When the exploitation is rapid, however, mines become less of a problem causing about 5% casualties. The average effect of US mines on German Tank activity was reported by General Guderian as being about 5% casualties.

NOTES ON KOREA: See ORO-R-1 (TFC), "Employment of Armor in Korea." It is suggested that the methods used by the North Koreans and Chinese may be studied to advantage as a reflection of Russian methods - on a limited basis, of course. Up to October 1951, US tank casualties numbered 355, with about 20% losses. (The losses have been reduced due to recovery of vehicles abandoned, sometimes many months previously.) These represent about 60% of all casualties due to weapons.

TRAINING IN MINE WARFARE: ORO observed the mine warfare activities at Exercise SOUTHERN PINE. (See ORO-T-122). It was concluded that the troops were poorly prepared either to use mines effectively against an enemy; and, as poorly prepared to deal with enemy mine warfare, especially important for troops other than engineers. It is believed that measures taken to correct this training problem would be quite worthwhile.

INSTALLATION OF MINES BY EARTH AUGERS: Mechanical installation of mines, especially those laid at more than 2-4 inches below the surface, has been the subject for considerable discussion and research and development. ORO tests in Korea may be of some interest. The K-44 and V-18 standard engineer equipment was used to advantage. The data can be seen in ORO-R-1 (TFC). The earth auger is indicated as being of interim value as a substitute for the more complicated methods contemplated; and may remain useful even though a more complex mechanical mine installation device is built.

AIRPHOTO DETECTION AND COUNTER-DETECTION MEASURES APPLIED TO MINE FIELDS: ORO conducted tests in the US (and in Korea) to determine the detectability of mines and mine fields by air photography. The results will bear on tactical doctrine and provides evidence with respect to means of camouflage. (See ORO-T-120, a document now being reproduced and will be made available to the Panel as soon as it is completed). The detectability problem is not alone that of photo-interpretation. In general, given an optimum altitude from which pictures are taken, and given good cameras and film, the results will indicate strongly the degree of detectability from the ground where the angle of sight is less than vertical; with respect to the kind of terrain and the effectiveness of the camouflage methods employed.

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Briefly the results are as follows: Detection first rests on the evidence of disturbed soils. This is due to change in moisture content of the soils which show up as "spots". Detectability also rests on association such as changes in the "tone" of the soil, crop differences, changes in natural vegetation, patterns of "spots" and "spots" in places of military significance. Detection also rests on the training and ability of the interpreter of the photograph and the quality of the film and camera.

Other factors are the care shown in replacing the soil, tarping it and cleanup of debris. Vegetative cover such as forests, orchards and various crops affect detectability. Shadows, cultural differences as in the size of fields play a part. And finally, and basically, clay soils offer the best types in which to lay mines successfully; silty soils are more difficult to work in; and sands are the most difficult. Note that trafficability for cross-country vehicles is most difficult in clays, and least difficult in sandy soils - in general. Tracks of vehicles are quite persistent, especially when viewed from the air.

To summarize: Given careful camouflage methods, detectability is low to impossible in clays, less difficult in silty soils, and fair to good in sands. Patterns of three or more mines increase detectability because of the association factor, therefore degrees of randomness are indicated. Vehicle tracks persist and positive camouflage (confusing the picture with many tracks) may frequently be necessary. Airphoto reconnaissance to detect mines and fields is worthwhile if the proper methods are used. But random fields installed by conscientious individuals will go a long way toward defeating this kind of detection.

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Presentation by Col. W. S. Triplett, GSC., made to the Hines Warfare Panel at Fort Belvoir, Virginia, on 10 February 1952.

COORDINATION AND SUPERVISION OF THE RESEARCH AND DEVELOPMENT PROGRAM

(Charts not attached)

Gentlemen:

Had I been called upon to discuss the coordination and supervision of the Army research and development program about 30 days ago, I would have been more able to do so than I am today.

A reorganization of this activity was effected on 15 January and, at the moment, the organization thereof is firm but the over-all plan of operation is in a flexible state.

I will present, however, the manner in which the program is intended to operate.

Significant changes may yet be introduced into this plan by the newly created office of Research and Development at Army Chief of Staff level.

Before I present the new organization, I will give a little of the historical background of the Research and Development organization.

Research and development activities have been an inherent portion of the technical service organization since their inception.

It was not until World War II, however, that an office was established at Army level which would lend more prestige to the Research and Development function.

This function grew from a very minor program, administered by Supply Division, G-4 of the General Staff prior to the war, to the major program it now represents and which involves the expenditure of many billions of dollars per year at the present time.

War-time operations and shortage of personnel prohibited any major organizational changes to be effected, and it was not until the close of World War II that it was possible to give much thought to the eventual form that the Research and Development organization was to take.

Based upon the recommendations of scientists and other people concerned with the research and development program, Research and Development was established as a separate General Staff Division in May 1946.

This office was created for a period of 18 months. During this short period, however, considerable progress was made in establishing a sound research and development program for the Army.

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During this period, and in consonance with the desires of the Chief of Staff to reduce the General Staff Divisions to a minimum, the Research and Development function again reverted to the same relative position on the organization chart from which it came.

It was merged with Service, Supply and Procurement Division in December 1947, which later became G-6, Army General Staff.

During the intervening period, Naval Research continued as a separate entity and, with the advent of the United States Air Force as a separate service, Air Force Research and Development was established under a Deputy Chief of Staff for Research and Development as a separate staff division. The relatively low position of Army research and development then became obvious. In order that our program might enjoy the prestige comparable to that given the Navy and Air Force programs, the Chief of Staff directed a reorganization to place the Research and Development Program Director at a level commensurate with the stature and importance of the present program.

The organization which was instituted on 15 January, and under which we now operate, is the resultant of that directive. In order that you may visualize the new organization, I have prepared an organization chart to explain the various segments and responsibilities of each of those segments.

(CHART #2, 1)

From the Chart, it may be seen that the Deputy Chief of Staff for Plans has taken on a new responsibility - that of research and development and, to implement this responsibility, a newly created office of the Chief of Research and Development has been established.

This office will concern itself more with the planning aspects of the program rather than the actual development work required to implement the plan. The basic factors which determine the research and development program are two - i.e., (1) strategic guidance emanating from the Joint Chiefs which forms the basis for the selection of the weapons and equipment which we must have to defeat our potential enemies, and (2) the funds furnished for the development of the required weapons and equipment.

The Chief of Research and Development is responsible that the research and development activities of the Army are in consonance with the missions assigned to the Army by the Joint Chiefs, the war plans, and latest tactical doctrine as formulated by G-3. He is also responsible that the program is pointed toward development of better methods, techniques and material for the accomplishment of the Army's mission. With respect to funding, the Chief of Research and Development is the Chairman of the R&D Budget Review Board. This board is comprised of general officer representatives of G-1, G-2, G-3, G-4, and Army Field Forces. The initial formulation of the annual research and development budgets made by this group. Estimates submitted by each Technical Service are carefully screened - first, to deter-

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first, the established requirement for the proposed developments; second, to determine whether proposed funding is correct for producing the required equipment in sufficient numbers and at the proper time; and third, to determine the priority of funding to assure development of the most critical equipment. In addition, the Chief of Research and Development sits on the Research and Development Board as the Army Military Member and represents the Army in its principal intra and extra-governmental relations with respect to research and development. The operational phases of research and development are delegated to the staff agencies which are assigned major program segments.

I as General Staff Agency and the Chief of Psychological Warfare has been assigned specific research and development responsibilities. I will touch lightly on G-1, G-2, and Psychological Warfare research and development activities, but will be more specific with reference to G-3 and G-4, as these latter two agencies are concerned with the major part of the program and particularly with that portion which affects your activities.

G-1 is responsible for that portion of the research and development program concerned with human resources, morale and training equipment; G-2 concerns himself with security equipment for use by Counter Intelligence Corps, Criminal Investigation Detachment, and The Army Security Agency; and the Chief of Psychological Warfare for the equipment required to carry on the responsibilities of his office. Some of these agencies actually perform research and developmental work. Their activities are such that requirements are developed by outside contracts or by delegation, through G-4, to one of the Technical Services for necessary developmental work. The research and development activities within these segments of the research and development program are either by comparison.

(CHART NO. 2)

This Chart represents the organization of the Research and Development Division of G-4. The Chief of G-4 Research and Development serves two hats, that of Deputy Assistant Chief of Staff for Research and Development and Chief, Research and Development Division, G-4. (See 11b - Explanation of Chart) (Will mention the various branches)

G-3 and G-4 are the two agencies which are concerned with the major segments of the research and development program. The activities of these two agencies can be illustrated best by following an item of equipment from its inception to the point where it is ready for issue to troops. This play-by-play description will explain what coordination and supervision of the research and development program is effected at the working level. I need the term "working level" vividly, realizing that staff is included therein but willing, i.e., that for some time, staff has been a "working" agency in fact. Since you are primarily interested in the development of mine warfare material, I will discuss in detail only the procedure for coordination of research and development of material required for use by elements of the field army. The coordination of material required for use by the other agencies of the Army differs in some respects.

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The development of an item of material is based upon a statement of military characteristics. The basic purpose of such a statement is to define the capabilities that the item should possess; in other words, to define in broad terms what is wanted, not how the result is to be obtained. Although our regulations permit for person or unit in the Army to initiate military characteristics, in practice these are generally initiated by the using agency -- by Army Field Forces in the case of equipment for use by the Field Army, generally on the basis of a study conducted by one of the Army Field Forces Boards. If the proposed item has more than one potential using agency, the statement of military characteristics is coordinated among all of the users to insure that the interests of all are protected. As each user seeks to protect his interest and include his own ideas, the military characteristics tend to grow in length, with a consequent restriction of the latitude available to the ultimate developing agency. Considerable effort is required to keep to the front the idea that the military characteristics should be as broad as possible and still delineate the item so that it meets the needs of the user.

A cardinal point to be considered at this stage of the development process is the question of whether the item planned for development is actually required. Although the potential user is in the best position to evaluate the need for a specific item, there is available an Army Equipment Development Guide which is essentially the report of the Army Equipment Board headed by General Hodge. This document reviews the overall considerations affecting Army equipment and states the specific qualitative requirements for principal items of equipment and supplies for which the Army does not now have acceptable models. It is a valuable reference for all agencies regarding what equipment is required and which of these requirements are the most urgent.

Assuming now that the military characteristics for our proposed item have been prepared by Army Field Forces, coordinated with other using agencies and with the proposed developing agency, and assuming that all agencies are in agreement, they are submitted to the General Staff.

(CHART NO. 1)

As I mentioned previously, the principal General Staff agencies concerned with the development process are G-3 and G-4. G-3 is concerned with evaluating the validity of the requirement and with monitoring of the item until such time as the military characteristics are approved. G-4 coordinates the actual development of the item, the funding, and the timing relative to other items until such time as a service test model is produced.

The final service test is then requested by G-3, who determines whether the original requirement has been met and who establishes the basis of issue.

(CHART NO. 2)

Initially then, the military characteristics are received by G-3 who determines whether the item is justified in terms of improved effectiveness

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over an older item, or is needed to fill an existing gap in our equipment. In the case of completely new major items of equipment or major modifications -- items important either from the standpoint of the high cost of a single item, or, like new uniforms, a high total cost because of the large number of items eventually to be procured -- the military characteristics are reviewed by the Materiel Requirements Review Panel.

This panel, consisting of general officer representatives of G-1, G-4, the Comptroller, and Army Field Forces, evaluates the need for the item, consumption of critical materials in production, potential impact on the productive capacity of the nation, the probable cost in production as compared to substitute items, and the possibility of using substitute items. If the Materiel Requirements Review Panel finds that development of the item is essential, staff control over the development passes to G-4, where it remains until such time as a service test model is produced. Having received the approved military characteristics, G-4 determines the appropriate developing agency. In the case of items for which other departments of the Department of Defense have research and development responsibility, the military characteristics are submitted to the appropriate Department as an Army requirement, together with a recommended priority for the prosecution of the work. More usual is the case where the development is accomplished within the Army, in which event the requirement is transmitted to the appropriate Technical Service for action by the technical committee. Each Technical Service maintains a technical committee to handle coordination among the developing and using agencies during research, development, test, and type classification of materiel. This committee consists of members from the parent Service, other developing agencies, the using agencies, the other Departments of the Department of Defense, and the General Staff. The military characteristics of our proposed item are reviewed by the technical committee from the standpoint of technical adequacy and possible duplication of the work being done by other agencies, and if approved, by all agencies represented, a formal project to develop the item of equipment is established. Approval of the project by the technical committee and by the General Staff representative constitutes final approval of the project, and is the authority for the developing agency to undertake the work. During the development phase, the progress of development, the funding, the relative priority of the work, and the timing of development to produce items when needed, are coordinated by G-4. Important actions relating to changes in the military characteristics and procurement of service test models are processed through the technical committee, in order that all parties may be aware of the changes in the status of development.

In addition, continuous liaison is maintained between the developing and the using agency to assure that development is proceeding along lines satisfactory to all. Having completed the design of an item expected to fulfill the military characteristics, the developing agency procures an engineering test model. This model is occasionally a complete item of equipment. Frequently it is but a rudimentary device, only complete enough to permit the determination of necessary engineering data and characteristics,

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and to aid in the military characteristics can be met by the design. This test model is then subjected to engineering tests by the developing agency to determine the technical adequacy. If engineering tests are satisfactory, two or three complete service test models are procured for test by the using agency. Service tests are then conducted by the user to determine if the item meets the requirements.

For this service test phase, staff mentorship of the item passes to G-5, who reviews the results of the service tests, determines if the item meets the requirements established, and establishes the basis of issue. If the item is satisfactory, the necessary classification papers are prepared for action by the technical committee, and the item is classified as a standard type. G-5 retains responsibility for the mentorship of the adopted item. This classification ends research and development activity, and the item enters the supply system.

If the item is found to be unsatisfactory, it is returned to G-4 for modification. There are, in the case of some items, variations in the above procedure, depending on a number of factors. In the case of items urgently needed, combined engineering and service tests are sometimes held, and in some cases, production is telescoped into the test phase.

In the case of other equipment, where a basis of issue cannot be adequately established by testing a limited number of items, sufficient equipment may be procured for a unit troop test.

At the present time, a considerable number of items are being service tested in Korea, since, of course, no test like combat for combat equipment.

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