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ASSISTANCE IN MINE CLEARANCE

Letter dated 7 October 1996 from the Permanent Representative of Denmark to the United Nations addressed to the Secretary-General

The International Conference on Mine Clearance Technology, held in Denmark from 2 to 4 July 1996, resulted in useful and practical recommendations that will provide the international community with the necessary guidelines for international mine clearance activities in the future (see the enclosed report of the Conference).

Denmark considers it to be of vital importance that this work is continued, and, with the cooperation of the Department of Humanitarian Affairs of the United Nations Secretariat, we are participating actively in the follow-up to the recommendations of the Conference. Denmark hopes that it will be possible early next year to finalize an international standard for humanitarian mine clearance.

Against this background, I respectfully request you to include the report as a document of the General Assembly, under agenda item 34, Assistance in mine clearance. It is my hope that a reference to this will be included in a resolution on assistance in mine clearance adopted by the General Assembly at its fifty-first session.

(Signed) Benny KIMBERG
Ambassador
Permanent Representative of Denmark
to the United Nations

ANNEX

Report of the International Conference on Mine Clearance Technology, held at Elsinore, Denmark, from 2 to 4 July 1996

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Abbreviations

AT	anti-tank
APERS	anti-personnel
EOD	Explosive ordnance disposal
GFR	Ground penetrating radar
GPS	Global positioning system
IED	Improvised explosive devices
IR	Infra-red
MEDDS	Mechem explosive and drug detection systems
MPV	Mine protected vehicles
RDX	Rapid demolition explosives
SFF	Self-forming fragment
SOP	Standard operating procedures
UXO	Unexploded ordnance

I. ORGANIZATION OF THE WORK OF THE INTERNATIONAL CONFERENCE ON MINE CLEARANCE TECHNOLOGY

A. Introduction

1. As a follow-up to the International Meeting on Mine Clearance convened by the Secretary-General of the United Nations at Geneva from 5 to 7 July 1995 pursuant to General Assembly resolution 49/215 of 23 December 1994, the Government of Denmark convened an International Conference on Mine Clearance Technology, with the support and cooperation of the United Nations Department of Humanitarian Affairs. The Conference was held at the Scanticon Conference Centre in Elsinore, near Copenhagen, from 2 to 4 July 1996.

2. The purpose of the Conference was to examine ways for improving mine clearance technology for mine-affected developing countries and to elaborate standards for the various aspects of mine clearance operations. The Conference was to focus on technology development and was not intended to address political, economic, social or other non-technological aspects of mine clearance.

3. Participants were also invited to attend an exhibition on current technology in mine clearance.

B. Opening of the Conference

4. The Conference was opened on 2 July 1996 by the Minister for Development Cooperation of Denmark, His Excellency Mr. Poul Nielson, who also served as President. For the opening statement of the President see annex I.

5. Also at the opening of the Conference, the Under-Secretary-General for Humanitarian Affairs, Mr. Yasushi Akashi, delivered a message from the Secretary-General of the United Nations (see annex II) and addressed the Conference (see annex III).

C. Attendance

6. The following States were represented at the Conference:

Afghanistan	Angola	Argentina
Australia	Austria	Bangladesh
Belgium	Bosnia and Herzegovina	Cambodia
Canada	Croatia	Czech Republic
Denmark	Egypt	Eritrea
Ethiopia	Finland	France
Germany	India	Indonesia
Ireland	Israel	Italy
Japan	Jordan	Lao People's Democratic Republic

Libyan Arab Jamahiriya	Mozambique	Namibia
Netherlands	Nicaragua	Norway
Republic of Korea	Russian Federation	Rwanda
Saudi Arabia	Slovakia	South Africa
Spain	Sweden	Switzerland
United Kingdom of Great Britain and Northern Ireland	United States of America	Viet Nam
	Yemen	Yugoslavia
	Zimbabwe	

7. The following intergovernmental organizations were represented:
European Commission
International Committee of the Red Cross
International Federation of Red Cross and Red Crescent Societies
Organization of the Islamic Conference
Organization of American States (Inter-American Defence Board)

8. The following United Nations bodies and programmes were represented:
United Nations Secretariat:
Department of Humanitarian Affairs
Department of Peacekeeping Operations
United Nations Children's Fund
United Nations Development Programme

9. Representatives of the following United Nations Demining Programmes and national staff were also present:
Central Mine-Action Office, Unit for the Coordination of Humanitarian Assistance to Angola;
Mine Awareness Programme (INAROE), Luanda, Angola;
Laos National UXO Programme;
Accelerated Demining Programme in Mozambique;
United Nations Transitional Office for the Former Yugoslavia;
Mine Clearance Programme of the United Nations Office for the Coordination of Humanitarian Assistance to Afghanistan;
United Nations Coordinator in Iraq;
Cambodian Mine-Action Centre;
Mine-Action Centre, United Nations Mission in Bosnia and Herzegovina;
Agency for Protection from Mines, Bosnia and Herzegovina.

10. The following non-governmental organizations were also represented:
Cap Anamur;
Danish Centre for Human Rights;
Danish Demining and Development Associates;
Handicap International;

Menschen Gegen Minen;
Mine Advisory Group;
Norwegian People's Aid;
Onlien Overseas Denmark;
Operation USA;
Red Barnet;
StiftungSankt Barbara Foundation

D. Agenda and documentation

11. At the first plenary meeting, on 2 July, the International Conference on Mine Clearance Technology adopted the following provisional agenda:

1. Opening of the Conference.
2. Organization of the work of the Conference.
3. Presentation of present problems and challenges in mine clearance.
4. Distribution of papers for discussion by the working groups on standards and technology for humanitarian mine clearance operations as listed in items 5 and 6.
5. Standards for humanitarian mine clearance operations:
   (a) (i) Survey standards for mine clearance;
   (ii) Standards for mined area marking;
   (b) (i) Quality assurance for mine clearance operations;
   (ii) Standards for humanitarian mine clearance operations;
   (c) Safety standards for mine clearance operations;
   (d) Standards for medical support to mine clearance operations.
6. Technology for mine clearance operations:
   (a) Detection of "hard to find mines";
   (b) Application of sensor systems to mine survey;
   (c) Protective equipment for mine clearance personnel;
   (d) Mechanical mine clearance;
   (e) New approaches to mine detection.
7. Recommendations of the Working Groups on agenda items 5 and 6.
8. Closure of the Conference.

E. Organization of work

12. At the first plenary meeting, on 2 July, on the proposal of the President, the Conference decided to establish nine open-ended working groups to consider the papers prepared under items 5 (Standards for humanitarian mine clearance operations) and 6 (Technology for mine clearance operations).

13. Accordingly, the following working groups were established:

I. Survey Standards for Mine Clearance
II. Quality Assurance for Mine Clearance Operations
III. Safety Standards for Mine Clearance Operations
IV. Standards for Medical Support to Mine Clearance Operations
V. Detection of "hard to find mines"
VI. Application of Sensor Systems to Mine Survey
VII. Protective Equipment for Mine Clearance Personnel
VIII. Mechanical Mine Clearance
IX. New Approaches to Mine Detection

14. Copies of the papers prepared for discussion by the working groups are available from the Mine Clearance and Policy Unit, Department of Humanitarian Affairs.

F. Participants at the exhibition on mine clearance technology

15. The following commercial enterprises participated in the exhibition:
Guartel Ltd., United Kingdom;
Demira;
Lihregm, Sweden;
Reutech Defence Industries, South Africa;
Bofors Applied Technologies AB, Sweden;
Vallon GmbH, Germany;
Celsiustech Electronics AB, Sweden;
Ebinger Pruf-und Ortungstechnik GmbH;
Akers Krutbruk Protection AB, Sweden;
SISU Defence, Finland;
Uhregm, Sweden;
Miltra Engineering Ltd., United Kingdom;
Gebr. Vielhaben, Germany;
Foerster, Germany;
White's Electronics (UK) Ltd., United Kingdom

II. PRESENT PROBLEMS AND CHALLENGES IN MINE CLEARANCE

SUMMARY OF PRESENTATION

16. Mr. Håvard Bach of Norwegian People's Aid delivered the introductory presentation to the Conference.

17. There are various factors in demining today that present obstacles in mine clearance. In order to address the problems related to demining activities, it is necessary to examine how mines are normally laid. The most common way of using landmines is to lay protective minefields around cities, villages, military positions, advanced routes, technical installations and borders. While these protective minefields account for the majority of landmines laid, they do NOT constitute the primary threat for humanitarian programmes. It is the mines that are laid unmarked and seemingly at random that comprise the largest humanitarian problem in a post-conflict situation. Additional elements that have a negative impact on mine clearance are discussed below.

Vegetation and Soil Problems

18. Heavy vegetation is a common phenomenon in a minefield. Areas containing heavy vegetation, as well as trees and bushes, make manual demining a very slow and time-consuming process. To be able to prod or use mine detectors, the vegetation must be totally removed. Other than carefully cutting vegetation by hand, a common way of removing overgrowth is to burn it.

19. Unfortunately, landmines will normally not be destroyed by fire, but will rather become unstable. Therefore, vegetation constitutes a severe problem when demining is carried out manually. In many instances, the speed is reduced by more than 80 per cent compared with the demining of open land. Also, the demining becomes more dangerous for the people involved.

20. Soil conditions can be a significant impediment for deminers. When the metal content in the soil is too high, it interferes with metal detectors and reduces sensitivity. In many cases, the metallic content in the soil is too high to allow the safe use of metal detectors. Likewise, hard soil surfaces are a common problem which makes hand prodding difficult and often unsafe. This can be eradicated by sprinkling the surface soil with water before demining. If water is not easily accessible, excavation of the soil may be used instead of prodding.

Survey Obstacles

21. Before any demining can take place, implementation of a mine survey is of utmost importance. If we look at the area cleared and compare it with the area physically mined, there will normally be a significant difference. Very often 10 to 20 per cent of an assessed area turns out to contain mines. In order to improve this statistic, area reduction teams may be tasked to reduce the suspected area before the demining platoons are deployed. It often ends up, however,with the demining platoons demining the area they believe to be mined after investigation and a close inspection.

Demining Priorities

22. In order to describe the obstacles of operational problems in mine clearance, demining priorities are an important factor. It is common that, during the first two or three years of a demining operation, the highest priority is the support of other aid programmes. These missions require a demining operation to be implemented quickly and mobility is a key factor. Any demining method that cannot live up to these requirements is often unsuitable for "emergency demining".

DEMINING OPERATIONS

Manual Demining Methods

23. Manual demining is the slow and time-consuming demining of every square metre of the mine suspected area. The speed of clearance is NOT related to the number of mines found, but rather to the vegetation and soil problems. Use of demining platoons to reduce suspected mined areas yields limited results when only 10 to 20 per cent of the suspected areas turns out to be mined.

Mine Dogs

24. Dogs are currently used in demining operations due to their ability to recognize the odour of different chemical components. Dogs do not discriminate between mines with or without metal content because they are trained to smell explosives. Their use is less widespread than traditional methods of manual detection equipment due to the difficult process of training dogs and dog handlers. Dogs have proved to be most effective in areas with a low density of mines. In terms of minefield clearance, dogs are less efficient.

Mechanical Mine Clearance

25. The implementation of mechanical mine clearance will require high investment costs. The equipment itself is expensive, but also the cost related to the logistic support of a mechanical mine clearance operation is significant. Many of the mechanical mine clearance units available on the market have been designed for the military market, making the equipment very heavy and less mobile. Mechanical mine clearance equipment for humanitarian demining should be light weight, easy to maintain, easy to repair, and the price must be favourable.

CHALLENGES IN DEMINING

The Tool-box Concept

26. The biggest challenge we are facing in future demining, in reality, is clearance speed. Manual demining will continue to play an important role in every demining operation. Manual demining must be used in conjunction with other methods, however, to increase the speed of mine clearance. All demining methods have their clear limitations. Mechanical mine clearance can normally not be carried out on steep rises, road sides, wet areas, heavy vegetation or rocky terrain. Dogs are generally useless for minefield clearance and demining under windy conditions. Demining platoons are generally not suitable for area reduction and mine verification due to clearance speed. Also,

platoons are not suitable for tasks in areas with a high metal content in the soil. The solution lies in the design of a tool-box, whereby the different tools are used in joint action to meet the overall requirement for demining.

Where Are We Going

27. Survey work is certainly an important element in most demining operations and should be clearly prioritized in terms of development. The existing surveys carried out in many countries today are dependent on good and detailed maps, which are often scarce and inaccurate. If we could carry out a proper survey today, we could possibly eliminate up to 90 per cent of the suspected mined areas.

28. Plastic mines and metallized soil are clearly problems that can be alleviated with improvements of the detection equipment and should be given a priority.

29. One mechanical mine clearance unit can, under certain conditions, work faster than 1,000 deminers. This distinct advantage will probably make mechanical mine clearance cost effective despite the high initial cost of the equipment. Development is needed of smaller, mobile mechanical units that are easy to maintain.

30. Dogs have already proved to be useful as demining tools. In South Africa, they have found a solution to overworking the dogs by bringing the odour to the dogs instead which is collected on fibre filters. This eliminates several of the problems related to the traditional use of dogs. The method seems to be a good area reduction tool that should be a subject for greater attention.

CONCLUDING REMARKS

31. It is time to take the next professional step in evaluating the results of what is being done. Programmes should not be evaluated based on the number of people involved in the operation. For demining to move forward, the areas that are NOT mined must be located and released and those areas that are mined must be demined in the fastest possible method. To accomplish this, new techniques and methods must be developed and this requires the assistance of politicians, scientists and manufacturers.

III. STANDARDS FOR HUMANITARIAN MINE CLEARANCE OPERATIONS

INTRODUCTION

32. Four working groups considered the papers on standards for mine clearance operations. The recommendations constitute the framework for the elaboration of minimum standards with which Governments and the private sector can advance the safety, effectiveness and professionalism of demining operations throughout the world. In order to finalize the text for international standards for humanitarian mine clearance operations, a small representative working group will meet at the technical level to examine the ISO 9000 and its applicability to mine clearance. The working groups will be required to conclude their recommendations by the end of the year.

REPORT OF WORKING GROUP I

Survey Standards for Mine Clearance
Standards for Mined Area Marking

SUMMARY OF DISCUSSION

33. The Working Group reviewed the contents of the three papers presented to the Conference entitled "Survey Standards for Mine Clearance", "Standards for Mined Area Marking" and "Standards for Minefield Information Systems". The Working Group endorsed those three papers as providing a sound basis for establishing international standards in these areas of activity. The participants proposed and agreed upon the following modifications to the aforementioned papers.

SURVEY STANDARDS FOR MINE CLEARANCE

Country Assessment

34. Prior to beginning a mine survey, a country assessment must be undertaken to ascertain the political will and commitment of the host nation to address the mine/unexploded ordnance (UXO) issue. Establishment of a centralized mine action centre to coordinate all mine related information and activities is required as evidence of that commitment. The host nation must invest this organization with sufficient authority to secure cooperation from other government entities. This is critical to the survey process because it ensures access to information and freedom of movement. A strong host nation commitment is vital to ensure continuity of purpose throughout the survey and demining process.

Terminology

35. The working group identified three distinct levels of survey activity and recommended that

they be named as follows:

(a) Level One Survey. Should be renamed Level One : General Survey;

(b) Level Two Survey. Should be renamed Level Two : Technical Survey;

(c) Level Three Survey. Should be renamed Level Three : Clearance Record.

Level One: General Survey

36. The objective of Level One: General Survey is to collect information on the general locations of mined areas. Information must be collected about the locations of areas affected by Mines/-UXO and areas that are not affected by Mines/UXO. These areas must be categorized into HIGH RISK and LOW RISK areas. This is important for assessing the mine/UXO problem and enabling a Mine Clearance Programme to set priorities and allocate resources to address the mine problem in a systematic manner. The creation of an information gathering organization with the capability of collecting, collating, and analysing mine/UXO data both in the field and at a centralized mine database is vital to this process. A Level One: General Survey is a prerequisite for the planning of Level Two: Technical Survey activities.

Level Two: Technical Survey

37. The objective of Level Two: Technical Survey is to determine and mark the perimeter of mined areas located during the Level One: General Survey. The marked perimeter of the mined area becomes the start line for future mine clearance operations. Identification of an area within the marked perimeter as HIGH RISK requires that areas outside the marked perimeter are confirmed as LOW RISK. For that reason, the conduct of a Level Two: Technical Survey requires trained and equipped mine clearance technicians with survey skills to record accurately their work. Level Two: Technical Survey may involve reducing the area previously suspected of containing mines by use of dogs, probing, or other means.

Level Three: Clearance Record

38. The objective of Level Three: Clearance Record is to provide an accurate and permanent record of mine clearance activities. A Level Three: Clearance Record should be undertaken following all mine clearance tasks either completed or partially completed.

Information Categorization

39. Information must be categorized in a simple clear manner so that field operators and mine database personnel can assess its value and reliability for Level Two: Technical Survey or clearance operations. Information collected should be categorized by both value and reliability of source.

Logistic Support

40. Training and Equipment. Survey teams must be trained and equipped to a level at which

they can safely conduct survey activities in the threatening environment that they are expected to encounter.

STANDARDS FOR MINED AREA MARKING

41. Purpose. The purpose of mine marking is to create a visual demarcation of a mined area to warn people of the presence of danger. Mine Marking may also involve construction of a physical barrier to prevent people and livestock from accidentally entering a mined area.

42. Type of Mine Marking. There are three types of Mine Marking differentiated by the primary function which the marking is intended to perform:

(a) Warning Mine Marking. The intention is to provide an immediate warning of a HIGH RISK area. This type of marking should be highly visible and clearly indicate the direction of the HIGH RISK area.

(b) Visual Demarcation. The intention is to establish a clear visual demarcation of the boundary of a mined area. This type of marking acts as a warning and can be utilized as a start line for mine clearance operations. In addition, specialized marking can be used within the mined area during clearance operations to indicate functional areas for operations and definitive boundaries between mined and cleared areas.

(c) Physical Barrier. The intention is to establish a physical barrier requiring humans or livestock to make an effort to enter the mined area. A physical barrier should also serve visually to demarcate the mined area boundary.

Levels of Mine Marking

43. The working group recommended the following changes in terminology:

(a) Emergency Marking. Emergency marking of suspected mined areas is intended to provide an immediate visual warning of the presence of mines. The type of marking should be a recognized mine symbol that clearly indicates danger (skull and cross bones). This type of marking would be utilized by persons involved in survey operations or selected local inhabitants of mine affected areas. Emergency marking should be clearly recognized from a distance of at least 50m and capable of enduring the elements for at least three to six months. Local innovations may be used when known and accepted by the local inhabitants.

(b) Temporary Marking. Temporary marking is used to demarcate visually a mined area boundary. This type of marking should use recognizable mine warning signs such as the skull and crossbones danger mine sign. The marking should be visible from a distance of at least 50m or from visual distance sign-to-sign in heavily vegetated or undulating ground. Mine signs should be placed convenient to the human eye approximately 1m to 1.25m above the ground to ensure that children and adults can clearly see the sign. Signs should be properly affixed to a picket or improvised material approved locally. Temporary marking must be monitored and maintained.

(c) Long Term. Long-term marking is for populated areas where it is not possible to

conduct demining operations in the immediate future. Long-term marking should be both a physical barrier to the movement of people and livestock and should provide a visual demarcation of the mined area boundary. Examples of long-term marking are chain-link fences with warning signs or steel pickets, barbed wire, and mine signs. Long-term marking must be monitored and maintained.

STANDARDS FOR MINED AREA INFORMATION SYSTEMS

44. Standard One - Categories of risk. All areas of a mine/UXO affected country or region are assigned one of two categories of risk - HIGH RISK or LOW RISK. No area is left "unknown". It is assumed that mines could be located anywhere. Therefore, all areas must be considered HIGH RISK until information indicates otherwise. A Level One: General Survey report; a Level Two: Technical Survey report; or a Level Three: Clearance Report is required in order to change the category of an area from HIGH RISK to LOW RISK. Areas can be identified as LOW RISK as a result of minefield survey activity or rendered LOW RISK by minefield clearance. An increase in area classified as LOW RISK represents a broader measurement of progress per unit time than either the number of mines destroyed or the amount of area cleared by deminers because it reflects work achieved by all activities related to humanitarian demining operations.

45. Standard Two - Categories of risk. Areas are classified as HIGH or LOW RISK with a degree of confidence corresponding to the level of minefield survey and minefield clearance activity that has been performed:

(a) Level 1 - High Risk. During a Level One: General Survey the team concludes that mines are present;
(b) Level 1 - Low Risk. During a Level One: General Survey the team concludes that mines are not present;
(c) Level 2 - High Risk. During a Level Two: Technical Survey the team concludes that they are inside the boundary of a mined area;
(d) Level 2 - Low Risk. During the Level Two: Technical Survey the team concludes that they are outside the boundary of a mined area;
(e) Level 3 - Low Risk. During the recording process it is established that the mined area has been cleared.

46. Areas previously considered LOW RISK can be reassigned to the HIGH RISK category in response to reports of mine incidents.

47. The working group participants acknowledged that a mined area database is a vital component of a mine action programme. Data should be stored in both document format and on computer. This applies to both text and map/graphic data. Acknowledging that different hardware/software solutions exist, the following minimum requirements were identified:

(a) Capable of producing (output):
    (i) Lists;
    (ii) Summary statistics;

(iii) Maps at a scale selected by the user;
(iv) Large format map overlays using transparent materials.

(b) Capable of analysis:
(i) Measuring areas;
(ii) Selection, viewing, and measurement of mined areas;
(iii) Using standard database queries (that is, priority, soil type, vegetation);
(iv) Selection, view, and measurement of mined areas;
(v) Using geographic based queries (that is, distance from a village, road, or slope class).

(c) Capable of displaying:
(i) Raster format images for air photos, site photos;
(ii) Vector graphic overlays of mined areas;
(iii) Text in host country language(s).

(d) Capable of precision map/graphic input, that is, Digitizing Table;

(e) Capable of safely storing data, that is, producing backup copies to prevent the loss of data.

RECOMMENDATIONS

48. The recommendations of Working Group I are as follows:

(1) That international standards be developed and applied for mine clearance surveys, mined area markings and mine information systems;
(2) That common terminology be developed;
(3) That host nation commitment be assured and country assessment be undertaken prior to a mine survey;
(4) That a centralised mine action centre be established;
(5) That "high risk" and "low risk" areas be identified;
(6) That trained and equipped mine clearance technicians conduct Level Two Technical Survey;
(7) That an accurate and permanent record of mine clearance activities be developed;
(8) That standards be established for information categorization;
(9) That common markings be developed for marking of a mined area;
(10) That common terminology be developed for the different levels of mine marking:
(11) That categories of risk be applied to all areas of a mine/UXO affected country;
(12) That mined area information systems be developed with minimum acceptable standards for outputs, analysis, display, precision and storage capability.

ACTION TAKEN BY THE CONFERENCE

49. The Conference endorsed the recommendations of the Working Group. The three papers presented to it on "Survey standards for mine clearance", "Standards for mine area marking" and "Standards for minefield information systems" were accepted with the modifications suggested.

REPORT OF WORKING GROUP II

Quality Assurance for Mine Clearance Operations
Standards for Humanitarian Mine Clearance Operations

INTRODUCTION

50. The paper on "Quality Assurance for Mine Clearance Operations" addressed the issue of how to establish quality assurance within the framework of a mine clearance programme. The paper provided basic definitions for quality control and quality assurance and proposed guidelines for achieving such a goal. The Working Group discussions focused on the quality assurance process as it would apply throughout the entire span of a mine clearance programme.

51. The paper on "Standards for Humanitarian Mine Clearance Operations" provided specific guidelines for standards applying to contractors, non-governmental organizations, and individuals engaged in demining activities. This paper lays the foundation for establishing standards pertaining to the overall operation of a humanitarian mine clearance programme.

52. The Working Group held a series of discussions on the factors concerning the standards to be aimed for in humanitarian mine clearance operations and quality assurance requirements as they pertain to mine clearance operations.

SUMMARY OF DISCUSSIONS

53. The Working Group addressed the issue of the humanitarian mine clearance standard of 99.6 per cent which was a major area of discussion. There was debate on how this figure could be interpreted, how effective it would be, and whether it could be used in mine clearance contracts. The working group decided the following:

(a) It was agreed that the 99.6 per cent humanitarian mine clearance standard should be viewed as an objective, that it was worthwhile to have an established standard figure, and that it should be retained;

(b) To clarify the meaning of the 99.6 per cent humanitarian mine clearance standard, the following statement was adopted:
"In a mine clearance operation, the area will be cleared of mines and UXO to a level or standard which is agreed by the host nation to be appropriate to the residual or planned use of the land, and which is achievable in terms of resources and time available. The Contractor must achieve AT LEAST 99.6 per cent of the agreed level or standard of mine clearance."

(c) This figure demonstrates an acceptable level of risk, appropriate to the use of the land cleared;

(d) This figure also becomes the accepted indicator of high operating and quality assurance standards;

(e) Individual demining mechanisms may not achieve the 99.6 per cent requirement, but the total system, both mechanical and manual, will achieve it.

54. In amplification, practical experience has shown that humanitarian clearance standards should be no less than 99.6 per cent of what is agreed as being reasonably achievable within the sum of technical, natural, political, and economic constraints of the component parts of the mine clearance activity.

55. The Working Group addressed the Standards Applying to the Individual, which were accepted with the following revisions:

(a) Local deminers. For all mine clearance personnel, the following minimum qualifications should be expected:
  (i) Trained in mine clearance to an acceptable standard; or
  (ii) Have at least one year of practical experience undertaking mine clearance for an acceptable contractor.

(b) Expatriate Deminers. For all mine clearance personnel, the following minimum qualifications should be expected:
  (i) Trained in mine clearance to an acceptable standard; and
  (ii) Have at least one year of practical experience undertaking mine clearance for an acceptable contractor.

56. The Working Group accepted the Standards Applying to the Contractor as presented in the paper with the additional statement included below:

The competent contractor will be able to provide proof of the matters set out below. The contractor will demonstrate:

(i) Competence of the personnel being used;
(ii) Provision of in-service training and in-country orientations;
(iii) Standard Operating Procedures (SOP) specifying the technical procedures to be used;
(iv) Written quality assurance policy;
(v) Written safety policy;
(vi) Insurance coverage for:
  a. Personal accident;
  b. Medical expenses;
  c. Third Party liability;
  d. Employer's liability.

57. The Working Group elected to accept specific standards from the other Working Groups (such as safety standards, medical standards etc.). These will be incorporated into the larger framework of the standards package for mine clearance operations.

58. The Working Group accepted the fundamental definition of quality control and quality assurance as:

(a) Quality Control - a system of inspection conducted just prior to when the customer receives the goods or services under commission;
(b) Quality Assurance - the system put in place to maximize quality at all stages of the work from beginning to end

59. According to the Working Group, quality assurance, rather than just quality control, is more appropriate to mine clearance. It was agreed that no single event achieves quality assurance. Rather it is a system of events which need to be considered as a whole.

60. The Working Group recommended that three levels of quality assurance be accepted, including the associated activities:

(a) Level I. There are two major components to this level. First, the contract must be precisely drafted, and secondly, the contractor must be carefully selected
  (i) Contract Drafting. It is to the benefit of the donor and contractor that both know exactly what is required. The minimum technical components of a contract should be:
    a. Location of the work to be done;
    b. Depth down to which clearance is to be undertaken;
    c. Timescale allowed;
    d. Performance milestones to be met;
    e. Minimum standards expected to be used by the contractor;
    f. Proof to be provided for:
      i. Competence of manpower;
      ii. Standard Operating Procedures;
      iii. Quality Assurance Policy;
      iv. Safety Policy;
      v. Insurance coverage.
    g. Reporting required during the task;
    h. Reporting required at the end of each separate task within the contract and at the end of the contract;
    i. Quality assurance procedures which the donor intends to implement.

(b) Level II. This comprises two possible components, both of which need not be used, but the assurance is greater if used together.
  (i) Monitoring. This involves the use of an independent observer to make judgements on the technical merit of the work on behalf of the donor. It is necessary to conduct a thorough assessment of all aspects of the work being undertaken. The monitor should be entirely independent and should not seek any contracting work within the humanitarian mine clearance field.
  (ii) Financial Retention. This is a principle employed widely in the construction industry. Typically, 5 per cent of the total contract value is retained by the client for a six-month period upon completion. At the end of six-months, if the client is satisfied, then the funds are released. This is a legitimate quality assurance procedure and it can play an important part in the total process.

(c) Level III. There are two ways this can be approached. The first is a simple, inexpensive method which can be used to reassure people who will use the land or facility that has been cleared. The second method is more complex and is a control measure which might require a demonstration that the work has been properly cleared.

(i) Reassurance. In this case, the contractor may walk or drive across a piece of land to demonstrate that an area is now cleared of mines;

(ii) Quality Control. In its simplest form this might involve confirming that the number of mines destroyed matches the number of mines shown in a minefield record. This may not realistically work in many cases. That procedure may be better utilized after a particular piece of equipment or high-value task has been completed.

RECOMMENDATIONS

61. The recommendations of Working Group II are as follows:

(1) That international standards be developed and applied to quality assurance for mine clearance and humanitarian mine clearance operations and included in overall "Standards for humanitarian mine clearance operations";

(2) That the 99.6% humanitarian mine clearance standards should be a minimum standard with definition;

(3) That the 99.6% be applied to a total demining system;

(4) That training levels be defined for local deminers and expatriate deminers;

(5) That standards applying to a contractor be revised and adopted;

(6) That three levels of quality assurance, as defined by the Working Group, be accepted;

(7) That established international standards, such as ISO 9000, be examined for their applicability to mine clearance;

(8) That standards for training should be reviewed and established;

(9) That a further meeting be convened to finalize standards for quality assurance in humanitarian mine clearance operations.

ACTION TAKEN BY THE CONFERENCE

62. The Conference endorsed the report of Working Group II and its recommendations. It was agreed that these recommendations would constitute the framework for the elaboration of international standards on humanitarian mine clearance operations and quality assurance for mine clearance operations.

REPORT OF WORKING GROUP III

Safety Standards for Humanitarian Mine Clearance Operations

INTRODUCTION

63. The paper on "Safety Standards for Mine Clearance Operations" as presented to the International Conference on Mine Clearance Technology was a discussion paper to establish a framework for the Working Group to address safety standards. The paper addressed the terminology as it applies to mine clearance and proposed a series of control measures, safety distances and procedures that were discussed by the Working Group.

64. The Working Group addressed a series of decision points pertaining to the paper that will form the basis of a comprehensive prime reference for mine detection and mine clearance. The Working Group established a set of standards setting forth in detail such items as safety distances, early warning requirements, procedures for the use of explosives, medical and communications requirements, safe lane/area requirements, explosive storage requirements and mine marking.

SUMMARY OF DISCUSSIONS

65. The Working Group addressed the definition of what is meant by " Humanitarian Mine Clearance". The Group decided that a definition of Humanitarian Mine Clearance must encompass the following components:

(a) Mine Clearance should also incorporate Unexploded Ordnance (UXO);
(b) Humanitarian mine clearance should aim at zero casualties during clearance operations;
(c) Humanitarian mine clearance should aim at the removal of all mines in accordance with international standards to allow the land to be returned to humanitarian uses.

66. The Working Group addressed the issue of standardizing terminology as it applies to humanitarian mine clearance. The following terms were agreed upon for inclusion in a final standard:

(a) Datum Point. A fixed marker on the Start Line from which all mine field measurements are taken;
(b) Start Line. A line through the Datum Point, forward of which all demining occurs. This line may also be known as the Base Line;
(c) Start Point. A point where each demining pair commences operations within their allocated clearance area. Normally the Start Point is the location where the first Clearance Lane intersects the Start Line;
(d) Working Lane. The lane where a demining pair is working;
(e) Clear Lane. A lane that has been cleared of all mines and UXO.
(f) Intermediate Line. A line forward of the Start Line (Base Line) where all cleared lanes finish and successive lanes commence. Intermediate lines are numbered successively forward of the Start Line;

(g) Safe Lane. A mine/UXO cleared lane;
(h) Reference Point. A fixed point outside the minefield from which all measurements to the Datum Point are made.

67. The Working Group addressed the layout requirements of a mine clearance operation up to the Start Line (Base Line). It was agreed that the following areas were the essential minimum, common to all mine clearance operations:

(a) Command Posts at all levels of command;
(b) A static medical point;
(c) Vehicle park;
(d) Briefing area;
(e) Explosive storage area;
(f) Scrap metal area;
(g) Equipment storage area;
(h) Rest point for large groups;
(i) Back-up area for the resting member of the demining pair.

68. Having defined the minimum layout requirements, the Working Group addressed the minimum marking requirements up to the Start Line. The Group decided that all safe lanes and control areas up to the Start Line must be marked by mine tape fixed to posts at a height of 0.8m. The width of Safe Lanes are to be a minimum of 1m and a maximum of 2m. Local innovations for the marking of safe lanes and control areas are acceptable, however, alternate marking systems must be of a semi-permanent nature that will remain in location for the duration of the clearance operation. Reference points and Datum Points are to be clearly marked. Control Areas are to be sign posted.

69. The Working Group addressed the minimum marking requirements beyond the Start Line. The Group recommended that all cleared areas are to be marked to the same standard as the Safe Lanes and the control points. Working Lanes are to be progressively marked with mine tape fixed to the ground on the uncleared side of the lane.

70. The Working Group addressed the issue of minimum safety distances as they pertain to mine clearance operations. The Group made the following recommendations:

(a) Deminers working in the minefield (relative to mine type). Deminers should always be in sight of their supervisor. The supervisor and the support man should be a minimum distance of 20 metres apart in a Working Lane in the case of anti-personnel blast mines; 50 metres distant when working with fragmentation mines; and 200 metres distant when working with directional fragmentation mines. Working Lanes should be the same distance apart relative to mine type.
(b) Safe areas/control points and mine clearance sites. Safe areas/rest areas should be a minimum of 200 metres distant from Working Lanes.
(c) Explosive demolitions. A provisional chart of safety distances relative to ammunition types was tabled. This is to be reviewed and a final version produced by members of the

Working Group after the conference.

71. The Working Group recommended a policy for the destruction of mines and UXO found during clearance operations. It is recommended that, as a matter of general policy, mines and UXO should be destroyed *in situ* either individually or in groups. The neutralization and lifting of mines and UXO should only be considered in extreme circumstances which are fully justifiable.

72. The Working Group established a recommended policy for demolition procedures to be adopted. It is recommended that, for reasons of control, the preferred method of initiation of explosive demolition is electrical. Non-electric initiations of demolition may be acceptable as an alternative during conditions where atmospheric electricity discharge may present a hazard.

73. The Working Group agreed to a series of standards pertaining to the storage and transportation of explosives used in mine clearance operations. The agreed standards are included in appendices I to IV. While it was further accepted that the enclosed standards were the minimum, the laws of the host country must take precedence.

74. The Working Group decided on a policy establishing the early warning requirements pertaining to the destruction of mines and UXO. Provision must be made to exclude all persons from the danger area during the explosive destruction of mines and UXO. These provisions must include the posting of sentries with radio communication to the demolition supervisor.

75. The Working Group addressed the need for communications to support mine clearance operations. It is recommended that the minimum communications requirements are for two radio nets. One net is required for internal site communications from the site commander to all levels of command. External communications are required from the site commander to the next higher headquarters primarily for Casevac. Whistles or sirens are required by team commanders for communications with the demining teams.

76. The Working Group recommended that the maximum time a deminer should work on a mine detector without a break is 25 minutes, after which he should have a 25-minute rest period. Deminers actively engaged in demining should work for no longer than 5 hours per day inclusive of rest periods. The maximum duration a deminer should work in a day is 8 hours.

77. The minimum recommended size of a mine clearance team should be two deminers and one commander. The team must have medical support available within 10 minutes (to be confirmed by the medical working group).

78. The Working Group recommended that the minimum safety vehicle requirement to support mine clearance operations is for an uncommitted and dedicated safety vehicle per demining site. The vehicle must be capable of carrying a stretcher.

79. The Working Group established a recommended policy for the marking and destruction of

mines and UXO found during mine clearance operations. The Group recommended that mines or UXO found in a Working Lane are to be marked and all work ceases in that lane. Clearance should recommence in an adjacent Working Lane. Deminers should not work over a mine or UXO.

80. The Working Group recommended that, for clarity on the degree of clearance undertaken, clearance should be categorized by depth. The recommended categories are:

(a) Sub-Surface Clearance. Down to 200mm;
(b) Deep Sub-Surface Clearance. Down to 400mm;
(c) Subterranean Clearance. Below 400mm.

81. The Working Group decided that the minimum recommended level of personnel protection equipment that should be available to the deminers actually engaged in a clearance operation is:

(a) Ballistic helmet and visor;
(b) Ballistic jacket without sleeves;
(c) Calf-length boots.

82. The Working Group agreed on a recommended policy for disposing of UXO. It is recommended that only deminers who have undergone formal training in basic UXO disposal procedures (Blinds Disposal) may destroy *in situ* any UXO up to 160 mm. All UXO that are to be moved or are over 160mm are to be destroyed *in situ* or moved by EOD personnel with recognized EOD qualifications.

83. The Working Group accepted a list of basic recommended equipment required for deminers. The list is exclusive of personal protective equipment. The minimum recommended equipment list is set forth in appendix IV.

RECOMMENDATIONS

84. The recommendations of Working Group III are as follows:

(1) That the standards agreed in Working Group III be accepted as the basis for an International Safety Standard for Mine Clearance Operations;
(2) That the working group definition of "Humanitarian Mine Clearance" be accepted;
(3) That standardized terminology be applied as recommended by the working group;
(4) That the layout requirements of a mine clearance operation up to Start Line be adopted as minimum standards;
(5) That minimum marking requirements be established;
(6) That minimum safety distances, as defined by the working group, be adopted;
(7) That mines and UXO be destroyed *in situ* except in extreme circumstances;
(8) That the demolition procedures outlined by the working group be adopted;
(9) That the procedures listed for the storage and transportation of explosives used in mine clearance operations de adopted;
(10) That a policy be established for the early warning requirements pertaining to the destruction of mines and UXO;
(11) That minimum communications requirements be established;

(12) That standardized work and rest periods for deminers be established;
(13) That a standardized minimum size for a mine clearance team be adopted;
(14) That a minimum standard be adopted for safety vehicles;
(15) That clearance should be categorized by depth;
(16) That the minimum level of personnel protection equipment as defined by the working group, be adopted;
(17) That the policy recommended by the working group for the disposal of UXO be adopted.

ACTION TAKEN BY THE CONFERENCE

85. The Conference endorsed the recommendations of the Working Group and the paper presented to it on "Safety standards for mine clearance". It was agreed that these recommendations will serve as the basis for the finalisation of international safety standards.

APPENDIX I

Storage of Explosives

a) Explosives need to be handled, stored and transported with care and attention.

b) Avoid excessive heat, dampness and rough handling.

c) Store explosives in a cool dry place, sheltered from the elements with good ventilation.

d) Protect them from the light.

e) Keep explosives off the floor, on duck boards or shelves.

f) Segregate explosives by type: some explosives give off vapour, which will react with other explosives in a confined space.

g) Keep detonators in a separate place from other explosives. If this is not possible then they must be isolated by blast proof sand bag partitions.

h) Never store unexploded munitions with bulk explosives.

i) Keep explosives in their packaging until required for use. Explosives may react with other materials such as paint, petroleum and diesel etc. All such materials must be stored in separate places remote from the explosive store. No inflammable materials, such as packaging waste, should be allowed to accumulate in the store.

j) Explosives must not be stored near radioactive materials.

k) An explosive store must be located a minimum of 200 metres from any building.

l) Smoking or open fires must not be allowed within 50 metres of the explosive store.

m) Radio transmission is prohibited within 50 metres of an explosive store.

n) Fire-fighting media must be located within easy reach and prominently marked and subjected to regular inspection and maintenance.

o) Foliage must be kept short around the store at a distance of a radius of 10 metres.

p) "No Smoking" and "No Open Fires" signs must be installed at clearly visible points at a radius of 50 metres from the store.

q) Entry to the store must be limited to authorized personnel.

r) Accurate issue and return records must be kept.

s) A system of regular stock checks should be put in place, together with regular routine inspections.

APPENDIX II

Explosives Store Construction

a) The construction should be light, but capable of being secured;

b) The roof should be made of low-density material, which would not be projected a great distance in the event of a major explosion;

c) The roof should have a thermal shield to assist in keeping the contents of the store cool. This may be achieved, for example, by installing a canvas cover over the roof in such a way as to allow air to circulate between the cover and the roof. The cover also prevents sunlight from impinging directly on the roof;

d) In the case of a high-capacity storage facility in (relatively) close proximity to other buildings, a bund, or retaining wall, may be constructed at a suitable distance from and surrounding the store. Such a bund or wall should, of course, be constructed outside the crater area of any explosion at the site and be as high as the storage structure;

e) The structure should be well ventilated.

APPENDIX III

Transportation of Explosives

a) While explosives are relatively easy to control when in a storage environment, the transportation of explosives, if not controlled effectively, may allow circumstances to develop which may have disastrous consequences.

b) Vehicles used for the bulk transportation of explosives must be:
   (i) Adequate in capacity and type for the intended use;
   (ii) Reliable in all aspects;
   (iii) Clean and carry no other cargo, particularly passengers.

c) Drivers of explosives-carrying vehicles should have received adequate training in both hazardous load handling and emergency procedures.

d) Explosives-carrying vehicles should be fitted with adequate fire fighting equipment.

e) Each explosives-carrying vehicle should carry brief but comprehensive Standard Operating Procedures to be complied with in the event of an accident or unusual occurrence. Drivers should be well versed in these procedures as well as normal operating safety procedures.

f) Common safety standards should be applied to all organizations involved in the carriage of explosive stores. This will involve the setting up of standard operating procedures, which should be coordinated and enforced by the central mine clearance organization.

APPENDIX IV

Minimum Equipment Required for Deminers

a) The following is the recommended equipment required for all deminers, excluding personal protective equipment:
   (i) Prodder;
   (ii) Trowel;
   (iii) Small Brush;
   (iv) Sharpening stone;
   (v) Pliers;
   (vi) Mine markers (x2);
   (vii) First aid kid;

(viii) Secateurs;
(ix) Saw;
(x) Two hand lopper;
(xi) Shears;
(xii) Trip wire feeler;
(xiii) Metre stick;
(xiv) Equipment bag.

REPORT OF WORKING GROUP IV

Medical Standards for Humanitarian Mine Clearance Operations

INTRODUCTION

86. The paper on "Standards for Medical Support to Mine Clearance Operations" as presented to the International Conference on Mine Clearance Technology was a discussion paper to establish a framework for the Working Group to address the medical support required for mine clearance operations. The paper addressed the training of medical personnel, the deployment of medical units and personnel, and the medical equipment and supplies required at each level.

87. The Working Group expanded its discussion to cover not only the points raised in the paper presented but also to address the structure and organization of medical teams and the reporting requirements to establish a database of mine victims.

SUMMARY OF DISCUSSIONS

88. Deployment and operation of medical teams. The Working Group made the following recommendations on the deployment and operations of medical support teams:

(a) Mine clearance will only be conducted when a medical team is on site.
(b) A medical plan should be developed in advance of the deployment of mine clearance teams. At minimum, the planning should be based on a map survey but recommended that a site visit take place. As part of the medical plan, helicopter or fixed wing landing sites must be determined.
(c) Medical teams should not enter a mine field. Deminers are responsible for provision of immediate first aid and the extraction of injured personnel to safe areas for medical treatment.
(d) Medical teams should be located at a static medical point 200m from the mine clearance operation. This may be reduced in suitable terrain.
(e) The medical team is always included on the internal site communications net.
(f) A Level 2 medical facility should not be more than three hours from the mine clearance site. Should this not be achievable the mine clearance operation must make provision for level 2 medical support.

(g) A helicopter or alternate air transport must be available within one hour of an accident.

(h) A level 3 or 4 hospital must be available in a host country.

89. Structure and Organization of Medical Teams. The Working Group made recommendations on the structure and organization necessary to support a mine clearance operation:

(a) For each mine clearance team of up to 30 people, the medical support required is:

(i) Two medics;

(ii) One paramedic;

(iii) An ambulance with a driver.

(b) A doctor is required for each mine clearance operation of up to 15 mine clearance teams. The doctor will be the medical manager responsible for the selection, training and supervision of medical staff. The doctor will also provide medical advice to team commanders and establish a quality assurance system for the provision of medical support.

90. Skills and Knowledge Requirements for Medical Teams. The Working Group recommended that all medical staff be trained in trauma treatment within the following guidelines:

(a) First Aiders/Medical Clearers. Minimum of 24 hours' medical training;

(b) Ambulance Drivers. Ambulance drivers must be trained to the level of the first aiders. A stand-by ambulance driver must be available. The stand-by ambulance driver may be one of the First Aiders.

(c) Medical Orderly (First Level Medical Technician). The recommended duration of training for a Medical Orderly is three to four weeks covering the following basic requirements:

(i) Airway management;

(ii) Ventilating;

(ii) Proper positioning;

(iv) Dressing;

(v) Simple splinting.

(d) Paramedics. The recommended duration of training for Paramedics is one year covering the following recommended subjects:

(i) Intubation;

(ii) Artificial ventilation;

(iii) Intercostal drainage;

(iv) Venous cut down;

(v) Intravenous fluid.

(e) If Paramedics are not rotated or changed every half year they must be tested and retrained for invasive procedures such as coniotomy, intercostal drainage and venous cut downs.

(f) In addition to the provision of trauma treatment, the Paramedics are responsible for running a clinic to provide basic medical attention to demining teams and the pro-

vision of advice on the prevention of diseases, sanitation and hygiene. They are responsible for the maintenance of medical stock levels.

91. Medical Equipment. For the proposed standard for medical kits, see the appendix below. Three kits are proposed:

(a) The main kit to be carried by the Paramedic;
(b) The kit to be carried by the Medics (2);
(c) Every deminer must carry two field dressings;
(d) All operational vehicles must carry a basic kit.

92. Quality Control. Medical cards are to be standardized with information about the injuries incurred during mine clearance operations. Copies of the cards can be anonymous and should be forwarded to a central medical office on a monthly basis for evaluation and quality assurance. The level of competence and medical treatment will be supplemented by incident reports. The Medical project managers will be responsible for quality assurance.

93. Standard Operating Procedures (SOP). Each medical unit must establish an SOP, which must include a medical examination of mine clearers periodically (including hearing disabilities).

RECOMMENDATIONS

94. The recommendations of Working Group IV are as follows:

(1) That the standards agreed to in Working Group IV be accepted as the optimum requirements for Medical Support to Mine Clearance Operations;
(2) That the deployment and operation of medical teams for mine clearance operations, as discussed in the working group, be adopted;
(3) The recommendations of the working groups regarding the structure and organization of medical teams necessary to support a mine clearance operation be adopted;
(4) That the required skills and knowledge for all medical staff in trauma treatment, as elaborated in the working group discussion, for mine clearance operations be adopted;
(5) That the proposed standard for medical kits, as listed in Appendix I of Working Group IV, be adopted;
(6) That medical cards, to be standardized with information about injuries incurred during mine clearing operations, will supplement incident reports and be the responsibility of the Medical project manager;
(7) That each medical unit, supporting a mine clearance operation, must establish an SOP.

ACTION TAKEN BY THE CONFERENCE

95. The Conference endorsed the recommendations of the Working Group and the papers presented to it on "Standards for medical support to mine clearance operations" as the optimum requirements. These requirements may not be necessarily practical to implement in all countries,

so a further detailed analysis is required to establish the **minimum** safe standards that can be achieved. The minimum standards must be further agreed by an "expert panel" and published as the International Standard for Medical Support to Mine Clearance.

Appendix I

Medical Kits Required for Mine Clearance Operations

Paramedic Kit

Serial	Item	Quantity
1	**Ventilation Equipment**	
2	Airways	2
3	Ventilating bags and masks	1
4	Foot operated suction pump	1
5	**Intravenous Fluids**	
6	Hartmann sol	21
7	Infusion sets	2
8	Intravenous cannula	5
9	Short arm splint	1
10	Venous tourniquet	1
11	Arterial tourniquet	1
12	Alcohol swabs	50
13	**Drugs**	
14	Morphine or Ketamine	2 amp
15	**Dressings**	
16	Field dressings	5

Serial	Item	Quantity
17	Abdominal dressing	2
18	Burn dressings	2
19	Triangles	3
20	Aid bandages	2
21	Adhesive tape	1 roll
22	Disposable gloves	5 pairs
23	Scissors	1
24	Gauze pads	20
25	Bandage gauze rolls	10
26	Polydyne solution	50 cc
27	Polydyne cream	1 tube
28	**Diverse**	
29	Stethoscope	1
30	Blood pressure manometer	1
31	Coniotomy set	1
32	Intercost drain	1
33	Surgical kit	1

Medical Orderly

Serial	Item	Quantity
1	**Ventilation**	
2	Disposable mask	1
3	Field dressing	4
4	Abdominal dressing	2
5	Burn dressing	2

Serial	Item	Quantity
6	Triangles	3
7	Adhesive tape	1 roll
8	Gauze rolls	5
9	Gauze pads	5
10	**Diverse**	
11	Arterial tourniquet	1
12	Disposable gloves	2 pairs
13	Scissors	1
14	Flash light	1

Ambulance

Serial	Item	Quantity
1	Hartman Solution	51
2	Dressings	20
3	Diverse splints	3
4	Back boards	2
5	Stretchers	2
6	Blankets	5
7	Strobe light	1
8	Signal smoke grenade	4
9	Water container	20 L

IV. TECHNOLOGY FOR MINE CLEARANCE OPERATIONS

INTRODUCTION

96. Five working groups considered papers on technology for mine clearance. The Conference concluded that much needs to be done in the area of technology development and application. Much equipment exists, but almost exclusively for military application and at high cost. The Conference stated that pressure should be put on governments, private institutions and companies to put available resources into the hands of mine clearance community. It was stated that it is morally unacceptable that innocent civilians are being maimed and killed everyday when technology exists to allow them to live free from the terror of mines. To ensure that cost-effective and appropriate technology is promoted, the United Nations will facilitate the establishment of a technical board to evaluate new technologies before it is utilized by the humanitarian demining community.

REPORT OF WORKING GROUP V

Detection of "Hard to Find" Mines

SUMMARY OF DISCUSSION

97. There are a number of systems in use that can supplement the present manual techniques and allow for either enhancement of detection or discrimination of signals.

Mechem Explosive and Drug Detection System (MEDDS)

98. Initially used in Mozambique, the system is an enhancement of sniffer dog capabilities to bring the results up to the 99.6 per cent clearance requirement. Subsequent development has in essence been that improvements have been brought about by mainly three factors. Firstly, using hand pumps instead of vehicle mounted pumps. Secondly, using the absorptive properties of vegetation in capturing explosive vapours to the maximum. Thirdly, statistics obtained from dogs working in separate environments, that is, in two separate dog centres, are more reliable.

99. The MEDDS system has proved to be a reliable method of detecting buried explosives even if they are deep or have no metallic parts. It also has the big advantage that it can sweep a width of up to 20 metres in one pass. The system uses a concentrating device to collect explosive vapours, and specially trained dogs to detect them. The system was originally developed by Mechem for explosive and drug detection at border posts and airports.

100. The system is so sensitive, however, that a swathe of a width of at least 10 metres is reliably audited in a single pass, indicating the presence of explosives within 5 metres, but even up to 15 metres of each side of a path. By spacing more than one concentrator on the front of a vehicle, cross checks can be obtained. The system works best in dense vegetation, as encountered in

Angola and Mozambique, because the plants absorb the explosive vapours and, in turn, the vapour concentrators pick them up. The position of markers of sectors is therefore confirmed with a Global Positioning System (GPS) reading, and this is recorded against the reference numbers of the relevant vapour concentrator tubes. The vapour concentrator tubes are then sent to where the specifically trained MEDDS dogs indicate those which are positive. The mine-free areas are indicated at a better than 99 per cent confidence level.

101. Auditing large areas with MEDDS will reliably show the explosive-free zones. This saves time and money, which would be wasted looking for mines to clear in those areas. The follow-up mine clearance can therefore be applied more productively.

Dogs

102. Experience with dogs has shown that the following factors must be considered:
(a) Dogs are very useful to define or identify a safe area, but a vapour detection system is still required to confirm the performance of the dogs. When explosives are detected, this detection must be followed up by environmental detection and clearance by manual methods using metal detectors and probes;
(b) Dogs require two years to train;
(c) Separate dogs must be trained to detect different explosive types, for example rapid demolition explosives (RDX) or propellant;
(d) Dogs are 50 to 60 per cent accurate;
(e) The longer a mine has been buried the probability of a dog detecting the explosive vapour improves. Explosive vapour will seep out of a mine and is absorbed in a 10m circle in the environment of the mine;
(f) Dogs can identify that mines are in an area but cannot normally locate the position of the mine.

Ground Penetrating Radar (GPR)

103. In the mid-1980s, the South African Army tested a locally developed GPR system. The north of Namibia, as well as the south of Angola, is a mix of loose sand and vegetation. None of the secondary roads have tennis court smoothness. The Army eventually did not use the system because, although one could detect and signal process at the required 20 km/h, one could not average more than 1 to 2 km/h because of false alarms. Especially the TMA-3 mine, which occurred 75 per cent of the time, has its signals lost or merged into that of the uneven surface reflection. Experience is that signal processing is better for deeply buried objects, but severely restricted if mixed into surface clutter.

104. Operator ability is very important, and one should not neglect the capability of the person when using a system like the GPR. Experience provides evidence that a person can interpret GPR signals to identify mine/UXO detections. The problems were with surface scatter. GPR worked better with mines having larger air gaps and not so well with mines having little or no air gaps. This sensor was used alone and it should probably be used in conjunction with one or more other

types of sensors.

105. In order to detect larger anti-tank mines GPR may be tuned to a lower frequency, which may work through vegetation. GPR can be tuned to address the environmental situation, but it requires careful adjustment. While GPR is only one type of radar, there are other types which can provide effective potential advances. In the future, GPR will be using technologies such as polarization, stepped frequency and improvements in digital signal processing.

Other Technology and Methods

106. Mechanical techniques proved to be capable in making the manual operation up to three times more efficient in both time and safety. These techniques include the following:

(a) Roller wheels to flatten undergrowth and leave safe track marks on which the operator can keep his feet;
(b) Rippers to loosen the earth, which lowered the magnetic background due to conductive soil so that sensitive settings on the metal detectors could again be used and the ground could be opened up;
(c) Steel wheels and disc rollers to detonate mines in anti-personnel minefields;
(d) Gasbag detonations to open the terrain and detonate most of the mines before the normal search and lifting;
(e) Dogs used in the normal search mode usefully complement people.

Infrared

107. Infrared sensors, like most sensors, are affected by the presence of vegetation. The first thing which may need to be done is to prepare mechanically the area to be cleared. Work is ongoing to produce an infrared system, which does not require cooling and will be less expensive. The United States has a hand-held thermal imaging system that does not require cryogenic cooling.

Conclusion

108. Technologies should be looked at to forecast how they may work together and the problems of data fusion and digital signal processing. The emphasis must be on the work situation of sensors rather than stand-alone equipment. There must, therefore, be a more scientific method introduced into the process. For example, using multi-coil metal detectors or sensor suites. Sensors must generally be used in a clear or cleared area and a tool-box approach must be used until a single item of equipment is developed that will do everything. This is not likely to happen in the short to medium term.

RECOMMENDATIONS

109. The recommendations of Working Group V are as follows:

(1) That metal detectors, currently used in demining operations, should continue to be

utilized;

(2) That the application of ground penetrating radar (GPR) should be explored for application in mine clearance operations only after several important issues, such as operator training, logistical support and costs, are examined;

(3) That the demining community must apply a "tool-box" approach to mine clearance operations;

(4) That the United Nations should develop detailed requirements for humanitarian demining;

(5) That the demining community should seek to establish a group of technical experts to advise mine clearance operations on the application and viability of various demining technologies;

(6) That the United Nations should provide technical advisory groups for countries requiring assistance in demining operations;

(7) That the United Nations should be supportive of NGO and United Nations contractor efforts to hire or loan capital-intensive equipment from commercial or government institutions.

ACTION TAKEN BY THE CONFERENCE

110. The Conference endorsed the recommendations of the Working Group. It was further agreed that these recommendations will serve as the basis for the development of a technical advisory support mechanism, in cooperation with the United Nations.

Appendix I

Detection Technologies and Methods

(in US dollars)

[illegible]	NOW	2 YEARS	5 YEARS	PRICE	[illegible]	[illegible]
Metal Detector (hand held)	X	Improved		1,500-5,000	Non-conductive soil conditions	Most mines
MEDDS	X	Combine with bio-sensors		5,000/pump	Best with vegetation	All mines
Bio-sensors		X			Best with vegetation	All mines
Free running dogs	X			OK	All	All
Ground Penetrating Radar - Vehicle - Hand held - Airborne	 X X ?	 ?	 ?	0.5-1.0M 30K	 Open terrain All Open terrain	 All AT AT
IR	Military				Open terrain	AT
Mixed suites		X		2M	Open terrain	AT, AP
IR Air		X			Very open cleared terrain	AT, freshly laid
Mechanical (Rippers, plows, tillers, flails)	X			5K-3M	Vehicle traversable terrain	All

REPORT OF WORKING GROUP VI

Application Of Sensor Systems To Mine Survey

111. Initial demining activities are normally aimed at assisting the peace-keeping process and supporting humanitarian assistance activities immediately after a conflict. The establishment of a national body, such as a central mine action office or equivalent organization, moves the development process from that of a peace-keeping role to the establishment of the national priorities or aims through a humanitarian mine clearance programme.

112. In order to establish national priorities, it is necessary to identify quickly the extent of the mine problem, general locations, types of mines, booby-traps and unexploded ordnances (UXO). It is therefore necessary in the early stages of any demining operation to survey the entire area under consideration in order to plan effectively. The product of the survey is the identification of low-risk areas that can be readily occupied and put to use, and high risk areas that require marking and prioritization for clearance.

113. The addition of sensor systems to the present method of survey at Level I (General Survey) will enhance the value of information gathered from military and civilian sources. There also exist areas that are inaccessible due to political and military restrictions.

114. The present survey process has many constraints. It is very time-consuming, is costly and, due to limited expertise during the initial phases of the development of a demining organization, has limited manpower. Its impact nationally, therefore, even after several months is minuscule. National priorities, therefore, if undertaken at all, are based on limited or no information. It is absolutely essential that a quicker and more efficient system is utilized to aid the planning process.

Airborne detection

115. The use of an airborne sensor system appeared to be the logical method to speed up this survey process, reduce the economic and logistic burdens in conducting the information gathering process and supporting emergency demining activities. An airborne system allows the mapping of large areas of land at virtually no risk to the operators of the system due to mines. Technology already in development will allow us to detect minefields from an airborne platform flying at altitudes between 100 and 600 metres.

116. Most of the present development is being funded by and for military use. The requirements for a humanitarian demining system are not necessarily consistent with those of a military system. There is sufficient commonality, however, in the tasks to be accomplished by such a system to warrant leveraging the investment in the military systems.

Sensor types

117. The most mature development involves the use of infrared sensors, which detect temperature differences between mines and the surrounding soil or, in the case of buried mines, temperature differences in the soil caused by the presence of the buried mine.

118. Other technologies under consideration include ground penetrating radar, millimetre wave radar and multispectral systems, which include visual sensors. All of these approaches have limitations, which include sensitivity to weather conditions, diminished capability in heavy vegetation and aspects pertaining to the duration of time the minefield has been in the ground. These systems in the short, medium, and possibly long term are not likely to nor are they intended to find each individual mine, but to identify minefields by finding clusters of anomalies which resemble minefields in their characteristics. A system even with the above limitations could be productive in identifying not high-risk or low-risk areas but high or low contamination areas.

Development for humanitarian demining

119. No development is being conducted specifically for the purpose of humanitarian demining. Development or acquisition of such a system would require the redirection of priorities within the demining community which would involve the investment of funds for such an effort.

120. This development would have to incorporate a multisensor mix or suite integrating the highest potential sensors for the humanitarian demining survey role. This mix would likely include infrared and visual sensors and ground penetrating radar. It is considered that the mix would still be likely to have limitations that would preclude its use in all environments, weather conditions and terrain. It would still not be suited to detection of individual mines or nuisance mines.

Use in the medium-term

121. The use of systems designed for military applications should be considered in the medium term. Such a system, if fielded for humanitarian demining, could be utilized in several different operations reducing the cost impact. Angola could use it for three months and Bosnia could use it for the following three months. It is useful as a planning tool and the limitations must be accepted, with appropriate work-arounds considered for those times when the system does not work.

122. The development and acquisition cost of an airborne detection system for humanitarian demining is not considered an impediment. A great deal of money is currently spent on country surveys and the return on investment for such a system should be readily achieved. It is believed that a concept or feasibility study is necessary to define the parameters, limitations and cost benefits of a system for demining use. This will require political support for the development and implementation of such a system.

RECOMMENDATIONS

123. The recommendations of Working Group VI are as follows:

(1) That a study be initiated to produce a comprehensive review of test data and developments for airborne detection systems and should include a definition of the limitations of the systems;

(2) That the study should provide specification of the optimal sensors, platform and processing equipment to mitigate the current limitations;

(3) That a cost/benefit analysis for the notional system be defined;

(4) That the study also include a recommended course of action for the design and development of both near-term and long-term solutions.

ACTION TAKEN BY THE CONFERENCE

124. The Conference endorsed the recommendations of the Working Group. The Conference agreed with the importance of timely survey in a mine clearance operation and concern with the constraints of the present survey process. It further recommended that nations which have been developing sensor systems for military purposes, particularly air-borne systems, should be invited to consider making these systems available and adapt them for humanitarian demining operations.

REPORT OF WORKING GROUP VII

Protective Equipment For Mine Clearance Personnel

125. One of the key issues on safety in mine-clearing operations at present revolves around two areas, where a vehicle detonates a mine or where the deminer manually begins to investigate the item detected. Experience gained in a number of theatres and missions supports the need for protective equipment for mine clearance personnel. This has been considered in two parts :

(a) Personal protective equipment;

(b) Mine-protected vehicles.

Personnel Protection

126. As well as the threat posed to personnel by anti-tank (AT) mines, deminers are further endangered by the plethora of anti-personnel (AP) mines, IED and unexploded ordnance (UXO) they can encounter when conducting clearance operations. As well as the blast and fragmentation mines typically encountered, the combination of AP mines laid on top of AT mines or explosives can also be a problem. Of these threats, directional fragmentation mines (Claymore) or bounding fragmentation mines are considered the worst. No personal protective equipment is ever likely to provide protection against anti-tank mines or large bombs.

127. Adequate personal protection equipment like flak jackets, visors, helmets and gloves is presently available as well as some other items, such as a water pocket in the sole of a shoe and, secondly, a steel-wedge shaped insert in the sole, mine shoes and mine mattresses. The issue of increasing the distance between the deminer and the mine was mentioned as a possible step to reduce injury. The total bomb suit was not considered practical for most of the deminers.

128. Experience in most demining programmes showed that over 50 per cent of demining injuries occurred during the prodding process, and this is reflected in the fact that head and eye protection is currently the only common item of protection in use. It was agreed that any new protective equipment will always be a trade-off between cost, productivity of the deminer and the level of protection required.

129. Personal protective equipment should be able to protect against blast, heat, fragmentation and pressure. Ideally, any new equipment should:

(a) Be inexpensive;
(b) Not restrict movement;
(c) Be lightweight and comfortable to wear;
(d) Not cause overheating of the deminer;
(e) Stop blast, heat, pressure and fragmentation to an acceptable standard.

130. A comparison of safety equipment used by existing demining programmes was made and a table reflecting that information is set forth below.

HUMANITARIAN DEMINING AGENCIES
Review of Protective Equipment Used

AGENCY	HELMET	VISOR/GOGGLES	JACKET	BOOTS	APV
United Nations					
Afghanistan	Yes	Visor	No	No	No
Angola	No	Visor	Yes	No	No
Cambodia	No	Goggles	No	No	No
Mozambique	No	Goggles	No	No	No
Non-governmental organizations (NGO)					
HALO Trust	No	Visor	Yes	No	No
Mine Advisory Group	Yes	Visor	Yes	No	No
Norwegian People's Aid	No	Goggles	No	No	No

Vehicle Protection

131. The threat to vehicles ranges from.

(a) Simple blast anti-tank mines with a typical charge weight of approximately 6 kg of TNT;

(b) Boosted anti-tank blast mines;

(c) Projectile-producing mines. These mines are of more modern manufacture and are particularly difficult to protect against, because they combine the penetration effect of a Misnay-Chardin self-forming fragment (SFF) with a normal AT blast mine effect. Protection against SFF mines requires a composite armour kit fitted as close as possible to the mine detonation;

(d) Anti-group anti-personnel mines. These mines produce shrapnel and therefore the vehicles must also have normal armouring of the hull. There are two types: surface Claymore types and buried jumping mines, usually triggered by means of a trip wire or pressure switch.

132. Experience gained by the South African Defence Force and the Police with mine protected vehicles both for combat and for border patrol work resulted in the development of a number of combat proven vehicles. These had a mine and ballistic protected armoured cab and hull mounted on a Unimog chassis. On the original vehicles, Buffels, the chief disadvantage was instability on sideways sloping ground, which could make cross-country work hazardous. The degree of protection was such that, in all the campaigns, less than 1 per cent of personnel involved in anti-tank mine detonations were killed.

133. A requirement from the South African Police led to the development of the Casspir, possibly the first successful monocoque mine-protected vehicle. With a very high level of protection, the Casspir proved to be ideal in the bush, as its height offered an excellent view and the low centre of gravity made it very stable. The big advantage which the Casspir had over the numerous other mine-protected vehicles in use at that time was that it could be repaired quickly and cheaply after a landmine detonation. A variety of other requirements for mine protected vehicles led to the development of a number of variants of these types of vehicles.

134. Future technological advances for MPV will probably come from defence research, as such vehicles have a direct military role. Factors to be considered as to whether a particular MPV was applicable to humanitarian demining would include cost, weight and performance degradation. Modification of existing vehicles would also be an important option to pursue.

United Nations requirements

135. United Nations Operations need mainly two types of vehicles:

(a) A mine-protected personnel carrier;

(b) A mine-protected load carrier.

136. It was believed by some members of the Working Group that all humanitarian demining groups in Bosnia should use MPV due to the high threat of anti-tank mines. Discussion followed as to whether they would be necessary in other mine affected countries, and it was agreed that MPVs had a role in the reconnaissance/survey process, and in areas where remining occurred.

137. The following practical tips for making existing vehicles safer in a mine environment were offered:

(a) Filling tires with water. The use of water (+ 70 litres) in the tires of normal trucks was found to reduce casualties in an AT mine explosion up to sixfold. This is due to the absorption of heat out of the blast, reducing overpressures and lengthening the time of the blast impulse;
(b) Placing sandbags in the floor of the vehicle;
(c) Adding steel plate/armour to the floor of the vehicle;
(d) Adding a V shape to the underside of the vehicle, to deflect blast energy;
(e) Ensuring that all passengers are strapped in to avoid injury from being thrown about in the vehicle.

138. It was agreed that there must be some form of standard set for protection equipment used by the United Nations and that the use of this equipment should be mandatory.

RECOMMENDATIONS

139. The recommendations of Working Group VII are as follows:

(1) That a standard should be established for protection equipment use by the United Nations;
(2) That the United Nations should investigate the purchase of MPV for use in high-risk areas, especially during the survey process and in areas where re-mining is prevalent;
(3) That the United Nations should monitor the technological developments of national Research and Development organizations, particularly with regard to MPV and materials providing ballistic protection;
(4) That a v50 rating (Dry) of 450m/s for a 1.102 g NATO fragment (STANAG 2920) is adopted as the minimum standard for personal protection equipment. The testing of equipment is to be in accordance with US NIJ 0101.03;
(5) That a v50 standard for a visor should be confirmed, however, in the case that this can not be provided, the visor used must be of at least 5mm polycarbonate;
(6) That a v50 standard and type of helmet is to be used by all demining personnel involved in mine/IED/UXO clearance;
(7) That protective equipment must be worn by all United Nations personnel when involved in mine/IED/UXO clearance.

ACTION TAKEN BY THE CONFERENCE

140. The Conference endorsed the recommendations of the Working Group. The

Conference encouraged donors to consider favourably the financing of MPVs as an integral part of humanitarian demining programmes. The development of cost-effective and lightweight MPVs was also encouraged.

REPORT OF WORKING GROUP VIII

Mechanical Mine Clearance

141. Before looking into possible technologies, a clear understanding of demining is important. Demining is not so different from road construction in that a system is required in order to implement the project. First there must be a survey to find the optimum, lowest-cost option which will meet the need, then the procedure to be used is defined and the equipment required is determined. No one piece of equipment can build a road effectively and the same holds true for demining operations. The overall approach must emphasize a "tool-box" methodology, where specific equipment and procedures are combined to produce a faster, cost- effective solution.

142. The essential components required in a mine clearance operation are as follows:

(a) Location/Detection. The need to know where the minefields are located and the ability to detect metal, minimum metal and non-metallic mines with a single piece of equipment. This equipment must be 100 per cent reliable. If that is not possible, procedures must be established and in place to produce this reliability. At present this has almost been achieved, extremely slowly, with mine detectors and prodders.

(b) Demining/Clearing. This is the process of removing/rendering harmless/neutralizing mines and making the land available for other uses. Presently the bulk of this requirement is done by manual clearance using mine detectors and prodding the ground. This process is slow and dangerous, but it is reliable and achieves a certainty of clearance of over 99.6 per cent. The slow nature of this process requires an alternative mechanical option capable of quickly rendering harmless all mines buried or on the surface. If technology does not allow this full capability, then any mechanical option alternative that speeds up manual demining should be considered. Another alternative is the use of dogs, but their use is usually limited to reconnaissance to find the edge of the minefield and for route clearance.

(c) Minefield marking. This involves marking mined areas which will not be cleared or will be cleared at a later date. This activity is normally carried out manually and it is a reasonably fast process once the edge of the minefield has been found.

143. Keeping in mind the remote locations involved and the lack of infrastructure usually available in the countries which have a mine problem, the need for simplicity, maintainability, ease of training and supportability are major considerations that need to be assessed in the overall manual clearance process. These are particularly relevant factors when considering the value of using mechanical equipment.

Technologies

144. New multi-sensor technologies in mine detection, with infrared (IR), ground penetrating radar (GPR), microwave, visible spectrum photography, photon backscatter, bio-sensors and thermo--neutron sensors are emerging, but it is not likely that a breakthrough will occur or be fielded within the next three to five years. What appears to be a practical and feasible option, in the near term, is the development of a mechanical clearance alternative which may not solve the problem 100 per cent, but may definitely provide relief to what is a desperate situation which causes the death or maiming of over a thousand persons per month. A mechanical option complementing traditional clearance methods has the potential to provide an acceptable, interim solution until proven mechanical solutions which provide the 100 per cent clearance are tested and field trial experience substantiates this confidence level.

Existing mechanical mine clearance options

145. There are a number of mechanical systems already fielded, but most of them have been designed for military use to breach a small gap in a minefield. These systems are generally not suitable to land/area clearance in a United Nations or peacetime environment. The following systems are in existence:

(a) Ploughs/Rakes. Ploughs come in various forms and shapes and have been around for decades. They are bulky and simply move the mines to the sides of the plough. They have limited use in humanitarian/area clearance except for quick access routes through large minefields. Rakes have been used in operations, but they are generally only of use in desert conditions. This type of equipment can be categorized as follows:

(i) Full-width mine plough. The prime mover of this plough is usually a tank, but can be an armoured dozer. It is V shaped and clears ground to a depth of 30 centimetres, pushing earth and mines to the side. It requires great horsepower to push the plough at the required depth.

(ii) Scatterable mine clearance device. It is designed primarily for surface mines and therefore can be pushed by smaller prime movers. It is of little use for buried mines.

(iii) Rake plough. This plough was specifically designed for the desert environment as the tines allow sand to pass through, but not the mines. The prime mover also tends to be smaller than for the full-width plough.

(iv) Armoured dozers. The dozers usually are of the commercial type with extra protection for the operator. The dozer blade pushes earth and mines to one side by angling the blade.

(v) Others. There are many other types of ploughs ranging from track-width to special designs for specific tasks. All ploughs, however, have limited use in humanitarian mine clearance.

(b) Flails. A flail is a mechanically driven rotating drum, with chains attached, that beats/-cuts into the ground, detonating or physically destroying the mines. Flails that physically destroy but do not detonate mines have an obvious advantage in reducing wear of the flail components. Flails are available now, but they are

either very costly or poorly engineered. Use of flail technology, in the short term, in specific conditions is very promising. Small, remotely controlled mini-flails are also emerging as viable options. Large flails remove the top soil of agricultural ground and may impact on the ecology of the land for future uses.

(c) Rollers. Rollers have been available for many years. They suffer from being terrain sensitive, but can be used for proofing minefields. Rollers can be defeated by certain types of mines or mine configurations. They are simple and can be made locally.

(d) Explosive techniques. There are many explosive techniques, but they are expensive and generally not suitable for area clearance.

(e) Explosive sniffer technology. The ability to proof non-mined areas versus mined areas is a capability which is extremely important to reduce the time and cost of mine clearance. A system using a Casspir, a mine proof vehicle with air sample collection tubes, is a valuable technology for the clearance of roads and specific mine environment conditions. The air samples collected are tested by dogs away from the mined areas. A system which would provide near real time analysis would be a significant improvement.

(f) Minimum metal mine detection arrays. Minimum metal mine detection arrays, up to six metres in width, may prove to be invaluable for road clearance, detection for large area clearance and proofing/quality control. This system can be mounted on a vehicle to cover much larger areas than a mine detector and at speeds up to 10 km/hr.

(g) Mine-proof vehicles. These mine-proof vehicles ensure personnel safety, which is essential in humanitarian mine clearance. Mechanical clearance attachments mounted on such vehicles significantly reduce the risk from potential improvised mines/missed mines, which can cause injuries to operators. Safety of operators is essential. The alternative is remote control.

146. The fact that mines vary in size significantly requires that any system designed needs to cover every centimetre of ground and up to a depth of 30 centimetres (50 cm is preferred). Also the personnel using the equipment must be protected for the worst case mine found in the theatre. To protect personnel in mechanical clearance, mine-proof vehicles/hardened operator's protective cupolas should be considered mandatory.

147. Unexploded Ordnance (UXO) are the munitions which have either been left behind by the combatants or munitions which have failed to detonate for some reason. They are a hazard which must be dealt with, but which usually pose less of a danger than mines. It is important to note that some UXOs contain explosive amounts greater than mines so there will always be a need to carry out a thorough reconnaissance to be aware of all explosive materials in the area. The decision of whether mechanical means can be used will depend on that information.

Understanding the mechanical clearance requirements

148. The main barriers to efficient manual demining operations can be summarized as follows:

(a) Tripwires;

(b) Vegetation;
(c) Hard ground for prodding;
(d) Mines/Booby traps;
(e) Confidence levels and risk;
(f) Metal fragments.

149. These barriers decrease productivity of mine clearance by a factor of three to five. If mechanical clearance can address some or all of these barriers, this will be a significant improvement in mine clearance world-wide.

150. In assessing mechanical clearance requirements, the following areas need to be addressed separately and will require different mechanical solutions:

(a) Roads and good tracks should not be destroyed by mechanical clearance. In many cases these areas have few mines, which are normally in clusters many kilometres apart;
(b) Large areas of agricultural or open lands;
(c) Small areas around installations, such as houses, wells, commercial facilities etc.;
(d) Scenario specific areas such as orchards, tree farms etc., where mechanical mine clearance on a large scale is not feasible or economically advisable for the population.

The question of effectiveness

151. Mechanical clearance alone will, at least in the near term, never meet the 99.6 per cent effectiveness criteria, but mechanical clearance supported by manual clearance will, and that approach may be cheaper and significantly faster than manual demining alone. At this initial stage humanitarian demining has no proven experience with the effectiveness of mechanical options. The effectiveness of the system will depend on terrain, types of mines, the ground and operator's capabilities. The introduction of mechanical options must be controlled and measured to allow experience and recorded data to determine the capability of various mechanical options as stand-alone systems. In the interim these mechanical systems should be viewed as aids to manual demining.

152. A comparison of the two methods quickly shows that a mechanical option is at least three to four times as fast and more cost-effective by at least US$ 40 million to US$ 50 million for the specified sample area. In fact it is even more effective, since quality control, which should be 5 per cent to 10 per cent of the area cleared by manual means, has not been taken into account in the manual demining option. The cost for quality control/check would be about 10 per cent of the overall manual demining costs. Quality control is not necessary with the combination of manual and mechanical systems. In addition, owing to the ability to address the mine problem more quickly, human misery would be significantly decreased and economical growth/stability would start much sooner. Risk to deminers is significantly reduced. It is important to note that mechanical and manual demining can be carried out at different times.

Suitable mechanical equipment available now or in short-term development

153. Large rollers, ploughs, rakes and flails are manufactured or are in development by a wide range of countries. They represent mature technology and development is very capital intensive. Most of these pieces of equipment require heavy prime movers and are extremely expensive and hard to maintain in third world countries. The major concern with these technologies is that they do not guarantee, to an acceptable level, operator safety unless they are remotely operated, which complicates the overall problem, or they have specifically designed protective structures to protect the operator. Some technologies, however, are available or in final development and are applicable to humanitarian mine clearance.

154. A list of equipment which would enhance the mine clearance "Tool-Kit" is set forth below:

(a) Rotating drum rotary tiller. This system concept is in final development/testing by the Germans and Norwegians and looks very promising. It has the advantage of not removing the soil and, in fact, prepares it for agricultural use. It can be mounted on an armoured dozer, a tank chassis or in a smaller version on a mine-hardened vehicle such as the Casspir or OKAPIR. The German system is being tested in Mozambique. Basically this concept is a rotating drum on which hardened teeth from the mining industry are mounted. It can clear mines to a depth of 50 cm and may be useful for off-route clearance.

(b) Explosive sniffing system. This concept has been in use in South Africa and Mozambique with good success. It is based on a Casspir taking air samples, which are later analysed by dogs. It is a quick, economical and effective system for roads and tracks in low contamination areas. Its prime purpose is to indicate no-mine areas as well as mined areas. Clearance of mined areas is followed up by dogs and manual clearance. In heavily mined areas it is not economically practical, unless supported by another system, such as rollers, owing to potential constant damage to the vehicle. New sniffer hardware is being developed which in time will provide near real-time analysis and will replace dogs in this and other such systems.

(c) Mine-proof vehicles with steel wheels. This concept has been used effectively in Mozambique in areas where there is no threat of anti-tank (AT) mines. It is a reasonably quick method which is reliable and safe for the operator. The concept works on criss-crossing the terrain to ensure that all mines are detonated or neutralized.

(d) Flails. Numerous flails exist on the market and are effective in certain situations. While Sweden has a truck-mounted rear flail, the United Kingdom, Germany and Israel have large flail systems. There are many others, but of particular interest are the remote control mini-flails, such as the Slovak and United States systems. Flails can be of varying sizes and can be mounted on a variety of vehicles. The main problem with large flails is that they are slow and they remove the top layer of soil, which in some countries destroys agriculture. Mini-flails are attractive as they work mainly the surface and are extremely cost-effective as a mine clearance tool.

(e) Ploughs. Ploughs come in many shapes and sizes. They can be useful in humanitarian demining to provide quick access through mined areas to minimize civilian casual

ties and allow quick access to critical resources such as food and water. An armoured dozer with a blade can provide similar capability.

(f) Rollers. Single or double rollers are particularly effective for proofing roads which are suspected of mine contamination. Numerous roller systems exist, but they tend to be heavy and require a powerful prime mover. Rollers can be most effective in the early stages of humanitarian operations to allow the establishment of supply routes. Smaller rollers (commercial versus military) can easily be manufactured to achieve low costs and easy repairs.

155. It is important to think of mechanical options as improved productivity tools. They all have limitations depending on the mine threat, the terrain and weather. But using mechanical options associated with sound procedures and manual demining can provide cost-effective increased productivity capabilities. Equipment procedures must be carefully developed to ensure safety and address equipment limitations. Technical and safety standards must always be enforced.

Testing of equipment

156. All mechanical equipment must be tested prior to deployment and must further be tested in specific theatres, with varying ground conditions and mine threats, to assess applicability. It must as a minimum have the following capabilities:

(a) To provide complete protection/safety for the operator unless it is remote control. The degree of protection will be theatre dependent based on the mine threat;

(b) To withstand nine mine blasts of nine kilograms of an explosive mine before requiring major repairs. Most of the mines in humanitarian demining contain less than nine kilograms of explosives. The system must not receive major damage from a single blast and must be repairable in the field in less than one hour;

(c) To be capable of operating at two to three kilometres per hour clearing a path two to three metres wide. Smaller capabilities need to be reviewed prior to dismissal;

(d) A daily maintenance routine of less than two hours should be maintained;

(e) To make sure that the system must be easily serviceable, maintainable, transportable and require minimum logistics backup, the equipment needs to cater to existing local infrastructure and terrain.

Clearance rates and mine removal efficiency

157. The system should be able to clear 50,000 to 80,000 square metres per day with a mine removal certainty of no less that 85 per cent clearance. Until a system can prove, under actual field conditions, a clearance rate of 99.6 per cent, the terrain covered must be checked by manual demining. If clearance is not 85 per cent, the system is still valuable provided it speeds up demining operations by a minimum factor of three. As the previous analysis shows, mechanical clearance remains a very effective option both in time and in cost reduction.

Limits to mechanical clearance

158. There will be, in the near future, limitations to mechanical clearance. The limitations can be terrain, transportation around the developing country, specific mine threats, maintainability and theatre-specific limitations. None the less each requirement must be assessed to determine use, cost-effectiveness and practicality. In general, mechanical options will provide an expedient means to improve existing methods.

Applicability to developing countries

159. Systems should be designed with the following in mind:
(a) Maintainable by local personnel using local material if possible;
(b) The system should be designed for maximum transportability and light weight;
(c) Guaranteed operator safety;
(d) Low costs and no frills;
(e) Systems should be preferably wheeled to allow movement without support equipment;
(f) The system should be capable of withstanding nine separate blasts of nine kilograms of explosives without major damage;
(g) Only minimum on-site logistic support should be required;
(h) Simplicity both mechanically and for use.

160. The working group concluded that mechanical options are really not options, but an economically feasible necessity. Adding to the demining system, mechanical clearance will revolutionize world-wide demining. It will provide the much needed solution to addressing the problem of providing quick access routes for relief operations and allowing timely resettlement and rehabilitation. By speeding up the process fewer lives will be lost or maimed and countries can return to a state of normalcy quickly to allow the countries to grow and prosper. It must be emphasized that demining requires a systems approach. This means that no one system can do it all. A demining system requires good detection equipment, trained personnel to demine manually, mechanical systems, mine dogs, a well developed mine database and good sound technical and safety procedures.

161. Mechanical options are available now and can be used to expedite existing mine clearance efforts. Their true efficiencies and full practicalities will never be known until they are fielded and on-the-ground experience provides input into new technology requirements. The long-term benefits are substantial and the financial risk, when compared to the existing manual demining costs and productivity, is low.

RECOMMENDATIONS

162. The recommendations of Working Group VIII are as follows:
(1) That mine clearance operations should include mechanical clearance as an ***essential*** tool of the demining "tool-kit" approach;

(2) That the mechanical mine clearance operations must be part of an integrated approach with the associated organizational structure, properly developed and documented procedure and support;

(3) That mechanical clearance is not a stand-alone system and requires close monitoring followed up by manual clearance and quality assurance;

(4) That prior to the implementation of a mine clearance operation, a thorough evaluation must be undertaken, inclusive of consultations with the Government and demining agencies which have already been established in order to assess applicability and establish working relationships. An analysis of a host nations ability to support mechanical systems must be conducted, including:

(i) Trafficability of roads and bridges in the area of operations in order to support the transportation of machines;

(ii) Availability of fuel and other logistic support requirements;

(iii) The host nation's priorities for humanitarian/developmental mine clearance.

(5) That the United Nations should carefully elaborate to donors the benefits of mechanical assistance to ensure longer-term funding cycles, which leads to a structured commitment to the more effective and efficient employment of mechanical demining;

(6) That mechanical clearance, as a minimum, should address the clearance of tripwires, vegetation and preparation of the terrain to accelerate manual clearance operations;

(7) That the United Nations should develop a mechanism to evaluate mechanical systems for applicability in scenario specific environments to minimize duplication and integrate current operations in country;

(8) That the chosen mechanical system must have the following features:

(i) Be safe for operators and cater to the specific mine threat and ground conditions;

(ii) The system must be supported by an effective management, administrative and logistic support structure, to allow integration with manual and other demining agencies, where appropriate;

(iii) It must be cost-effective and productive;

(iv) Simplicity of design and operation;

(v) Maintainability and sustainability within the area of operation;

(vi) The complete system should be easily repairable from a blast within one hour;

(vii) Routine maintenance must be kept to a minimum.

ACTION TAKEN BY THE CONFERENCE

163. The Conference endorsed the recommendations of the Working Group. It was agreed that mechanical mine clearance should be recognized as an essential component of the demining toolbox in light of its cost, time and safety benefits. It was further stated that mechanical mine clearance must be a part of an integrated approach with the associated organizational structure, procedures and support and should be followed up by manual clearance and quality assurance.

164. The Conference also agreed with the Working Group's recommendation that the United Nations facilitate the establishment of a technical board to evaluate new technologies, including

mechanical clearance equipment for their cost-effectiveness and technical capabilities before utilization by humanitarian demining organizations.

REPORT OF WORKING GROUP IX

New Approaches to Mine Detection

165. A multi-system approach (tool-box) with specific environmental terrain and mission capabilities will be required for a minimum of three years or longer until highly advanced multi-purpose sensor systems can be placed in operation. Many new such "tool-box" solutions are just becoming available and are expected to enter service shortly. These solutions encompass both high and low technologies and will serve to enhance demining operations until the "optimum" solutions are available.

166. Because of the world's highly varied terrain, environment and weather, it will be necessary to optimize (tailor), at least initially, sensor and equipment function with respect to local conditions.

167. As these systems and technologies mature, the aim will be to develop platforms and sensors which allow system reconfiguration and "tailoring" for any mission scenario, terrain or environment.

Governmental Support

168. Governments involved in demining require vast assets and resources. This dilemma will drive the equipment developer to place great emphasis on the need to consider their research investment against a background of cost-effectiveness and value added to mission optimization. Until these optimization strategies can be identified, it will be difficult for researchers to determine how to prioritize their research and development investment. It is essential that Governments place strong emphasis on and encourage national research facilities, industry and academia to participate in solving this problem. Likewise, Governments must encourage and support applied research for this worthwhile cause.

169. There will be instances in which low-density, high-cost equipment is critical to the success of the demining mission. Means must be explored to allow Governments to lease/borrow such items for short durations, then return them for redeployment. This concept will permit the use of high-cost and high-tech equipment without incurring the cost of procuring it.

170. There are many opportunities to assist demining mission planners by gaining access to high resolution geographical and military records. This requires planners to have access to satellite imagery and terrain databases. Supporting government can increase planning efficiency by making this information available.

171. To meet the multiple challenges of developing demining equipment, it is strongly felt that it is essential to motivate and seek the assistance and resources of the world's scientific community. Collaboration between government experts in all demining endeavours is to be recognized as key to the early success of solving detection problems. It is essential that a proposal evaluation process be developed to encourage a broader scope in considering contributions from governments, non-governmental organizations and vendors.

Returning populace

172. Populations must be allowed to return to their land as soon as possible. Detecting mine-free areas not only facilitates this need, it is critical to mission planning and prioritization for areas known to be mined. Defining of mine-free areas is also probably the most effective opening of land and therefore the most effective mine clearing.

173. There is a definite need to ensure that all technologies and options are considered so as to allow the removal of mines as quickly as possible. In many cases the need to remove the mines negates the ability to wait for new technology to be fielded. Use must be made of a tool-box approach where a number of different elements or tools are used to solve a problem.

RECOMMENDATIONS

174. The recommendations of Working Group IX are as follows:

(1) That a multi-system "tool-box" approach with specific environmental terrain and mission capabilities be used until highly advanced multi-purpose sensor systems can be placed in operation;

(2) That the Governments be encouraged to support applied research;

(3) That with the support of the government, planning efficiency can be augmented by making information available and providing access to high resolution geographical and military records, which include access to satellite imagery and terrain databases;

(4) That the United Nations should explore ways that would allow Governments to lease/-borrow such items for short durations, which will allow the use of high-cost and high-tech equipment without incurring the cost of procurement.

(5) That the United Nations should explore methods to motivate and seek the assistance and resources of the world's scientific community. This is to include collaboration between Government experts in all demining;

(6) That an evaluation process for proposals be developed to encourage a broader scope in considering contributions from Governments, non-governmental organizations and vendors;

(7) That the defining of mine-free areas should be considered as more effective for the returning or opening of land for use by returning people than actual mine clearing.

ACTION TAKEN BY THE CONFERENCE

175. The Conference endorsed the recommendations of the Working Group and the papers presented to it on "New approaches to mine detection". The Conference also agreed to encourage the scientific community, Government and industry, to support efforts to meet the multiple challenges of developing appropriate technology for mine clearance operations, including equipment that would identify not only mines but also mine-free areas to enable affected populations the earliest resumption of normal life.

V. CLOSURE OF CONFERENCE

176. The Conference was closed by the following statement by His Excellency, Mr Poul Nielson, Minister for Development Co-operation of Denmark

177. In bringing this Conference to a close, I would like to refer briefly to the reason that brought us together this week - landmines.

178. Landmines have a profound effect on the lives of millions of people around the world. They prevent women from the simple everyday tasks of gathering firewood and collecting water, children from playing and going to school. After a war, the social and economic effects of landmines are felt for decades.

179. It is my hope that more countries - ultimately all countries - will support a total ban on anti-personnel landmines. The CCW Review Conference in Vienna and Geneva has led to progress already. Denmark has also declared a total ban. Let me express the hope that more governments will soon follow.

180. But even if a total ban is obtained, we face a continuing humanitarian disaster caused by around 110 million unexploded anti-personnel mines in almost 70 countries, every year maiming or killing at least 25,000 people and preventing civilian resettlement on former battle grounds.

181. That is why the international community must also speed up the development of small scale, low cost, technically feasible, safe, sure and easy to operate mine detector systems for all types of mines. Or in other words: A tool box with the necessary tools to do the job. If that is accomplished, large amounts of aid funds will be available to speed up the clearance operations. If this Conference has brought us closer to this scenario we might seriously start to hope for turning the negative trend of the mine menace.

182. A ban is a must, but so is new and appropriate technology to remove the already existing menace to humanity.

183. Humanitarian mine clearance is new to the international community - there have been no

internationally accepted standards or rules and, as we have heard here today, very little in the way of technology, outside of that developed for military application.

184. The Government of Denmark is extremely pleased with the progress made here over the past three days in order to improve this situation. The technical experts, NGOs and private sector representatives have worked together to approve a comprehensive set of recommendations for standards and procedures related to mine clearance. These recommendations will serve as the framework for the elaboration of minimum standards which with governments and the private sector - indeed all those working in the area of mine clearance - can advance the safety, effectiveness and professionalism of demining operations throughout the world.

185. All too often, we hear that things cannot proceed quickly in the international arena because of the various complexities involved. With the papers presented today, you have shown that the international community can move quickly, creatively and realistically to put forward concrete recommendations. You have also shown that interaction between field people, government and industry is particularly important.

186. The standardisation of terminology for safety standards and the development of a standardised layout of a mine clearance operation are already operational in many areas of the world but by formalizing these into an international standard you will enable those new to the area of demining to approach it in a safer manner.

187. Survey standards for mine clearance and standards for the marking of mined areas as presented today also provide us with a sound basis for establishing internationally-accepted standards in these areas of activity.

188. As agreed by the Conference, in order to finalise the text for international standards for humanitarian mine clearance operations, a small, representative working group will meet at the technical level to examine the ISO 9000 and its applicability to mine clearance. The working group will be required to conclude their recommendations by the end of the year in order to maintain the momentum we have gained at this Conference.

189. The Conference has concluded that much remains to be done in the area of technology development and application. Protective equipment, sensor systems, mechanical mine-clearance equipment - all of these things exist, but almost exclusively for military application. The high costs associated with such equipment has put it out of range for most mine-affected countries. However, mine clearance equipment, such as that we saw at the exhibition site yesterday, should be an essential tool of the demining tool kit as part of an integrated approach to mine clearance operations.

190. This Conference has heard ample evidence of the fact that there is a key role for governments. Similarly, it has been stressed that a strong involvement of the private sector is crucial. Since research and product development is carried out by governments, private institutions and companies we must put pressure on them to put resources into the hands of the mine clearance community. It is morally unacceptable that innocent civilians are being maimed and killed every

day when the technology exists to allow them to live free from the terror of mines. For example, the identification of mine-free areas is already feasible and in the first phases after a conflict this could enable an early resumption to a productive, normal life. Again, sophisticated sensor systems are widely used for military application and if modified could be adapted to humanitarian purposes. Governments should act on the responsibility to promote access for humanitarian projects to available technology.

191. The private sector has been well represented at this Conference and has played an essential role in developing recommendations in conjunction with the working groups. It is my hope that they too will assist in the development of appropriate technology for the low cost and safe clearance of landmines. If not for altruistic reasons alone, then from a range of motives including company policy on long term profit.

192. To ensure that cost-effective and appropriate technology is promoted, the United Nations will facilitate the establishment of a technical board to evaluate new technologies, including mechanical clearance equipment, before it is utilised by the humanitarian demining community.

193. Although overall economic feasibility issues were not widely discussed, I would like to emphasize that more work needs to be done to devise proper appraisal techniques that can be applied to mine clearance projects, similarly to the way we assess other development activities. Then only by combining technical and feasibility tests can we arrive at optimal choices. The clearance of some mine fields are prohibitively expensive, and the resources would be better applied to other purposes.

194. The momentum gathered over the past three days should not be lost. I look forward to the United Nations, with the continued support of the Government of Denmark, maintaining this momentum in working towards the finalisation and international acceptance of the recommendations put before us today.

195. The Government of Denmark, together with other governments, will make sure that the very positive recommendations of this Conference will gain the broadest possible support in all relevant international fora including the upcoming session of the United Nations General Assembly.

196. Thank you all for the tremendous efforts you have put into this Conference. Your work in the field of humanitarian mine clearance will hopefully be made safer and more efficient as a result of your interaction here.

ANNEX I

Speech by Mr. Poul Nielson, Minister for Development Cooperation, at the opening of the Conference on Mine Clearance Technology in Elsinore, Denmark, 2-4 July 1996

Mr. Under-Secretary-General, Delegates.

It is with great pleasure that I - on behalf of the Danish Government - take the floor today to welcome all of you to this Conference on Mine Clearance Technology.

The background - however - is as sad as can be: We experience a continuing humanitarian disaster caused by around 100 million unexploded anti-personnel landmines in close to 70 countries. Every year landmines are maiming or killing at least 25,000 people, half of them children. New landmines are placed at a speed that by far exceeds the present level of mine clearance. The clearance operation is dangerous and costly. The survivors of mine accidents with amputated limbs number more than 250,000 and cost more than one billion dollars for treatment and rehabilitation. Scarce health sector resources are being further strained in many poor countries. Large tracts of arable land and grazing areas for livestock are left unused with serious loss of economic opportunities. Fragile peace agreements and reconciliation efforts are threatened by repeated mine accidents even years after hostilities have ceased.

This is the sad and serious background for this conference. The idea of calling the conference, as a joint venture between the Department of Humanitarian Affairs and Danida, was born during a discussion late last year, when Mr. Akashi's predecessor - Mr. Peter Hansen - visited Copenhagen. When reviewing with him the most pressing humanitarian issues we discussed the need to urge for improved technology for mine clearance in all relevant fora. I was immediately very positive indeed to offer Danish assistance to realize the idea of calling a conference with this purpose.

We are therefore now here to work together during the next three days to promote research and development concerning better mine clearance technology. We are also here to discuss technical standards for mine clearance projects. As a further outcome I hope that the conference will stimulate future networking, including among researchers and specialists in product development and thereby improve international contacts and ventures. During the conference - I am sure - it will also be made quite clear that the aid donor community is prepared to assist investments in new and better technology.

Let me make a few comments on the modalities of the conference: At a planning meeting in New York in December last year I participated in further elaborating the plans for the conference. We decided to combine two major topics: 1. Standards for humanitarian mine clearance operations and 2. Technology for mine clearance operations, into one agenda. It was further decided to organize parallel to the conference the exhibition, which we have just opened, to illustrate and demonstrate the present state of technology and methodology and to indicate the potential for further technological advances.

It was further decided to invite all countries with serious mine clearance problems and countries, which have contributed to the funding of United Nations-sponsored mine clearance programmes and with a capacity to fund and support technology development for detection and clearance of anti-personnel landmines.

I am indeed very satisfied with the response to our invitation. Almost 70 Governments were invited and around 50 have responded positively and have sent delegates competent in the respective technical fields. I do regret that some countries have chosen to stay away notably China {, Russia} and Pakistan. Invited international NGOs are here as well as most of the invited intergovernmental organizations. In addition a large number of observers have on their own request been approved to participate. Each and everyone - I am sure - with a solid interest in the topic.

Let me raise a few issues which seem to me to illustrate the dilemma we are faced with.

My first question is: Why is the technology for detection of landmines - especially related to humanitarian mine clearance programmes in the poorer countries - not further developed already?

Obviously technology development is induced by the level of effective demand for it. The progress we have experienced since the last world war is beyond imagination. The race for the exploration of outer space since its inception in the 1950s induced further speed and quality into research and development by government agencies and private firms. The new information technology has revolutionized our live in many ways.

Where the demand is weak and where funding and political interest is limited, technology development moves - at best - very slowly. Appropriate technology for developing countries always appears to be losing out in the competition for available global resources for R and D. I am often confronted with this in my work as minister for development cooperation. Although a special effort has been made for decades to find special funding sources, including from the budgets for development cooperation - it is still striking that researchers and developers are not more keen to trace the links between technology advances geared to the development of poor countries and adaptation to the needs of those countries of the technology of the more advanced societies.

I sincerely hope that this conference can illuminate these links as far as mine detection technology is concerned. That successful product development adapted to the cleaning up of the many battlefields in poor countries will also entail development of important elements for military use.

The second question I would like to ask is: Why has it not been possible to adapt the technology used in military operations for mine field breaching to humanitarian mine clearance projects?

The links are obvious and should work both ways. It is a fact that vast amounts have been spent to develop, produce and operate heavy duty hardware for mine field breaching while the efforts to adapt modern military technology to the environments of poor developing countries are hardly noticeable.

Against this background I would like to express a hope and to make a commitment:

My hope is that this conference can help draw the attention of researchers, product developers, aid donors, military experts, civilian administrators, NGOs, the press and others to be much more aware of the need for technology development in this field. I hope these three days will illustrate to all participants where the bottlenecks are - and where the potential for new products can possibly be found. I hope that private companies will receive a further inducement to realize how their resources can be combined to limit the inhumane effects of the mine menace and how to create profits for the owners of their companies. It might be an overly optimistic and idealistic hope, but even so: I also hope that this conference can create new networks and alliances that can promote further research and development.

And now my commitment. The policy for development cooperation of my Government gives the highest priority to poverty-oriented assistance and to efforts helping the most vulnerable groups. We have already committed a very high percentage of our total assistance to projects in many of those countries which are affected by mines. Some of these are among the 20 programme countries selected for bilateral Danish support programmes. In addition I would like to reiterate our commitment to allocate funds from the budget for humanitarian assistance to support those programmes through NGOs - Danish as well as international and through the United Nations system, notably the work sponsored by the Department of Humanitarian Affairs. My commitment on this occasion is to increase our allocation for this work.

Finally, my Government will closely monitor the possibilities of further supporting initiatives taken by the research community to develop mine detection equipment. Presently a Danish para-statal organization, the Centre for Advanced Technology, is coordinating a feasibility study. If our assessment of the results study is positive, the plan is to initiate further practical experiments and the development of prototypes.

In closing let me combine my hope and my commitment. If an appropriate, small-scale, low-cost, technically feasible, safe, sure and easy to operate mine detector for all types of mines can be developed, there will be large amounts of aid funds available to speed up the clearance operations. The standards for such operations - hopefully further refined at this conference - will assist to assure the quality of such operations. If this conference can bring us closer to this scenario we might seriously start to hope for turning the trend of the mine menace.

Let me also express the hope that more countries - ultimately all countries - will support the ban on anti-personnel landmines. This is not the topic on this occasion, but is obviously so closely connected that it deserves mentioning. The CCW Review Conference in Vienna and Geneva has led to progress already. Denmark has also declared a total ban. Let me express the hope that more Governments will soon follow.

Finally: Let me once more welcome all of you to Denmark and to this MCT-Conference. I wish for us all that the Conference will move smoothly and productively through the rather heavy agenda. I am looking forward to the programme - not least to the reports from the working groups the day after tomorrow.

It is my pleasure and privilege now to declare the MCT-Conference open.

And I now invite Under-Secretary-General and Head of the Department of Humanitarian Affairs, Mr. Yasushi Akashi, to take the floor.

ANNEX II

Secretary-General's Message to the International Conference on Mine Clearance Technology Delivered by Under-Secretary-General Yasushi Akashi

Landmines are a problem that kill and maim not only during a conflict, but even after hostilities end among combatants.

Even while you meet here today in Denmark, more mines are being laid and innocent victims killed around the world. Mine-clearance activities are, therefore, an important humanitarian undertaking which will reduce unnecessary casualties and, at the same time, enable fragile societies that emerge from conflicts to rebuild their civil societies.

While the world has made tremendous strides in the development of technology, including in the field of weapons, little progress has been achieved in the advancement of technical know-how in mine clearance. I, therefore, warmly welcome the initiative of the Government of Denmark to convene this Conference, to bring together interested governments, demining experts, non-governmental organizations and the private sector from around the world to discuss and promote the development of appropriate technology for humanitarian demining activities. I sincerely hope that, as a result of this unique partnership, a network will be established to strengthen, in particular, the technological capacity of the countries which require this support in eliminating these indiscriminate weapons from their schoolyards, fields, roads -- from their everyday lives.

Mine clearance, as we all recognize, is an increasingly important but relatively new humanitarian problem. We would all benefit from internationally recognized standards and procedures to promote greater cost-effectiveness, higher quality of delivery and improved safety for mine clearance workers in the field. Of equal importance is the ability to provide a safer environment to enable victims of conflict to return to normal economic and social activities. I look forward to concrete recommendations from your Conference in the establishment of internationally recognized standards for mine-clearance purposes. The United Nations will spare no efforts to promote the adoption of such standards by all those who engage in mine-clearance activities.

While we should continue to increase and improve our efforts to move these indiscriminate weapons from the ground, today more mines are being laid than cleared. It is, therefore, imperative that the international community not be allowed to be complacent with the progress made so far in the banning of land-mines. As I have said on many other occasions, a total ban on the production, sale and use of these immoral weapons must be achieved.

Once again, I would like to thank the Government of Denmark for convening this important Conference, and I wish you all every success with your endeavours here today.

ANNEX III

Statement by Under-Secretary-General Yasushi Akashi at the Official Opening of the International Conference on Mine Clearance Technology
Copenhagen, Denmark, 2 July 1996

Minister, Ladies and Gentlemen,

I wish to open my remarks by thanking the Government of Denmark for its foresight and initiative in convening this International Conference on Mine Clearance Technology.

What brings us all here today is our joint commitment to clearing the world of the scourge of landmines. We are only too familiar with the numbing statistics: more than 110 million landmines are currently deployed around the world, and another two to three million more mines are laid each year. At present, we are clearing about 100,000 mines annually. At this rate, with all our best efforts and the untiring work of the extraordinary men and women who work in the field as deminers, we can expect the total number of these insidious weapons to increase to 135 million by the next millennium.

Under the leadership of Secretary-General Boutros Boutros-Ghali, we at the United Nations are committed to working towards the total elimination of landmines. This will require a two-pronged approach: first, we will continue to strongly advocate for a total ban on landmines. At the same time, the UN, in partnership with the humanitarian community, will strive to redress the devastating humanitarian consequences of those landmines already in place. As participants to this Conference are already aware, landmines are a major impediment to the efforts of nations weakened by conflict to rebuild their societies. Landmines prevent agricultural land from being worked; roads from being used; people from returning to their homes; confidence from being restored. It is shocking to know that more women and children and agricultural workers are killed and maimed after a cease-fire than during the actual conflict.

The United Nations has focused on the crucial issue of mine clearance in post-conflict peace building. Over the last seven years, we have established mine clearance operations of considerable size in Afghanistan, Angola, Bosnia and Herzegovina, Cambodia, Croatia, Mozambique and Yemen. The mine-clearance programme in Afghanistan, with 3,000 deminers, is actually the biggest employer in that country. Together with 1,600 deminers in Cambodia, 500 in Mozambique, and 900 being deployed in Angola, these dedicated technicians toil in the most difficult of circumstances to clear the land in order to enable civilians to return to their everyday tasks safely. Together, these operations have removed some 200,000 mines in those four countries. Yet despite these Herculean efforts, the total achievement represents a tiny fraction - less than one per cent - of the landmines in these countries. The task of clearing the mines is slow, arduous and extremely dangerous. Most mines are detected individually, by prodding, metal detection or sniffer dogs. And the risks are high. For every 2000 mines cleared, one deminer is injured. For every 5000 mines cleared, one deminer gives up his life.

It is clear that new technology is vital to improving mine clearance yet there has been little research and few advances in the last half century. Today, here in Denmark, and thanks to the generosity of the Government of Denmark, we have a unique opportunity to find ways to accelerate the rate of mine clearance and to increase the safety of clearance operations. Over the next few days, you will be holding important working groups on mine clearance technology and mine clearance standards. You will be addressing the application of technology to the humanitarian demining programmes worldwide. Your work here this week will have a direct impact on the daily lives of civilians whose simple wish is to watch their children grow up without fear of dismemberment or death.

There is a brief story from Mozambique that I would like to share with you..... a true story of how valuable your work is and how directly mine clearance can provide help to entire communities. For six years, a population of 10,000 people in a village in Kalanga had been unable to return to their village because of the presence of mines. The Governor of the province called the UN demining programme in Maputo and told them of the problem and asked for their help. A survey team was sent to the area and once they realized that there were only a few mines they proceeded to clear the area. They found a total of eight mines. Eight mines had kept 10,000 people from their homes for six years. Today, 15,000 people are living in the village of Kalanga.

This compelling story tells us two things: first, it demonstrates how tangible and immediate mine clearance helps affected populations. But, it also shows us how even a small number of mines can deprive people of their homes and lives and how long it can take until help arrives; and it reminds us of the thousands of villages around the world that probably will have to wait for years until their houses and fields are cleared of these agents of death.

As Special Representative of the Secretary-General in Cambodia and the former Yugoslavia, I have witnessed the heavy toll landmines take on nations that are striving to recover from years of armed conflict. I therefore very sincerely wish you every success in your deliberations and hope that you will have a successful meeting that will further the progress of humanitarian mine clearance operations.

Before closing my remarks, I would like to express once again my appreciation to the Government of Denmark for all their efforts to increase landmine awareness and support demining operations. Minister Nielson, the leadership shown by your Government has brought us here together - representatives from governments and agencies around the world, technical experts and NGOs. You have provided us with the opportunity to work together to find ways to improve the lives of the millions of people held hostage by landmines.

Thank you.

ANNEX IV

Statement by Under-Secretary-General Mr. Yasushi Akashi at the closing of the International Conference on Mine Clearance Technology
Tuesday, 4 July 1996

When the Conference was opened here two days ago, I was very impressed by all the presentations. I felt, however, that we may have set for ourselves extremely ambitious goals to achieve for just a three-day Conference. I am, however, delighted that the Conference under your able leadership has indeed met this formidable challenge and adopted a series of practical and forward-looking recommendations.

As we are all aware, the demands for humanitarian demining operations are enormous. The framework adopted for the elaboration of international standards and procedures for such operations will go a long way to make future mine clearance activities safer, more cost-effective and more professional. The Department of Humanitarian Affairs will spare no effort to maintain the momentum created by this Conference and endeavour to finalize an international standard in the context of the technical working group that the Conference has established. As mentioned by the Secretary-General in his message to this Conference, the United Nations will advocate application of this international standard by humanitarian organizations once it is finalized.

I am gratified to note the growing awareness among Governments and the private sector of the need to develop appropriate technology for humanitarian mine clearance operations as reflected in our discussion, as well as at the exhibition. I am particularly encouraged by the progress in the area of mechanical mine clearance. The Conference has recognized the great potential benefits of mechanical mine clearance, while at the same time stating clearly that at this juncture, mechanical demining technology must be followed by manual clearance and quality assurance. I sincerely hope that this message will further encourage the private sector and related institutions to develop mechanical mine clearance machines which would meet the specific requirements of the third-world countries where these machines are most needed. I also call upon donors to consider financing the inclusion of such machines in humanitarian demining programmes.

The Conference has reviewed and adopted other recommendations encouraging the development of potential technologies and equipment for humanitarian demining operations. I would like to add my voice to those who have emphasized the need to strengthen our capacity to identify "safe" and "low-risk" areas in the earliest stage of our demining operations so as to enable affected populations to return to normal life as soon as possible.

In the past three days, we have brought here an unprecedented number of experienced mine clearance experts with a professional commitment to improving humanitarian demining operations. Their vast and diversified experience and dedication are well reflected in their achievements. At the same time, we must reach out and broaden our network to include research institutes, academic institutions and the private industries in order to mobilize their support for our common objectives.

In conclusion, Mr. President, I would like on behalf of all participants as well as on behalf of the United Nations to express our sincerest gratitude to the Government of Denmark and to you personally, Mr. Minister, for hosting this very timely and useful Conference. I am very heartened to hear the commitment you have just announced. We will be leaving Denmark with a very positive sense that we have together in these past three days made a difference in this world. And I pledge to you, Mr. President, and to all participants, that the Department of Humanitarian Affairs will continue to work with you all to ensure the expeditious follow-up to all the recommendations of the Conference. Last and not least, let me take this opportunity to pay tribute to all those who are not here with us today but are risking their lives to rid the earth of this cruel and indiscriminate weapon.
