

DDAS Accident Report

Accident details

Report date: 15/03/2004	Accident number: 374
Accident time: 08:40	Accident Date: 31/07/2001
Where it occurred: MNB West, Kurvala region, Albania/Kosovo border	Country: Kosovo
Primary cause: Victim inattention (?)	Secondary cause: Unavoidable (?)
Class: Excavation accident	Date of main report: 11/08/2001
ID original source: BOI: No 010/2001: MF	Name of source: KMACC
Organisation: Name removed	
Mine/device: PMA-3 AP blast	Ground condition: grass/grazing area metal fragments rocks/stones
Date record created: 22/02/2004	Date last modified: 22/02/2004
No of victims: 1	No of documents: 3

Map details

Longitude:	Latitude:
Alt. coord. system: DN 25610 13131	Coordinates fixed by:
Map east: GR 34T	Map north:
Map scale:	Map series:
Map edition:	Map sheet:
Map name:	

Accident Notes

inadequate equipment (?)
handtool may have increased injury (?)
inadequate metal-detector (?)
inadequate medical provision (?)
metal-detector not used (?)

Accident report

[What follows is the report of a Board of Inquiry investigation that was made available in January 2002. It has been edited for anonymity.]

REPORT FOR ACCIDENT INVESTIGATION BOARD OF INQUIRY – No 010/2001

Mine Accident that occurred in MNB West on the 31st July 2001

Introduction

- 1) In accordance with the Mine Action Co-ordination Centre (MACC) Standard Working Procedure No 4, the MACC Programme Manager, issued a Convening Order on Tuesday 31st July 2001, for an accident investigation Board of Inquiry (BOI). Annex A details the Convening Order.
- 2) This is a comprehensive report by the Board of Inquiry into the Mine accident that occurred on the 31st July 2001. Based on the investigation, [the Demining group's] internal report, the statements from [the Demining group's] personnel involved in the accident (see Annex B), visits to the accident site and the photos from the accident site, this can be considered as a preventable mine accident.
- 3) The information provided by [the Demining group] to the MACC Headquarters in the "Mine/UXO Incident/Accident Report", attached as Annex C is confirmed. The accident occurred at approximately 0840 hrs on 31st July 2001 in a minefield located in the Kurvalla region of Western Kosovo at GR 34T DN 25610 13131 (seat of detonation). Annex D details a map of the general area.

Pre-Accident events

- 4) [The Demining group] had one manual demining team (B1) working in the Kurvalla region at the time of the accident, the team consisted of a Team Leader, a 21/C and two pairs of manual Deminers. The team had recently completed Dangerous Area (DA) No 1893 and had moved onto DA No 1899 on the 30th July 2001.
- 5) On the 30th July 2001 work on the site consisted of setting up the administrative area, clearing a safe lane into the mined area and establishing a base lane. A total of 598sq/m were cleared resulting in the location and collection of 89 x metal contamination pieces; no mines were cleared on the first day of operations.



[The picture above shows the safe lane leading to the gully where the accident occurred.]

- 6) On the day of the accident work had started on the minefield at 08:00 hrs, the team were cutting breach lanes into the now identified mine rows from the base lane. The first pair of Deminers [names excised] was clearing in a Westerly direction due South of a small river in a "reentrant". Clearance was being conducted using the detector to check for metallic signals

and probe to investigate the signals. After a short period of time the Demining pair had to revert to the probe and excavation method (15cm-clearance depth) due to the increase metallic content of the area. The increased contamination level was due to the metallic residue of a previously detonation of a PMR-2 anti-personnel fragmentation mine. Once they had cleared past the seat of detonation of the PMR-2 the pair reverted back to the detector and probe method of clearance. Up to the time of the accident the pair had cleared 168 sq./m and recovered 17 x metal contamination pieces.

7) At approximately 08:40 hrs whilst Deminer [name excised] was either investigation a previously identified signal with his probe, or attempting to move a rock with his probe, an uncontrolled detonation of a PMA-3 anti-personnel blast mine occurred.

[Photograph of the accident lane – the accident site is in the middle of the picture where the marking tape ends.]



Post-Accident events

8) [The Victim] extracted himself from the immediate area and was then assisted to the control point by Deminer [name excised] where he received medical assistance from the team medic. Following the stabilisation of the casualty he was taken to the team base location at GR 34T DN 26665 12892 where the casualty and Team Leader [name excised] were air lifted out from Red 28 HLS by the Italian KFOR.

9) [The Demining group] Operations Officer [name excised] who had been working in the Kurvalla region preparing a previously worked site for completion then secured the accident area. All accident information was passed to the MACC in a timely manner by [the Demining group's] Programme Manager [name excised]. Annex E details a schematic diagram of the general area and Annex F details a schematic diagram of the accident area.

PMA-3 parts located at the site.



Work History of [the Victim]

10) [The Demining group] Deminer [the Victim] had been working for [the Demining group] since 1996 in different countries around the world. He is considered to be a competent and trustworthy employee and disciplinary action has never had to be taken against him.

Past History of the Area

11) The mine-contaminated area in and around the area of Kurvalla was identified from Vojska Jugoslavije (VJ) records. The VJ carried out some mining in the area in August 1998 (DA 1893) and again in May 1999 (DA's 1898 and 1899). Due to the high altitude (2300m), VJ forces would normally only occupy the Kurvalla area during the summer months, withdrawing to lower altitudes on the onset of winter. Albanians burned down the old VJ defensive position (location of [the Demining group]'s present base camp) in the winter of 1998. During the conflict Kosovo Liberation Army (KLA) forces operated a supply route through the Kurvalla area from the Albanian border through to Rugova near Pec.

12) The VJ record details that the minefield consists of 2 x rows of mines that cross a stream which runs through a valley between the two heights of Tromeda and Bogieвица. The total number of mines in the minefield is 20 x PMR-2 and 30 x PMA-3 anti-personnel mines. The first row contains 10 x PMR-2 mines with 20 x PMA-3 mine keepers, the second row contains 10 x PMR-2 mines with 10 PMA-3 mine keepers. Annex G details the VJ record.

Sequence, Documentation and Procedure of Tasking

13) The task dossier, No. W01-40 was issued from the MACC to [the Demining group] on the 09th May 2001. There are three DA's detailed in the task dossier. No's 1893, 1898 and 1899. Work commenced on the first area (DA 1893) on the 02nd July 2001 and the DA was completed on the 28th July 2001. During the clearance operation 1148 m/sq. of contaminated land was manually cleared resulting in the clearance of 26 x PMR-2A anti-personnel fragmentation mines. The site has recently been prepared for completion and a Quality Assurance (QA) completion evaluation will take place on the 09th August 2001.

Geography and Weather

14) Kurvalla is situated in the West of Kosovo lying less than 1km from both the Albanian and Montenegrin borders. It is a desolate and remote mountainous area (heights exceeding 2400m in places) which is only accessible via stone tracks during the summer months. The local populous from both Albania and Kosovo use these higher plateaus as bases for summer camps. Agriculture is limited to summer grazing and fruit picking with forestry being the main activity in the lower valleys. The weather at the time of the accident was slightly overcast with a temperature of approximately 20 degrees Celsius.

Site Layout and Marking

15) The site layout and marking prior to the accident were in accordance with [the Demining group]'s SOPs. Securing and marking the accident scene following the accident were however not conducted as per [the Demining group]'s SOPs nor MACC Guidelines and Technical Standards.

Management Supervision and Discipline

16) An International Operations Officer has direct operational responsibility for all [the Demining group]'s manual demining teams with International Team Leaders being directly responsible for the teams. Each [Demining group] demining team consists of the Team Leader, a Team 2I/C, 2 x manual demining pairs and a medic. Overall discipline with [the Demining group] teams both on and off site is excellent.

Quality Assurance and Quality Control

17) [The Demining group]'s Internal Quality Control (QC) is achieved through a system of on-site checks by International Team Leaders and 2I/C's to ensure adherence to demining SOPs. Normally 10% of each lane is physically checked using a different detector that cleared

the lane initially. The MACC QA teams conduct external QA on all sites on a weekly basis. The last MACC QA visit was scheduled for the 26th July 2001, but due to access problems to the site the visit was cancelled. The last actual QA site visit was conducted on the 19th July 2001 where Manual clearance was evaluated, the evaluation result was good.

Communications and Reporting

18) Communications in-between the Kurvalla base camp and [the Demining group] base location in Djakovica is maintained via HF communications. Communications in-between the actual demining site and the base camp is maintained using VHF communications as is communications in-between Djakovica base location and KFOR using the MNB(W) channel. On the day of the accident, communications between the demining site, Djakovica base location and KFOR were good with all accident information being passed to the relevant personnel.

Medical Details

19) [The Victim] suffered traumatic amputation to part of the left hand index finger, with damage also to the surrounding tissue and fracturing of bones to his left hand. No other personnel were injured. Annex H details the MACC QA Medical Officers Report

Personnel

20) A list of all personnel and their duties has been previously detailed at Annex B. Written statements from [Demining group] personnel directly involved in the accident and [the Demining group]'s internal report form Appendices to this Annex.

Dress and Personal Protective Equipment (PPE)

21) At the time of the accident all personnel working in the mined area were wearing PPE. Following the accident all items of PPE were removed and cleaned by [the Demining group]'s personnel. On inspection of the PPE the following day, the only damage sustained was to the left hand glove.



The victim's PPE is shown above.



The victim's left glove is shown above.

Tools and Equipment

22) Following the accident [the Demining group] personnel removed all tools and equipment from the accident scene. This made it somewhat difficult to conduct a full and thorough investigation, as the investigating officer had to rely on the memory of a manual Deminer in order to reconstruct the accident scene.

23) At the time of the accident it has been ascertained that [the Victim] was using his probe. On inspection of the tools and equipment no damage was sustained following the accident other than a slightly bent probe.

Details of Mine Involved

24) The PMA-3 is a small anti-personnel mine, which consists of a two part flat cylindrical body. The upper and lower body parts are sealed with a black synthetic rubber cover. The upper body part is a rotating pressure plate, which contains the 35g pressed TNT main explosive charge and fuze housing. A spring safety ring is retained by plastic clip with a lanyard attached. The lanyard is wound around the circumference of the mine and secured with a length of adhesive tape.

24) The UPMAH-3 fuze with chemical friction igniter is almost entirely made from plastic, with the only metal components being a small metal firing pin encased in a plastic nipple, which protrudes from the bottom of the fuze and an aluminium cover on the detonator cap. The low explosive chemical friction igniter contains potassium chlorate, red phosphorus and a binder. The primary high explosive detonator consists of a M-17 P2 detonator which contains tetryl, lead azide and lead styphnate.

25) The PMA-3 is designed to function only when the upper pressure plate rotates within the lower housing. The emplacement directions recommend a cover of 2-4mm and horizontal placement of the pressure plate to take advantage of the pressure hardened or blasts resistant design. Additionally the design for a non-axial load means that the necessary pressure to function the mine decreases, as the load is placed closer to the edge. The normal operating pressure ranges from 8kg to 20 kg. However, it is possible that when pressure is applied right at the very edge of the upper body part, as little as 3kg could function the mine.

26) Pressure on the top of the mine causes the upper pressure plate to rotate within the lower housing. The fuze nipple, which fits tightly in the fuze cap, breaks igniting the low explosive friction igniter. The resulting explosion is transferred to the primary high explosive detonator. The detonating wave is then transferred into the main secondary high explosive charge.

[Pictures of a PMA-3 have been removed.]

Account of Activities

28) The following is a description of the events leading up to and following the accident. The information from the investigation forms the basis of the description of events.

31/07/01.

0840 hrs – Uncontrolled detonation at W01-40.
0843 hrs – Medical treatment given at the CP.
0845 hrs – MACC informed of accident from 56A.
0845 hrs – Information passed to KFOR.
0855 hrs – MACC Programme Manager informed.
0900 hrs – Casualty taken to HLS red 28.
0940 hrs – Casualty arrives at HLS Red 28.
0947 hrs – Heli move of casualty to KFOR military hospital in Pec.
0950 hrs – MACC passed all accident details from 56A.
1000 hrs – BOI convened by MACC Programme Manager.
1005 hrs – 56A informed of BOI and asked to secure the site and extract senior personnel.
1015 hrs – QA Medical Officer departs for KFOR military hospital in Pec.
1330 hrs – QA Medical Officer arrives at KFOR military hospital in Pec.
1600 hrs – QA Medical Officer departs hospital.
1800 hrs – QA Medical Officer arrives at MACC.

01/08/01

0600 hrs QA Team Leader departs MACC for accident site.
0600 hrs QA Medical Officer departs MACC for [Demining group] base location.
0800 hrs QA Medical Officer arrives at [Demining group] base location and questions medic.
0900 hrs QA Medical Officer departs [Demining group] base location.
1000 hrs QA Team Leader arrives at accident site.
1200 hrs QA Team Leader departs accident site for KFOR military hospital in Pec.
1500 hrs QA Team Leader arrives at hospital.
1600 hrs QA Team Leader questions [the Victim] with reference to the accident.
1700 hrs QA Team Leader departs hospital for MACC.

Insurance Details

29) All [Demining group] staff involved in UXO/mine clearance activities in Kosovo are covered by the standard [Demining group] insurance through Lloyds of London

Conclusions

30) Based on the accident investigation, the statements and visit to the site, the BOI conclude the following:

- There was an uncontrolled detonation of a PMA-3 anti-personnel mine on the 31st July 2001, in a minefield situated in the Kurvalla region of Kosovo.
- [The Victim] could not exactly remember what action he was carrying out at the time of the accident. He stated, when questioned, that he was either probing or moving a rock with his probe.

- The uncontrolled detonation therefore occurred either through one of the following actions:
 - a) [The Victim] probing directly onto the PMA-3 mine.
 - b) The probe contacting with the PMA-3 mine as [the Victim] attempted to remove a rock (which was just in front of the detector signal), with his probe through pivotal action.
- Either of the above actions would cause the detonation of a PMA-3 anti-personnel mine, especially if the pressure was applied on the outer edges of the pressure plate.
- In either case, the accident is therefore deemed preventable through non compliance to [Demining group] SOPs (Para 153, 154 and 168 to Addendum No 6 dated 12th April 2001) and MACC Guidelines and Technical Standards for Mine/UXO Clearance (Para 4.7 and 4.19 dated 13th February 2001).
- The 10mm diameter thick probe, as used by [Demining group] demining personnel, may also have been a contributing factor.
- The accident scene was not secured as per MACC instructions on the day of the accident. Clearance continued 1/2m past the seat of detonation, the equipment and PPE were removed from the site and the lane was not closed off. It is appreciated that due to the location of the site, it was not possible for the BOI to attend the scene on the day of the accident, but everything should still remain in place and not be tampered with. One exception to this rule would be the removal of expensive items of equipment such as detectors.
- The BOI therefore disagrees with the following points as detailed in the [internal Demining group] Accident Report:
 - The drills were not being carried out as per SOPs (see above).
 - The accident was preventable (see above).
- Concerns expressed in the above report regarding the use of Red 32 HLS and the provision of helicopter assistance have now been rectified.
- The PMA-3 anti-personnel mine had not been laid on its side to defeat manual clearance techniques.
- Confusion exists with regards to the exact type of casualty information that needs to be passed onto to KFOR.
- The medical evacuation was very good, considering the distances and terrain involved (the helicopter was actually waiting for the casualty to arrive at the HLS).
- Further specific medical conclusions are detailed at Annex H.

Recommendations

31) The following are recommendations based on the BOI conclusions:

- No amendments be made to [Demining group] SOPs or the MACC Guidelines and Technical Standards for Mine/UXO Clearance.
- [Demining group] conduct refresher training for all their manual demining teams with regards to manual clearance techniques and SOPs.
- [Demining group] looks into their design and dimensions of their probe, namely the diameter of the probe. It is appreciated that there is a fine line between manual dexterity and increased the fragmentation hazard of disintegrating probes on uncontrolled detonations, but a 10mm thick diameter probe does seem rather wielding and excessive.
- The post accident/incident scene management drills are followed in their entirety as per organisational SOPs and MACC Guidelines and Technical standards.

- MNB (W) Liaison Officer confirms exactly what information is required by KFOR in order to instigate a casualty evacuation plan. Also that this information is passed onto all clearance organisations and the MACC QA Section in writing.
- Once the above confirmation has been finalised, a CASEVAC exercise be conducted in MNB(W). Results of which are to be passed to MACC QA Section.
- Further specific medical recommendations are detailed at Annex H.

Signed: UNMIK Mine Action Co-ordination Centre, QA Team Leader.

Annexes: [some not made available]

- A. MACC convening order for accident investigation Board of Inquiry.
- B. List of personnel involved with attached statements as Appendices.
- C. IMSMA Mine/UXO Incident/Accident report.
- D. Map of the general area.
- E. Schematic diagram of the general area.
- F. Schematic diagram of the accident area/scene.
- G. VJ Mine Record
- H. QA Medical Officers Report.

Comments by the MACC Chief Operations Officer

I fully concur with the Investigating Officers conclusion that this accident may be deemed preventable. Both the [Demining group] SOP, page 27 and 29, paragraph 154 and 168 respectively, in conjunction with the MACC Technical Guidelines and Standards, page 20, paragraph 4:19, state clear drills to be observed when conducting prodding drills over stony terrain. They both specify that individual rocks are to be fully and carefully probed around prior to removal. This specific drill was introduced following a similar accident in 2000.

Whilst the cause and effect of this accident are considered to be relatively straight forward and the de-miner is fortunate to have only suffered comparatively light injuries, the non-adherence to basic after accident scene management is particularly disturbing. The drills and procedures for the preservation of an accident scene are clearly identified in MACC Technical Guidelines and Standards Chapter17 and should be fully adhered to. In this way valid and objective conclusions and recommendations may be arrived at so that objective lessons may be learnt by all and a repeat of the same accident may be avoided.

The concerns regarding the ability of a helicopter to land at HLS Red 32 are now proven to be invalid. Their source was a young KFOR helicopter pilot who was not in possession of all the necessary facts. The Chief of Air Ops for MNB (W) has personally stated that helicopter Medevac from either Red 28 or 32 HLS is not only possible but will be implemented whenever it is required.

The Recommendations and Conclusions of the Board of Inquiry are fully endorsed and agreed with.

Signed: UNMIK Mine Action Co-ordination Centre, Chief of Operations

Victim Report

Victim number: 479	Name: Name removed
Age:	Gender: Male
Status: deminer	Fit for work: not known
Compensation: Not made available	Time to hospital: 1 hour 20 minutes
Protection issued: Frontal apron	Protection used: Frontal apron, Long visor

Long visor

Summary of injuries:

INJURIES

minor Face

severe Hand

AMPUTATION/LOSS

Finger

COMMENT

See medical report.

Medical report

[The following report was made available by the Kosovo MACC in January 2002. It has been edited for anonymity.]

(W 01-40) accident 31/07/01.

This report is based on interviews/statements of the following persons:

[Name excised]: [Demining group] Medic.

[Name excised]: [Demining group] Deminer (Victim)

Dr. [Name excised]: Surgeon at Italian KFOR Hospital in Peja

Victim: [Name excised]:

[Demining group] Deminer

Injuries:

[The Victim] was taken by helicopter to KFOR Hospital in Peja and treated for: Traumatic amputation of part of left hand forefinger with destruction of surrounding tissues.

Introduction:

At the time of the accident the Team Leader and the Medic with all his medical equipment was at the Control Point. At 08:40 they heard a detonation from the area where the deminers were working. The Team Leader went to investigate and the Medic stayed at the C.P to prepare for first aid.

After a few minutes the casualty came walking to the C.P assisted by the Team Leader and a deminer. The Medic immediately took care of him.

[The Victim] had injuries on his left hand, there was no major bleeding but he was in a lot of pain.

The Medic gave analgesic: 100mg Pethadine intra muscular.

No intravenous cannula was set and no other drugs were given.

The hand was bandaged with first aid dressing and crepe bandages and a triangular bandage was applied, a minor wound in the face was also cleaned.

A request for Helicopter MEDEVAC was sent to KFOR but the most suitable HLS is 2 km from the place of the accident.

[The Victim] had to walk 2 km over difficult terrain assisted by the Team Leader and the Medic. At 09:30 they got to the HLS where the Helicopter was waiting for them. The Medic handed the casualty over to the Helicopter crew and the Team Leader accompanied the casualty to Italian KFOR Hospital in Peja.

There was no Medic and no medical equipment in the Helicopter during the flight to Peja.

The Helicopter arrived at the hospital at 10:00.

At the hospital Dr. [name excised] and Dr. [name excised] took care of the casualty and he was immediately sent to the operating theatre for a primary surgery.

He had serious injuries in his left hand and amputation of the top of the forefinger and he will stay at the hospital for further treatment.

Conclusions:

No intravenous cannula was set and no fluid was given.

There was no Medic or medical equipment in the Helicopter during the flight to Peja.

The casualty was not carried on a stretcher.

Overall CASEVAC time was 1 hour 20 min.

Recommendations:

In case of trauma injury:

- Always set intravenous cannula and give fluid.

- It is preferable to give analgesic intravenously.

- The Medic must always accompany the casualty to the next level of medical facility.

- Always take trauma victims on a stretcher.

- The overall MEDEVAC time should be within the hour.

Signed: Medical Quality Assurance Officer, MACC Kosovo

Analysis

The primary cause of this accident is listed as "Victim inattention" because it seems that the victim tried to move a rock with his probe, or probe around a rock without sufficient caution. The secondary cause is listed as "Unavoidable" because he may have been working in an approved matter when the accident occurred.

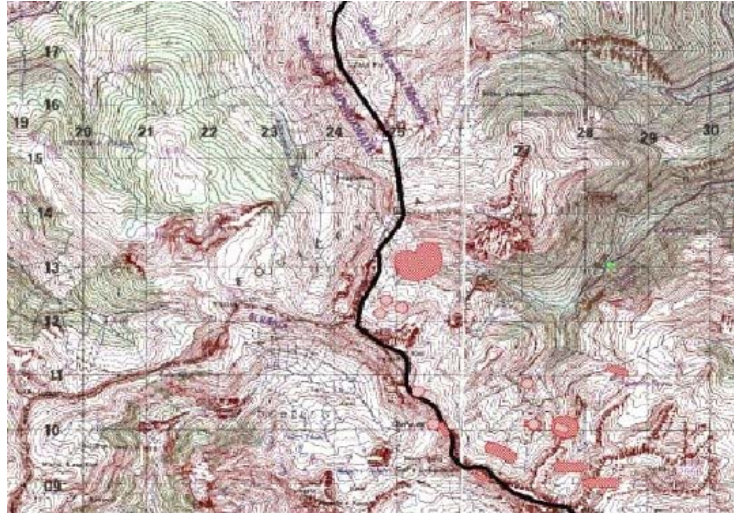
Note the fact that the gardening glove provided no protection to his left hand. If the deminer was right handed, the left hand would have been guiding the probe and would have been far closer to the detonation than the right hand. This may be especially true when trying to move rocks with a probe. There is no record of which hand the deminer favoured.

The 10mm thick mild steel probe had been favoured by the demining group for several years and had been approved for use in Kosovo. However, it is thick, heavy and not easy to push into soft soil. It was the only excavation tool issued to these deminers, which meant that the drills involved removing loosened soil with the left (other) hand. This has often been criticised as especially dangerous.

The body armour apron used by the demining group is made of ballistic aramid and has a NATO STANAG V50 rating of 380 m/s (as opposed to the 450 m/s recommended in the IMAS). The lower rating and the more flexible material have proven effective against blast mines in more than 25 excavation accidents listed in this database.

Maps

The following area map was appended to the UN MACC report as an Annex.



Related papers

[Some annexes were made available (see also “Maps”). Other annexes were mostly cover sheets without content. The exceptions are reproduced below.]

Annex A to MACC Accident Report No 010/2001 dated 06/08/01

CONVENING ORDER FOR ACCIDENT INVESTIGATION BOARD OF INQUIRY.

1. The Programme Manager of the Mine Action Co-ordination Centre hereby appoints the following members to form a Board of Inquiry to investigate a UXO accident that occurred on the 06th April 2001
 - a. President - MACC QA Team Leader.
 - b. Member - Medical Officer.
2. {Demining group} Programme Manager is requested to provide an observer and assistance to the Board of Inquiry.
3. The Board of Inquiry is to carry out a full investigation and provide a written report to the MACC by 0800 Tuesday 07th August 2001. The report is to be written in the English language.
4. The Report of the Board of Inquiry is to consider the details attached at Appendix 1 to this Annex.
5. The Board of Inquiry is to issue an information bulletin to members of the mine/UXO clearance community in Kosovo, to inform them of the accident and any relevant information and actions that should be taken by them immediately.

Annex B to MACC Accident Report No 010/2001 dated 06/08/01

LIST OF PERSONNEL.

1. The following personnel are members of [Demining group] Team No1 and were working in the accident area on the day of the accident:
 - a. – Team Leader.
 - b. – Injured Deminer
 - c. – Deminer (No2 to D. Singe).
 - d. - Deminer
 - e. - Deminer
 - f. – Medic.

2. The following personnel were not directly involved in the accident:
 - a. – [Demining group] Programme Manager.
 - b. – Operations Officer.

Appendices: [not made available]

1. [Demining group] Accident Report.
2. Witness statement from Team Leader.
3. Witness statement from Deminer
4. Witness statement from Deminer.
5. Witness statement from Deminer.
6. Witness statement from Medic.

Appendix 1 to Annex A to MACC Accident Report: No 010/2001 dated 06/08/01

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The Report of the Board of Inquiry is to consider the details below:

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4. Priority of Task.
5. Site Layout and Marking.
6. Management, Supervision and Discipline on site.
7. Quality Assurance and Quality Control.
8. Communications and Reporting.
9. Medical, including injuries sustained.
10. Personalities, Team Identity No's and Interviews.
11. Equipment and Tools.
12. Details of the Mine/UXO involved.
13. Evidence of re-mining.
14. Dress and Personal Protective Equipment.
15. Use of Dogs.
16. Use of Machines.
17. Particulars of Deminers Insurance.
18. Detailed account of the activities on the day of the accident.
19. Summary.
20. Conclusion.
21. Recommendations.