

DDAS Accident Report

Accident details

Report date: 15/05/2006	Accident number: 219
Accident time: not recorded	Accident Date: 14/03/1998
Where it occurred: Trebinje, Nr Dubrovnik, RS	Country: Bosnia Herzegovina
Primary cause: Unavoidable (?)	Secondary cause: Management/control inadequacy (?)
Class: Missed-mine accident	Date of main report: 25/03/1998
ID original source: RM/LS/SL/EB	Name of source: BiH MAC
Organisation: Name removed	
Mine/device: PMA-2 AP blast	Ground condition: electromagnetic hard
Date record created: 16/02/2004	Date last modified: 16/02/2004
No of victims: 1	No of documents: 2

Map details

Longitude:	Latitude:
Alt. coord. system:	Coordinates fixed by:
Map east:	Map north:
Map scale: not recorded	Map series:
Map edition:	Map sheet:
Map name:	

Accident Notes

dog missed mine (?)
mine/device found in "cleared" area (?)
inadequate metal-detector (?)

Accident report

A Board of Inquiry report was made on behalf of the relevant government body (not the MAC which was then UN controlled). The BOI report was made available by the country MAC. The investigators included an ex-pat Technical Advisor and QA staff, although the accident was not classed as a demining accident because it did not occur during formal demining. What follows is a summary of the report. The full report (edited for anonymity) is in *Related papers* at the "Other documents" tab.

The demining group were undergoing training in preparation for an anticipated joint demining contract with an international demining company. The weather in their home area was bad so they went to Trebinje to "refine drills and procedures".

The accident occurred in a suspected mined area where no detailed records were available. Mines in the area were mostly PMA-2 and PMR2-A. Both types were found when the area involved was cleared in January 1998 (by a commercial company).

The area was mountainous with much of the land having a thin soil cover that made it generally accepted that prodding to the required depth was "difficult". The "high metal content of the ground" could make it impossible to use detectors. The favoured demining method for the area was explosive detecting dogs.

The training programme on the day included marking practice and demining drills using manual methods and dogs. The victim was putting in route markers. "During this task he apparently stepped onto a mine which activated, causing extensive injury to his right foot and lower limb". The mine was 1.2 metres inside the area marked as clear by the previous commercial company. The training exercise included full medical support and the victim was evacuated to Trebinje hospital within 25 minutes.

The investigators, from experience and in the absence of fragments, decided that the crater was a typical PMA-2 crater, and PMA-2s were known to have been in the original minefield. "Based on the evidence of a series of tests conducted on this type of mine in similar soil conditions" the investigators concluded that the mine had been 13-14cm below the surface. They considered this depth "at the extreme limit of optimum performance of the best detectors" and "below the normal depth for prodding".

Conclusion

The investigators concluded that the mine had been missed during the earlier clearance tasks. Also that the training area was "extremely hostile" and easier sites could have been used. The investigators observed that the UN MAC Technical Guides "give no real guidance as to what alternative procedures should be undertaken" when detecting and prodding are inadequate in an area. In previous missed mine incidents in the area (involving two other commercial companies) the mines were also PMA-2s.

Recommendations

The investigators recommended that explosive detecting dogs be used in the area and in sites with similar conditions. [They were used by the group that missed the mine in this accident.] It was felt that the fact that other mines were found close to the missed-mine during the original clearance may have confused the dogs - "the scent pattern could have permeated the ground to some distance from the mines" - and they recommended that the limitations of dogs be recognised.

Revisions to the make-up of investigating boards were suggested, along with the formulation of technical guidance for work in such areas.

Victim Report

Victim number: 283	Name: Name removed
Age:	Gender: Male
Status: deminer	Fit for work: not known
Compensation: not made available	Time to hospital: 25 minutes
Protection issued: Not recorded	Protection used: none

Summary of injuries:

AMPUTATION/LOSS

Leg Below knee

COMMENT

No medical report was made available.

Analysis

The primary cause of this accident is listed as "*Unavoidable*" because the victim and his group appear to have been working responsibly during training when the accident occurred in an area that should have been safe. The secondary cause is listed as a "*Management/control inadequacy*" because if the MAC's QA and QC systems worked, the previous clearance of the area would have rendered it safe.

The investigation of the accident was annotated aggressively by UN MAC staff who appeared to have resented an outside report and did not know how to react to suggestions from an outside body. The approved demining methods in use ought to leave cleared land safe for civilian use. In fact a commercial company had found three mines on an area of ground previously cleared by a UN MAC team and other devices had been found on land supposedly cleared by other groups. The need to find new ways of improving the clearance standard was obvious, and the failure of the UN MAC to recognise this was a serious failing.

The investigator's suggestion that dogs be used in PMA-2 areas despite their observation that the dogs also missed the mine involved in this incident, is strange.

Related papers

Other documents in the file included reports of other missed mine incidents, a sketch map of the site and the crater. There were also photocopied and indistinct photographs of the site.

Original investigation report

What follows is the original investigation, edited for anonymity.

Report of the Investigation into the Mine Incident in the Trebinje Area on 14th March 1998 by the Republika Srpska Investigation Board.

General

1 A mine incident occurred on the morning of 14th March near Trebinje in an area that had been mined but which had been cleared under the terms and conditions of a previous PIU (World Bank) contract. A [Demining group A] deminer was injured during the incident which occurred while the company was involved in a non-operational training programme, conducting site preparation drills as refresher training prior to commencing a survey and clearance contract. The deminer, [name excised], suffered a traumatic amputation of his right foot above the ankle. No other injuries were sustained.

2 Due to the special circumstances of the incident the RS Demining Commission member and PIU Director, [name excised], requested that the RS International Technical Advisor and three RS Quality Assurance and Accident Investigation members conduct an on site investigation. This was convened on 16th March and the investigation was completed on 17th March 1998.

3 The board members were selected for their knowledge and experience of demining, the local area and accident investigation procedures. It should be noted that with effect 31 March, or the establishment of the EMAC, a team of similar composition would conduct all future investigations.

Mine Incidents and Mine Accidents

- 4 The UN MAC Technical Guidelines define accidents and incidents as follows:
- a A mine accident is defined as an accident involving a mine/UXO, caused during a demining or EOD operation.
 - b A mine incident is an accident involving a mine/UXO not caused during a demining or EOD operation.

5 The UN MAC Technical Guidelines also state that mine incidents can be reported by anyone as the incident can involve any person. The standard form, shown in Technical and Safety Standards Guidelines, should be completed for input into the Mine Database. Mine Accidents that are caused by demining or EOD operations are to be investigated thoroughly, with the aim of preventing a repetition of the accident.

6 Under the terms of the UN MAC Technical Guidelines the event referred to is officially termed as an incident, and as such should be reported to the Republika Srpska police for investigation. Where possible a report, using the format outlined in the UN MAC Technical Guidelines, should be forwarded to the UN MAC to allow inclusion of the data in the Information DataBase. This report has also been submitted to the UN MAC. However, due to the fact that the incident took place in a previously mined area, and involved a Republika Srpska demining company, the PIU Director decided that a technical investigation should be conducted. It is understood that the local police have conducted their investigation.

[Demining group A]

7 The Republika Srpska has two commercial demining companies, [Demining group A] based in Pale and [Demining group B] based in Banja Luka. [Demining group A] has been the more active of the two companies having undertaken several Emergency Demining contracts for the UN MAC and was a logistic support and local co-ordinator to [Demining group C], an International Demining Company, during the previous RS PIU contract.

8 The [Demining group A] Standing Operating Procedures (SOPs) have been accredited by the UN MAC and all members of [Demining group A] teams have previously passed recognised demining qualification training on either US State Department, [Demining group D] or [Demining group E] basic demining training courses.

The 1998 PIU Contract for the RS

9 The latest PIU Contract for the Republika Srpska has been awarded to [Demining group C] who have previously utilised [Demining group A] for logistic, support and co-ordination. [Demining group C] has not yet completed it's mobilization plans or agreed the terms of the contract with the PIU. No members of [Demining group C] were present at Trebinje before or during the training undertaken by [Demining group A].

[Demining group A] Training Plans

10 [Demining group A] teams were conducting basic demining training in preparation for future demining contracts, under the authority of the director of [Demining group A]. Due to winter weather conditions in the Pale region the company personnel travelled to Trebinje to further refine drills and procedures.

Ground Conditions in Trebinje Area

11 An evaluation of the ground conditions in the Trebinje area were conducted by the board members. Trebinje is in the southern part of the Republika Srpska, close to Dubrovnik on the Mediterranean coast. It is a mountainous region, consisting mainly of rocky terrain, sparse scrubland with limited areas of agricultural land. The majority of the rock and soil has a high metallic content, making it unsuitable for the majority of metal detectors currently in use in BiH. In many areas there is little soil covering the rock and what soil there is very compacted, making normal prodding procedures impossible in many locations. This is described in more detail later. During the winter period the vegetation can be easily cut using normal clearance techniques.

The Mine Threat in the Trebinje Area

12 The IEBL and areas adjacent to it in the Trebinje area have, as would be expected, been heavily mined. There are a large number of records of minefields in this area. It is also known that several minefields were rapidly laid by the Serbs, of which no records are available; the PIU has been informed that no records were kept. The incident occurred in one of these areas. This will also be referred to later in this document.

13 The majority of mines found in this area are PMA 2 (minimum metal content mines) and the PMR 2A (fragmentation stake mines). Both types of mines were found and cleared during clearance work in January 1998 on the site where the incident occurred. Annex G details the amount of mines removed from this site during the recent [Demining group C] clearance task.

Previous Work in the Area

14 Trebinje has been nominated as one of the priority areas for clearance and there are a large number of refugees in the area, a figure of 20,000 was given to the board members during discussions with refugee support workers in the area. This figure has yet to be confirmed. The PIU tasks in this area have been at the request of the Ministries of Industry and Reconstruction (Electrical and Power). And are considered important for the reconstruction programme.

15 Over the past year a series of priority tasks have been given to three demining organisations in order to facilitate the clearance of mines in this area. The contracts are detailed below.

a [Demining group D]

[Demining group D], acting on behalf of the US State Department and tasked by the UN MAC, conducted clearance operations in the Trebinje area in March 1997, the site was some 38 kilometres from the centre of Trebinje on a site said to contain mainly PMA 2 and some TM 500 mines.

b UN MAC

UN MAC demining teams from Banja Luka region, acting on behalf of UN MAC Sarajevo, conducted clearance operations in the Trebinje area during December 1997. The site was 11 kilometres South West of the centre of Trebinje and contained PMA 2 and PMR 2A mines.

c [Demining group C]

The Republika Srpska PIU, as part of the 1997/98 contract, tasked [Demining group C] to conduct survey and clearance work in the Trebinje area. Tasks B002 and B003 cleared the area beneath electrical power lines to facilitate repair and reconstruction of this part of the power grid. The site is about 11 kilometres South West of the centre of Trebinje and contained PMA 2 and PMR 2A mines. It is very close to the UN MAC site detailed above. See Annex A for a map of the area illustrating the survey and clearance work undertaken during these tasks.

Previous Accidents/Demining Incidents in the Area

16 The particularly hazardous conditions are well known by all demining organisations who have worked in this area. All have commented on the difficulty of conducting normal prodding procedures to the required depth, i.e. to a depth of 10 cm as specified in UN MAC Technical Guidelines. The high metal content of the ground makes the use of metal detectors redundant. Normal demining procedures therefore cannot be used in this area except in very limited areas of the terrain. The best 'tool' therefore, when available, is the EDDs. To use EDDs correctly special drills and procedures need to be devised and adhered to. This is referred to in the Summary and Recommendations.

Missed Mines

17 The difficulty of conducting clearance operations in this area has been explained above and an historical check of work conducted in this area has revealed that only the three companies mentioned above have worked in the area in the last eighteen months. Of these,

two of the companies have had accidents; occasions have also been documented where mines have been found after the clearance has been conducted.

a [Demining group D] - A mine accident occurred on 14 March 1997. The mine detectors being used were the Schiebel AN 19/2 and the detectors signalled even when there was no metal to be found in or on the ground (the ground has a high metal content). The use of a prodder was deemed as difficult due to rocky terrain and shallow soil coverage. In the investigation summary it states that the deminer had 'missed' the mine and had passed over it twice before it detonated on the third traverse. It should be noted that the accident investigation board consisted of 3 USDCC members and 1 from the UN MAC. See UN MAC report at Annex B.

b UN MAC - A mine accident occurred on 17 December 1997. The mine detector used was the MD 8, the report states that the detector could not function effectively due to the high metallic content of the soil and that prodding was extremely difficult due to rocky terrain. It recommended that excavation must be done and concluded that the mine was 'missed' by the team during the clearance operation. It should be noted that all members of the board were UN MAC personnel. See UN MAC report at Annex C

18 In addition, [Demining group C] found three mines on an area of ground, which had previously been cleared by a UN MAC demining team. See report at Annex D.

19 The incident of 14 March 1998 occurred on an area of land that had been cleared as part of Tasks B002 and B003. See map at Annex E. The [Demining group A] deminer injured in the incident of 14 March 1998 was on a site previously cleared by [Demining group C] and would appear to have activated another 'missed' mine.

Events Leading to the Incident

20 The [Demining group A] training programme on the day of the incident included marking and practice clearance drills, using manual methods and EDDs. The site previously cleared by [Demining group C] was being used to prepare access routes, safe lanes and outer minefield marking. The training programme was not evaluated, as it had no impact on the incident. The statements indicate a series of normal instructions and events for demining training.

The Incident

21 During the training phase [the victim] was putting in route markers near the edge of the cleared area and painting the tops of the markers red. During this task he apparently stepped onto a mine which activated, causing extensive injury to his right foot and lower limb. The location of the mine was some 1.2 metres from the minefield marker, which had been placed by [Demining group C] to define the extent of the cleared area. Photographs of the site are at Annex F.

22 During the training phase the teams all had medical orderlies on site with full equipment. A full casualty procedure was immediately activated and Basic Life Support given. The casualty was carried to the ambulance medical vehicle in the CP for evacuation to the local hospital. The CASEVAC was conducted well and took less than 25 minutes from the incident to arrival at the Trebinje hospital.

23 Discussions with the doctor confirmed that the CASEVAC was well organised and that the medical orderly had dealt with the casualty in an excellent manner.

Site Investigation

24 Statements were taken from all involved personnel, the statements confirmed that normal training activities were being conducted. The site had been selected for training activities, was clearly marked and had been 'closed off' in accordance with Technical Guidelines. The site was checked by EDDs and deminers using prodders before the team conducted the site investigation. The incident occurred some 1.2 metres from the edge of the marked mined area.

25 The hole created by the explosion was 54 cms x 58 cms wide at the top with a depth of 20 cms. The ground around and below the location of the explosion contained rocks and very firmly compacted soil material. No metal, plastic or other material indicating the type

of munition was in or around the hole. The shape of the hole was generally round with the sides shaped to an estimated 50-degree angle. All RS members of the board had recently conducted some 20 accident investigation tests in various soil conditions and agreed that this was typical of a PMA 2 detonation. In addition a PMA 2 mine had been found during the clearance task just 2 metres from the incident site, a PMR 2A had been removed approximately 10 metres to the right. The minefield had contained only PMR 2 and PMA 2 mines. See the site map drawing and photographs at Annex E and F.

26 Based on the evidence of a series of tests conducted on this type of mine in similar soil conditions the conclusion was reached that in probability the detonator was approximately 13 – 14 cms below the surface. If a detector could have been used this would have been at the extreme limit of optimum performance of the best detectors. This is also below the normal depth for prodding.

Evaluation and Equipment Testing

27 During the investigation the normal methods of mine and munition detection were investigated. The following comments are made:

a Testing of metal detectors - A test was conducted on four types of detectors, which were the MD 8, Ebinger 420 PB, the Vallon ML 1614 C and the Vallon ML 1620 B. The test was conducted on several areas of several sites in order to obtain results from the different types of ground conditions. The results confirmed that the majority of the area has a very high metallic content making the use of metal detectors impractical. This conclusion was also reached by the investigation into the [Demining group D] and UN MAC mine accidents detailed above.

b Battery Decay Tests - The mine detectors were all tested for several hours to investigate battery decay and its impact on detector performance and effectiveness. Tests conducted in the Trebinje area established that battery decay has a serious impact on the effectiveness of the detector over a much shorter period than expected.

c Prodding Tests - Prodding tests were conducted in order to establish the ground conditions in the area and to determine the depth to which prodding activities might have been successful during previous clearance operations. The tests confirmed that the prodder could not penetrate the ground to an adequate depth without excavation. This conclusion was also reached by the investigation into the [Demining group D] and UN MAC mine accidents detailed above.

Summary

28 It is the Board's opinion that the mine activated during the [Demining group A] training was a missed mine in an area that had been previously cleared by [Demining group C] during the early part of 1998 as part of task B002, task number 25/17. The training was being conducted in an extremely hostile clearance environment and easier sites could have been utilised. Although most companies would not have conducted training on previously cleared or in such difficult terrain this was not considered to be an attributing factor.

29 This area of land is extremely difficult to demine. Previous accidents, missed mines, lack of detailed records and the impractical use of the basic tools, 'normal' drills and procedures make this area one to be treated with extreme caution.

30 Prodder and Detector performance in this area are, in most cases, impractical and the UN MAC Technical Guidelines give no real guidance as to what alternative procedures should be undertaken. All three contractors involved recently in clearance work did not seem to have developed a technical answer to the problems created by the area, in so much as no amendments appear to have been made to normal drills and procedures. In agreement with the PIU [Demining group C]'s clearance procedures were allowed to include the use of dogs which were not part of the original contractual agreement.

31 The two previous accident investigation reports indicated that the missed mines were both PMA 2 type Anti Personnel mines.

Conclusion

32 While carrying out site marking refresher training the [Demining group A] deminer appears to have stood on a PMA 2 mine which was missed during the previous clearance operation undertaken by [Demining group C].

Recommendations

33 The use of EDDs has proved to be extremely effective during the US State Department and PIU contracts in both the Federation and RS. The restrictions and limitations imposed by the poor clearance conditions in the Trebinje area do not adversely effect the EDDs' performance, however it should be noted that EDDs were used on the [Demining group C] clearance work in the area of the [Demining group A] mine incident. Nevertheless it is strongly recommended that, where possible, dogs should always be used on sites with such difficult clearance conditions but 'normal' drills may require modification.

34 The site records indicated that on the previous clearance task another mine had been found in close proximity to the mine which detonated on 14 March 1998 with another 10 metres away. It should be recognised that since these mines had been in the ground for some time the scent pattern would have permeated the ground to some distance from the mines. Depending on wind conditions and the method of using the dogs it is not impossible that the dog could have indicated the presence of explosives, a mine was found and assumed to be the sole reason for the positive indication. When using dogs on mine clearance sites their limitations must be recognised and procedures used must take these limitations into account.

35 On difficult terrain such as this, consideration must be given to increasing the amount of quality control that is undertaken on the site. For instance, most companies check a 5-10% area of work, it may be necessary to increase this to as much as 20% in difficult areas. This should be considered by the Technical Working Group.

36 Any area of land that has unique features requires special drills and procedures to be adopted in order to ensure a safer and more effective clearance operation. This is certainly the case in the Trebinje area. Special drills were not recommended or instigated after the previous accidents, but they are strongly recommended by this report. Indeed should any contractor be tasked to work in this area during any future RS PIU contracts, drills and procedures will have to be developed and tested in an effort to ensure a safer and more effective operation.

37 The definition of a mine accident and a mine incident contained in UNMAC Technical Guidelines does not conform to the definitions contained in the UN International Standards for Humanitarian Mine Clearance. As this is the definitive document for UN operations it is recommended that the UN MAC Technical Guidelines should be amended accordingly.

38 Accident Investigation Board members should not be members of the organisation being investigated. The board should consist of independent personnel, a member or members of the organisation being investigated should only attend as an observer. It is recommended that this should be considered for inclusion in UN MAC Technical Guidelines.

39 Guidance, drills and/or procedures for areas of land where it is difficult to utilise the 'standard' equipment and methods should be outlined in more detail in the UN MAC Technical Guidelines.

40 Future work in the Trebinje area must develop special drills and procedures in order to address the difficult terrain and ground conditions of the area.

41 UN MAC Technical Guidelines and other documents refer to recommended detectors but do not address the matter in sufficient detail. It is recommended that all aspects of detector selection and use is reviewed with some urgency.

42 The RS PIU must review if it is necessary to undertake work over previously 'cleared' areas in the Trebinje. It is not known if [Demining group D] or the UN MAC have undertaken such a review if not this is also strongly recommended.

Signed by members of the Investigation Board

1	RS Quality Assurance Monitor	March 1998
2	LRS Quality Assurance Monitor	March 1998
3	RS Quality Assurance Monitor	March 1998
4	Technical Advisor to the BiH Demining Commission	March 1998

To PM UN MAC

Date 25 March 1998

Subject: Investigation into the Mine Incident at Trebinje on 14 March 1998

Dear [Programme Manager]

Please find attached the report into the incident at Trebinje that occurred on 14th March 1998. As explained in the report this incident has special circumstances and it was decided to initiate a full investigation. A final copy of the report will be sent to the World Bank by this department. Due to the intense interest shown by the US State Department I have, on this occasion, included them in the distribution list. The final report can of course be distributed, at your discretion, to all interested parties as deemed necessary. I understand that [The World Bank TA] has been requested to explain the cause, circumstances, conclusions, the historical background and technical implications at the next TWG.

It should be noted that we consider that there are several critical issues raised by this report that require to be addressed. We should also like to know what work the UN MAC has undertaken in the Trebinje area and what action was taken after the accident on 17 December in respect of this site. In the light of this investigation's findings it is clear that action should have been and must be initiated.

Please note that due to the composition of this team the text, statements and other documents have taken some time to translate.

Yours sincerely

Copy to World Bank - Washington
US State Department - Sarajevo