

Test and Evaluation Protocol

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Follow-up After Machines

Director
United Nations Mine Action Service (UNMAS)
380 Madison Avenue, M11023,
New York, NY 10017, USA

E-mail: mineaction@un.org
Telephone: (1 212) 963 1875
Fax: (1 212) 963 2498

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Foreword

This CEN Workshop Agreement has been drafted and approved by a Workshop of representatives of interested parties, the constitution of which was supported by CEN following the public call for participation made on 27 November 2006.

Participants in the process were drawn from the following sectors with interests in humanitarian demining: non governmental organisations, other international organisations, national mine action authorities and manufacturers and users of demining machines. The following organisations have been actively participating in the process: Geneva International Center for Humanitarian Demining (GICHD), Switzerland. Active contributions have also been received by representatives from ANAMA, CMAC, CTRO, INTERSOS, PNDHD, SWEDEC, UNMACA, UNMAS, Norwegian People's Aid, Idea Group, Cranfield, DOK-ING, MineWolf Systems AG and Scanjack AB.

The formal process followed by the Workshop in the development of the CEN Workshop Agreement has been endorsed by the National Members of CEN but neither the National Members of CEN nor the CEN Management Centre can be held accountable for the technical content of the CEN Workshop Agreement or possible conflict with standards or legislation. This CEN Workshop Agreement can in no way be held as being an official standard developed by CEN and its members.

The final review/endorsement round for this CWA was started on 2007-12-21 and was successfully closed on 2008-02-21. The final text of this CWA was submitted to CEN for publication on 2008-03-27.

This CEN Workshop Agreement is publicly available as a reference document from the National Members of CEN: AENOR, AFNOR, ASRO, BDS, BSI, CSNI, CYS, DIN, DS, ELOT, EVS, IBN, IPQ, IST, LVS, LST, MSA, MSZT, NEN, NSAI, ON, PKN, SEE, SIS, SIST, SFS, SN, SNV, SUTN and UNI.

Comments or suggestions from the users of the CEN Workshop Agreement are welcome and should be addressed to the CEN Management Centre.

The development of this CWA has benefited from an EC - EuropeAid Co-operation Office, financial contribution allocated in the context of the EC Mandate M/306.

Introduction

Demining machines are essentially used for two functions, ground preparation or ground processing. To operate effectively in either role it is fundamental that the machine must be “fit for purpose”. For example, a vegetation cutter that does not engage the ground/soil cannot effectively be used to process ground if the intent of the operation is to disrupt the soil to a depth of 20 cm.

The concept of “intent” is very important and, before the application of any machine, it must be agreed /decided exactly what is expected/anticipated of the machine in the specific operation, i.e. what is intended to be achieved.

In *ground preparation* operations intent can be relatively straightforward: vegetation cutting and/or clearing, removal of tripwires, loosening of soil, removal of metal contamination, removal of building debris, boulders, rubble, defensive obstacles etc, and the sifting of soil and debris.

However, in *ground processing* the intent can be more complex. For example the demining machines can be used to:

- find mines;
- clear mines; or
- prove there are no mines.

The role against which the machine’s performance is to be measured must be decided early in the planning stages.

1 Scope

This agreement analyses the follow-on processes after the use of demining machines. It makes a general statement about follow-on processes after the use of a demining machine in a *ground preparation* role when the operation is carried out within an area of suspected hazard. More specifically, this agreement focuses on follow-on after the use of machines in the *ground processing* roles of finding mines, clearing mines and proving that no mines exist in a given area.

This document seeks to define the requirement for follow-on behind a demining machine. It does not describe the method of follow-on activities that are already well known and understood by the mine action community.

2 References

The CEN Workshop Agreement CWA 15044 established guidelines that are recommended to be considered before a demining machine is deployed in a hazardous area.

Users of this CEN Workshop Agreement should also refer, in particular but not only, to the following CEN Workshop agreement, International Mine Action Standards (IMAS)¹⁾ and standards from the International Standards Organisation (ISO):

CWA 15044, *Test and evaluation of demining machines*;
IMAS 03.40, *Test and evaluation of mine action equipment*;
IMAS 04.10, *Glossary of mine action terms definitions and abbreviations*;
IMAS 07.10, *Guide for the management of demining operations*;
IMAS 07.30, *Accreditation of demining organisations and operations*;
IMAS 07.40, *Monitoring of demining organisations*;
IMAS 08.20, *Technical survey*;
IMAS 09.10, *Clearance requirements*;
IMAS 09.20, *Guidelines for sampling*;
IMAS 09.40, *Guide for the use of MDD (mine detection dogs)*;
IMAS 09.50, *Mechanical demining*;
IMAS 10.20, *Safety and occupational health (S&OH) demining worksite safety*;
EN ISO 9000, *Quality management systems – Fundamentals and vocabulary (ISO 9000:2005)*;
EN ISO 9001, *Quality management systems – Requirements (ISO 9001:2000)*;
EN ISO 9004, *Quality management systems – Guidelines for performance improvements (ISO 9004:2000)*.

In addition readers should refer to the National Mine Action Standards (NMAS) and/or the National Standard and Technical Guidelines (NSTG) which are in force in their country of operation. They should also refer to any other relevant country-specific technical notes.

The guidance in this Workshop Agreement on follow-on processes after the use of demining machines should be used to augment the guidance offered in the above documents. Other useful references are the CEN Workshop Agreement CWA XXXXX²⁾ *Quality Management – Quality Assurance and Quality Control for Mechanical Demining*, and the 2004 The Geneva International Centre for Humanitarian Demining (GICHD) publication *A Study of Mechanical Application in Demining*.

1) IMAS can be accessed through www.mineactionstandards.org.

2) Result from CEN/WS 29, under publication.

3 Terms and definitions

In the context of this document the definitions in IMAS 04.10 and the following apply.

3.1

follow-on

clearance activities that are undertaken on a site that was initially worked on by a demining machine

NOTE Follow-on activities are not compulsory after a demining machine has been applied on a clearance site as the primary demining activity. In most cases however, follow-on activities are required to achieve the given performance standards.

4 The use of demining machines

4.1 General

The intended outcome of the use of a demining machine will determine what follow-on procedures are applied, assuming that the machine used is fit for purpose.

4.2 Ground preparation

Machines used for ground preparation are those machines primarily designed to improve the efficiency of demining operations by reducing or removing obstacles (see *IMAS 09.50*). In this context, “ground” refers more generally to the area of suspected hazard and not specifically to the soil/s and composition of the earth.

Operations can be carried out using both intrusive and non-intrusive methods.

Intrusive operations are those in which the demining machine (with or without an on-board operator) is deployed inside the boundaries of the suspected hazardous area. In non-intrusive operations the demining machine (or platform machine) is operated from outside the suspected hazardous area – on known safe or previously cleared ground – and an attached tool “reaches” into the hazardous area.

Ground preparation does not normally result in clear ground. Ground preparation is carried out with the *intention* and *expectation* that a follow-on clearance asset or process will clear the ground after the use of the machine. Ground preparation may involve the detonation, destruction or removal of some, but not normally all, landmines and ERW.

Typical activities carried out in order to prepare ground include but are not limited to:

- flailing;
- rotary tilling;
- raking (scratching/pecking);
- ripping;
- rolling; and
- lifting/removing obstacles, etc.

NOTE Some of the above activities can also be used in ground processing (see below).

Given that the intention to remove obstacles in a suspected hazard area is to allow follow-on clearance operations, it follows that ground preparation operations must be followed by a clearance method or a re-assessment of the situation. Which follow-on method is eventually used will be determined by the local conditions, e.g. ground, climate and expected hazard.

4.3 Ground processing

4.3.1 General

In this context, “ground” refers more specifically to the earth/sand in which the hazard is suspected to be buried and not to the general area of the hazard.

In ground processing operations the intent can be to:

- find mines;
- clear mines; or
- prove there are no mines.

Processing operations can occur both on, and off, the suspect hazardous area. Off-site operations are activities that involve the removal of the earth/sand/soil from the suspected hazardous area to an area where some other activity is conducted to remove the hazards, such as sifting and soil processing inspections. On-site operations are activities that occur in the suspected hazardous area such as use of the machine:

- in a technical survey role – where the intent is to find the general location of mines;
- to detonate mines – where the intent is to clear mines; or
- to process soil in an area suspected to be hazardous even though the evidence suggests that there are no hazards; in this case the intent is to use a machine process to “prove that there are no mines”.

4.3.2 Off-site

When a machine is used as part of an integrated off-site processing operation there is no requirement for follow-on procedures in the original suspect hazard area when the soil/sand is replaced, provided adequate QA and QC procedures are in place at the off-site location. However, it should be noted that the guarantee of clearance is restricted to the depth of the earth/sand/soil removed, processed and replaced.

4.3.3 On-site – survey

When machines are employed in technical survey operations, the information they provide is used to make an informed judgement about what to do next. This is no different from technical survey conducted using dogs, manual deminers or some other observational or sensory method.

Follow-on operations after technical survey may not be required, if the machine does *not* encounter a hazard, and has been proven capable of detecting and destroying similar expected hazards in similar conditions. If a machine *does* encounter a hazard then follow-on will be required in all but exceptional cases. The specific follow-on activity can only be determined at the site – and would normally be either by manual demining or mine detection dogs (MDD). The specific area for follow-on operations will be determined on the site on a case-by-case basis.

If optimum climatic and topographical conditions for using MDD are met and the machine has been used to process the whole area on-site, it is recommended by this agreement that only one MDD is required for follow-on because a single MDD is effectively a second tool to the machine.

4.3.4 On-site – technical survey

When machines are employed in technical survey operations, the information they provide is used to make an informed judgement about what to do next. This is no different from technical survey conducted using dogs, manual deminers or some other observational or sensory method.

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If optimum climatic and topographical conditions for using MDD are met and the machine has been used to process the whole area on-site, it is recommended by this agreement that only one MDD is required for follow-on because a single MDD is effectively a second tool to the machine.

4.3.4 On-site - clearance

When machines are employed to detonate mines and where the intent is to clear mines. Follow-on operations after clearance will most likely be required in order to ensure that mines indeed have been cleared. The specific follow-on activity can only be determined at the site and would normally be through manual demining in such case the objective has been to detonate mines. If the purpose has been clearance the ground will be contaminated with explosives as a consequence of detonations and breaking up of mines. This will make employment of MDD in the area difficult unless a considerable soak time is applied.

4.3.5 On-site – ground processing (technical survey)

The purpose of ground processing in a suspect hazardous area is to prove that there are no mines present. Follow-on operations after ground processing may not be required, if the machine does *not* encounter a hazard, and has been proven capable of detecting and destroying similar expected hazards in similar conditions. If a machine *does* encounter a hazard then follow-on will be required. The specific follow-on activity can only be determined at the site – and would normally be either by manual demining or MDD.

5 Follow-on requirements in areas where no hazard has been encountered

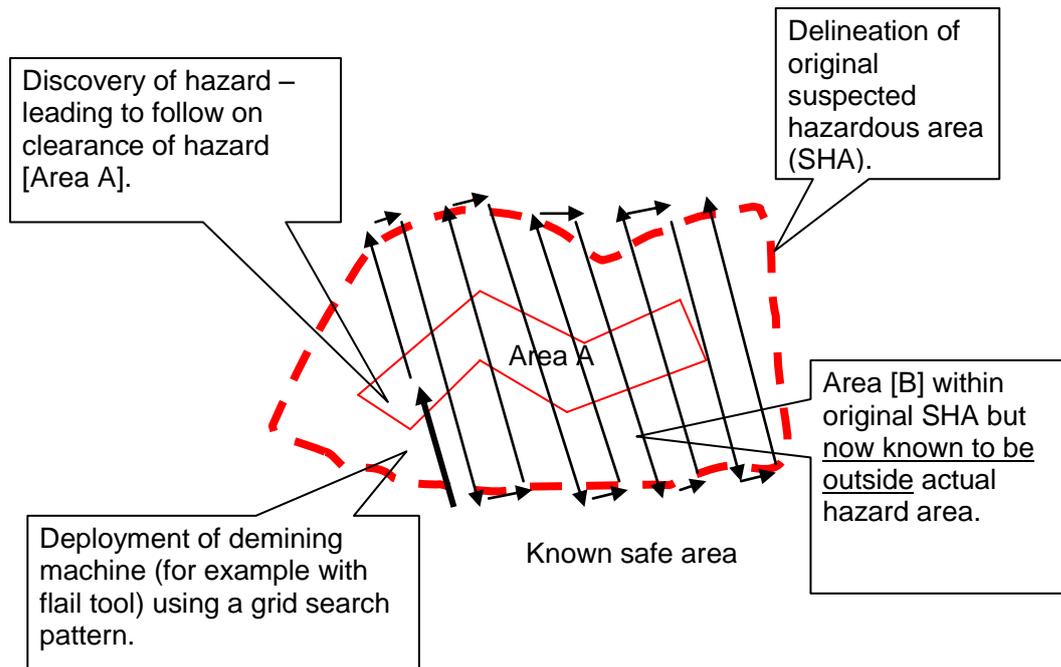
5.1 General

There are four general scenarios in which the outcome of machine use can be the discovery of no hazard. The four scenarios are the use of a demining machine in:

1. Technical survey operations;
2. Hazard mitigation procedures outside, or adjacent to, a known minefield;
3. Verification (that no mines exist) procedures;
4. Clearance operations – where a machine is used with the intent to clear ground but no hazards are found.

5.2 Scenario 1: Use of a demining machine in technical survey operations

In this scenario a demining machine with, for example, a flail tool is used to define the limits of a hazardous area. Characteristically the machine will be used to overlay a grid of search lanes over the suspected area. (See Figure 1.)



Mine detonations or evidence of mines in Area A enable the operator to define the hazard area. This area will then be subject to follow-on clearance
Figure 1 – Standard Use of a demining machine in technical survey operations.

It follows that the demining machine will, if the intent of the operation is successful, process ground that is *both mined and not mined*.

When mined ground is encountered follow-on in line with IMAS 09.50 will occur, as the now-confirmed hazard will be defined and can be cleared with other assets, and subjected to QA and QC before it is released for handover as safe cleared ground.

NOTE The machine use may result in no defined area of hazard but simply confirm that there are random and sporadic mines laid to no discernable pattern within the SHA – in which case follow-on will occur on most if not all of the SHA.

Other ground in the SHA, however, that is “processed” to reach and define the actual mined area may not contain a hazard or hazards: it follows therefore that follow-on, with another machine, MDD or manual deminer, *may not be required*.

Establishing whether this is true or not must be based on:

- full knowledge of the targets likely to be encountered; and
- understanding (through QA and QC) that the demining machine and tool is working to capability (i.e. fit for purpose, for example that it is working to the specified depth).

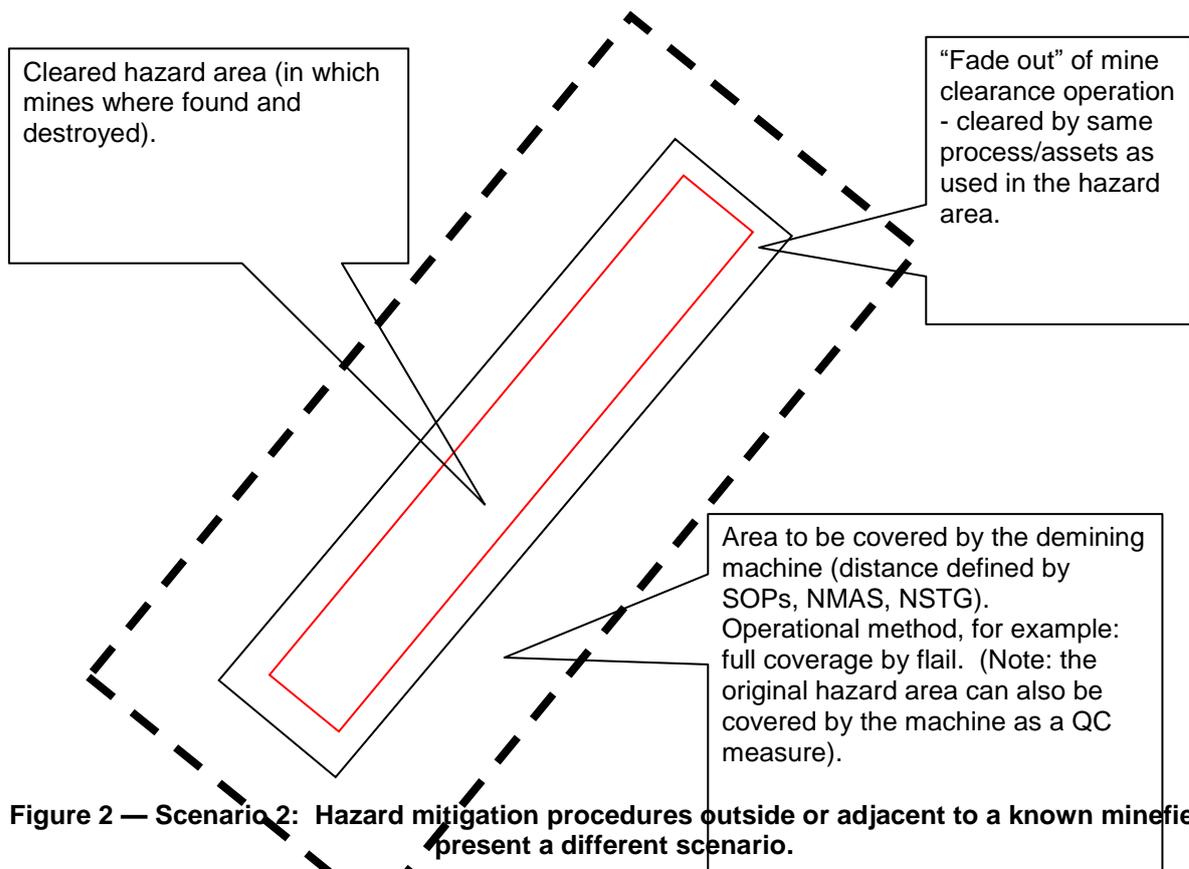
If these conditions are met there is no requirement to apply follow-on procedures or assets. These conditions and the method to evaluate that the conditions have been met, must be defined in the operators Standard Operational Procedures (SOPs) and in NMAS or NSTG.

This workshop agreement recommends that where a demining machine has been successfully used to reduce an SHA to a definable minefield (which will be cleared with other assets) there is no requirement for follow-on in the area where mines have not been encountered.

However, although no follow-on with other assets is required, QC and a visual inspection in the area should be conducted. Also, the decision making process leading to the “not to follow-on” decision shall be fully documented in release documentation.

5.3 Scenario 2: Use of a machine in areas outside, or adjacent to, a known minefield

In this scenario an SHA has been identified as a mined area that it is accurately delineated – possibly through possession of reliable minefield records. The hazard area will normally be cleared by assets other than a machine – although a machine may be used to conduct ground preparation or ground processing. Once the delineated hazard has been cleared – SOPs or NMAS or NSTG may require a confidence procedure to check that no hazard has moved from the known mined area into the surrounding area, for example because of animal traffic or water wash. In this case, a demining machine with a tool such as a flail may be used to verify that no hazard exists. (See Figure 2.)



If a hazard is encountered in the area outside the original hazard area then follow-on shall be conducted in line with IMAS 09.50

If, however, no hazard is encountered then a follow-on process is not required.

This workshop agreement recommends that where a demining machine is used in this confidence role, and where no hazard has been encountered, there is no requirement for follow-on in that area.

However, although no follow-on with other assets is required, QC and a visual inspection in the area should be conducted. Also the decision making process shall be fully documented in release documentation.

NOTE The procedures of Scenario 2 can be used when a single mine is encountered – i.e. the mine is manually cleared and “fade out” distance/area defined and then a machine is used to mitigate outside this area and over the hazard spot for QC purposes.

5.4 Scenario 3: Verification

In this scenario, a demining machine is used to verify that an area of ground suspected to be hazardous does not in fact contain hazards. This scenario tends to occur when an implementer has more information than local people – but, for reasons of confidence building with the community, the clearance implementer (or national authority) decides to demonstrate that the area is not hazardous. (See Figure 3.)

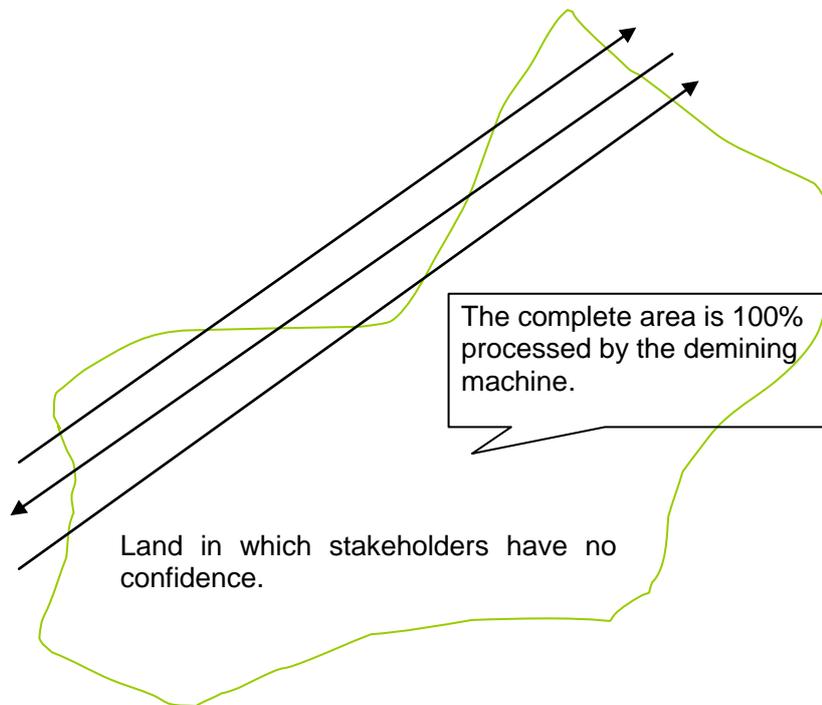


Figure 3 —Scenario 3: Verification.

If no hazards are encountered during the verification process then follow-on is not required.

However, although no follow-on is required, QC and a visual inspection in the area should be conducted. And the decision making process shall be fully documented in release documentation.

5.5 Scenario 4: Clearance operations

Unfortunately, survey data can be based on incomplete information – and uncertainty can lead to areas being assumed to be hazardous when they are not.

A demining machine may be used to process such an area with the intention of clearing it yet the result is that there is no evidence of any hazard. ***In this case – if the capability of the machine is well understood and the anticipated target was inside the capability range of the machine – a decision could be taken not to follow-on.***

However, although no follow-on is required, QC and a visual inspection in the area should be conducted. And the decision-making process shall be fully documented in release documentation.

6 When follow-on is not required after hazards are encountered

In certain circumstances a demining machine can be used as the primary clearance asset at a hazardous site. In some **exceptional** circumstances (explained below) no follow-on – beyond visual inspection – is required.

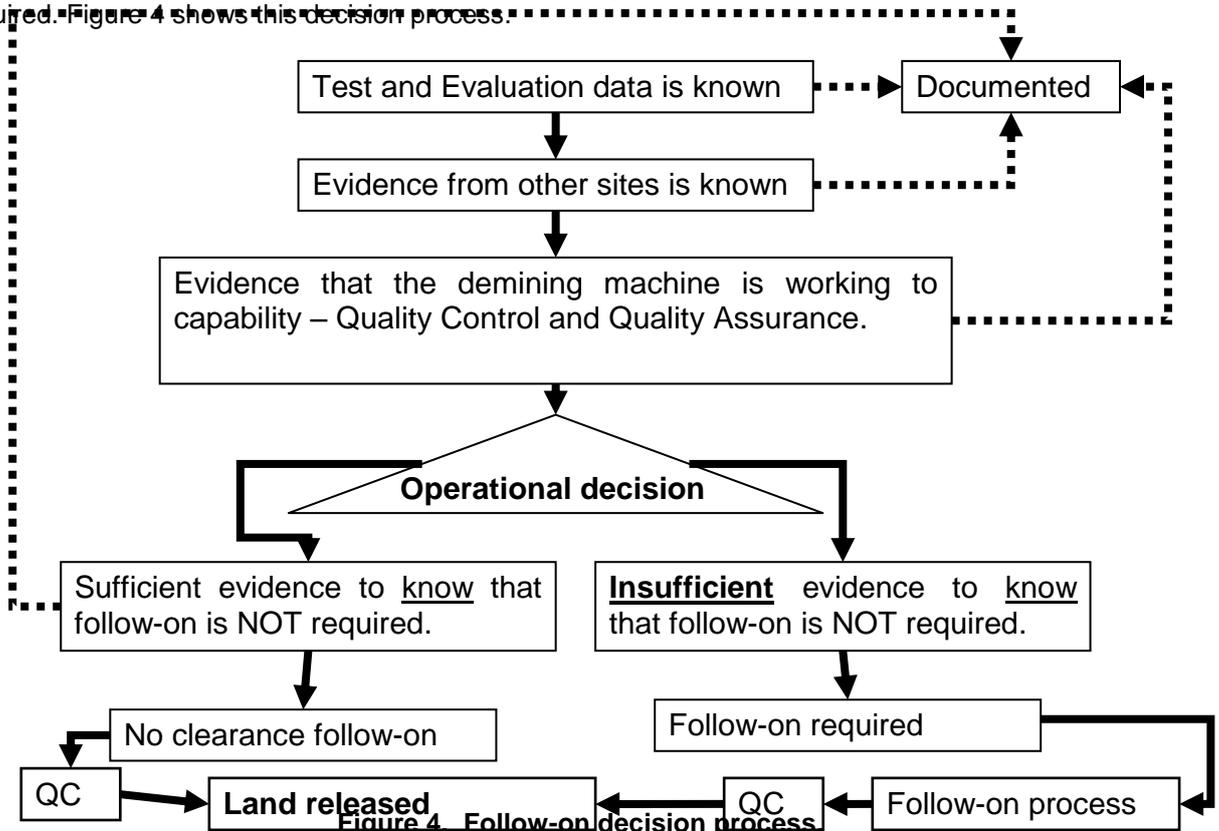
The decision whether to follow-on or not must be based on evidence. This evidence must be based on knowledge documented from:

- previous testing and evaluation of the demining machine;
- national accreditation of the demining machine;
- previous field evidence (from similar sites) of the capability of the demining machine to destroy the specific and expected target hazard;
- evidence, through QA and QC monitoring, that the demining machine is working to its optimum capability at the site; and
- evidence, through QA and QC monitoring, that the operator is working the machine correctly.

Furthermore, the criteria for this operational decision must be included in the operators accredited SOPs for the demining machine and be in line with criteria set out in NMAS or NSTG (and/or national law).

NOTE Demining law that details specific clearance operations are the exception rather than the norm.

Possible example: a machine of known capability is working to that capability in conditions similar to those in which it was tested and evaluated, and in conditions similar to other areas where a sufficient body of evidence exists to state that it is *known* that the machine will destroy all targets of a specific type, therefore no follow-on is required. Figure 4 shows this decision process.



The conditions for no follow-on occur *very exceptionally* and in general follow-on will be undertaken when demining machines are used for clearance.

7 Summary

In summary, the overall guidance of this Workshop Agreement is as follows:

- a) The intended outcome of the use a demining machine will determine what follow-on procedures are applied.
- b) Follow-on is required when a machine is used for ground preparation in a hazardous area.
- c) Follow-on is not required when a machine is used for ground preparation in an area that is not hazardous.
- d) When a machine is used as part of an integrated off-site processing operation there is no requirement for follow-on procedures in the original suspect hazard area when the soil/sand is replaced provided adequate QA and QC procedures are in place at the off-site location
- e) Follow-on after survey: if the machine does not encounter a hazard, but has been proven to be capable of detecting and destroying similar expected hazards in similar conditions, then follow-on operations may not be required. If a machine does encounter a hazard then follow-on in anything other than exceptional cases should be undertaken.
- f) Follow-on is also not required in four general scenarios in which the outcome of machine use is the **discovery of no hazard**. They are the use of a demining machine in:
 - technical survey operations;
 - hazard mitigation procedures outside, or adjacent to, a known minefield;
 - verification (that no mines exist) procedures; or
 - clearance operations – where a machine is used with the intent to clear ground but no hazards are found.

In these circumstances, if no hazard is encountered no follow on is required – given that the capabilities of the machine are understood and QA and QC systems are in place.

In certain circumstances a demining machine can be used as the primary clearance asset at a hazardous site. In some **exceptional** circumstances no follow-on – beyond visual inspection – is required.

- g) Decisions about follow-on be based on documented evidence from:
 - previous testing and evaluation of the demining machine;
 - national accreditation of the demining machine;
 - previous field evidence (from similar sites) of the capability of the demining machine to destroy the specific and expected target hazard;
 - evidence, through QA and QC monitoring, that the demining machine is working to its optimum capability at the site; and
 - evidence, through QA and QC monitoring, that the operator is working the machine correctly.

8 Agreement statement

The agreement described in this document has been reached over three meetings. The workshop concluded that this agreement should be seen as an advisory document towards the development or revision of existing, International Mine Action Standards. The workshop members do not believe that this agreement should, in itself, be a stand-alone document defining specific actions within the complex considerations of the use of machines in humanitarian demining. The workshop also concluded that this agreement is of a significantly different character to those that have preceded it in the mine action sector such as CWA 14747-1 [1], CWA 15044 [2] and CWA 15464 [3].

Unlike preceding CEN Workshop Agreements, this agreement does not set out a test nor does it set out any evaluation procedures or processes. Instead, this agreement is presented as a series of condition statements contributing to the wider consideration of the use of machines.

The workshop consensus was that the CEN workshop process was not ideally suited to the subject of follow-on processes after the use of demining machines. This was not at first apparent but, by the second meeting, it was clear that, within the subject matter, there was little of real contention and little that was not already covered either directly or obliquely in many IMAS, national mine action standards or operator standard operating procedures. The utility of this agreement document is, however, that the various key factors are presented in one document.

Bibliography

- [1] CWA 14747-1, *Humanitarian Demining Actions – Test and evaluation – Part 1: Metal Detectors*
- [2] CWA 15044 -2004 *Test and evaluation of demining machines,*
- [3] CWA 15464-2005 *Humanitarian Mine Action – EOD Competency Standards – Parts 1 to 5*