

# Environmental Management Tool Kit for Obsolete Pesticides



## Volume 3

- G. Safeguarding strategy
- H. Disposal strategy
- I. Environmental assessment report and environmental management plans

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# Foreword

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**T**his third volume of the FAO Environmental Management Tool Kit (EMTK Volume 3) provides a framework for how to use the data collected using tools A–F in EMTK Volumes 1 and 2 in designing a project-implementation plan for obsolete pesticides. It provides practical guidance on how the inventory, environmental risk assessment data, store prioritization, storage and transport data for obsolete pesticides in a country can be used to produce three main outputs:

- **A safeguarding strategy (tool G)**, which describes who will take the key responsibilities in implementing the repackaging, transportation and storage of obsolete pesticides and contaminated materials for higher-, moderate- and lower-risk sites (tools A and B), and, more particularly, the role of national personnel (government and private sector) and the level of input from specialist waste-management contractors.
- **A disposal strategy (tool H)** that outlines how the country may treat each of the major waste streams identified in the inventory (obsolete pesticides, contaminated soils and building materials, and contaminated containers and equipment), with a focus on maximizing the use of local or national facilities and, most importantly, according to international best practices and proven technologies.
- **An environmental assessment (EA) report** with an environmental management plan (EMP) (tool I), which provides a format for the presentation of all data and outputs from Volumes 1–3 of the EMTK series to produce a plan for the environmentally sound management of obsolete pesticides and associated wastes based on the country's overall environmental situation.

This volume is aimed at country project managers (as part of a project management unit [PMU]) who will be responsible for preparing the project implementation plan. It is designed to assist them in reaching fact-based decisions to determine strategies for the safeguarding and disposal of the wastes identified during the inventory. It will also assist in the development of implementation plans that will be presented for endorsement to national stakeholders and decision-makers, donors and international agency partners. It is envisaged that in key areas the PMU will be supported by specialist consultants who have experience in the main subject areas. The number and type of consultants a country needs will depend on the capacity of government personnel to complete sections of the analysis themselves and on the availability of competent national consultants to assist government staff. The introduction to EMTK Volume 3 advises how countries can define the level and type of input from consultants that will be needed. It is important to keep in mind that the PMU and other national stakeholders have a central role in the development of the various outputs – of which the final options selected will have to be approved by the responsible agency within the national government.

The EMTK series is supplemented by other guidelines of the FAO Pesticide Disposal Series. The FAO Pesticide Stock Management System (PSMS), which was developed to automate the process of site prioritization and environmental risk assessment presented in EMTK Volume 1, is also assumed to be available to the PMU. Each set of guidelines is supported by a series of training modules that can be obtained from FAO upon request and for which FAO can provide technical support based on access to project funding. The guidance contained in the EMTK series, other FAO guidelines and the training modules form a complete package that will assist the country in selecting the most appropriate implementation strategies based on a detailed situation analysis and an assessment of local capacity (both personnel and technological).

Note that these guidelines do not aim to provide detailed guidance on the various technical details of the safeguarding process; nor do they give an in-depth technical review of the various disposal options currently used to deal with obsolete pesticides and associated waste. These issues are dealt with in detail in EMTK Volume 4 and in guidelines developed by other partners, such as the Global Environment Facility, the World Bank, Secretariats of the Basel and Stockholm Conventions and the United Nations Environment Programme (Chemicals).

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# Acronyms

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ASP	Africa Stockpiles Programme
DTO	disposal technology option
EA	environmental assessment
EMP	environmental management plan
EMTK	Environmental Management Tool Kit for Obsolete Pesticides
ERA	environmental risk assessment
ESM	environmentally sound management
FAO	Food and Agriculture Organization of the United Nations
HSE	health, safety and environment
M&E	monitoring and evaluation
MSDS	material safety data sheet
PMU	project management unit
POP	persistent organic pollutant
PPE	personal protective equipment
PSMS	Pesticide Stock Management System
SBS	Secretariat of the Basel Convention
SC	steering committee
SOP	standard operating procedure
SWOT	strength, weaknesses, opportunities and threats [analysis]
TOR	terms of reference
UN	United Nations
UNEP	United Nations Environment Programme
WHO	World Health Organization



# Table of tools in the EMTK series

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The Environmental Management Tool Kit (EMTK) series for management of obsolete pesticides is composed of the following volumes, each of which contains a series of tools. For ease of the reading, references to the tools will only be mentioned by their numbering.

Environmental Management Tool Kit Volume 1:

- Tool A: Environmental risk assessment
- Tool B: Prioritization of stores
- Tool C: Regional prioritization and risk tracking

Environmental Management Tool Kit Volume 2:

- Tool D: Selection of collection centres
- Tool E: Management of collection centres
- Tool F: Transport planning

Environmental Management Tool Kit Volume 3:

- Tool G: Safeguarding strategy
- Tool H: Disposal strategy
- Tool I: Environmental assessment report and environmental management plan

Environmental Management Tool Kit Volume 4:

- Tool J: Zoning of the workplace
- Tool K: Risk assessment
- Tool L: Standard operating procedures
- Tool M: Selection and use of equipment
- Tool N: Health, safety and environment plans

# Introducing the FAO Environmental Management Tool Kit for Obsolete Pesticides

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## Background

The preparation of coherent and environmentally sound strategies for the safeguarding and disposal of obsolete pesticides and associated wastes is a vital component of pesticide management. The guidance contained in this document provides the user with the support needed to complete the development of the strategies for safeguarding and disposal along with offering formats for the presentation of the *environmental assessment* (EA) and associated *environmental management plans* (EMPs). The development of a project-level EA that includes a detailed EMP to identify and then mitigate the risks associated with the implementation of these strategies is a prerequisite for any project supported through FAO and other agencies, such as the World Bank<sup>1</sup> involving the safeguarding and disposal of obsolete pesticides and associated wastes. The EA should provide a detailed analysis of the relationship of the pesticides and their storage locations with the country's<sup>1</sup> general environment. This will allow a complete assessment of potential impacts during the implementation of safeguarding and disposal activities.

Volume 3 of the Environmental Management Tool Kit series for Obsolete Pesticides (EMTK Volume 3) provides countries with step-by-step advice on how to develop these strategies and how to then identify the risks associated with their implementation. It uses data collected during the inventory and through the application of tools A–C (EMTK Volume 1) and tools D–F (EMTK Volume 2) to formulate a series of national strategies based on the specific country situation. It then shows how these crucial outputs can be combined to form a single, country-specific EA report for obsolete pesticides and associated wastes. Both the EA and the EMP should be considered as practical tools to act as an overall guide in assisting countries during subsequent project implementation.

## Objectives

As outlined in the foreword to this document, EMTK Volume 3 provides the user with the support necessary to meet the objectives facilitated by tools G–I. Tool G supports the development of a safeguarding strategy that is based on the specific conditions in the country plus the production of an objective risk analysis of the implementation options available. Tool H assists in the development of a coherent disposal strategy for all types of waste based on an analysis of national capacity to treat persistent organic pollutants (POPs), other obsolete pesticides, contaminated soils and building materials, and contaminated containers and equipments. Tool I consolidates all outputs from tools A–H and the relationship of the affected sites with the overall environment of the country into a country-level EA report. Using this tool will also support the formulation of a project-level EMP for higher-, moderate- and lower-risk sites as identified using tools A–C.

## Audience

EMTK Volume 3 has been developed for:

- **Officers of the Ministries of Agriculture, Environment and Health** to support them

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<sup>1</sup> The World Bank Safeguards Policy on Obsolete Pesticides requires that any project that meets the criteria resulting in it being classed as a Category A (high risk) must complete a Country Environmental and Social Assessment. This process has been followed for countries participating in the first phase of the Africa Stockpiles Programme which were supported through global environment facilities (GEF) funds channelled through the World Bank.

in the development of objective strategies for safeguarding and disposal based on local conditions and bearing in mind national capacity.

- **Country project managers, project coordinators and PMUs** in charge of the national obsolete pesticide programmes to help them devise and develop EMP for risk reduction.
- **Key decision-makers** within government.

#### Presentation

The document is divided into three main tools based on key outputs, and it also refers to the use of outputs from other tools within the EMTK series.

**Tool G** (safeguarding strategy) reviews the options available to countries regarding the role of national personnel from government or the national waste-management sector and the level of input from specialist waste-management contractors and/or consultants. The strategies proposed look at the likely roles and responsibilities of key participants in the repackaging, transportation and storage of the obsolete pesticides and associated wastes. It explores a number of options for safeguarding and reviews their potential for dealing with the higher-, moderate- and lower-risk sites (see tools A and B for definition). It is foreseen that the PMU will develop the safeguarding strategy with facilitation from FAO or a similar organization.

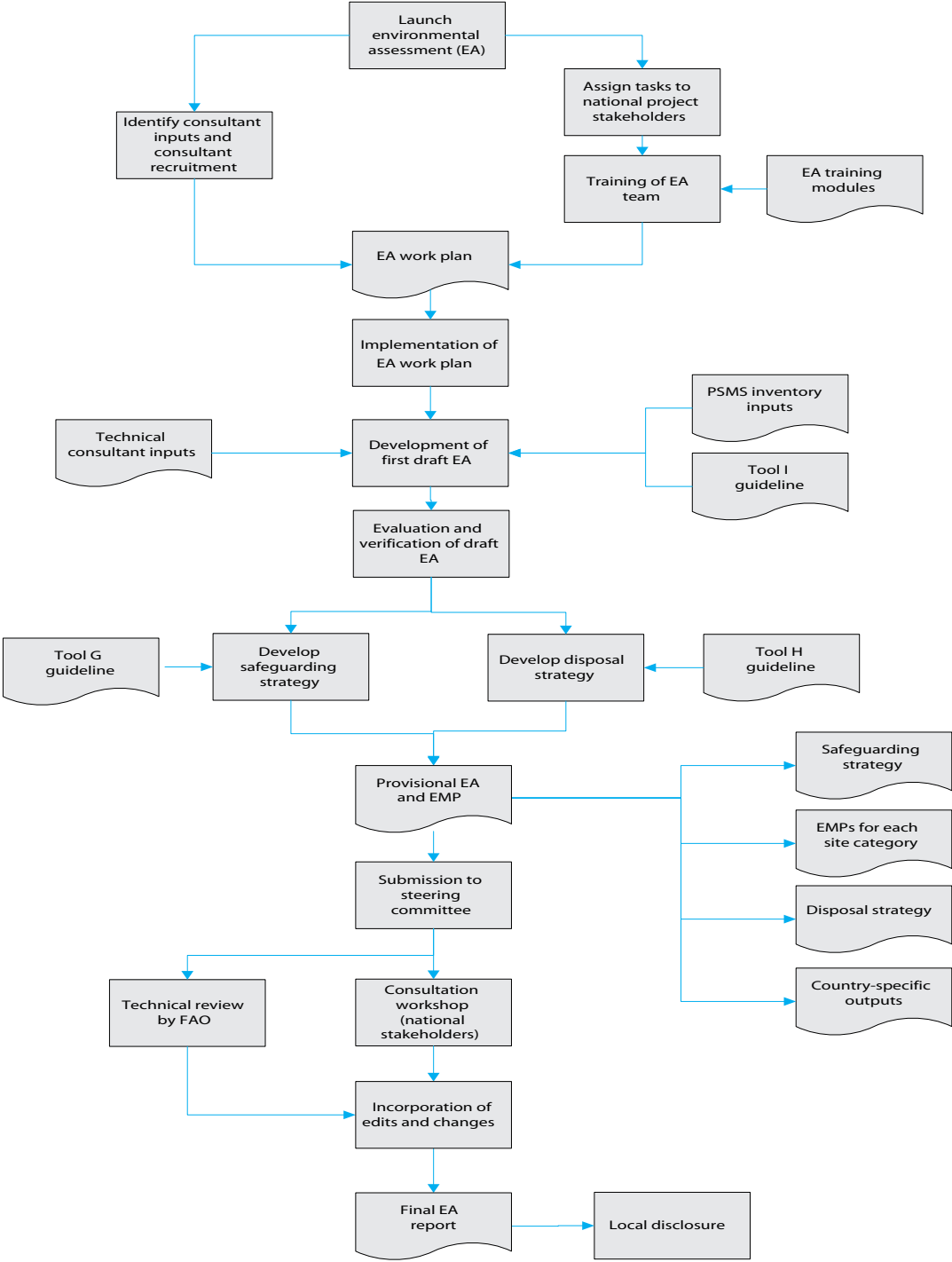
**Tool H** (disposal strategy) provides guidance on how countries may treat each of the major waste streams identified in the inventory (obsolete pesticides, contaminated soils and building materials, and contaminated containers and pesticide-application equipment). It centres on the completion of a national disposal capacity assessment, typically by a consultant. It provides draft terms of reference for this study. As a general principle, the strategy will try to maximize the level of local disposal for each waste stream, provided compliance with international best practice can be ensured. The issue of standards of disposal is also highlighted, with links to other related guidelines provided.

**Tool I** provides a format for combining and presenting all data and outputs from tools A–H into a national EA report. The format provided allows for the presentation of the various outputs in relation to the broader environmental situation in the country. It is anticipated that the EA report will be drafted by a consultant in collaboration with, and under the supervision of, the PMU. The EMP annexed to the EA examines the implications of the safeguarding and disposal strategies in terms of several key factors and supplies details on the specific risk-mitigation strategies to adopt to ensure that implementation of the plans has no adverse impact on public health and the environment. Formats are presented as a guide and it is expected that the EMP will also be completed by a consultant working in close collaboration with the PMU. The EMP gives the PMU an opportunity to investigate the potential budget needed to implement their preferred strategies. Both the EA and EMP formats have been developed in collaboration with the World Bank during implementation of the first phase of the Africa Stockpiles Programme (ASP). The formats are provided as guidance and the preparation of the final EA report will need to take account of any national requirements during preparation and approval.

Note that EMTK Volume 3 does not supply in-depth guidance on the various technical details of the safeguarding process nor an exhaustive technical review of the various disposal options currently used to deal with obsolete pesticides and associated waste. These issues are dealt with in detail in EMTK Volume 4 and in guidelines developed by other partners as listed in the foreword to these guidelines. EMTK Volume 3 aims to provide the tools necessary to allow countries to develop coherent risk-based strategies for the safe repackaging, transportation, storage and disposal of obsolete pesticides based on the scope of the problem and an assessment of national capacity.

It is assumed that the PMU has completed a national inventory of all obsolete pesticides and associated wastes successfully and that this data has been entered and verified within the FAO PSMS. If the project does not have access to the PSMS it is assumed that the principles of tools A–C

Figure 1  
Outline of the steps in drawing up an environmental assessment (EA) report



have been applied manually and that a preliminary risk-based prioritization of all affected locations has been completed.

## Importance of the safeguarding and disposal strategies

The development of the safeguarding and disposal strategies along with the preparation of EMPs for higher-, moderate- and lower-risk sites will have a direct impact on the implementation phase of the project. The assessment of the national capacity for the safeguarding and disposal of the waste will allow the PMU to determine the exact inputs and resources that will be needed for safe and successful implementation, and ultimately to define *who* will take the key responsibilities for completing the different safeguarding activities. The strategies will also inform the development of the scope of work for any future tender for safeguarding and disposal services. They will have a direct bearing on:

- the plan for inputs procurement such as drums and protective equipment (government or contractor);
- the type, amount and duration of personnel inputs (managerial, supervisory and operational);
- transport requirements for personnel, equipment and waste (in-country and internationally);
- disposal services for obsolete pesticides and associated wastes (in-country and international options).

The EA and associated EMP will allow the PMU to outline the risks and mitigation measures for the various categories of affected site. It is likely that different safeguarding strategies will be appropriate for higher-, moderate- and lower-risk locations. Similarly, the potential for using a national disposal/treatment option for each of the major waste streams may differ. The EMP examines this data and provides a format that can be used to present it in an easily understood manner. In all cases, it is important that the data collected and the decisions reached are risk based, justifiable and fully transparent.

The EA format presented in this volume will allow the PMU to present the relevant data in a document that can be discussed with all project stakeholders. Public consultation and complete disclosure of the information will be a key factor when trying to secure full public support for the project.

It should be noted that during the implementation of safeguarding and disposal operations, it may be necessary to resettle people living in close proximity to a contaminated area temporarily. FAO has no formal policy on temporary or permanent resettlement. For the purposes of this document it is assumed that any resettlement will be completed according to national regulations by the appropriate government department. Any and all costs associated with such resettlement will follow the rules of the national government which must also accept all liability associated with this issue. Under certain circumstances, the safeguarding activity may be completed with the support of other development partners. In such cases, it is likely that policies related to resettlement will need to be drawn up. This may require a more detailed social analysis of the impact of the project (which is not covered in this document) and additional advice from the relevant institution needed.

Figure 1 presents the process for completion of the strategies, the EA and the EMP. It also highlights the need for specific inputs at various stages of the process in terms of consultants, training and technical guidance. Figure 1 clarifies how these inputs fit into the overall process of completing the EA process. By following this step-by-step approach, it is anticipated that PMUs can manage the process of EA development and can understand the importance and timing of key aspects such as consultation and disclosure, and the timing of consultant inputs.

## Consultation and disclosure

The development of plans related to the safeguarding and disposal of hazardous wastes typically attracts a great deal of interest from a wide variety of stakeholders at national and international level. Figure 1 identifies key points in the EA development process, where formal consultation with stakeholders is advised and which also allows for the public disclosure of the complete EA report. The aim of the consultation step in the process is to allow for comment and inputs in the final EA report by stakeholders outside the PMU, such as the steering committee (SC) and technical agencies supporting the EA process. Inputs from non-governmental organizations (NGOs) and civil society partners, local research bodies, the pesticide industry and the farmers groups all need to be considered in the final EA document. With respect to the disclosure step, it is important that societies in the vicinity of any of the affected sites, proposed storage areas and final disposal facilities are informed ahead of time of any new project to allow for any concerns over the proposed EA to be raised before the implementation phase starts. Failure to address the consultation and disclosure aspects of the EA process adequately pose significant risks to the project in terms of potential complaints and resistance to implementation in the form of demonstrations, adverse media coverage and associated negative publicity and reputational risk to all partners.

## Institutional arrangements

The implementation of the process outlined in Fig. 1 will require inputs from a number of key partners and the establishment of a management structure that facilitates the preparation of the outputs and their approval and adoption by decision-makers. The following text outlines the key components of the *institutional arrangements* typically in place to allow the process to proceed effectively and efficiently.

### Project management unit

Typically, the overall responsibility for preparing the safeguarding and disposal strategies plus the EA rests with the government through the PMU, which has been appointed to implement the project on behalf of the government. The team responsible for the project preparation is typically composed of a national project manager or coordinator supported by staff from government departments (e.g. agriculture, health and environment) and is usually hosted within the lead ministry coordinating the overall project. During the strategy-development process, the PMU is typically supported by representatives of the NGO sector, the local pesticide industry and specialist consultants (national or international). As it is the PMU that is generally most familiar with the distribution of wastes and the overall country context, it completes much of the preliminary data collection used to develop the EA, such as inventory data and site prioritization (tools A–C), identification of potential storage and collection-centre locations (tools D and E), and the development of transport plans for centralization (tool F). The PMU will also play a lead role in developing the safeguarding strategy for each category of affected site (higher, moderate and lower risk) with support and facilitation from external partners, such as FAO, other agencies or external consultants. The PMU is again a key partner in this process as it is best placed to assess national capacity and the potential for using government personnel, government vehicles and national contractors during the safeguarding process. The PMU will need to follow national regulations related to the submission of the final EA document for in-country approval by the national environmental body, and this should be clarified at the start of the EA process to ensure that the roles of all partners are defined and accepted clearly.

### Steering committee

The approval of safeguarding and disposal strategies and of the final EA report is also the government's responsibility, typically through the *national project steering committee* for

the project. The steering committee (SC) is composed of representatives from government departments (agriculture, environment, health and others) and key stakeholders in the country (e.g. farmers groups, civil society, pesticide industry).<sup>2</sup>

### Consultants

At the initial stage of scoping the EA process, it is important that the PMU identifies all consultant inputs that are required, based on the country setting and national capacity. The country may choose to hire a single consultant firm to complete all tasks or a series of individual consultants. Given the highly technical nature of some of the surveys and the limited numbers of national and international experts available on the market, another option would be to encourage consultants to form a consortium based on the project's needs and their specific areas of expertise. The requirements of the procurement process should be considered during this assessment as this may pose limitations on the type of consultant to be hired (company versus individual) and the selection process to be followed.

It is advised that a principal environmental assessment consultant (herein referred to as *principal consultant*), with experience in the preparation of comprehensive EA reports of this type be recruited. The principal consultant will provide support to the PMU in consolidating all the various inputs into the EA and in formulating a provisional EA document that can be sent for presentation to all stakeholders as part of the national consultation process.

In addition, it is likely that specialist technical consultant inputs will be needed in certain key areas, such as:

- reviewing the national disposal capacity, which forms a key input to the project's final disposal strategy and will need assessment by a competent, impartial body;
- assessing the potential for local management of contaminated containers along with the assessment of contaminated sites;
- developing recommendations related to long-term remediation of contaminated sites and material.

The relative importance of these inputs will vary from country to country. Therefore, the PMU will need to assess the number and type of consultants needed to assist in EA preparation. Typically, the PMU will request the recruitment of a series of national or international consultants based on the terms of reference (TOR) for each group. (Examples of some TORS are provided in Annex 1.) The outputs from these studies will also be incorporated into the final EA report by the principal consultant.

### National environmental body

The final approval of the EA on behalf of government typically rests with the national environmental body under application of national regulations. This will include the application of rules related to public disclosure of the document to allow for any comments from possible interested and affected parties. This may also influence the structure and contents of the EA and EMP reports and have an impact on the overall process to be followed by the PMU and consultants.

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<sup>2</sup> See *FAO Inventory guideline* (Section 2.2 "Institutional and implementation arrangements for inventory") for further information about the management structure typically developed under an inventory project but which might very well be maintained for the rest of the safeguarding project.

# Tool G

## Safeguarding strategy

Previous tools presented in EMTK Volumes 1 and 2 provide detailed guidance on establishing: *what* are the types of waste to safeguard and the risks associated with pesticides inside the store and outside for public health and the environment (tool A); *which* are the sites to safeguard in priority (tools B and C); *where* and how should the safeguarded pesticides be transported and safely stored (tools D–F). Tool G deals with the question of *who* will do the work and take the key responsibility during implementation of the safeguarding activity (repackaging, transport and storage) of the three site categories (higher-, moderate- and lower-risk sites).

Tool G will also highlight how the decisions made regarding the safeguarding process need to be integrated into the project's final EA presented in tool I. The EA will be subject to a national consultation and disclosure process, so it is important that there are rational arguments for the selection of one strategy instead of another. The principal responsibility for making these decisions will rest with the PMU and ultimately the SC. There is also a clear role for the principal consultant as outlined above.

It is anticipated that this strategy will be developed as a collaborative, consultative process involving development partners such as FAO and national stakeholders, including line ministries, NGO groups and the local pesticide industry. It is foreseen that the development of the strategy will include consultant inputs in key areas related to soil assessment and container management, and that a principal consultant will be responsible for reviewing data and drafting the final strategy document. The strategy will then need to be approved by national decision-makers and included in the overall project EA (tool I) prior to disclosure and wider consultation at national level.

### Objectives of the tool

Tool G shows the user how to:

- define the components of safeguarding;
- examine the potential safeguarding options;
- select the most appropriate safeguarding options for higher-, moderate- and lower-risk locations;
- analyse the risks for the preferred safeguarding options;
- develop risk-mitigation plans for the selected safeguarding options.

### Outputs of the tool

Tool G assists the user in achieving the following outputs:

- 1 completed Tables G1 and G3, which are used to determine who will take the responsibility for key actions during the different safeguarding activities (repackaging, transportation and storage) and for the different site categories (higher-, moderate- and lower-risk sites);
- 2 determining the relative merits of each possible safeguarding option through an analysis of their relative strengths, weaknesses, opportunities and threats (a SWOT analysis). This process includes an assessment of the availability of competent government and national contractor staff to complete the various safeguarding activities;
- 3 a set of G5 forms completed for all high- and moderate-risk locations;



- 4 a completed Table G7 to provide a risk analysis of each stage of the safeguarding options selected in point 2 above;
- 5 a completed Table G8 to provide a mitigation plan for the risks identified.

## Description of the tool

Tool G contains three main sections. The first guides the user through the process of adopting the most appropriate *safeguarding options* regarding who will complete the different safeguarding activities in the three site categories and who will take key responsibility for the work. The second section assists the user in strengthening the safeguarding strategy by assessing the major risks associated with the implementation of the preferred options. The third section helps the user develop a mitigation plan to reduce these risks.

The formats and examples aim to provide adequate support for selecting and justifying the most appropriate safeguarding option for each of the higher-, moderate- and lower-risk stores as defined in tool B. The tables presented in tool G should be considered the minimum level of outputs needed to define the safeguarding strategy selected for each category of site. The user is free to supplement the analysis and the tables, based on experience and local risk-assessment requirements. Additional technical guidelines related to this tool are provided as annexes at the end of this volume. FAO has also developed a series of training modules that can be used to consolidate the process developed in this tool (see footnotes throughout this text). Prior to reviewing each of the steps above in more detail, the user is invited to recap on the environmental risk assessment (ERA) and the site prioritization process presented in tools A–C. A recap of these tools is presented in Annex 2.

### Defining the components of safeguarding

The term *safeguarding* has various meanings. In terms of the management of obsolete pesticides, FAO defines *safeguarding* as the steps needed to repackage, transport and store obsolete pesticides safely. The term can be expanded to include such aspects as the excavation of buried pesticides and heavily contaminated materials (which will then be repackaged to allow transport and storage) and the decontamination, crushing/fragmentation and centralization of old pesticide containers. Safeguarding can therefore be seen as the main risk-reduction step in the overall management of obsolete pesticides. By the end of the safeguarding stage, all obsolete pesticides should have been:

- repackaged safely into new United Nations (UN) approved packaging suitable for transport to an interim storage point or the final disposal/treatment facility;
- transported safely to predetermined centralized storage facilities according to the requirements set out in tool F;
- stored safely at collection centres selected and managed according to tools D and E, pending final environmentally sound disposal.

## Practical guidelines for the development of a safeguarding strategy

Selection of safeguarding options (see Table G1 and Box G1)

The safeguarding strategy developed as part of the overall EA for obsolete pesticides must provide details on *who* will be responsible for each step in the three main activities (repackaging, transport and storage) for each category of site (higher, moderate and lower risk) identified using tools A–C. An analysis of the alternatives and a justification of the final decisions made are also required. By the end of this section the user should be able to complete Table G1 below, which helps identify key areas of responsibility.

**Table G1**  
**Selection of responsibility options for key safeguarding components**

	Repackaging	Transport	Storage
Higher risk	Management: Supervision: Implementation:	Personnel: Equipment: Waste:	At the site: Interim collection points: Main collection points:
Moderate risk	Management: Supervision: Implementation:	Personnel: Equipment: Waste:	At the site: Interim collection points: Main collection points:
Lower risk	Management: Supervision: Implementation:	Personnel: Equipment: Waste:	At the site: Interim collection points: Main collection points:

When a project on safeguarding starts, the preferred option is often for all safeguarding activities to be completed by specialist waste-management contractors. The following sections show that while this option may appear to be the easiest strategy and that it does offer some clear advantages, it is not always feasible, desirable or even economically justified. It is important to consider national competences and to explore ways in which they may be developed during the implementation of a project. In general terms, the following safeguarding options are considered for all projects:

- Option 1:** 100 percent international contractor implementation.
- Option 2:** 100 percent government self-implementation.
- Option 3:** international contractor implementation in partnership with government.
- Option 4:** international contractor implementation with subcontracting to a national contractor.

FAO provides support to countries in selecting the most appropriate option. This process considers issues such as the:

- risks associated with each option;
- time frame for implementation of each option;
- cost implications of each option;
- scope of work as set out in the inventory (number and distribution of stores, type and quantity of waste, amount of leakage, etc.);
- risk profile (proportion of higher-, moderate- and lower-risk stores) as defined in EMTK Volume 1 and in the PSMS;
- definition of who is responsible for management, supervision and implementation of safeguarding activities;
- establishment of who will be responsible for the procurement and supply of all equipment inputs and services;
- assessment of local capacity in the government and the private sector;
- assessment of the potential for capacity development in the government and the private sector.


This process of defining who is responsible for each set of activities can be completed as a training workshop involving a mixed group of stakeholders. In workshops provided by FAO, the PMU and other stakeholders are requested to complete a SWOT analysis<sup>3</sup> for each option above based on their current understanding of the project in their country. Participants are also invited to provide additional options which are then also subjected to the SWOT analysis

3 The SWOT analysis requires the PMUs to examine the strengths, weaknesses, opportunities and threats of each option.

process. In general terms, the four options provided in the text are applicable to over 90 percent of safeguarding projects. When analysing each option, it is important that the core issues of risk, cost, time and capacity development/skills transferred are considered.

The process should be completed for each category of store (higher, moderate and lower risk), as factors such as number of stores, presence of highly toxic materials requiring specialist handling, risk to public health and environment and the need for trained personnel will vary for each category. The responsibility for managing, supervising and implementing should also be explored in each option as this will influence the final safeguarding option selected for each category.

**BOX G1**  
**SWOT analysis to determine responsibilities for key actions during safeguarding**




The positive side of the 100 percent international contractor option is the low risk because of the assumed high level of competence (training and experience) of the contractor personnel. It also means the transfer of risk and liability for any accident resulting from factors such as the selection of wrong packaging, poor work practice or road accidents, as all aspects of the management, supervision and implementation are the contractor's responsibility. The 100 percent contractor option may also result in quick implementation if the contractor can mobilize all personnel and equipment to the country in good time.

However, on the negative side, using expatriate contractors to complete all aspects of the project results in relatively high costs compared to other options. In addition, this option does not usually result in the training of national staff, so the level of skills transfer is low.

In contrast, the SWOT analysis for Option 2 (100 percent government implementation) provides a relatively low-cost solution compared to using contractor personnel. It also means greater levels of stakeholder ownership and involvement. There are, however, major issues related to the safe implementation, risk management and overall competence of government staff to implement this type of project. There may also be issues related to the willingness of government to assign staff to manage, supervise and implement such a technically complex and potentially high-risk project. Another major limitation identified for this option is the capacity of national procurement processes to ensure the timely supply of equipment to the correct specification (packaging, protective equipment, etc.).

*Figure G1*  
*SWOT analysis for Option 1 (100 percent contractor implementation)*



*Figure G2*  
*SWOT analysis for Option 2 (100 percent government implementation)*

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FAO PESTICIDE DISPOSAL SERIES –  
ENVIRONMENTAL MANAGEMENT TOOL KIT FOR OBSOLETE PESTICIDES – Volume 3

It is now necessary to examine the options for each of the main components of safeguarding (repackaging, transport and storage). The level of contractor and government involvement can vary greatly in each of these areas, so any safeguarding strategy should clarify who is responsible for the management, supervision and implementation of the repackaging, transport and storage of the obsolete pesticides and associated wastes. This will have a direct impact on the scope of services included in any tender for safeguarding and disposal services.

Selection of repackaging options (see Boxes G2 and G3)

The repackaging of obsolete pesticides is a potentially highly hazardous exercise. All personnel involved in this activity should have proven competencies or should be trained to complete the work safely and with no impact on themselves, their co-workers, the general public or the environment. Tools A–C show how to identify higher-risk stores that pose the greatest risk owing to the toxicity of the products, the quantity of material or the risk of exposure because of leakage. These stores invariably need high levels of worker protection, strong management systems and well-developed emergency plans to complete the repackaging safely.

At the other end of the spectrum, it is likely that there are stores that contain small amounts (less than 500 kg) of low toxicity materials (WHO Class III or U) which are in packages in relatively good condition with little or no potential for exposure of workers. All workers must still be competent to complete the repackaging activities, but the lower-risk means that the level of worker protection and the systems used to repackage this waste will differ greatly from the higher-risk stores.

It is therefore common for projects to adopt different strategies for the repackaging at each category of store, with varying levels of inputs from specialist contractors and locally contracted labour (government or local waste-management companies). It is important to note that worker safety and environmental protection are key considerations when any repackaging option is being planned. FAO will support only those projects that adopt the highest standards of worker safety and environmental protection. It is also important to consider the points in Box G2 concerning competence when making decisions on repackaging options.

**BOX G2**  
**Involvement of government staff**

A decision needs to be reached as to the level of involvement the government can commit to. In some instances, involvement will be limited to the development of the TOR for national and international contractors to complete safeguarding activities. Alternatively, the government may wish to use the project as an opportunity to develop a national chemicals-management capacity at managerial, supervisory and implementation levels. In addition to the policy issues, it is also important to consider the scope of the project. Typically, projects that involve the safeguarding of large amounts (several hundreds of tonnes) of obsolete stocks scattered in numerous locations (more than ten) over a wide geographical area will require increased levels of government or national contractor inputs, as the hiring of international contractors will be too costly. However, in many instances, there is a lack of national contractor capacity. Thus, it is left to the government to provide the personnel, who are then trained to develop the necessary level of competence by the disposal contractor or FAO. Such skills transfer typically involves supervised work at high-risk locations with increasing levels of responsibility transferred to national staff over time, based on continuous assessment of the individual staff member. In the recent past, this strategy has been successfully adopted in projects in Ethiopia, Mali, Mozambique, the United Republic of Tanzania and Tunisia.

Each of the four safeguarding options outlined above offers a potential solution for the repackaging of obsolete pesticides. It is important that the PMU now examines the specific needs of the project on the one hand and the national capacities available to assist in the implementation of repackaging activities (as highlighted in Boxes G2 and G3) on the other.

BOX G3

Involvement of national contractors

The use of national contractors working in partnership with experienced international companies has been successful in a number of projects completed to date. The decision to use a national contractor can either be the result of a local tender/procurement process or because an international contractor has appointed a local partner to assist in implementation. In both cases it is critical that there is a full assessment of any national contractor’s capacity to ensure that it is competent to complete all activities assigned to it under a safeguarding contract. It may be possible to promote the competence of the local contractor for implementation of future projects through a skills-transfer plan. This would also develop local capacity in the private sector which would assist in the overall development of a chemicals-management capacity at national level.

A further factor to consider is liability and insurance coverage. All local contractor inputs will require similar levels of insurance coverage as for international contractors. In the case when more than one contractor is involved in the project, seamless insurance coverage must be assured. Local contractors have been used successfully in projects managed through CropLife International in Kenya and Malawi. In these cases, supervision was provided by an international contractor and monitoring and evaluation (M&E) support by FAO.

The challenge the PMU faces is deciding which combination of options is best suited to the scope of the project as defined in the inventory and ERA in the PSMS. In most instances, a combination of options is selected for the different categories of site. Table G2 provides guidance on how the PMU can make decisions on the most appropriate safeguarding option needed for each category of store.

Table G2

Assessment of options for repackaging (higher-, moderate- and lower-risk stores)

Risk (for worker and environment)	Potential level of international contractor input	Potential level of government input	Potential level of national contractor input	Most commonly adopted repackaging option¹
Higher-risk stores	Management, supervision, implementation	Implementation of repackaging with strong supervision by contractor staff (skills transfer)	Supervision and implementation of repackaging based on competence assessment	Option 1 (3 and 4)
Moderate-risk stores	Management, (supervision)	Supervision and implementation of repackaging if skills transfer has been successful	Management, supervision and implementation of repackaging based on competence assessment	Option 3 (2 and 4)
Lower-risk stores	Management (including equipment supply)	All repackaging activities based on competence developed at higher- and moderate-risk stores. All storage and transport	All repackaging activities based on competence assessment	Option 2 (3 and 4)

The most commonly adopted repackaging options for each category of site therefore change according to the risk at the stores and the progressive development of competence gained within government or the national contractor sector through skills transfer and working in cooperation with specialist international contractors.

Even so, this approach of progressive skills transfer and capacity development will not be suitable for all safeguarding projects. There will remain instances where the safest, simplest and most cost-effective solution will be to contract a specialist waste-management company to complete all activities. The decision to opt for one of the solutions outlined above will ultimately be driven by a number of key factors, including:

- **Scope of project:** A project concerning a large number of moderate- and lower-risk stores scattered over a wide geographical area will need longer to implement than one where the waste is concentrated in a relatively few stores. International contractors may not wish to commit large numbers of highly skilled staff to long-term projects. Thus, use of local (government or contractor) personnel may become the only option available.
- **Competence of national staff:** Where national staff (government or contractors) have past experience in implementing similar projects, the option to adopt local implementation is far easier to justify. The development of the necessary level of competence for management, supervision and implementation takes time. Therefore, there is a critical point at which projects may not be large enough to allow national staff to develop the necessary skills to allow safe implementation. Training is only part of the solution; there is a need for extended and supervised implementation in the field to validate and consolidate the competences of national staff.
- **Available budget:** In general terms, the higher the level of input from an international or national contractor the higher the cost per tonne to repackage the obsolete stocks. Personnel costs for contractor personnel are significant and are generally charged on a daily rate which far exceeds the cost of government personnel. In addition, contractors are in the business of waste management to make a profit and so every service provided by them will include a profit margin. With the current funding limitations for projects of this type, it is therefore likely that a lower-cost option using targeted contractor inputs in association with government inputs will be preferred if all obsolete stocks are to be safeguarded.
- **Equipment supply:** The quantities and types of equipment needed for the safeguarding of obsolete pesticides will be defined by the inventory and ERA data. While FAO can supply information concerning the standard and specification of equipment, the exact numbers of each item will need to be determined on a country-by-country basis. A number of options are open to countries for the supply of equipment. The first option is to pass all responsibility for estimating the amounts of materials and supply to the international contractor as part of the overall safeguarding and disposal contract. A second option (which has happened in limited instances) is that FAO has taken on the responsibility for the procurement of equipment. Finally, the country may decide to source suppliers of equipment directly. The first option is recommended as this will result in the international contractor providing the equipment and materials to repackage all waste in all categories of store (higher-, moderate- and lower-risk). This overcomes issues related to the compatibility of packaging with the waste included in the inventory and any issues related to the provision of suitable protective equipment for use by national staff during implementation of repackaging at moderate- and lower-risk stores.
- **Liability and insurance:** The repackaging of obsolete pesticides at all locations will pose a potential risk to public health and the environment. It is possible to minimize this risk to acceptable levels by ensuring all personnel are competent and by adopting procedures and management plans. However, the potential for accidents due to unforeseen problems and human error remains. Any repackaging activity must take account of this risk and provide



the necessary risk-management strategy to mitigate the impacts of any accident. This is most commonly done through liability insurance. International companies will commonly hold high levels of public liability, worker liability, professional indemnity and environmental impairment insurance. It is therefore advantageous to use companies that can provide the necessary coverage under the safeguarding and disposal contract. In the option of 100 percent government implementation, the issue of coverage in case of an accident needs to be considered and adequate insurance be put in place by the national implementing agency in accordance with national legislation.

There are, therefore, a large number of options open to the PMU when it is deciding who will be responsible for the repackaging activities. It will be important that the PMU consider all the issues highlighted above and that there is wide consultation within the government and with other national stakeholders as to the most appropriate option, based on the scope of work, competence and available budget. It is generally accepted that all activities at the highest-risk stores will be completed with higher levels of international contractor input. Within this option, the potential to develop national capacity exists through skills transfer and training of national staff, which can then assist in the repackaging at the moderate- and lower-risk stores. The decision on the level of national implementation will, therefore, form a key component to any safeguarding strategy. The preferred option for repackaging responsibility should be indicated in Table G1.

The final decision on which option is taken for each risk category of store will rest with the SC as the principal government authority. It is therefore important that there are reasoned arguments for selecting a particular strategy versus the alternatives. The PMU will need to present these arguments as part of the overall justification for the selected strategy, which will be included in the final EA document and be subject to public consultation and disclosure (see tool I).

Selection of transport options (see Box G4)

Tool F provides detailed guidance on the safe transportation of pesticides. It deals with the issue of *how* obsolete pesticides should be transported but does not provide guidance on *who* should complete the transport of personnel, equipment and obsolete pesticides. It is important to consider the number and types of transport typically needed during a safeguarding project. Under normal circumstances it will be necessary to provide transport to complete the following tasks:

- deliver equipment to the main storage depot;
- onward transport of equipment to the store where repackaging is to be completed;
- transport project personnel to the store;
- transport repackaged waste to the nearest interim or main collection centre;
- transport personnel and unused equipment to the next store or main collection centre.

In all cases:

- All vehicles will be inspected and will have to meet the minimum standard for safety as set out in tool F.
- All drivers will require training and will be required to follow transport instructions as indicated in tool F.
- The timing of journeys and all routes will need to be planned to avoid seasonal weather variations, dangerous roads and “sensitive” areas as defined in tool F.

The rules in tool F should be applied to all vehicles, irrespective of whether they are project owned, government supplied, locally contracted haulage or internationally supplied. The only exception to this is where local public transport is used for the movement of project personnel to the nearest major town. In such cases, it is impractical to apply the rules presented in tool F.

Factors such as the number of stores in each risk category, their geographical distribution, the amount and type of equipment required and the number of project personnel needed to

complete the activity will have a direct impact on the amount and types of transport needed for project implementation. Box G4 presents some of the more common vehicle supply options used in past projects.

**BOX G4**  
**Options for transport**

**Contract haulage:** The use of contracted haulage for moving personnel, equipment and obsolete stocks will be a major cost to the project and – where possible – it is strongly recommended that this option be minimized or avoided. Transport is typically charged at a “per kilometre” rate, so projects characterized by a wide geographical distribution of stores will have relatively high transport costs. Contracted haulage is typically used to supply equipment to a main collection/distribution point and for the final transport of the waste from the main collection points to the port of exit and treatment/disposal facility. Access to good-quality vehicles with well-trained and reliable drivers is not always possible in the developing country context, so this introduces another risk into the overall safeguarding process. It is possible to include the transport component in the overall safeguarding contract placed with an international company. This allows for the inclusion of insurance to cover all aspects of transport but will contribute significantly to higher costs of implementation.

**Government vehicles:** This option is increasingly favoured during the implementation of safeguarding projects. Typically, there will be initial costs to maintain vehicles and to make them compliant with the standards set in tool F. Thereafter, the operational costs are reduced greatly and generally limited to fuel, maintenance and driver costs. This option is favoured for moving personnel and equipment but there remain issues regarding liability and insurance when waste is being transported by government vehicles. The PMU should address this insurance issue if this option is selected.

**Project vehicles:** In some instances projects have purchased fleets of vehicles to complete all transport. While this does provide an element of control over the management of transport and maintenance of the vehicles, there is a general move away from this option. While it is likely that projects will include the purchase of a station wagon or pick-up type vehicles, which may be suitable for transporting personnel and limited amounts of equipment or waste (typically less than 1000 kg gross weight), it is not common for projects to purchase larger vehicles to be used for moving larger amounts of equipment or waste. If available, project vehicles may have an important role to play in the collection of small quantities of materials from stores and the transport of personnel, but major sites will require either government or contract haulage vehicles.

**Public transport:** This option can offer a relatively cheap and reliable option for the movement of project personnel between stores. The cost can be factored into the scope of the services to be provided by the contractor to avoid project personnel having to pay for this service or, in the case of government personnel, may form part of the government contribution to the overall project budget.

It is critical that the PMU defines the transport needs for the safeguarding phase based on the inventory data and make objective decisions as to the types of vehicle needed and the most cost-effective mechanism to supply those vehicles. From Table G3, it is clear that there is



potentially a significant role for government and project vehicles during the implementation of any safeguarding option listed previously.

**Table G3**  
**Transport options for safeguarding of obsolete pesticides**

	Personnel	Equipment	Obsolete pesticides
Higher risk	Contractor- supplied vehicles, government/project vehicles, public transport	Haulage company, government/ project vehicles	Haulage company, government/ project vehicles
Moderate risk	Government/project vehicles and public transport	Government/project vehicles	Haulage company, government/ project vehicles
Lower risk	Government/project vehicles and public transport	Government/project vehicles	Government/project vehicles

*Before proceeding with the next safeguarding option, the user should fill in the preferred option for transport responsibility in Table G1.*

Selection of storage options (use with Box G5)

All safeguarding projects will require the storage of new equipment, obsolete pesticides and other wastes before they are sent for environmentally sound disposal. Typically, the repackaged wastes will be consolidated at one of a network of preselected and pre-prepared collection centres. This step should be included in the overall safeguarding plan, as there will be implications in terms of personnel, training, contracts for refurbishment, and supply of essential equipment, which will need to be understood fully before any tender for safeguarding and disposal is finalized.

Before any safeguarding operations can start, it is important to identify all interim and central collection points where the obsolete pesticides will be consolidated. Tool D provides the necessary guidance for an environmental risk-based selection of possible collection points, and factors in logistical considerations such as any refurbishment or expansion of capacity, based on the estimated total waste to be stored. Furthermore, tool E provides detailed advice on the management of collection centres to avoid emergency situations once stocks have been centralized. Both tools provide guidance on *how* storage should be done safely. Neither tool provides guidance on *who* should manage the storage. So the next task is to address the following questions.

- Who will be responsible for selecting the final collection centres?
- Who will complete any refurbishment and building works at the collection centre?
- Who will develop the management plans for the centre based on the stocks earmarked for collection from outlying stores?
- Who will be responsible for the ongoing supervision of the centre during the safeguarding project?

**BOX G5**  
**Guidance for determining storage responsibility**

**Selection of collection centres:** This step should be completed before any significant safeguarding activities begin. Typically, there are insufficient project funds to build a network of new purpose-build stores to meet the needs of the project. The data collected during the inventory is used to determine if any of the stores surveyed meet the minimum environmental criteria to be used as collection centres for storing the repackaged obsolete pesticides. Tool D can then be used to

**BOX G5 cont.**  
**Guidance for determining storage responsibility**

factor in logistical considerations such as the geographical distribution of the obsolete stocks in relation to the proposed collection centres. Under some circumstances, stores may not be used as collection centres as they are not close enough to the waste. In addition, stores may require expansion to allow them to store all wastes from the surrounding geopolitical area safely. It is therefore important that the personnel completing the selection process are familiar with the country setting and have first-hand experience of the conditions at each of the stores. Thus, it is recommended that the initial selection of collection centres be completed by the PMU and that their decision be checked as part of the principal consultant review outlined in the introductory section of these guidelines. In some cases, it may be possible to resolve this issue through the use of existing licensed waste-management transfer stations. Such depots are typically licensed to store waste by local government agencies and are operated by local waste-management companies. This option is not widely available in most developing countries but where they do exist they may offer an alternative to the use of government-owned stores. Another alternative to using government stores is the rental of purpose-built stores operated by the local pesticide-distribution industry. Under the project, it may be possible to secure the use of such stores as either a contribution to the project by the pesticide industry or through the leasing of the premises for a limited time.

**Refurbishment and building works:** In most cases, the project will rely on existing government stores for collection centres. Existing government stores will rarely meet the minimum requirements for storage as set out in tool D. As a result, existing stores will either need to be refurbished to meet minimum environmental standards or, in some cases, new purpose-built stores will have to be constructed (these can be used after project completion for other purposes). While the refurbishment or construction of storage facilities can be included in the overall safeguarding tender specification, the timeline for completion and cost considerations usually result in this component of the safeguarding strategy being completed through locally placed construction contracts. This may require local tendering, which can take a significant amount of time. It is important that this step be factored into the timeline for the preparation of the safeguarding process, as all works will need to be completed before any waste is repackaged and transported.

**Collection-centres management plans:** Tool E provides guidance on how to set up management plans for all collection centres based on inventory data. It is expected that the PMU will complete a draft plan, which will be reviewed and finalized by the principal consultant hired to draft the final EA report. The latter will be reviewed and finally adopted by the safeguarding and disposal contractor.

**Supervision and management:** The responsibility for the supervision of collection centres will depend on the exact country situation. In cases where government stores have been refurbished, it is likely that the government will assign a storekeeper to manage that location. Similarly, if private sector waste-transfer stations or pesticide-distributor stores are used, it is likely that they may assign a member of their staff to supervise the storage of obsolete stocks. In all cases, it is important that the storekeeper has received adequate appropriate training and that the person fully understands her/his responsibilities. This will need to be documented in the final safeguarding plan included in the EA report (tool I). The collection-centre management plans will also include details on the type and amount of specialist equipment needed at each collection centre plus the training requirements for the ongoing supervision and the management of each centre. It is possible to include the supply of all safety and other equipment needed at the store, as detailed in tool E, as part of the goods and services to be supplied under the final safeguarding and disposal tender. As an alternative, these materials may be purchased locally through direct government

**BOX G5** *cont.***Guidance for determining storage responsibility**

purchase. Again, the final EA report should detail the type of equipment required and the supply option selected with associated justifications. It is probable that some form of site security will also be needed. This may take the form of a guard appointed by the government, or, in certain circumstances, the allocation of a police or military guard while personnel and equipment are at the site. This will also require a case-by-case analysis and the selection of the most appropriate option based on the country situation.

Box G5 provides some guidance on how a decision can be reached for each of the points listed above.

The strategy must consider the most appropriate place to repack obsolete pesticides. As indicated in tool E, in limited cases repackaging operations may be completed at the collection centre. Tool H will show the different options commonly considered for safeguarding projects for obsolete pesticides:

- **Pack and go option:** Repackaging operations are completed at the original store and the repackaged waste is transported to a pre-prepared collection centre. This option is preferred in most cases.
- **Go and pack option:** Based on an assessment of the risks, obsolete stocks found in sound original packaging suitable for transport may be centralized safely at the main collection centre – either in the original packaging (if considered fit for transport) or following over-packing into certified, reusable UN salvage packaging (sometimes referred to as T-drums because of the T in the UN code designation). On arrival at the collection centre, the material will be inspected and repackaged in appropriate new UN packages chosen for final transport to the disposal facility. Once the stocks are finally repackaged, they will enter the storage regime at the collection centre as for the first scenario.
- **Pack and store option:** Typically adopted in cases where an emergency intervention requires stocks to be repackaged to prevent a worsening of the environmental situation. In this case, it is likely that the selection and upgrade of any central collection points has not yet been completed. Under these circumstances it is necessary to store the waste at the original location temporarily, pending the completion of the collection-centre preparation process. This requires an assessment of the original store to determine how the repackaged materials can be stored safely. An alternative reason for adopting the *pack and store* option may be that the quantities of stocks at the store are significant enough to justify the use of the location as a storage point pending the removal of stocks for disposal. This decision will be based not only on the safety assessment of the site and its suitability to store wastes (tool E and D), but also the logistics and risk assessment for the transport of the stocks to another location (tool F) and the overall risk benefit to the project as a whole (will the stocks be any safer at the new site and what is the risk of an accident during transport?).

The first two scenarios are based on the assumption that the environmental and logistical assessment for the collection centre has been completed. They also assume that any improvements to the store are complete and the necessary management structures are in place. In the case of the pack and go option it is also assumed that the collection centre has adequate facilities to allow the safe repackaging of the hazardous materials and that the EA report will indicate where such repackaging will occur, who will complete the activity and what management systems and procedures will be adopted to ensure no impact on public health and the environment. It is recommended that the PMU indicates that the development of site-specific health, safety and

Table G4

Application of safeguarding options to past projects

Safeguarding option (repackaging, transport and storage)	Risk profile from Tool C	Number of stores	Amount of waste	Time frame for implementation	Role of contractor	Examples
Option 1: 100% contractor	Large proportion of higher-risk stores. Few moderate- and lower-risk stores	Relatively few (less than 50) in close proximity to one another	High concentrations of waste (greater than 100 tonnes) in limited number of stores	Whole project completed in relatively short time to maximize profitability	All management, supervision and operational personnel, all equipment and all transport	United Republic of Tanzania (1991) Uganda (1992) Kenya (1992) Zanzibar (1995) Zambia (1996)
Option 2: 100% government	High proportion of lower-risk sites with very few higher-risk stores	Single emergency operations or large number of stores (100s) scattered over a wide geographical area	Single store with a specific problem or more commonly low concentrations of waste in a large number of stores	No time constraints for implementation	Acceptance of waste at the main collection centres after verification and analysis	Tunisia emergency safeguarding (2007) <sup>4</sup> Mozambique Phase 2 (2005–7) <sup>5</sup>
Option 3: Government/contractor partnership	Distribution of sites through all categories (higher, moderate and lower risk)	Large number of stores with a range of distances/ distribution over the country	Typically large amounts of waste but variable distribution. Some sites with 10s and 100s of tonnes of stocks. Others with less than 500 kg	Higher-risk sites completed initially as a relatively short-term exercise. Follow-on project over longer time frame to complete the safeguarding exercise	Phase 1: All management, supervision and implementation of safeguarding. Training of national supervisors and implementation team. All equipment. Transport shared between government and contractor. Phase 2: All inputs from government based on capacity development	Ethiopia Phase 1 (2000–2003) Ethiopia Phase 2 (2003–2008)
Option 4: International and national contractor	Distribution of sites through all categories (higher, moderate and lower risk)	Mixed	100s to 1000s of tonnes with large concentrations at some stores and burial sites	High level of international contractor inputs at higher-risk locations with handover to local contractor under supervision as capacity developed. Government role as regulator and monitoring and evaluation	Principle contractor to complete all management. Local contractor to implement under supervision	Columbia (2005) Chile (2006) Kenya (2010/11) Malawi (2010/11) Moldova (2007) <sup>5</sup> South Africa (2008)

<sup>4</sup> The operation in Tunisia was an emergency intervention completed by FAO in collaboration with the Tunisian authorities. The work was completed at a single store over a three-week period in early 2007.

<sup>5</sup> In both projects training of national government teams was completed by FAO and specialist consultants. National teams were directly supervised until competence to complete repackaging, transport and storage of materials was clearly evident. FAO also took responsibility for supply of all essential equipment.

environment (HSE) plans in FAO format,<sup>6</sup> or similar, will be developed by the body responsible for the safeguarding (government or contractor) and that the plan be approved through official channels prior to any repackaging work being started. This scenario also requires careful management of the transport component of the safeguarding activity.

The user is now directed back to Table G1 and should fill in the preferred option for storage responsibility, based on the advice provided above and an analysis of the needs of the project.

#### Summary of safeguarding options

The four commonly proposed safeguarding options introduced above have all been applied in past projects. In general terms, the various options are best suited to the following scope of projects (in terms of the risk profile, number of stores, amount of waste and time frame for implementation).

Table G4 demonstrates a number of interesting trends that warrant further discussion:

- Before 2000 the trend was for 100 percent contractor implementation with little or no involvement from the national government or national contractors.
- Since 2000 there has been a tendency for more government implementation with varying levels of international contractor support, either for implementation at the higher-risk sites or the supply of equipment and supervision/training.
- Using national contractors is largely limited to more industrially developed regions (Latin America, Eastern Europe and South Africa). They have a larger waste-management market that is not just based on obsolete pesticide issues and that has stimulated the development of local waste-management companies.
- International contractors are increasingly looking to minimize the commitment of expensive expatriate staff to projects and would rather concentrate on the management and supervision of contracts with more national implementation (government or contractor). The costs of maintaining large field teams of international staff is high and the frequency of projects limited, resulting in contractors needing to cover high overhead costs between projects.
- Since 2000 there has been a policy of maximization of national capacity development and skills transfer by international agencies such as FAO and national development partners, which has led to a move away from simple “turnkey” operations implemented solely by international contractors.

It is therefore clear that, when considering the options available for safeguarding, a wide variety of local factors must be taken into consideration. The government will have a role to play and it is important that the limits of its role are considered carefully. A decision to use government personnel to assist in the supervision and implementation of safeguarding activities raises important questions in terms of worker safety and competence. It will likely require support from senior management and possibly ministerial-level endorsement before a final decision on the use of government personnel is made. Similarly, a decision to opt for local contractors to complete safeguarding activities requires an assessment of their capacity, past experience and overall competence to complete the project. Finally, it is important to remember that safeguarding has three components (repackaging, transport and storage) and that all three components need to be considered when choosing the most appropriate option for any project. The role of government and contractors can and will most likely change as implementation proceeds from higher- to moderate- risk and lower-risk locations. National staff are likely to be more involved as the risk profile of the project decreases and their competence increases through training and skills transfer.

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<sup>6</sup> The HSE plan and advice on how to complete the document can be found in EMTK Volume 4, tool N.

## Practical guidelines for a risk analysis of the safeguarding strategy

Once the PMU has completed an analysis of the various safeguarding options for each risk category of store, it is important to complete a more detailed analysis of the risks associated with implementation. Past projects have identified seven major risk classes.

- 1 **Health and safety:** Does the preferred option address concerns regarding the health and safety of personnel during implementation plus the general public during transport and storage?
- 2 **Environmental protection:** Does the preferred option address any specific environmental risks and how will any potential environmental impact be addressed/assessed?
- 3 **Equipment supply:** How can it be ensured that equipment supplied is to the correct specification? Will it be supplied according to the timeline for project implementation?
- 4 **Project management/planning:** Does the preferred option guarantee the allocation of adequate resources to planning and the competency of the responsible agents to complete this critical activity?
- 5 **Consultation/communications:** How do the preferred safeguarding options address needs in terms of consultation with the general public, communications around affected stores, and so on?
- 6 **Sustainability/capacity development:** Will implementation result in any national capacity development (personnel, managerial, systems, infrastructure)?
- 7 **Budget:** Do the options selected fit the available budget? If not, how far will the funds support implementation?

The following sections look in more detail at the main issues that the preferred safeguarding option will need to address. It is recommended that this exercise is completed during a workshop with the PMU and the facilitation of the principal consultant and FAO. Table G7 presents the compact output of this risk analysis.

Health and safety (use with Table G5)

As previously indicated, the repackaging, transport and storage of obsolete pesticides have a potential impact on the health and safety of workers and the general public. Therefore, the PMU should analyse the preferred safeguarding options and identify the potential risk of exposure at each category of site with reference to the inventory data presented in tools A–C. For this purpose, *risk profile dossiers* for each site category with a detailed analysis of the pesticides' toxicity, the amount of likely exposure (from leakage) and the size of stocks (related to the possible duration of exposure during repackaging activities) need to be completed and included in the safeguarding plan.

Table G5 provides a format for the cover sheet of the risk-profile dossier with an explanation of what information should be entered. The dossier should be prepared for each store and will be used during implementation of the safeguarding activities as the main file for consolidating and storing all procedures and site-specific operational plans conducted at a site. At this stage, the cover-page format below and all associated supporting documentation such as the material safety data sheet (MSDS) and other reference materials should be annexed to the EA under the safeguarding strategy component (Section 6 of the EA, see tool I). The PMU should conduct the initial work on completing the dossier, with review and finalization by the principal consultant.

This format or a similar local equivalent can be used for detailed risk identification at any specific site. This will be essential for determining the health and safety implications during the repackaging activities and will help advise the PMU on the most appropriate option for safeguarding. The format provided also includes sections related to risks associated with

transporting and storing the stocks. This is also an important consideration when assessing the total risk posed by the stocks at a given site during the complete safeguarding phase – not just during the repackaging activities.

Ideally, the format should be completed for *all* stores. The aim of this process is to document the factors that contribute to the overall risk rating. As a minimum, this format should be completed for all higher- and moderate-risk sites and for all sites containing WHO Class 1a and 1b pesticides. All MSDSs for pesticides should be attached to the cover sheet and this should be annexed to the overall “Safeguarding strategy” document annexed to Section 6 of the EA. As safeguarding implementation proceeds and site-specific HSE plans are developed with the associated standard operating procedures (SOPs) as presented in tool N (EMTK Volume 4), the file for each site should grow. All data needed for the completion of this format can be easily derived from the PSMS.

**Table G5**  
**Risk profile dossier: material for health and security analysis**

Store-specific risk-profile dossier: initial risk assessment					
Store no: [From PSMS]	Completed by: [Insert name]			Date of completion: [insert date]	
Risk category: [from PSMS]	Higher-/moderate-/lower-risk store [delete as applicable]				
F <sub>p</sub> value: [insert]					
F <sub>e</sub> value: [insert]					
	Class 1a	Class 1b	Class 2	Class 3	Class U
Total pesticides	[kg and litre]	[kg and litre]	[kg and litre]	[kg and litre]	[kg and litre]
Active ingredients Class 1a	[insert list from PSMS and attach MSDS]				
Active ingredients Class 1b	As above				
Active ingredients Class 2	As above				
Active ingredients Class 3	As above				
Active ingredient Class U	As above				
Special personal protective equipment (PPE) [from MSDS and other references]	[indicate for which pesticide]	[indicate for which pesticide]	[indicate for which pesticide]	[indicate for which pesticide]	[indicate for which pesticide]
Special packaging requirements [from MSDS]	[indicate for which pesticide]	[indicate for which pesticide]	[indicate for which pesticide]	[indicate for which pesticide]	[indicate for which pesticide]
Leaking products	[indicate which pesticide is leaking and how badly – data from PSMS]	[indicate which pesticide is leaking and how badly – data from PSMS]	[indicate which pesticide is leaking and how badly – data from PSMS]	[indicate which pesticide is leaking and how badly – data from PSMS]	[indicate which pesticide is leaking and how badly – data from PSMS]
Estimated duration of exposure	<15 min/ 15 –30 min/ 30 –60 min/ >60 min [delete as applicable]	<15 min/ 15 –30 min/ 30 –60 min/ >60 min [delete as applicable]	<15 min/ 15 –30 min/ 30 –60 min/ >60 min [delete as applicable]	<15 min/ 15 –30 min/ 30 –60 min/ >60 min [delete as applicable]	<15 min/ 15 –30 min/ 30 –60 min/ >60 min [delete as applicable]
Key environmental risks (store structure)	[insert the key factors related to the store structure which make it a risk] <ul style="list-style-type: none"> <li>• ;</li> <li>• ;</li> <li>• .</li> </ul>				



Key environmental risks (location)	<p>[insert the key factors which make the store a higher-risk due to its location and proximity to water, population, etc.]</p> <ul style="list-style-type: none"> <li>• ;</li> <li>• ;</li> <li>• .</li> </ul>
Key transport risks	<p>[indicate if presence of highly hazardous materials requires escorting of the load, additional emergency planning, avoidance of routes close to water bodies, avoidance of population centres, etc.]</p> <ul style="list-style-type: none"> <li>• ;</li> <li>• ;</li> <li>• .</li> </ul>
Key storage risks	<p>[indicate any special storage requirements and reactivity which may impact on packaging requirements, segregation of materials during storage and any special emergency instructions – all from MSDS]</p> <ul style="list-style-type: none"> <li>• ;</li> <li>• ;</li> <li>• .</li> </ul>
Summary of significant risk factors	<p>EXAMPLE:</p> <p>The store poses a higher-risk owing to it containing large amounts (insert amounts) of Class 1a pesticides (insert names) which are leaking.</p> <p>MSDS data indicates the need to use a high level of PPE which requires specialist training (list items).</p> <p>It is estimated that potential contact time with the pesticides during safeguarding will be &gt;60 minutes and hence posing a direct risk to workers during safeguarding operation.</p> <p>The store is also in poor repair and has no rook allowing access of rainwater, resulting in spread of contamination.</p> <p>The store is located within 50 m of a populated area and is within 100 m of a ground water extraction point.</p>
Recommendations	<p>EXAMPLE:</p> <p>Based on the risk analysis above it is recommended that this site be safeguarded by a specialist waste-management contractor.</p>

By analysing the site-specific formats presented in Table G5, it is possible to consolidate the major risks for the repackaging, transport and storage of higher-, moderate- and lower-risk sites. These risks should be summarized for each category of site (higher-, moderate- and lower-risk sites) and presented in Table G7 below.

Environmental protection (see Table G5)

As with the health and safety section above, it is important that the preferred safeguarding strategy takes into account the specific environmental risks for each category of store included in the national inventory (tools A–C). Therefore, an assessment of possible impacts during repackaging, transport and storage should be carried out. Again, it is suggested that the PMU, with support from the principal consultant and FAO complete – ideally during a workshop – a detailed analysis of the specific risk factors that make sites a concern in terms of their possible environmental impact.

The analysis of the site-specific environmental risks and the consolidation of the main factors for each category of site will be a valuable input into the overall risk evaluation process.



As with the health and safety analysis above, it will allow for the identification of trends that are common to sites in each category of risk. Again, the user should now list in Table G7 major environmental risks revealed when linking the information from the risk profile dossier (consolidated from site-specific data collected using the format in Table G5).

Equipment supply (see Table G6)  
 The preferred safeguarding option should also address the risk of supplying the wrong type or amount of equipment needed to implement a project. The supply of items not meeting the required specifications (e.g. drums, protective equipment and pumps) can result in all safeguarding activities being delayed or can cause accidents. The strategy must identify the risks related to this factor for each risk category of store and the possible impact each item may have on the ability to implement the project safely and effectively. It is proposed that the PMU completes Table G6 and that this be included in the overall EA report. Major risks should also be included in Table G7.

**Table G6**  
**Risk analysis for safeguarding equipment**

	Higher-risk sites	Moderate-risk sites	Lower-risk sites
Packaging	Specific types of package, which are not generally available locally, may be needed at higher-risk locations	Risk of no suppliers locally for UN approved packaging	Risk of no suppliers locally for UN approved packaging.
Personal protective equipment (PPE)	Specify types of PPE as detailed in the MSDS for highly toxic materials. Generally supplied by manufacturer. Not generally available locally	Usually lower specifications of PPE needed. Potential for local supply, but standard of materials needs to be assessed	In general, lower specification needed, which may be available locally
Electrical	Generally all equipment needs to be flame proof (pumps, vacuums, etc.). If used outdoors, 110 V is recommended, which is generally not available on local markets	Same level of equipment needed as for higher-risk sites	Same level of equipment needed as for higher-risk sites
Handling equipment	Drum handling equipment (trolleys, fork lift truck attachments, etc.), not generally available locally	Use equipment as supplied for higher-risk sites	Use equipment as supplied for higher-risk sites
Other (general site equipment)	Emergency spillage kits, paramedic first aid kits, emergency showers, etc. Usually not available locally	Use equipment as supplied for higher-risk sites	Use equipment as supplied for higher-risk sites

Table G6 shows that there may be a variation in the type of equipment needed based on the risk profile of the sites for items such as packaging and PPE. In general terms, the non-availability of equipment to the required specifications poses a significant risk to the project plan. For items such as electrical equipment, handling equipment and other general site items it is important that the PMU completes a survey of potential local suppliers at an early stage in the EA process. If there is any doubt regarding the availability of suitable items, it is again advisable to opt for international supply together with items for higher-risk sites and to use this equipment during safeguarding of the moderate- and lower-risk sites. The procurement process used and the

delivery schedule for the equipment will have a direct impact on the project work plan. Delays are common because of insufficient time being allowed for completing and delivering procurement and for customs clearance.

In summary, the need to import large amounts and a wide variety of specialist equipment poses a significant risk to the project. The specifications for the different types of equipment need to be based on the inventory of waste. The PMU should ensure that all equipment is fit for the purpose for which it is intended and that it all meets any international standards applied (e.g. UN certification and the testing of packaging materials and the PPE). FAO can provide further guidance on equipment specifications as part of the training package that accompanies these guidelines. It is therefore essential that the equipment needs and the most appropriate supply options are considered when selecting a safeguarding option. This should include an assessment of the national procurement capacity for options where government will take a leading role in project implementation. It is suggested that the principal consultant takes an active role in leading the risk assessment associated with the supply of equipment.

Once the assessment of needs and options for supply is complete, the user should add the top three risks for packaging, transport and storage to the existing data in Table G7 for each category of store (higher, moderate and lower risk).

#### Project management (see Table G7)

Poor planning of the safeguarding activities may result in accidents, time overruns and higher costs. The saying “a failure to plan is a plan to fail” is directly applicable to safeguarding activities. Project management is more than the development of plans for implementation. It also involves the M&E of project implementation, and the related assessment and reporting of actual progress in project implementation against what was originally planned. The need to adjust or change the working plan based on a process of constant assessment and review is a key aspect of successful project management. There should be no problem in adjusting a plan following an assessment of needs and changes in priority based on actual circumstances encountered during project implementation. The planning process allows project managers to be able to identify when problems occur and develop mitigation strategies as needed. Therefore, project management should be seen as an investment of time and resources to ensure the selected safeguarding strategy is implemented on time, within budget and to the required technical standard or specification. This is true for all safeguarding options presented in this document – there will always be a need for a robust overall project management, irrespective of the option selected. Responsibility for project management may depend on the option selected and it is critical that the responsibility is defined clearly for each country project and for each category of site (higher, moderate or lower risk).

Unlike the inventory process, which is predominately planned and implemented by the PMU from the government or civil society sectors, safeguarding activities will involve a variety of partners, including specialist contractors, haulage companies, government staff, locally hired labour and representatives from civil society. A coherent strategic-level project management plan is therefore needed to ensure that all project activities can be completed in good time and to the required standard. Each safeguarding option will have differing needs in terms of project management and will involve different partners in key roles.

While many government departments do have experienced technical staff who are competent in a variety of aspects of pesticide management, there is often a general lack of capacity to manage technically varied and complex projects. This provides the project with an opportunity to develop national capacity during the implementation of the safeguarding activities in the key areas indicated below. The role of consultants, specialist waste-management contractors and FAO technical advisors will need to be defined clearly in the safeguarding strategy, and it is proposed

that the principal consultant takes on the role of developing a training and skills transfer plan in this particular area.

Before proceeding to the risk analysis of the next major risk class, the user should list in Table G7 the major risks emerging when confronting the risk analysis of the management of his or her project with the selected safeguarding options. The exercise should also be completed for the other site categories.

Consultation/communication (see Table G7)

Lack of consultation and communication with interested and affected parties may result in a lack of cooperation and the generation of an atmosphere of mistrust between stakeholders. This would pose a significant risk to the project. As part of the overall project strategy, it is vital that a comprehensive communications strategy is developed. It is important that the PMU ensures that issues related to consultation during safeguarding and disposal operations are addressed adequately in this strategy.

In addition, as part of the EA process, the PMU must make certain that the final EA report (including the detailed safeguarding strategy, disposal strategy and the EMP) is presented to key stakeholders. This consultation step will be necessary to ensure that all parties have the opportunity to query the content of the EA document and identify any issues that may not have been considered previously. A failure to complete this critical step is a risk to the project and may result in complaints from stakeholders and in the worst-case scenario withdrawal of support for the project. The safeguarding strategy must therefore make reference to the proposed consultation process to ensure complete transparency and also ensure that all stakeholders have had the opportunity to question the proposed methodology and implementation arrangements.

Sustainability/capacity building (see Table G7)

As with all projects completed under or as part of development assistance, it is necessary to demonstrate capacity development and sustainability. As discussed previously, the safeguarding of obsolete pesticides can be achieved by specialist international contractors with a minimum level of government or local staff involvement. This will not, however, result in any measurable sustainability or national capacity development. This is a risk that needs to be examined as part of the final strategy development. The safeguarding strategy chosen for each category of site and for each safeguarding activity should take into account the need to leave capacity for dealing with similar problems that may occur in the future (in other chemical waste and industrial waste sectors, for example). Sustainability in terms of the safeguarding process can be divided into three broad categories: (i) infrastructure, (ii) personnel and (iii) management systems. A summary of the potential for developing sustainability and capacity in each of these three areas is provided below. It is proposed that the safeguarding strategy detail the type and extent of capacity developed as a result of adopting the chosen strategy:

- **Infrastructure:** The refurbishment of stores and the building of new stores to act as collection centres will invariably result in capacity that can be used in the future. The safeguarding strategy needs to factor in future needs when considering the development of collection centres used for the safeguarding operations.
- **Personnel:** To the extent that the PMU is used to implement part or all of the safeguarding activity, there will be skills transfer and national capacity development. This provides an opportunity to use the skilled personnel to complete similar work in the future. The capacity need not be formalized as part of the government sector and can just as easily result in the development of capacity within the private national waste-management sector, which can act as contractors to the government on an as-needed basis in the future. This will contribute to the overall chemicals-management agenda.

- **Management/systems:** The development and implementation of the safeguarding strategy will invariably require the development of systems and strong project management. These skills are not subject specific, and personnel who have been exposed to these aspects of the project will develop skills and experience that can be used in their own jobs when the project is over or provide the necessary competence to allow them to support similar projects in other countries as technical advisors.

The final combination of safeguarding options selected for higher-, moderate- and lower-risk sites will need to state clearly the level and type of capacity and sustainability that will result from project implementation. It is proposed that the principal consultant plays a lead role in the drafting of this section, based on the aspirations of the government within the limitations of the project scope.

Budget (see Table G7)

Ultimately, whichever safeguarding options are selected, they must fit within the existing budget. The risks posed by an inadequate budget require the PMU to assess the probable cost of each safeguarding option and to optimize the level of government inputs in terms of personnel, transport, equipment and funding contribution. The principal consultant will be required to assist the PMU in assessing the costs of each option and comparing this with the available budget. This will probably result in the need to prioritize inputs and activities to ensure that the final safeguarding strategy adopted has the maximum impact in terms of overall risk reduction.

Summary of the risk analysis

Based on the risk assessment made using the examples above, it is now possible to identify the main risks to the safeguarding options selected for the safeguarding activity (repackaging, transport and storage) and repeat the exercise for each site category by completing Table B7. Again, it is proposed that this exercise be completed by the PMU during a workshop with facilitation from the principal consultant and a competent technical agency such as FAO. The table requires the user to confirm their safeguarding option based on the risk analysis data. When the risks for each safeguarding option have been assessed, it is necessary to re-examine the original selection for each safeguarding activity and site category, and determine if it is still valid. Factors such as a national desire to generate national chemicals management capacity, the development of a network of pesticide stores for future use and budget limitations may result in a shift away from the original preferred option to a lower-cost alternative. The data collected in this table will be transferred directly into the mitigation plans developed as part of the EMP in tool I of this document.

**Table G7**  
**Risk identification matrix for safeguarding activities**

[Insert the risk category of store]7	Packaging	Transport	Storage
Initial safeguarding option [insert preferred safeguarding option]	Management: Supervision: Implementation:	Personnel: Equipment: Waste:	At the site: Interim collection points: Main collection points:
Scope of work	[insert number of sites and total tonnes]	[insert type and number of vehicles needed for each transport category]	[insert number of storage sites and collective tonnage for each storage location]
Risk category			
Health and safety	Choose maximum of three from: <ul style="list-style-type: none"><li>• Deliberate sabotage</li><li>• Poor training of staff</li><li>• Incorrect inventory data</li><li>• No on-site emergency plan</li><li>• Lack of medical support</li><li>• Other (specify)</li></ul>	Choose maximum of three from: <ul style="list-style-type: none"><li>• Incorrect labelling</li><li>• No documentation</li><li>• Driver error</li><li>• Lack of vehicle inspection</li><li>• No speed control device (disc)</li><li>• Vehicle unattended</li><li>• No/inadequate PPE for the driver/escort team</li><li>• Incompatible materials in same container</li><li>• No fire control material</li><li>• Other (specify)</li></ul>	Choose maximum of three from: <ul style="list-style-type: none"><li>• Structure not suitable</li><li>• Structure not large enough</li><li>• No storage plan</li><li>• No training of personnel</li><li>• Incompatible materials in same container</li><li>• Incompatible materials stored next to each other</li><li>• Lack of stores security (fence, buffer security zone, storekeeper, etc.)</li><li>• Other (specify)</li></ul>
Environmental	Choose maximum of three from: <ul style="list-style-type: none"><li>• Climatic factors (provide details, e.g. heat, storms, etc.)</li><li>• Seasonal weather variations (provide details)</li><li>• Cross contamination during implementation</li><li>• No off-site emergency plan</li><li>• Other (specify)</li></ul>	Choose maximum of three from: <ul style="list-style-type: none"><li>• Poor route planning</li><li>• Plan ignored</li><li>• Bad weather conditions</li><li>• Extreme weather conditions</li><li>• Incorrect loading</li><li>• Lack of emergency training</li><li>• Other (specify)</li></ul>	Choose maximum of three from: <ul style="list-style-type: none"><li>• Location in close proximity to water</li><li>• Location in close proximity to population</li><li>• Location in close proximity to agricultural production area</li><li>• Other (specify)</li></ul>

[Insert the risk category of store?]	Packaging	Transport	Storage
<b>Equipment</b>	Choose maximum of three from: <ul style="list-style-type: none"> <li>• Incorrect PPE supply</li> <li>• Incorrect packaging supply</li> <li>• Electrocuton</li> <li>• No waste handling equipment</li> <li>• No maintenance</li> <li>• Incorrect use</li> <li>• Poor selection</li> <li>• Other (specify)</li> </ul>	Choose maximum of three from: <ul style="list-style-type: none"> <li>• Vehicle not suitable</li> <li>• Lack of emergency equipment</li> <li>• No spare tyre</li> <li>• Other (specify)</li> </ul>	Choose maximum of three from: <ul style="list-style-type: none"> <li>• Inadequate emergency materials</li> <li>• Equipment out of date</li> <li>• Packaging incompatible with contents</li> <li>• Other (specify)</li> </ul>
<b>Project management</b>	Choose maximum of three from: <ul style="list-style-type: none"> <li>• Incorrect use of PPE</li> <li>• No supervision</li> <li>• Poor communication within the command structure or between partners</li> <li>• No operating systems</li> <li>• No risk assessment</li> <li>• Late delivery of equipment</li> <li>• Customs problems</li> <li>• Lack of inputs from other partners (specify)</li> <li>• Other (specify)</li> </ul>	Choose maximum of three from: <ul style="list-style-type: none"> <li>• No supervision</li> <li>• No operating systems</li> <li>• No contingency plan</li> <li>• No/poor transport plan</li> <li>• No vehicle inspection records</li> <li>• No vehicle escort</li> <li>• No risk assessment</li> <li>• Late delivery of equipment and vehicles</li> <li>• Customs problems</li> <li>• Lack of emergency procedures</li> <li>• Lack of inputs from other partners (specify)</li> <li>• Poor communication within the command structure or between partners</li> <li>• Other (specify)</li> </ul>	Choose maximum of three from: <ul style="list-style-type: none"> <li>• Storage sites not ready</li> <li>• No supervision</li> <li>• No operating systems</li> <li>• No risk assessment</li> <li>• Poor emergency management (internal and external)</li> <li>• Lack of data recording (equipment, pesticides, etc.)</li> <li>• Late delivery of equipment</li> <li>• Lack of inputs from other partners (specify)</li> <li>• Poor communication within the command structure or between partners</li> <li>• Other (specify)</li> </ul>
<b>Consultation/communication</b>	Choose maximum of three from: <ul style="list-style-type: none"> <li>• Lack of consultation</li> <li>• No on-site communications plan</li> <li>• Lack of consultation with population</li> <li>• No notification of local administration</li> <li>• No notification of local emergency services</li> <li>• Other (specify)</li> </ul>	Choose maximum of three from: <ul style="list-style-type: none"> <li>• Lack of consultation with population</li> <li>• No transport notification of local administration (also in case of accident)</li> <li>• No notification of local emergency services</li> <li>• Other (specify)</li> </ul>	Choose maximum of three from: <ul style="list-style-type: none"> <li>• No on-site communications plan</li> <li>• Lack of consultation with population</li> <li>• No notification of local administration</li> <li>• No notification of local emergency services</li> <li>• Other (specify)</li> </ul>

[Insert the risk category of store] <sup>7</sup>	Packaging	Transport	Storage
Sustainability	Choose maximum of three from: <ul style="list-style-type: none"><li>No management training of local staff</li><li>No supervisory training of local staff</li><li>No implementation training of local staff</li><li>Staff turnover</li><li>Other (specify)</li></ul>	Choose maximum of three from: <ul style="list-style-type: none"><li>No management training of local staff</li><li>No supervisory training of local staff</li><li>Lack of driver training</li><li>Staff turnover</li><li>Other (specify)</li></ul>	Choose maximum of three from: <ul style="list-style-type: none"><li>No management training of local staff</li><li>No supervisory training of local staff</li><li>No implementation training of local staff</li><li>Staff turn-over</li><li>Other (specify)</li></ul>
Budget	Choose maximum of three from: <ul style="list-style-type: none"><li>Insufficient funding</li><li>Funding misappropriated</li><li>Funding withdrawn</li><li>Funding reallocated</li><li>Other (specify)</li></ul>	Choose maximum of three from: <ul style="list-style-type: none"><li>Insufficient funding</li><li>Funding misappropriated</li><li>Funding withdrawn</li><li>Funding reallocated</li><li>Other (specify)</li></ul>	Choose maximum of three from: <ul style="list-style-type: none"><li>Insufficient funding</li><li>Funding misappropriated</li><li>Funding withdrawn</li><li>Funding reallocated</li><li>Other (specify)</li></ul>
Priority risks (top five from any category)	i ii iii. iv v	i ii iii iv v	i. ii. iii. iv. v.
Revised safeguarding option	[insert revised safeguarding option here. If same reconfirm]	[insert revised safeguarding option here. If same reconfirm]	[insert revised safeguarding option here. If same reconfirm]

<sup>7</sup>This table should be completed for higher-, moderate- and lower-risk stores.

**Practical guidelines for the development of mitigation plans for a safeguarding strategy (see Box G6)**

The process outlined in this tool has allowed the identifying of risks associated with the preferred safeguarding strategy. It is now important to examine each of the risks and state clearly how to mitigate the risks during project implementation. The section will build on the results of the risk analysis presented in Table G7. The output from this process will contribute to the overall EMP developed under tool I presented later in these guidelines.

Table G8 provides a format for the recording of mitigation measures for each of the risks identified in Table G7. The results from Table G8 will allow the PMU to ensure that all activities related to the safeguarding of the different categories of store have taken adequate account of the risks. It is proposed that Table G8 be completed by the principal consultant recruited to the project to complete the EA and the EMP process. The table should be used as a tool by the PMU to assess technical proposals from safeguarding contractors and as a template for continued M&E of implementation.

The process of identifying the risks and developing mitigation plans should be completed for higher-, moderate- and lower-risk stores as it is likely that the specific risks associated with the different implementation strategies for each category of store will have an impact on the mitigation measures needed.

**BOX G6**  
**Common risk-management and mitigation strategies**

Risk management is typically associated with the use of insurance to cover the operations of a commercial company. In more general terms, it can be considered as the assessment of uncertainties and risks associated with a specific activity or group of activities and the management of that risk through the targeted use of resources and procedures or systems. The terminology used when considering risk management is covered under the International Organization for Standardization (ISO) guideline *Risk management — Guidelines on principles and implementation of risk management*. A key consideration of this document is that organizations should not over-react unnecessarily to risk, resulting in their over-allocation of limited resources.

In term of obsolete pesticide management, it is important to look at three variables when considering risk management: (i) budget, (ii) quality and (iii) scope. Generally, the budget for project implementation will be fixed. The quality or standard of operation is also fixed, with no compromise of safety being allowed. This leaves the scope of the project as the only variable that can be adjusted. The change of scope may relate to the prioritization of safeguarding and disposal activities with a focus on higher-risk sites or to a change in safeguarding strategy with less supervision and implementation by specialist contractors and more country-level implementation by the PMU. This is, however, possible only if the risks associated with increased levels of national implementation are addressed adequately through a risk-management mitigation plan.

Risk management or “mitigation” plans are typically based on one of four responses to risk:

- Redesign: In many projects not involving hazardous materials or dangerous environments it is possible to change the scope of the work to remove risk. With safeguarding projects, this option is not available. The risk assessment process outlined in tools A–C prioritizes sites with higher risk and requires that any safeguarding strategy deals with these sites first. It is therefore not possible to redesign a pesticide safeguarding project to remove the risk.
- Transfer: Risk may be transferred from one stakeholder to another. In projects that adopt a safeguarding strategy based on using specialist contractors it is possible to transfer the risks through project-specific insurance. The contractor will be required to have adequate



**BOX G6** *cont.***Common risk-management and mitigation strategies**

insurance coverage for all aspects of implementation, including repackaging, storage and transport (in-country and internationally). The transfer of risk will be a feature of the contract and the cost of insurance will be covered through the payments made to the contractor. For cases where the government chooses to implement the safeguarding operations, it is advised that adequate insurance be taken out to cover environmental impairment, worker or public liability, transport and indemnity.

- **Management:** Risks may be mitigated through the development of management and supervision strategies, which use management policies and procedures. The development of systems to train personnel, supervise performance, and monitor and evaluate implementation is a common method used to limit risk. In cases where specialist contractors are hired to complete operations at higher-risk locations they will be required to adopt management procedures to mitigate the risk. Skills transfer through training and co-working of national personnel will then allow the same procedures to be used at moderate- and lower-risk locations. Similarly, the scheduling of activities to take account of seasonal climatic variations (wet seasons, etc.) can be considered as managing the risk associated with transport.
- **Acceptance:** Under certain circumstances a decision may be made to accept the risks associated with an activity. This is the usual approach in cases where the impact of the risk is small and can be absorbed while maintaining standards of operation, scope and budget. At the other extreme this category also includes risks that would have such a massive impact that they cannot be catered for in any management plan. Natural disasters and war are prime examples of this category of risk that are generally accepted.

In terms of obsolete pesticide management the common risk-management strategies adopted include that:

- transfer of risk at higher risk stores through the contracting of a specialist waste-management company with high competences and adequate insurance coverage in case of accident;
- management of risk at moderate- and lower-risk stores through the development of competent national teams who have been trained by specialist contractors. All teams operate within a strict management system that is monitored and evaluated independently;
- management of risks associated with seasonal climatic variations through the scheduling of activities in an integrated work plan;
- management of transport and storage activities through training, adoption of proven management systems and independent inspections;
- acceptance of risks over which there is no control.

**Table G8**  
**Mitigation planning for repackaging, transport and storage**

Higher-risk stores	Risk analysis	Mitigation plan		
		Repackaging	Transport	Storage
Health and safety	[Copy the top three risks for each risk category from Table G7]			
Environmental				
Equipment				
Project management				
Consultation				
Sustainability				
Budget				
Moderate-risk stores	Risk analysis	Mitigation plan		
		Repackaging	Transport	Storage
Health and safety				
Environmental				
Equipment				
Project management				
Consultation				
Sustainability				
Budget				
Lower-risk stores	Risk analysis	Mitigation plan		
		Repackaging	Transport	Storage
Health and safety				
Environmental				
Equipment				
Project management				
Consultation				
Sustainability				
Budget				

An essential aspect of risk mitigation is good project-management planning. The principle tasks to be completed under the project management heading are:

- **Work-plan development:** A detailed *work plan* will need to be prepared, irrespective of the safeguarding option selected. In all cases, the work plan must be developed by the partner responsible for implementation. Its development requires training and experience as it should be developed following established project-management practices, including the linking of activities based on their interdependency. FAO can provide guidance and training in this area if required.
- **Procurement-plan development:** Similarly, it will be essential that a detailed *procurement plan* be prepared by the party completing the safeguarding. The importance of selecting appropriate materials and the need to factor the delivery time for key items (e.g. PPE and packaging materials) was already demonstrated above. The procurement plan will have a direct impact on the overall work plan and, here feasible, both should be integrated into a single system.
- **Setting of standards:** For all safeguarding activities, it is critical to set appropriate standards and to follow them during implementation. The responsibility for setting the standard will rest with the PMU in consultation with the principal consultant. Additional support can be offered by FAO along with guidance on equipment specifications provided in EMTK Volume 4. Standards include equipment specifications, but also standards related to worker and environmental safety. For any safeguarding strategy, only competent personnel should be responsible for the setting of appropriate standards for implementation.
- **Monitoring and evaluation:** M&E will be an essential component of all safeguarding projects. It is necessary to monitor and evaluate performance against the original work plan. M&E will be needed at various levels and it will be important to have a level of independence in the system to ensure it is not abused. The plan will also need to provide a system for assessing if SOPs are being met and if equipment specifications are appropriate. The safeguarding strategy will therefore need to provide details on the M&E system and indicate who will be responsible for administration of the system. FAO can assist by providing a generic M&E template that can be adapted to meet country-specific needs. The preparation of the M&E plan is covered under separate FAO guidance (<http://www.fao.org/ag/obstocks.htm>).
- **Reporting (progress and budget):** The final component of project management which the safeguarding strategy will need to address is the reporting on progress and budget usage. The M&E system will provide the necessary formats for monthly progress reporting and it is necessary to ensure that the responsibility for completing these reports is defined in the overall safeguarding strategy.

The safeguarding strategy will need to define who will be responsible for all the activities listed above for each category of affected site. It is anticipated that the principal consultant will assist the PMU in determining the most appropriate partner to complete each task.

## Summary of tool G

The previous sections should have assisted the user in addressing the issues of:

- defining the scope of safeguarding and the activities included;
- the options available for safeguarding obsolete pesticides and associated wastes;
- who will take responsibility for the repackaging, transportation and storage of all obsolete pesticides and wastes;
- the risks associated with all activities and options;
- the mitigation measures needed to ensure safe and effective project implementation.

The user should now be able to apply the principles presented in the previous sections to their local situation and thereafter develop a risk-based strategy for safeguarding based on the highest levels of safety, national capacity development and sustainability, taking into account the limitations of budget and the current levels of competence in all areas of the safeguarding process.

# Tool H

## Disposal strategy

Tool G assisted the user in defining the most appropriate strategies on who will take the key responsibilities during the implementation of the different safeguarding activities for the three categories of site (higher, moderate and lower risk). Tool H follows up this work by defining the most appropriate strategies for the implementation of the disposal phase of a project. The tool analyses a series of waste-management and disposal options commonly used for such projects. It is necessary to assess the risks associated with the preferred disposal strategy and to propose mitigation measures that will be used to ensure that the risks are managed, as was done for the safeguarding options in the previous tool.

The disposal strategy should include all waste streams (obsolete pesticides, contaminated soils and building materials and contaminated containers and equipment) identified in the inventory and entered in to the FAO PSMS. The strategy needs to address issues such as:

- the compliance of any local disposal facilities with international standards for environmentally sound disposal as set forth in international instruments such as the Basel and Stockholm Conventions;
- the possibility to develop national capacity to deal with some of the waste streams via feasibility studies (both technical and financial); and
- an assessment of the overall regulatory framework related to waste management at national level.

### Objectives of the tool

The completion of tool H will allow the PMU to:

- review the inventory data to assess the number and type of waste streams;
- adopt a standards-based approach to select the disposal technology;
- assess local disposal capacity and options for local treatment;
- set criteria for the assessment of disposal options proposed by contractors.

### Outputs of the tool

At the end of this tool, the user should have produced the following key outputs:

- a completed Table H1 indicating an initial assessment of disposal options;
- completed Tables H which summarizes the outputs from Tables H2–H4 for the various waste streams considered under the project;
- a complete review of all national waste-disposal standards for pesticide wastes and contaminated material, and a comparison with international standards;
- an assessment of existing waste-management options, including a review of pesticides that can be used safely through an extension of expiry date;
- an identification of the stocks that can be treated to the required standard using existing national capacity, including an assessment of the relative importance of these stocks in comparison with other hazardous waste streams produced at national level in order to consider the feasibility of developing national waste-management capacity (if the data is available);

- a risk-based survey and a review of all contaminated sites plus an identification of possible remediation strategies that could be used;
- a technical and financial feasibility study for the safe recycling of pesticide containers;
- a risk assessment for each disposal option.

Combined, the outputs above will present a comprehensive disposal strategy. It is anticipated that some external consultant support will be needed to complete some of the above tasks. Where appropriate, the text makes reference to draft TORs for national and international consultants who could be hired to assist the PMU.

## Description of the tool

The tool adopts three key steps to develop the pesticides waste-disposal strategy:

- 1 Conduct a preliminary review of national disposal needs and capacity.
- 2 Assess disposal standards.
- 3 Consider waste-disposal options, including a risk assessment for preferred options and the provision of mitigation measures.

In addition to the material presented in this section, important technical guidelines related to tool H are provided at the end of the volume. Annex 4 assists the user in selecting potential disposal options for pesticides waste on the basis of waste factors; Annex 5 provides a review of international standards related to disposal technologies and options; while Annex 6 presents the principle of waste hierarchy necessary to set initial waste-management preferences.

## Practical guidelines for the development of a disposal strategy

### Background

Historically, obsolete pesticide disposal strategies have focused on the export of repackaged obsolete pesticide stocks to licensed high-temperature incinerator facilities in Europe. Until recently, little or no attention has been given to treating other waste streams common in all pesticide projects – such as contaminated soils, old pesticide application equipment and old contaminated containers. Similarly, there has been only limited use of national disposal options to treat obsolete pesticides and associated wastes, and little importance has been given to reviewing a country's own ability to treat various wastes, either through existing facilities or through the development of national capacity.

Increasing industrialization and general awareness related to waste-management and environmental issues in developing countries will intensify pressure for countries to become self-reliant in terms of waste-disposal capacity. While this long-term aim is desirable, any disposal options should conform to the standards set in international chemical conventions such as the Basel and Stockholm Conventions. Only the *environmentally sound* disposal of wastes should be considered. Tool H is therefore based on two guiding principles:

- 1 All disposal activities are completed to the same standard irrespective of the location of disposal (international or national disposal options).
- 2 Only technologies with a track record of compliance with the standards highlighted in this tool are considered, so that developing countries are not used as a testing ground for unproven disposal technologies.

With respect to point 1 above, FAO compares any national standard for the treatment or disposal of hazardous wastes to the series of regulations related to treatment of waste in the EU and the United States of America. The regulations in these two regions are considered as comprehensive and meet all requirements as set out in the chemical conventions.

This tool will not present a review of existing disposal technologies. Many existing texts provide a panorama of the status of the various technologies currently operating in the market place<sup>8</sup>. Annex 4 reviews the suitability of various technologies for each of the major waste streams common to obsolete pesticides. It also sets out a decision-making process by which the user can assess the suitability of a specific technology to treat a variety of pesticide and other wastes. The process will assist the user in determining if a specific technology has a proven track record in treating a particular type of pesticide waste or associated waste. This will also help to assess disposal options proposed by waste-management contractors.

Preliminary review of national disposal needs and capacity (see Table H1)

As past projects focused predominately on the disposal of obsolete pesticides and usually excluded other associated wastes such as contaminated soils and old contaminated pesticide containers, the development of a comprehensive national disposal strategy should take into account the treatment of *all* waste streams and the risks generated by their treatment. The separate FAO guidance, *The Preparation of Inventory of Pesticides and Contaminated Materials* and tool A of EMTK Volume 1, require that all waste streams be considered and inventoried carefully. Thus, data recorded in the PSMS will include a variety of waste types characterized by their chemical properties and physical form. It is unlikely that a single disposal option will be appropriate – even if it is technically capable of dealing with the different types of waste. The issue is to prioritize the allocation of available resources with the aim of minimizing risks by differentiating the types of waste that should be addressed as part of the immediate disposal project and wastes that can be dealt with as part of a longer-term waste-management programme. It is assumed that the PMU will already have the inventory data and the PSMS reports to review the risks associated with each category of waste as well as preliminary EA reports for each location (completed at the time of inventory) to examine the potential impact of contamination on natural resources.

There are many reported instances of POP pesticides contaminating large areas of land. Particular attention should be paid to the extent of soil contamination by POPs or other pesticides, as inventory data and PSMS reports may only present an indication of *potential* contamination. Ultimately, this will affect the amount both the waste and the requirement for more technologically advanced treatment solutions (see Annex 4 for examples). It is therefore recommended that the PMU carry out a detailed survey of the extent of potential contamination based on the preliminary data in the PSMS. In cases where it is believed that there already are significant levels of POP contamination (or contamination from other pesticides), it is proposed that an in-depth investigation of the type and extent of contamination be completed as part of a separate consultant work. Terms of reference for such a survey are presented in Annex 1 and it is suggested that, where feasible, the survey utilize national research capacity to complete sampling and analysis. Further advice on the assessment of contaminated site is available from FAO based on experience gained in Botswana, Mali, Mauritania, Mozambique and the United Republic of Tanzania.

To save time and resources, a preliminary assessment of disposal options should be completed by PMU members. This should be done in consultation with representatives from the Ministry of Environment responsible for waste-management issues. Table H1 sets out the basic factors necessary for determining disposal strategies for each waste stream. A disposal consultant will then develop the disposal strategy based on this data.

8 Principal references for disposal technologies include: Africa Stockpiles Programme Disposal Technology Options (DTO) study at <http://www.africastockpiles.net/index.php?page=disposal-technology-options-study-report-2008>; Secretariat of the Basel Convention Technology Fact Sheets available at <http://www.basel.int/meetings/sbc/workdoc/techdocs.html>; the report of the Science and Technology Panel (STAP) of the Global Environment Facility Scientific and Technical Advisory Panel to the Global Environment Facility on non-combustion technologies for the destruction of POPs stockpiles, April 2004, GEF Washington at <http://stapgef.unep.org> (search for POPs disposal); 43 IHPA and NATO Committee on the Challenges of Modern Society (CCMS) Pilot Study Fellowship Report – Evaluation of Demonstrated and Emerging Remedial Action Technologies for the Treatment of Contaminated Land and Groundwater (Phase III), available from the International HCH and Pesticides Association at <http://www.ihpa.info/libraryNATO.htm>

**Table H1**  
**Preliminary assessment of disposal options**

	Obsolete pesticide wastes	Contaminated soils and building materials	Contaminated containers and equipment
Amount of waste (from PSMS <sup>9</sup> )			
Number of affected locations			
Existence of national disposal capacity			
Location for facility			
Licence and operating standards			

<sup>9</sup> PSMS: pesticide stock management control.

- Before completing this table, the PMU must:
- review current waste-management practices for each waste stream to establish the baseline of current treatment and disposal capacity nationally;
  - based on tool F, review the proximity of the treatment/disposal facility to the central collection centres and main locations with contaminated soils/containers as well as the development of transport plans;
  - assess any existing facilities in terms of their current operating permit or licence. This report should consolidate details such as issue and expiry dates, licensing authority, non-compliance with licence and operating standards used.

Assessment of disposal standards (see Boxes H1–H3)

Completing Table H1 allows a preliminary review of the national disposal capacity for all waste streams identified in the national inventory. It is now important to benchmark all potential national disposal options against international best practice and what are often termed *international standards*. It is proposed that this exercise is completed by a specialist consultant, either as a single exercise or as a series of waste-specific contracts (pesticides, soils and containers).

The term *international standards* is often used in the context of hazardous wastes disposal. To be useful, this term requires a closer definition, especially when considering the treatment of three different waste types as is typically the case for obsolete pesticide projects. It is also important to make reference to the waste-destruction requirements as set out in the Basel and Stockholm Conventions and the practical regulations concerning waste-management as set out by developed countries such as those in Australia, Canada, the EU, Japan and the United States of America.

A detailed study of regulations related to the disposal of pesticides and POP wastes was completed as part of Phase 1 of the ASP. The ASP *Disposal Technology Options Study Report* (DTO report) completed a detailed review of all regulations and standards concerning the disposal of pesticides waste. The review identified several well-developed systems of legislation and regulation for the effective management of hazardous waste treatment and disposal operations. A striking feature of these systems is that they all identify and address substantially the same key issues in a broadly similar manner. This suggests that there is broad agreement on the issues that need to be addressed to develop soundly based, effective and environmentally protective regulatory systems for hazardous waste treatment and disposal. The user is directed to this report for details on the points introduced below.<sup>10</sup> Annex 5 of this tool presents Sections 3.4.1–3.4.3 of the DTO report. The information contained therein is valid for pesticide disposal projects anywhere in the world. Some of the key points from the DTO report are presented in the following boxes. Box H1 details the significant implications for POP-contaminated soils and containers.

<sup>10</sup> Please refer to Chapter 6 and Annex B of the DTO report for a detailed review of disposal standards and a comparison of current legislation frame-works, at <http://africastockpiles.net/>.



**BOX H1**  
**Low persistent organic pollutant (POP) waste**

Any pesticide, containers, soil, waste or other materials and equipment that has POP pesticides at less than 50 mg/kg (ppm) is defined as a low POP waste. The Stockholm Convention requires that the low POP waste is exempt from the requirements of the convention.

Box H2 provides a summary of findings with relation to the importance of the Basel and Stockholm Conventions.

**BOX H2**  
**Stockholm and Basel Conventions: key points for hazardous waste management and disposal**

- All hazardous wastes arising under pesticides disposal projects should be subject to environmentally sound management (ESM) as defined by the Basel Convention.
- The Basel Convention states that hazardous wastes and other wastes should, as far as is compatible with environmentally sound and efficient management, be disposed of in the state where they were generated, so solutions in the country of origin would be preferred when they are environmentally sound.
- Any waste or stockpile consisting of POPs at concentrations greater than 50 mg/kg (ppm) should be treated to destroy or irreversibly transform the POP content (unless other ESM is the environmentally preferred option). Guidance on ESM for POP wastes is provided by the Technical Guidelines from the Basel Convention.
- Any transboundary movements of waste must be in accordance with the requirements of the Basel Convention.
- Attention must be paid to the avoidance of unintentionally produced POPs. For pesticides wastes this means care should be taken over disposal and treatment processes that may produce dioxins and furans.
- Effective public awareness and participation in decision-making is a core principle.

Box H3 summarizes the key points related to standards for disposal.

**BOX H3**  
**Key points related to international standards**

- Waste treatment and disposal operations should comply with the requirements of the Stockholm and Basel Conventions (see box H2).
- The most useful comparator for systematic and coherent regulations on waste treatment and disposal is the EU system which is comprehensive, sets high standards of environmental protection and is available in both English and French.
- The ASP DTO report sets out ways in which pesticides disposal projects in any country can use the standards to deal with waste treatment and disposal for the following options.
  - 1 Pack and go to an established treatment or disposal facility in a highly regulated environment (most likely, but not necessarily, Europe).

**BOX H3 cont.****Key points related to international standards**

- 2 Treatment in an existing facility that could be modified for the purpose and is designed to operate in the long term (on other wastes) – in the country of origin or abroad (e.g. a regional facility).
  - 3 Treatment in a newly developed facility (as a hazardous waste-management facility – i.e. that would continue processing other wastes after stockpiles were treated) in the country of origin or abroad.
  - 4 A special project – development of a dedicated facility or modification to an existing facility with the sole purpose of treating the pesticide stockpile with no expectation of continued operation.
- A country will need to draw on the relevant parts of the EU (or other) system for their specific circumstances, wastes and options for treatment and disposal.
  - In addition to the regulatory standards, it is essential that the necessary infrastructure, skills, capacity and support are in place to enable a facility to operate reliably and successfully.

As stated at the start of this section, the principles used to establish suitable standards for disposing of hazardous wastes such as obsolete pesticides are generally applicable globally. It is suggested that the PMU hires a national or international consultant team (see TOR templates in Annex 1) to complete a review of existing standards and legislation (if present), and to identify gaps and variances with the standards summarized in the DTO report. As a default, it is recommended that countries adopt the standards outlined in this tool as the minimum requirement for the environmentally sound disposal of pesticide and POP wastes.

#### Assessment of waste-disposal options

The assessment of available options for the disposal of obsolete pesticides and associated waste follows a number of guiding principles:

- Standards for disposal in terms of safety and contamination risks are of paramount importance. No compromise on safety and standards should be considered during the evaluation. This is equally relevant to national and international treatment facilities.
- Selection should be based on *standards* and not on technology.
- The options should cover all waste streams stored in the national inventory, which most probably includes pesticides of a variety of chemicals groups (organochlorine, organophosphate, carbamate, pyrethroids, etc.) as well as contaminated soils and other contaminated items such as containers and equipment. Focusing on only one aspect of the disposal strategy will result in gaps when it comes to project implementation.
- The type and quantity of waste are key considerations when selecting the disposal option for a particular waste stream. It is ill advised to preselect a disposal technology in the hope that it will prove capable of dealing with all wastes.
- Where possible, the proximity principle should be taken into consideration. The nearest treatment facility that operates to the required standard should be considered in priority.

The need for each country to assess the relative importance of obsolete pesticides compared to the total national hazardous waste profile should be addressed before the disposal project or the construction of a disposal facility begins.

The relative importance of historical stockpiles of obsolete pesticides compared to stockpiles of other toxic chemical waste and new waste produced on an ongoing basis from continued

industrial production will vary from country to country. Countries with little or no industrial sector will generally have little other toxic chemical waste to consider other than other POP wastes such as polychlorinated biphenyls (PCBs).<sup>11</sup> As such, the disposal option selected by the country will need to address a finite, well-defined amount of waste. Under such circumstances, economics will generally dictate that the waste is dispatched to an existing disposal facility outside the country for environmentally sound disposal rather than the establishment of a new local facility. Nevertheless, the inventory of obsolete pesticides should be examined to identify the waste streams that could be treated locally without generating an unsustainable level of capital investment.

In contrast, many developing countries and countries in economic transition have an industrial and chemicals sector that produces wastes on an ongoing basis. Initiatives such as waste minimization and cleaner production will allow these industries to avoid repeating mistakes made in Europe and the United States of America in the past.<sup>12</sup> Nevertheless, industrial and chemicals production will result in the production of toxic waste streams that require some level of treatment and disposal. In such cases, the integration of the inventory of obsolete pesticide wastes with a more general inventory of the total national waste production can assist in the decision-making process and affect the final disposal strategy a country adopts.

In both scenarios above, it is recommended that the country completes a *National Chemicals Profile* as promoted by the United States Institute for Training and Research (UNITAR). The profile will help countries to identify other waste streams that need to be treated and allow for an assessment of the relative importance of the obsolete pesticide waste in the broader national context. Advice on the completion of the profile can be found at [www.unitar.org](http://www.unitar.org). The output from this exercise will then feed into the strategy for the disposal of obsolete pesticides.

Waste-management options for obsolete pesticides (use with Fig. H1)

This section outlines the decision-making process for identifying disposal options for technical grade and formulated pesticides (chemical wastes). In terms of waste hierarchy,<sup>13</sup> recycling and reuse are preferred waste-management options to disposal (see Annex 6). Therefore, where possible, pesticides should be reused or recycled to avoid the unnecessary costs of disposal and the waste of a usable product. However, this should be considered only if the conditions outlined below are met.

### Reuse of old pesticides

Determining the reusability or potential for recycling of old pesticides is a costly and protracted process, since detailed laboratory tests and field efficacy trials will be required for each batch and type of pesticides. Therefore, it is important to first ensure that the pesticides designated for reuse or recycling are genuinely reusable and a real need has been identified for them. It is also sensible to test only large-quantity pesticides and when they appear to be in good condition. It is recommended that all other pesticides should be designated obsolete and immediately reviewed for disposal.

For this purpose, the PMU, with external assistance as needed (consultant or technical agency) should review all inventory data and complete the assessment process outlined below before finalizing the amounts and types of pesticide that require disposal. The review should

11 PCBs are one of the 12 initial POPs chemicals of the Stockholm Convention. They are typically used as a dielectric coolant in items such as electrical transformers and capacitors. Large amounts of PCB-containing equipment were installed in the electrical distribution systems of many countries. This equipment constitutes an historical waste stream that requires environmentally sound disposal. PCBs pose similar disposal issues to many obsolete pesticides such as DDT.

12 For example, in the 1960s, POPs waste was dumped into the Love Canal in the USA: see <http://www.epa.gov/history/topics/lovecanal/01.htm>.

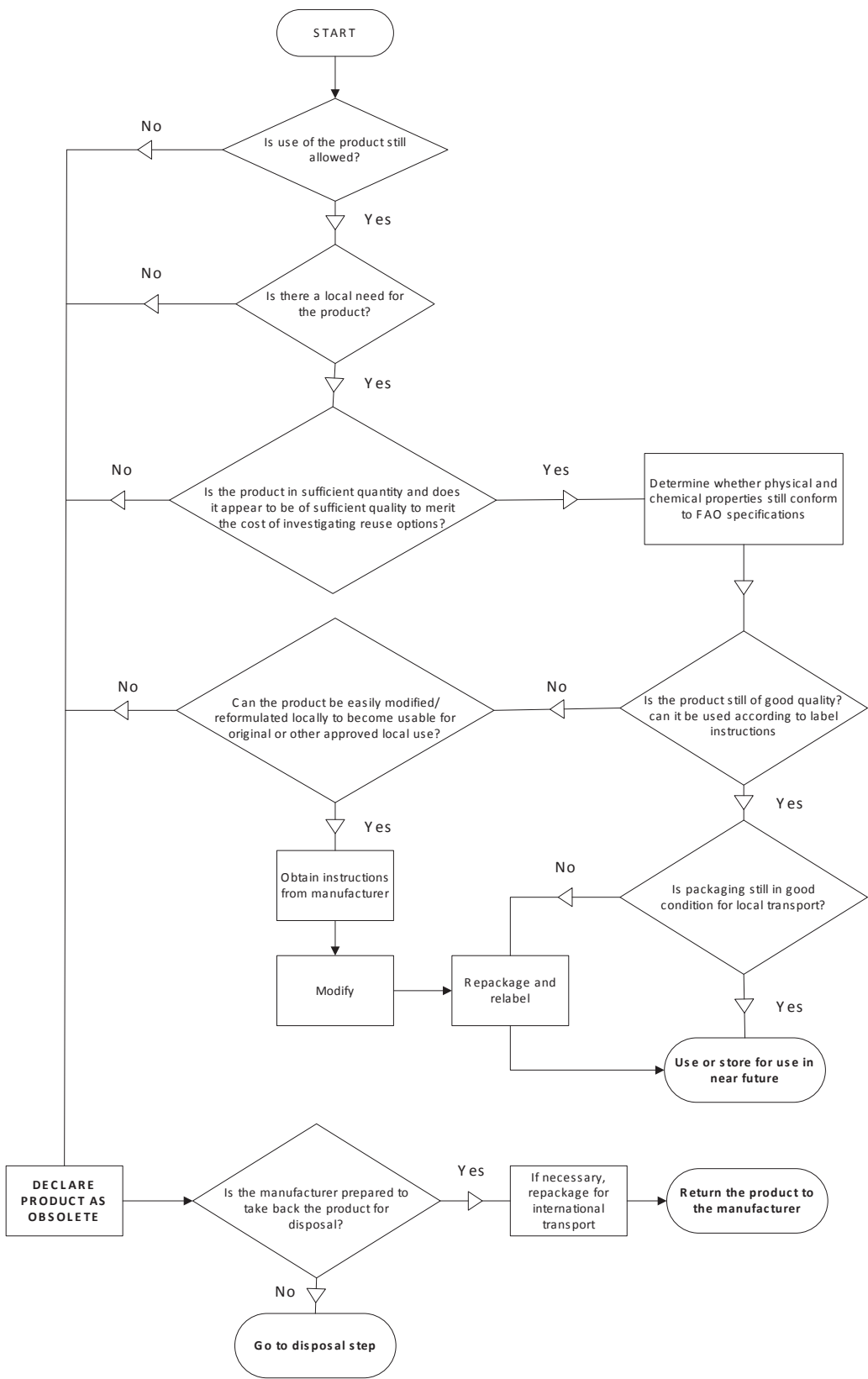
13 The concept of a waste-management hierarchy is enshrined as the basis for waste legislation, particularly throughout the EU. The hierarchy prioritizes the selection of options for managing wastes – avoid in the first place, then in the following order: reuse, recycle, resource recovery, and, in a last resort, destruction (see Annex 5).

include pesticides in the inventory that are currently listed as usable but which are approaching (within three months of) their expiry date. This will form an integral part of the disposal strategy and can have a significant impact on the amount of waste being sent for final disposal, resulting in substantial cost savings.

- **Establishing the need for the pesticide:** It is rational to declare the product obsolete immediately and plan its destruction if it is unlikely that a user within the country with a genuine need for the product can be identified. Furthermore, only large volumes of a single product that may be usable make it worth spending time to find a user within the country with a genuine need for it. Where a need is identified, it is important to ascertain the rate at which it will be used. With low rates of use, there is the risk that the pesticide will become obsolete again before it can be used. In this case it is sensible to designate the proportion that is unlikely to be used for immediate disposal.
- **Testing for reuse:** Once a genuine need has been established, the pesticides should be tested. The testing of products is complex and requires a well-equipped and staffed quality-controlled laboratory, together with appropriate test methods and specifications. If the government does not have a pesticide quality-control laboratory, analysis may possibly be carried out at a local university or at a manufacturer's laboratory. If not, seek a qualified commercial laboratory or request assistance from an aid agency that has a pesticide laboratory. It is also necessary to conduct field-efficacy trials to establish whether the products are usable. Expert advice on the expected decomposition products should also be provided and should again be available from the manufacturer. The testing involves a physical study and a chemical analysis. The chemical analysis must demonstrate that the pesticide is within a 5 percent tolerance of the original specification. Pesticides outside this tolerance should be designated for destruction. The pesticide may require reformulation to make it usable for its original purpose.
- **Products that are usable again after reformulation/reworking:** Products that are still in good condition, but cannot be used because the formulation is not appropriate for the intended use, may possibly be reformulated to produce a usable product. Advice should be sought from the manufacturer or a pesticides expert to find out whether reformulation is feasible. The manufacturer can also advise on facilities needed to reformulate the product, the formulation method, safe handling and packaging. Reformulation makes sense only if there is a permitted use for the reformulated product and an identified user with a genuine need. However, if a local testing laboratory and a pesticide formulation plant are not available, it is probably not feasible to reformulate the product locally.
- **Products that are still usable:** These are products that have expired but have not yet deteriorated. This should be determined by laboratory testing and field efficacy trials. If possible, these products should be used for the purpose they were intended or an alternative purpose that requires the same chemical. Use avoids wasting the product as well as the cost of buying new products and the cost of destruction. These products may need to be repacked and relabelled before distribution.

Figure H1 show a decision tree for determining whether a pesticide can be reused, recycled or requires disposal.

Figure H1  
Decision tree for assessment of pesticide reuse options



When products are confirmed as obsolete it is necessary to assign an appropriate DTO to treat the waste. Annex 4 provides currently available options for the most common categories of obsolete pesticides. It should be noted that technical innovation is dynamic and a comprehensive review of available and suitable DTOs is necessary as part of the overall disposal strategy. This assessment should simply look at possible technologies that could be used to treat the waste safely and, at this stage of the process, should not address issues such as cost or local/international availability. It is recommended that the principal consultant described in the introduction of this volume completes this component of the strategy.

### **Pesticides that should not be reused**

There are some pesticides that should not be reused or recycled. These include:

- **POPs and other banned pesticides:** Pesticides that are no longer allowed to be used in developed countries must be destroyed. These include all the pesticides designated as POPs under the Stockholm Convention. Others have been banned because of their hazard to the global environment and to public health. It is possible that there is still a local demand for these pesticides but, because they represent such a hazard and their use is banned, they must be destroyed.
- **Aged pesticides:** Old pesticides that have expired and that analytical tests have shown to be unfit for use.
- **Pesticides deteriorated beyond usability:** Pesticides that show visible signs of deterioration that make them unusable (for example, caked powders, caked emulsions, flakes and crystals in liquids).
- **Pesticides contaminated with other products:** Where products have become cross-contaminated (e.g. where a liquid from a corroded drum has seeped into a sack of pesticide powder, or powder from a split sack has fallen onto a contaminated floor).
- **Highly hazardous pesticides:** There is little justification for the reuse of any WHO Class 1a or 1b products. Under FAO's risk-reduction strategy, countries are encouraged to eliminate the use and to re-register such products. Only under exceptional circumstances and in cases where no less toxic alternative is available should use of this group of products be considered.

### **Summary**

The PMU is now able to resume the review of possible alternatives for the safe disposal of obsolete pesticides. As for the safeguarding options, there is a need for a complete review of the risks associated with the preferred options and of the mitigation measures to minimize the occurrence of the risk. Table H2 and tool G provide a format to guide the user in this process.

Table H2  
Analysis of alternatives for disposal of pesticides

	Alternatives considered to include SWOT analysis and final decision on acceptance or not	Location of disposal	Risk analysis	Mitigation measures
Obsolete pesticides	[Select potential technologies/ treatment options based on the ability to treat pesticide wastes safely. Annex 4 may assist in this process. For each possible technology, it is necessary to provide reasons why it may not be feasible for the project. Examples: cost, geographical location, transport issues, packaging issues, only suitable for some of the pesticides in the inventory]	[For each alternative provide an indication of the proposed location for treatment. Examples: in-country using existing facilities, in-country following development of capacity, as part of a subregional capacity development project or overseas at an existing, licensed facility. Indicate implications in terms of licensing of facilities, capital investment, cost, time for construction/ commissioning and adherence with international conventions]	[Identify the risks associated with the selected strategy. Examples: lack of infrastructure, potential for environmental damage as a result of accident, the need for international transport with associated potential for accident, public opposition]	[Present at least one mitigation measure for each of the risks identified]
Alternative 1				
Alternative 2				

Add rows to table depending on number of alternatives considered.

Assessment of waste-management options for contaminated soils and building materials (see Box H4)

The breakdown of packaging materials over time owing to poor handling, bad storage, adverse climatic conditions and other factors will inevitably result in the leakage of pesticides. This will result in the contamination of the surrounding environment both inside and outside the store. Such uncontrolled releases of toxic materials can also result in the contamination of the store structure and other items stored with the pesticides, such as fertilizer, farm implements and seeds. The spread of contamination makes the process of safeguarding and decontamination increasingly hazardous and technically complex. Ultimately, the release of the chemicals from the confines of the original container will result in the contamination of soil, ground water and air. The dispersion of obsolete pesticides into the general environment often poses the most direct threat to public health, especially for communities living in close proximity to the store where the leakage has occurred and for the wider environment through the transport of persistent

materials such as POP pesticides and highly toxic Class 1a and 1b pesticides. This problem will be made worse if the original storage location is situated near water sources such as rivers and lakes, which can spread the contamination a long way from the point of contamination in a very short period of time.

It is therefore important that any disposal strategy developed provides advice on the assessment and treatment of contaminated soils and store materials. The largest problem facing the user is that the majority of studies on soil remediation have been carried out in the United States of America or in Europe. Climatic conditions, soil type and the natural soil microbiology can differ greatly to those found in tropical regions where many developing countries are located. The advice offered in these guidelines therefore attempts to present the options open to countries, based on what can be applied “off the shelf” with a minimum level of development to local conditions. FAO in cooperation with the University of Wageningen in the Netherlands has developed a series of risk-assessment tools that can be used to assess the extent and type of soil contamination, and the risk it poses to public health and the environment. This is presented below. Only when a risk-based assessment of the type and extent of the contamination has been completed can a disposal strategy be developed.

**Contaminated building materials**

Where pesticides have leaked or been spilled, the floor and walls of the store will be contaminated. The more porous the building material, the greater the level of contamination held by the substrate. Various methods exist, but care must be taken during the safeguarding exercise to ensure that there is no adverse affect on public health, workers or the environment. An activity- and site-specific SOP and risk assessment will need to be developed for such activities (as presented in EMTK Volume 4).

Only under exceptional circumstances will a store need to be demolished. This can only be decided following a detailed investigation and analysis on the type and extent of the contamination. Based on the level of contamination measured in weight-for-weight terms, a decision will need to be made as to whether the demolition material should be handled as pesticide waste (requiring technically complex handling, packaging and treatment methods) or as low-contamination industrial waste, which could theoretically enter the local waste chain, based on the assessment of national capacity completed previously. Ultimately, the level of contamination and the type of contaminant will determine the most appropriate disposal option.

**BOX H4**  
**Case study: Arjo, Ethiopia**



This wooden and earth-walled structure had stored POP pesticides for over 30 years. The store was positioned immediately next to a well and was within 10 m of housing for a family including four children. An analysis of water and soils indicated that the pesticides had leaked, and had contaminated the surrounding area.



**BOX H4** *cont.*  
**Case study: Arjo, Ethiopia**



The poor repair of the store and analytical results from tests performed on the structure resulted in the decision to demolish the store completely in order to remove the risk to the local population. Before work started, the entire working area was tented to prevent any dust migration, and floor areas were covered to prevent contamination during the work.



The demolition team comprised international contractor personnel working with pesticide experts from the counterpart Ministry of Agriculture. The national personnel gained experience in working procedures, which allowed them to become highly competent project field managers during work on moderate- and lower-risk sites. All operations were supervised by an international technical adviser from FAO.



All store building materials, chemicals and other wastes from inside the store were placed in new UN-approved packages (steel 200- and 320-l drums). All drums were stored on the demolition site until work was complete. The outer surfaces of the drums were then decontaminated and the drums moved to a vehicle for transport to a major collection centre.



After the demolition was completed and the pesticides and other contaminated materials removed, the project team worked on removing the remaining store structure, including a compacted soil floor. All contaminated materials were treated as if pesticides and packaged for disposal overseas as part of an international safeguarding and disposal contract.

**BOX H4 cont.****Case study: Arjo, Ethiopia**

The cleared site was sampled along with water in the well (shown in the foreground). Clean soil was brought into the area to cover any residual levels of contamination and the well was capped to prevent use. The demolition of the store had successfully removed a significant risk to the local population and the general environment.

**Contaminated soil (see Box H5)**

FAO is currently working (2010) with other partners to develop a risk-based approach to soil remediation. This methodology is being applied to contaminated sites in Botswana, Mali, Mauritania, Mozambique and the United Republic of Tanzania where large-scale decontamination is prohibitively expensive. By completing a risk-based analysis of the problem, it is possible to focus limited resources in areas that pose the greatest risk. FAO will continue to complete soil decontamination trial projects and the results from these projects will be added to the FAO Web site along with any further developments in this area. The user is also directed to Guideline 8, *Assessing soil contamination; a reference manual* in the FAO Disposal Series.<sup>14</sup> The guidance gives detailed advice on the procedures to be undertaken to assess the severity of contamination and whether action or remediation is required.

The completion of the national inventory and the application of tools A–C allow the identification of all locations where there is a visual indication of soil contamination. However, the visible inspection of the soils will capture information for only the *worst* cases of contamination. In general, this heavily contaminated soil should be considered as pesticide waste and included in the inventory of pesticide waste requiring disposal. In these cases the removal of the most heavily contaminated material will:

- prevent a worsening of the level of contamination in the surrounding area;
- reduce the risk to populations living in close proximity to the location;
- reduce the risk to valuable resources such as ground and surface water.

This strategy relies on the fact that the contaminated soil is either dispatched to a final disposal option or is placed in an engineered storage location such as a secure purpose-built hazardous-waste landfill designed for the specific purpose of storage pending the identification of a suitable disposal option.

Unfortunately, the situation above is not typical in many developing countries. In many cases the visible indicators for contamination will not be present and the project will rely on either historical records or, in the worst-case scenario, reports of poisoning from use of the soil or water in an area. In such cases, a more in-depth survey of the location is necessary to determine the type and level of contamination. Systems such as bio-immunoassay and the use of bio-indicators

<sup>14</sup> FAO. (2000). *Assessing soil contamination; a reference manual*. FAO Pesticide Disposal Series 8 (also available at [www.fao.org](http://www.fao.org)).

can often work well in addition to the more common sampling and analytical approach, which relies on technology for analysis and is often costly. By combining other methodologies, it may be possible to limit the requirement for expensive laboratory analysis whilst maintaining the quality of the investigation at the location. This strategy has been adopted successfully in Mali, Mauritania and the United Republic of Tanzania.

In such cases it is critical that any disposal strategy is based on sound analytical data. Annex 1 provides TOR templates for international and national consultant inputs for identifying and quantifying contamination at storage locations and for developing risk-based, site-specific remediation strategies (see also Box H5, which explains the protocol to be followed). The output from the consultant study on soil contamination should be used along with the inventory data for pesticide wastes and the feasibility study for treating contaminated containers to develop a complete disposal strategy at the national level.

**BOX H5**  
**FAO risk-based approach to soil assessment and treatment**

The remediation of sites contaminated with pesticides typically follows the sequence below. Historically, the remediation of contaminated soils in developed regions such as Europe and the United States of America depended on sophisticated technological solutions. The economic and technological challenges in most developing countries make the wholesale adoption of similar solutions unfeasible. The Pesticide Risk-Reduction Group at FAO in collaboration with other partners has therefore developed a system that minimizes the need for complex technological solutions to the most heavily contaminated and highest risk materials.

**Site identification**

The inventory process identifies locations where pesticides have leaked and caused contamination in and around stores. It also provides environmental data on the proximity of these storage locations to sensitive areas such as human settlement, water sources and agriculturally productive land. The PSMS allows the user to separate these stores from the broader inventory data, hence allowing a more detailed examination of the factors that make a store higher risk. It also provides data related to the likely contaminants to be found at the store. In addition, community reports, NGO surveys and complaints by the general public provide worthwhile information concerning contamination of the local environment. In such cases a data review will be needed to determine if the location should be included in the site survey stage (below). The site identification stage may include a preliminary rapid environmental assessment (REA) of the potential sites. This allows for a review of all sites and a selection of those that are considered as posing a real problem in terms of contamination, as well as the evaluation of sites that have been reported by third parties (e.g. at locations where pesticides are believed to be buried), which may not be included in the original inventory data. A format for REA is provided in Annex 7.

**Site survey**

Based on the review of PSMS data and other reports, a site survey plan and teams are established. The development of the survey plan – typically by a specialist consultant – includes setting out the number, depth and kinds of sample to be collected and the sampling protocol to be used. The field sampling may be contracted to a specialist institution such as a research institute or university, with project personnel providing logistical support and covering the M&E role to ensure sampling is completed following the survey plan and the sampling protocol (sample-taking, sample-numbering, sample-storage, etc.). Samples are taken from a variety of media, including soil, water,

**BOX H5 cont.****FAO risk-based approach to soil assessment and treatment**

flora and fauna at the location. In cases where contaminated dusts are believed to be spreading pesticides beyond the known area of contamination, air sampling is required.

**Analytical report**

In addition to the site survey and sampling protocol development, it is critical that the appropriate analytical techniques are applied to the samples. Access to laboratory facilities may be limited and the cost of analysis may require the use of alternative approaches. Recent experience has shown that the use of immunoassay test kits for specific pesticides can be used to reduce the number of costly laboratory analyses needed. The use of composite sampling (where a number of samples are combined and re-sampled) can also reduce the number of costly laboratory analyses needed. The need for laboratory analysis will never be removed completely and any analytical survey plan must include details of the most appropriate laboratory (in terms of cost and technical capacity) for completion of the analysis. This assessment of laboratory capacity should be included in the TOR for the consultant. As a general rule, laboratories should be able to meet the “Good Laboratory Standard – GLP” requirements or be accredited to the higher standard of ISO 17025, with proven experience in pesticide analysis of soils and water. The report produced should provide detailed concentration data on the major contaminants to allow adequate hazard identification and risk assessment to be completed (see below). In addition to the analytical laboratory tests, the report needs to include details on the soil characteristics, such as grain-size distribution, humic/organic content, clay article content, moisture levels and any soil flora and fauna.

**Risk assessment**

Based on the sampling regime and analytical survey results, it is possible to develop a three-dimensional picture of the level and type of contamination at each location. This data, along with information on hydrogeology or proximity to sensitive areas, is used to estimate the level of hazard posed to general public health and the environment. The assessment also includes an evaluation of likely exposure pathways, including the potential for entry of contaminants into the food chain through contamination to drinking-water supplies and the uptake of pesticides by food or fodder crops. Issues related to water run-off and wind transport of contaminated dusts also require assessment. When the risks have been assessed fully, an appropriate remediation strategy can be determined.

**Development of a remediation strategy**

Based on the risk assessment, all contaminated sites included in the survey can be placed into one of three remediation categories.

- Category 1 (lower or no risk): Sites with low-level contamination, which pose no threat to public health or the environment and where no or very limited intervention is needed. Possible solutions include the fencing of the area, the planting of cover crops to prevent dust migration and the diversion of water courses to prevent spread of contamination.
- Category 2 (moderate risk): Sites with intermediate-level contamination, which pose a potential or actual threat to public health or the environment and where remediation through low-input solutions should be possible. In addition to options highlighted for Category 1, site solutions such as land farming, in situ bioremediation using existing soil bacteria or added cultures and phytoremediation can provide viable treatment options

**BOX H5 cont.**  
**FAO risk-based approach to soil assessment and treatment**

at a relatively low unit cost. The option of excavation of the soil and removal to a specially engineered landfill site for sequestration may also be considered.

- Category 3 (higher risk): Sites contaminated with WHO Class 1 pesticides, POP pesticides at a level greater than 50 ppm or which generally exhibit high levels of contamination with other pesticide classes. They pose an immediate or potential risk to public health or the environment. Such locations are likely to require excavation and transportation to a sophisticated technological facility established in the country or overseas. Treatment options include a variety of thermal treatments, mechanical destruction and soil washing. The use of soil pretreatment methods such as particle size grading of contaminated materials can have a significant impact on the final volume of material requiring sophisticated treatment. Recent work on mechanical treatment of POP-contaminated soils has confirmed that POP pesticide contamination is often found in the clay- and silt-size particle ranges (less than 0.002 mm and 0.002–0.05 mm, respectively). Less contaminated materials can be sampled and treated as Category 1 or 2 wastes.

The aim of a remediation strategy is to maximize the level of local, in situ treatment options requiring low levels of inputs and of sophisticated technological solutions. The consultant is required to develop site-specific remediation strategies according to local conditions and the potential for use of low-input, relatively unsophisticated technology options (e.g. bioremediation and phytoremediation), based on soil characteristics such as the level of organic matter, clay particle content, water content or access to water (important in arid areas), natural soil flora and fauna, and past experience with similar soils and contaminants. The use of pretreatment options can also significantly reduce the final volume of waste requiring a Category 3 solution.

**Site prioritization**

Based on the risk assessment and analytical reporting, it is possible to reintroduce a site into the PSMS. This allows a comparative risk analysis of the contaminated sites compared to the remainder of the stores in the inventory. The final EA report (tool I) should present a risk-based strategy based on objective findings. In some cases, the remediation of Category 3 contaminated sites may take precedence over the removal and disposal of well-packaged, safely stored pesticides. The pesticides will eventually require environmentally sound disposal, but, in terms of risk reduction, remediation of the contaminated site will have the greatest impact. The final decision on the prioritization of affected sites and the funding for treatment and disposal will ultimately be a national issue subject to debate among all project stakeholders.

The PMU should now summarize the alternatives considered and select the preferred disposal strategy as proposed in Table H3 below. Based on the risk-management principles presented in tool G, the PMU should then identify the risks associated with the selected strategy and propose mitigation measures to reduce the level of the risks.

Table H3  
Contaminated soils and building materials: disposal options, risk analysis and mitigation measures

	Alternatives considered to include SWOT analysis and final decision on acceptance or not	Location of disposal	Risk analysis	Mitigation measures
Contaminated soils	[Summarize the various alternative treatment options considered following the completion of the process as outlined in Box H5 for each category of site. Provide data as to why the alternatives may not be suitable for the sites as characterized by the analytical survey and hazard identification]	[Summarize the site-specific remediation strategies and technologies to be applied for each category of contaminated site]	[Summarize risks associated with the strategy]	[Present mitigation measures for each risk]
Category 1				
Category 2				
Category 3				

Add rows to table depending on number of categories considered.



Assessment of waste-management options for contaminated containers and application equipment (see Box H6 and Table H4)

In addition to obsolete pesticides and contaminated building material and soils, it is likely that there are also contaminated containers and application equipment (e.g. sprayers). These need to be identified during the inventory. FAO Guidelines on *Preparation of Inventories for Pesticides and Contaminated Materials* provides detailed guidance on how to record the numbers and types of old pesticide containers, and the FAO PSMS acts as the central database for the records from each country.

The store or surrounding area may hold empty or partially empty containers (drums, plastic and glass bottles, cans, gas cylinders, boxes and sacks) contaminated with pesticides. Their presence may arise from a number of possible reasons:

- after use of the pesticide, the containers were returned to the store for safe keeping;
- containers that have corroded and their contents leaked out;
- containers that were inappropriate for transportation as part of a safeguarding exercise and whose contents have been transferred to other containers;
- small containers, whose contents have been consolidated into 200-l drums or intermediate bulk containers (IBCs);
- gas cylinders and pressurized containers whose contents have been decanted.

Contaminated containers represent a particular environmental and public health hazard. Empty containers have a high residual commercial value in many developing countries and are used by both urban and rural communities for storing water and food or for recycling into cookware and tools. The resale price of a single 200-l steel drum may be equivalent to one month's salary or more for a storekeeper in some regions. The temptation to supplement income by selling returned containers with no attention to the potential health or environmental risks must be taken into consideration.

This problem may be compounded by a lack of regulation or control systems, resulting in the improper use of the containers and the subsequent transfer of hazardous pesticide residues into food and water supplies. It is important that empty containers are treated in a way that prevents their inappropriate use. Contaminated containers should be decontaminated safely and rendered unusable so that they no longer represent a hazard or they should be destroyed in an environmentally sound manner. FAO and other partners offer technical support on how to deal with this problem and there exist numerous national initiatives in developing countries such as Brazil, where container-management schemes are operating successfully.

In addition to the containers, attention must also be paid to contaminated secondary packaging such as plastic wrapping, pallets and cardboard boxes. Often these items are discarded at the delivery location and accumulate over time. As a general rule, pallets and other secondary package materials that have been used in the store and that show signs of contamination should be treated as hazardous materials. Uncontaminated items should be discarded into the normal domestic waste system.

The variety of contaminated containers requires a range of disposal solutions. The level of contamination, the condition of the container and the material of manufacture are the main factors that will influence the choice of treatment. Box H6 provides general indications for distinguishing recyclable and non-recyclable contaminated containers.

## BOX H6

### Criteria to determine if contaminated containers can be reused

Containers that must be sent for disposal generally show some or all of the following characteristics:

- poor physical condition (e.g. rusted steel drums);
- heavily contaminated;
- contamination with pesticide residues that are not easily removed by washing techniques;
- pesticides have penetrated into the containers such as paper and cloth sacks, cardboard and wooden boxes.



*Examples of old rusted steel drums and assorted contaminated packaging that should not be reused or recycled*

Containers suitable for decontamination and recycling are generally:

- in good physical condition;
- show little or no visible contamination;
- container surfaces are smooth and impermeable such as uncorroded steel and aluminium, glass and plastics.

In general terms, the recyclable and non-recyclable categories of contaminated containers arise from two distinct issues related to pesticide management.

The first category of container requires a final disposal solution and is typically found with historic stockpiles of waste which may have been stored for decades under poor conditions. The level of residual contamination in the containers is often high as evaporation of contents over time results in the deposition of concretions of crystalline residues that are difficult to remove. Such containers are typical of obsolete pesticide disposal projects and pose a direct threat to public health and the environment. These items are treated as waste and the disposal strategies developed for their treatment are similar to those applied for the pesticide wastes detailed above.

The second category of container is suitable for the recycling option and typically consists of newer items generated from the ongoing use of pesticides. In most cases, the contents of the original container have been used for the designated purpose. Provided that the containers have been cleaned immediately according to the manufacturer's and FAO guidance following the deployment of the contents, the levels of residual contamination are generally low. The containers are not old and are in good physical condition, making the temptation for improper use difficult to



resist. This category of container can be considered more of a pesticide management issue than an obsolete pesticide issue. The following sections of this guideline will, therefore, focus more on the options applicable to the highly contaminated materials common to obsolete pesticide stockpiles.

It is clear that the proposed treatment methods for contaminated pesticide containers will depend on container category. The decision on specific technologies for disposal or recycling will be influenced by the container material, contaminant, size and the potential for reuse of the decontaminated product. It is recommended that the review of needs for treatment of this waste category feature as part of a consultant contract. The consultant outputs should be a complete analysis of the potential treatment options plus a full feasibility study for the implementation of selected options within the current country setting. Draft templates for TOR for such a study are provided in Annex 1.

At the end of this process, the PMU should summarize in Table H4 below the possible alternatives for the disposal of contaminated containers, assess the risks associated with the preferred disposal option or strategy and establish mitigation measures to ensure the management of risks control.

**Table H4**  
**Contaminated containers: disposal options, risk analysis and mitigation measures**

	Alternatives considered to include SWOT analysis and final decision on acceptance or not	Location of disposal	Risk analysis	Mitigation measures
Contaminated containers	[Present treatment options for both categories of contaminated containers, based on an analysis of the inventory data. The analysis should include a summary of any decontamination options, plus an assessment of the suitability of recycling or final treatment options of the different types of container (plastic, metal, paper, etc.)]	[Complete a final selection of technologies for the treatment of both container categories (heavily contaminated/corroded and potentially treatable for recycling) based on the findings of the feasibility study outlined above. The summary should indicate conditions for adoption of the strategy and highlight the potential to build on existing container management initiatives]	[Identify the risks associated with the strategy selected for containers]	[Identify the mitigation measures that will be employed for each risk]
Legacy (steel)				
Legacy (plastic)				
New (steel)				
New (plastic)				

Add rows to table depending on number of container classes considered.

## Summary of tool H

Table H5 below summarizes a preliminary strategy for management and disposal of all waste streams identified during a complete review of the inventory data in the PSMS. To complete this strategy, the PMU has reviewed:

- All pesticides stocks and associated waste (contaminated soils, building material, containers and equipment) in the PSMS.
- All waste-management/disposal options and technologies available in the country.
- Pesticides that can be safely used through an extension of expiry date and/or repackaging.
- All national waste disposal standards for the management of all pesticide waste streams and comparison with international standards.
- The stocks that can be treated in the country to the required standard, including an assessment of the relative importance of these stocks in comparison with the national waste profile in order to consider the feasibility of developing national waste-management capacity.
- All contaminated sites, and conducted a risk-based survey of the sites plus identification of remediation strategies that could be used.
- The technical and financial feasibility study for a safe recycling of pesticide containers.
- A risk assessment with mitigation measures for the preferred disposal option.

Table H5 is a template that can be used to present a summary of the findings and conclusions reached as a result of using this tool. This table should be completed as part of the overall disposal plan developed by the PMU and the principal consultant. The outlined summary plan should then be presented to interested parties via a multi-stakeholder national workshop or seminar as part of the overall consultation process for the project. This will provide the PMU and consultants with an opportunity to present their conclusions at an early stage in the process and factor in any issues that may be highlighted by other stakeholders involved in the project, such as civil-society or NGO groups and national waste-management companies. It is recommended that the completion of the summary plan form an integral part of the TOR for the principal consultant.

An aspect not covered so far in these guidelines is the issue of transportation to the final disposal facility. Many of the principles pertaining to the collection and centralization of the waste under the safeguarding component will apply to the movement of waste to the final disposal facility. Tool F should be applied and in instances where waste requires transboundary transportation to another country, the user is directed to the Web site of the Secretariat of the Basel Convention ([www.basel.int](http://www.basel.int)) where advice on transportation notification procedures can be obtained. The user is also advised to meet with the National Basel Convention Focal Point (usually within the Ministry of Environment) to ensure all requirements of the Convention are met. In cases where transfer involves rail or sea transport, the user should consult the codes of the relevant transport mode concerning any additional packaging, labelling and stowage requirements. For the purposes of the disposal strategy, it will be important that the PMU addresses the issues of alternative transport options (routes and mode), risks of transport and mitigation measures adequately. This may be added to the detail provided in Table H5.

**Table H5**  
**Summary of disposal options with risk analysis and mitigation measures**

	Alternative selected and justification	Location of disposal	Summary of risk analysis	Summary of mitigation measures
Pesticides	[List potential technologies/treatment which could treat pesticides waste safely. Add reasons why certain options may not be feasible for the project. See Table H2]	[List the potential treatment options with indications for the proposed location for treatment as well as implications. See Table H2]	[Risks associated with the selected strategy]	[Mitigation measures proposed for each of the risks identified]
Soils	[List the various treatment options considered and provide data as to why certain options may not be suitable for the sites. See Table H3]	[Present a summary of site-specific remediation strategies and the technologies to be applied for each category of contaminated site. See Table H3]	[Summarize the risks associated with the strategy. See Table H3]	[Present the mitigation measures for each risk. See Table H3]
Containers	[List treatment option for both categories of contaminated containers Include a list of containers suitable for recycling and an assessment of the options for decontamination, recycling and final treatment processes. See Table H4]	[List the preferred technology options for the treatment of both categories of containers (heavily contaminated/corroded and potentially treatable for recycling). Include in the list the conditions for adoption of the strategy and highlight the potential to build on existing container management initiatives. See Table H4]	[List the risks associated with the strategy selected for containers. See Table H4]	[List the mitigation measure(s) that will employed for each risk. See Table H4]

Add rows to table depending on number of waste classes considered.

# Tool I

## Environmental assessment report and environmental management plan

To be able to start with the detailed preparation of the safeguarding project implementation, it is important to have a document in hand, the environmental assessment (EA) report, consolidating all relevant data and key decisions to be adopted for an ESM based on the country's overall environmental situation. The EA report will be used to present the project to stakeholders (national and regional authorities, donors, local communities, NGOs, etc.) for approval and support. It will also serve as the master document for preparing the site-specific implementation of safeguarding activities, which is the subject of the next volume of the EMTK series. Finally, the EA is an essential document for preparing the tender for disposal services at the start of the project-implementation phase.<sup>15</sup> The EA is supported by a detailed environmental management plan (EMP), which summarizes the risks and mitigation measures of each category of site (high, medium and low risk). The EMP is an integral part of the EA report.

### Objectives of the tool

The aims of tool I are to provide guidance on:

- the consolidation of outputs from tools A–H into a country-level EA report for obsolete pesticides and associated wastes;
- the consolidation of outputs from tools G and H into a country-level EMP annexed to the EA report.

The overall goal of the EA report (together with the annexed EMP) is to show that all relevant operative aspects, decisions and strategies have been carefully and objectively studied and considered in the light of the broader environmental situation in the country, and that the safeguarding will result in an improvement of the situation.

### Outputs of the tool

The two outputs from tool I are:

- a complete country-level EA report which provides essential data on the country of the project and gathers key outputs of other EMTK tools into one report;
- a complete country-level EMP including tables I1 and I2 which provides data on:
  - the safeguarding strategies to be adopted for higher-, moderate- and lower-risk storage locations;
  - a comprehensive disposal plan for all waste streams included in the national inventory (typically pesticides, contaminated containers and material, and contaminated soils and building material).

### Description of the tool

The following sections propose formats for the presentation of both outputs. These formats are based on those developed jointly by FAO and the World Bank as part of the first phase of the ASP. The formats differ, however, from the guidance provided to ASP Phase 1 countries and focus

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<sup>15</sup> Separate guidance is available from FAO to assist the formulation of a tender based on the inventory data and specific safeguarding and disposal strategies to be adopted. FAO. 2000. *Formulation of technical specifications for pesticide disposal projects*.

predominantly on environmental issues in line with FAO policies. The EA plan brings together information from EMTK Volumes 1–3:

- country setting, including a review of areas of possible sensitivity;
- institutional and legal setting for completing the project (implementation arrangements);
- baseline data on pesticide quantities and distribution (Inventory Guideline; tools A and B);
- the National Risk Index (tool C);
- proposed collection-centre locations, management systems and transport plans (tools D–F);
- analysis of the alternatives considered in terms of safeguarding and disposal options (tools G and H);
- an EMP that provides relevant details on the proposed safeguarding and disposal strategies (tool I);
- an M&E plan (covered by a separate FAO guidance<sup>16</sup>).

The EA places this data in the overall national environmental context and provides a report with which all stakeholders can be consulted on issues related to overall project implementation. Similarly, the data required to complete the EMP is largely a consolidation of the conclusions reached through tools G and H and includes:

- analysis of the risks associated with the proposed disposal plan;
- mitigation measures;
- indications concerning institutional responsibilities;
- estimated timeline for implementing safeguarding activities;
- estimate of cost of implementation based on market-survey data;
- details on the proposed M&E plan to support implementation of the safeguarding strategies;
- an analysis of training and capacity development requirements to implement project activities effectively;
- a timeline for implementation of the disposal activities.

The EA and the EMP are the documents submitted for approval by national decision-makers, donors, technical assistance agencies and the general public. Thus, the content and quality of the final document needs careful consideration to win support from all sectors. The scope for detail is limited, so it is important that documentation is available to support the EA and EMP conclusions in case any party has queries or challenges an aspect. Completing the final EA report and EMP is a key activity and will require inputs from specialists with experience in the preparation of such documents. It is recommended that the project's principal consultant take on this responsibility.

As mentioned in the introduction to this volume, social impacts such as issues related to resettlement and loss of livelihood are not covered by these guidelines and for the purposes of this document are considered to be a matter for national government policy. Neither do these guidelines cover the aspects of public disclosure and consultation common to many EA processes. The country will use other existing mechanisms to complete the development of a social-impact assessment and management report, and to ensure that issues related to its disclosure are addressed adequately.

## **Practical guidelines for the development of the environmental assessment plan (see Box I1)**

The EA report is a tool to assist in project implementation. It should be recognized as the primary means by which the scope and scale of the project and its potential impact on public health and

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16 FAO, 2000. Guideline on "Formulation of technical specifications for pesticide disposal projects".

the environment are presented to stakeholders. The report allows countries to define the scope of the problems faced from obsolete pesticides and associated wastes in detail and to present the strategy for addressing these problems. The EA should therefore:

- provide data on the interrelationship of the locations where pesticides are stored with the broader environment in the country;
- present the strategy to be adopted for the safeguarding of obsolete pesticides (repackaging, transport and storage);
- justify the selection of storage locations based on the risk posed to public health and the environment;
- present a disposal strategy based on an assessment of national capacity to treat wastes in an environmentally sound manner.

A degree of flexibility remains in the final content of the EA. This allows countries to tailor the finished document to meet any additional needs they may wish to prioritize. The outline provided in this document should, however, be regarded as a minimum requirement for countries to demonstrate that they have completed an assessment of the potential impacts of project implementation.

Countries may wish to include additional studies and information related to improving general environmental awareness and chemicals management. These could include specific studies in certain areas, such as the current status of waste legislation, the process for licensing disposal facilities compared to best practice applied in other regions, or a more detailed study of the country’s waste-disposal needs – all of which are beyond the limited scope of a typical pesticide management project. While such initiatives are encouraged, the funds available to complete such work are frequently limited. Countries may be able to mobilize additional financial support to cover more detailed studies in specific areas. Box I1 presents a suggestion for the structure of the EA.

The following sections provide more detailed guidance on the content of each of the major headings (Box I1).

<b>BOX I1</b>	
<b>Recommended generic list of contents for environmental assessment plan</b>	
<b>Executive summary</b>	
Section 1	Country setting
Section 2	Policy, legal, and institutional framework
Section 3	Baseline data
Section 4	Environmental impacts
Section 5	Analysis of alternatives
Section 6	Safeguarding and disposal strategies
Section 7	Environmental monitoring plan
Section 8	Environmental management training requirements
<b>Annexes:</b>	Environmental management plan
<b>Appendices:</b>	List of tables
	List of figures
	List of annexes

### Section 1: Country setting

Data concerning sensitive geographical areas should be presented, such as:

- population centres (with size);
- world and national heritage sites;
- national parks;
- wetlands;
- areas of importance with regard to biodiversity (both fauna and flora);
- sensitive areas owing to topography;
- distribution of major hospitals and clinics, with their capacity to deal with poisoning;
- any other “special” areas.

### Section 2: Policy, legal and institutional framework

Much of this data may have been outlined in an operational manual of the country project. The PMU should compile a complete set of all relevant government policies, decrees and regulations that could potentially affect the implementation of the obsolete pesticides safeguarding project.

Areas of focus should include:

- national pesticide legislation and regulations;
- national waste-management legislation;
- regulations governing the national transport of hazardous goods;
- environmental assessment impact regulations;
- national labour regulations.

The text should note that the EA plan is being prepared in strict compliance with the requirements of the country environmental regulations regarding EA. In cases where national disposal facilities are being considered, the review should also include issues related to environmental impact assessment studies, permitting regimes, monitoring of operations, etc. Donor EA requirements may also need to be accounted for under this section.

In addition, the section should explain the relevance of the three chemical conventions (Basel, Rotterdam and Stockholm) to the proposed work. This should include a statement indicating that the disposal process will assist the country in meeting its obligations to remove agricultural POPs as required under the Stockholm Convention.

In terms of the institutional arrangements for implementing the project, the section should also define the responsibilities for risk mitigation and monitoring along with arrangements for information flow, especially for coordination between agencies responsible for mitigation. This is especially important since the project requires cross-sector and cross-institutional integration. The EA should outline the key responsibilities for the mitigating and monitoring measures, of implementation, training, financing and reporting. Institutional arrangements should be proposed that will maintain support for agreed enforcement measures for environmental protection.

### Section 3: Baseline data

The section should include:

- a summary of any previous waste-management and pesticide-disposal initiatives;
- a statement on the causes of accumulation as identified by prevention studies;
- all PSMS data related to the pesticide stores in the country, including the plot of environmental and pesticide risk factors  $F_e$  and  $F_p$  (tool C);
- a preliminary register of all contaminated sites (PSMS report);
- a review of potential storage locations (tool D);
- a review of proposed transport routes to main collection points and port of export, as appropriate (tool F);

- an assessment of national management capacity to complete a national safeguarding operation (tool G, Table G1);
- an assessment of current disposal capacity in the country, to determine the potential for local treatment of the pesticide wastes (tool H, Table H1).

#### Section 4: Environmental impacts

Based on the general country setting presented in Section 1 and the baseline pesticide data presented in Section 3, the PMU should provide the following assessment of environmental impact:

- a list of the higher-risk sites with a summary analysis of the principle factors that make them a risk to either public health and/or the environment (PSMS report);
- an assessment of the potential impacts of the locations based on their proximity to and interrelationship with the broader environment (PSMS report).

Inputs will also include the risk data from any survey of pesticide-contaminated sites (see Box H5) and an assessment of disposal options for contaminated containers. In all cases, particular attention should be paid to discussing potential health and safety impacts on local populations and workers involved with project implementation.

The review process should also include an indication of any locations where permanent or temporary resettlement may be needed to allow the safeguarding operation to proceed. As stated previously, the actual resettlement measures involved are beyond the scope of this document and an issue for national regulation.

#### Section 5: Analysis of alternatives

Tools G and H provide advice on how to study the alternative strategies for both safeguarding and disposal of obsolete pesticides and associated wastes. The EA needs to present the various options that have been considered and provide a reason for their selection or rejection (see Table G7 and equivalents for moderate- and lower-risk sites). The SWOT analysis completed as part of tool G and the resultant exercises in reviewing options for repackaging, equipment supply, transport and storage management can be summarized and presented in this section. Similarly, Table H5 can be used to present the various options considered for disposal of each waste streams. Alternatives to the preferred options should be available from analyses and exercises completed during the development of safeguarding and disposal strategies. The principal consultant can also help to provide alternatives and elements for the SWOT analysis. Table I1 may be used to summarize the data in an easy-to-understand format.

After completing Table I1, the section should close with a statement selecting the preferred option for each main activity with a detailed justification for selection based on the results of the application of tools G and H.



**Table I1**  
**Summary of alternatives for project implementation (SWOT analysis)**

	Alternatives	Strengths	Weaknesses	Opportunities	Threats
<b>Repackaging</b> (repeat for moderate- and lower-risk sites)	Higher-risk sites	[			
	Management				
	[Insert preferred option from Table G7]				
	[Insert first alternative] <sup>1</sup>				
	[Insert second alternative] <sup>1</sup>				
	Supervision:				
	[as previously]				
	Implementation:				
	[as previously]				
<b>Transport</b>	Personnel:				
	[as previously]				
	Equipment:				
	[as previously]				
	Waste to interim collection points:				
	[as previously]				
	Waste to main collection point/point of export:				
	[as previously]				
<b>Storage</b> (store refurbishment and management)	At the site:				
	[as previously]				
	Interim collection points:				
	[as previously]				
	Main collection point:				
	[as previously]				
<b>Disposal</b>	Obsolete pesticides:				
	[as previously]				
	Contaminated soils and building materials:				
	[as previously]				
	Contaminated containers and equipments:				
	[as previously]				

<sup>17</sup> To be filled with information of the completion of safeguarding and disposal strategies and/or with the help of the principal consultant.

After completion of Table I1, the section should close with a statement selecting the preferred option for each main activity with a detailed justification for selection based on the results of application of Tools G and H.

## Section 6: Safeguarding and disposal strategies

### Safeguarding strategy

Tool G provides detailed guidance on the preparation of a comprehensive safeguarding strategy for obsolete pesticides and associated wastes. The PMU should integrate the following information in the EA report:

- the risk-based prioritization of the stores and geo-political regions (tools B and C);
- who will complete the safeguarding (national capacity, contractor or both) at higher-, moderate- and lower-risk sites (tool G);
- where the safeguarding will be completed (at the original location or at a collection centre) (tool D);
- where the safeguarded stocks will be stored and how the stores will be managed (tools D and E);
- how and who will transport the stocks to the collection point, and from collection centre to the point of export or to the final disposal facility (tool F);
- the involvement the country wishes to have during the safeguarding stage, i.e. to implement the safeguarding with the government and/or national staff, or to supervise the completion of the works by external contractors.

### Disposal strategy

Tool H provides detailed guidance on the preparation of a complete disposal strategy for obsolete pesticides and associated wastes. The EA report should contain the following outputs:

- a detailed analysis of the waste streams to be dealt with as part of the safeguarding project;
- an assessment of national capacity to deal with the various waste streams;
- preferred disposal options based on the waste streams and their respective volumes/ amounts, current national capacity to deal with each waste stream, and barriers to implementation of a national disposal option;
- tender/bid documents to allow the selection of an environmentally sound disposal option (subject to a separate technical guidance).

The process of developing a disposal strategy allows countries to prioritize waste streams as defined at the inventory stage. The risk-based assessment of all disposal locations and the assessment of the potential for disposal toxic by-products to adversely affect human health and/or the environment is a key factor in the EA process.

## Section 7: Environmental monitoring plan

The development of a comprehensive *environmental monitoring plan* is a critical aspect of project implementation preparation: it allows the country to demonstrate that project implementation in no way results in a worsening of the current baseline situation, and that all activities are completed as per the work plan and the original budget estimates. This plan is distinct from the detailed M&E planning for project implementation, which is a section of the site-specific health, safety and environment (HSE) plans presented in tool N (EMTK Volume 4) and also the subject of separate FAO technical guidance on development of M&E project delivery, available from FAO on request.

In addition to the meeting of project milestones as defined in the work plan for safeguarding and disposal (part of the overall project M&E system), the environmental monitoring plan may also introduce additional indicators, such as:

- tracking of the national risk factor (NRF) from obsolete pesticides (see Fig. C2 in tool C);
- reporting on spills, leakages, accidents or injuries during safeguarding and disposal;
- concentration of contaminants in soils before and after site remediation;
- amount of each waste stream processed by the allotted disposal technology;

- health surveillance data for project workers and air-quality monitoring at locations where work has been completed.

Table I3 below provides a format for the presentation of the EMP. It also provides an opportunity to indicate by whom M&E will be completed at each stage of implementation and allows for a cost estimate to be factored into the overall project budget.

By setting clear indicators for the safeguarding and disposal components of the project, it is possible to demonstrate that the project complies with international best practice for the implementation of waste-management projects. The implementation of the EMP needs to include supervision missions and audits from a number of key players. These may include FAO and other development partners, as well as independent monitoring by local or international NGO groups. Through Table I2, the cost implication of this activity can be estimated and factored into the overall project budget.

#### Section 8: Environmental management training requirements

Any training requirements associated with implementing the safeguarding and disposal strategies, the EMP and the monitoring plans should be presented in detail, including associated costs. In addition, the overall institutional capacity for environmental management should be evaluated, and components identified for a broader programme of institutional strengthening developed for future funding as part of subsequent capacity building plans.

#### Annex to the EA: Environmental management plan format

As a general guideline, the EMP only needs to provide details on the strategy to adopt. The examination of the alternatives is carried out as part of the overall EA process.

Table I2 provides a format for summarizing the data collected in tools G and H. The detailed Tables G2, G3, G7 (and equivalents for the other risk site categories), G8, H1 and H5 must be attached to Table I2, which serves as a cover sheet for the complete dossier. The whole package is included as part of the overall EMP, which is annexed to the final EA document. Note that the format provided in Table I2 is a draft template and PMUs are free to improve the format and content, based on experience and national requirements for EMP development.

Table I3 provides a format for summarizing the M&E plan for the implementation of the safeguarding and disposal activities. M&E is an essential aspect of project implementation and it is critical that the EMP provides information on how this will be managed during the project.

Table I4 provides a format for summarizing the timeline for project implementation. This should be considered a best-case scenario based on the data at the time of preparation of the EMP. A detailed work plan will need to be prepared later as part of the inception phase of the safeguarding and disposal activities with inputs from all major stakeholders, including any waste-management companies hired to complete the work, transportation contractors and disposal companies.

It is recommended that Tables I2–I4 be inserted with any associated supporting documents as an annex to the final EA plan. As previously mentioned, it is recommended that the EMP be completed by the principal consultant with technical inputs as needed. The consultant should have:

- no formal affiliation with the project regarding its future implementation;
- competence to complete the preparation of the document;
- capacity to train the operational staff who will implement the plan as presented in the EMP;
- familiarity with the implementation of projects in the developing country context.

The EMP will provide a basis for the future development of the detailed site-specific HSE plans for project implementation discussed in EMTK Volume 4.

**Table I2**  
**Environmental management plan: summary table**

Project activities/ Seven major risk categories	Potential risks	Mitigation measure(s) (incl. legislation and regulations)	Institutional responsibilities (incl. enforcement and coordination)	Timeline	Cost estimates	Comments
Repackaging						
Higher-risk stores						
I Health and safety						
II Environmental protection						
III Equipment						
IV Public consultation						
V Management and planning						
VI Sustainability (capacity building and skills transfer)						
VII Budget planning						
Moderate-risk stores						
(the 7 risk categories as previous)						
Lower-risk stores						
(the 7 risk categories as previous)						
Transport						
(the 7 risk categories as previous)						
Storage						
(the 7 risk categories as previous)						
Disposal						
Obsolete pesticides						
(the 7 risk categories as previous)						
Contaminated soils and building materials						
(the 7 risk categories as previous)						
Contaminated containers and equipments						
(the 7 risk categories as previous)						
Total costs:						



# Summary of tool I

In summary, the EA together with the EMP can be considered as a tool to illustrate the interrelationship between the human and physical geography of the country and the locations where obsolete pesticides and associated contaminated materials are found. It examines the institutional setting in which the problem is set. Finally, the EA presents the preferred strategies for implementation of the safeguarding and disposal components and demonstrates that the PMU has made objective decisions on how to address the risks posed by obsolete pesticides in a safe and environmentally sound manner. The EA will therefore aim to consolidate a very diverse set of factors influencing the implementation of the project and present it in such a way that it is clear to all stakeholders.

# Annexes

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- Annex 1: Template for terms of reference (TOR) for consultant inputs
- Annex 2: Recap on EMTK Volume 1
- Annex 3: Sources of hazard data for pesticides
- Annex 4: Selecting potential disposal options
- Annex 5: Disposal technology options – report on standards
- Annex 6: The principles of waste hierarchy
- Annex 7: Format a rapid environmental assessment (REA)
- Annex 8: Example of a completed Table H5 (Summary of disposal options with analysis and mitigation measures)

## **Annex 1: Templates for terms of reference (TOR) for consultant inputs**

The templates for the various TOR presented here allow the user to either hire a series of individual consultants from each subject area or, alternatively, hire a single contracting firm to complete all studies and produce a consolidated final report. It should be noted that the specific details of the TOR must be country specific and the exact content of the TOR should be developed by the PMU at the start of the overall strategy development- and environmental assessment process.





Food and Agriculture Organization of the United Nations

Terms of Reference for Consultant/PSA

Job Title	Environmental Assessment and Environmental Management Plan Consultant (EMTK Volume 3)		
Division/Department	AGPM		
Programme/Project Number			
Location			
Expected Start Date of Assignment	Duration:		[insert number of days]
Reports to	Name:	Title:	

**GENERAL DESCRIPTION OF TASK(S) AND OBJECTIVES TO BE ACHIEVED**

The international consultant will be responsible for the following key activities and will be supported by members of the country project team, thematic specialist consultants and national consultants as required. The consultant will:

- Develop a work plan for the EA and EMP development in collaboration with other stakeholders.
- Complete a review of FAO PSMS and other inventory data to determine the risk profile of the project in terms of numbers and distribution of high-, moderate- and low-risk storage locations/affected sites.
- Draft the initial draft of the country EA in accordance with tool I based on inputs from country team members as needed.
- Facilitate the drafting of the safeguarding strategy and complete and compile all outputs as defined in tool G.
- Facilitate the drafting of the disposal strategy and complete and compile all outputs as defined in tool H.
- Integrate specialist consultant outputs related to contaminated site assessment and container management into the overall outputs from tools G and H.
- Draft the initial EMP for the project activities based on the outputs from the steps above and in line with guidance in tool I.
- Assist in the submission of the EA and EMP to the country project’s steering committee for approval.
- Participate in the national consultation workshop as directed by the PMU.

**KEY PERFORMANCE INDICATORS**

Expected Outputs: <ul style="list-style-type: none"><li>• Complete safeguarding strategy in line with tool G.</li><li>• Complete disposal strategy in line with tool H.</li><li>• Complete EA in line with tool I.</li><li>• Complete EMP in line with tool I.</li></ul>	Required Completion Date:
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**REQUIRED COMPETENCIES**

Academic Qualifications:

- Advanced degree in chemistry, geology, environmental science or related subject area;
- Professional qualifications related to waste management, project management, financial management an advantage;

Technical Competencies and Experience Requirements:

- 10 years’ experience in environmental assessment for projects involving hazardous materials.
- 10 years’ experience related to development of strategies for project implementation based on risk analysis data.
- 10 years’ experience of working in developing countries with an emphasis on the region/country in question.
- Proven skills in management of mixed ability teams.
- Excellent communications skills in writing, spoken and presentational.
- Language (fluency in working language of UN in the country in question Arabic/Chinese/English/French/Russian/Spanish).



Food and Agriculture Organization of the United Nations

Terms of Reference for Consultant/PSA

Job Title	Contaminated Site Assessment		
Division/Department	AGPM		
Programme/Project Number			
Location			
Expected Start Date of Assignment	Duration:	[insert number of days]	
Reports to	Name:	Title:	

GENERAL DESCRIPTION OF TASK(S) AND OBJECTIVES TO BE ACHIEVED	
<p>The international consultant will be responsible for the following key activities and will be supported by a local consultant from a research institution who can assist in implementing the strategy developed. Based on an REA of the contaminated sites by the project team, the consultant will develop detailed site-specific sampling plans which detail:</p> <ul style="list-style-type: none"><li>i The number and location of samples to be taken at each site (on a site plan).</li><li>ii The depth for each sample.</li><li>iii The type of samples to be collected (soil, vegetation, etc.).</li><li>iv The sampling protocol to be adopted with guidance notes for the sampler on equipment needed, precautions to prevent cross contamination, etc.</li><li>v Labelling and storage of samples once collected.</li><li>vi Analytical technique to be used for analysis.</li></ul> <p>The analysis will be completed in a stepwise progression to allow for the identification of hot spots which then will require more in-depth investigation. Following the completion of the sampling and analysis programme the consultant will use the data to provide:</p> <ul style="list-style-type: none"><li>• Site-specific Environmental Management Plans (EMPs) in the FAO format to be provided.</li><li>• Site-specific remediation strategies based on a risk management approach (details to be provided by FAO prior to the assignment).</li><li>• Site-specific technology assessments for the treatment of the contaminated materials, based on technical and economic feasibility assessments.</li></ul>	
KEY PERFORMANCE INDICATORS	
<p>Expected Outputs:</p> <ul style="list-style-type: none"><li>• Site-specific preliminary assessment report to include site sampling plans and methodologies.</li><li>• Site-specific EMPs based on analytical report from sampling programme and a comparative risk analysis for all sites included in the survey.</li><li>• Site-specific remediation strategies to include selection of most appropriate treatment options and budget estimates for remediation.</li></ul>	Required Completion Date:
REQUIRED COMPETENCIES	
<p>Academic Qualifications:</p> <ul style="list-style-type: none"><li>• Advanced degree in chemistry, geology, soil science, environmental science or related subject area.</li><li>• Professional qualifications related to waste management, project management, analytical chemistry an advantage.</li></ul>	
<p>Technical Competencies and Experience Requirements</p> <ul style="list-style-type: none"><li>• 10 years' experience in waste management with a focus on contaminated site assessment.</li><li>• 10 years' experience related to implementation of contaminated site remediation in developing countries.</li><li>• 10 years' experience of working in developing countries settings with limited access to infrastructure and resources.</li><li>• Familiarity with the region/country in question (a minimum of 5 years' experience in the region).</li><li>• Proven skills in management of mixed ability teams.</li><li>• Excellent communications skills in writing, spoken and presentational.</li><li>• Language (fluency in working language of UN in the country in question Arabic/Chinese/English/French/Russian/Spanish).</li></ul>	



Food and Agriculture Organization of the United Nations

Terms of Reference for Consultant/PSA

Job Title	National Consultant: Contaminated Site Assessment		
Division/Department	AGPM		
Programme/Project Number			
Location			
Expected Start Date of Assignment			Duration:
Reports to	Name:	Title:	

<b>GENERAL DESCRIPTION OF TASK(S) AND OBJECTIVES TO BE ACHIEVED</b>	
<p>The national consultant will work closely with the national project team and the international consultant to complete the following tasks:</p> <ul style="list-style-type: none"><li>• The completion of a REA of the identified sites to allow prioritization of sites. FAO formats to be provided.</li><li>• Training of local teams to complete the sampling programme.</li><li>• Sourcing of sampling equipment as defined by the international consultant.</li><li>• The completion of the sampling programme based on guidance provided by the international consultant.</li><li>• The identification of a suitable laboratory to complete the analysis.</li><li>• The review of preliminary analytical data to identify areas of concern or locations where a more detailed set of data is required.</li></ul>	
<b>KEY PERFORMANCE INDICATORS</b>	
<p>Expected Outputs:</p> <ul style="list-style-type: none"><li>• Completed REAs for all suspected sites.</li><li>• Sampling programme report detailing type of samples taken in all locations.</li><li>• Analytical data report following analysis of all samples.</li></ul>	<p>Required Completion Date:</p>
<b>REQUIRED COMPETENCIES</b>	
<p>Academic Qualifications:</p> <ul style="list-style-type: none"><li>• Postgraduate qualification in analytical chemistry, environmental chemistry, soil science or geology.</li></ul>	
<p>Technical Competencies and Experience Requirements:</p> <ul style="list-style-type: none"><li>• 10 years' experience in analysis of pesticides using GC MS and other similar equipment.</li><li>• 10 years' experience in development of sampling plans and sample management.</li><li>• Excellent report writing skills.</li><li>• National UN working language plus local language as needed.</li></ul>	



Food and Agriculture Organization of the United Nations

Terms of Reference for Consultant/PSA

Job Title	Container Management		
Division/Department	AGPM		
Programme/Project Number			
Location			
Expected Start Date of Assignment	Duration:		
Reports to	Name:	Title:	

**GENERAL DESCRIPTION OF TASK(S) AND OBJECTIVES TO BE ACHIEVED**

There is therefore a need to develop suitable independent guidance to government on how to supervise industry to ensure what is proposed in terms of future container management is acceptable and in line with international best practice. The consultant will therefore:

- Review existing container management and recycling practices in operation in Kenya in relation to international best practice.
- Provide government with a set of guidelines on appropriate standards related to the reuse or recycling of pesticide containers.
- Stipulate appropriate disposal options for containers in cases where reuse or recycling is not appropriate.

<p><b>KEY PERFORMANCE INDICATORS</b></p> <p>Expected Outputs:</p> <ul style="list-style-type: none"><li>• Report on existing container management practices to include assessment of existing container recycling options. Report to include an analysis of local options and their compliance with international best practice.</li><li>• A framework guideline document on operational standards and permitting/licensing for container recycling and disposal.</li><li>• A feasibility study for container management options based on import data for new pesticides entering the country.</li></ul>	<p>Required Completion Date:</p> <p>Within the first 6 months of project implementation</p>
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**REQUIRED COMPETENCIES**

Academic Qualifications:

- Degree in agriculture, business studies, economics, supply chain management or a related relevant subject.
- Professional qualifications related to container management.
- Professional qualification in economics, financial management, business planning or a related subject.

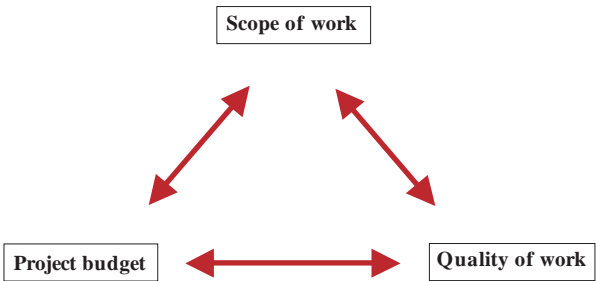
Technical Competencies and Experience Requirements

- 10 years' experience in container management with a focus on the pesticide industry.
- 10 years' experience in supply chain management with an emphasis on reverse distribution for container management.
- 5 years' experience in budget development and costing of project implementation.
- 5 years' experience of working in the pesticide distribution industry or regulation thereof.
- 10 years' experience of working in developing country settings with limited access to infrastructure and resources.
- Familiarity with the region/country in question (a minimum of 5 years' experience in the region).
- Proven skills in management of mixed ability teams.
- Excellent communications skills in writing, spoken and presentational.
- Language (fluency in working language of UN in the country in question Arabic/Chinese/English/French/Russian/Spanish).

## Annex 2: Recap on EMTK Volume 1

When deciding the most appropriate option for the implementation of a safeguarding project, it is important to remember the relationship of three main interrelating factors: (i) the scope, (ii) the budget and (iii) the quality. In general terms, the budget for the project is fixed. For all projects, irrespective of who is completing the safeguarding, FAO insists in the maintenance of the highest standards in terms of quality. This means that the only variable that can be changed is the scope. It is therefore necessary to develop objective, transparent criteria on which the scope of the project can be defined. Tools A–C in EMTK Volume 1 provide this by adopting a risk-based system for the prioritization of all stores where obsolete pesticides are kept.

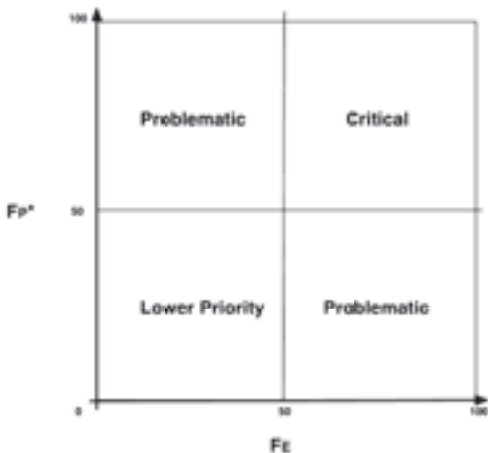
**Figure A2.1**  
**Interrelationship of quality, budget and scope**



The risk-based prioritization allows for the development of a safeguarding strategy that addresses the highest-risk locations first and allows potentially limited funds to be focused on reducing the overall risk posed by obsolete pesticides at the national level.

The examples provided in tools A and B show how, by using two risk factors  $F_p$  (associated with the properties and quantity of the pesticides) and  $F_e$  (associated with the relationship of the store with its surroundings), it is possible to categorize all stores affected by obsolete pesticides relative to one another as either higher risk (high  $F_p$  and  $F_e$ ), moderate risk (high  $F_e$  or  $F_p$ ) or lower risk (low  $F_p$  and  $F_e$ ). Figure A2.2 provides the plot of  $F_p$  vs.  $F_e$  presented in tool A for reference.

**Figure A2.2**  
**Format for plot of  $F_p$  versus  $F_e$  presented in EMTK Volume 1**



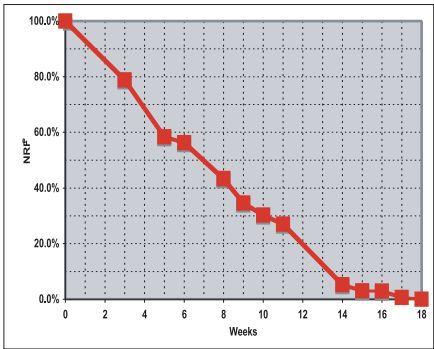
As a general rule, all stores which plot in the “critical” quadrant of the plot should be safeguarded as a priority, irrespective of their geographical distribution. Using the FAO PSMS database, it is possible to select specific stores in both the problematic quadrants of the graph and to add them to the higher-risk grouping. This function allows stores on the border of being higher risk to be included in the first safeguarding operations of the project. In addition, it is recommended that any intermediary- or lower-risk stores in close proximity (in the same compound or in the same town) also be safeguarded at the same time to increase the efficiency of the project. In all cases it is necessary that the PMU examines the specific factors that make a store higher risk (quantity, amount of leakage, proximity to population/water, etc.) and to ensure that these factors are presented in the justification for prioritization presented in the final EA report (tool I).

Once all the higher-risk stores have been safeguarded, the question of what stores should be safeguarded next is to be faced. The system for prioritization based on risk presented in tool C allows the PMU to group stores from a region, province or state (geopolitical zones) together. Tool C allows for the comparative analysis of all the stores in each geopolitical zone in a country, based on the total risk in that zone. This process results in the ranking of all zones in terms of their risk relative to each other. Again, the  $F_p$  and  $F_e$  for the region can be plotted on a plot similar to that in Fig. A2.2. It is proposed that the safeguarding strategy, once all higher-risk sites have been removed, will then start in the region with highest risk and proceed to the region with the lowest risk.

The process of prioritization based on risk allows answering the question of “WHEN” the sites will be safeguarded. The remainder of this section will now examine the question of “WHAT” will be safeguarded and “WHO” should complete the safeguarding of higher-, moderate- and lower-risk stores. The question as to “HOW” the safeguarding is completed will not be dealt with further in this document and the user is directed to FAO’s *Guideline on Safeguarding of Obsolete Pesticides*.

As the pesticides in each store are safeguarded, the values for both  $F_p$  and  $F_e$  are reduced. By the time that the stocks have been transported successfully to the new collection/storage centres and have been placed into supervised storage, the risk from the pesticides in a particular store ( $F_p$ ) and their impact on the environment around the store ( $F_e$ ) can be assumed to be zero. Tool C provides a risk-reduction tracking tool that allow PMUs to monitor the overall risk reduction as and when affected stores have been safeguarded successfully. It is recommended that this tool is used as the principle indicator for monitoring the progress of the safeguarding stage against a baseline as defined in the safeguarding work plan.<sup>18</sup>

**Figure A2.3**  
**Plot of national risk factor against time during the safeguarding phase of the project**



18 All safeguarding projects, irrespective of the final strategy adopted, will require the development of a detailed work plan. The work plan will set out the timeline for safeguarding of all affected stores (higher, moderate and lower risk). Thus, it is possible to establish a baseline plot of risk reduction against time, based on the plan. It will also be possible to monitor performance against this baseline as stores are actually safeguarded as the project proceeds. This will provide a strong indicator as to whether the project is on schedule or not and allow the project team to make the necessary interventions to ensure the implementation plan is met.

## Annex 3: Sources of hazard data for pesticides

### British Crop Protection Council (CPC)

*The Pesticide Manual*

Pesticide manufacturers

<i>Bayer CropScience:</i>	<a href="http://www.bayercropscience.com">http://www.bayercropscience.com</a>
<i>BASF:</i>	<a href="http://www.agproducts.basf.com">http://www.agproducts.basf.com</a>
<i>CropLife International:</i>	<a href="http://www.croplife.org">http://www.croplife.org</a>
<i>Dow AgroSciences:</i>	<a href="http://www.dowagro.com">http://www.dowagro.com</a>
<i>Dupont:</i>	<a href="http://www.dupont.com">http://www.dupont.com</a>
<i>FMC:</i>	<a href="http://www.ag.fmc.com">http://www.ag.fmc.com</a>
<i>Monsanto:</i>	<a href="http://www.monsanto.com">http://www.monsanto.com</a>
<i>SIPCAM/OXON:</i>	<a href="http://www.sipcam.com">http://www.sipcam.com</a>
<i>Sumitomo:</i>	<a href="http://www.sumitomo.com">http://www.sumitomo.com</a>
<i>Syngenta:</i>	<a href="http://www.syngenta.com">http://www.syngenta.com</a>

Occupational safety and health regulations

**United States Environmental Protection Agency (EPA):** [www.epa.gov](http://www.epa.gov)

Search for OSHA.

Pesticide regulations: [www.epa.gov/pesticides/CFR.htm](http://www.epa.gov/pesticides/CFR.htm)

**United States Department of Labor, Occupational Safety and Health Administration:**

<http://www.osha.gov>

Search for HAZMAT (information on hazardous waste and training required for clean up).

**United Kingdom Health and Safety Executive:** [www.hse.gov.uk](http://www.hse.gov.uk)

Search for publications (EH40 Occupational Exposure Limits and Monitoring Strategies).

Search for PPE.

Search for Construction Design and Management (CDM) Regulations 1994.

Material safety data sheets (MSDS) and labels

<http://www.cdms.net/manuf/manuf.asp>

<http://www.ilpi.com/msds/index.html>

Protective clothing manufacturers

<http://www.moldex.com>

<http://www.3m.com>

<http://www.dupont.com/Tyvek/protective-apparel/europe>

WHO hazard classification

<http://www.who.int/pcs/docs/Classification%20of%20Pesticides%202000-01.pdf>

Cornell University

<http://pmep.cce.cornell.edu/>

PAN Asia Pacific

<http://www.poptel.org.uk/panap/>

PAN-UK data sheets

<http://www.pan-uk.org>

PAN Pesticides Database

<http://www.pesticideinfo.org/>

Search engines

**Yahoo:** <http://www.yahoo.com>

Select “Health” and search for specific ailment/problems such as poisoning, bleeding, shock, insecticides, CPR, eye injuries, etc.

**Google:** <http://www.google.com>

Search for pesticide poisoning first aid.



## Annex 4: Selecting potential disposal options

### Categories of disposal

Once it has been determined that a pesticide is a waste and cannot be reused or recycled, the best disposal option needs to be determined. Disposal technologies for pesticides can be grouped into two categories:

- 1 **Destruction processes** that break the chemical bonds in the pesticide molecule and form new compounds that are less harmful (e.g. incineration, dechlorination).
- 2 **Sequestration processes** where the pesticides compounds are unchanged, but the method of disposal prevents them from escaping and affecting the environment (e.g. engineered landfill, fixation processes for contaminated soils or long-term storage in salt mines for arsenic and mercury compounds).

Because of the threat that pesticides pose to the environment, removing them completely through destruction processes has a priority over sequestration.

### Physical factors affecting the selection of disposal option

The waste-management options available for a specific pesticide depend on the:

- Physical state type (solids, liquids, gases) and formulation (e.g. mixtures of solids and liquids) are important characteristics of a waste because not all technologies can process all physical states. Generally, the available technology options for solids and mixtures of solids and liquids are fewer, more complex and more costly than for liquids and gases.
- Packaging type, which will determine the handling technique of the disposal operations.
- The hazard classification, which will determine how the pesticide can be handled in preparation for transportation and disposal.
- Chemical composition of the pesticides (it is possible to group pesticides into groups with similar chemical compositions) is an important characteristic of a waste because not all technologies can process each chemical composition. The available technology options are fewer and more costly for highly hazardous pesticides and those containing high concentrations of halogens.

The decision-making process for selecting the available disposal options for each waste involves four steps:

**Step 1:** There is a separate decision process for each pesticide dependent on an initial assessment classifying its physical state. Make an initial assessment of the physical state of the pesticide into one of the following:

- the package contains liquid, sludge, or a mixture of solids and liquids;
- the package contains solids;
- the package contains a gas or pressurized liquid.

**Step 2:** Select the appropriate decision tree from the examples provided based on the initial assessment of the physical state. The decision tree describes the material handling and repackaging steps for segregation into the three physical states: (i) solids (including sludge, gels, pastes and other similar mixtures of solids and liquids), (ii) liquids and (iii) gases. The decision trees describe how the materials should be consolidated and packaged to simplify the disposal process and to ensure that transportation to the disposal facility is safe, legal and cost effective.

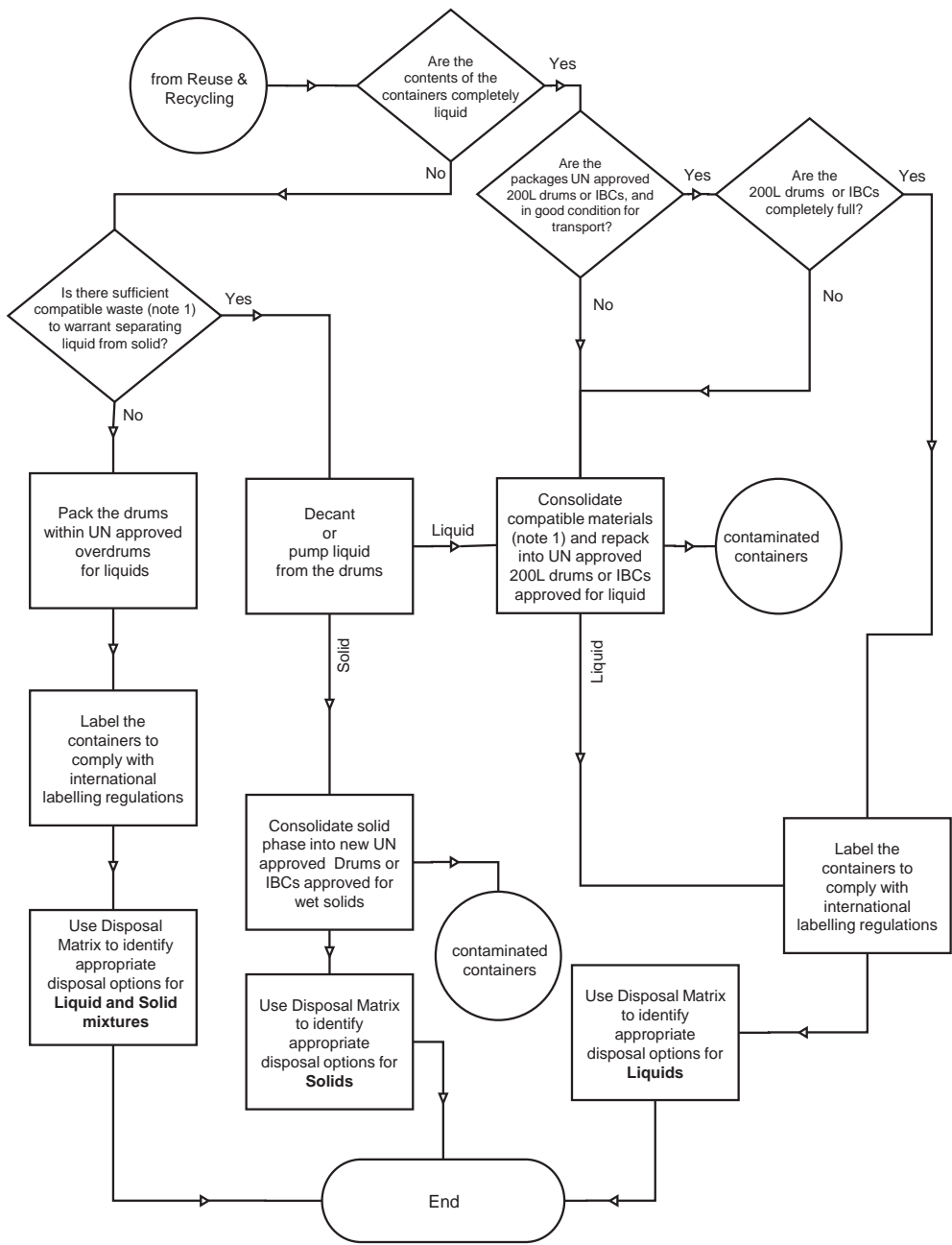
**Step 3:** Classify the pesticide according to its chemical properties and formula into a chemical group for disposal.

**Step 4:** Use a matrix to select the appropriate disposal technologies. The matrix identifies the possible disposal options for each combination of physical state and chemical group.

Figures A4.1-A4.3 show how the physical state of the pesticide waste can influence the selection of a disposal option.

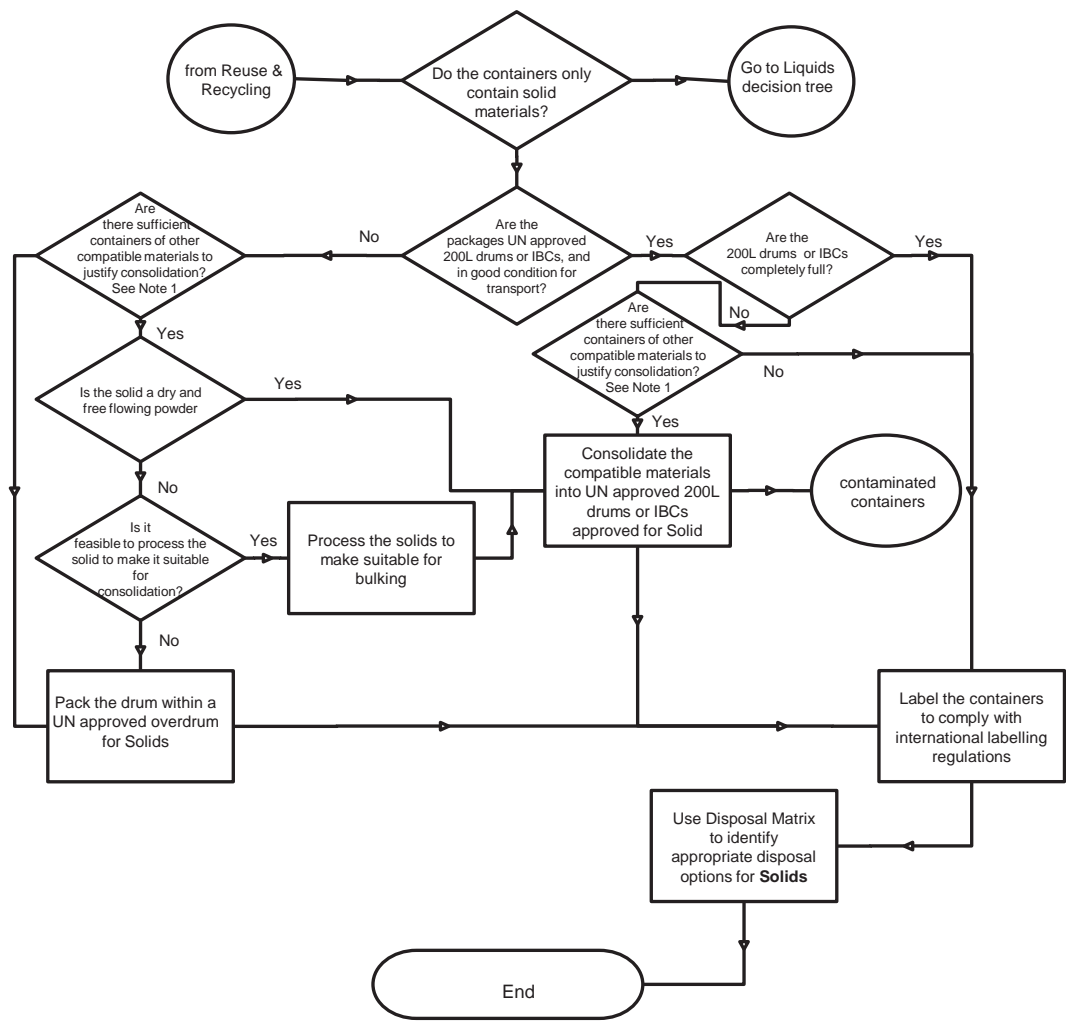
Option I: Decision process for packages containing liquid, sludge, or a mixture of solids and liquids

**Figure A4.1**  
**Decision process for liquids, sludge or mixtures of solids and liquids**



Note 1: Compatible materials in the context of this decision tree signifies materials with the same trade name and manufacturer. Where materials have a different batch numbers, they should only be consolidated if the materials do not show any signs of physical or chemical degradation.

**Figure A4.2**  
**Decision process for solid pesticides**



Note 1: Compatible materials in the context of this decision tree signifies materials with the same trade name and manufacturer. Where materials have a different batch numbers, they should only be consolidated if the materials do not show any signs of physical or chemical degradation.

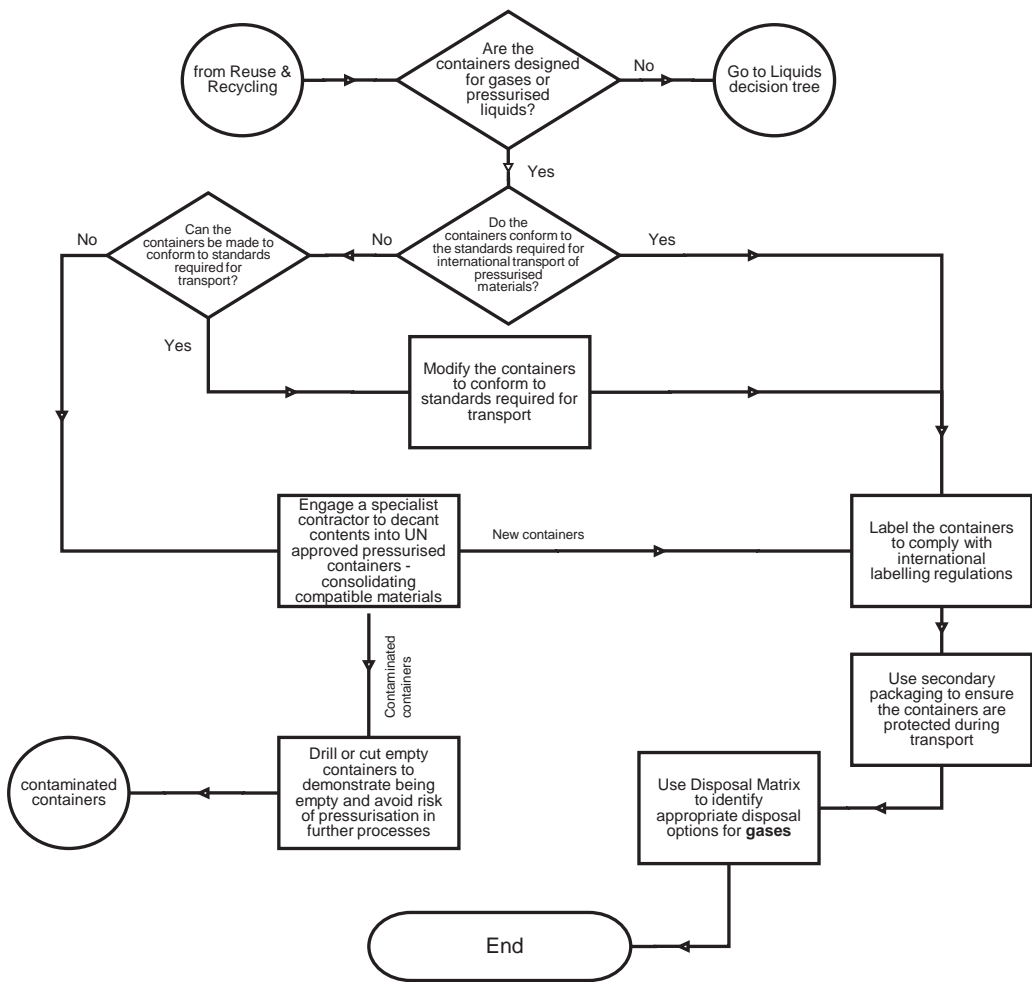
Option III: Decision process for containers designed for gases or pressurized liquids

The decision process for containers designed for gases or pressurized liquids is shown in Fig. A4.3 below. Gases are suited to most disposal processes, but there are handling and transportation issues. Many containers will be damaged or corroded, often with valves that do not function. The decision tree describes the steps to make the containers safe for transport. In many cases this involves engaging a contractor with specialist equipment to decant the contents from containers with non-functional valves into new containers.

The most common obsolete gaseous pesticide is the fungicide methyl bromide. This can pose problems for destruction technologies because of the high bromine concentration. In the destruction process, the bromine tends to form elemental bromine or hydrogen bromide, which requires highly efficient gas cleaning systems to remove it.

After the contents have been decanted from a gas cylinder, it is important that the empty cylinder is made safe for further processing. The metal content of cylinders should be recycled where possible. However, the cylinders should be cut in half or have a large hole drilled into their sides before they are sent to the smelter to avoid the risks of the containers pressurizing and exploding in the furnace.

**Figure A4.3**  
**Decision process for containers designed for gases or pressurized liquids**



Note 1: Compatible materials in the context of this decision tree signifies materials with the same trade name and manufacturer. Where materials have a different batch numbers, they should only be consolidated if the materials do not show any signs of physical or chemical degradation.

Chemical factors affecting selection of disposal options

After each specific pesticide has been categorized and consolidated according to its physical properties in the decision trees given above, the next stage in the disposal technology selection process is to categorize the waste according its chemical properties. *The Pesticide Manual* (see Annex 3) includes more than 8000 current and more than 2000 discontinued trade names of pesticides. It includes 160 classes of pesticide.

Fortunately, many of the pesticides share similar chemical characteristics, so it is not necessary to identify the disposal options for each one individually. Most disposal technologies are able to destroy a broad spectrum of chemicals, although some technologies are able to accept a wider range than others. From the review of the technologies below, it is possible to categorize pesticides into groups that are suited to the different technologies, based on their chemical properties.

All destruction technologies are based around breaking the chemical bonds of the pesticide molecules. The capability of each technology to be effective at processing a particular chemical family of pesticides is related to the chemical elements within the pesticide molecules. The technology’s capability of processing a particular element is a function of the destruction process and post-destruction cleaning systems that capture harmful emissions.

There are other factors that do not impact the determination of the appropriate technologies, but may impact the processing costs and rates at which the pesticides can be destroyed. These include:

- energy content of the waste, particularly important for combustion processes such as cement kilns and incinerators;
- particulate content of the emissions from the destruction process;
- concentration of halogens, phosphorus, nitrogen and sulphur;
- heavy metal content such as mercury, arsenic and lead;
- water content is an issue for some processes that require chemicals to be dry when entering their process.

The chemical categories for pesticides for the disposal matrix are shown in Table A4.1 below.

**Table A4.1**  
**Categories of pesticide chemicals for disposal selection**

	Chemical Group	Description	Disposal issues	Examples
1	Organochlorine and other organohalogens <sup>19</sup>	Compounds containing carbon, hydrogen, oxygen, nitrogen, fluorine, chlorine and bromine	<ul style="list-style-type: none"> <li>• All destruction technologies are capable of destroying chlorinated organics</li> <li>• Cement kilns can only accept waste with low chlorine concentrations</li> <li>• Bromine and Iodine are difficult to remove from the exhaust gas of the destruction process</li> </ul>	DDT, Dieldrin, Mirex, lindane, bronopol, ioxynil, brompyrazon, bromadiolone, methyl bromide, flupropanate, fluoroimide
2	Organophosphates <sup>19</sup>	Compounds containing carbon, hydrogen, oxygen, nitrogen phosphorus and sulphur	<ul style="list-style-type: none"> <li>• Tend to be very odorous and require effective materials handling systems</li> <li>• Generates a fine particulate of P2O5 in the exhaust gases that requires efficient removal systems</li> </ul>	dimethoate, malathion, methidathion
3	Other organic pesticides <sup>19</sup>	Compounds containing carbon, hydrogen, oxygen and nitrogen	<ul style="list-style-type: none"> <li>• Tend to be the easiest compounds to destroy</li> </ul>	maleic hydrazide, 4-aminopyridine, aviglycine, cymoxanil
4	Organic pesticides containing non-volatile metals <sup>19</sup>	Organic compounds of tin, manganese and zinc	<ul style="list-style-type: none"> <li>• Cement kilns can only accept waste with low chlorine concentrations</li> </ul>	tributyltin oxide, fentin, mancozeb, zineb, cuprobam
5	Pesticides containing heavy metals	Pesticides containing arsenic and mercury	<ul style="list-style-type: none"> <li>• Volatile metals are difficult to capture from the exhaust gases from a destruction process.</li> </ul>	phenylmercury dimethyldithiocarbamate, methylarsonic acid
6	Inorganic pesticides	Inorganic compounds of heavy metals	<ul style="list-style-type: none"> <li>• Destruction methods are ineffective with inorganics</li> <li>• Chemical treatment is the most effective solution</li> </ul>	arsenous oxide, copper hydroxide, mercuric chloride

<sup>19</sup> Where a pesticide can be categorized in more than one of the groups, it will only be appropriate for a disposal option that is applicable to each of the groups in which it occurs.

Table A4.2  
Common pesticide types and their chemical group for disposal

Pesticide type	Type symbol	Elements	Examples	Chemical group (Disposal) number					
				1	2	3	4	5	6
organoarsenic compounds	AS	C, H, As, O, N, S, Na	methyldarsinic acid, dimethylarsinic acid, urbacid					✓	
inorganic arsenic compounds	OAS	As, O, K, F	arsenous oxide, hexafluorate						✓
bipyridylium derivative	BP	C, H, Br, Cl, N	paraquat, diquat, diquat dibromide	✓					
carbamate	C	C, H, N, O, S, Cl	aldicarb, carbaryl, chlorpropham, carbofuran	✓					
coumarin derivative	CO	C, H, O, with Br, F and S	warfarin, coumatetralyl, brodifacoum, bromadiolone	✓					
organocopper compound	OCU	Cu, C, H, Cl, N, S, O,	cuprobam				✓		
inorganic copper compounds	CU	Cu, O, H, S, Cl, N	copper hydroxide, cuprous oxide, bordeaux mixture, copper oxychloride						✓
organomercury compounds	OHG	C, H, Hg, N, S, O	phenylmercury acetate, phenylmercury dimethyldithiocarbamate,					✓	
inorganic mercury compound	HG	Cl, Hg, O	mercuric chloride, mercurous chloride						✓
nitrophenol derivative	NP	C, H, N, O	dinoterb, dnoc			✓			
organobromine compounds	OB	C, H, Br	methyl bromide	✓					
organochlorine compound	OC	C, H, Cl	ddt, gamma-hch	✓					
organiodine compounds	OI	C, H, I, O, N	ioxynil, methyl iodide	✓					
organophosphorus compound	OP	C, H, Cl, N, O, P, S	chlorfenvinphos, chlormephos, diazinon, malathion	✓	✓				
organotin compound	OT	C, H, N, O, Sn	azocyclotin, fentin, tributyltinoxide				✓		
phenoxyacetic acid derivative	PAA	C, H, Cl, O, Na	2,4,5-t, 2,4-d	✓					
Pyrazole	PZ	C, H, Cl, N, O, S	benzofenap, pyrazolynate, pyrazoxyfen	✓					
Pyrethroid	PY	C, H, Cl, F, O	cypermethrin, permethrin, tefluthrin	✓					
triazine derivative	T	C, H, Cl, N	atrazine, simazine	✓					
Thiocarbamate	TC	C, H, N, O, S	butylate, dimepiperate, methasulfocarb			✓			

**Table A4.3**  
**Matrix for disposal option selection for technical grade and formulated pesticide waste**

Physical state	Chemical group					
	Organochlorine and other organohalogens	Organophosphates	Other organic pesticides	organic pesticides containing non-volatile heavy metals	Pesticides containing arsenic, mercury	Inorganic pesticides
Solids	RKHTI BCD-TD GPCR-TD PA-TD	RKHTI BCD-TD* GPCR-TD* PA-TD*	RKHTI BCD-TD* GPCR-TD* PA-TD*	RKHTI BCD-TD* GPCR-TD* PA-TD*	Sq	CT Sq
Sludges, pastes and gels, mixed solids and liquids	RKHTI BCD-TD GPCR-TD PA-TD	RKHTI BCD-TD* GPCR-TD* PA-TD*	RKHTI BCD-TD* GPCR-TD* PA-TD*	RKHTI BCD-TD* GPCR-TD* PA-TD*	St + Sq	CT
Liquids	RKHTI SHTI BCD GPCR PA CK	RKHTI SHTI BCD GPCR PA CK	RKHTI SHTI BCD GPCR PA CK	N/A	St + Sq	CT
Gases	RKHTI SHTI BCD GPCR PA CK	RKHTI SHTI BCD GPCR PA CK	RKHTI SHTI BCD GPCR PA CK	N/A	N/A	N/A
Smoke fumigants	RKHTI	RKHTI	RKHTI	RKHTI	N/A	RKHTI

BCD: Base-catalysed decomposition; BCD TD: Base-catalysed decomposition with thermal desorber pretreatment; CK: Cement kiln; CT: Chemical treatment; GPCR: Gas-phase chemical reduction; GPCR TD: Gas-phase chemical reduction with thermal desorber pretreatment; RKHTI: Rotary kiln high-temperature incineration; SHTI: Static kiln high-temperature incineration; PA: Plasma arc; PA TD: Plasma arc with thermal desorber pretreatment; Sq: Sequestration; St: Stabilization; SW: Soil washing.

The procedure for using the matrices provided in Table A4.3:

- Identify the chemical properties of each of the pesticides in the inventory – in particular, the chemical formula of the pesticide.
- From the list of chemical groups in Table A4.1, identify the chemical group into which the pesticide falls. For complex pesticides and mixtures of pesticides, it is possible that it should be classified in more than one group. Examples include Bromophos (with the chemical

formula  $C_8H_8BrCl_2O_3PS$ ) is both a halogenated pesticide and an organophosphate, Decafentin ( $C_{46}H_{51}BrClPSn$ ) is a halogenated pesticide, an organophosphate, and an organo-tin compound. Table A4.2 shows common pesticide types and the chemical groups under which they should be classified.

- Using the matrix for disposal option selection in Table A4.3, find the row that corresponds to the physical state of the pesticide and the column that corresponds to its chemical group. The cell in the table that lies at the intersection of the row and the column contains abbreviations of disposal options appropriate for the pesticide.

In cases of complex pesticides that can be classified in more than one chemical group, find the intersecting cells for the row of the physical state and each of the columns for the chemical groups. The available disposal options will be those that are common to each of the cells. The matrix has a legend that explains the significance of each abbreviation.



## Annex 5: Disposal technology options – report on standards

This annex is derived from Sections 3.4.1–3.4.3 of the DTO report completed as part of Phase 1 of the ASP. It reviews all regulation and standards concerning disposal of pesticides wastes.

### Basel Convention and Stockholm Convention requirements

The ASP has been developed in close cooperation with the staff involved in the operation of the Basel and Stockholm Conventions, which are key international agreements to advance the management of potentially harmful wastes and chemicals and consequently will contribute to the prevention of major deterioration in environmental quality. A guiding principle of obsolete pesticides safeguarding projects is that countries taking part should demonstrate commitment to implement these conventions.

These two conventions directly address aspects of disposal of obsolete stocks. Full details of the convention texts and associated documentation and guidance are presented on the respective Web sites and these should be referred to for definitive information on the conventions – what follows here is a short summary only.

#### *a. The Stockholm Convention on Persistent Organic Pollutants*

The Stockholm Convention is designed to protect human health and the environment from the harmful effects of POPs. Of the initial 12 chemicals included in the Stockholm Convention, nine are pesticides or often associated with pesticides (HCB). In May 2009, the Conference of the Parties (COP) of the Stockholm Convention listed nine additional chemicals as persistent organic pollutants among which five are pesticides.

The Convention includes specific measures that address stockpiles and wastes and contaminated sites. These require that stockpiles are managed in an environmentally sound manner and that POP wastes are:

- 1 Handled, collected, transported and stored in an environmentally sound manner;
- 2 Disposed of in such a way that the persistent organic pollutant content is destroyed or irreversibly transformed so that they do not exhibit the characteristics of persistent organic pollutants or otherwise disposed of in an environmentally sound manner when destruction or irreversible transformation does not represent the environmentally preferable option or the persistent organic pollutant content is low, taking into account international rules, standards, and guidelines, including those that may be developed pursuant to paragraph 2, and relevant global and regional regimes governing the management of hazardous wastes;
- 3 Not permitted to be subjected to disposal operations that may lead to recovery, recycling, reclamation, direct reuse or alternative uses of persistent organic pollutants; and
- 4 Not transported across international boundaries without taking into account relevant international rules, standards and guidelines.

Environmental sound management (ESM) in this context is understood to mean taking all practicable steps to ensure that wastes are managed in a manner that will protect human health and the environment against adverse effects that may result from such wastes. Stockpiles must be managed and disposed of in an environmentally sound manner, and POPs or POP-containing wastes must be destroyed or irreversibly transformed unless this does not represent the environmentally preferred option.

The Stockholm Convention refers to the Basel Convention for guidance on ESM of wastes and stockpiles and the detailed technical guidance produced by the Secretariat of the Basel Convention (SBC, see below).

Provisional levels for “low POPs” are given as 50 mg/kg (ppm) for each of the POP pesticides. Note that these values are described as provisional and further revisions may be made – the user should check for the latest situation.

This provision means that any stockpile or waste that has concentrations of any POP pesticide at or above a level of 50 mg/kg has to be considered a POP waste and handled and disposed of accordingly. Therefore, it will have to be treated to destroy or irreversibly transform the POPs unless environmentally sound disposal is a better environmental option.

Furthermore, any soil that may be excavated that is contaminated above 50 mg/kg with any of the POP pesticides would be considered a POP waste and subject to the same requirement. The general technical guidelines for ESM of wastes containing POPs also contain the following on levels of destruction and irreversible transformation.

The technical guidance includes a listing of methods of destruction and irreversible transformation that may be applied to POP wastes. This listing of techniques may be updated in future as additional techniques are developed and deployed, further information should be sought from SBC.

The Convention requires that strategies are developed to identify sites contaminated by POPs and that if remediation is undertaken it shall be performed in an environmentally sound manner.

The other aspect of the Convention that needs to be considered is the potential for unintentional production of POPs, in particular dioxins and furans. Many processes can lead to environmental releases of dioxins and furans and the Convention requires parties to develop and implement action plans to minimize these releases, with the ultimate aim of elimination where feasible. Some operations associated with pesticide disposal could lead to release of unintentionally formed POPs.

A document on Best Available Techniques and Best Environmental Practices (BAT-BEP) has been produced to give guidance to parties on the control of some processes that have the potential to produce unintentional POPs. This document includes guidance on the achievable performance for processes including hazardous waste incineration and co-incineration of wastes in cement kilns. The guidance does not substitute for regulation but should be consulted in the development of plant-specific regulations.

Public participation is addressed in article 10 of the Convention and calls on parties to promote and facilitate public participation in dealing with POPs.

#### *b. The Basel Convention on the Controls of Trans-Boundary Movements of Hazardous Wastes and their Disposal*

The Basel Convention was developed with the aim of establishing a framework to control movements of hazardous wastes across national borders and to ensure that hazardous wastes, generated at the national level, are managed in an environmentally sound manner. The requirements of the Convention with respect to trans-boundary movements of hazardous wastes are relevant for any country planning to export pesticides wastes, or any country planning to import such wastes for disposal but these requirements are beyond the scope of this document and are not discussed further. The preamble to the Basel Convention notes that parties are

“convinced that hazardous wastes and other wastes should, as far as is compatible with environmentally sound and efficient management, be disposed of in the State where they were generated”.

In addition article 4, Section 2b places the obligation on parties to take appropriate measures to “ensure the availability of adequate disposal facilities, for the ESM of hazardous wastes and other wastes, that shall be located, to the extent possible, within it, whatever the place of their disposal”.

The key issues addressed by the Basel Convention from the perspective of this document are on ESM of hazardous wastes and in particular the sound management of pesticides wastes and wastes containing POPs.

The Basel Convention has developed and adopted a series of technical guidelines providing details of ESM of hazardous wastes. The relevant document for management of wastes, that

may contain POPs, arising under obsolete pesticides projects is *General Technical Guidelines for the Environmentally Sound Management of Wastes consisting of, containing or contaminated with Persistent Organic Pollutants (POPs)*<sup>20</sup>.

This technical guideline is intended to serve as umbrella guidance to be used in conjunction with other technical guidelines. There are four other guidelines that are particularly relevant, related to wastes containing DDT, dioxins, pesticides and PCB (all available on the Web site indicated below; see footnote):

Public participation is a core principle of the Basel Declaration on ESM as well as other international agreements.

The technical guidelines provide detailed guidance for the ESM of the wastes and should be referred to by the user. The guidelines include details of technologies for treating POP wastes. The guidelines are not statutory but may be used by countries as a basis for national regulations although this is not required by the Convention. The guidelines may be revised and reviewed to take account of new developments and information so that a wider range of technologies may be included in future.

## Regulatory frameworks

### *a. Key common features of regulatory systems for hazardous waste treatment and disposal facilities*

Within established and successful regulatory systems for hazardous waste management the key elements that are seen as minimum requirements for safe and satisfactory operation of hazardous waste treatment and disposal facilities are:

- planning new or substantially altered disposal facilities would require environmental impact assessment (EIA);
- prior authorization and comprehensive environmental permitting;
- monitoring and enforcement.

Based on the findings of the review, the EU system is recommended as the most appropriate to use as a reference for the DTO. This is because it is a comprehensive system addressing the essential aspects of environmental protection and it sets high standards of performance.

### *b. The European Union system*

European Union policy and legislation is implemented by member states translating EU directives and other instruments into national systems. The principal EU instruments relevant to treatment/disposal of pesticide wastes are:

- *The Waste Framework Directive* (2006) – setting the overall policy framework for waste management;
- *Hazardous Waste Directive* (1991) – defining hazardous wastes (which would include pesticide wastes) and rules for hazardous waste management;
- *Waste Incineration Directive* (2000) – setting operational requirements and emission limit values for incineration plants;
- *The Landfill Directive* (1999) – setting requirements for landfill design and operation and criteria for acceptance of wastes (in conjunction with the Hazardous Waste Directive);
- *The Integrated Pollution Prevention and Control Directive* (IPPC, 1996) – which establishes a system for integrated environmental permitting for industrial facilities which includes most facilities for both hazardous waste and municipal solid waste management;

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<sup>20</sup> See Basel Convention. *Updated general technical guidelines for the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants (POPs)*. <http://www.basel.int/meetings/sbc/workdoc/techdocs.html>

- *The Environmental Impact Assessment Directive* (EIA, 1997) – which sets requirements for EIAs and public consultation for new projects.

The review conducted for the DTO report contains details of each of the elements that make up the comprehensive framework. When looking at the individual directives, it is important to consider all the elements that are addressed and not simply to focus on numerical limits for example. The *Waste Incineration Directive*, for example, sets out a mechanism to manage and regulate incineration processes and includes emission limit values for stack gases setting maximum acceptable concentrations of designated pollutants. The emission limit values and other specific criteria are included in DTO report's Annex B.

However, the directive will only be effective if all elements are addressed including mechanisms for waste acceptance, plant operation, emission limit values and monitoring requirements. The *Best Available Techniques Reference (BREF) Documents* that are developed to be used alongside the *Integrated Pollution Prevention and Control Directive* provide valuable discussions of the plants that may be used and the achievable performance that can be expected. The concept of BAT (best available techniques) is a key part of regulation of industrial facilities and is defined in the legislation as follows:

“Best Available Techniques shall mean the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole.”

The most relevant BREF documents for the DTO are those on waste incineration, waste treatment industries and cement kilns. Several of the waste treatment systems that are discussed in this report are not explicitly addressed in the BREF documents at this time.

### *c. How to use the standards*

Contracts for waste treatment and disposal under pesticide waste projects will be bid for competitively under a process organized in conjunction with FAO's technical support unit (TSU) using agreed procedures. This document does not attempt to substitute or replace those procedures. For a decision-maker considering options for waste treatment and disposal proposals these are likely to fall into one of the following categories:

- *pack and go* to an established treatment or disposal facility in an environment that has been highly regulated for a considerable time (most likely, but not necessarily, Europe);
- treatment in an existing facility which might be modified for the purpose and is designed to operate in the long term (on other wastes) – in the country of origin or abroad (for example, a regional facility);
- treatment in a newly developed facility (as a hazardous waste-management facility – i.e. that would continue processing other wastes after stockpiles were treated), in the country of origin or abroad;
- a special project – development of dedicated facility or modification to an existing facility with the sole purpose of treating the pesticide stockpile with no expectation of continued operation.

For proposals in Category I, the onus will be on the contractor to demonstrate to the satisfaction of the decision-maker that the regulatory system of the facility is adequate (i.e. EU or functional equivalent) and the enforcement and monitoring regime demonstrates effective control and compliance. This would ensure that the facility is licensed for these wastes, tightly regulated and operated within the regulatory limits established.

For Category II, a contractor would be proposing to use existing waste treatment facilities

or plants that could be modified for waste treatment (e.g. cement kilns). In these cases an assessment is required of:

- the technical feasibility of treating the designated wastes in the plant;
- the regulatory controls (against the standards laid out above) covering site licence, operational standards and performance data;
- an arrangement for the disposal of any residual materials;
- the effectiveness of the monitoring and enforcement systems;
- the suitability of the necessary infrastructure, training and operational experience.

For plants that would require modifications to be suitable, there would need to be an EIA, a technical feasibility assessment and site licensing, in addition to the requirements for an existing facility. A trial to demonstrate effective operation and adequate destruction of the wastes should be considered.

For Category III developing a new facility, all the steps outlined in the review of regulatory systems would be needed - that is to say technical feasibility assessment, EIA, public consultation and, if these are positive, comprehensive site licensing. In addition, the decision-maker should be satisfied that the necessary infrastructure, training and operational experience are available.

If a country pursues options (II) or (III), it is essential that any decisions are informed by clear assessment of the ongoing sustainable demand for the facility. Investment costs and project complexity will vary from project to project and can only be assessed on a case-by-case basis. However, the investment costs are typically very high, the requirements for high standards of operation, maintenance and availability of trained staff are crucial and any developer will need to make a full and robust assessment of the long-term feasibility of the project. For the decision-maker dealing with obsolete pesticide wastes, the key issues to take into account are that developing any facility will be expensive and can take a long time (years). It is also risky so that a decision-maker will need to be satisfied that a policy relying on these options will be successful and will not result in a long delay, prolonged storage and possible failure to achieve the necessary waste treatment and disposal.

Category IV deals with cases where a proposal is developed to construct and operate a facility to treat one or more of the waste streams and is designed to be dismantled and removed once those wastes are treated. Such options have been used for treatment of pesticides – for example making modifications to a cement kiln for a short-term project (see DTO report, Section 7.4.1 and Annex C), also for treating on-site contaminated materials (see for example the BCD/Spolana case study, DTO report, Section 7.4.1 and Annex C) and for treating contaminated soils on-site. If such a proposal is made it may be appropriate to develop a system of oversight and supervision that delivers the functions of the comprehensive regulatory regime but specifically for the site and project involved. In other words ensuring that for the project itself, the necessary technical assessments and environmental impacts are addressed and that site-specific monitoring and oversight is achieved. Typically this would involve a partnership between the government and site operators using external consultants or contractors to monitor and report on plant operation and performance. In addition the project assessment must take account of the availability of the necessary infrastructure, availability of the necessary services, trained personnel, etc.

The German Agency for Technical Assistance (GTZ) and Holcim (an international cement company) have compiled guidance on the use of cement kilns for waste treatment. This guidance sets out approaches to process operation, monitoring and stakeholder engagement, the guidance is focused on cement kilns but could also provide useful information for projects seeking to develop other types of waste treatment capacity. For obsolete pesticide projects, it will be necessary to ensure that all facilities considered for treatment of wastes under any category meet the standards of the country where the facility is located *and* the standards determined based on the information in this report (i.e. “international standards”).

In all cases, it is important to ensure that, in addition to the treatment plant, there is also suitable capacity to dispose of or further treat any residual products/wastes/residues and effluent streams. In many cases this will require access to a licensed and well-operated hazardous waste landfill to dispose of any residual materials still classified as hazardous waste. Such facilities are not available in many countries.

The need for suitable country infrastructure, skills and capacity

Focusing exclusively on standards in the sense of laws, regulations and emission limits is not sufficient to ensure that an effective project will result. Experience has demonstrated that failure to focus also on the suitability of the infrastructure in a country or region to support a technology or a waste disposal strategy will result in severe or fatal flaws in project delivery.

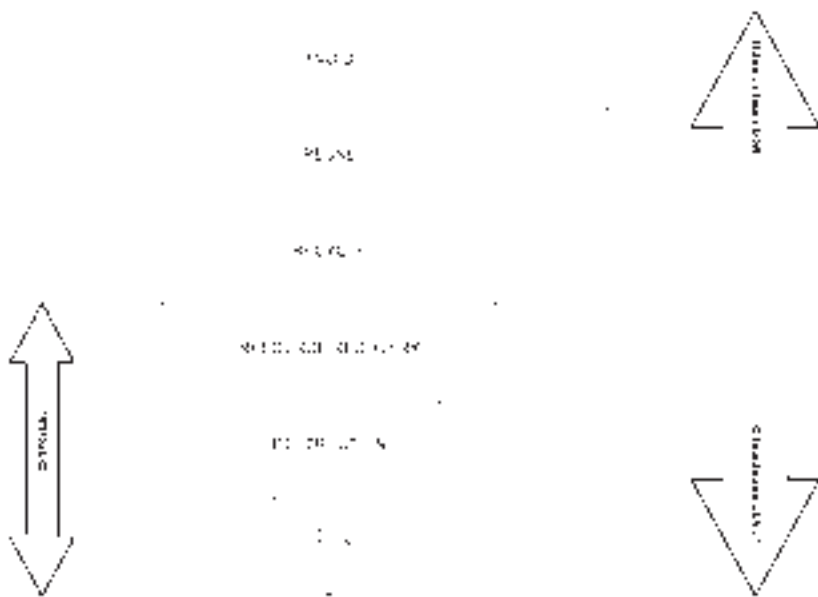
Any project to dispose of hazardous wastes will make certain demands on infrastructure, skills and local capacity. These will vary from project to project but even a strategy based on *pack and go* will only work effectively if, in addition to all the necessary legal elements concerning trans-boundary shipments, the necessary systems of supervision, technical skill, power, water, transport and others are in place or provided for the project. For any project involving development or deployment of technologies in permanent or temporary, project-specific situations, greater demands will be made of power supplies, transport links, water, sanitation, communications and emergency response systems.

Not only are practical systems and services required as noted above but it is important that the capacity of the national or other authorities charged with permitting, oversight, monitoring and enforcement are all sufficiently strong to deal with the issues raised by projects concerning obsolete pesticides. Institutional capacity may be lacking where these projects are amongst the first to deal with hazardous wastes or are significantly different or more challenging than previous projects. The specific requirements that should be taken into account in considering what is required of the infrastructure and systems in a country to apply a given technology is laid out in the Basel guidance *Adaption of the country to the technology*. These issues are also addressed in the DTO report Section 7 and the individual technology data sheets (included in the DTO report, Annex C). The central importance of ensuring that all the necessary elements of the infrastructure, services and skills are present and functioning reliably cannot be overstated in the consideration of any waste treatment facility or proposed project. Without these elements *and* a suitable system of regulation, monitoring and enforcement projects are unlikely to succeed and there would be a significant risk of costly and potentially environmentally threatening failures.

## Annex 6: The principles of waste hierarchy

The concept of waste-management hierarchy is enshrined as the basis for waste legislation, particularly throughout the EU. The hierarchy, which prioritizes the selection of options for managing wastes, is shown below in Figure A6.1.

**Figure A6.1**  
**Schematic representation of waste hierarchy**



The hierarchy is a rational approach to waste-management selection as it aims to minimize the burden on the environment and reduces costs, by avoiding waste production in the first place.

### Avoid

In the case of pesticides, FAO already issues guidance on the *Prevention of accumulation of obsolete pesticides*,<sup>21</sup> which focuses on their use and procurement. FAO’s policy aims to reduce the unnecessary use of pesticides through initiatives such as Integrated Pest Management. Guidance on procurement, storage and usage practice aims to ensure that pesticide wastes are avoided:

- only sufficient quantities of pesticides are procured;
- they are stored appropriately to extend their shelf life;
- stocks are used on a “first in-first out” basis to ensure that they are used within their shelf life.

Such practices will minimize the quantity of pesticides that become obsolete and require disposal.

### Reuse and recycle

To conserve global resources, reusing or recycling pesticides is the next most attractive option for unwanted pesticides in terms of the principles of the waste hierarchy. In general terms, reuse avoids the need for the manufacture of replacement materials and avoids any costs and risks that may occur in a disposal route.

This guidance document sets out a procedure for determining whether unwanted pesticides can be reused or recycled. This procedure should be adhered to when assessing pesticide

21 FAO, 2010. *Prevention of accumulation of obsolete pesticide stocks*. FAO Pesticide Disposal Series 2 (available at [www.fao.org](http://www.fao.org)).



inventories. The decision tree for assessing the reusability of pesticides is set out in Fig. A5.1. Crop Life International (CLI), the association representing multinational pesticide manufacturers, may also be able to provide guidance on the reuse and formulation of specific pesticides that have been manufactured by their members. The process for assessing pesticides for their appropriateness for reuse or recycling can be, however, costly and complicated. In practice, it has been found that there are few opportunities for reuse or recycling of pesticide stockpiles. It is sensible therefore to undertake an initial screening to identify pesticides with a high probability of being reusable or recyclable. Only large volumes of individual pesticide formulations that appear to be in good condition should be considered for appraisal for reuse or recycling.

However, recycling is a practical option for materials that have been contaminated with pesticides such as steel and plastic containers. There are existing programmes in both developing and developed countries that show that where containers have very low levels of contamination, they can be recycled. The recycling of such containers is dependent on the effective decontamination through a process of triple rinsing.

#### Disposal – resource recovery

Resource recovery means the recovery of some value from the waste during the disposal process, primarily in the form of energy substitution or conversion. This can substitute for the use of virgin materials and scarce fossil fuels. Examples are:

- the use of fuels manufactured from flammable hazardous wastes as an energy source in an energy-intensive industry, such as in a cement kiln. In such cases it is important that the use of the fuel does not impair the quality of the product or the emissions from the process;
- the generation of energy and supplying of district heating from a licensed incinerator;
- containers manufactured from non-chlorinated plastics can be shredded and used as a solid fuel in a power station;
- certain types of contaminated soil can be used as a raw material in a cement or lime kiln, reducing the requirement for the extraction of virgin minerals.

#### Disposal – destruction

Destruction comprises any disposal method that breaks the bonds within the pesticide, converting it to other harmless compounds, thus removing any risk of it causing environmental impairment. There are two groups of destruction technology:

- combustion technologies such as high temperature incineration;
- non-combustion technologies such as chemical de-chlorination with the gas-phase chemical reduction and base-catalysed decomposition technologies.

The Science and Technology Advisory Panel (STAP) of the UN Global Environment Facility (GEF) has been commissioned to review non-combustion technologies and advise the GEF on their potential application in developing countries and countries with economies in transition for the destruction of obsolete POPs. The STAP adopted a working definition of non-combustion technologies: “technologies where the major proportion (99.99 percent) of POP destruction takes place under reducing conditions”.

It should be noted that currently the development of non-combustion technologies tends to be more readily accepted by the public and NGOs than combustion technologies.

#### Disposal – sequestration

Disposal by sequestration should be the last choice, after ruling out all earlier options. Disposal by sequestration leaves the pesticide unchanged but isolates it and prevents it from entering into the environment. Examples of disposal by sequestration are landfill and long-term storage in salt mines.



Annex 7: Format for a rapid environmental assessment (REA)

Rapid Environmental Assessment for Pesticide Contaminated Locations			
Subject	Questions	Score	Comments
Section 1: Proximity to water sources (pathway)			
Water table	· Surface water	5	The presence of surface water and high ground water greatly increases the risk of spread of contamination.
	· 1 m depth	4	
	· 5 m depth	3	
	· 10 m depth	2	
	· > 10 m depth (estimate actual)	1	
River / water body	· Running through the contaminated sites	5	Streams and rivers crossing the contaminated site result in migration of contaminants. Indicate if the stream is season or permanent
	· Within 5 m of contamination	4	
	· Within 50 m of contamination	3	
	· Within 100 m of contamination	2	
	· No water source in vicinity (estimate nearest)	1	
Well	· In the contaminated sites	5	Spread of surface or underground contaminants can pollute well water. Wells in the hot zone should be sampled and capped
	· Within 5 m of contamination	4	
	· Within 50 m of contamination	3	
	· Within 100 m of contamination	2	
	· No well in vicinity (estimate nearest)	1	
Section 2: Geology (pathway)			
Soil type	· Sandy	5	The type of soil has a direct impact on the ease of spread of contaminants. Loose sandy soils, lateralsols and volcanic soils are generally more porous
	· Loam	2	
	· Clay	1	
	· Volcanic	4	
	· Lateritic	5	
Soil depth	· 1 m	1	This influences the depth of migration before lateral spread due to a more impervious bed rock layer
	· 3 m	2	
	· 5 m	3	
	· 10 m	4	
	· >10 m (estimate actual)	5	
Bedrock type	· Sedimentary rock	3	Indicate specific rock type if known and joining/bedding features which aid migration
	· Metamorphic rock	2	
	· Igneous rock	1	

Section 3: Human exposure (receptor)			
On the site	· Are people living on the contaminated site	3	Direct exposure will result in impacts on health. Indicate how many and ages
	· Are people working at the contaminated site	2	
	· Do people visit the contaminated site	1	
Within 50m	· Are people living within 50 m	3	Indicate if impacted by water and wind borne contaminants or consume food from the area
	· Are people working within 50 m	2	
	· Do people visit within 50 m	1	
Within 100m	· Are people living within 100 m	3	Indicate if impacted by water and wind borne contaminants or consume food from the area
	· Are people working within 100 m	2	
	· Do people visit within 100 m	1	
Reports of poisonings	· Have there been verified reported of poisoning at the site	3	Verified relates to confirmed poisoning by a specific chemical at a known time.
	· Have there been verified reports of poisoning within 500 m	2	
	· Have there been suspected poisonings reported	1	
Section 4: Flora and Fauna (receptor)			
Vegetation cover (move to pathway / indicator for hazard)	Is the contaminated bare	3	Indicate what type of vegetation (if any) is found at the contaminated site
	Is there sparse grass cover	2	
	Is there complete grass cover and other vegetation	1	
Crop production	Are crops produced in the contaminated area	3	Indicate what crops and what they are used for (local consumption, sale at market, export etc)
	Are crops produced within 10 m of the contaminated area	2	
	Are crops produced within 100 m of the contaminated area	1	
Animal production	Do animals graze / feed in the contaminated area	3	Indicate the number and type of animals in all cases and whether they are free to roam over the site
	Do animals graze / feed within 10m of the area	2	
	Do animals graze / feed within 100m of the area	1	
Previous land use	When was the area last cultivated / ploughed	INSERT DATE	Disturbance of the surface layers and deeper soil profile may affect migration. Covering of the site by tarpaulins or concrete can reduce migration
	Has the area been excavated in install drainage channels, pipes, cables etc	Y / N - DATE	
	Since contamination has the area been exposed to the elements	Y / N	
	Since contamination has the area been covered	Y / N	
Section 5: Extent of contamination (contaminant)			
Staining	What is the approx. surface area in m <sup>2</sup> of the stained area	[surface area]	The visual inspection of the contaminated area can indicate if the contamination is concentrated at the surface or has penetrated deeper.
	Is surface saturated with pesticide (visibly moist)	4	
	Is the surface completely discoloured due to pesticide	3	
	Is the surface slightly discoloured / stained	2	
	Is there no sign of staining	1	

Odour	Is there a strong odour within 10m of the contamination	4	The presence of a strong odour is a good indication of the level of contamination when compared to pesticide data and formulation information
	Is there a strong odour at the site of contamination	3	
	Do surface soil samples have perceptible odour	2	
	Is there no odour from surface samples	1	
Analytical data	Have any samples been taken at the site before the contamination	Y / N	Detail the type and number of samples taken, the date taken, where they were analysed and the results
	Have any samples been taken at the site since contamination	Y / N	
	What were the findings from previous examination	SEPARATE SHEET	
Historical data	Has the land been used for agricultural production (what) 1	1	Indicate how long the land was used for the purpose, when it was last used and what chemicals were applied, stored, formulated
	Has the land been used as a pesticide storage site (what)	2	
	Has the land been used as a pesticide formulation site (what) 3	3	
Section 6: Chemical data (contaminant)			
Pesticide	· Commercial name		The details of the pesticide contaminant(s) will define the hazard at the site
	· Active Ingredient (acute or chronically toxic)		
	· WHO toxicity class (1a – U):	RANGE 5 - 1	
Formulation type	· Liquid: EC / ULV / other	2	The formulation type will influence the ease of migration of the contaminant
	· Solid: granules / powder / other	1	
	· Details of adjuvant / solvent / carrier (add to liquid)		
Amount	· <200 litres / kg	1	The amount of contaminant and the surface area (Section 5) will provide a dose per m2. This will contribute to the risk calc.
	· 200 – 1000 litres / kg	2	
	· >1000 litres / kg	3	
Date of leakage	· Within 30 days	3	Indicate as closely as possible the exact date that the contamination occurred
	· Within 1 year	2	
	· Longer than 1 year	1	
Duration of usage leaking	· One-off use for pesticides handling	3	Indicate if the contamination occurred over an extended period of time, if so how long
	· Occasional use for pesticides handling	2	
	· Frequent use for pesticides handling	1	
Are pesticides still used	· Regularly	3	Indicate if pesticides are still used, stored, formulated at the site and if contamination is on-going
	· Occasionally	2	
	· Never	1	
Section 7: Climatic (pathway)			
Annual rainfall data	· <200 mm	1	Heavy seasonal rainfall may wash contaminants deeper into the soil over time
	· 200–500 mm	2	
	· 500–1000 mm	3	
	· 1000–2000 mm	4	
	· >2000 mm	5	

Temperature	· Average temperature (summer / winter)		Extremes of temperature can influence movement of contaminants in the soils column and through generation of contaminated dust
	· Maximum temperature (summer / winter)		
	· Minimum temperature (summer / winter) range?		
Wind	· Was is the predominant wind direction (Y / N)		The spread of contaminated dusts by wind is a significant risk to receptors such as crops, animals and humans. The relationship between wind direction and receptors needs to be defined.
	· Is there area prone to dust storms (Y / N - 1 / 0)		
	· Are there receptors (crops, animals and humans) within 10m along the direction	3	
	· Are there receptors within 50 m along the wind direction	2	
	· Are there receptors within 100 m along the wind direction	1	
Topography	· Area is flat	1	The position on the slope and the gradient of the slope both need to be assessed and taken into account when assessing the possible migration of contaminants and impact on receptors
	· Top of slope	2	
	· Bottom of slope	4	
	· On the slope	3	
	· Gradient <5% (1 in 20)	1	
	· Gradient 5–10%	2	
	· Gradient is >10%	3	

**Annex 8: Example of a completed Table H5 (Summary of disposal with analysis and mitigation measures)**

Waste	Alternatives considered	Disposal strategy	Risk analysis	Mitigation measures
Obsolete Pesticides	High Temperature Incineration (HTI), Rotary and Static.	International Transportation of waste to European facility by international contractor.	Potential for environmental damage during transportation via road and sea. The requirement for international transportation. Technically feasible to dispose of large range of pesticides, however not suitable for all pesticide wastes. Transfer of risk to international contractor. Potential for waste to become stranded on route.	Transport using carefully selected hauliers. Supervision of transportation to port. Strict adherence to local and international regulations and conventions (IMDG code and BASEL Convention). Supervision of contractor by third party including international NGO. Ensuring that contractors have required insurance cover in place and financial guarantee. Audit of foreign facilities and procedures.
	Local Cement Kiln	Local disposal of material within Africa.	Not complete destruction, off gas toxic if no physical and systematic controls - high potential for environmental damage. Local regulatory and monitoring systems may not be robust enough. Project overtime and budget due to the required installation of control measures. Significant investment required to bring plants up to local and international standards. Not suitable for all pesticide wastes.	Total assessment of legislative, budgetary, technical and project management issues relating to installation.
	Ball Milling	Import of foreign technology and plant. Local disposal of treated material.	Restriction on import by local govt. Technology may not be ready for use in project time frame. Regulatory and monitoring systems may not be strong enough. Project overtime and budget. Environmental pollution. Very high set-up costs for a relatively small amount of material. Significant local legislative obstacles to over come before importation and operation possible. Use of non thermal technology strong benefit, however balling milling as a technology non-proven in this situation ie under rigorous conditions of Africa.	Total assessment of legislative, budgetary, technical and project management issues relating to installation. Environmental monitoring programme implementation.
	Mobile HTI	Import of technology and plant. Local disposal of treated material.	Restriction on import by local govt. Technology not ready for use in project time frame. Regulatory and monitoring systems not strong enough. Project overtime and budget. Environmental pollution. Very high set-up costs for a relatively small amount of material. Significant local legislative obstacles to over come before importation and operation possible.	Total assessment of legislative, budgetary, technical and project management issues relating to installation. Environmental monitoring programme implementation.
	Thermal Desorption - Mobile Pyrolysis	Import of technology and plant. Local disposal of treated material.	Restriction on import by local govt. Technology not ready for use in project time frame. Regulatory and monitoring systems not strong enough. Project overtime and budget. Environmental pollution. Very high set-up costs for a relatively small amount of material. Significant local legislative obstacles to over come before importation and operation possible.	Total assessment of legislative, budgetary, technical and project management issues relating to installation. Environmental monitoring programme implementation.
	Chemical treatment	International Transportation of waste to treatment plant abroad.	Potential for environmental damage during transportation via road and sea. The requirement for international transportation. Only suitable for some types of pesticide wastes. Potential for waste to become stranded on route.	Transport using carefully selected hauliers. Supervision of transportation to port. Strict adherence to local and international regulations and conventions (IMDG code and BASLE Convention). Supervision of contractor by third party including international NGO. Ensuring that contractors have required insurance cover in place and financial guarantee. Audit of foreign facilities and procedures.

