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PRESIDENT'S MALARIA INITIATIVE BMP MANUAL

BEST MANAGEMENT PRACTICES (BMP) FOR INDOOR RESIDUAL SPRAYING (IRS)
IN VECTOR CONTROL INTERVENTIONS



Updated July 2010

Cover photograph: Spray Team ready for spray operation in Ghana.

ACRONYMS

ACT	Artemisinin-based Combination Therapy
BEO	Bureau Environmental Officer
BMP	Best Management Practices
COP	Chief of Party
CDC	U.S. Centers for Disease Control: Prevention
COTR	Contracting Officer's Technical Representative
FAO	U.N. Food and Agricultural Organization
EIA	Environmental Impact Assessment
IPT	Intermittent Preventive Therapy (for pregnant women)
ITN	Insecticide Treated Bed Net
IRS	Indoor Residual Spraying
IVM	Integrated Vector Management
MEO	Mission Environmental Officer
MOH	Ministry of Health
NMCP	National Malaria Control Program
OHS	Occupational Health and Safety
PEA	Programmatic Environmental Assessment
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
SEA	Supplemental Environmental Assessment
USAID	U.S. Agency for International Development
WHO	World Health Organization
WHOPES	World Health Organization Pesticide Evaluation Scheme

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PREFACE

In June 2005, the United States Government announced a five-year, \$1.2 billion President's Malaria Initiative (PMI) to scale up malaria prevention and treatment interventions in 15 priority countries in sub-Saharan Africa. The PMI is a U.S. Agency for International Development (USAID)-led initiative that is implemented in partnership with the U.S. Centers for Disease Control and Prevention (CDC). The program's goal is to reduce malaria-related mortality by 50% after five years of accelerated implementation in each PMI country, with the aim of achieving 85% coverage of children less than five years of age and pregnant women with proven interventions, including artemisinin-based combination therapy (ACT), intermittent preventive treatment (IPT) for malaria in pregnancy, indoor residual spraying (IRS), and insecticide-treated bed nets (ITNs). Start-up activities have been staggered in three phases across the 15 PMI countries to allow for effective implementation and scale-up.

IRS and ITN activities involve the use of pesticides and hence are subject to USAID's 22 CFR 216 regulations particularly the implementation of the monitoring and mitigation requirements of the original programmatic environmental assessment (PEA) of the Integrated Vector Management (IVM) Program and the development and application of standard procedures and best environmental management practices.

This manual is comprised of the Best Management Practices (BMPs) that cover the range of activities associated with pesticide use in IRS:

1. Environmental Assessment
2. Worker and Resident Health and Safety
3. Pesticide Storage, Stock Control and Inventory
4. Pesticide Transport
5. Spraying Techniques
6. Effluent Waste Disposal
7. Solid Waste Disposal
8. Spill Response
9. DDT Special Considerations

To ensure that these best practices have been properly implemented, a series of BMP assessment checklists has been developed to be completed during field inspections. The checklists are divided into three chronological activities and include the following:

- Pre-spray activities - Storage and Transport
- Spray Activities - Spraying
- Post-spray Activities - Wash up and Waste Disposal

The forms are to be photocopied and completed at each region of operations that is visited. To fill out the forms, first select the appropriate response, either yes or no, to each question and then include a comment to help explain the response, or provide recommended actions and timelines for these actions if the activity is not following BMP guidelines. These checklists will be used to prepare field reports that will be presented to PMI staff and will help guide forthcoming IRS activities in environmental compliance.

ACKNOWLEDGEMENTS

International Resources Group (IRG) prepared this manual through an Environmental Policy and Institutional Strengthening (EPIQ) Indefinite Quantities task order (Environmental Monitoring and Capacity Building) with the US Agency for International Development, Bureau for Global Health (USAID/GH/HIDN) (Task Order No. 12). Susan Anderson and Jeanne Chabrier coordinated the development of this manual and contributed technically to its contents. Special thanks to Kathy Alison, Maura Fulton and Jiwon Paik of Training Resources Group, Inc. for creating the final document.

The BMP Manual was a collaborative effort with Research Triangle Institute (RTI) International. RTI provided invaluable experience based on IRS implementation since 2004. Special thanks to the following experts: Tito Kodiaga, Autman Tembo, Gaspard Bikwemu, and John Chimumbwa.

The guidance drew largely on decades of experience in pesticide management and vector control activities by the following key organizations: World Health Organization (particularly the World Health Organization Pesticide Evaluation Scheme), United Nations Food and Agricultural Organization, and Crop Life.

We appreciate the guidance of the USAID/GH Bureau, including Teresa Bernhard, Elissa Jensen, Brian Hirsch, Julie Wallace, and Michael Macdonald. We would also like to thank the staff and contractors of the USAID Missions in the PMI countries - especially Regional and Mission Environmental Officers - for their continued efforts to ensure the safe and judicious use of insecticides in vector control.

BMP I: ENVIRONMENTAL ASSESSMENT

Purpose and Scope

This Best Management Practice (BMP) establishes a uniform approach for the environmental assessment of Indoor Residual Spraying activities intended to ensure compliance with USAID and host country environmental regulations. It also describes the content requirements of the Supplemental Environmental Assessment (SEA).

A Programmatic Environmental Assessment (PEA) for Integrated Vector Management, finalized in January 2007, detailed the pathways of risk associated with IRS through various media (e.g., inhalation, oral, etc) and activities (e.g., mixing pesticides, spraying, etc); evaluated human health risks associated with WHOPEs-approved IRS pesticides; and contained a section outlining Environmental Assessment that included a sample narrative for each section. The PEA outlines a process by which individuals could then evaluate and document site specific impacts of IRS campaigns via a SEA.

The BMP establishes requirements for the following activities:

- Responsibilities for Environmental Assessments
- Contents of Supplementary Environmental Assessments (SEA) and Host-country Environmental Impact Assessments (EIA)
- Determining scope of the project
- Procedures for processing Supplemental Environmental Assessment

Acronyms & Definitions

BEO	Bureau Environmental Officer
BMP	Best Management Practices
COTR	Contracting Officer's Technical Representative
EIA	Environmental Impact Assessment
IRS	Indoor Residual Spraying
MEO	Mission Environmental Officer
MOH	Ministry of Health
NMCP	National Malaria Control Program
OHS	Occupational Health and Safety
PEA	Programmatic Environmental Assessment
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
REA	Regional Environmental Advisor
SEA	Supplemental Environmental Assessment
WHO	World Health Organization
WHOPEs	World Health Organization Pesticide Evaluation Scheme

SUPPLEMENTARY ENVIRONMENTAL ASSESSMENT

The general purpose of a Supplemental Environmental Assessment is to provide Agency and host country decision makers with full display of environmental effects to consider during the decision making process. Therefore, a SEA is initiated early, ideally six months prior to spraying.

The collection of baseline data, analysis of impacts and consideration of alternatives should be done in collaboration with the host nation to help build institutional capacity as well as gain a solid understanding of the local environmental conditions.

Scoping Environmental Impact

Defining the Purpose and Need (22 CFR 216.6 (C) (2))

The assessor needs to define the existing conditions that are driving the need for vector control such as the malaria burden in country, low pesticide treated material use, and malaria morbidity. The assessor then describes the PMI team goals and objectives. This section becomes the basis for how decisions on alternatives will be made. Those alternatives which meet the goals will be considered.

Defining the Proposed Action and Alternatives (22 CFR 216.6 (C) (3))

The assessor uses interactions with the PMI team to understand the various alternatives that were considered when determining the preferred proposed action. These variations may be based on geography, pesticide choice etc. These various actions should be outlined in this section and their impacts also should be assessed along with the “no action alternative”. The “no action” alternative is defined as if the project were not to be implemented.

Assessing Impact

Defining the Affected Environment (22 CFR 216.6 (c) (4))

Succinctly describe the potentially affected environments. A list of species of concern, such as local threatened and endangered species and local habitats of concern should be included as well as a map of local special habitats and reserved lands as IRS will not be conducted in protected lands (such as parks, preserves, national forests etc.). This section should include a brief description of soil types, prominent water bodies relevant to the project area, special habitats, fisheries, agricultural zones in IRS areas. Also describe the environmental impacts of the action and alternative actions, including the no action alternative. The level of detail should be commensurate to the potential effects on the environment.

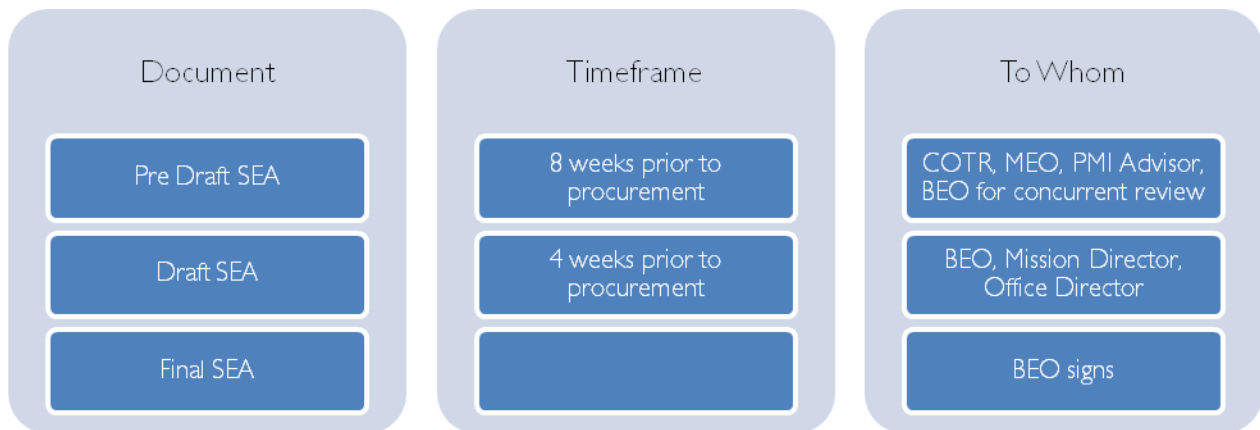
Assessing the Environmental Consequences (22 CFR 216.6 (C) (5))

This section describes the environmental and human health impact of the alternatives including the proposed action and any adverse effects that cannot be avoided, should the proposed action be implemented (22 CFR 216.6 (c)(5)). This section discusses the direct and indirect effects of the action, the cumulative effects, as well as any irreversible commitment of resources. Direct impacts include the impact that may occur to poultry that are not adequately isolated during the spraying or to workers that do not adequately use personal protection equipment during spray operations. This section also describes the mitigation measures and conditions required to minimize, avoid and offset environmental impacts. Conditions should include avoidance of spraying within 30 m of a water body or wetland, use of personal protective equipment by workers, and clearing of houses of personal items prior to spraying. The PEA has a list of other required conditions.

Processing the SEA

Preparations of SEA/EIA reports should occur 4-6 months before the beginning of spray operations by coordination with the PMI team host country experts, and a visit to the spray locations/sites. The drafting of the SEA is the last step in the environmental planning and impact assessment process. It is at this step in the process that the data collection and analysis is completed to determine the preferred action, alternatives, conditions and mitigation measures.

The SEA is reviewed by environmental officers (MEO, REA, BEO), the PMI advisors, the PMI COTR and the Mission Director. Once the reviewer's comments are incorporated into the document the SEA is briefed to the mission director for his/her signature and then re-submitted to the Global Health and Africa Bureau Environmental Officers for signature.



COUNTRY HOST EIA

Most of the countries receiving support under the President's Malaria Initiative have national laws that require environmental assessments for any public or private program with potential environmental and human health impacts. National regulations may require a separate Environmental Impact Assessment (EIA) that meets specific guidelines for scope and contents, or it may be possible to satisfy national requirements simply by requesting that national officials review and approve the SEA prepared for USAID. Governments frequently require that the applicant pay a fee for the EIA or SEA review.

Without fail, IRS activities, including procurement of pesticides and equipment cannot be initiated until the SEA has been approved by USAID and the host country environmental protection agency where applicable.

As a proof of USAID and host government approval of the reports, evidence of approval by way of signatures must be provided by:

- EIA Approval Certificate from environmental authority
- Provide certificate to Global Health BEO

RESOURCES AND REFERENCES

USAID

Integrated Vector Management Programs for Malaria Vector Control:
Programmatic Environmental Assessment USAID (January 2007)

USAID

22 CFR 216 USAID Environmental Procedures

BMP 2: WORKER AND RESIDENT HEALTH AND SAFETY

Purpose and Scope

This Best Management Practice (BMP) is intended to provide acceptable safety standards and practices for the handling, storage, transportation and use of pesticides used in Indoor Residual Spraying (IRS) of the PMI program, to minimize the risk for human exposure. It is drawn largely from guidelines from the World Health Organization and (WHO) Food and Agricultural Organization (FAO).

This BMP was developed for all spray personnel, (supervisors, storekeepers, drivers, washers, and spray operators) during the handling, storage, transportation and spray operations, and the beneficiaries of the IRS program, and covers the following areas:

- Personal Protective Equipment (PPE)
- Workers' Safety During and After Spraying
- Safety of Women Spray Personnel
- Transportation of Spray Operators to and from the Field
- Residents' Safety
- Pesticide Exposure and Treatment

Acronyms & Definitions

BMP	Best Management Practices
FAO	Food and Agricultural Organization
IRS	Indoor Residual Spraying
MOH	Ministry of Health
NMCP	National Malaria Control Program
OHS	Occupational Health and Safety
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
WHO	World Health Organization

Exposure The condition of being unprotected from to the effects of pesticides

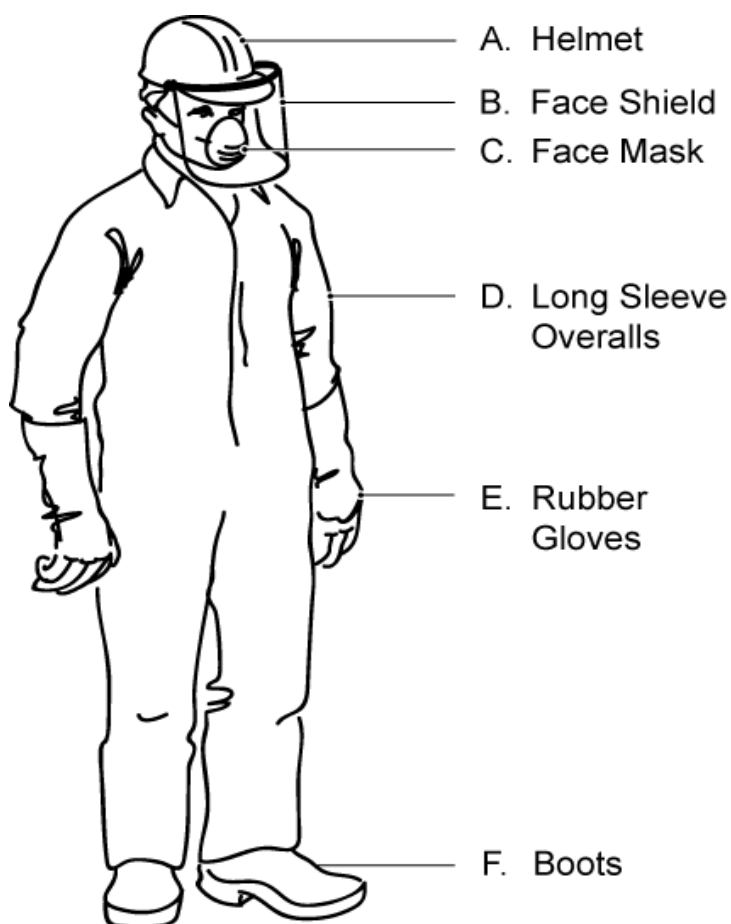
Contamination To render impure by contact or mixture; pollute

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Adapted from: Manual for IRS Application of Residual Spraying for Vector Control, 5th edition.

In accordance with WHO health and safety regulations, all persons working on IRS must be adequately protected against potential harm due to exposure from pesticides. All persons with potential direct contact or exposure to pesticides during handling, transportation, storage, use and cleaning of pesticides or pesticide contaminated materials must wear appropriate personal protective clothing in accordance with the safety instructions on the product label or material safety data sheet (MSDS). The following guidelines should be followed:

- Overalls should be made of cotton and of a weight and thickness appropriate for the climate.
- Have a distribution of sizes for coveralls and boots that are appropriate for the specified work force (women's sizes and men's sizes). There must be extra gloves, boots, face shields, and helmets to mitigate for breakage and loss.
- Spraying staff must have two uniforms minimum to allow for frequent changes.
- New filter masks must be replaced each day for spray operators. For the 8-hour filter mask, the masks can be changed once every two days.
- Replace worn out gloves with new gloves immediately.
- Gloves should be examined carefully before use for any signs of wear or tear, particularly in the areas between the fingers. If there is any doubt about their protectiveness, they should be replaced. At the end of each day's use, gloves must be washed inside as well as outside before they are used again.
- Overalls must be changed daily for spray operators using carbamates, pyrethroids, or organophosphates; every two days for spray operators using DDT (to minimize effluent waste).
- Overalls must be changed immediately when a direct spill occurs onto the overalls.
- Overalls should not be tucked into boots.
- Washers should wear their long gloves over sleeves.
- The Supervisor shall ensure that all workers wear protective clothing.



Spray Operator wearing full PPE

Minimum PPE Required for Workers

Role	Minimal PPE Required
Store Manager & All Workers handling equipment and pesticides	<ul style="list-style-type: none"> • Boots and overalls at all times • Gloves and filter mask when handling • Goggles when cleaning up dry or wet pesticide spills
Washers	<ul style="list-style-type: none"> • Overalls, pesticide apron, boots • Filter mask • Nitrile rubber, neoprene, PVC or butyl rubber gloves long enough to cover forearm and very flexible to use in washings, without inside lining (lining can retain pesticide and increase dermal exposure for staff routinely exposed to pesticide-contaminated water); for more comfortable protection, disposable polyethylene gloves can be used
Site Managers/ Supervisors	<ul style="list-style-type: none"> • Overalls, boots, gloves, and filter mask (when entering houses to supervise spray operations)
Spray Operators	<ul style="list-style-type: none"> • Filter masks (as identified in the MSDS for the pesticide being used), overalls, face shield, nitrile rubber, neoprene, PVC or butyl rubber gloves, broad-rimmed helmet (protects head, face and neck from spray droplets) • Face shield or goggles (face shield preferable -protects face and eyes against spray fall-out) • 2 or 3 cotton long-sleeved overalls per spray operator (keep overalls outside of boots) • Rubber boots or heavy canvas boots that are unlined and can be easily rinsed • Helmet • Neck protection
Drivers	<ul style="list-style-type: none"> • Boots, gloves, filter mask (when washing vehicle after a spill)

Washing PPEs

The following are the steps taken when cleaning spray pump and PPEs at the end of the day:

- Contaminated protective clothing should be thoroughly washed using industrial grade detergent followed by several rinsings.
- Wash overalls daily for spray operators using carbamates, pyrethroids, or organophosphates; every two days for spray operators using DDT (to minimize effluent waste).
- Protective clothing should only be washed in Wash Areas (see Effluent Waste Disposal BMP). Gloves should be worn when washing protective clothing.
- Washed clothes should be hung to dry in the soak pit or evaporation tank wash area.
- Where there is a large patch of fabric that has been contaminated by toxic concentrates and replacement clothing is available, it is best to dispose of the clothing as per the Solid Waste Disposal BMP.



Washer wearing appropriate protection while washing PPE

WORKERS' SAFETY DURING AND AFTER SPRAYING

During spray operations, scrupulous attention to personal hygiene is essential for the safe use of pesticides. For spray staff, safety precautions will depend largely on personal hygiene, including washing and changing clothes. The following guidelines should be followed:

- Eating, drinking and smoking while applying pesticides must be strictly forbidden. IRS operations can be physically demanding under harsh environments and may tempt spray operators to break this rule. It is strongly advised to feed spray operators a large meal in the morning before they conduct spray operations.
- Spray operators should be encouraged to hydrate frequently, and ideally, drinking water will be provided. However, spray operations should take off gloves and wash hands with soap and water before drinking any liquids
- Spray operators must wash off immediately with soap and water if the skin is contaminated with pesticide; if pesticide gets into the eyes they should immediately flush with plenty of water. In case of ingestion, see pesticide poisoning BMP
- In general, spray operators work only 5-6 hours a day.
- Apply pesticide in the cooler hours of the day when it is more comfortable to wear protective equipment.
- Water breaks may be required if day extends beyond six hours. Washing of hand and face are required prior to drinking. Wash face and hands after spraying or handling pesticides and equipment.
- After spray operation, spray personnel should wash their faces and hands at a minimum. If showers are available/appropriate, then spray personnel should shower although this is often not feasible.



Staff should not eat in the pesticide storage area

SAFETY OF WOMEN SPRAY PERSONNEL



Pregnant women should not conduct spraying

It is inadvisable for pregnant women and nursing mothers to handle DDT pesticides. Therefore, pregnant women and nursing mothers are prohibited from handling DDT pesticides. When recruiting spray operators, pregnancy tests should be conducted during a normal medical exam to ensure that pregnant women do not join the spray team as a spray operator or washer.

- For spray campaigns lasting longer than 30 days, the pregnancy tests should be repeated once every month during the campaign.

As the literature regarding DDT's impact on fetal development is under review, it is advised, as an extra precaution, that countries using DDT exclude women as spray operators and instead use women to mobilize communities. However, local labor regulations should be considered.

TRANSPORTATION OF SPRAY OPERATORS TO AND FROM THE FIELD

The quality of the vehicle is an important requirement in assuring the safety of the spray operators while en route to spray sites. Spray personnel are typically transported via pickup truck or mini bus. Spray pumps should be placed between their legs to minimize the risk of spillage. Ideally in the case of pickup truck transport where spray operators sit in the back compartment of the vehicle, it is recommended to retrofit this compartment with side hand bars on the periphery, and to install benches lining the middle and the sides of the back (see photo below). While vehicle accident insurance is costly, if possible, it would be recommended to obtain this. In addition, it is also required to consult and abide by the health and safety worker regulations of the host country. For example, in some countries it is required to offer the spray operators health insurance.



Truck retrofitted with side bars and benches both for SO safety and comfort



Spray Operator Transportation Vehicle overcrowded to an uncomfortable and high-risk point; note woman spray operator not wearing gloves while handling spray can

Special Cases

In some countries, road access is very limited and/or poor. In many cases, these roads can only be accessed by foot or by smaller motorized vehicle such as a moped or even in certain cases, donkeys and bicycles. It is advised that this form of transport be used with caution and special care to avoid pesticide spills. This type of transportation should be authorized by the host country.

RESIDENTS' SAFETY

Informational campaigns and mobilization are critical to ensure the safety of residents.

The following safety actions must be completed *before spraying* can commence:

- Clear homes of mats or rugs, furniture, cooking implements and all foodstuffs prior to spraying.
- Move all furniture that cannot be moved from the home to the center of the room and cover it with a tarpaulin.
- Advise occupants to stay outside the home during spraying and for at least two hours after spraying.
- If persons are unable to be removed from the house, prohibit spraying.
- Move all animals outside the home and tether or cage away from the house during spraying, and for two hours after spraying.
- Advise residents to keep children away from the house during spraying.
- Advise residents not to prepare food in close proximity to the house during spraying.



Improper preparation of household before spraying (all household items should be removed or covered)



Immovable household furniture covered with a protective tarpaulin before spraying takes place

Upon completion of spraying:



After spraying takes place, residual mosquitoes and other insects should be swept and disposed of in a latrine pit

- Residents must sweep floors free of residual pesticide and insects killed from the spraying and drop them in latrine pits, or in lieu of a latrine pit, dig a hole and bury the swept material. Do not allow children or animals inside until this has been completed.
- Advise residents not to plaster or paint walls after walls have been sprayed.
- If skin itches after re-entrance into the home, wash with soap and water; for eye irritation, flush eyes with water; for respiratory irritation, leave the home for fresh air; if ingested, contact program staff or go to nearest health facility.
- When spillage has occurred, restrict access and cover the spill with earth, sand, etc.; no attempt should be made to wash away the spill with water or other liquids. (See the Spill Response BMP).

PESTICIDE EXPOSURE AND TREATMENT

All public health facilities near the spray sites should be stocked with the following recommended medications for use in case of accidental poisoning or dermal or eye exposure. The health officers, spray operators, supervisors, and drivers will also receive training on treatment for emergency cases of critical exposure and poisoning before the spraying occurs. In case of extreme exposure (such as direct spills on spray operators), remove contaminated clothing and wash the affected skin with clean water and soap, and flush the affected area with large quantities of clean water. Keep the patient calm and in quiet, shaded conditions and transfer to nearest health clinic.

Basic List of Medicines by Class of Pesticide

To be administered by a profession at the hospital:

Organochlorine (DDT):	Activated Charcoal (priority) Diazepam or Lorazepam (for seizure) Phenobarbital Cholestyramine resin	
Organophosphates:	Atropine sulfate or Glycopyrolate (priority treatment) Furosemide (less critical) Diazepam or Lorazepam (for seizure)	
Carbamates:	Cholestyramine Atropine (priority) Furosemide (less critical) Diazepam (for seizure)	
Pyrethroids:	<i>Name of Drug</i>	<i>Active Ingredient(s)</i>
	Promethazine	Promethazine Hydrochloride
	Panadol	Paracetamol
	Diazepam	Benzodiazapine/Diazepam
	Lorazepam	Lorazepam
	Calamine cream	Calamine, zinc oxide, glycerol, phenol, purified water, sodium citrate, betonite,
	Vit E	Tocopherol, fragrance, mineral oil, deionized water, sodium hydroxide, stearic acid
	Hydrocortisone cream	1% hydrocortisone
	Salbutamol	Salbutamol 100 mcg, suspended inert aerosol
	Salbutamol tablets	Salbutamol sulphate 4 mg
	Activated Charcoal	Activated Charcoal

First Aid Kits

The following are minimum requirements of a first aid kit:

- Band-aids
- Gauze
- Antibiotic Cream
- Eye wash
- Hydrocortisone Cream/Calamine
- Aspirin

Keep first aid kits at all storage facilities and in transport vehicles.

Health Worker Training

Health workers should be trained in recognizing and treating pesticide exposure symptoms. In some countries this is done during the course of medical training, in other countries, additional training will be needed. Health institutions within the country can provide this training, or USAID can support such training. All training should be consistent with the exposure treatment guidelines that are available through the Ministry of Health. If such guidelines are not available or need supplementary material, exposure treatment guidelines are included in Annex I of USAID's *Integrated Vector Management for Malaria Vector Control: Programmatic Environmental Assessment (PEA)*.

RESOURCES AND REFERENCES

RTI	Indoor Residual Spraying (IRS) for Malaria Control Indefinite Quantity Contract (IQC) Task Order 1: IRS Training Guide for Spray Operations – draft, RTI International.
WHO	Application of Residual Sprays for Vector Control, WHO Communicable Disease Control, Prevention and Eradication WHO Pesticide Evaluation Scheme, 2002
USAID	Integrated Vector Management Programs for Malaria Vector Control: Programmatic Environmental Assessment. USAID: January 2007
FAO	Guidelines for Personal Protection When Working with Pesticides in Tropical Climates: March 1990
Illustrations	RTI, based on WHO , Manual for Indoor Residual Spraying: Application of Residual Sprays for Vector Control, 2003

BMP 3: PESTICIDE STORAGE, STOCK CONTROL AND INVENTORY

Purpose and Scope

This Best Management Practice (BMP) provides guidance on the management of pesticide stocks from the point that they have been received in country through the various storage options and eventually to the spray operators and their subsequent return as empty sachets. Close scrutiny is paid to storage and commodity chain-of-custody as avoiding the inadvertent loss or leakage of pesticide stocks. It is critical to ensure that these pesticides will be used safely, thereby avoiding adverse impacts on human health or environmental contamination. In addition, careful management of storage facilities, stock control and inventory will minimize the risk of leakage into other sectors (e.g. agricultural sector) or the market. Extra care must be taken since the pesticides are in their concentrated form.

This BMP, drawn heavily from the FAO Storage and Stock Control Manual, is intended to provide acceptable safety standards and practices for the following:

- Storage Facilities
- Stock Management

Acronyms

BMP	Best Management Practices
FAO	Food and Agriculture Organization
IRS	Indoor Residual Spraying
MOH	Ministry of Health
MSDS	Material Safety Data Sheet
NMCP	National Malaria Control Program
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
WHO	World Health Organization

STORAGE FACILITIES

Suggested conditions for storage facilities differ by duration and quantity of stored pesticides. It is common for a given country to have multiple levels of storage facilities, including: annual, large-volume national/central facilities where pesticide are first delivered and then re-stored at end-of-campaign; regional facilities where pesticide are stored for up to four months; and district or operational base facilities where pesticides are received and distributed on a weekly or daily basis.

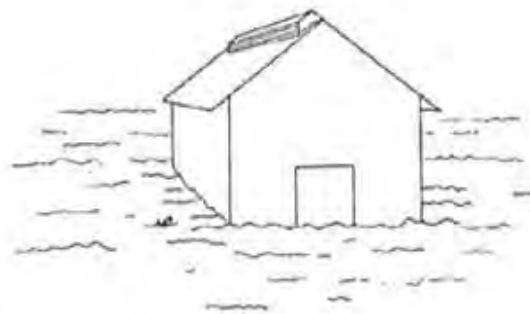
Siting

- Away from schools, animal feed depots, water courses and residential homes (generally 100 meters away)
- Minimum of 50 meters away from health clinics, and generally away from pedestrian routes to the clinic
- Out of potential flood zones, water zones, wells and other supplies of water for domestic or stock animal use
- Away from areas where ground water is close to the surface
- Easily accessible by transport and easy exit in case of an emergency



Design and Structure of Building

- Ventilated so that pesticide vapors as well as temperatures don't reach dangerously high daytime temperatures (window access usually provide proper ventilation)
- Floors should be impermeable (e.g. concrete surface) to minimize absorption in case of spills and facilitate clean up
- Large enough to allow for proper accommodation of pesticides as well as storing empty containers and pesticide waste



Pesticide storages should be kept away from sources of water and from flood zones.

Note: Due to access limitations and distances of some spray sites, small-scale storage facilities are often necessary. It is not always feasible to locate facilities away from hospital/clinic/markets. It is therefore important to be extra vigilant that access to unauthorized personnel is denied.

Pesticide Shelving

- Pesticides should always be shelved on wooden pallets and not directly on the floor to prevent them from getting wet.
- Pesticide stacking should not be unreasonably high, which poses two risks: 1) risks of tipping, and 2) risk of perforation of boxes. A general rule is to not exceed a height of 2 m.
- Do not store liquid materials above dry materials. This prevents any liquid leaks from comingling with dry product.

The following four guidelines apply to any pesticide storage facilities, regardless of size

1. Storage facilities are expected to have double locks, and be guarded at all times
2. Roofs should be well maintained (e.g. no leakage)
3. Post storage signage and warning notices
 - A notice should be prominently displayed on the outside of the store in the local language(s) with a skull and crossbones sign saying “Danger, Keep Out, Pesticide Storage” to convey that entry is prohibited to unauthorized persons.
4. Pesticide Stacking
 - Containers should be arranged to minimize handling and thus avoid mechanical damage giving rise to leaks.
 - Floor spaces should be uncluttered to permit easy inspection and allow free airflow. This also enables immediate clean up in the event of any leakage or spills.



Example of a Danger Sign



Danger sign in Amharic (Ethiopia)



Pesticide boxes in this storage facility are stacked too high



Boxes have been crushed, and pesticide is leaking from them



Floor in this storage facility is wet. This could indicate a problem. Boxes should be stacked on pallets to protect the pesticide from contact with moisture.

Essential Equipment within a Pesticide Store

Thick polyethylene sheeting on floor (if surface is not concrete or otherwise impermeable)
Wooden pallets
Ramps at entrance to contain leakage
Entrance door with lock to prevent unauthorized entry
Secured windows and ventilators to prevent unauthorized entry
Spill response kit: <ul style="list-style-type: none">• container of absorbent sand, sawdust or dry soil• shovel• long-handled brush with stiff bristles, and• short-handled brush and pan• water supply, or container of water, with soap• detergent solution
Fire-fighting equipment: fire extinguisher and fireproof blanket
Extra PPE (see Worker and Resident Health and Safety BMP)
Empty pesticide containers (preferably salvage drums that can contain a whole 200-litre drum)
Empty bags to repack heavily damaged or leaking containers
Self-adhesive warning labels for marking containers
First aid kit
Stock record sheets

STOCK MANAGEMENT

Storage facilities should have a proper system of stock planning and should maintain a daily accounting of records of stocks received, held and issued. No more pesticide should be ordered than is required or than can be stored in an appropriate way.

The most effective safeguard is a direct and clear understanding on the part of all staff involved, including the spray operators, of their responsibilities for accounting for the pesticides entrusted to their care and the consequences for not doing so. In addition, the following best practices facilitate the control and accountability for pesticide stocks, including:

- Careful planning of pesticides requirements is essential to avoid the accumulation of stocks.
- Stock control begins with ensuring that the correct pesticide has been procured and delivered and therefore all products should be appropriately and correctly labeled.
- Material Safety Data Sheets (MSDS) should be readily available for dispatch with pesticides stocks leaving the central storage facilities. Pesticide stock should be verified at each point of delivery. At all storage facilities the manager/storekeeper should be present when pesticide deliveries are being made and log receipt of boxes. Boxes are then randomly sampled for both quality and quantity controls. If, during the visual inspection, they are damaged, the supplier should be notified and the pesticide should not be accepted.
- Incoming stock should be carefully recorded on inventory stock cards. The following is an example of a stock card:

Estimated 25,000 sachets received on dd/mm/yyyy in central store

- X sachets (from box #-box #) to district A on dd/mm/yyyy
- X sachets (from box #-box #) to district B dd/mm/yyyy

- Boxes should be numbered to track the distribution. In the event of inventory loss, misplacement, or quality concerns, the boxes can be tracked back.
- Pesticide stocks should be distributed on a “first-in/first-out” basis to avoid the risk of stocks becoming obsolete (past their useable life dates).
- Stock delivery records require dual signatures, of those dispatching or delivering the pesticide stocks and of those receiving them so that there is no confusion about the amounts utilized within the program.
- At the secondary level, a storekeeper must record and sign quantity of pesticide received and distributed. In order to minimize theft, a double lock system should be utilized such that both the storekeeper and guard are needed to open the warehouse, and each will keep one key only.

RESOURCES AND REFERENCES

Crop Life International	Guidelines for the safe and effective use of crop protection products. Crop Life International, Brussels, May 2006, pp.- 62.
USAID	Environmental Guidelines for Small-Scale Activities in Africa: Chapter 13- Pest Management II: Safer Pesticide Use. USAID/Africa Bureau, Washington, March 2009, pp.- 13-1 to 13-61.
UN FAO	Pesticide and Stock Control Manual: www.fao.org/docrep/V8966E/V8966e00.HTM
US EPA	www.epa.gov/pesticides/regulating/storage.htm
Illustrations	Pesticide and Stock Control Manual: www.fao.org/docrep/V8966E/V8966e00.HTM

BMP 4: PESTICIDE TRANSPORT

Purpose and Scope

This Best Management Practice (BMP) is intended to cover *transport activities* involving large quantities of pesticides (associated with spray activities) carried in motorized vehicles, typically trucks or pickup trucks. Frequently, because of the nature of the program, these pesticides are being transported to remote rural areas, over poor roads, and where supervision and assistance becomes more difficult in the event of an accident. These characteristics add to the hazards and the potential for adverse impacts and therefore underscore the need for extra care with the transport of the pesticides associated with IRS programs.

The BMP is targeted at the prevention of accidents and also deals with the necessary responses should an accident occur and covers the following areas:

- Pesticide Loading and Containment
- Pesticide Transportation Route Planning
- Selection of Vehicles to be Used for Transporting Pesticides
- Pesticide Driving Training
- Responding to an Accident
- Vehicle Decontamination

Acronyms & Definitions

BMP	Best Management Practices
FAO	Food and Agriculture Organization
IRS	Indoor Residual Spraying
MOH	Ministry of Health
NMCP	National Malaria Control Program
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
WHO	World Health Organization

TRANSPORT

In this case, *transport* refers to motorized vehicles such as 10 ton trucks and pickup trucks. This BMP refers to the transport of pesticides or pesticides shipped in bulk within the host country, from the port of entry, to the central storage facility, to the secondary district and operational site facilities. It does not address the transport of program personnel or spray operators (please see Worker and Resident Health and Safety BMP).

The principal risk during the transport of pesticides is that the packaging might be damaged, as the result of being improperly stowed within the vehicle and/or as the result of a road accident. Such an occurrence could lead to pesticide over-exposure of the driver, transport helper bystanders, or leakage into the environment.

AVOID ACCIDENT RELEASE

The following are measures to abide by to avoid accidental release during transport.

Pesticide Loading and Containment

- Ideally, only IRS materials should be in the truck during transportation. Open or leaking containers should never be transported. If co-transport is necessary, IRS materials should be compartmentalized.
- Pesticide containers should be loaded in such a way that they will not be damaged during transport, that their labels will not be rubbed off and that they will not shift and fall off the truck on rough road surfaces (the load must be securely fixed).
- The pesticide load should be checked at intervals during transportation and any leakage, spills or other contamination should be cleaned up immediately. If a leakage is noticed in transit, the vehicle should be brought to a halt immediately, the leak stopped and contained, and the spill cleaned up.
- The truck, including tarpaulins and other goods, should be checked for evidence of spills or leaks after the pesticides have been unloaded, and then decontaminated.
- Newly arrived consignments should be checked for leaks and loose lids, and repacked immediately if necessary. Replace torn or unreadable labels.



Pesticide containers should be loaded and unloaded carefully

Pesticide Transportation Route Planning

- Planning is a key part of what must happen to avoid accidents and includes the following:
 - planning for safe routes, with secure stopovers if necessary
 - verifying that the driver has been trained and fully briefed
 - providing the driver with a detailed inventory of stock or bill of lading and material safety data sheet (MSDS)
- Any risk that could be present during the course of the route of transport should be considered when planning the transport route to its final destination. These risks could include but are not limited to: poor quality of the road, driving at night, and/or pilferage/security threats. In certain countries where security risks are high, it would be advisable to hire a security escort.
- The project or organization doing the transport should have a system of registration and a series of checklists for dispatchers, warehouse managers loading or receiving cargos and drivers that have been prepared for the specific cargo and conditions.

Selection of Vehicles to be used for Transporting Pesticides

- Vehicles should be in good condition (have a certification of road-worthiness) and capable of the trip being planned. They should also be fully securable.
- Vehicles should be equipped with a fire extinguisher and first aid kit.

Drivers Training

Prior to long-distance transport of pesticides from the customs warehouse/central storage facility to the secondary storage facility, drivers should be informed about pesticides and how to handle emergency situations (e.g. road accidents). Training for long-distance transport should include:

- Understanding the toxicity of the pesticide and security issues and implications of the pesticide getting into the public's hands (such as contamination of environment and health hazards)
- Handling an accident or emergency
- The combustibility and combustion byproducts of pesticide
- Handling vehicle contamination

Vehicles and drivers should be carefully selected and suitably qualified and licensed for this kind of transport tasks. Ensure that drivers are literate.

Appropriate Response

Responding to an Accident



Pesticide transport vehicle in an accident, with spilled pesticide

Should an accident occur, the driver and helper should have been adequately trained in the proper response under the circumstances, including:

- Protective clothing should be donned prior to attempting to clean the spills.
- It is imperative to avoid fire as a result of the accident and a fire extinguisher should be deployed just in case. The engine should be shut off and smoking in the area strictly prohibited.
- Onlookers and bystanders should be cautioned against approaching the accident site.
- If the crew has come in contact with the pesticides, they should remove contaminated clothing immediately and wash the pesticide off their skin.
- For major spills send for help immediately; drivers should have cell phones and an emergency number for use in such cases.
- People should be kept away and the spill covered with earth, sand, etc.; no attempt should be made to wash away the spill with water or other substances.



Bystanders should be at a safe distance away from the vehicular accident and spill

In case of accident refer to the Spill Response BMP.

Vehicle Decontamination

It is important to ensure that pesticide contamination in the vehicle does not have negative impacts when the vehicle is subsequently used for another purpose (e.g. food transport). Drivers are responsible for cleaning and decontaminating the interior of the vehicle and exterior bed. The vehicle should be cleaned at the end of the spray day if the vehicle will then be used for other purposes. If it is used solely for transporting pesticide for the duration of the spray season, cleaning once activities have concluded is sufficient. Drivers should be provided with gloves to wear for cleaning the vehicle. All cloths used in wiping down the interior and bed of the vehicle should be washed with spray operator overalls.

RESOURCES AND REFERENCES

FAO

FAO Storage and Stock Control Manual, 1996
www.fao.org/ag/AGP/AGPP/Pesticid/.../103809_en_No_3_Storage.pdf

Illustrations

FAO Storage and Stock Control Manual, 1996
www.fao.org/ag/AGP/AGPP/Pesticid/.../103809_en_No_3_Storage.pdf

BMP 5: SPRAYING TECHNIQUES

Purpose and Scope

This Best Management Practice (BMP) covers the spraying techniques used for IRS. The effectiveness of residual spraying depends on the timing of the spraying relative to the peak of transmission, taking into consideration the residual effect of the pesticide that is applied. Some pesticides stay effective longer than others and can determine how many times a year IRS should be conducted.

Pesticides are applied to a household's surface. Once sprayed on the wall the water evaporates leaving a crystalline "particle". Upon contact with the sprayed surfaces (walls, eaves and roofs) the mosquitoes absorb a lethal dose of the pesticide.

The effectiveness of indoor residual spraying depends on a host of factors, including:

- The resting behavior of the particular mosquito
- The toxicity and period of effectiveness of the pesticide against the mosquito
- The effect of the pesticide on the resting behavior of the mosquito
- The type of structure and type of building material (mud, thatch, cement, tin, bamboo, etc.)

This BMP is intended to provide appropriate safety standards and practices for spraying activities and covers best practices for the following:

- Appropriate equipment
- Preparing pesticide mixture
- Spraying techniques
- Cleaning spray pump and nozzles

Acronyms & Definitions

BMP	Best Management Practices
IRS	Indoor Residual Spraying
MOH	Ministry of Health
NMCP	National Malaria Control Program
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
WHO	World Health Organization

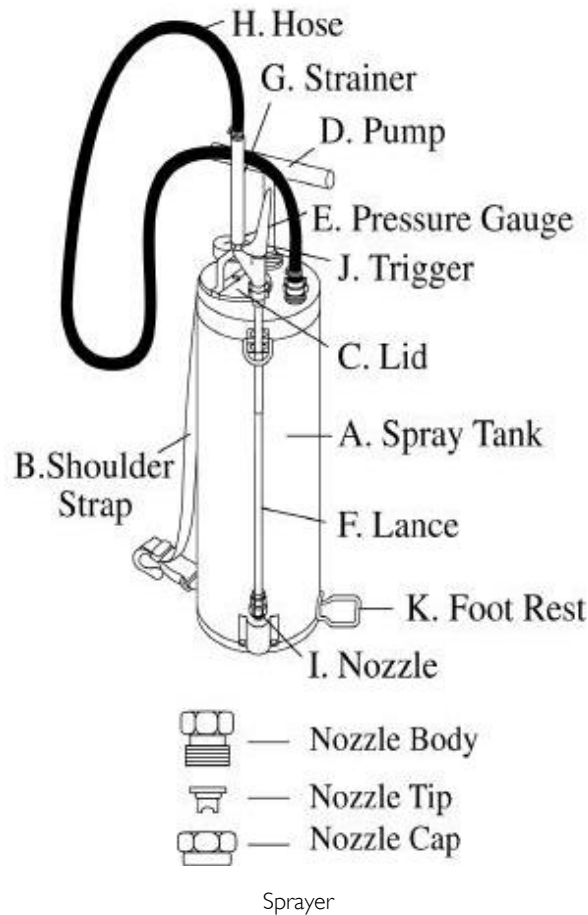
APPROPRIATE EQUIPMENT

Spray Pumps (also referred to as sprayers)

High quality, reliable spray pumps are essential for an effective spraying program. Indoor residual spraying of pesticides is normally done using hand-operated compression sprayers.

Before starting a spray operation, the equipment should be checked as faulty spray pumps may result in under or over application and/or leaks. Supervisors, team leaders, or dedicated maintenance technician should examine spray pumps visually to ensure that all parts are present, assembled correctly and in good condition.

The Hudson X-Pert compression sprayers are commonly used in disease vector control programs.



Nozzles

Standardized nozzles should be used throughout the IRS program, although different types are necessary for different pesticides and surfaces (absorbent and non-absorbent). Currently, there are two nozzles, both are fan type (TEEJET) and differ only in their throughput per minute at 40 psi (276 kPa). Specifications are as follows:

HSS 8002 / 8001 or HSS 8002E / 8001E nozzle tips

HSS = Hardened Stainless Steel

80 = 800 (angle of spraying fan)

02 = 0,2 US. gallons (757 ml) per minute, or

01 = 0,1 US. gallons (378 ml) per minute

E = Even (consistent uniform coverage requiring no overlapping of spray).

The 8002 nozzle should typically be used for:

- application of DDT
- application of synthetic pyrethroids/carbamates on absorbent surfaces (e.g., mud and unpainted cement)

The 8001 nozzle should typically be used for:

- application of synthetic pyrethroids/carbamates on nonabsorbent surfaces (e.g., painted surfaces)

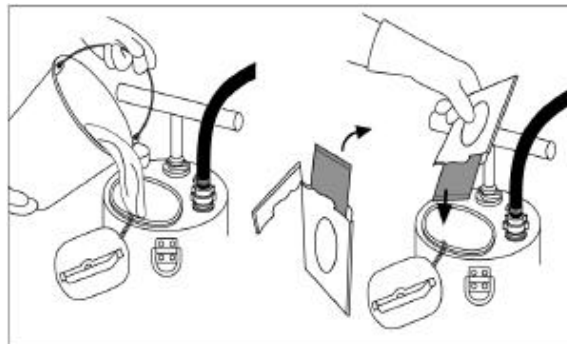
PREPARING PESTICIDE MIXTURE

Pesticide spray (e.g. ratio of water to pesticide) varies according to the manufacturer's instruction. The pesticide may be:

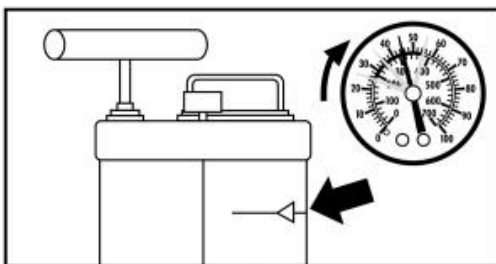
- a. mixed separately in a bucket and poured into the sprayer, or



- b. added directly to the water-filled spray pump. Scenario (b) should be practiced when using water-soluble sachets, tablets and pesticides granules, as these formulations mix readily with water.



Note: A spill could potentially occur during this procedure; please see the Spill Response BMP.



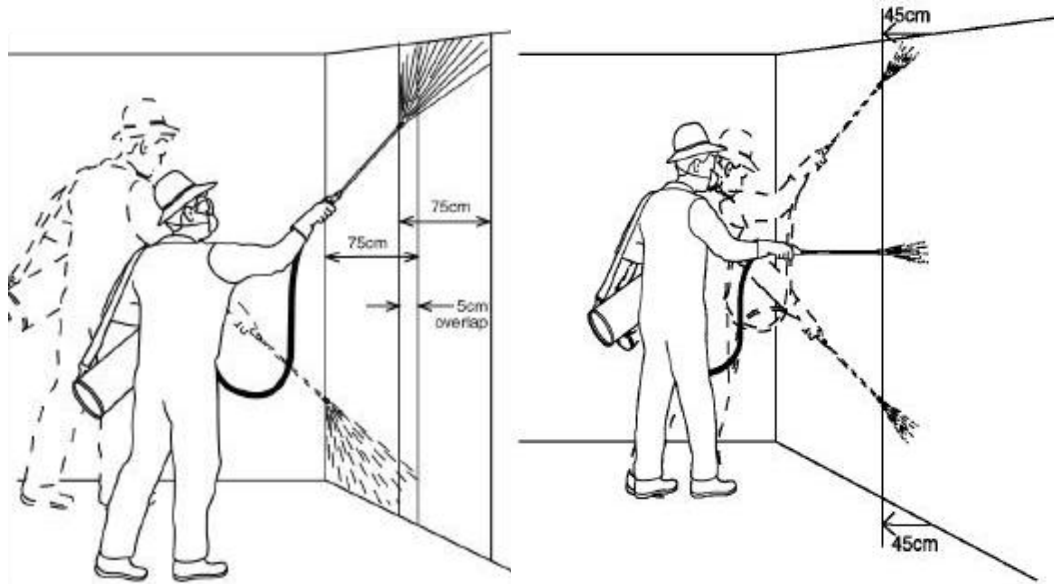
When the sprayer has been filled with water to the maximum level indicated on the tank, the lid of the tank is fitted and the sprayer pumped until the pressure gauge shows 55 psi (3.8 bar). Every full stroke gives about 1 psi. Therefore, about 55 full strokes are required to reach the working pressure. Hissing sounds should not be present as these indicate possible leaks.



The contents of the tank should be thoroughly mixed by shaking the tank before starting

SPRAYING TECHNIQUES

Pesticides should be applied in vertical swaths 75 cm wide (2.46 feet). Swaths should overlap by 5 cm. The walls of the room should be sprayed in downward and upward motions.



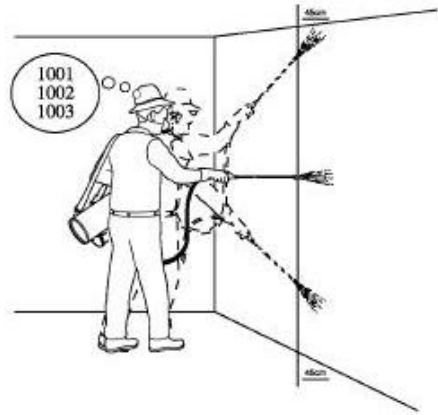
To ensure the correct swath width, the spray tip should be about 45 cm (1.48 feet) from the wall. The spray operator should lean forwards as he/she sprays from top of the wall and move back as he/she brings the nozzle downwards. The process should be continued, moving in a clockwise direction until the room is completed.



Spray Operators will spray households with walls made out of very different materials

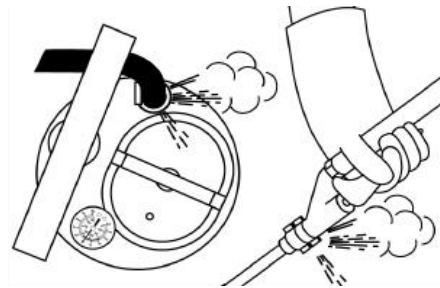
The spray speed should cover one meter every 2.2 seconds, i.e., 4.5 seconds for a 2 m high wall. Timing may be aided by mentally counting “one thousand and one – one thousand and two – one thousand and three -...”

The tank should be re-pressurized when the pressure gauge falls below 25 psi.

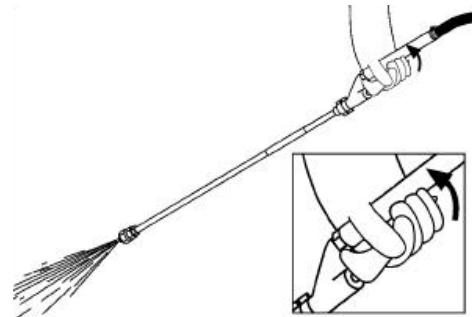


Spray Pump in Proper Working Order

There should be no leaks along the lance and hose, especially where hose joins tank and trigger on/off valve.



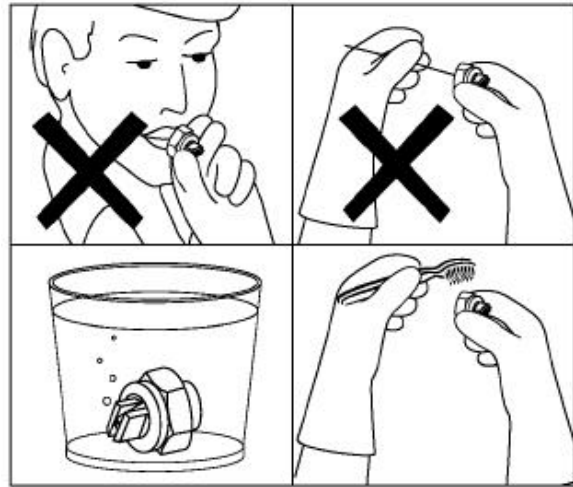
The spray pattern should be even and without streaks.



The nozzle should not drip when the trigger on/off valve is released. If there is dripping and /or puddling at bottom of the wall, spray operators should be instructed to wipe these areas with a rag.

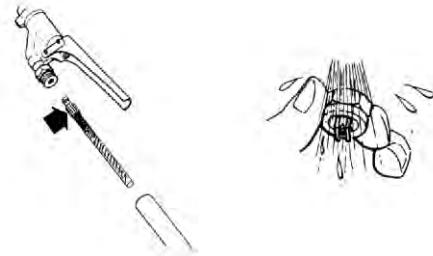


Clogged nozzles should be put in a container with water for several hours before the blockage is removed by a very soft toothbrush. NEVER clean nozzle with a hard pin or piece of wire and NEVER put a nozzle to your mouth to blow through it.



CLEANING OF SPRAY PUMPS AND NOZZLES

Equipment should be maintained through daily cleaning. To clean spray equipment, first rinse cans thoroughly with water from the progressive rinse (see the Effluent Waste BMP). Remove the nozzle and add about 4 L of fresh water to the tank. Pressurize the sprayer to x psi and flush water through system. Release tank pressure. Drain the discharge assembly by holding it pointed downwards with spray control valve open. Drain tank and wipe interior wall.



The stored spray pumps should be hung upside down with lid open to allow air circulation. Allow lance to hang from D-ring on the tank with the trigger valve kept open.

Before storing after spray operations (for a period of weeks or months), each sprayer should be completely disassembled and all parts cleaned and dried. The plunger cup leather must be well oiled, while the threaded fittings should be lightly oiled. Oil and aromatic solutions must never be used on the rubber or plastic components of the sprayer.

Note: At the end of each day, clean PPE's as described in the Work and Resident Health and Safety BMP.



Spray cans should be hung upside down for drying

RESOURCES AND REFERENCES

RTI	Indoor Residual Spraying (IRS) for Malaria Control Indefinite Quantity Contract (IQC) Task Order 1: IRS Training Guide for Spray Operations – draft, RTI International.
Manuel Lluberás	Progressive Rinse: a New Approach at Reducing Waste from Indoor Residual Spraying Campaigns www.hdHUDSON.com/vc-news-fb-07-malaria-fish-net.html
WHO	Application for Residual Sprays for Vector Control, Third Edition
IRS	W. E. Farrell, Malaria Vector Control, The Application of Insecticides, correct use and care of equipment used and staff training. Wefco Marketing International, Pietermaritzburg, PA.
Illustrations	RTI, based on WHO (2000.3), Manual for Indoor Residual Spraying: Application of Residual Sprays for Vector Control

BMP 6: EFFLUENT WASTE DISPOSAL

Purpose and Scope

In the implementation of IRS activities, waste water (effluent) is generated on a daily basis, at the end of a spray day, during the cleaning process. Because this wastewater is contaminated with the pesticide, unsound or improper disposal of the IRS effluent can end up polluting and causing adverse risk and damage to environment.

This BMP addresses site considerations, standard design and construction, proper use, and decommissioning protocols for the following IRS effluent cleaning and disposal facilities:

- Progressive Rinse
- Soak Pits
- Evaporation Tanks
- Wash Areas for PPE

Acronyms & Definitions

BMP	Best Management Practices
FAO	Food and Agriculture Organization
IRS	Indoor Residual Spraying
MOH	Ministry of Health
NMCP	National Malaria Control Program
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
WHO	World Health Organization
Water Table	The top water level of the aquifer; the highest point in the aquifer from which water can be accessed. The water table is the very top of the zone of saturation, the point of which is directly affected by the geological character in a given area and by the periodic changes in the amount of ground water.
Runoff	The movement of water over a sloping surface.
Leaching	The movement of water through the soil.

Note:

1. This document does not include disposal of IRS solid waste which is addressed in a different BMP.
2. Water generated from spray personnel cleaning themselves (mainly hands and face) is not considered contaminated. Use of PPE is strictly enforced during IRS, thereby reducing pesticide deposition on skin to trace amounts, if any. Therefore, water used to clean spray personnel does not need to be drained into designated areas.

SITE CONSIDERATIONS

Appropriate site considerations for locating all IRS cleaning and waste facilities (Progressive rinse, Soak pits, Evaporation tanks, and Wash areas) depend on soil, topography, ground water, and proximity to lakes or streams and sensitive areas. In general, most facilities should be located adjacent to the storage facilities, where they can be more easily protected and monitored. Due to access limitations and distance of some spray sites, it may be more feasible to locate a small facility in an appropriate area near the site.

- Soil characteristics affect how pesticides move through the soil. Clay soils have a high capacity to absorb many pesticides, while sandy soils have a much lower capacity to absorb. Where possible, locate facilities on fine textured soils with good absorptive properties. Hard packed clay or rocky soils are not appropriate.
- Pesticides may move in water runoff as compounds dissolve in water or attach to soil particles. Facilities should be located on high, level ground to minimize exposure to runoff. Avoid steep slopes or natural runoff flow lines. Where feasible, construct berms to divert runoff away from the facility.
- Groundwater may be contaminated if pesticides leach from the facilities. The following table summarizes groundwater contamination potential:

Summary of Groundwater Contamination Potential as influenced by water, pesticide and soil characteristics		
	Risk of Groundwater Contamination LOW	Risk of Groundwater Contamination HIGH
Pesticide Characteristics		
Water solubility	Low	High
Soil adsorption	High	Low
Persistence	Low	High
Soil Characteristics		
Texture	Fine clay	Coarse sand
Organic matter	High	Low
Macropores	Few, small	Many, large
Depth to groundwater	Deep (100 ft.)	Shallow (20 ft or less)
Water Volume		
Rain	Infrequent, short, light rainfall	Frequent, heavy rainfall

McBride, D.K. 1989, Managing pesticides to prevent ground water contamination, North Dakota State University

- Avoid areas with high groundwater table or that are prone to flooding.
- Avoid locating near crops, animal enclosures, beehives, or public buildings such as schools and surface waters, if possible.
- Particles and biomass can clog the soak pit and will need to be removed periodically.

PROGRESSIVE RINSE (ALSO REFERRED TO AS TRIPLE RINSE)

Progressive Rinsing is a method used for cleaning spray equipment used during IRS. The equipment is washed daily through a series of rinses that re-uses water, thereby reducing the amount of water used and effluent produced. This in turn minimizes the quantity of water reaching soak pits and evaporation tanks and reduces the potential for pollution from contaminated rinse water.

Standard Design and Construction

Seven 200L barrels are placed in a line, as shown in following illustration. The first, third, fifth and seventh barrels are left empty, and the second, fourth, and six barrels filled with clean water. It is helpful if the barrels are wide and deep enough to submerge entire spray pump. The following are the steps taken when cleaning the spray pumps at the end of the day:

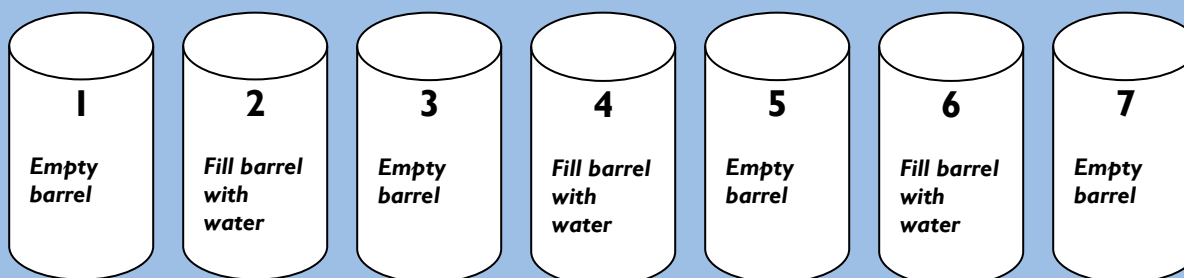
1. Spray teams return to their staging areas at the end of spraying operations each day, where the spray pumps are depressurized and any leftover pesticide is poured in the first barrel (No. 1; empty).
2. Approximately two liters of water is added to the spray pump from the second barrel (No. 2; filled with clean water). The spray pump is then closed and shaken so all inside surfaces are rinsed.
3. The contents are then emptied into the third barrel (No. 3; empty).
4. The spray operator then repeats the process two more times using the remaining barrels - No. 4 (full) & 5 (empty) and container No. 6 (full) & 7 (empty). Upon rinsing the spray pump three times, the water emptied into the No. 7 barrel and should appear clean.
5. Any remaining residue from the strainer and nozzles should be rinsed using water from the 6th barrel and poured into the 7th barrel. At this point, the spray pumps are considered cleaned.



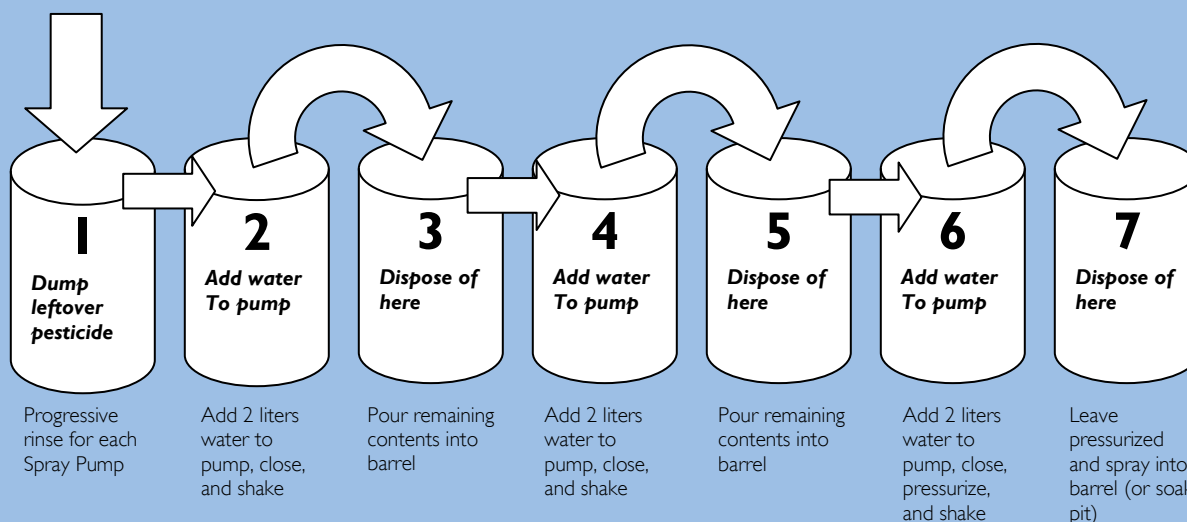
Spray operators conducting the Progressive Rinse. Barrel #1 is for dumping, Barrel #2 is for fetching clean water to shake spray can with, Barrel #3 is for dumping for a second time... and so forth

Progressive Rinse Schematic

Start of spray operations:



End of spray operations:



Once progressive rinse has been completed, rinse out spray nozzles thoroughly with clean water, or water from the #7 barrel, and dispose of rinse water in soak pit.

The next day, spray pumps are filled with leftover pesticide from the first barrel. Liquid from barrels three (3) and five (5) are then used to prepare the pesticide. Any liquid remaining in the seventh barrels contains diluted contaminants and can be disposed in a soak pit or evaporation tank, depending on which pesticide was used.

The process continues on a daily basis until the spray season ends. The rinse water can be disposed in the soak pit or evaporation tank.

Proper Use

Health & Safety

All persons handling spray equipment should wear a complete PPE while carrying out the progressive rinse activity. Helmet can be removed once it has been rinsed.

Access

The entire structure should be fenced off to block access to animals and unauthorized personnel. The fence can be simple (single gated) made from tree branches and/or barbed wire or other cross-structures. The fence also serves as temporary hanging places for washed clothes to sun dry.

Warning

Hazardous warning signs must be posted in the area to further caution the public.

Decommissioning

Progressive Rinse sites should be restored to their previous condition and tested to ensure there is no lingering pesticide contamination.

SOAK PITS (ALSO REFERRED TO AS BIOBEDS)

A soak pit is a specially-designed hole in the ground for disposing of biodegradable waste (e.g., waste from pyrethroids, carbamates, and organophosphates). A properly constructed and sited soak pit protects the environment from contamination while allowing pesticides to degrade and become harmless.



Latest Soak Pit Design: With concrete curb and private washing area (note: all soak pits may not represent this level of effluent containment)

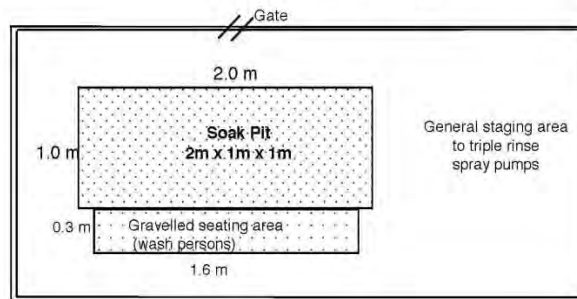
Standard Design and Construction

A soak pit measuring 2m by 1m by 1m is usually sufficient to absorb the effluent produced from 20-30 spray operators during the duration of the spraying operations. The bottom of the pit is lined with 1.0 to 1.5 bags of sawdust (where feasible), followed by 1.5 to 2 bags of charcoal. A layer of stone aggregate is then placed on top, followed by a layer of course gravel, and then a layer of small gravel to create a filter one meter in depth (see illustration). As the effluent percolates through these materials, the pesticides filter out and degrade before reaching the surrounding soils. A concrete curb should be built around the soak pit to contain effluent and divert runoff from the surrounding area.

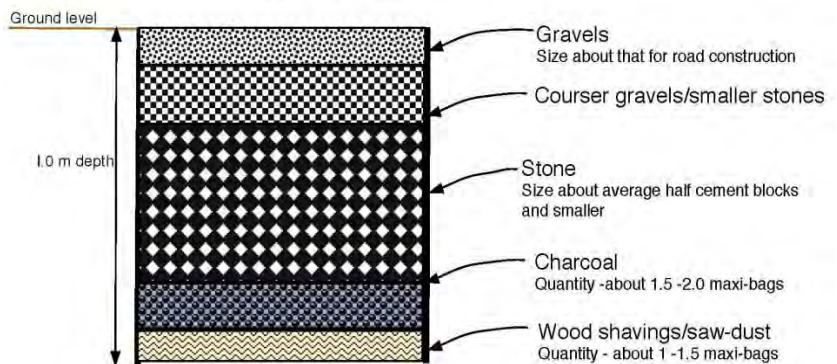
Siting

Soak pits should be adjacent to or co-located with both the progressive rinse area and the wash area. This is to avoid potential spills when transporting effluent to the pit. Note: Due to access limitations and distances of some spray sites, a scaled down version of the soak pit located near the site, may be more appropriate.

Top View: Soak Pit for Pyrethroids



Cross section: Soak Pit for Pyrethroids
Showing Filling materials



Soak Pit for Pyrethroids

Proper Use

Health & Safety	All persons handling spray equipment or maintaining the soak pit should wear a complete PPE.
Access	The entire pit should be fenced off to block access to animals and unauthorized personnel. The fence can be simple (single gated) made from tree branches and/or barbed wire or other cross-structures. The fence also serves as temporary hanging places for washed clothes to sun dry.
Warning	Hazardous warning signs must be posted in the area to further caution the public.

Decommissioning

Soak pits will not require extraction of the gravel, stones, charcoal or saw dust filter; instead the pit area will require restoration to previous conditions by filling in, leveling and planting with appropriate local vegetation.

EVAPORATION TANKS

An evaporation tank is a sealed tank for the disposal of non-biodegradable liquid pesticide waste contaminated with DDT.

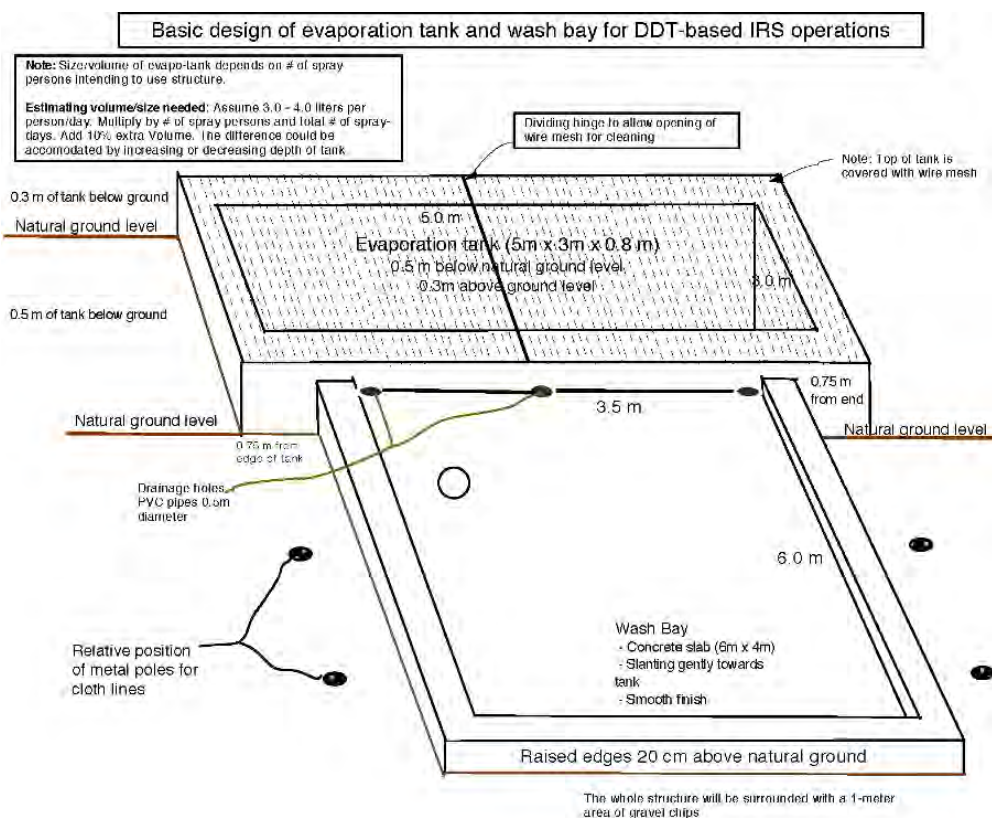
Standard Design and Construction

An evaporation tank should hold approximate 15750 liters or 4100 gallons (based on amount of effluent produced each day minus evaporation rates), which should be sufficient to allow disposal of effluent from 20-30 DDT spray operators. The tank should be designed to have maximum surface area to promote evaporation. The larger the surface area, the faster the liquid in the tank will evaporate.

The tank should be constructed with an impervious surface (e.g., concrete) and covered with a lockable wire mesh. Once evaporation is complete, the dried DDT residue is collected and then disposed of together with the other solid DDT waste. If overflow is a risk during operations, a berm should be constructed around the perimeter of the tank to help contain the waste. The tank should be also be fitted with an overflow drain allow for drainage during the rainy season once operations have been completed and the tank has been cleaned of residues.

Siting

Evaporation tanks should be constructed away from flood prone areas, steep gradients and slopes, and water sources (wells and springs). The tanks should also be located downhill from the progressive rinse area so that so that run-off from this facility can be directed into the tank.



Proper Use

- After a spray round, all of the sand, sludge, and pesticide residue remaining in an evaporation tank should be scooped out, placed into a sealed container, placed with empty sachets, and disposed according to BMPs for solid waste disposal.
- Cover the tank with a tarpaulin if it rains during spraying operations to avoid extra rainwater from flooding the tank and causing overflow.
- If water level in the tank comes within 6 inches of the drainage hole, liquid should be siphoned into plastic polytanks (around 4k L) for temporary storage, until they can be added back to the tank.

Health & Safety

All persons handling spray equipment or maintaining the evaporation tank should wear a complete PPE.

Access

The entire structure should be fenced off to block access to animals and unauthorized personnel. The fence can be simple (single gated) made from tree branches and/or barbed wire or other cross-structures. The fence also serves as temporary hanging places for washed clothes to sun dry.

Warning

Hazardous warning signs must be posted in the area to further caution the public.



Evaporation Tank with wash area adjacent

Decommissioning

If transferring operation of evaporation tanks to another implementing partner or another entity, remove DDT residue from tank prior to transfer. If evaporation tanks are to be decommissioned, they should be dismantled and restored back to their natural state as much as possible once IRS activities discontinue permanently. Pesticide sampling of the site should be done to determine there is no trace of DDT in the soils.

WASH AREAS FOR PPE

Standard Design and Construction

A wash area occurs within the soak pit and is where PPE (and drop clothes used to cover household items) are washed with detergent and water. Provide a separate wash basin for daily washing of face and hands.

When washing non-DDT PPE a tarpaulin should be used to capture all effluent and directed to soak pits PPEs used for DDT IRS activities should be washed in a cemented bay that drains into the evaporation tank. Hanging lines for drying the overalls should be erected directly over the washing areas.



Soak pit with warning sign and secured lockable fencing



Spray staff washing equipment and themselves inside the soak pit

Proper Use

Health & Safety

Spray operators should wear recommended PPE when completing end-of-day washing of spray pumps, and washpersons should wear boots, gloves, and aprons when washing PPEs.

Access

The entire structure should be fenced off to block access to animals and unauthorized personnel. The fence can be simple (single gated) made from tree branches and/or barbed wire or other cross-structures. The fence also serves as temporary hanging places for washed clothes to sun dry.

Warning

Hazardous warning signs must be posted in the area to further caution the public



Evaporation tank with PPE hanging to dry

Decommissioning

Wash sites that handled DDT should be decommissioned the same at the evaporation tanks. Other sites should be restored to their previous condition and sampled to ensure there is no pesticide contamination.

RESOURCES AND REFERENCES

RTI	Indoor Residual Spraying (IRS) for Malaria Control Indefinite Quantity Contract (IQC) Task Order 1: IRS Training Guide for Spray Operations – draft, RTI International.
Manuel Lluberas	Progressive Rinse: a New Approach at Reducing Waste from Indoor Residual Spraying Campaigns www.hdHUDSON.com/vc-news-fb-07-malaria-fish-net.html
Illustrations	RTI Training Manual (2009) Schematic from IRS Training Manual

BMP 7: SOLID WASTE DISPOSAL

Purpose and Scope

This Best Management Practice (BMP) is intended to provide acceptable safety standards and practices for the storage and disposal of solid wastes generated during IRS operations.

Contaminated solid waste is generated during the implementation of IRS activities in the form of empty pesticide sachets, damaged PPE equipment, used cleaning equipment, materials such as sawdust used to clean up spills, and contaminated soil from accidental spills. These substances create pesticide residue and pose health and environmental hazards if not disposed in an environmentally sound manner.

This document details the standard requirements for the following:

- Solid Waste Storage and Management
- Disposal of Pesticide Containers
- Disposal of Unwanted Pesticides
- DDT Waste Disposal
- Incinerators

This document does not include disposal of IRS effluent waste which is addressed the Effluent Waste BMP.

Acronyms & Definitions

BMP	Best Management Practices
FAO	Food and Agriculture Organization
IRS	Indoor Residual Spraying
MOH	Ministry of Health
NMCP	National Malaria Control Program
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
WHO	World Health Organization

Contaminated waste waste that has come into contact with pesticides whether purposefully (e.g. immediate packaging of pesticide sachets), or accidentally (e.g. via spill, leak, etc.) or secondary packaging

Uncontaminated waste packaging and materials (e.g. pallets, outer packaging of water-soluble pesticide sachets, and outer cardboard cartons) which have not come into direct contact with pesticides and can be assumed to be uncontaminated

SOLID WASTE STORAGE AND MANAGEMENT

All the IRS solid waste must be collected at the end of the spray round and stored in centralized warehouses while waiting disposal. Certain IRS wastes like empty sachets and respirators are collected on a daily basis while other waste types (e.g. gloves, and covering sheets) are collected periodically.

Safe and Secure Storage

The storage facility must be lockable, with a roof in good condition, adequate ventilation, accessible and away from flood prone areas.



Security guard at central storage facility



Storage facility with double lock, fire extinguisher, and warning sign

IRS Waste Stock Management Records

STOCK CARD	
DATE	QUANTITY OF STOCK
1/1/2020	1000
2/1/2020	1000
3/1/2020	1000
4/1/2020	1000
5/1/2020	1000
6/1/2020	1000
7/1/2020	1000
8/1/2020	1000
9/1/2020	1000
10/1/2020	1000
11/1/2020	1000
12/1/2020	1000
13/1/2020	1000
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21/1/2020	1000
22/1/2020	1000
23/1/2020	1000
24/1/2020	1000
25/1/2020	1000
26/1/2020	1000
27/1/2020	1000
28/1/2020	1000
29/1/2020	1000
30/1/2020	1000
31/1/2020	1000

The storekeeper is responsible for maintaining an accurate inventory of all IRS wastes using the forms for stock management. Sachets, spray operator sign-out of sachets and inventory of empty sachets returned to supervisors should be tracked daily.

DISPOSAL OF PESTICIDE CONTAINERS

Disposal of Uncontaminated Waste

Materials that have not been in contact with pesticides (secondary wastes: boxes and paper) can be disposed of as municipal waste.

Disposal of Contaminated Waste

The following guidelines apply to containers that have been in contact with pesticides:

- Empty containers awaiting disposal should be stored in a special, secure area in the pesticide store area to ensure that they are not stolen and used for other purposes.
- Empty sachets should always be cleaned out, as far as is practicable, before disposal to minimize both hazard and waste of residual pesticide. Sachets that have contained emulsifiable concentrate, or wettable powder (wp) formulations should be rinsed with water several times and the rinsings added to the spray pump before the tank is filled to the required volume.
- Container rinse that has not been added to the spray pump, should be added to a soak pit or evaporation tank (please see Effluent Waste Disposal BMP).
- Heavily contaminated PPE should be triple rinsed, shredded or punctured and sent to central disposal centers.
- Highly contaminated cardboard, paper and jute materials should be collected and sent to the central disposal centers along with other contaminated waste.
- Containers rendered unusable should be collected and sent to a central location for disposal.
- Glass containers should be smashed and steel drums and metal and plastic containers punctured and crushed (do not puncture aerosol containers) to ensure that they cannot be reused, before being sent to a central location for disposal.



Cardboard boxes with empty sachets stored and labeled properly

DISPOSAL OF UNWANTED PESTICIDES



Pesticide solid waste neatly stored before proper disposal

To avoid excess waste, use the correct amount for each day's operations, and prepare the correct amount to fill each spray pump as needed. Whenever possible, only one year's supply of pesticides should be ordered (pesticides only have a two-year shelf life).

Occasions will arise when it will be necessary to dispose of pesticide concentrates. This is usually because the stock is outdated and has been found to be unusable, because the product is no longer registered for the original purpose, or because resistance has emerged. Where very large quantities are to be disposed of, professional advice must be sought from the suppliers and national authority. If only a few kilograms or litres of pesticide are involved, it should be collected and sent to a central location for disposal by the implementing partner. Pesticides are best disposed of by burning in a special incinerator that burns at 1100°C-1300°C. Storekeepers should not become directly involved with pesticide disposal and should refer to the relevant national authority.

DDT WASTE DISPOSAL

DDT solid waste will be stored in a similar manner as all other IRS wastes. Suppliers are required to dispose of all DDT waste, and provide a certificate of destruction as proof that the wastes have been disposed.

DDT solid waste can be disposed of in an approved in-country incinerator that meets DDT disposal requirements. If no in-country incinerator exists, the waste must be transported out of the country to a certified facility. This can be complicated due to inter-country transport/export/import laws. Once incinerated, the remaining ash residue from the must be treated as toxic waste and be disposed according to the requirements for disposal of toxic ash residue—principally in regulated landfills.

INCINERATORS

Incineration of IRS wastes, also known as thermal destruction, is the standard method that is used in the disposal of solid wastes in all participating countries.



Incinerator

The wastes will only be disposed in incinerators that meet the following requirements (*drawn from WHO and FAO guidelines*):

- Commercially Licensed facilities that are accredited and licensed by the host governments to dispose toxic waste. Obtain a list of all the approved and licensed facilities from the environmental agencies/authorities.
- Facilities that are assessed by the implementing partner and found to satisfy international requirements for toxic waste disposal.
- Incinerators constructed or procured by the implementing partner that meet international standards (WHO/FAO).
- Incinerators that consistently burn between 1100°C and 1300°C, with a minimum 2 second residence time in the afterburner chamber (hot zone) with excess oxygen (>11%) and with high levels of induced turbulence in the gas stream to promote complete combustion. This is then rapidly cooled to eliminate the risk of Dioxin and Furan formation.
- Incinerators with air scrubbers to ensure minimal impact to air quality.
- An example of an incinerator that meet these requirements is the Thermopower plant in South Africa, that incinerates DDT waste from Zambia and Mozambique.
- In some cases incineration can be negotiated with the pesticide manufacturers, who is responsible for recapturing solid wastes and then disposing of those wastes in a environmentally sound way.
- Alternatively, cement kilns or furnaces can also be considered for disposal in countries where cement factories or copper furnaces and meet the above criteria are available.

WORKER HEALTH AND SAFETY

Full PPE is required for all incineration activities. The following PPE will be provided for the incinerator operators where needed:

Helmet
Face shield or goggles
Dust Masks (vented version preferable)
A pair of overalls
Nitrile rubber, neoprene, PVC or butyl rubber gloves long enough to cover forearms.
Rubber boots, gloves

TIMELINE

Solid wastes from IRS activities should not be allowed to accumulate and should be disposed at the end of each seasonal spray schedule, wherever possible.

RESOURCES AND REFERENCES

WHO

Health and Safety Guide-Cyhalothrin and Lambda-cyhalothrin. International Programme on Chemical safety. Health and Safety Guide No. 38. World Health Organization, Geneva, Switzerland (1990).

<http://www.inchem.org/documents/hsg/hsg/hsg038.htm> Accessed 06 June 2008

FAO

International Code of Conduct on the Distribution and Use of Pesticides: Guidelines on Management Options for Empty Pesticide Containers. Food and Agriculture Organization of the United Nations. Rome, Italy (2008). Accessed 2 June 2008

ASTDRUS

ASTDRUS Agency for Toxic Substances and Disease Registry, Production, Import/Export, Use and Disposal of DDT <http://www.atsdr.cdc.gov/toxprofiles/tp35-c5.pdf>

Africa Stockpiles Programme (ASP)

Review of Disposal Technology Standards, November 2007

BMP 8: SPILL RESPONSE

Purpose and Scope

This Best Management Practice (BMP) is intended to provide acceptable safety standards and practices for responding to pesticide spills in the event of an accident. Pesticides are biologically active materials and potentially hazardous to human health and the environment. There will occasionally be spills even in the best-run programs, especially where pesticides are repacked and transferred into other containers. Complete decontamination and effective disposal are often very difficult to achieve. Pesticide spills can be the result of:

- Natural disasters (flash flooding, fire, earthquake, cyclones etc.)
- Vehicular accidents of any type that result in damage to the vehicle or its contents
- Accidents involving tools, pesticides or equipment in use by personnel

This BMP addresses the following measures to be taken in the event of natural disasters or accidents:

- Spills in Storage Facilities
- Spills During Spray Operations
- Spill During Transport
- Human Health precautions post-spill
- Major Emergencies
- Reporting of accidents

Acronyms & Definitions

BEO	Bureau Environmental Officer
BMP	Best Management Practices
COP	Chief of Party
IRS	Indoor Residual Spraying
MEO	Mission Environmental Officer
MOH	Ministry of Health
NMCP	National Malaria Control Program
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
WHO	World Health Organization

THE THREE “C’S”

The basics of a good spill response program are the three “C’s”:

CONTROL	Control the spill (minimize the volume released)
CONTAIN	Contain the spill (to as small an areas as possible)
CLEAN	Clean up the spill immediately (consider possible use of spilled material or disposal)

IMPLEMENTING THE THREE “C’S”

Spills in Storage Facilities

Regardless of the type of pesticide (liquid or solid) the following principles are considered best practices in managing spills:

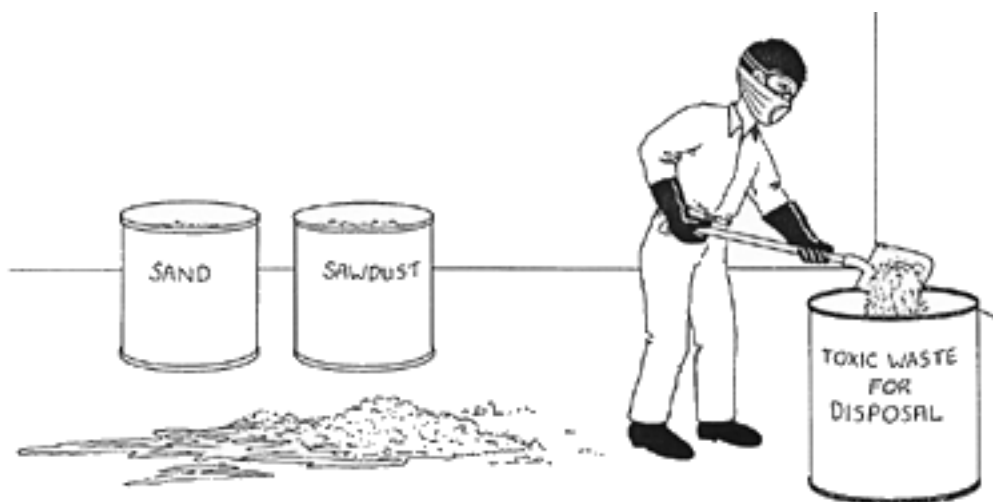
- Spills must be cleaned up immediately.
- At least more than one worker should respond to severe spills. Ensure that they are wearing protective nitrile rubber gloves and facemasks.
- Pesticides should be stored in warehouses with floors constructed of impermeable (sealed) concrete or other non-absorbent material. If this is not feasible, then immediate action is even more critical, as spilled pesticide may be absorbed into the floor.
- The spill should NOT be hosed down with water as this merely disperses the pesticide over a wider area.
- A supply of absorbent sawdust, sand or soil should be kept in a container in the store.
- Sawdust, sand or soil should be scattered over the area of the liquid spill and mixed with the pesticide. If wettable powders have been spilled, the sawdust, sand or dry soil should be dampened to avoid excess dust.
- The sawdust, sand or soil containing absorbed spilled pesticide should then be swept or shoveled carefully and placed in a marked, enclosed container for disposal.
- After sweeping (more than once if necessary) use a scrubbing brush at the end of a stick to scrub down the area with minimum amount of water and detergent. Excess soapy water should be soaked up and removed with a rough floor cloth and not hosed down. The brush and cloth should then be cleaned in the soak pit or evaporation tank wash areas.



A spill response kit: bucket with sand, shovel and fire extinguisher

Spills During Spray Operations

- When a spill has occurred, restrict access and cover the spill with earth, sand, etc.; no attempt should be made to wash away the spill with water or other liquids.
- Contaminated material should be placed in container for collection and central disposal.



Spill soaked up by sand or sawdust being carefully swept up by the storekeeper and placed in a container to be collected and taken for central disposal by the national authority

Spills During Transport

Transport vehicles should be decontaminated thoroughly as soon as spills or leaks are seen. Considering that vehicles will often be used for other uses, such as transporting food or people, it is especially important that the spill be cleaned up immediately to avoid permeating the vehicle with the pesticide. Spills should be cleaned as previously described for warehouses. The contaminated washings from the vehicle should also be absorbed by sawdust, sand or soil and placed in a container for collection and central disposal. Therefore, transport vehicles that are used for transporting large quantities of pesticides should be equipped with a bucket of sand, sawdust or soil, a shovel, and fire extinguisher.

HUMAN HEALTH PRECAUTIONS POST-SPILL

Spray Personnel Safety for Minor Exposure

Pesticides coming into contact with the skin can enter the body. Successful decontamination of body surfaces requires prompt action: rapid application of plenty of soap and water and thorough washing.

Anyone contaminated with pesticide should strip off their clothing and quickly and thoroughly scrub the affected part of their body with soap and water. Careful rinsing and toweling dry should follow this. (See Spraying Techniques BMP.)



Personal hygiene and drying PPE



Spray staff thoroughly washing themselves in the soak pit

Spray Personnel Safety for Moderate to Severe Exposure

Health workers within IRS areas should receive training and the necessary equipment and medical supplies to support the spray teams and the population in the treatment and management of pesticide exposure cases.

Provision of Poison Treatment Drugs	Provision of First Aid Kits
<ul style="list-style-type: none">• Treatment medication for dermal exposure or pesticide poisoning should be available in all health facilities as recommended by WHO.• Health personnel from the MOH or certified nurses in the spray area should be trained to deal with pesticide exposure emergencies. In the event of accidents or injuries, the exposed or injured person should be given first aid attention and then taken immediately to the health center.	<ul style="list-style-type: none">• First-aid kits should be readily available in case of an emergency in every IRS operational center, warehouse and vehicle transporting spray operators.• Persons using the First Aid kits should be well trained on first aid.• The contents of the First Aid kits should be reviewed and adapted to spray work environment and should include eyewash kit. Ensure instructions are in host country language.

Residents Safety in Case of Exposure

In the event that residents are exposed:

- For accidental exposure, if skin itches, wash with soap and water; for eye irritation, flush eyes with water; for respiratory irritation, leave the home for fresh air; for ingestion, contact program staff or go to nearest health facility.
- To avoid exposure when a spill has occurred, restrict access and cover the spill with earth, sand, etc.; no attempt should be made to wash away the spill with water or other liquids.



Eyewash station



First aid kit

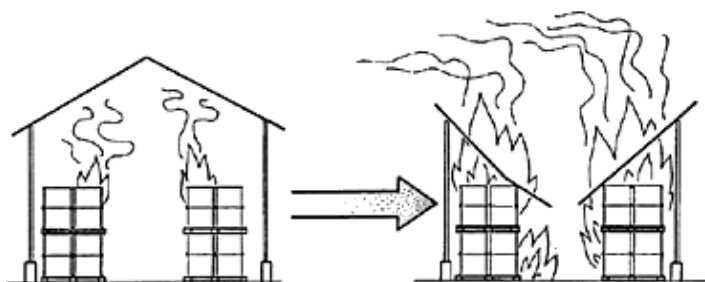
MAJOR EMERGENCIES

Major emergencies are a far greater risk where pesticides are stored than they are elsewhere. Pesticides present major fire hazards because the solvents used in formulations (oils and petroleum distillates) have low flashpoints and may be readily vaporized at normal temperatures. To reduce the risk of fire the following steps should be taken:

- The outside of pesticide stores should bear prominently displayed warning notices stating "Danger pesticides: authorized persons only" and "No smoking: no naked flame" as well as symbols. These rules should be strictly followed.
- Fire extinguishers (powder or carbon dioxide, not water) should be available in the store and should be regularly checked.
- Static or running water (required, together with soap, for decontamination purposes) should also be available.
- Buckets of sand or earth (also required for absorbing any liquid pesticide spills or leaks) are useful for putting out small fires.
- The local fire brigade should be informed of the store's existence and the hazards involved.
- It is very useful to place a notice on the outside of the store giving names and addresses of those responsible for the store (including key holders) who can be contacted in an emergency.
- Fires in pesticide stores that contain organophosphorus compounds and carbamates can be extremely dangerous to fire fighters. Firefighter should always wear breathing apparatus and avoid being downwind of the fire. Protective clothing and equipment used by fire-fighter should be thoroughly decontaminated after the fire.
- Solid water streams from fire-fighting hoses should be avoided since they can disperse the pesticide over a wide area (especially powder formulations).
- Care should be taken to avoid dragging fire hoses through contaminated water.



Extinguishing a small fire in a pesticide store using shovelfuls of sand container



Pesticide store in flames - the light roof has collapsed thus preventing an explosion

REPORTING

Report Content

The adverse event report must include the following information:

<ul style="list-style-type: none">• Brief description of event
<ul style="list-style-type: none">• Date, time and exact known location of the event
<ul style="list-style-type: none">• Name(s) of person(s) involved
<ul style="list-style-type: none">• Nature of Implementing Partner's relationship with any involved persons (specify 3rd party, Implementing Partner's employee, Implementing Partner's consultant, subcontractor employee or a seconded person and include the direct employer of any seconded personnel)
<ul style="list-style-type: none">• Involvement of police or any administrative authority
<ul style="list-style-type: none">• Existence of a police report if applicable (which should be scanned and attached)
<ul style="list-style-type: none">• Extent of damage to, or loss of, property or personal injury to Implementing Partner's personnel, including whether or not any those personnel are able to report to work
<ul style="list-style-type: none">• Extent of property damage or injury to a third party
<ul style="list-style-type: none">• Information on the following:<ul style="list-style-type: none">– Complaints or reports filed with the authorities– Payments already made to provide emergency medical care– Press or newspaper report– Status of Implementing Partner's client's awareness of the incident.– Any information on local procedures, common practices, traditional processes and requirements, or demands on those involved for similar incidents or situations. Please provide a short initial analysis of liability if any. Also, please include sources of the information provided on this point
<ul style="list-style-type: none">• Any further information that would be helpful or questions/requests for guidance.

Timeline for Report Submission

- All SAEs (serious adverse events) must be reported within 24 hours to the Chief of Party, Bureau Environmental officer and Mission Environmental Officer.
- All adverse events must be reported within five business days.

RESOURCES AND REFERENCES

FAO

Pesticide Storage and Stock Control Manual 1999

<http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGP/AGPP/Pesticid/Disposal/V8966E/01.htm>

BMP 9: DDT SPECIAL CONSIDERATIONS

Purpose and Scope

IRS programs can be sustained for many decades and have been shown to have considerable impact on malaria morbidity and mortality. However, any country considering using DDT should ensure that the right regulatory mechanisms are in place and that the program is well controlled with scientific and medical oversight (*from: Considerations for the Use for DDT in Malaria Control, American Enterprise Institute for Public Policy Research*).

This Best Management Practice (BMP) is intended to provide acceptable safety standards and practices for the handling, storage, transportation and use of pesticides used in Indoor Residual Spraying (IRS) of the PMI program, to minimize the risk for human exposure.

This BMP has been developed to provide acceptable safety standards and practices for all IRS activities.

Most of these standards and practices are applicable for DDT applications, though, due to its biopersistence, the following are **special BMP considerations for DDT**.

- Worker Health and Safety
- Pesticide Storage and Stock control
- Effluent Waste Disposal
- Solid Waste Disposal
- Spraying Techniques
- Monitoring Sampling

Acronyms & Definitions

BMP	Best Management Practices
IRS	Indoor Residual Spraying
MOH	Ministry of Health
NMCP	National Malaria Control Program
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
WHO	World Health Organization
DDT	from its common name dichlorodiphenyltrichloroethane

DDT

DDT is an organochlorine pesticide with low volatility and very low solubility in water, but soluble in fats and organic solvents. DDT is highly persistent, and has a long residual effect on most sprayed surfaces. The long persistence in the environment and its high bioaccumulation in fatty tissues have contributed to the dispersal of DDT residues everywhere (including arctic ice) from its agricultural use in the 1950s and 1960s. This bioaccumulation has resulted in highly toxic effects at the top of food chains, particularly in sharks, eagles, and falcons.

The main danger of environmental contamination from using DDT as an indoor residual spray comes from diverting the pesticide from malaria control to agricultural use. A similar danger would occur if containers were inadequately disposed of or pumps indiscriminately washed in surface waters. These risks could be prevented by proper education and strict supervision (*from: Treatment Guidelines for WHO recommended pesticides for Indoor Residual Spraying*).

WORKER HEALTH AND SAFETY

Safety of Women Spray Personnel

As the literature regarding DDT's impact on fetal development is under review, it is especially important for countries using DDT to ensure that pregnant women and nursing mothers are not exposed to DDT.

It is advisable for pregnant women and nursing mothers not handle DDT pesticides. When recruiting spray operators, pregnancy tests should be conducted during a normal medical exam to ensure that pregnant women do not join the spray teams.

- For spray campaigns lasting longer than 30 days, the pregnancy tests should be repeated once every month during the campaign.

Pesticide Exposure and Treatment

Early symptoms may include paresthesia (tingling) of the tongue, lips and parts of the face, which in severe cases extends to the extremities. The patient may have a sense of apprehension and disturbance of equilibrium, dizziness, confusion, and a characteristic tremor.

Remove contaminated clothing and wash the affected skin with clean water and soap, and flush the affected area with large quantities of clean water. Keep the patient calm and in quiet, shaded conditions and seek medical assistance. Do not give the patient oils and fats (*from: Treatment Guidelines for WHO recommended pesticides for Indoor Residual Spraying*).

Medicines to be Administered by a Professional at the Hospital in Case of DDT Poisoning

Activated Charcoal (priority)

Diazepam or Lorazepam (for seizure)

Phenobarbital

Cholestyramine resin

PESTICIDE STORAGE AND STOCK CONTROL

Strict auditing and mechanisms for retrieving empty sachets of DDT from the districts should be established. Once retrieved, the empty sachets will be kept in a secured designated location until incinerated in a certified incinerator (see solid waste disposal). Strict punitive measures against pilferage and unauthorized use of DDT should be enforced.

EFFLUENT WASTE DISPOSAL

In the implementation of IRS activities, waste water (effluent) is generated on a daily basis at the end of a spray day during the cleaning process for the spray pumps and PPE's (overalls, gloves, boots) and tarpaulin covering sheets. Because this waste water is contaminated with the pesticide, unsound or improper disposal of the IRS effluent could pollute and cause adverse risk and damage to environment.

Evaporation Tank

An evaporation tank is a sealed tank for the disposal of non-biodegradable liquid pesticide waste contaminated with DDT (see Effluent Waste Disposal BMP).

After a spray round, all of the sand, sludge, and pesticide residue remaining in an evaporation tank should be sampled for DDT concentrates, then scooped out, placed into a sealed container, placed with empty sachets, and disposed according to the BMP for Solid Waste Disposal.

Polythene Tanks

In cases where the evaporation tank is not large enough to handle the amount of DDT effluent safely, or where there are no evaporation tanks, the DDT effluent should be stored in polythene tanks. Once the level in the tank has dropped sufficiently, the effluent can then be added to the tank, or transported to the closest evaporation tank.



Polythene tank used as secondary storage of DDT effluent waste

Decommissioning

Evaporation tanks should be dismantled and restored back to their natural state as much as possible once PMI DDT activities discontinue. Pesticide sampling of the site should be done to determine there is no trace of DDT in the surrounding soils.

PPEs used for DDT IRS activities should be washed in a cemented bay that is adjacent and drains into evaporation tank. Hanging lines for drying the overalls should be erected directly over the evaporation tank.

SOLID WASTE DISPOSAL

Contaminated DDT solid waste is generated during the implementation of IRS activities in the form of empty pesticide sachets, damaged PPE equipment, used cleaning equipment, and materials such as sawdust used to clean up spills, evaporation tank residue, contaminated soil from accidental spills, and expired pesticides. These substances are generally toxic and pose health and environmental hazards and should be incinerated in a certified incinerator.

All DDT solid waste will be stored in similar manner as all other IRS wastes. Ideally suppliers are required to dispose of all DDT waste, and provide a certificate of destruction as proof that the wastes have been disposed of in a certified facility.

Should DDT solid waste be disposed of in an approved incinerator, the remaining ash residue from the incineration must be treated as toxic waste and be disposed according to the requirements for disposal of toxic ash residue principally in regulated landfills (see the Solid Waste Disposal BMP).

SPRAYING TECHNIQUES

Appropriate Equipment - Nozzles

Standardized nozzles should be used throughout the IRS program, although different types are necessary for different pesticides and surfaces (absorbent and non-absorbent). Currently, there are two nozzles, HSS 8002 or 8001, both are fan type (TEEJET) and differ only in their throughput per minute at 55 psi. The 8002 nozzle should typically be used for application of DDT.

MONITORING SAMPLES

Procedure Detail

This procedure defines the types of environmental monitoring required as part of any IRS program using DDT for Malaria vector control. It also defines the requirements for monitoring in accordance with the USAID environmental regulations 22 CFR 216 and the Programmatic Environmental Assessment for Integrated Vector Management for Malaria. This procedure intends to provide brief guidance on when and what to sample. It does not include detailed protocols for sampling, analysis, or data management, analysis, and interpretation.

The EMP/QAPP must be developed in conjunction with the sampling plans. The EMP provides detailed information concerning the objectives, and scope to be used in the monitoring program. This should include any benchmark for humans and ecological receptors such as maximum residual levels, and toxicity reference values. These benchmarks should be selected based on site specific receptors and must be identified prior to any undertaking any sampling.

EU MRLS for food (0.05mg/kg) for DDT can be found at:

http://ec.europa.eu/sanco_pesticides/public/index.cfm?event=substance.resultat&s=1

Other helpful benchmarks can be found in the IRIS database at the US EPA website, and at the ECOTOX website and at www.mrlatabase.com maintained by the US Department of Agriculture Foreign Agricultural Service (USDA/FAS). Last, the PEA for IVM for Malaria contains several benchmarks which are important for evaluation. Work with a human and ecological risk assessor to assist in choosing the most appropriate benchmark for receptors.

The QAPP provides detailed information on the management structure, staff roles, training requirements, quality control procedures, and documentation required to assure the overall quality of monitoring data collection, management, and analysis. This would include sampling and analysis techniques (statistical, laboratory, and sampling techniques).

Environmental Monitoring Plan (EMP) and Quality Assurance Project Plan (QAPP)

Baseline Sampling Plan

The data from this sampling round acts as a baseline by which all future rounds are compared and must be executed prior to the launch of USAID-supported IRS programs. Programs with DDT spraying already underway should consider “round 1” of sampling the as the baseline, though it can also be used to compare to previously agreed benchmarks. This sampling and analysis effort establishes pre-USAID supported IRS DDT levels in media of concern (e.g., soil, sediments and homestead and field crops), and is collected from randomly-selected future IRS homesteads. It should be noted if DDT has ever been used in the area and how much time has passed since the last IRS event. DDT daughter products, such as DDE, and DDD should also be analyzed as the ratio of DDT to DDE and DDD can give an indication of weathering/age of product.

If the area targeted for IRS includes locations at which elevated concentrations of DDT might be expected (e.g., fields previously used for growing cotton, plants used to process cotton, prior IRS operations), samples should also be collected from such locations.

Environmental Monitoring Plan (EMP) and Quality Assurance Project Plan (QAPP)

IRS Source Monitoring Plan

One of the main concerns of any monitoring program is the fate and transport of the IRS DDT from the spraying in the home to any sensitive receptor. This may include children or women of childbearing age, birds, aquatic life and invertebrates. Because DDT degrades slowly and is highly adsorbed to organic materials it has a tendency to move with soil and becomes sequestered in sediments such as streambeds. While this is a highly unlikely scenario for IRS (because of the mitigations and conditions placed on the spray techniques), it should be noted that DDT could move along these pathways to important receptors. Therefore, the following sampling strategy should be employed:

Crops stored in home	Crops stored in the home should be sampled to monitor DDT transport from the spray area to the stored crop. It is important to note that while crops are moved out of the home during spraying event, residual DDT may volatilize to crops stored in the home. Metadata should include crop type, and storage means (sack, bowl etc). Crops should not be stored against the walls if possible.
Crops grown near homes	Sampling and analysis of crops grown in areas where houses will be treated with DDT, to detect a potential increase in DDT levels in crops destined for regional or international markets. Crop samples should be collected pre-IRS and post-IRS from a variety of locations in the chain of production and commerce, e.g. fields, storage facilities, local markets, processing facilities, and points of transit.
Soil near homes	To understand if DDT is moving from the home to outside the home, take several samples near the homestead entrance. If DDT is detected at statistically significant levels this may indicate that wash water from the walls or floor dust is being swept out the door. This creates a transport pathway to other receptors such as crops, birds and aquatic life.
Soil near and in evaporation tanks	The sediment at the bottom of the evaporation tank need only be sampled at evaporation tank clean out or tank closing. The results are used for the purposes of tank closeout or for disposing of waste sediment. However, because we can not be certain there were no incidental spills, sampling and analysis of soils near the evaporation tank must occur at a statistically valid sub set of tanks each year and at all tanks at close out. If a tank is found to have DDT in soils above the selected benchmarks for relevant receptors (selected in the environmental monitoring plan) these soils must be excavated and properly disposed.

INCIDENT MONITORING

Should sampling and analysis of soils, sediments, crops, etc indicate statistically significant levels of DDT (relative to baseline or benchmarks), the site may require further sampling for the purposes of delineating the extent of the DDT. Such samples may also be required if post-IRS source monitoring detects DDT levels substantially above baseline. This would be done to determine the route or magnitude of environmental contamination associated with the DDT. In either case, further action may be required and the BEO and MEO should be contacted for further assistance prior to any action.

ENVIRONMENTAL MONITORING REPORT

The Environmental Monitoring Report presents results and interpretations from the monitoring program. It summarizes the purpose of the monitoring program, sampling design, sampling and analytical methods, results, and conclusions. The analysis and interpretation are considered during the annual Malaria Operational Planning. Therefore it is imperative that the data be made available in a timely fashion.

RESOURCES AND REFERENCES

IVM for MALARIA IVM for Malaria Programmatic Environmental Assessment

EU EU MRLs http://ec.europa.eu/sanco_pesticides/public/index.cfm?event=substance.resultat&s=1

ECOTOX ECOTOX Benchmarks http://www.pesticideinfo.org/DetailPesticide.jsp?Rec_Id=PC33482#Toxicity

EPA EPA IRIS database

IRS ENVIRONMENTAL EVALUATION CHECKLIST I: PRE-SPRAY ACTIVITIES – STORAGE AND TRANSPORTATION

Country:	Province:	District:
Division/Commune:	Village:	GPS Coordinates:
Implementing Organization(s):		
Monitoring Date:		
Monitoring Done by (Name, Title):		

SECURITY AT CENTRAL WAREHOUSE AND EACH DISTRICT STORAGE FACILITY					
MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
	YES	NO			
1) Is the storage facility properly secured including:	YES	NO	To avoid pilfering and for safety reasons		
a) Double locks?	YES	NO			
b) Guarded 24 hours every day?	YES	NO			
c) Windows barred	YES	NO			
d) Doors secured?	YES	NO			
2) Are guards equipped with appropriate gear	YES	NO	Boots, whistles and flashlights		
3) Is the facility fenced	YES	NO			

SECURITY AT CENTRAL WAREHOUSE AND EACH DISTRICT STORAGE FACILITY					
MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
4) Does the facility have “danger warning” signs marked with skull and cross bones? ¹	YES	NO	Should be visible at all times.		
5) Have local fire brigades been notified of facility contents?	YES	NO	In the event of fire		
6) Is the storage facility located an adequate distance from schools, homes and water bodies?	YES	NO	For safety reasons and possible contamination in the event of spills		
STOCK REVIEW					
MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
1) Do they have a system of recording stock cards?	YES	NO			
2) Are the stock cards up to date?	YES	NO			
3) Do they have an adequate filing system?	YES	NO	To easily locate records for review		
4) Using these stock cards, can the warehouse supervisor indicate the quantity and age of remaining stock?	YES	NO	Stock card should include all tracking information for each sachet of pesticide		
5) Using these stock cards, can the supervisor indicate the quantity of stock that has been used to date?	YES	NO			
6) Are the stocks orderly shelved? ²	YES	NO			
7) Are pesticides properly labeled?	YES	NO	For identification and stock management		

STOCK REVIEW, Continued

MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
8) Are the insecticides distributed on a "first in, first out" system so that the insecticide that arrived first is distributed first?	YES	NO	Avoids accumulation of expired stock		
9) Are there any insecticides past their expiration date?	YES	NO	Using first in and first out management, this should not be an issue. Expired pesticides must be disposed of in an appropriate manner		
10) Are barrels or containers for waste available and clearly labeled?	YES	NO			
11) Are the used sachets counted and stored neatly in boxed/containers or barrels? ³	YES	NO	Need to ensure that all sachets are accounted for to avoid pilfering		
12) Do they add up to what the supervisor indicated as the quantity of stock used to date?	YES	NO	If outstanding balance, determine cause		
13) Is extra equipment clean and stored properly?	YES	NO			

CENTRAL WAREHOUSE / DISTRICT STORAGE FACILITIES					
MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
1) Is there a thermometer for monitoring daily temperature in the storage facility?	YES	NO	Pesticides lose effectiveness and shelf life in high heat		
2) Is the pesticide stock stored no more than 2 m high and off of the ground? ⁴	YES	NO	For worker safety and accessibility		
3) Are there liquids stored above dry pesticides?	YES	NO	Not recommended in case of leaks or spills		
4) Is there an emergency spill kit? ⁵	YES	NO	Check to ensure kit contains required equipment, absorptive material, shovel, bucket		
5) Is there a fire extinguisher or firefighting equipment?	YES	NO	Alternative fire fighting systems may be allowed if appropriate (e.g. bucket of sand)		
6) Is the floor impermeable (concrete or plastic)?	YES	NO	For safety and in case of spills		
7) Is the roof well maintained?	YES	NO	For security and to protect the equipment and pesticide from the elements		
8) Is there ventilation via windows?	YES	NO			
9) Is there more than one spray season of accumulated solid waste?	YES	NO	May indicate no disposal system in place		
10) Is there a strategy in place for disposing of solid waste?	YES	NO			
11) When will disposal take place?	YES	NO			

CENTRAL WAREHOUSE / DISTRICT STORAGE FACILITIES

MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
12) Have there been any complications with identifying a disposal system?	YES	NO			
13) Is there evidence of a pesticide leak?	YES	NO	Signs of dust or granules		
14) Is soap and water available? ⁶	YES	NO	For washing hands after handling pesticides		
15) If present, are foods, medicine and other products stored separately from pesticides?	YES	NO	To prevent possible contamination		

HEALTH & SAFETY ISSUES

MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
1) Is the pesticide Material Safety Data Sheet (MSDS) available?	YES	NO			
2) Is there a fully stocked emergency first aid kit specifically for spray activities?	YES	NO			
3) Are there extra clean PPE?	YES	NO			
4) Do supervisors know where the nearest health facility is located?	YES	NO			
5) Are warehouse supervisors familiar with the symptoms of pesticide poisoning?	YES	NO	Ask what the symptoms are		
6) Do warehouse supervisors know how to treat suspected pesticide poisoning?	YES	NO	Ask what actions they take in case of poisoning		
7) Do people entering the warehouse wear masks?	YES	NO			
8) Do warehouse teams eat inside the warehouse? ⁷	YES	NO	Ask workers where they do eat		
9) Is there soap and water available for washing hands?	YES	NO			
10) Are warehouse supervisors/storekeepers wearing appropriate PPE?	YES	NO	Overalls, gloves, face masks and boots (or at least closed toe shoes)		

HEALTH CLINIC

MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
1) Is there a health clinic located nearby?	YES	NO			
2) Do the medical professionals know the treatment for pesticide poisoning?	YES	NO			
3) Are the antidotes available at the clinic?	YES	NO			
4) Are there records showing that women on the teams have had monthly pregnancy tests?	YES	NO			
5) If using organophosphates, is a biomonitoring program in place?	YES	NO			
6) Did they establish baseline AChE level?	YES	NO			
7) Has any workers AChE level changed 30% or more from baseline?	YES	NO	If yes have appropriate actions been taken: 30% change -retrained, 50% change - removed from operations		

TRANSPORTATION OF PESTICIDES & SPRAY OPERATORS					
MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
1) Is there a spill kit in the vehicle?	YES	NO	Absorptive material, shovel and bucket		
2) Is there an emergency first aid kit in the vehicle?	YES	NO			
3) Is there eye wash in the vehicle to rinse eyes in case of an emergency?	YES	NO	In first aid kit		
4) Can the pesticides be adequately secured and tied down in the vehicle?	YES	NO			
5) Is there a separate vehicle for transporting pesticides and personnel?	YES	NO			
6) Is the vehicle retrofitted to ensure the safety of SOs?	YES	NO	Appropriate seating and railings		
7) Is the vehicle overcrowded? ⁸	YES	NO			
8) Does the driver have certification (driver's license, etc.) for transporting goods or numerous people?	YES	NO			
9) Is the vehicle certified?	YES	NO			
10) Do the drivers know what to do in case of an accident?	YES	NO			
11) Do the drivers know what to do in case of a spill?	YES	NO			

TRANSPORTATION OF PESTICIDES & SPRAY OPERATORS, Continued

MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
12) Is there evidence of pesticide leakage in the trucks?	YES	NO	Evidence of chemical dust or granules		
13) Has the driver attended any safety training?	YES	NO			
14) Do drivers have appropriate PPE in case of a spill?	YES	NO			
15) Are food products, animal feed, or consumer good transported in the same truck?	YES	NO	Bulk pesticide cartons must be kept separate and securely fixed		
16) Have there been any vehicular accidents?	YES	NO	If so, when and where, and how were they handled?		

ADDITIONAL COMMENTS & REMARKS

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1: Warning sign with skull and cross bones



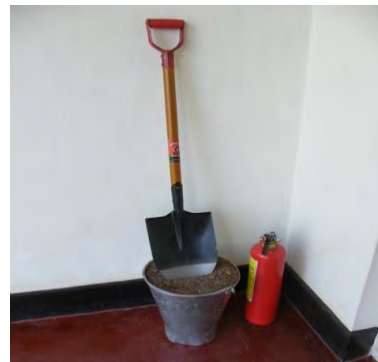
2: Stocks orderly shelved



3: Sachets counted and stored in clearly labeled boxes



4: Pesticide boxes are stacked too high



5: A spill response kit



6: These items should not be present in the store houses



7: Spray operators (SO) should not be eating in the store house



8: This vehicle is clearly overcrowded and is compromising the spray operators' safety

IRS ENVIRONMENTAL EVALUATION CHECKLIST 2: SPRAYING ACTIVITIES

Country:	Province:	District:
Division/Commune:	Village:	GPS Coordinates:
Implementing Organization(s):		
Monitoring Date:		
Monitoring Done by (Name, Title):		

FIELD SITE OFFICE / DISTRICT STORAGE FACILITY					
MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
1) Is the Field Office stocked with the recommended medicines?	YES	NO	In case of accidental poisoning, dermal or eye exposure		
2) Is there someone there that has been trained in first aid, specifically in treating pesticide exposure?	YES	NO			
3) Does the field office know where the nearest Health Clinic is located?	YES	NO			
4) Is the supervisor/storekeeper wearing appropriate PPE?	YES	NO			

WOMEN SPRAY OPERATORS (SO)					
MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
1) Do any of the SO appear to be pregnant or breast feeding?	YES	NO	Pregnant women and nursing mothers should not handle pesticides		
2) If DDT is being sprayed, are there any women on the spray teams?	YES	NO	Women should not be exposed to DDT		
OBSERVATION OF SPRAY OPERATORS (SO) AT SPRAY SITE					
MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
1) Is the number of sachets counted and recorded before distribution to SO?	YES	NO	Daily up-to-date record of stocks received, held and issued should be maintained		
2) Do the SOs have clean PPE at the start of each work day?	YES	NO			
3) Are all SOs properly attired (full PPE)?	YES	NO	PPE should be worn during all phases of operation		
a. Goggles/face shield?	YES	NO			
b. Face masks?	YES	NO			
c. Overalls?	YES	NO			
d. Gloves?	YES	NO	Should be outside of overalls		
e. Boots?	YES	NO	Should be outside of overalls		
f. Are the gloves or boots in good conditions?	YES	NO	There should be no holes or worn areas.		
g. Neck protection?	YES	NO	Towel or cloth covering back of neck		
h. Flashlight?	YES	NO	To ensure appropriate application in dark rooms		
i. Are PPE appropriate size?	YES	NO	If they are too big, the person may not always wear them		

SPRAY OPERATORS (SO) AT SPRAY SITE, Continued

MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
4) Are any of the SOs observed eating?	YES	NO	Eating, drinking and smoking while spraying is strictly forbidden		
5) Are any of the SOs observed smoking?	YES	NO			
6) Are any of the SOs drinking while spraying?	YES	NO			
7) Were the SOs given a meal before the workday?	YES	NO			
8) If the spray operations last longer than 6 hours, is there a contingency plan to allow the SOs to drink water during a break?	YES	NO	What is the plan?		

HOUSEHOLD PREPARATION BEFORE SPRAYING OPERATIONS COMMENCE					
MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
	YES	NO			
1) Do the SO ask if the residents have been informed about the spray activities?	YES	NO	Informational campaigns (IEC) and mobilization are critical to ensure the safety of residents		
2) Have all personal belongings been moved outside of the house? ²	YES	NO	Residents should remove their own property. SOs could contaminate personal property		
3) Are all items that cannot be removed covered with a tarpaulin? ³	YES	NO	Items too large to be moved or religious items		
4) Are all animals kept outside of the home during spraying?	YES	NO			
5) If there are people (sick, elderly, babies) that cannot be moved, is this household being sprayed?	YES	NO	Prohibit spraying in households that are occupied		
6) Are the residents informed not to re-enter the house for two hours after spraying is completed?	YES	NO			
7) Are they also informed to then open the windows, leave and wait another 30 minutes before re-entering?	YES	NO			

SPRAY CAN PREPARATION

MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
1) Are spray pumps filled using water from the previous day's progressive rinse?	YES	NO	Ask supervisors		
2) Is the pump pressurized to 3.8 bar, (55 psi)?	YES	NO			
3) When testing the spray pump, does the nozzle drip?	YES	NO	Have spray pump technician repair or replace nozzle.		
4) When the spray can is refilled during the spray operations, is it mixed outside of the house.	YES	NO	Is some situations it may be appropriate to mix inside (wind, pilferage, level ground) any spilling should be wiped up		
5) When the contents are mixed in the tank, is the tank shaken before pressurizing?	YES	NO			

SPRAY OPERATIONS

MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
1) Are the SO spraying floors, metal roofs, doors, glass, inside of cupboards, wallpaper, food granaries, curtains, latrines, animal pens?	YES	NO	These should not be sprayed		
2) Are all walls, not-metal ceiling, outdoor eaves, wooden or straw doors, and the underside of furniture being sprayed?	YES	NO			
3) Are spray operators:	YES	NO			
a. Standing so the spray nozzle is 45 cm from the wall?	YES	NO			
b. Standing parallel to wall being sprayed?	YES	NO			
c. Using vertical swaths with downward and upward motion?	YES	NO			
d. Frequently shaking spray can?	YES	NO			
e. Observing the compression gage?	YES	NO			
f. Is the spray swaths overlap by 5 cm	YES	NO			
4) Is there adequate supervision during the operation?	YES	NO			
5) Is the spray pattern even without streaks?	YES	NO			
6) If the nozzle clogs, does the SO try to unclog it with their mouth or with a small pin/wire?	YES	NO	Should be cleaned with soft toothbrush		

HOUSEHOLD AFTER SPRAY ACTIVITIES

MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
1) Are the residents told not to plaster, paint or clean the sprayed surfaces?	YES	NO			
2) Are the residents informed to sweep up dead mosquitoes and deposit them in latrine pit and not to allow children or animal inside until this has been completed?	YES	NO			
3) Have residents been informed that if they have any reactions, itchy skin, that they should wash the area with soap and water?	YES	NO			
4) If the residents are experiencing any symptoms, have they been told to go to the nearest health clinic?	YES	NO			

SPRAY OPERATIONS (SO) AFTER SPRAY ACTIVITIES					
MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
1) Do the SOs continue to wear the PPE on the way back to the field office/ wash site?	YES	NO	Should continue wearing during progressive rinse and cleaning of all equipment		
2) Do workers have access to end-of-day washing (including soap and water)?	YES	NO	Wash hand, neck and face to decontaminate, wash rest for personal hygiene and comfort		
3) Have SO complained of irritation (throat, skin, etc.)?	YES	NO	Should go to health clinic		
4) Have there been any reported accidents?	YES	NO	If so, when and where, and how were they handled?		
5) Are SO completing daily report forms?	YES	NO	Daily up-to-date record of stocks received, held and issued should be maintained		
6) Are forms checked by spray supervisors?	YES	NO			
7) At the end of the shift, are full and empty sachets returned?	YES	NO			
8) Are the empty sachets counted and stored in labeled, sealed containers?	YES	NO			

ADDITIONAL COMMENTS & REMARKS

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1: Spray operators (SO) should not be eating in the store house



2: This household was poorly prepared for spraying, none of the household items were removed and will be contaminated with pesticide



3: This bed is covered with tarpaulin, effectively protecting it from being contaminated by IRS

IRS ENVIRONMENTAL EVALUATION CHECKLIST 3: – POST-SPRAYING ACTIVITIES WASH UP AND WASTE DISPOSAL

Country:	Province:	District:
Division/Commune:	Village:	GPS Coordinates:
Implementing Organization(s):		
Monitoring Date:		
Monitoring Done by (Name, Title):		

OBSERATION OF SPRAY OPERATORS (SO) ARRIVING AT FIELD STATION / WASH UP FACILITY / PROGRESSIVE RINSE					
MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
	YES	NO			
1) Is the wash site located near the field station/district storage facility?	YES	NO			
2) Are all SOs wearing PPE when they return from spraying?	YES	NO			
3) Are all persons conducting the progressive rinse in full PPE?	YES	NO			
4) Are all wash persons wearing appropriate PPE?	YES	NO			
5) Are any SO eating, drinking or smoking?	YES	NO			

OBSERATION OF SPRAY OPERATORS (SO) ARRIVING AT FIELD STATION / WASH UP FACILITY / PROGRESSIVE RINSE					
FINDING(S)	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
	YES	NO			
6) Are the #2, 4 and 6 wash tanks filled with water?	YES	NO			
7) Are spray pumps triple rinsed using the progressive rinse method? ¹	YES	NO	Pesticides poured into tank #1 can be used the following day. Rinse water should be dumped into soak pit.		
8) Are the outsides of the tanks rinsed off in the soak pit?	YES	NO			
9) Are the helmets and visors rinsed off in the soak pit?	YES	NO			
10) Are the PPE washed and then hung for drying over the soak pit? ²	YES	NO			
11) Are evaporation tanks, soak pits or ablution blocks used to dispose of all used water?	YES	NO			
12) Are spray pumps hung upside down to dry? ³	YES	NO			
13) Are washed spray pumps stored in an orderly way for easy preparation the next day?	YES	NO	Spray pumps normally should be hung upside down after being washed		

SOLID WASTES

MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
1) At the end of the shift, are full and empty sachets returned?	YES	NO			
2) Are empty sachets inventoried and documented?	YES	NO			
3) Are all contaminated empty sachets contained in storage?	YES	NO	Not thrown on ground, buried or burned in open pit		
4) Are contaminated dust masks stored with empty sachets?	YES	NO			
5) Are any other contaminated material, cardboard, materials for cleaning spills, etc. placed in a container?	YES	NO			
6) Have unusable contaminated PPE been cleaned and disposed of with other waste material?	YES	NO			
7) Have DDT sachets been incinerated at a certified facility?	YES	NO	Has one been identified?		

EFFLUENT WASTES SOAK PITS					
MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
1) Is the soak pit located away from bodies of water?	YES	NO			
2) Is the soak pit located in a flood prone area/or steep slope?	YES	NO			
3) If located on a slope, is there a berm to prohibit runoff from entering on the uphill side, and one on the downhill side to contain effluent runoff?	YES	NO			
4) Is the soak pit absorbing all the effluent waste?	YES	NO			
5) or creating a puddle and/or runoff?	YES	NO			
6) Is there adequate gravel to act as a filter?	YES	NO	No soil/vegetation should be observed within the soak pit		
7) Is the soak pit area fenced and gated? ⁴	YES	NO	To keep out children and animals		
8) Is there a skull and cross bones warning sign to keep out unauthorized person at the soak pit?	YES	NO	If not, has there been adequate communication with the community so they understand not to enter the wash areas?		

EFFLUENT WASTES EVAPORATION TANKS (DDT)

MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
	YES	NO			
1) Are evaporation tanks located away from bodies of water?	YES	NO			
2) Are they located in a flood prone area/ or on a steep slope?	YES	NO			
3) If located on a slope, is there a berm to prohibit runoff from entering on the uphill side, and one on the downhill side to contain effluent runoff?	YES	NO			
4) Do you see cracks in concrete?	YES	NO	Would mean the tank isn't sealed and there may be seepage into the soil		
5) Do see signs of evaporation?	YES	NO	Traces of dried residue on sides of tank above water surface		
6) If not, do you see effluent contained safely elsewhere (polythene tanks)?	YES	NO			
7) Is there any cover available in the event of rain?	YES	NO	Could be permanent shelter or temporary tarpaulin		
8) Is the evaporation tank fenced off and gated?	YES	NO	To keep out children and animals		
9) Is there a skull and cross bones warning sign to keep out unauthorized person at the evaporation pit?	YES	NO	If not, has there been adequate communication with the community so they understand not to enter the wash areas?		

EFFLUENT WASTES WASH AREAS					
MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
1) Is there a concrete catchment area or tarpaulin spread out on the ground to catch all effluent?	YES	NO			
2) Can all effluent be easily drained into a soak pit or evaporation tank? ⁵	YES	NO			
3) Are the overalls hung out to dry on lines over the wash area? ⁶	YES	NO			
4) Is the wash are fenced off and gated?	YES	NO	To keep out children and animals		
5) Is there a skull and cross bones warning sign to keep out unauthorized person at the evaporation pit?	YES	NO	If not, has there been adequate communication with the community so they understand not to enter the wash areas?		
OTHER					
MITIGATION ACTIONS	FINDING(S)		NOTES:	COMMENTS / RECOMMENDED ACTIONS	TIMELINE FOR ACTIONS
1) Have local authorities been notified of the dangers of insecticide leakage?	YES	NO			

ADDITIONAL COMMENTS & REMARKS

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I 10 IRS Environmental Evaluation Checklist 3: Post-Spraying Activities – Clean Up and Waste Disposal



1: Spray operators using progressive rinse method to triple rinse spray pumps



2: Washed PPE hanging over soak pit to dry



3: Spray pumps should normally be hung upside down after being washed



4: Soak pit area should be fenced to keep out children and animals



5: Soak pit area should be fenced to keep out children and animals



6: Overalls hanging on lines over wash area for drying

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