UN environment programme

POLYCHLORINATED BIPHENYLS **PHASE-OUT PLAN**

DISPOSAL OF PCB OILS CONTAINED IN TRANSFORMERS AND DISPOSAL OF CAPACITORS CONTAINING PCBS IN SOUTHERN AFRICA (**GEF PROJECT 5532**)

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ACRONYMS

ESM	Environmentally Sound Management
GEF	Global Environment Facility
NIPs	National Implementation Plans
ppm	Parts per million
PCB	Polychlorinated biphenyls
SAPP	Southern Africa Power Pool
SOPs	Standard Operating Procedures
UNEP	United Nations Environment Programme

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INTRODUCTION

Background

According to Annex A: Part 2 of the Stockholm Convention on POPs each party shall **eliminate the use of polychlorinated biphenyls (PCB) in equipment by 2025** and **make determined efforts designed to lead to environmentally sound waste manage (ESM) of liquids containing PCB and equipment contaminated with PCB, as soon as possible but no later than 2028**, in accordance with its provisions.

Through the GEF-funded project "Disposal of PCB oils contained in transformers and disposal of capacitors containing PCB in Southern Africa", among other things, all participating countries are given support to develop a pragmatic PCB Phase-out Plan as provided for and committed to by ratifying the Stockholm Convention. The overall objective of the project is to reduce environmental and human health risks from PCB releases through the demonstration of a regional approach to the introduction of cost-effective and socially acceptable ESM of PCB oils, equipment and wastes held by electrical utilities and other PCB owners in twelve participating countries: Botswana, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, Swaziland, Tanzania, Zambia and Zimbabwe.

The project also assists participating countries with a legal review, the verification of inventories, disposal of confirmed and decommissioned contaminated oils/equipment, and capacity building and risk communication up to 2022.

Objectives

Towards meeting the Stockholm Convention obligations of (1) phasing out the use of PCB by 2025 and (2) making determined efforts designed to lead to ESM of waste liquid containing PCB and equipment contaminated with PCB no later than 2028, this National Phase-out Plan sets the following general objectives:

- **Identify** key agencies and stakeholders responsible for sound management of PCB and ensure their roles and responsibilities are understood and enforceable;
- **Establish** and maintain a national inventory of all PCB contaminated equipment that are not available for immediate disposal in Phase 1 of the project;
- **Agree** on concrete actions by key agencies and stakeholders to ensure that all contaminated equipment is either decommissioned and disposed of in Phase 2 of the project, or is scheduled for replacement and disposal by the owners of the contaminated equipment; and
- **Present** the strategy and activities to be implemented in a set timeframe (a road map) by each entity, individually or in collaboration.

Approach

At national level, PCB containing equipment are owned and managed by diverse sector entities, mostly comprising the private sector including the power sector but also tourism and industry; and in some cases, government affiliated agencies such as defence, civil protection and hospitals. Environmentally sound management (ESM) and disposal of PCB oil and PCB contaminated equipment, and conforming to related national and international obligations are vested in national Governments. It requires close collaboration, coordination and commitment of all related stakeholders for the development of a pragmatic Phase-out Plan and successful delivery of expected outcomes. All signatories to the Stockholm Convention are obliged to prepare National Implementation Plans (NIPs) and required to review and update them as appropriate. The PCB Phase-out Plan should be developed in close coordination with these NIP updates.

At regional level, the Southern Africa Power Pool (SAPP) and investment banks (e.g., World Bank and African Development Bank) are investing in electricity grids and are essential partners for long-term phase out and replacement of contaminated items.

PART 1 - KEY ELEMENTS AND LOGICAL SEQUENCE OF A TYPICAL PHASE-OUT PLAN

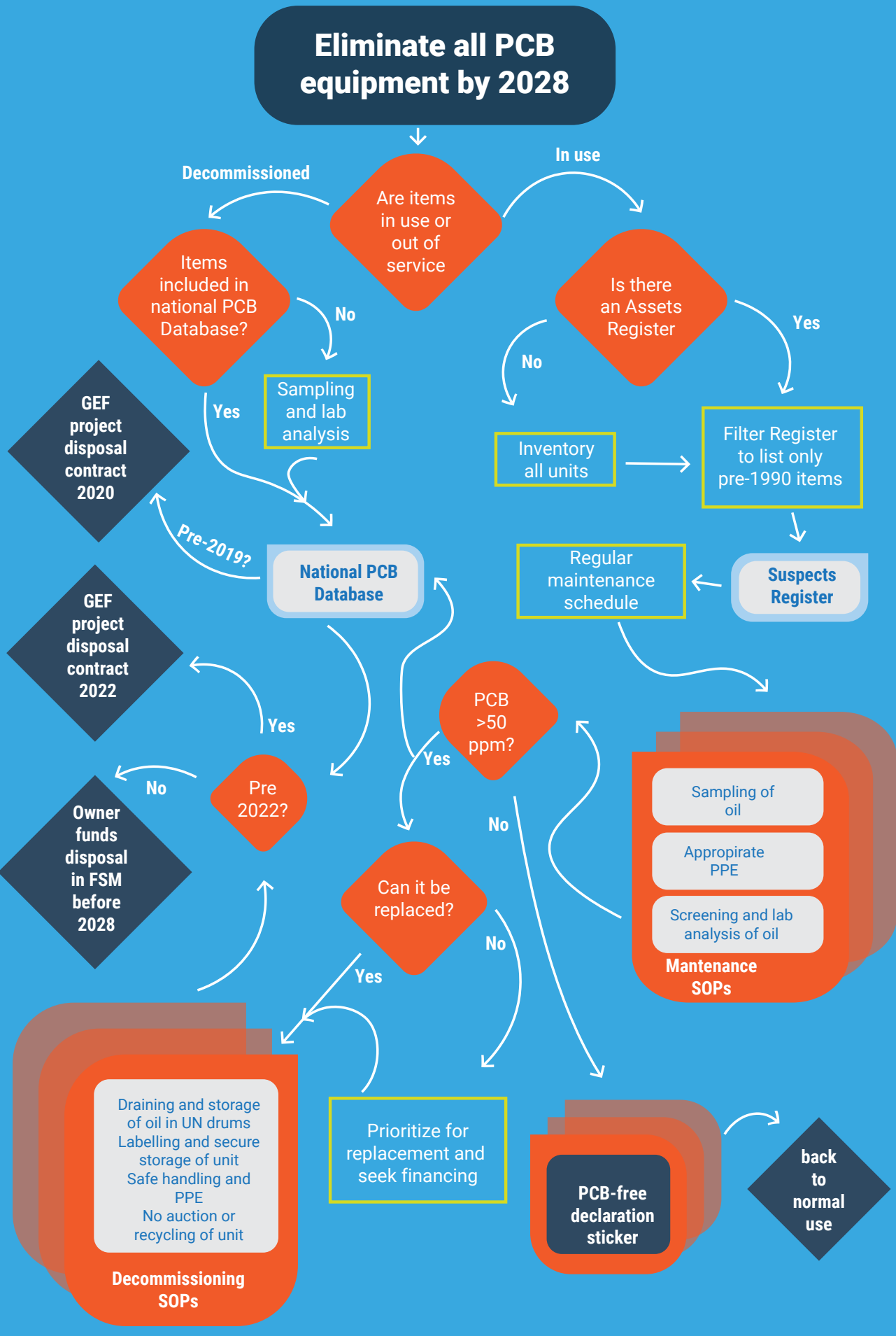

Figure 1: Key elements for development a PCB Phase-out Plan

Process elements for the development of a Phase-out Plan

The process requires the engagement of relevant regulatory agencies responsible for each element of the lifecycle of PCB, careful consideration of related national policies, comprehensive review and identification of key players, review of current status with respect to PCBs and efficient collaboration and cooperation of all Parties concerned. It consists of:

- Establishment of institutional arrangements for efficient and effective coordination and collaboration;
- Initiating tasks as appropriate to engage all stakeholders for the development of the Phase-out Plan; taking into consideration of a set of key elements and implementing them in a logical sequence (See Figure 1).
- Consensus of and commitment by each player identified in the Phase-out Plan for effective and efficient implementation of assigned tasks towards successful delivery of expected outcomes.

Step 1: Institutional arrangements for collaboration and coordination

Task 1.1: Establishment of a national coordinating team

A small coordinating team needs to be in place to ensure effective coordination of activities and communication with various stakeholders towards successful completion of the development of national PCB Phase-out Plan. The team should preferably consist of one senior official from the national power sector, one from each national power entity if there is more than one, and the ministries of power and environment, preferably the official contact point for the Stockholm Convention.

Task 1.2: Effective and regular consultation

Regular meetings of the coordinating team are desirable to inform about background, objectives and deliverables. The expected outcomes of these consultations is a consensus on the plan of action and support in its implementation.

Step 2: Situational analysis

The situational analysis should focus on all sectors that may be holding PCB contaminated equipment (public and private utilities but also other sectors such as defence, tourism etc). It should consist of:

- Related national policy elements;
- Existing institutional and reporting arrangements under the Stockholm Convention, including that of the National Implementation Plan and National Reporting under the Convention;
- Legal and administrative provisions within the country on both PCB and power sector;
- Infrastructure capacities for regulatory enforcement and power sector asset management;
- Inventories of PCB equipment including results of analysis confirming contamination levels;
- Existing reporting and record keeping practices in the power sector;
- Investment and development plans in the sector including upgrade and replacement of transformers and other equipment.

Step 3: Workplan

The workplan for the development of the Phase-out Plan should include a detailed list of specific tasks to be undertaken including:

- Roles and responsibilities of each stakeholder for the development of the Phase-out Plan;
- Clearly identified roles and responsibilities and reporting line and;
- Date of delivery of tasks and responsible officer/agency.

It is important that the workplan is developed in consultation with key stakeholders. The situational analysis developed at the above step should form the basis for the engagement of staff and institutes as well as for the deliberations on developing the workplan. It should include the activities and timeline for the delivery of tasks. It is also important that the workplan is effectively communicated to all concerned for effective participation.

Step 4: Writing and Roll Out of Phase-out Plan

The actual writing of the Phase-out Plan, including compiling all the detailed information for the annexes (e.g., a detailed list of individual equipment to be phased out) needs to be driven by the owners of the equipment in question.

Once finalized, the Phase-out Plan needs to be implemented by the PCB owners and other stakeholders. The Plan should make explicit provision for adoption of the best available technologies for replacement.

The stakeholders should confirm modalities of executing the Phase-out Plan; and preferably establish a regional mandate to bind every participating country and regularly update on progress until December 2025 and 2028.

Useful elements to consider in the Phase-out Plan

A Phase-out Plan presents a strategy and identifies the activities to be implemented in a set timeframe (a road map) by an entity, individually or in collaboration. It should also identify, as appropriate, risks of failure in implementing the task towards delivering the outputs/outcomes expected. The plan is detailed and comprehensive enough that it is self-explanatory. Following some of the few elements useful under the project to be considered:

Under the GEF project (ID# 5532) the following activities are already underway:

- Review of existing legislation, development and promulgation of Regulations covering ESt of PCBs, including control of import, use and disposal as well as transboundary movement procedures. Already going into regulations all countries.
- National Steering Committee led by GEF project national focal points from the Government and Utility Company is already in place with regular meetings and coordination.
- National inventory of ALL decommissioned equipment is complete, and an inventory of the remaining in-use is underway. Database of contaminated equipment already developed and being regularly updated by the GEF project.
- Phase 1 disposal of decommissioned equipment and oils contaminated with PCB above450 parts per million (ppm) has initiated and will be completed in 2020.

Project resources available to support development and roll out of Phase-out Plans:

- International consultants and Technical Assistance including mission to each country to develop Phase-out Plan
- International consultancy support to develop methodology and country by country assessments of the cost benefit analysis for the replacement of old equipment with energy efficient units
- Potential support from SAPP to develop regional coordinated approaches and leadership. This may include generic Standard operating procedures (SOPs) for PCB contaminated equipment management
- A regional meeting and national meetings for review and development of Phase-out Plans
- Second disposal to be tendered in 2022 with whatever equipment they manage to decommission by then.

PART 2 - PHASE-OUT PLAN OUTLINE: BE COMPLETED BY EACH COUNTRY/ WASTE OWNER/UTILITY]

Section A: to be completed by each country Stockholm Convention focal point/government

A - Legal context

International level:

According to the Stockholm Convention on POPs, each party shall eliminate the use of PCB by 2025 and make determined efforts towards thet(ES) of waste liquids containing PCB and equipment contaminated with PCB, as soon as possible but no later than 2028.

[Key information to be included in this section:

- Existing institutional and reporting arrangements under the Stockholm Convention, including that of the National Implementation Plan and National Reporting under the Convention]

National level:

[Key information to be included in this section:

- A review of related national policy elements related totESM and disposal of PCB in accordance with the Stockholm Convention
- An overview of initiatives or planned activities, if any, for further strengthening of policy and/or legal framework to facilitate ESM and disposal of PCB and to implement the national Phase-out Plan, effectively and efficiently.

- Local administrative and institutional arrangements for policy implementation
- Explain the legal obligation which exists on owners for replacement/ disposal, including plans/ activities in place for further developments, if any.
- Identify steps taken by each country for managing PCBs in an environmentally sound manner, if any, including dedicated/secured storage facilities for equipment out of service]

B - Policy/ political context of national development

[Key information to be included in this section:

- A review of national development plans on energy, electrification or any other related topics (e.g., electrification targets, investments and challenges to meet energy demand).
- Gender and human-right aspects related to ESM of Chemicals, POPs and in particular PCBs

C - Stakeholder analysis

[Key information to be included in this section:

- Identify and provide a comprehensive review of key players, including roles, responsibilities in implementing the Phase-out Plan and ESM for disposal of PCBs
- Discuss the strengths and weakness of each key stakeholder/waste owner/utility in relation to effective and efficient implementation of the Phase-out Plan, including pragmatic proposals to address those issues of concerns, if any.]

Section B: Should be completed by whom it may concern, waste owner/ utility, and/or Stockholm Convention focal point/government

D - Review of current status with respect to PCBs within the context of the UNEP/GEF PCB disposal project (GEF ID 5532).

- Description of contaminated equipment (inventory results) including consideration of which are easy and more difficult to replace (for operational reasons)
- A comprehensive maintenance program of all identified equipment containing PCB above450 ppm which cannot be immediately replaced to ensure that suspected equipment can be continuously tested and if found to be contaminated, handled in a way to avoid further cross-contamination.
- Budget and plan for ESM disposal of contaminated equipment (with project budget pre-2022 and other sources identified post-2022).

[Key information to be included in this section:

- A review of the results of the inventory and a description of contaminated equipment. Include the actual inventory as an annex to the Phase-out Plan. The "Draft guidance for development of PCB inventories and analysis of PCB" can be downloaded from http://chm.pops.int/TheConvention/ConferenceoftheParties/Meetings/COP10/tabid/8397/Default.aspx (UNEP/POPS/COP.10/INF/12).
- For the equipment that cannot be immediately replaced, include a maintenance program to be handled in a way that avoids further cross-contamination and annex the SOPs that are used for maintenance, decommissioning and disposal (including PCB specific ones if they exist

- Include, if applicable, information about possible refill of oils in transformers in operation]

E - Economic justification and benefits of replacing these priority items, preferably including energy efficiency benefits for the replacement of confirmed contaminated items

- Decommissioning and replacement costs and planning (link to actual and specific planned investments)
- Quantification of benefits from upgrading the energy-efficiency of contaminated equipment, including payback period, improved system reliability and reduction in peak demand losses

[Key information to be included in this section:

- Information on economic justification of more energy-efficient transformers and benefits including a plan for replacement of existing inventory and associated costs
- Case study demonstrating cost-effectiveness of replacement with more energy-efficient retrofit transformer, including payback period and energy savings at peak time

Cost-Effectiveness Payback Period Transformer Model for PCB Study

A model regarding the cost-effectiveness payback period was developed in order to estimate the necessary investment and the benefits for upgrading the distribution and transmission transformers in service that may contain hazardous levels of PCBs in the cooling fluid. A detailed description of how the model was develop and how to use the Excel spreadsheet associated for modelling can be found in the Annex X.

One of the challenges in the phase-out of PCB equipment is the cost associated with the replacement of the existing contaminated transformers and switchgear. The reason for this model and spreadsheet is to evaluate and quantify the economic benefits to the removal of PCBs and the upgrading of this infrastructure. This model looks at the cost of replacing contaminated equipment by quantifying the value of the energy savings that will come from replacing a pre-1990, PCB-contaminated transformer with more energy-efficient models that incorporates modern (efficient) core steel and manufacturing techniques that reduce transformer losses.

All the inputs needed to run the model are given on one Excel tab. The numbers or options that are adjustable are highlighted in bright yellow. There are four inputs adjustable according to the data available for each country:

- **Input #1. Country, discount rate and electricity price**
  The model was developed for the SADC project countries, but it can be adjusted for other countries. The discount rate for each electric utility and the value of a kWh of electricity consumed are adjustable for each transmission or distribution transformer.

- **Input #2. Number of transformers installed before 1990**
  The number of transformers installed before 1990 in each national network are scaled from the stock and age of transformers in the Mozambique network. The input can be corrected/modified with actual/field/real numbers.

- **Input #3. Pre-1990 Models that Need Replacement (PCB contaminated)**

These inputs – the results of transformers sampled and tested for a Screening Test, Gas Chromatography Test and Degree of Polymerisation Test - is expected to vary widely across the region. Users can enter the percentage of transformers that pass (do not contain PCBs > 50 ppm) or fail (do contain PCBs > 50 ppm) for each of the three tests shown.

- **Input #4. Price and Performance of Transformers that need replacement**
  Updated the typical losses (at 100% load) for a non-evaluated (low efficiency) transformer and for a high efficiency unit. The price of the high efficiency unit should also be entered to calculates the number of years before the new unit fully pays for itself through energy savings.

The results of the calculation of the model are presented as tabular with the investment and graphical results. The tabular and graphical results show the annual investment and savings over a 13-year time period – undiscounted (nominal) US dollars.

- Overview of a total national replacement scenario of PCB equipment by 2028 or before
  - › Quantify existing stock and capacity of PCB transformers to be replaced; annual energy consumed; any system reliability issues
  - › Energy-efficient replacements of the PCB transformers, including the cost of replacements and quantification of benefits - energy savings, cost savings, payback period
  - › Realistic timeline for implementation, including necessary annual investments
- Quantification of other benefits: PCBs removed; CO_2 savings; system reliability increased, etc.

F - Road map of the Phase-out Plan

[Key information to be included in this section:

- Describe in detail, the actions agreed, in consensus with respective stakeholders, to be implemented for phasing out of PCBs in accordance with the Stockholm Convention national obligations, including roles, responsibilities and timeline.
- Identify risks in the implementation of Phase-out Plan and risk mitigation actions, as needed.]

G - Periodic reporting mechanism of PCB related data to the National government.

[Key information to be included in this section:

- Clear timeline, reporting lines and responsibilities on reporting the progress of implementing the road map of the Phase-out Plan.
- Mechanism in place for the review of progress and terms of references for national review team, including decision making process for additional activities or measure to address any issues of implementation, where applicable.
- National and/or regional database for monitoring equipment]

Annexes (as applicable):

- Data on PCBs from existing and recent Stockholm Convention national reports
- List of suspected (pre-1990) and confirmed PCB contaminated equipment with contamination levels in ppm (excel and GIS version)
- SOPs that are used for maintenance, decommissioning and disposal (includin. PCB specific ones if they exist)
- Investments on the grid and transformers (past and future)
- Cost-Effectiveness Payback Modelling Spreadsheet

CONCLUSION

Toward meeting the Stockholm Convention obligation, the present document details the general steps needed for developing National PCB phase-out plan in order to achieve the goals to eliminate the use of PCB in equipment by 2025 and to environmentally sound waste manage (ESWM) liquids and equipment contaminated with PCB before 2028.

The few of the key steps identified in the present document to support the development the national PCB phase-out plans, include:

- the identifications of key agencies and stakeholders at national and regional levels,
- the establishment and maintenance of an updated inventory of all PCB contaminated equipment in the nation,
- to agree on concrete action by all stakeholders involved including private and public sector, and
- to present a details timeframe for the elimination of PCB and ESWM.

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