



The International POPs Elimination Project

*Fostering Active and Effective Civil Society Participation in
Preparations for Implementation of the Stockholm Convention*

Hotspot report for Pattern of Practices: PCBs Sources and Releases in Tanzania



AGENDA for Environment and Responsible Development (AGENDA)

AGENDA
Tanzania Bureau of Standards (TBS) Building
Morogoro/ Sam Nujoma Roads, Ubungo Area
P.O. Box 77266
Dar es Salaam, TANZANIA
Tel: +255 22 2450 213
Fax: +255 22 2450 836
E-mail: agenda@bol.co.tz
Website: www.agenda-tz.org

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About the International POPs Elimination Project

On May 1, 2004, the International POPs Elimination Network (IPEN <http://www.ipen.org>) began a global NGO project called the International POPs Elimination Project (IPEP) in partnership with the United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Program (UNEP). The Global Environment Facility (GEF) provided core funding for the project.

IPEP has three principal objectives:

- Encourage and enable NGOs in 40 developing and transitional countries to engage in activities that provide concrete and immediate contributions to country efforts in preparing for the implementation of the Stockholm Convention;
- Enhance the skills and knowledge of NGOs to help build their capacity as effective stakeholders in the Convention implementation process;
- Help establish regional and national NGO coordination and capacity in all regions of the world in support of longer term efforts to achieve chemical safety.

IPEP will support preparation of reports on country situation, hotspots, policy briefs, and regional activities. Three principal types of activities will be supported by IPEP: participation in the National Implementation Plan, training and awareness workshops, and public information and awareness campaigns.

For more information, please see <http://www.ipen.org>

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LIST OF ABBREVIATIONS

ABB TANALEC	A company that produce and service electrical equipment including transformers
BP (T)	British Petroleum (Tanzania)
CBOs	Community Based Organizations
DAWASA	Dar es Salaam Water and Sewerage Authority
DIA	Dar es Salaam International Airport
GCLA	Government Chemistry Laboratory Agency
KILTEX	Kilimanjaro Textile Industry
MUTEX	Musoma Textile Industry
MWATEX	Mwanza Textile Industry
NGOs	Non-Governmental Organizations
PCBs	Polychlorinated Biphenyls
POPs	Persistent Organic Pollutants
SFPC	State Fuel and Power Cooperation
SPM	Southern Paper Mill
TANESCO	Tanzania Electric Supply Company
TAZARA	Tanzania-Zambia Railway Authority

1. INTRODUCTION

Polychlorinated Biphenyls (PCBs) are a class of synthetic organic chemicals that are chemically inert. PCBs have been used as additives to oils in electrical equipment, hydraulic machines, and other applications where chemical stability has been required for safety, operation, or durability. Unfortunately if it is mishandled in the course of its use it may cause both environmental and health problems due to its non-biodegradable characteristic and tendency to accumulate in human and animal fatty tissues. The likely extended period of its use, and the persistence of PCBs once released into the environment means that PCBs could pose a threat for decades to come. It is for this reason that PCBs were included among the 12 persistent organics pollutants (POPs). Therefore the policy framework set out in the Stockholm Convention on May 2001 on Persistent Organic Pollutants requires parties to eliminate the production and use of Polychlorinated Biphenyls (PCBs).

Due to these problems many countries banned the production and use of PCBs in the early 1970s. Although manufacture of PCBs has reportedly ceased, the potential or actual release of PCBs into the environment has not, since significant quantities of PCBs oil are still in use or in storage facilities. PCBs are still favoured by major users in some countries despite being extremely toxic to human and animal health and other environmental organisms.

For example, electrical equipment replaced and disposed of long ago in developed countries is kept in service far longer in the less developed countries. Tanzania being one of the developing countries that used PCBs in the past may still have PCBs in use or in stores and/or leaking or failed equipment releasing PCBs into the environment. This study focuses on identifying PCBs-hotspots, pattern and practices that release PCBs into the environment in Tanzania paying particular attention to electrical equipment. The study also assesses the extent of contamination and availability of alternatives to PCBs locally and globally. Finally the report gives recommendations on how to deal with the hotspots and PCBs releases in general.

2. ACTIVITY THAT GENERATE PCBs

The Guidelines for the identification of PCBs and Materials containing PCBs of 1999 lists the following activities that generate PCBs into the environment:

- Production
 - i. Production of PCBs
 - ii. Production of PCBs containing fluids

- Uses
 - iii. Use of PCB-containing equipment and fluids
 - iv. Handling of PCB-containing equipment and fluids

- v. Storage of PCB containing equipment and fluids
- vi. Leakage of PCB containing equipment
- vii. Maintenance and Repair of PCB containing equipment
- viii. Retrofilling

- Disposal of PCB containing equipment
- Misuse of PCB containing fluids

The above activities, which are potential pattern of practices that release PCBs, are discussed in the following subsections:

2.1 Production

2.1.1 Production of PCBs

PCBs are man-made chemicals. During the production of this chemical there is generation of effluents which when discharged untreated may release PCBs into the environment. Fortunately, Tanzania does not produce PCBs.

2.1.2 Production of PCBs containing fluids

PCB is used as an additive in the production of fluids such as transformer oil, lubricants, heat exchanger fluids etc. During the production spillage/leakage of the fluids may occur. Again, Tanzania does not produce PCB containing fluids.

2.2 Uses

Use of PCBs oils and fluids

As it is reported in the Vice President Draft Report on Inventory of PCBs, Tanzania in the past used to import and use PCB oils and fluids for many purposes, including the following:

- a) As oils in electrical equipment such as transformers, capacitors, switchgears and circuit breakers
- b) As lubricants for turbines and pumps
- c) As heat exchanger fluids
- d) As additives in sealants, adhesives, chlorinated rubbers, paints, glues, tapes and carbonless copy paper

1. As oil in electrical equipment

The use of PCBs containing oils in electrical equipment is regarded as the main problematic area in Tanzania. This study on pattern of practices and the Vice president Draft report on PCB inventory in Tanzania found out that electrical equipment constitutes a major source of PCBs releases as they were used or still in use in

- ♦ Water treatment plants e.g. Dar es Salaam Water and Sewerage Authority (DAWASA) Lower and Upper Ruvu stations in Kibaha and Bagamoyo.

- ♦ All substations in Tanzania which include large transformers.
- ♦ Medium size transformers that are scattered in many places in the country.
- ♦ Normal industrial and domestic application e.g. in capacitors (from those fitted to fluorescent lights to high voltage units), switchgears and circuit breakers.

Information gathered indicated presence of PCBs in old electrical installations owned both by private and the Tanzania Electrical Supply Company (TANESCO) as shown in Table 1.

Table 1: Transformers found to contain PCBs

Place	Number of Transformer/Type	Oil Mass	Total Oil Mass
Dar es Salaam International Airport (DIA)	16 Transformers with PCBs type "Askarels"	870kg each	13,920 kg
Tanga	9 Transformers with Pyrochlor, a PCB mixture	627 litres each	5,643 litres
MWATEX - Mwanza	9 Transformer (Pyralene)	2168kg x 6 3140kg x 3	13,008 kg 9,420 kg

Source: Proceedings Subregional Workshop on Management of PCBs and Dioxins/Furans, Arusha, Tanzania, 13-16 November 2000.

2. As lubricant and heat exchanger fluid

PCBs were used as a lubricant for turbines, pumps and in hydraulic machines. Also PCBs were used as heat exchanger fluids. The use of PCBs in this equipment is estimated to be 15% of the use.

3. As additives

PCBs were used as additives in carbonless carbon paper, paint, chlorinated rubbers, plastics, sealants, adhesives, glues and tapes. The use of PCBs however was in fewer amounts. According to an expert from Insignia (manufactures Coral Paints) the company is no longer using PCBs in its production.

From the above it can be concluded that all areas where there was/is a significant use of PCBs containing fluids in electrical equipment are potential hotspots, because of the above factors. Use/handling of oil in electrical equipment is further discussed later in the report.

Handling of PCB containing equipment and fluids

Improper handling of transformer and waste oil may lead into significant oil leakages and/or spillages, which poses a serious health risk to the workers, particularly those involved in maintenance and repairs, and the environment. Poor handling of equipment containing PCBs and transformer oils during retro-

filling, filtration and topping-up of oil to transformers and circuit breakers may also lead to spills of the oil into the surrounding.

Storage of PCB containing equipment and fluids

If the storage facilities for transformer and waste oil is open type, or the storage facilities are of inadequate size to accommodate the amount of the waste oil available, spillage is an inevitable consequence.

Leakage of PCBs containing equipment

Leakage of PCB from the equipment can occur as a result of accident or damage of the equipment or as a result of corrosion to the metallic parts of the equipment due to weathering effect.

Maintenance and repair of equipment

PCB emissions may occur during equipment servicing/repairing and decommissioning or as a result of damaged equipment. When transformer seals are dismantled (to allow access to the core), there are possibilities that PCBs vapour, fumes or aerosols to be released. This effect can be very significant at higher temperatures. Heat from any sort of flame-cutting operation or welding not only vapourises PCBs on the surface of the piece being cut, but spreads to adjacent parts and increase the volatilisation of nearby PCBs.

Retrofilling

This is a process of emptying the equipment of its dielectric fluid, and replacing it with new non-PCB oil. The oil is first filtered to remove particulate matters before retrofilling. It is worth mentioning that transformer usually contains wooden and possibly paper components. These materials are porous and retain some oils, which may be contaminated with PCBs. The employment of the same facilities that were used many years ago for filling transformers with PCBs oil will lead into cross contamination when used to fill non-PCBs oil. The leakage of the PCB-contaminated equipment may lead to PCB contamination of the environment.

Disposal of PCB containing equipment

Improper disposal of waste oil and equipment containing PCBs results in contamination of soils, surface as well as ground water.

Misuse of PCB containing fluids

There are cases where leaks of the oils have been caused by malicious tampering of equipment mainly with intent to steal the oil. There are undocumented claims that the stolen oil is used for various purposes such as blending with cooking oils for profit making, and/or selling the product as lubricating oil. Sometimes the oil is used as medicine for curing muscle pains, like in sprain or injuries and burns and as skin lightening product as shown in appendix 2.2.

Other improper use of waste oil includes burning the oil in boilers and use of waste transformer oil in welding machines. The latter misuse occurs when waste oils are given away to individuals.

The importation of the PCBs oil in the past and the continued use of PCBs in the country imply the availability of the activities that involve the use of PCB and PCBs containing fluids. The significant use of PCBs oil in electrical equipment makes all sites where there was/still use of PCBs transformer oil to be potential hotspots in the country. The above mentioned activities (excluding the production of PCBs and PCBs containing fluids) are the pattern of practices that exist in Tanzania. From here forth the report will focus on the use of PCB oils in electrical equipment in Tanzania, since this was identified as the major user.

3. HISTORY OF USE OF PCB OILS IN ELECTRICAL EQUIPMENT IN TANZANIA

Polychlorinated Biphenyls (PCBs) have been in use for variety of industrial applications since they were first used in the late 1920's, and have been exported as chemicals and in products to virtually every country in the world, Tanzania inclusive. Apart from other applications, PCBs-containing oil additives were used in large amounts in transformers in many countries in the past, Tanzania being among them.

Tanzania does not produce transformer oils but imports them. The history of PCB oil usage goes back to when the first thermal power plant was built in Tanzania i.e. November 1931. Ever since power generation has been expanding and hence use of transformers, circuit breakers etc. It may be assumed that all transformers that were manufactured before 1986 contained PCB oils. All transformers manufactured in the former USSR, India and China post 1980 and probably up to 1990 are suspected to contain PCB oil.

Since 1982 ABB TANALEC, the main manufacturer and supplier of transformers in Tanzania, has stopped using PCB oils, and the Tanzania Electrical Supply Company (TANESCO) has stopped importing transformers containing PCBs since the 1990s.

It may therefore be speculated that the main problem facing Tanzania is handling the existing stocks of PCBs, whether in use or in stores.

4. HOW USE OF ELECTRICAL EQUIPMENT GENERATES PCBs

Polychlorinated Biphenyls (PCBs) were intentionally produced to be used in transformers and other equipment due to their technical properties. The use of

PCB oils and fluids in this equipment may result in release of PCBs into the environment depending on the structure and condition of the equipment, mechanical and accidental damage of the equipment, and other environmental factors as described under each application below

4.1 PCBs in Transformers

A transformer outer casing is made of iron or steel. It includes a system of cooling fins, implying complex shapes, and many welds. The cooling system is designed to allow the heat that is generated in the oil during its electrical functioning, to be evacuated through the cooling fins. This overall system means that several causes of degradation can develop pin-hole leaks in the welds leading to influx of moisture and/or air, excessive variations in the temperature of the oil, because of ambient temperature changes, influx of air and moisture through seals and gaskets¹. These incidents will allow air (oxygen) and water to interact with the PCB oil leading to chemical degradation of the oil. The oxidation of the oil may lead to increase in the acidity of the oil. The effects of the acidity will then be to favour corrosion of the metallic parts of the transformer.

Leaks/spills typically occur in transformer when the stopcock, seals and gasket joining the top to the body corrodes, tears, or physically fails. PCBs can then leak past this failed section and potentially spill onto the surrounding ground. In addition, leakage may occur due to defects by mechanical and accidental damage in the metallic structure or outer casing of the transformer². The damage may render the casing more liable to attack by acidity in the oil. This acidity may then cause internal corrosion at the weaker parts of the transformer, even if it is apparently in satisfactory condition. These weaker parts are the transformer cooling fins that are manufactured by bending, forming and possibly welding. These operations can cause stresses and weakening of the structure and increase the chances of corrosion and then leakage (see plate 1).

TANESCO's Ubungo electric workshop in Dar es Salaam is the major maintenance and repair workshop for all TANESCO's electrical equipment and plants. The workshop is also used for commissioning of sub-station equipment and testing of new transformers before commissioning. Therefore there is a huge concentration of equipment including old transformers and circuit breakers which might contain PCB oils (see plate 2). This site is inadequately managed due to lack of capacity and experience not only to monitor the release of PCBs into the environment but also to monitor and manage the site in general.

In Ubungo Electric Workshop in Dar es Salaam and KILTEX Sub Station in Arusha the storage facilities for transformers are the open type, which results in a weathering effect on the material of the equipment and causes leaks as shown in plate 3. Also, unavailability or inattentive follow-up of maintenance schedules results in heavy leaking transformers in most of the sites (see plate 4). For

¹ PCB Transformers and Capacitors, From Management to Reclassification and Disposal, First issue, May 2002, UNEP

² Draft Report on Inventory of Polychlorinated Biphenyls (PCBs) in Tanzania, Vice President Office, Division of Environment, May 2003

example, at Dar es Salaam International Airport, there are 16 transformers with PCB oil of Askarel type, some of which are leaking, and at Urafiki textile mill in Dar es Salaam, two transformers are leaking.

Handling of PCBs-containing equipment especially transformers as observed in the sites visited is generally poor. Spillage during topping-up of transformer oil, filtration and general services were also observed in many sites. Filtration of oil is, in most cases, carried out on non-concrete surface, there is no service bay for trapping transformer oil. Filtering equipment is shared among many sites. Protective gears are not used.

In some cases, waste transformer oil is stored, but the storage facilities are of inadequate size to accommodate the whole amount of the waste oil available on site; some of storage containers for transformer oil are leaking. The storage facilities also do not have concrete floor. At some sites, the storage sites are too close to water bodies, residential areas and farms, e.g. at Ubungo Electric Workshop (see plate 2).

As described early on misuse of the oils, draining of oil from transformers was previously a problem in a few regions only, but now this practice is troubling TANESCO in almost the whole country. Dar es Salaam (includes: Tabata, Mbezi Louis, Vingunguti, Ukonga etc.), Tanga, Morogoro, Arusha and of late Tabora are the mostly affected regions where such cases of theft are rampant. The theft activity has caused spillage of the oil and hence contaminating the sites involved.

The burning of transformer oils in boilers has also been practiced in some of the industries, for example, Urafiki Textile Mills and Voil in Mwanza use transformer waste oils as source of energy in boilers.

4.2 PCBs in Capacitors

Capacitors are devices that can accumulate and hold an electric charge. The main structure of a capacitor consists of electric conducting surfaces (thin metallic foils) separated by a dielectric, i.e. non-conducting material. These surfaces are coils of metallic foils. There are two electrically separated foil coils, each fitted with contacts leading out of the capacitor. The dielectric material is usually dielectric fluids which may or may not contain PCBs. Capacitors are therefore maintenance free but may leak at welds. Capacitors typically fail by rupturing, exposing the contained PCBs to the environment. Failure is caused by environmental and weathering effects (e.g., lightning) or material failures (e.g., metal fatigue).

4.3 Switchgears and Circuit breakers

Switchgears and Circuit breakers are devices used to connect or disconnect the flow of current in an electric line and to break flow of current through the electric circuit when there happens a current flow break down or short circuit

respectively. The presence of joints and seals in switchgears and circuit breakers of the PCB containing oil, offering the possibility of release in small amounts of fluids or PCB emissions during normal operation.

In most sites waste oil is disposed of haphazardly and occasionally given away to individuals. Generally, there is no proper disposal mechanism of the waste containing PCBs oils including contaminated solids, obsolete / defective / decommissioned transformers, capacitors, switch gears, circuit breakers, filters and residues from electrical equipment in most of the sites as shown in plates 5 and 6.

The above practices result in emissions to the environment and have direct impacts on human and animal health.

5. ENVIRONMENTAL, SOCIO-ECONOMIC AND HEALTH CONSEQUENCES

Apart from suitable properties, PCBs have adverse impacts on the environment, human health and animals because they are toxic and extremely persistent in the environment.

5.1 Environmental Consequences

Generally, PCBs ends up in the environment through accidental release of PCBs from in-service / obsolete / defective / decommissioned equipment or malicious tampering of equipment. The proportion of spilled PCBs that enters the atmosphere, runs off to surface water, or remains in or on the surface depending on a variety of factors including the porosity of the surface onto which the PCBs are spilled (concrete, soil), the PCB isomers that are spilled, ambient conditions (i.e., temperature, wind, speed, precipitation), and the cleanup schedule.

Environmentally, PCBs are non-biodegradable and travel long distances from the point source. They can cause contamination and pollution of indoor and outdoor air, surface and ground water, soil and food. For example, the disposal of waste oil by burning in boilers as described above under the misuse of the oil at Urafiki Textile Mills in Dar es Salaam and Voil industry in Mwanza which are both situated in the city centres, may result into indoor and out door air pollution especially when the boilers used is not of high efficiency to attain the required PCBs destruction efficiency. PCBs half-lives can vary from 2 to 6 years.

In Tanzania there are several sites with leaking units. The sites vary from contaminated sites which are seriously contaminated to heavily contaminate. These sites will become potentially contaminated if mitigation measures are not instituted urgently. Table 7 under Appendix 1 shows the list of heavily contaminated sites in Tanzania.

Electrical equipment constitutes a major source of PCBs releases. Major parts of transformers are found in water treatment plants e.g. DAWASA Lower and Upper Ruvu and all electric substations which are scattered in many places in the country. These sites are reported as a heavily leaking or contaminated site that needs immediate mitigation³. Rainfall may cause surface runoff and hence contamination of water when equipment that contains PCBs is leaking. Water from the Ruvu supplies a major part of Dar es Salaam City and nearby District including Kibaha, Bagamoyo and Chalinze. This means a lot of people are at risk.

Transformers at Old Pangani and Nyumba ya Mungu are also leaking. After the power generation the water is released to downstream users. Members of community use this water for irrigation and domestic purposes. At the dam of Nyumba ya Mungu there are fishing activities as shown in plate 7, which means that many people are exposed to PCB ingestion.

5.2 Socio-economic Consequences

The stealing of the transformer oil as described above has social-economic consequences to both the company owning the equipment such as TANESCO, and the nation at large.

The stealing of the oil has resulted in operational problems in the area of incidence and sometimes explosion of the affected equipment may occur. At the end of 2003, the TANESCO regional office in Morogoro announced a loss of Tanzania Shillings (Tshs.) 65m/- (about US\$63,000) from theft and vandalism of 18 transformers. In Dar es Salaam five transformers exploded within an interval of three days, after oil was drained (stolen) causing a loss of Tshs. 50m/- (about US\$48,000) [Tshs. 35m/- (about US\$33,000) due to theft of transformer oil or coolant in Ilala District alone].

Early this year (2005), TANESCO has incurred a loss of over Tshs. 74m/- (US\$71,040) after thieves stole transformer oil from 12 transformers in a period of one week in Dar es Salaam. See appendix 2.3 for more details. The vandalising of transformers has been affecting production in industries when such incidents occur around industrial areas. In addition, residents are sometimes forced to throw away foodstuffs as they get spoiled because of power disruption resulting in non-use of fridges and freezers.

The consequence of the stealing of transformer oils is that TANESCO is incurring huge losses, which are later passed on to the consumer. Raised electricity tariffs mean that the majority of people revert to using charcoal as a primary source of energy, which contributes to rapid acceleration of forest clearance.

³ Draft Report on Inventory of Polychlorinated Biphenyls (PCBs) in Tanzania, Vice President Office, Division of Environment, May 2003

5.3 Health Consequences

Exposure to low levels of PCBs may cause various chronic health effects to both humans and animals. They are non-biodegradable, and are able to accumulate in the fatty tissues of the body and cause an array of adverse effects notably death, disease and birth defects among humans and animals. They are linked to reproductive failure and suppression of the immune system in various wild animals; severe human intoxication occurs due to accidental consumption of PCB-contaminated oils⁴. PCBs are toxic to fish, killing them at higher doses and causing spawning failures at lower doses.

As described above, stolen oil containing PCBs is sometimes used as an ingredient in the manufacturing of skin and medicinal product for curing muscle pains and mixing with cooking oils. All these practices may result in health problems such as skin ailments and other diseases mentioned above.

According to the Government Chemist Laboratory Agency (GCLA), in Tanzania, there is no proper study that has been conducted to establish the adverse effects of POPs in human and animal health and the environment. However, there is one known reported case at the Dar es Salaam International Airport (DIA), whereby members of the staff who handled PCBs without proper protective gear suffered body weaknesses, skin ailments, and eventually death.

Most of the personnel dealing with electrical equipment containing transformer oils which containing PCB are not aware of health hazards associated with PCBs. It is common practice to handle such oils with bare hands, health impacts not withstanding. Plates 8, 9 and 10 show a lady who worked at the Dar es Salaam International Airport (DIA) with skin ailments. The condition could be related to improper handling of PCBs. Five (5) transformers with PCBs (Askerel) were found at the DIA.

6. RESPONSIBLE PARTIES

6.1 Responsibility

Management of PCBs involves various stakeholders such as owners of equipment that contain PCBs e.g. TANESCO and SFPC, other parastatals and private enterprises e.g. Dar es Salaam International Airport (DIA), Urafiki Textile mills, Voil and MWATEX industries etc., regulators such as Government Chemistry Laboratory (GCLA), manufacturers of electric equipment e.g. ABB TANALEC, and importers of oils in the country i.e. BP (T) Ltd. The poor or complete lack of awareness of the potential adverse effects posed by PCBs has

⁴ Project on enabling activities to facilitate early action on the implementation of the Stockholm Convention on POPs, March 2004

contributed to the lack of appropriate management practices in many sites in Tanzania. By the fact that the level of awareness is dismal in the visited sites, and that there are no monitoring and management practices, it is not likely to find any best available techniques or best environmental practices on site.

6.2 Future plans

Tanzania Electric Supply Company (TANESCO) does provide services to most of its equipment and those owned by private institutions. The company has adopted the new technology in some of the sites that does not involve the use of PCBs by purchasing small and medium transformers from local manufacturers i.e. ABB TANALEC. However, the company still owns old equipment that is suspected to contain PCBs and the fate of their disposal is not known.

TANESCO also, offers a 500,000/- (US \$480) (as described in appendix 2.1) reward for a tip to the police and individuals that could lead to the arrest of individuals who destroy its transformers as the measure of fighting against such activities.

ABB TANALEC, apart from manufacturing the equipment also provides services to the same. In doing so, the company does not service any equipment that uses or is suspected / condemned to contain PCBs oil. This has been the measure of the company in promoting its products and new technologies available, and by rejecting maintenance of PCBs-containing equipment; they discourage the continued use of the PCBs technology.

The major oil suppliers BP (T) Ltd. provide Material Safety Data Sheet (MSDS) to their customers as one of its effort to educate and keep their customers aware on the adverse effect of the oils, but this information is not available at the end-users such as the personnel, and to individuals who use the oils for other unintended purposes.

6.3 Relation to government regulation

In Tanzania, there are no legal instruments that specifically address the issue of PCBs. They are addressed under general category of POPs. For example the Environmental Management Act 2004 has specific section (Paragraph 77) for the management and control of persistent organic pollutants in general. This paragraph commits the Government of Tanzania to comply with Stockholm Convention on Persistent Organic Pollutants of 2001. Paragraph 179 of the Act commits the Government to develop legislation to address the requirements of International Agreements to which Tanzania is a Party, Stockholm Convention being one of them.

Also the Industrial and Consumer Chemicals (Management and Control) Act of 2003 which is implemented under Government Chemist Laboratory Agency

(GCLA), partly has provisions for the control of imports of restricted chemicals such as POPs. The Act can be used to control and manage PCBs, particularly the registration provision (Part 2 and 3) and the management and control (Part 4) in which PCBs is included in the list of severely restricted/banned/eliminated chemicals. However, the conditions for using PCBs containing equipment and their ultimate elimination are not addressed in the Act. Part XI Paragraphs 151 – 155 of The Environmental Management Act 2004 may be used to effect remediation and management of contaminated sites.

6.4 Liability framework

However, using the above Act the Government through its Chemistry Laboratory Agency (GCLA) on 06 August 2004, banned the importation into the country and consumption of five industrial and consumer chemicals which have been proved to be hazardous to human life and the environment and PCBs is among them. The Industrial and Consumer Act of 2003 stipulates fines to offenders, these include fines of not less than 5m/- (about US \$4,800) and not more than 50m/- (about US \$48,000), two years imprisonment or both. The ban spares nobody as it touches power utility firms, dealers, importers, exporters and producers of equipment etc.

7. ALTERNATIVE PRACTICES

7.1 In use in the country

Already, ABB TANALEC based in Arusha produces small and medium size transformers, medium and low voltage switchgears and capacitors that use PCB-free transformer oil (i.e. mineral oil of dry type) since the start of production in 1982. The company has the ability to produce 1500 units per annum. The company supplies its products to Power utilities in Eastern and Central Africa. In Tanzania the major customers of the company include TANESCO, State Fuel and Power Cooperation (SFPC) of Zanzibar and other parastatals and Private enterprises.

Although the technologies that allow use of non-PCBs oils are available in the market, some institutions seemed to be less aware of these technologies or felt that they had no access to these technologies due to investment costs.

However, TANESCO has switched to non-PCB transformer oils, although they claim to experience frequent transformer breakdown as a result.

7.2 In other countries

Many dielectric oils that can be employed for refilling electrical equipment that require the application of fluid existing in the country and globally. Such alternatives include: mineral oils which are widely used around the world in place of transformer oil; silicone fluids which are used in the manufacture of new transformers in Europe and the United States and in synthetic ester materials; and sulphur hexafluoride (SF₆) used in oils of circuit breakers instead of PCB oils. According to one expert from TANESCO SF₆ is very cheap and easy to use during operation as compared to PCB oil in transformers and circuit breakers. It is worth noting, however, that SF₆ is a greenhouse gas.

8. CONCLUSION

This study shows that in Tanzania there is still some equipment that contains PCBs oil both in use and in stores (waste/obsolete). It is further revealed that there is a low level of awareness on the adverse effects of PCBs oil among the general public of Tanzania. As a result, handling of equipment contained PCBs oil is very poor in many sites. Malicious practices exist involving stealing transformer oil (some of which may contain PCBs) which results in negative socio-economic consequences to both the Tanzania Electric Supply Company and the consumers. Some of equipment, which is still in use, is leaking and contaminating soils and water bodies. Consequently, communities living close to such sites are exposed to PCBs. Enactment of the Environmental Management Act 2004, may assist in the management and control of PCBs in Tanzania.

9. NGO RECOMMENDATIONS

The main recommendations from the study include:

1. Create awareness on the management of PCB oils and hazards of PCBs to the decision makers and users;
2. Create public awareness on PCBs sources and their effects on human health and the environment;
3. Establish proper storage facilities for the PCBs-containing equipment and waste oil;
4. Promote research/further studies on the sites mentioned e.g. analysis of water and soil samples to assess the extent of contamination; effectiveness of substitutes to PCBs; and community monitoring to assess the impact of PCB to human health;
5. Study or search for remediation techniques;
6. Undertake remedial measures to clean-up sites contaminated with PCBs;

7. Impress on the Government to review and formulate policies/regulations on management of PCBs in line with the Stockholm Convention as per provisions of the National Environmental Management Act 2004'
8. Carry out capacity building for NGOs and CBOs to ensure active participation of the same'
9. Impress on the Government of Tanzania to keep her promise on taking necessary measures and actions to eliminate POPs and protect the public's health and the global environment from the injuries that are caused by PCBs and POPs in general.

10. BIBLIOGRAPHY

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4. Proceedings Sub regional Workshop on Management of PCBs and Dioxins/Furans, Arusha, Tanzania, 13-16 November 2000.

ANNEX: Description of Photos



P1: A distribution transformer at a substation near TBL in Arusha



P2: Out of service transformer stored outside the Ubungu Central Workshop



P3: Power transformer at a substation located at the Old power station Arusha, Unga Limited area



P4: 132 KVA Power transformers at Kivungi Substation, Moshi



P5 and P6: Out of service transformer stored at the Old Power Station in Moshi.



P7: Fishing at Nyumba ya Mungu: key to the local culture and economy



P8: A lady working at DIA suffered skin ailments due to contact with PCB oil



P9 and P10: A lady working at DIA suffered skin ailments due to contact with PCB oil

APPENDICES

Appendix 1: Tables showing inventory of PCBs and contaminated sites in Tanzania

Data for closed and partially closed units suspected to contain PCBs are as shown in tables below

Table 2: Number of Partially closed Units suspected containing PCBs

Equipment	Number of Units	Oil mass [kg]
Oil Cooled Circuit	112	252,252

Source: Draft report on inventory of PCBs in Tanzania, Vice President Office – Division of Environment, 2003

Table 3: Number of Closed Units suspected containing PCBs

Equipment	Number of Units	Oil mass [kg]
Transformer	2,462	23,999,884
Switch Gears	50	80,668
Capacitors	4	1,920,218
Total	2,516	26,000,770

Source: Draft report on inventory of PCBs in Tanzania, Vice President Office – Division of Environment, 2003

Data for partially closed, closed and waste condemned to contain PCBs are as shown in tables below

Table 4: Number of Partially closed Units condemned containing PCBs

Equipment	Number of Units	Oil mass [kg]
Oil Cooled Circuit	112	252,252

Source: Draft report on inventory of PCBs in Tanzania, Vice President Office – Division of Environment, 2003

Table 5: Number of Closed Units condemned containing PCBs

Equipment	Number of Units	Oil mass [kg]
Transformer	457	9,654,641
Switch Gears	49	80,258
Capacitors	4	1,920,218
Total	510	11,655,117

Source: Draft report on inventory of PCBs in Tanzania, Vice President Office – Division of Environment, 2003

Table 6: Waste possibly contaminated with PCBs

Equipment	Number of Units	Oil mass [kg]
Transformer	273	10,637,355
Switch Gears	3	16,800
Capacitors	1	80
Oil Cooled Circuit Breakers	17	47,370
Total	294	10,701,605

Source: Draft report on inventory of PCBs in Tanzania, Vice President Office – Division of Environment, 2003

Table 7: Sites heavily contaminated with PCBs (Hotspots)

No.	Site	Priority
1	Dar es Salaam – DIA	1
2	DAWASA Lower Ruvu – Bagamoyo	1
3	DAWASA Upper Ruvu – Mlandizi intake	1
4	Kikuletwa Mini Hydro	1
5	Mbalizi Minihydro Station – Mbeya	1
6	Morogoro Tanneries Industry	1
7	Nyumba ya Mungu	1
8	Old Pangani Hydro	1
9	TANESCO Electrical Workshop Ubungo	1
10	Tosamaganga Mini Hydro Iringa	1
11	Water Pump – Kibaha District	1
12	Bukoba - Sadelmi Store	2
13	Kidatu Hydro Plant	2
15	Kilombero 2	2
15	Morogoro Msamvu Office sub – Station	2
16	Ubungo Thermal Power Station	2
17	Zanzibar – Mtoni Sub Station	2
18	Zanzibar – Wesha Power Station	2
19	Zanzibar – Tibirizi Power Station	2
20	Dar es Salaam City Centre substation	3
21	Gongo la Mboti Substation	3
22	Kidatu Switch Yard	3
23	Mlandizi substation (TANESCO)	3
24	Musoma – Power Station	3
25	MUTEX - Musoma	3
26	MWATEX – Mwanza	3
27	SPM Mills CO.Ltd Mgololo	3
28	TAZARA Workshop – Mbeya	3
29	Tumbi Sub-station (TANESCO)	3
30	Ubungo Control Centre 33/11 S/yard	3

Note:

- ♦ Heavily leaking or contaminated site, very close to sensitive sites (water sources, public, etc.) – priority 1
- ♦ Serious leaking or seriously contaminated site – priority 2
- ♦ Contaminated site – priority 3

Appendix 2: Reported theft cases of Transformer oils in Tanzania

Appendix 2.1: The use of stolen transformer oils

FEATURES

TANESCO woes stem from the search for beauty

LAUGHTER TALK



With Anthony Muchoki

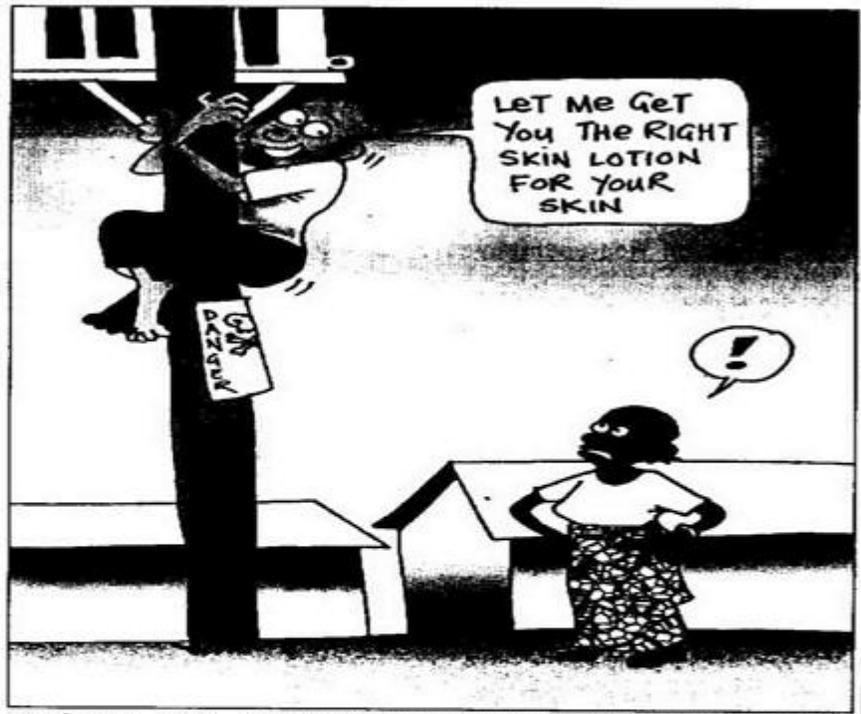
NOW I am convinced more than ever that for TANESCO to save us from the malaise of darkness that face us every night, the firm must with immediate effect start a truth and reconciliation commission, Archbishop Tutu style. Why do I say this?

Look at the darkness that has been facing Ilala District of late. Already some naughty wives have forced their bitter halves to buy generators causing them to forfeit several months' bottles of beer. This in turn could ultimately lead to TBL making less profit and thus paying less tax. It's not desirable... it could lead to a national disaster.

Because I am neither too foolish nor too clever I don't dispute the rumours that as long as black skinned chaps want their complexion to grow lighter, TANESCO's transformers, unless guarded by guards with very *Athwa kali*, will continue disappearing mysteriously. If not, the precious liquid that makes them to work will have no respite.

The liquid, the gossips (which I can bet are as true as the gospel truth) has it is main raw material for manufacturing a certain powerful medication called locally *mkorogo*. The said medicine is capable of transforming a black charcoal complexion in a man or woman to a brand new near- *masungu* skin.

It just happens that so many *bongolanders* (and *Africalets* in general) believe that a lighter skin is beauty and is an automatic ticket to get "things" such as happiness and so more nonsense. Sadly, this is true. Some really want to transform their complexion so much, they will not care about the danger of being electrocuted by *mama* and *papa* Tanesco as they climb dangerously up the power poles that house



transformers with the precious liquid. Such a highly valued liquid, is worth more than silver and gold to saskess of beauty. So quite a number of people if their hands are greased with some reasonable cash, will turn their eyes blind as a man or a woman climbs atop power poles to draw the liquid. Most likely they will not call the recent Tanesco hotline on informing such incidents. They will just let the criminal have his way to beauty.

The power firm and the police should pay me a consultation fee - two or five millions would do for this information. If they want to know who steals transformer oil they should target people who have used *mkorogo*, and they would be led to the manufactures, who would have to say how they get their chief raw material and this would save them maybe billions.

Another problem that faces Tanesco is non-payment of the bills. With the latest budget and revelation that it has forgiven Zanzibar government bills worth 15b/=-, that can be the beginning of reconciliation.

Let the firm start a South African style truth and reconciliation commission, where the public will confess. ~~How they have these colluding with the junior staff at Tanesco to steal electricity in exchange of immunity and forgiveness.~~

Some months ago I moved out of a house because of electricity problem. The landlord was always punctual to get my share of the bill, but he never used to pay. So when the bill reached something close to a million I started seeing red.

Every month Tanesco technicians would come and disconnect the power, only for the landlord to get hold of them, pay them some money (no receipt) and they would reconnect. One day I was at home when the disconnection was taking place.

How unfortunate because almost all the houses around that area were disconnected. Then the two technicians doing the job went to a strategic pub nearby and started having one for the road. I called my landlord and he came. He asked me to lend him 10,000/-.. Armed with the cash we went to the pub, and I could count as many as twenty landlords, who were queuing to grease the palms of the Tanesco gentlemen...

By evening all the houses around had power back. And this was just about two months ago. With those kinds of employees Tanesco needs no enemies. Yours truly, just want to restate maybe that a truth and reconciliation commission is what the firm needs for its woe to end and make us have power all the time.

I also hear that there are ghost workers in Zanzibar and the power Tanesco 'transports' there for sale 40% of it is lost along the way. I stand to be corrected but could be as my imagination tells me, the ghost workers consume the damn power and its not just lost.

Ghosts can insert their names on the payroll, apply for water, power and even receive salaries but my mother used to tell me they cannot eat, so a human being has to help them in a way to finish all the money they get for not working. Could we be informed how many human workers work with ghost workers in consuming what they earn?

Source: The Guardian, 16th June 2004

Appendix 2.2: Man nabbed with 200 litres of transformer oil

By Guardian Reporter

Police in Dar es Salaam have arrested a man in possession of 200 litres of oil suspected to have been stolen from transformers. The man was arrested in Mbezi on Saturday night after police tipped off by a good Samaritan. Dar es Salaam Police Commander Alfred Tibaigana confirmed yesterday that a number of people had been arrested in connection with the theft of transformer oil.

“I’m aware that some people were arrested on Saturday night in possession of several jerrycans full of transformer oil. I’m aware of the theft, but I’m not sure where the crime took place,” Tibaigana said.

Tanzania Electric Supply Company (TANESCO) Public Relations Manager Daniel Mshana said he had “sketchy” details of the theft and arrest and was yet to confirm the reports.

He said, however, that the person who provided information which led to the arrest and recovery of the oil was entitled to a 500,000/- (US\$ 480) reward from the utility firm if the reports were found to be true.

The informer, who requested anonymity, said he saw two men carrying 20 litre jerrycans from the direction of a transformer in Mbezi as he was walking home on Saturday night.

He said he immediately suspected that the pair were up to no good and decided to report them at Mbezi Luis Police Post. However, the man saw police patrol car near the Mbezi Lutheran church and informed the officers whom he took the scene of the theft where they arrested a suspect with 13 jerrycans, seven of which were full of oil. His accomplice escaped.

The suspect claimed that he had been forced by thieves to help them drain oil from transformer, according to the informer, who said he had reported the matter at TANESCO’s Kinondoni South Office at Magomeni.

The informer said he accompanied several Tanesco technicians to Mbezi to assess the damage and one of the company’s employees confirmed that oil had been stolen from the transformer.

“Half of the oil had been drained, crippling the transformer...it couldn’t work without oil” he said.

The technician said they were surprised at the theft as the transformer was heavily fortified against vandalism and theft.

The theft of transformer oil is rampant in some parts of Dar es Salaam whose residents frequently go without power for days after transformers in their areas blow up after being drained of oil.

The thefts have caused damage running into tens of millions of shillings, prompting Tanesco to set up a hotline through which members of the public could give tips-off on the theft of Tanesco property and vandalism on power apparatus.

SOURCE: *The Guardian*, 5th July 2004

Appendix 2.3: The report on transformer oils stolen early this year

TANESCO loses over 74m/- transformer oil

By Ludger Kasumuni

THE Tanzania Electric Supply Company (TANESCO) has incurred a loss of over 74m/-, after thieves stole coolant from 12 transformers in Dar es Salaam.

Speaking to *The Guardian* yesterday, Public Relations Manager Daniel Mshana said the huge theft of transformer oil occurred in a period of one week.

As a result, Mshana said the transformers were destroyed, thus occasioning a loss of 74.4m/- in just a short time. Some areas have since been plunged into darkness.

He mentioned the affected areas as Tototundu-Segerea, Ilala-Sharifi Shamba, Kipunguni, B-Ukongu, Mchikichini, Buguruni kwa Moto, KMKM-Ukongu and Fidahusein-Vingunguti in Ilala District.

Others which are in Temeke district include Mtomi kwa Dosa, Yombo-Kilakala and Yombo-Vituka.

In Kinondoni District, the affected areas are Kimara kwa Bisalo and Kibamba-Kibwegere.

He also said that four people were caught red-handed with containers full of oil at Chang'ombe-Viwandani.

Without revealing their names, Mshana said the four were taken to Chang'ombe Police Station by Ultimate Security Company guards last Thursday.

"Several areas have suffered the consequences. We are appealing for the traditional militias (sungusungu) to protect transformers from thieves. TANESCO is incapable of

guarding the installations in the whole country," he said.

He warned that TANESCO could not replace the transformers promptly "as the new stocks are meant for development projects."

He said that it would take time before power is restored as the company will have to order new transformers.

In low voltage areas, Mshana said TANESCO would install transmission lines between Kisukuru and Segerea areas in Ilala District and a 33kv line between Kipawa and Mbagala, via Kurasini in Temeke District.

Meanwhile, Mshana said that TANESCO was receiving 100 megawatts from the Independent Power Tanzania Limited (IPTL) through the national grid.

He was reacting as to whether a power crisis was imminent following destruction of some oil pipelines at the Dar es Salaam Port.

"The supply from IPTL is stable. I am not sure if the damage affected production at IPTL," he said.

Source: *The Guardian*, 11th January 2005