Inventories of PCB including cooperation between government and PCB holders

Regional training workshop

Kingston, February 2nd to 5th 2008

Michael Mueller
Environmental Consultant

Seven steps towards the target

1. Preliminary inventory
2. Priority & national objectives
3. National implementation plan
4. Formulation of objectives
5. Detailed inventory
6. Evaluation of national treatment
7. Disposal

Michael Mueller
Environmental Consultant

Inventory - theoretical approach I

Where is PCB??? - Nearly everywhere!!!

Electrical devices (transformers, capacitors, rectifiers, bushings,…)

Hydraulic systems (mining industry, theatres, heavy industries,…)

Buildings (as weakener in paints, rubber etc.)

Recycled materials (paper, oil,…)

Nature (soil, sediments,…) as result of leakages, illegal activities etc.

Michael Mueller
Environmental Consultant

Inventory – theoretical approach II

PCB sources in the **nature** are hardly to detect. You need the knowledge and willingness of local people for getting any information. These sources do usually not exceed 5 % of the „total“ quantity and is furthermore widely spread over the country and are less in the contamination level (mostly).
Major contaminations are with mining industry, scrap dealers, some other heavy industries, petrol, gas and similar.
Older contaminations could be identified by checking the downstream groundwater contamination.

Inventory – theoretical approach III

Buildings

Some producers of window putty used PCB as a softening agent. Today it should not be used any more. Thus you may find it in older buildings (erected between 1960 and 1985, roughly). The PCB is now as well in the concrete around the windows.
A similar use has been in paints, for the same reason. One example from Germany showed about 4 % PCB in the interior paint of a food silo (for animals). From there it went to the cows, to the milk and finally to humans. Major facilities could be detected, smaller ones hardly.

Inventory – theoretical approach IV

Hydraulic systems

Some hydraulic fluids got mixed with PCB at the production already, some later caused by services. The “good” technical properties of PCB have been responsible for their use. The possible contaminations varies between “pure” PCB and some hundred ppm. As well maintenance could have caused these contaminations. Main sources are huge hydraulic systems in the mining and heavy industry, but as well in smaller systems such as hydraulic stage systems.

Michael Mueller
Environmental Consultant

Preliminary Inventory I

You have seen now what a comprehensive inventory would be and what it would cause: much time and money!!!

That is what we do not have for the NIP report.

What now?

A preliminary inventory is a small part of the whole picture. If we have carefully selected this small part we may multiply it by a factor and will get a rough approach of the whole picture.

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Preliminary inventory II

How to find the right small part?

- Do a historical overview: When was the factory erected, e.g. Factories younger than 20 to 25 years will most probably equipped with PCB free units. Put the quantity of transformers and capacitors in the list “Free”.
- If the factory is older, you have to check for the devices. How old are they, may be already replaced in the past. Put the younger ones again to “Free”.
- The others must be checked. “Pure” PCB devices can in most cases be identified by name plate or test certificate of the manufacturer. Put these quantities in the list “PCB”.
- The rest may be oil filled devices. They have to be checked by analytical test. After getting the result put PCB-free into the list “oil devices tested PCB-free”, the others in the list “oil devices tested PCB contaminated”.

Preliminary inventory III

That was now a check for a “full” inventory. What can we now learn from that?

A good inventory lives from the amount of reliable results. If we spent some time for such historical reviews we can have a long list of equipment without leaving the office.

Put all the younger companies together and you have already a long list of PCB-free devices, but keep in mind that maintenance may have “imported” PCB. That is what we have to mention.

Total number of transformers minus transformers from young companies will be number of transformers for detailed consideration.

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Environmental Consultant

Preliminary inventory IV

Try to check now the number of transformers at major old companies. Here we only take companies with more than 5 or 10 transformers. This will be a task for an electrician, may be in collaboration with the utility as they know who gets voltages above 400 V.

For the preliminary inventory we should approach these companies for their electrical installations (how old is the working equipment, do they have some old devices on stock).

Now select some of them for a site inspection with sampling, mainly on old transformers, but check as well whether there are as well capacitors.

The result will be representative for all of them plus/minus 20 %, roughly.

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Environmental Consultant

Preliminary inventory V

Now we have already quite good figures at the private industries. Now we have to check the public sector and the utility.

The utility will have lists of their transformers where we may see old installations. The percentage of old transformers we may multiply by 20 % to be on a rather safe side. That is the quantity of PCB cross contaminated oil transformers. We will not take samples there as it takes too much time and costs, but that will be for a later project with according budget.

We will specifically look at the repair shop of the utility. Here we take samples for testing. It is easier and takes less time. We can furthermore check their stock transformers.

The result will cover over 90 % of all transformers in the country with a reliability of about 80 %.

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Environmental Consultant

Preliminary inventory VI

Finally we take a look at public buildings, such as hospitals, embassies, major houses, shopping malls, ministries, airports, ports, schools etc.

Again we only look for the bigger ones in main cities. We select one or two out of each category (but only older buildings!) and collect some samples for testing. Finally we can multiply the result again and have a good approach for our preliminary inventory.

At the end we put all together and mention strategy, methodology and results in our PCB part of the NIP report.

Analysis – Fundamental Problems

- Inventory shows total number of transformers
- Inventory shows total number of capacitors
- Unknown cross-contaminations
- Unknown contaminated areas
- Is there PCB in oil?
- Separation of oil and PCB filled devices
- How to sample?

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Environmental Consultant

Analysis - Transformers

Any analysis will cost money, therefore:

- **Check whether it is an oil transformer or an “Askarel”* transformer**
- **When was the transformer manufactured**
- **Who is the manufacturer**

* Askarel stands for all brand names of PCB containing coolants

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Environmental Consultant

Have look what is a transformer

- Electrical device for transforming electricity for the needs of the user
- Once placed it seldom changes its location
- Casing is normal steel
- Outside corrosion might occur
- Leakages are possible

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Environmental Consultant

Analysis - Capacitors

Capacitors have less cooling liquid than transformers (some few litres). They are hermetically sealed after filling with liquid. Therefore there is no risk on cross-contaminations with maintenance. The PCB is lower chlorinated and was cheaper therefore. Manufacturers did not use both, oil and Askarel. They had only one cooling liquid, either oil or Askarel. Any PCB contamination on oil capacitors is not known to me. Thus it seems to be easy to identify whether it is PCB waste or not, but there is one problem:

Not in all cases the coolant type is mentioned and if, it is difficult to find it out: e.g. ICME: CM…. Capacitor Mineral Oil
CS…. Capacitor Synthetic (=PCB)

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Environmental Consultant

Analysis – Oil Transformers

If you have identified an oil transformer, you have to take a sample as the oil will not tell you its contamination!
What are the reasons for such cross-contaminations:

1. Manufacturer: He used the same equipment for filling up Askarel and oil transformers.
2. Maintenance: They used the same equipment for both types of transformers and the same intermediate storage tanks.
3. Manufacturer: Askarel was sometimes used as bubble killer. Bubbles are dangerous for transformers.
4. On-site: People filled up transformers with Askarel if oil level was low.
5. Manufacturer: Impregnation of coils before final essembly.
6. …

Michael Mueller
Environmental Consultant

Analysis – How to identify the transformer type

- Name plate:
  - cooling type: ONAN/ONAF stands for oil, CNAN/LNAN for PCB
  - liquid weight: total weight/liquid weight =< 3 => PCB
    total weight/liquid weight => 4 => oil
- Expansion box: Sometimes the coolant is written there. Look at the glass pipe (showing the filling level): in case the liquid is colourless it will most probably be PCB, oil is yellow to brown, sometimes black.
- If there are leakages: fresh leakages smell sweet (from 30 % Chlorobenzenes in Askarel), elder leakages have no smell, but you can test by using a small stick and put it into the liquid (which looks like water) and if it is sticky you have PCB.

Analysis – sampling where and how ?

We focus on sampling of oil transformers!

- Whenever the sampler feels uncomfortable, the transformer must be switched off
- Bottom valve, but use metal tray underneath
- Glass at the expansion box
- Expansion box by using a pipette
- Ware gloves and glasses
- provide adsorption material for emergency cases
- Never do it alone (safety reason!)

Analysis – Labelling

- Each sample should be labelled with a unique inventory number for re-identification.
- The transformer should get the same unique number.
- Write this number as well in the inventory book.
- Parallel each transformer should get an own “location sheet” where the exact location is shown, any other observations etc. If the location has no special name, use a GPS system for determination.
- Askarel transformers should not be sampled but should get an inventory number as well.

Analytical methods and costs

- Gas chromatography (GC) with mass spectrometer (MS) or electron capture detector (ECD): very specific on PCB, expensive equipment, sample changer reduces manpower
- X-Ray: lower equipment costs than GC, only detecting chlorine, lowest consumption on chemicals
- Chlorine Electrode: lower equipment costs than GC, only detecting chlorine, low consumption on chemicals
- Clor-N-Oil and Kwick-Skrene: both are only indicative tests and show more or less than the limit, fastest test, on-site test possible
- L 2000: based on Clor-N-Oil, low equipment costs, higher consumption on chemicals, shows value, on-site tests possible

Analysis – Outcome of Analysis

The analysis will show the real needs for the elimination of PCBs in Suriname (for transformers). Following activities could follow:

1. Oil change at transformers with PCB contamination > 50 and < 1,000 ppm (mg/kg). Only the oil must be disposed.
2. Over 1,000 ppm PCB up to 4,000 or 5,000 ppm minimum two oil changes must be done with 6 months period in-between. Costs are higher and are only economic if the transformer is not too old.
3. Over 5,000 ppm we need minimum 3 oil changes which is in most cases not any more economic. Total replacement is recommended. This could be done by using detergent technologies which are cheaper than solvent technologies.
4. Askarel transformers or very high contaminated transformers which are very seldom need to be treated by solvent technologies.

Michael Mueller
Environmental Consultant

Basis for good projects

- Clear priorities in the NIP report
- Practical and viable objectives
- Full country support
- Good support of Executing Agency
- Realistic budget
- Confirmed co-financing without conditions which are not related to the project itself

Michael Mueller
Environmental Consultant