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REPORT

ON

Development of National Implementation Plan on Persistent Organic Pollutants (POPs) - Polychlorinated Biphenyls (PCBs) in India".

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BY

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TABLE OF CONTENTS

REPORT ON POLYCHLORINATED BIPHENYLS (PCBs)

1. Background

Scientific studies have revealed that the present and future generations of human beings and wildlife are at risk due to the toxic effects of various industrial chemicals, pesticides and unintentional by-products. Some of these substances are persistent, toxic, bio-accumulate in human and animal tissues, and bio magnify leading to serious health concerns.

Persistent Organic Pollutants (POPs) are, as the name suggests, persistent and extremely toxic. Even when released in relatively small quantities they degrade very slowly. They remain in the environmental media for years. POPs are lipophilic and hence bio accumulates in the fat tissue of organisms once exposed. They move from one level to higher level in the food chain and bio-magnify. Furthermore, POPs have the ability to travel and concentrate in the environment and biota of regions far away from the original source of production which suggests through the long-range transport mechanisms through air and water. Thus POPs is an issue of national, regional and global concern.

In 1992, the UN Conference on Environment and Development adopted Agenda 21 including Chapter 19 on "Environmentally Sound Management of Toxic Chemicals Including Prevention of Illegal International Traffic in Toxic and Dangerous Products," In 1995, the UNEP Governing Council (UNEP GC) invited the Intergovernmental Forum on Chemical Safety (IFCS) and Inter-Organization Programme on the Sound Management of Chemicals (IOMC) to initiate an assessment regarding a short-list of 12 POPs. In 1997, efforts were initiated on a global scale to deal with POPs through the United Nations Environmental Programme (UNEP). In 1998, the Intergovernmental Negotiating Committee (INC) for POPs held its first meeting in Montreal to discuss the threats posed by the dirty dozen as an initial target for immediate action. Thereafter INCs were held in Nairobi, Geneva, Bonn and Johannesburg. A global legally binding treaty to protect health and the environment from POPs was adopted on 22 May, 2001, and entered into force on 17 May, 2004. The treaty bans some POPs, but restricts or otherwise controls others.

India signed the Convention on 14th May 2002 and ratified it on 13 January 2006 and became a Party to the Stockholm Convention on POPs. Parties to the Stockholm Convention are required to develop National Implementation Plans (NIPs) to demonstrate how their obligations to the Convention will be implemented. India recognizes its obligation, under Article 7 of the Convention to develop and submit a NIP to the Conference of Parties (COP). India after the ratification of the Stockholm Convention on 13th January 2006 has accelerated the preparatory activities for the National Implementation Plan (NIP). India has started to pursue developing and endeavouring the post-NIP program for the implementation of its obligations under the Convention. The Stockholm Convention places obligations on the Parties for 12 chemicals; however a provision is also made in this NIP to respond to the listing of any new chemicals.

India is committed to prepare the National Implementation Plan (NIP). As such, the country invited the United Nations Industrial Development Organisation (UNIDO) to act as the GEF Executing Agency with expanded opportunities for the development of the NIP and opted to undertake this work in two phases through the full GEF project cycle.

The Ministry of Environment and Forest (MOEF), Government of India is the nodal ministry to implement this NIP programme in India.

The MOEF has entrusted the Central Power Research Institute (CPRI) which is a autonomous body under ministry of Power, Government of India to undertake this project to and for the activities relating to developing inventories of PCB's, PCB containing equipments and wastes in India.

2. Indian perspective on POPs

A highly populated and developing country like India is subjected to environmental contamination of POPs from several sources and activities. This leads to considerable exposure of all organisms as relatively high levels of POPs have been detected in all quarters of the environment. PCBs have also been reported in drinking water, food products, animals and even human breast milk.

2.1 *Sources*

The identified sources of POPs in India include production units, equipments in use containing PCBs, illegal imports as well as stockpiles of obsolete stocks etc. Stockpiles of unused POPs including PCBs are a cause of concern mainly because in many places they still remain unidentified.

Fortunately PCBs were never produced in India. The usage of PCBs oils began in 1950's in India. PCBs have been imported in India mainly for Power Sector as transformer oil. PCB containing equipments were imported from various countries. The import of PCBs was banned in 1998. The usage was gradually stopped from 1974 to the 1998's. PCBs oils can be used to produce many kinds of PCBs-containing products. PCBs usage is divided into three categories (according to the extent of contact of PCBs in products with the outside): closed use (such as capacitors, transformers and current stabilizers), semi-closed use (such as heat transmission oil, hydraulic oil and vacuum pump oil) and open use (such as printing ink, dope and fireproofing paint).

2.2 PCBs import/export in India

Little information is obtained about the import situation of polychlorinated biphenyl raw material and availability of finished product in India. However, the estimated quantity of PCB in India is about 2000 – 4000 MT PCBs[18]. Further, it has been worked out that on scrapping an American merchant ship generates about 0.25 – 0.80 MT of PCBs[19]. A list of few PCB Manufacturers in the world is mentioned in Table 1.

Table 1: List of PCB manufacturers in the world

Sr. No	Company Name	Trade name	Country
1	Caffaro	Apirolio, Fenclor	Italy
2	Monsanto	Apirolio, Fenclor	USA, UK
3	Monsanto	Araclor, Pyrenol	UK
4	Monsanto	Pyrochlor	USA
5	Bayer AG	Clophen	Germany
6	Chemco	Delor	Former Czechoslovakia,
7	Westinghouse	Inerteen	USA
8	Kanegafuchi Chemical Co.,	Kanechlor	Japan
9	Prodelec	Pyralene	France
10	?	Sovtol	Former USSR,

The Government of India, vide its Policy Circular No. 18(RE-2000)/1997-2002 dated 17th July 2000, to All Licensing Authorities and Commissioners of Customs has brought out the following:

• Attention is invited to Notification No. 2 (RE-2000)/97-02 dated 31.03.2000 to import of PCBs classified under Exim Code Nos. 851790 00.10 and 853400 00.20 was made free. Attention is also invited to Notification No. 15 (RE-2000/97-02 dated 10.05.2000, according to which license No. 2 at the end of chapters 84, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96 and 98 was deleted and public notice 290 (PN) dated 31 April 1995 was drawn.

• Representation have been received by this office seeking clarification regarding submission of Import License (SIL) for import of PCBs, imported during the period 31 March 2000 to 10 May 2000.

• In this regard it is clarified that substantive entries of PCBs were free on 31.03.2000. However, licensing notes of certain chapter in ITC (HS) were not deleted, inadvertently. These notes were deleted in 10 May 2000. However since, in fact, PCBs had been made free on 31 March 2000,all consignments imported during the above mentioned period but yet to be cleared, shall be allowed without insist surrender of SIL. It is further clarified that in all such cases where imports took place during the said and were released by Customs without surrender of SI under ITC bond, such bonds shall be released without insisting on surrender of SIL.

• This issues with approval of Director General of Foreign Trade (DGFT).

• As stated in The Gazette of India, Extraordinary, Part II- Section 3, Sub section (ii), 23rd May 2003, New Delhi P.112. Table 2 below shows the current status of hazardous waste prohibited for import and export

Basel No*	OECD No. **	Description of Material
A 3180	AC 120	Waste, substances and articles containing, consisting of or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polychlorinated napthalenes (PCN) and/or polybrominated biphenyls (PBB) or any other polybrominated analogues of these compounds

Table 2: Hazardous Waste prohibited for import and export

Note: * Basel Convention on Control of Trans-boundary Movement of Hazardous Waste and their Disposal
** Organization for Economic Cooperation and Development

2.3 POWER SCENARIO IN INDIA

In all 28 states and 7 union territories of India (Fig.1), an estimated total number of about 45,000 power and about 3,500,000 distribution transformers exist. While the total amount of PCB-oils as well as PCB-containing equipment imported is unknown, the estimated quantity of PCB-containing equipment and pure PCB-oils in India today amounts to about 10,000 to 15,000 tons (ref. IITR). However the data / information collected and collated to develop an inventory of PCBs in India clearly indicates that the amount of PCB and its waste exceeds the estimated quantity.

Table: 3 All India Region wise Generating Installed Capacity (Mw) Of Power Utilities Including Allocated Shares In Joint and Central Sector Utilities

SL. NO	REGION	THERMAL				Nuclear	HYDRO (Renewable)	R.E.S.@ (MNRE)	TOTAL
		COAL	GAS	DSL	TOTAL				
1	Northern	21950.00	3563.26	12.99	25526.25	1620.00	13350.75	2690.62	43187.62
2	Western	28525.50	8143.81	17.48	36686.79	1840.00	7447.50	4849.93	50824.22
3	Southern	18572.50	4557.78	939.32	24069.60	1100.00	11157.03	8329.67	44656.30
4	Eastern	16895.38	190.00	17.20	17102.58	0.00	3882.12	334.91	21319.61
5	N. Eastern	60.00	766.00	142.74	968.74	0.00	1116.00	218.19	2302.93
6	Islands	0.00	0.00	70.02	70.02	0.00	0.00	6.10	76.12
7	All India	86003.38	17220.85	1199.75	104423.98	4560.00	36953.40	16429.42	162366.80

(As on 30-06-10

Captive Generating capacity connected to the Grid (MW) = 19509

RES -Renewable Energy Sources includes Small Hydro Project(SHP), Biomass Gas(BG), Biomass Power(BP), Urban & Industrial waste Power(U&I), and Wind Energy.

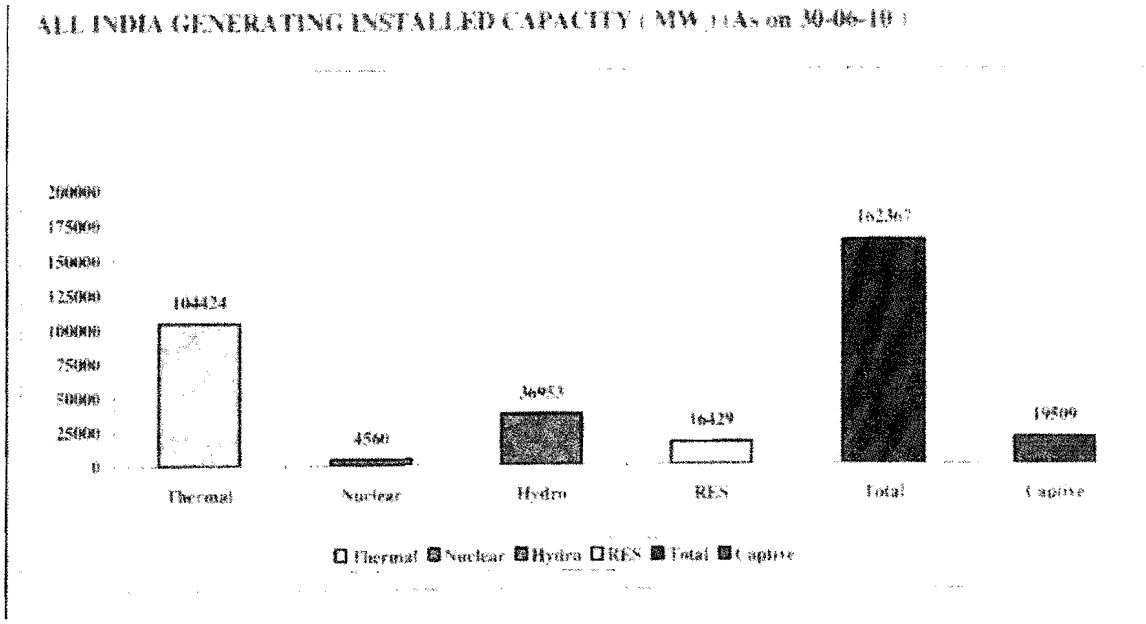

Fig:1 All India Generating installed Capacity

The installed capacity figures as on 31.03.10 in respect of RES is based on statement dated 28-05-10 received on 28-05-10 from Ministry of Renewable Energy(MNRE) where cumulative Grid interactive power installed capacity has been indicated as16817.04 MW Reconciliation of installed capacity of Hydro capacity resulted in transfer of 135 MW from conventional to SHP-RES and retrieval of installed capacity of 67.20 from SHP-RES to conventional Hydro has resulted in net addition of 67.8 MW to SHP under RES .Also 30 MW of capacity in the nature of Waste Heat Recovery Power Plant at Goa Energy Private Limited under U&I category of RES. Out of this installed capacity due to wind - (374.636 MW) and small hydro (110.79 MW) appearing in captive capacity has been deducted to arrive at installed capacity of utilities in respect of RES. (16817.04-485.43+67.8+30=16429.42

Different Geographical Regions of India earmarked for the data collection purpose

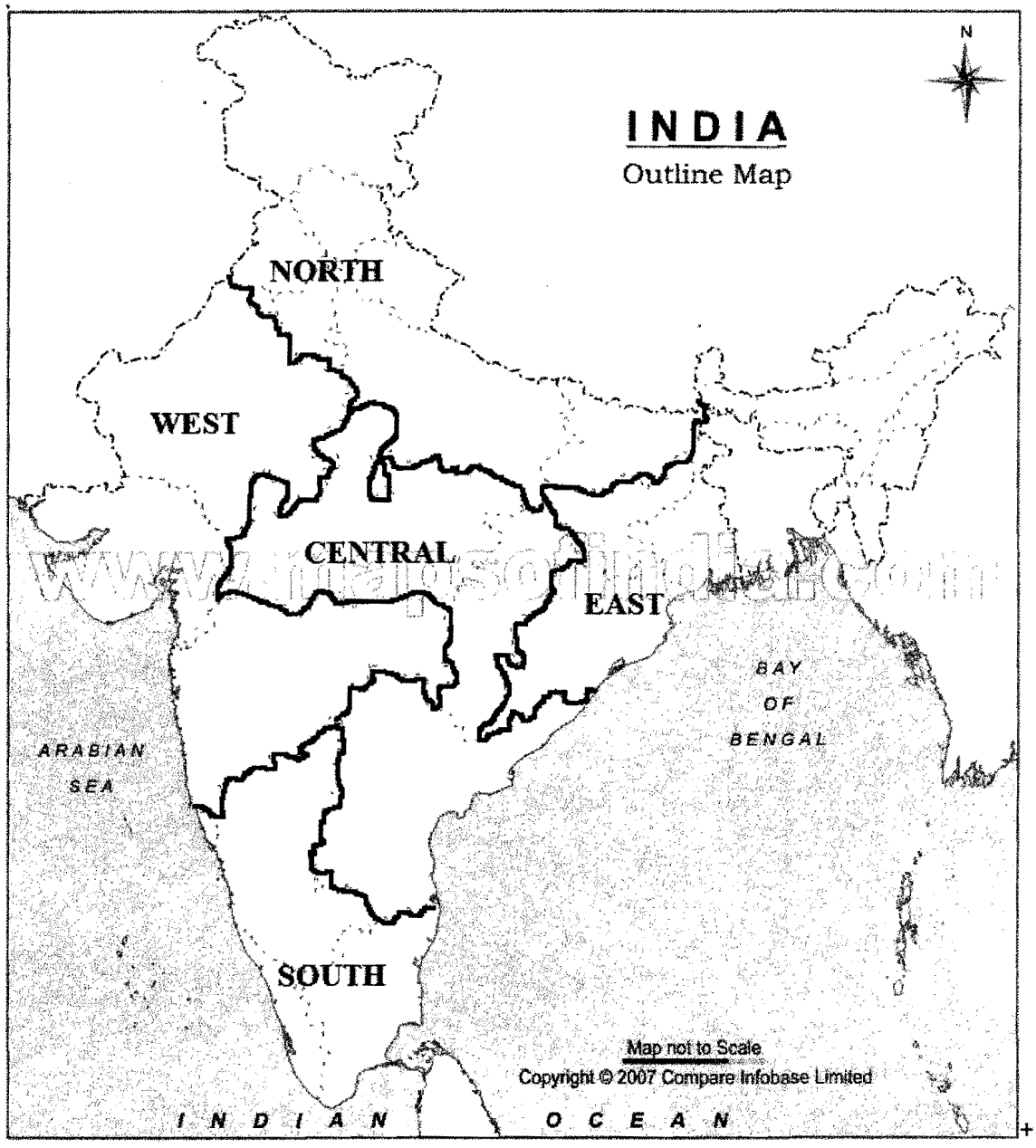

Fig. *2: Geographical Regions of India earmarked for the data collection purpose*

During the 1950's to the 1980's, India used to import PCBs-containing electrical equipment from other countries without being informed, most of which were transformers and capacitors for large facilities for specific application. The imported PCBs-containing electrical devices were mostly distributed in large enterprises and

the rest were distributed in the electrical power sector. At present, it is beginning to be found that there were PCBs contained in about 500 capacitors (already discarded) and about 500 transformers (already discarded) in the electrical power sector; but the data for the most of the imported PCBs-containing electrical devices, possibly in large enterprises in the non-power sector, are not available. The present investigations/survey show that a considerable amount of PCBs, PCB containing equipments and wastes exist in other sector such as cement, steel and paper etc.
The region wise distribution of PCB is shown in table 4 .

Main owners of PCB containing equipment and PCBs oil in the public sector are the power generation and transmission companies (State Electricity Boards), heavy industries like cement, fertiliser and steel and in the private sector the mining, lubricant and ship-breaking industries, etc.

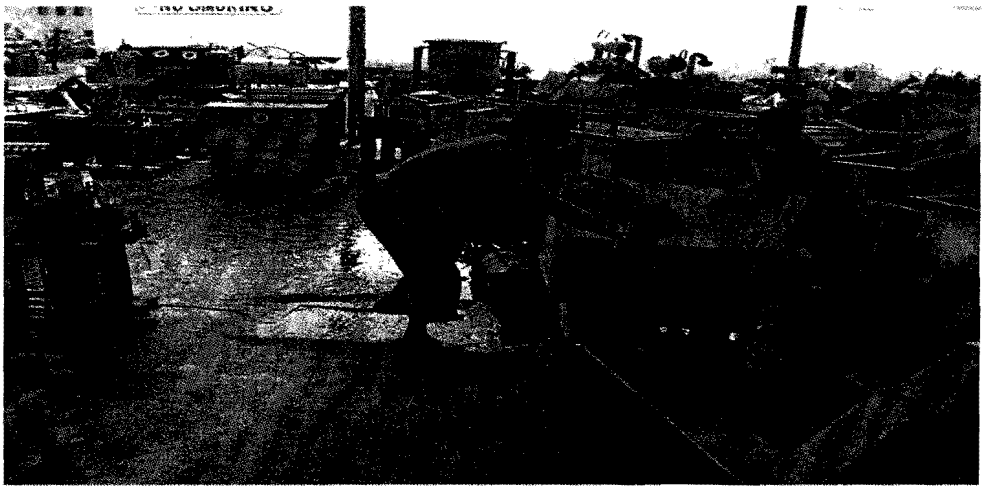

Fig:3 Transformers repair yard in a utility

Fig: 4 Transformers storage yard in a utility

Fig:5 Transformers stored in a open yard

In India, the State Electricity Boards have been trifurcated into different organisations namely, Power Generating Company, Power Transmission Company, and Power Distribution Company. Most of the PCB containing transformers have been found with Power Generating and Transmission companies. Only small quantities of PCBs have been found in distribution transformers.

Most of the broken down transformers are recycled and reused (Fig3). The out of service capacitors are stored at the owner's facilities. However, the PCB containing equipment and oil is not managed in an environmentally sound manner.

Investigations show that out of service electrical devices in the Power Sector are temporarily stored in the yards (Fig 4&5) throughout the country. However, due to limited monitoring, the number of PCBs containing electrical devices is not available.

3. Import issues

In spite of the fact that as per Gazette of India, Extra-ordinary, Part-II, Sec-3, Sub-sec(ii) dated 28th Sept 2007 GOI, MOEF, Notification and Rule 5 of Chapter II of Import and Export of Hazardous Material, the import of PCB's is banned for disposal, a significant quantity of PCB's is being continued to be imported to India. (Ref: Under Down to Earth Vol 14 Issue 20060228 dated February 2006 & Thai Indian News: Another Blue Lady heading to India, March 24th 2008).

3.1 Raising Awareness

All efforts were made for raising awareness and educating stakeholders and other concerned on PCBs issues through organising workshops / training programmes. During the project investigations, a total of thirty Awareness Raising Programme were successfully organised at different locations in the country for the stakeholders from the Power Sector, Steel, Cement, Fertilizer, other industrial sectors, etc. During the awareness programmes, Stockholm Convention, toxic aspects of PCBs management of PCBs, state of art available technologies for destruction of PCBs were discussed.

3.2 PCBs containing devices which are in use

PCBs containing devices in use include PCBs-containing capacitors and transformers. Investigations show that PCBs containing electrical devices other than transformers in use in India are capacitors, most of which are commissioned in large enterprises and institutes of the non-power sector.

Due to improper / lack of labelling, PCBs containing capacitors in use need to be identified mainly through detection. **During the project implementation, 1290 transformer samples have been taken from power utilities, major industries**

and private sector industries for inspection and analysed for PCB concentration in the oil. All the transformers have been found to contain PCBs in high concentration. In addition, 400 drums stockpiled in yard containing pure PCBs, located at different places in the country (fig7&8), have been inventorized. The data on the transformers containing PCBs were inventorized covering 28 States and 7 Union territories. The data as collected and collated is presented as distribution of PCB containing equipment region-wise and industrial sector-wise in Table 4 and Fig.6, Table 5 and Fig.7, respectively.

Table 4. REGION WISE DISTRIBUTION OF PCBs IN INDIA

Sl.No	Region	No of Transformers	Total tonnes of PCB's
1	East	76	1064.289
2	West	138	2054.889
3	North	79	2138.234
4	South	342	2688.826
5	Central	913	1910.210

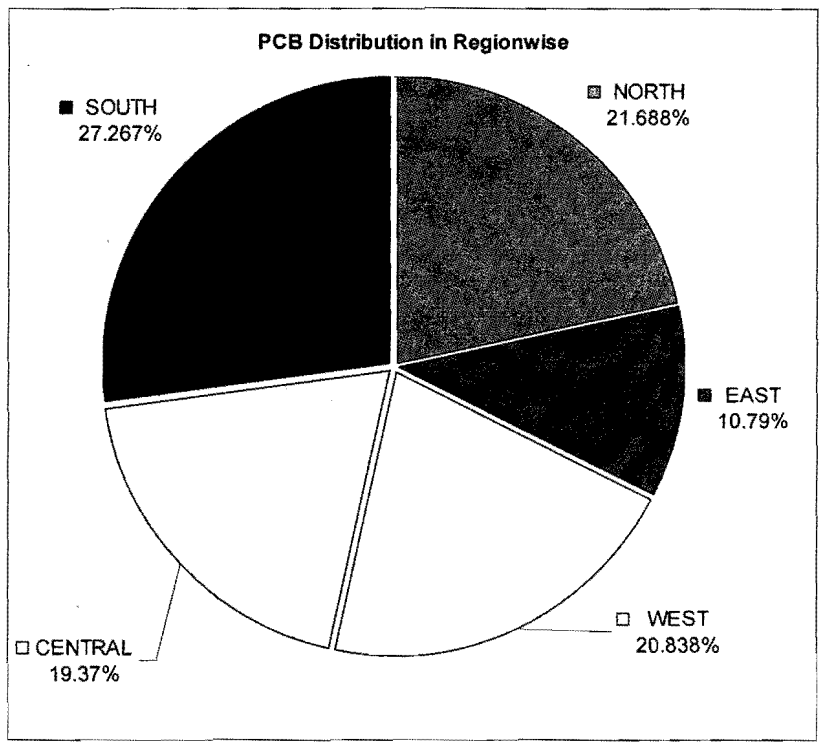

Fig. 6 Region wise distribution of PCBs in India

Table 5. PCB DISTRIBUTION IN SECTORWISE

Sl.No	Sector	Total number of Transformers	Total tonnes of PCBs
1	Power Sector	407	7016.034
2	Steel Sector	913	1772.428
3	Cement Sector	34	49.29
4	Fertilizers	16	28.68
5	Others	178	971.23

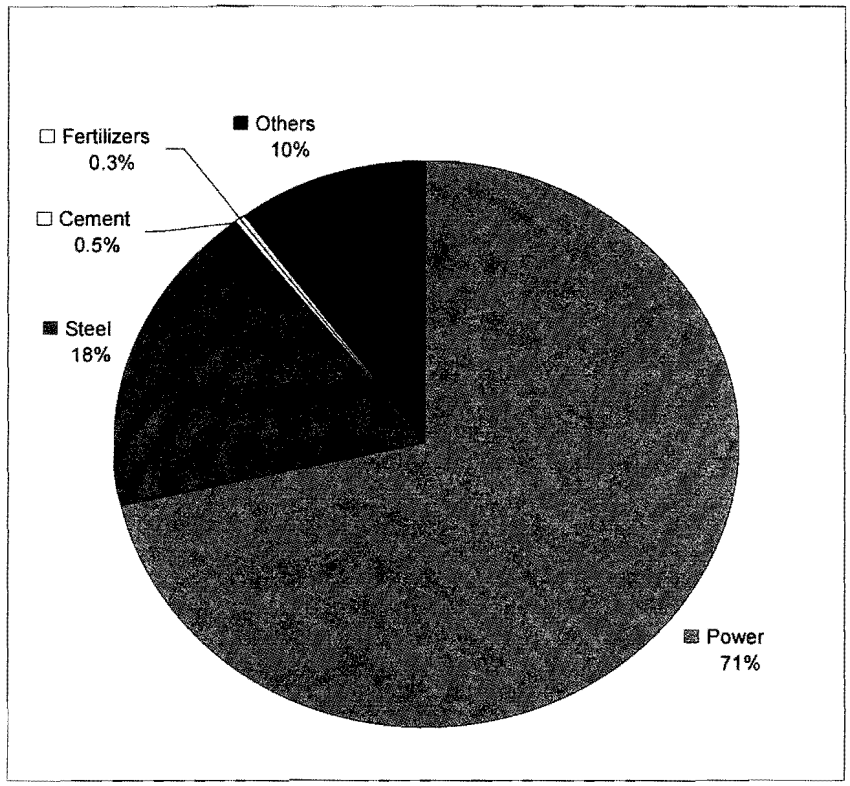

Fig.7 Sector wise distribution of PCBs in India

It was also observed that during long term stockpiling many of the old transformers became untraceable or junk and these were concerns that such stockpiled PCB might contaminate the environment. PCBs oil analysis has been carried out using Gas Chromatography with ECD/ Mass Spectrometry (GC-ECD/MS). The results of some of the selected analysis are presented in Table 6 below.

Table 6: PCB Test Report of selected samples collected from different locations in India

Sample No.	Sample Locations	PCB concentration (ppm)
1.	SRS, Gokula , KPTCL	1185
2.	BHEL,	1014
3.	Kudremukh Iron ore Company	1847
4.	Karnataka Forest department	1581
5.	Heidelburg Cement	1055
6.	Heidelburg Cement	1322
7.	Heidelburg Cement	1178
8.	BEML	1123
9.	Shimsha Generating Station	1263
10.	Shimsha Generating Station	1454
11.	TNEB	7834
12.	TNEB	18900
13.	TNEB	1668
14.	TNEB	7136
15.	TNEB	17755
16.	TNEB	15033
17.	TNEB	14994
18.	TNEB	8863
19.	TNEB	15344
20	TNEB	18711
21.	TNEB	1400
22.	TNEB	3384
23.	TNEB	1794
24.	TNEB	1715
25.	TNEB	1888
26.	TNEB	12057
27.	Neyveli Lignite Corporation Ltd.,	1057
28.	Neyveli Lignite Corporation Ltd.,	1159
29.	Neyveli Lignite Corporation Ltd.,	1217
30.	Neyveli Lignite Corporation Ltd.,	1355
31.	Neyveli Lignite Corporation Ltd.,	1049
32.	Neyveli Lignite Corporation Ltd.,	1651
33.	Neyveli Lignite Corporation Ltd.,	1177
34.	Neyveli Lignite Corporation Ltd.,	1220
35.	Neyveli Lignite Corporation Ltd.,	1014
36.	Neyveli Lignite Corporation Ltd.,	1284
37.	IFFCO	1005
38.	HPCL	1356
39.	RICTPS	212872.67
40.	PTPS	225369.22

4. PCBS STORAGE CONDITION IN INDIA

The major users of PCB were power generation unit and the state electricity board. These users do not store transformer oil. They have given service and maintenance of transformers and capacitors on contract system to local parties. Hence do not have PCB storage. Further, users of capacitors are large units not into manufacturing of capacitors. Therefore such units do not have stock of PCB in their premises.

Further, the PCB containing oils that need to be replaced from time to time are collected by local agents. These local agents in turn sell them to oil reprocessing units wherein the moisture content is removed. It is then repacked and sold in the market. The electricity companies auction the old and defunct transformers. Agents then buy these transformers and use them for reprocessing activities. Picture shown is of a site in Delhi (Fig 5) with number of disposed transformers. Particularly with respect to the oil contained in transformer, are removed and sold out to transformer oil re-processors. This information was obtained during the extensive field investigations carried out but a detailed study of the same needs to be undertaken in the NIP.

The Indian Institute of Petroleum estimated that the Indian lube market consumes around 1,000,000 tonnes of lube oil annually, out of which about 65% is utilized by the automotive sector as engine crankcase oil, hypoid gear oil, etc. Used oil potential from automotive sources is estimated to be about 25-35% of total supplies. This can generate over 100,000 tonnes of re-refined oil. The CPCB has suggested a code of practice for re-refined oils for safe disposal of hazardous wastes. Most modern processes bypass the acid treatment stage, but require heavier capital investment, and are economically viable only at higher plant capacities. They are therefore out of the reach of most small-scale entrepreneurs.

In 1986, the Ministry of Petroleum had formulated a policy that required all public sector undertakings to sell their used oil to registered re-refiners but its actual implementation needs to be verified. Moreover, no steps were taken to compel the major oil companies to buy back a percentage of the re-refined oil. Hence, the policy remained only on paper. The result was that channelisation never took off, and the

re-refining industry also had to fold up for a variety of reasons. (It is estimated that out of 60 registered re-refiners in India today, only 3-4 are functional.

The rest have shut down because of the non-availability of used oil and lack of support from various quarters.) Because of the failure of the policy, the used oil went back into the hands of the *kadaiwallahs*, like in the used lead acid battery sector, where lead processing returned to backyard smelters. In 1995, the MoEF issued a notification allowing the Ecomark to those marketed oils that had more than 50% of re-refined oil by volume. This scheme failed too, since the volume required for blending was too high.

Fig :8 PCB's stockpiles in a large steel industry

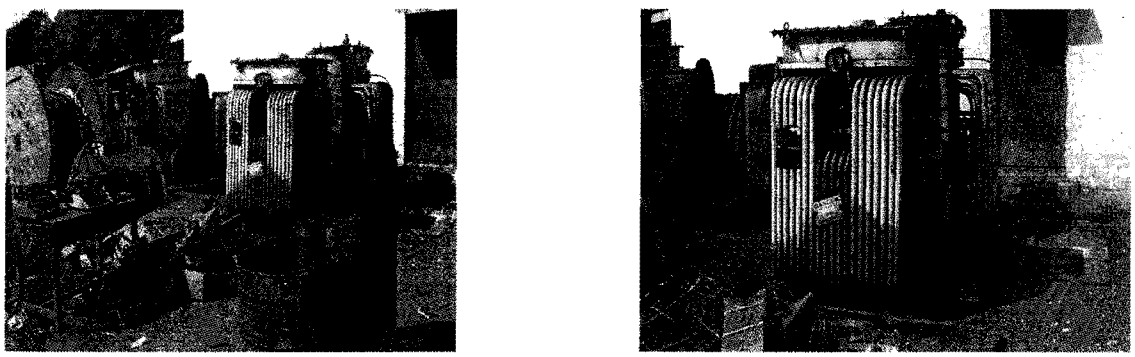

Fig:9 Failed PCB's containing transformers stored in yard in an industry

Table 7 indicates the quantity of oil re-refined in the country has been going down.

Sr. No.	Year Production of Re-Refined Oil.	Metric Tonnes
1	1991-92	49,050
2	1992-93	58,000
3	1993-94	70,600
4	1994-95	60,000
5	1995-96	30,000
6	1996-97	10,000

Table 7: Productions in Re-Refining Units

Since different oils are formulated differently, used oils are required to be segregated on storage into broad categories. Unless an organized effort is put in, this does not happen. For example, in many sources of used oil from abroad, particularly from the Middle-East region, it has been found that transformer oils containing large amount of polychlorinated biphenyls (PCBs) are mixed in the general pool, thus rendering the entire lot hazardous. It is therefore to be ensured that used oil that is to be recycled or re-refined should not contain any of the hazardous substances beyond permissible limits. These limits may be as specified by the Basel Convention, or, if required, defined locally.

Most of the re-refining units in the small-scale sector in India use the acid-clay process. This classical process, which once used to be the basic one all over the world, has the disadvantage of resulting in the generation of large quantities of hazardous and toxic acid sludge and clay contaminated with oil and heavy metals. For this reason, the acid-clay process is not an environment friendly process and has been given up for some years in most countries including the USA, the European Union and other industrially advanced countries. Since this sludge contains a significant amount of oil and has fuel value, it is presently also used in India as a fuel, e.g. in brick manufacturing units. Though this is a reuse of a resource, burning of acid sludge in brick kilns creates environmental problems by generating hazardous gaseous emissions, as the kilns are not properly equipped with air pollution control devices. In 1997, the CPCB issued a direction to the SPCBs to disallow the acid-clay process. In 2000, Government decided to allow the modified acid-clay process.

The re-refining industry argues that recycling must be made mandatory and that an environment tax should be imposed on fresh lube oil. The SPCB must monitor all

significant users of lube oil, particularly the garages and workshops. Fresh oil sale should be made dependent on return of used oil. This will stop the wrong use of waste and used oils at source, increase the quantities of oil available for re-refining, reduce dependence on imports, and help conserve foreign exchange and natural resources.

The MoEF has set up a separate working group on used oil in 1999, of which a member of the HPC (Director, Indian Institute of Petroleum) is also a member. The workings of this group were never communicated to the HPC. The member concerned finally submitted the record of the discussions of the group to the HPC.

A draft notification on controls over the collection and handling of used waste oils called the Waste Oil Management Rules 2000 has been prepared. The notification also mandates buy-back of redefined oil by major oil companies. It draws a distinction between waste oil and used oil, and seeks to permit the import of used oil, provided it meets parameters given in a schedule. Though the draft was prepared in April 2000, it has not yet been notified. The HPC feels the draft notification is a welcome step and should be pursued to its logical conclusion as speedily as possible.

A detailed investigation on the storage condition of PCBs has to be carried out, which could be undertaken in the NIP. At present, in terms of investigated PCBs storage condition, it has been found that the concerned stakeholder being unaware could not provide relevant information. However, means of handling PCB in other parts of the world is as follows:

• Concentrative sealing-up-for-keeping (SK) in caves. The SK objects are mainly capacitors and PCBs pollutants.

• Concentrative underground SK: The SK objects are mainly PCBs capacitors and PCBs pollutants. Such kind of SK is to seal normally the PCBs capacitors and pollutants in the reinforced concrete groove, bury and label them in underground.

• Temporary storage inside the factory site. The SK objects are mainly PCBs capacitors, PCBs transformers and PCBs oil. PCBs capacitors are normally sealed by a cement wall in a designated area.

A good storage management to be adopted for PCBs capacitors, transformers and pollutants should be sealed in identified places. Based on the quantity of PCB stocks SK sites to be identified. Management to be adopted for PCBs capacitors, transformers and pollutants should be sealed in identified places. Based on the quantity of PCB stocks SK sites to be identified.

5. PCBs IN INDIA: POLLUTION vis a- vis ENVIRONMENT

5.1 Environmental exposure route of PCBs in India

After it was synthesized for the first time in laboratory in 1881, PCBs found wide application in the additives of impregnate of power capacitors, dispense agent of lubricating oil and cutting oil, paint, pesticide, plastics and adhesive. Analyzing from the application of polychlorinated biphenyl and the relation of environmental exposure, the environmental exposure route is divided into three categories:

• Controllable closed system. Polychlorinated biphenyl is used as dielectrics of transformers and capacitors. As long as the transformers and capacitors are designed properly during production and service process, they are normally not apt to leak and cause environmental exposure.

• Uncontrollable closed system. Polychlorinated biphenyl is used in heat conduction and hydro system. Although the system is closed in technique, it still may leak and need a small quantity of supplement. Thus, it is also difficult to recover thoroughly. The system may be apt to cause losses and pollution accidents.

• Consumptive use. Polychlorinated biphenyl is used in a variety of dispense agents and additives of lubricating oil and paint. It is lost in the environment due to its open use. The pollution source and pollutant pathway of polychlorinated biphenyl can be analyzed in three aspects of production, service and storage.

• The major uses of PCB are as closed application in electrical transformers, electrical capacitors, electrical motors and electric magnet. In general, it is often

difficult to determine the presence of PCBs in sealed equipment, since breaking open the equipment to ascertain this information will usually be inappropriate. Consequently, as a first step the maintenance records, manufacturers literature, trade association and equipment manufacturing companies were approached for finding information on dielectric fluid contained in the product.

• Transformers are very important component in many different types of electric circuits, from small-signal electronic circuits to high voltage power transmission systems. The physical size and shape of transformers vary greatly. The main structure of transformer consists of one or more electrical coils linked together magnetically by a magnetic circuit or core. For most large transformers, the entire unit is filled with dielectric fluid to increase the insulation between and to cool the electric coils. Any damage to the transformer's outer casing may result in PCB fluid leakage.

Distribution transformers were commonly found to lower the voltage on the distribution line household use. PCB/transformer oils were used in these distribution transformers.

• In the capacitors, which are a device for accumulating and holding charge of electricity, dielectric fluids are use. Typically a capacitor that may contain PCB is a completely sealed metal "can "with two electrical leads or contacts. The entire "can" is normally filled with PCB.

• Partially closed application includes heat transfer fluid, hydraulic fluid, vacuum pumps, switches, voltage regulators, liquid filled electrical cables, and liquid filled circuit breakers. In such application, PCB if at all used is not directly exposed to the environment. But may become exposed during the periodic usage. They then will enter air, water and soil media.

The open applications are those in which PCBs come in direct contact with the environment. Direct contact of PCB with the environment is of great concern. Plasticizers are the largest group of open application and are used in PVC (Polyvinyl Chloride), neoprene and other chlorinated rubbers. In addition, PCBs have been

used in number of other open uses including paints as flame-retardants, adhesives in plasticizers, and in surface coatings as flame-retardants.

Main exposure mode of polychlorinated biphenyl is controllable closed system, according to the quantity distribution of polychlorinated biphenyl used in above three modes. Next exposure mode is consumptive open system and uncontrollable system. Majority of PCBs used in India is used in the power sector and power capacitor, which is a controllable closed system, while the rest is used for other applications.

Apart from the above-mentioned application of PCB that is sources of PCB contamination, another source of PCB could be from the Ship breaking yards. A study conducted by R. Hess. et.al, on Disposal Options for Ships focusing on American Ship Industry, found that another source of PCB was from the ship breaking industry.

5.2 PCB's from ship breaking yard

Until 1960, ship breaking involved mainly dismantling of small-disused barges and coastal wretches but during seventies, the ship breaking activity registered commendable growth and later by the year 1979 it was recognized as full-fledged small-scale industry. The activity, which was confined to Mumbai and Kolkata, spread primarily on the western coast and other parts of the country.

The major centres for ship breaking activities in the country are as given in Table 8.

Table 8: Ship breaking centres in India

Sl No.	State	Ship breaking Activity locations
1.	Andhra Pradesh	Vishakhapatnam
2	Gujarat	Alang Sachna
3.	Karnataka	Tadri,Mangalore,Malpe
4.	Kerala	Baypore,Cochin,Azhical
5.	Maharashtra	Mumbai
6.	Tamilnadu	Tuticorin
7.	West Bengal	Kolkata

On an average, around 200 ships are broken up every year in Alang. The classes of ships broken are given in Table 9 .

Table 9: Classes of ships arriving at Alang for breaking

S.N0.	Types of ship	Approx. %
1	General cargo and Bulk carrier	60-65
2	Refrigerator Cargo Vessel including fish factory vessel	15-20
3	Oil Tankers	10
4	Passenger-ship and Warship	5
5	Cruiser and Drill ships	4-5

A total of 4551 ships have been broken amounting to 31.95 Million LDT (3.95 million tonnes) till 1999.

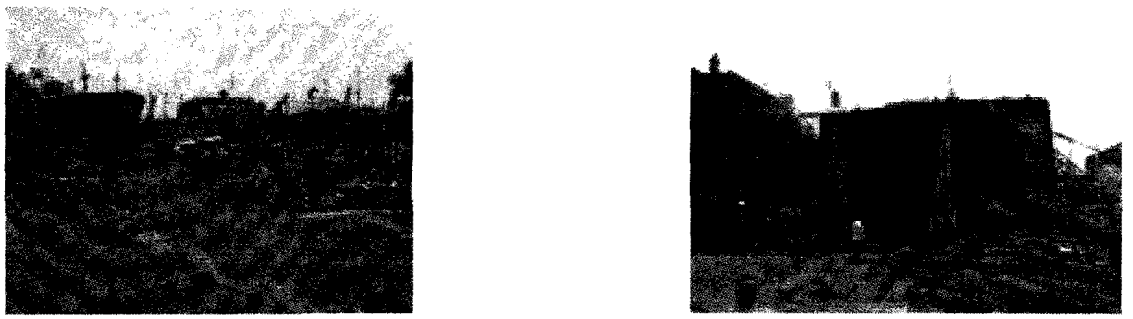

Fig:10 Ship breaking activity at Alang

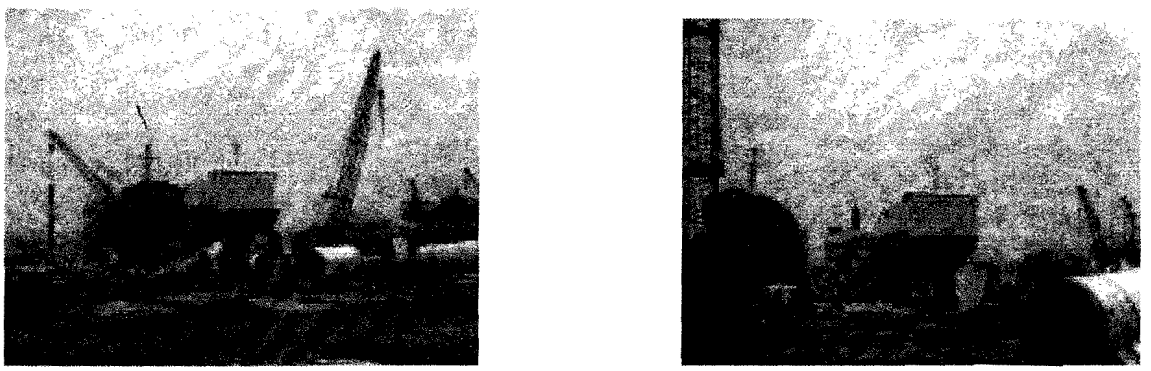

Fig:11 Ship breaking activity at Alang

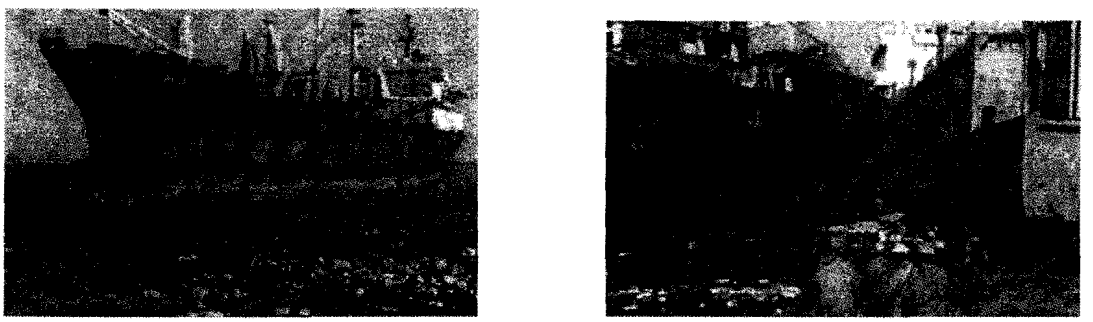

Fig:12 Ship breaking activity at Alang

5.3 STATISTICAL OUTPUT

- No of Vessels beached till June – 2010 : 5252
- LDT Broken: 37.46 Million MT

The statistics of ship breaking activities at Alang is as shown in Table 10.

Table 10 : Statistics of ship breaking activities in Alang

STATISTICS OF SHIPBREAKING ACTIVITIES AT ALANG/SOSIYA				
YEAR	NO.OF SHIPS	TONNAGE IN MT	CUMULATIVE TOTALS	
			NO.OF SHIPS	TONNAGE LDT
1982-83	5	24716	5	24716
1983-84	51	259387	56	284103
1984-85	42	228237	98	512340
1985-86	84	516602	182	1028942
1986-87	61	395139	243	1424081
1987-88	38	244776	281	1668857
1988-89	48	253991	329	1922848
1989-90	82	451243	411	2374091
1990-91	86	577124	497	2951215
1991-92	104	563568	601	3514783
1992-93	137	942601	738	4457384
1993-94	175	1256077	913	5713461
1994-95	301	2173249	1214	7886710
1995-96	183	1252809	1397	9139519
1996-97	348	2635830	1745	11775349
1997-98	347	2452019	2092	14227368
1998-99	361	3037882	2453	17265250
1999-00	296	2752414	2749	20017664
2000-01	295	1934825	3044	21952489
2001-02	333	2727735	3377	24680224
2002-03	300	2420724	3677	27100948
2003-04	294	1986123	3971	29087071
2004-05	196	938976	4167	30026047
2005-06	101	480361	4268	30506408
2006-07	136	760800	4404	31267208
2007-08	136	643437	4540	31910645
2008-09	264	1945540	4804	33856185
2009-10	348	2957225	5152	36183410
2010-11 UP TO 28 JUNE 2010	100	646740	5252	37460150

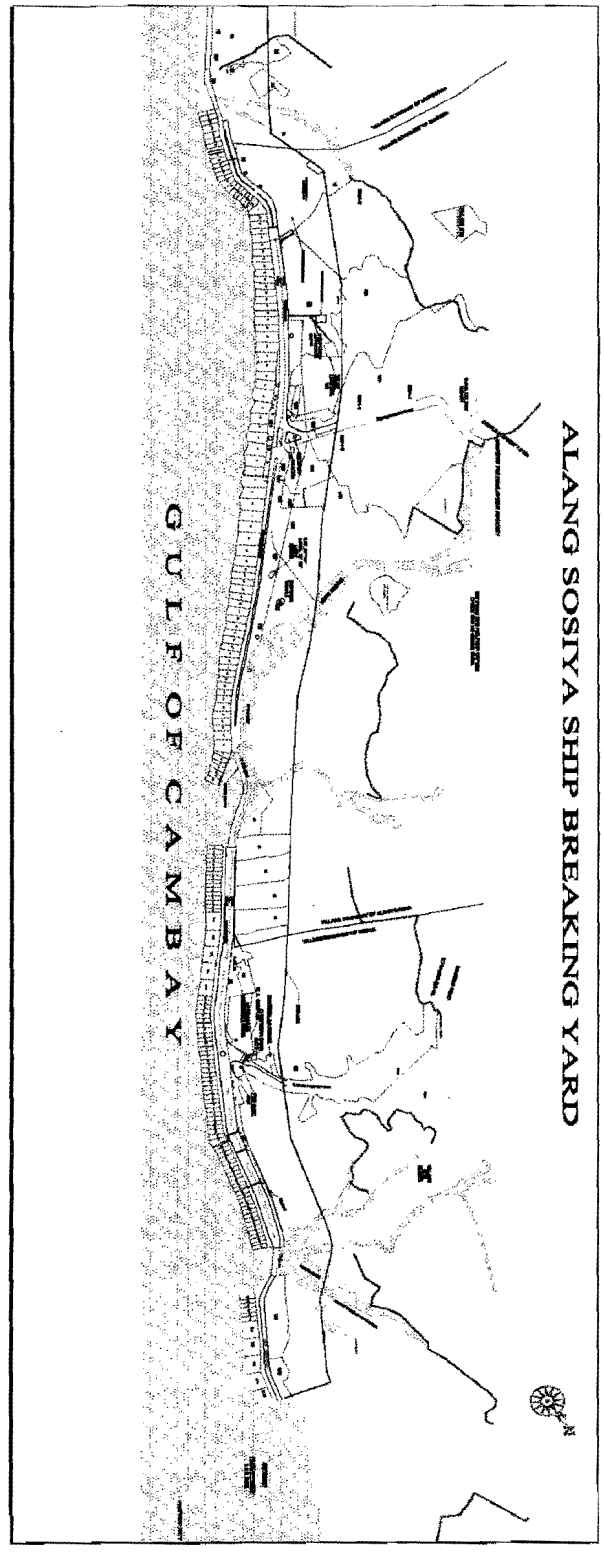

Fig:13: Alang Sosiya Ship Breaking Yard

The Alang Ship breaking Yards in Gujarat Fig13are plots on the Alang beach assigned to plot holders who purchase ships for breaking (Fig10-12), then have them piloted to the Gujarat coast. The difference between low and high tide in this area is more than 10 meters that makes it ideal terrain for beaching and dismantling operations. Photos show ships in the initial stages of being broken up.

House-keeping in the ship breaking industry is fairly poor or non-existent. Everywhere the beach is strewn with debris and litter from broken ships including non biodegradable thermocole, and asbestos.

The beach has retained a permanent dark stain due to continuous exposure to oily wastes. PVC bags bloated with oil sludge's taken from the ship prior to its dismantling. Many of the bags had burst their contents onto the sand. Yet HPC was continually assured the oil was "carefully" removed from ships before they were broken.

More than 90 per cent of the material is steel, less than 1% is considered hazardous waste. Yet, even this 1% is not handled as per the laws and guidelines on ship breaking in force. The graveyard of ships may eventually become a graveyard of the environment as well.
Open fires on the beach used to eliminate hazardous wastes like oil, asbestos, thermo Cole, glass wool and other unwanted debris. This practice must be absolutely abandoned, as it is a source of dangerous air pollutants as well.

5.4 PCBs – Analytical Studies in India

PCBs are regularly encountered during recycling of merchant ships. B. D. Ghosh (1999) reports up to 800 kilograms of PCBs in the paint of merchant ships recycled in India in recent years and also reports PCBs in electric cables and other materials. India's Ferrous Scrap Committee reports that there are PCBs in many materials in the commercial ships recycled at the Alang, India, yards but that none were found in the environment surrounding the yard [30].

A vessel's pipe and tanks contain oil and sludges from the fuel and lubricating oils. Oils and fuels poison marine organisms and soil of the environment, threatening

natural resources. Oils and fuels are toxic to humans and can be inhaled or consumed in contaminated fish or water. At Alang, however, waste oil is burned on the shore, along with whatever cannot be sold. In Mumbai, it is callously pumped into the sea.

Bilge is water that is heavily contaminated with oil and cargo residues, which has drained to the ship's bilge. While a ship is being scrapped, there is further water contamination as rainwater and water used for fire control joins it. Ballast water is water that has been intentionally brought on board to adjust the trim and stability of the ship. This wastewater often contains pollutants that could include the POPs. Sometime oil cargo tanks are used for ballast, making the ballast water particularly oily. Ballast water may also contain aquatic organisms brought from another part of world, which threaten the ecological balance in the seas where they are released; and viruses and bacteria, which can transfer to humans.

The mean concentration of PCBs in the Indian Ocean as investigated by number of scientist is furnished in Table 11.

Table 11 : Mean concentration of PCBs in the Indian Ocean

Region	Sample/Number	PCB Concentration **(ppb wet weight)**	Reference
I	Fish (13)	N.D.	Sarkar, A and R. Sen Gupta 1992
II	Fish (48)	N.D.	"
III	Zooplankton (33)	N.D.	"
IV	Water (6)	95 (10-310)	"
V	Sediment (42)	54 (35-72)	"
VI	Sediment (87)	9.02 (2.1-40.6)	Burns, K.A. et al., 1982 & Fowler, S.W. 1990
VII	Fish (57)	0.098 (0.051-0.25)	Rajendran, R.P. et al. 1992 Ramesh, A. et al., 1990
VIII	Water (6)	55.93 (0.4-295.4)	*Ibidem* Tanabe, S. et al.1993
IX	Seal muscle (11)	3.2 (0.66-7.1)	Cockcroft, V.G. et al.1989 Cockcroft, V.G. et al.1990
X	Water (25)	4.7 (4.2-5.7)	*Ibidem* Monod J-L. 1992

The transboundary impacts of PCBs could possibly be felt in India. PCBs have entered and still enter the environment from different routes in different modes. Since, studies on PCB contamination are yet in a dormant stage in the country barring a few individual or project specific studies, it is difficult to either quantify or identify the presence of PCBs in India. Another limitation is the available of an appropriate methodology for analysis.

6. PCB MANAGEMENT: POLICIES AND LEGISLATIONS IN INDIA

6.1 Prevailing PCB management policies in India

Oil and oily waste may contain substances in concentrations, which make them hazardous, such as transformer oils; coolants containing hazardous substances like PCBs, etc. Unused Fuels such as LDO and HSD may remain as it is in storage tank. In such cases the unused oil may be directly sold in the market. If the oil belongs to the waste oil category then it can be used as a fuel for energy recovery provided content of PCB in that oil is known. If oil / waste oils are not classified as used oil, then it must be tested to determine pollutant concentrations and evaluate if they are hazardous. PCBs (Polychlorinated Biphenyls) belong to a broad family of man-made organic chemicals known as chlorinated hydrocarbons. Due to their non-flammability, chemical stability, high boiling point and electrical insulation properties. PCBs are found in solid (waxy) and liquid (oily) forms in the equipment and materials on ships being scrapped. PCBs study shows evidence for potential carcinogenic and non-carcinogenic effects.

Oil sludge and waste oil is regulated as Hazardous Waste (HW) by MOEF under the schedule-1, appended to rule 3(i)(a) categorized in waste 37.1 of HWM amended rule [2000]. Waste oil for which no concentration limit is given comes under schedule-2, appended to rule 3(i)(b) categorized in class E of HWM amended rule [2000].

PCBs are regulated as HW by MOEF under the schedule-1, appended to rule 3(i)(a) categorized in waste 28.1 and 32.4 of HWM Amendment Rules [2000]. The concentration limit for PCBs given under schedule-2, appended to rule 3(i)(b) categorized in class A (A16) of HWM amended rule [2000] is 50 mg/kg.

Regulations of unprecedented scope and impact have been passed by the Government of India in order to protect and improve our natural environment and resources. The forty-second amendment of our Constitution (1976) underscored the importance of "green thinking". Article 48A of our Constitution enjoins the state to protect and improve the environment and safeguard the forests and wild life in the country. Further, Article 51A(g) of the Constitution states: "Fundamental duty of every citizen is to protect and improve the natural environment including forests, lakes, rivers, and wildlife and to have compassion for living creatures".

The spirit of environmental protection, expressed by the Indian Constitution, has been embodied in the "Water Act" of 1974 and the "Air Act" of 1981, which addressed the pollution issues related to water and air, respectively. The Central Pollution Control Board (CPCB) has evolved the national level industry-specific standards called Minimal National Standards *(i.e.* MINAS) which contemplate a minimum level of treatment for the specific industrial wastewater. This minimum level of treatment has been stipulated on the basis of the annual turnover of the industry as well as the techno-economic feasibility of the control objective. Thus, in principle, the MINAS consider a certain kind of equity amongst the similar industries.

The need for disposal of toxic and harmful liquids, solids, and sludge has been answered by articulating regulations for disposal of hazardous wastes. The "Environment Protection Act", 1986 closed the loop and under the authority invested in the Ministry of Environment and Forests (MOEF) three sets of rules regarding hazardous wastes/chemicals were promulgated. The "Manufacture, Storage, and Import of Hazardous Chemicals Rules" of November 1989 are motivated by a desire to prevent the industrial accidents. These rules distinguish the chemicals based on the level of potential hazard.

A variety of agencies and trade promotion councils have been interested in counting the generation rates of hazardous waste at state as well as national level in India for quite some time. All their efforts were at best sketchy because no reliable data were forthcoming from the SPCBs, CPCB or from the MoEF. The question of reliable inventory came on to the anvil even in the Supreme Court petition and the High

Power Committee (HPC) made efforts to gain a realistic idea of the nature and quantum of hazardous wastes generated within the country.

The HPC sought status reports in three specific areas:

(a) Number of units involved in Generation / handling of hazardous wastes and therefore covered by the HWM&H Rules, 1989;
(b) Nature of wastes handled;
(c) Quantities of hazardous wastes generated.
As relevant records, required under the statute, were not maintained either by industries or SPCBs, the data made available to the HPC by the various authorities relating to the number of units generating/recycling hazardous wastes in the respective states was found to be unreliable and therefore unacceptable for the various reasons recounted in this report.

The HPC conducted a survey by sending questionnaires to all the State Pollution Control Boards (SPCBs). The collected information was collated with respect to amount of waste generated, the quantity and type of waste as well as facilities available for their disposal. Table 14 gives the state wise status of number of units generating waste as well as quantity of waste generated in wastes types like recyclable, incinerable and disposable [HPC Report, volume II, Annexure 7, 2000]. In the present manuscript, the data published by the HPC Report, volume II, Annexure 7 [2000], as shown in Table10, has been regarded as the authentic information. 16.86 million tonnes hazardous waste generated in the country is recyclable every year, 18.81 million tonnes is incinerable and 25.30 million tonnes is destined for land disposal.

6.2 Relevant statuary bodies for PCBs management in India

India has a policy on PCBs but these need to be further strengthened by taking into account the total PCB in use and the sources of their entry into the country. Thereafter, steps have to be undertaken to identify movement of PCB from cradle to grave. A good disposal system has to be formulated in order to prevent the spent oils/lubricants containing PCB enter the natural environment.

On 28th July 1989, the Ministry of Environment and Forests (MoEF) brought in The Hazardous Wastes (Management and Handling) Rules, 1989, under the provisions of the Environment Protection Act, 1986 (These Rules were amended on 6.1.2000.) The Rules were drafted to enable the authorities to control the handling, movement and disposal of hazardous wastes generated indigenously within the country, as well as imports of such wastes into India.

The HW Rules, 1989, provide for controls on the generation, collection, treatment, transport, storage and disposal of hazardous wastes listed in the Schedule annexed to these Rules (The full text of the HW Rules, 1989 is provided at ***Vol.III: B3***).

The principal thrust of the HW Rules, 1989, is that every occupier generating hazardous wastes will do so only with authorization from the State Pollution Control Board (SPCB); that the SPCB will grant such authorization only after verifying and satisfying itself that the occupier possesses appropriate facilities, technical capabilities and equipment to handle hazardous wastes safely. The Rules also require that hazardous wastes will be packed and labelled during transport and that they will be deposited in waste disposal sites selected by the State Government after an environment impact study.

6.3 Responsibilities of Statutory Authorities

The implementation of these rules was largely to be effected through the identified agencies, viz. MoEF, CPCB, SPCBs, and the State Governments (Departments of Environment). The following were the responsibilities of the MoEF, the CPCB, SPCBs, and State Governments as per the HW Rules, 1989, in so far as they dealt with indigenously generated hazardous wastes:

(a) Ministry of Environment and Forests

The MoEF is responsible for the implementation and enforcement of the Environment Protection Act, 1986, and Rules issued under the Act, including the HW Rules, 1989. Under sections 3 and 5 of the EP Act, 1986, it retains enormous powers to issue directions in the interests of environment protection.

(b) **Central Pollution Control Board (CPCB)**

The CPCB is responsible for the overall implementation and monitoring of air and water pollution control regimes in the country under the Water Act, 1974, and the Air

Act, 1981. But under the HW Rules, 1989, it was not assigned any statutory role in the management of hazardous waste.

The CPCB was involved in the matter of hazardous waste management in its role as a State Board for Union Territories until such functions were transferred from the Central Board to the Pollution Control Committees under the directions of the Central Government.

(c) **State Pollution Control Boards (SPCBs)**

The HW Rules, 1989, assigned the principal role in the safe handling and management of hazardous wastes to the SPCBs. The SPCBs were required to:

i) Grant authorization to occupiers/operators to conduct any activity connected with the generation and handling of hazardous wastes. For this, the SPCB had to examine the applications (made by occupiers in Form 1) for authorization to deal with hazardous wastes, and to grant authorization for operating facilities for collection, reception, treatment, storage, transport and disposal of hazardous wastes in Form 2 (Rule 5).

ii) The State Board was prohibited under Rule 5 (4) from granting authorization if it was satisfied that the occupier did not have the necessary facilities, technical capabilities, and equipment for safe handling of hazardous wastes.

iii) The Board could suspend or cancel the authorization (Rule 6) or refuse it (Rule 7), if conditions imposed in the letter of authorization were not met by the occupier/operator.

iv) Under Section 9, proper records had to be maintained by the occupiers and the returns had to be sent annually to the SPCBs in Form 4. Accidents had to be reported to the SPCB in Form 5. Under the Environment

Protection Act, 1986, the State Boards were delegated powers of entry and inspection (section 10), sample collection (section 11) and powers for prosecuting (section 19) any industrial unit that violated the prescribed standards and provisions of the rules. The power to give direction (section 5) for closure of the unit covered under the HW Rules, 1989, was delegated subsequently in 1997.

(d) **State Governments**

Under the HW Rules, 1989, State Governments were entrusted with certain responsibilities in relation to management of hazardous wastes. These were:

I) Identification of sites for the disposal of hazardous wastes in their States, after ascertaining the suitability of the sites through Environment Impact Assessment studies (Rule 8);

II) Preparation and maintenance of an inventory of such sites (Rule 8).

III) Preparation and notification of hazardous wastes dump sites (Rule 8).

Thus, the State Governments undertake a continuing program for identification of sites for disposal of hazardous wastes. They are also required to undertake Environment Impact Assessment (EIA) studies before identifying such waste disposal sites. More importantly, they are required to publish an inventory of sites within which hazardous wastes had at any time been stored or disposed of, together with the location and description, and also information relating to the amount, nature, and toxicity of hazardous waste at each of such sites along with the inventory.

6.4 Amendment of HW Rules, 1989, on 6 January 2000

The MoEF commenced study of amendments to the HW Rules in 1992. After India ratified the Basel Convention, it was required to bring its national legislation in line with the commitments made by it under the Convention. The MoEF used the opportunity to modify the Rules dealing with indigenously generated hazardous wastes as well. The amendments came into force on 6 January.2000.

The responsibilities assigned to various statutory authorities for management and handling of indigenous hazardous wastes are set out in Schedule 4 of the HW Rules, 1989/2000 and are as furnished in Table 12.

(a) **Ministry of Environment and Forests:**

MoEF remains in overall charge of implementation of the Rules at the national level, while the SPCBs are responsible for implementation at the State level. The MoEF has also retained with itself the power to decide on identification of hazardous wastes. In 1996, an Expert Committee headed by Dr R.A. Mashelkar, DG, CSIR, was assigned the task to prepare a report advising the Ministry on hazard characterization and prioritization of hazardous wastes with a view to regulating and managing imported and indigenously generated wastes.

(b) **Central Pollution Control Board:**

The CPCB has now been assigned an enlarged and specific role in hazardous waste management that comprises:

i) Coordination of activities of SPCBs in relation to hazardous wastes.

ii) Monitoring the compliance of the conditions of authorization issued by the SPCBs.

iii) Conducting training courses for authorities dealing with management of hazardous wastes.

iv) Recommending standards for the treatment and disposal of wastes and leachates, and specifications of materials and procedures for characterization of hazardous wastes.

Table 12: Schedule 4 of the HW Rules, 1989/2000

S.No. (1)	Authority (ies) (2)	Duties and corresponding Rule (3)
1.	Ministry of Environment and Forests under the Environment (Protection) Act, 1986	i) Identification of hazardous wastes as per Rule 3 ii) Permission to exporters as per Rule 14(3) iii) Permission to importer as per Rule 13(3)
2.	Central Pollution Control Board constituted under the Water (Prevention & Control of Pollution) Act, 1974	i) Coordinate activities of the State Pollution Control Boards and ensure implementations of the conditions of imports ii) Monitor the compliance of the conditions of authorization, import and export iii) Conduct training courses for authorities dealing with management of hazardous wastes iv) Recommend standards for treatment, disposal of waste, leachate and specifications of materials v) Recommend procedures for characterization of hazardous wastes
3.	State Pollution Control Boards constituted under the Water (Prevention & Control of Pollution) Act, 1974	i) Grant and renew authorisation under rule 5(4) and rule 8 ii) Monitor the compliance of the various provisions and conditions of authorisation iii) Forward the application for imports submitted by the importers as per rule 13(1) iv) To review matters pertaining to identification and notification of disposal sites.
4.	Directorate General of Foreign Trade constituted under the Foreign Trade (Development & Regulation) Act, 1992	i) Grant licence as per rule 13(5) ii) Refuse licence for hazardous wastes prohibited for imports under the Environment (Protection) Act, 1986
5.	Port Authorities and Customs Authorities under the Customs Act, 1962	i) Verify the documents as per rule 13(6) ii) Inform the Ministry of Environment & Forests, Govt. of India of any illegal traffic as per rule 15 iii) Analyse wastes permitted for imports and exports iv) Train officials on the provisions of the Hazardous Wastes Rules and in analysis of hazardous wastes.

SPCBs:

SPCBs have been made responsible for review of matters relating to identification and notification of disposal sites. This is in addition to their responsibilities under the HW Rules, 1989, which remain unchanged, but have been set out now in greater detail. Earlier, the SPCBs had no statutory role in the identification and notification of disposal sites. However, in many states they were directed to take up this work or provided an advisory role.

(C)State Governments

The responsibility of the State Government to identify hazardous waste disposal sites has been diluted. Identification of sites will now be a shared responsibility between industry and the Government. Once a site has been identified, it must be subjected to the EIA process. The Government will then notify the site, inviting objections and conduct a public hearing if there are objections. The responsibility of the Government to compile and publish an inventory of such disposal sites has been maintained.

6.5 Need for monitoring and evaluation of PCB management strategies in India

• India lacks an effective management system for handling PCBs.

• There is a need to identify dedicated sites for disposal of PCB containing waste (if any are the country).

• Though PCBs are framed under the Hazardous Waste Management Rules, its concentration in the wastes is not measured and monitored.

• There is dearth of PCB data availability in the country. Data that exists is scattered and is related to research work by individuals or individual agencies.

• The rules and regulation framed for handling hazardous waste at the ship-breaking yard need to be implemented.

• Though there exist policies that ships entering ship-breaking yard to be well inspected for all hazardous commodities, practice of the same is doubtful.

• Manufacturers of transformers and Capacitors are also unaware that the oil used for testing purpose contains PCBs.

• Lack of good management practices for PCBs was observed even in the corporate sectors that under normal circumstance maintaining proper data and management of hazardous waste is lacking.

• Rules and policies framed have not penetrated to the grass root level.

• There is no dedicated manpower to monitor implementation of rules and regulation of hazardous waste.

7. Preliminary analysis of the preferential fields and activities of category PCBs, POPs Convention

India never was a manufacturer of PCB. The requirements of PCB for numerous applications were through imports. The problem in India with respect to PCB is due to unaccountability of the used transformer oils and those used in open and partially open applications. Since, trace concentration has been monitored and estimated in samples tested for PCB, precaution has to be taken to prevent contamination on account of PCB. Management and proper handling of PCB stockpiles has to be carried out using adequate technical support. There prevails problem due to PCB contamination in India based on the scanty literatures available.

Being signatory to the Stockholm Convention provides the best opportunity for solving issues pertaining to PCB and other POPs in the country. However, alternative for PCB has to be provided with technical economical assurance.

Above all the necessity is for sensitizing stakeholders on the subject of PCB and consequences it can create to environment and human health. This is because the issue does not stand true to a single country as PCB has got trans-boundary movement and is persistent in environment.

Efficient monitoring on a continuous basis is essential to understand the trend in PCB concentration. This can be achieved provided there are sufficient numbers of well-equipped laboratories that follow standard protocols for estimating PCB concentration.

Monitoring body has to be set up at the Central, State and district level for regular analysis of PCB and a data bank has to be developed for proper interpretation of analytical information. Special consideration has to be made in the NIP stage for proper analysis, analytical facilities, training, required standard chemicals and protocols. Above this, detailed inventory for estimation of the stockpiles and other sources of PCB has to be carried out in NIP.

7.1 Effective enforcement and capability enhancement of policies and regulations on PCBs.

The policies and legislations framed for hazardous waste management need to be practiced. The officials associated with government bodies at the Centre and at the State Level have to effectively implement the rules and regulations.

Only on practicing the existing rules the lacuna if any in the current legislations and policies can be identified. Therefore, it is essential to review the existing policies and legislations on PCBs management in the draft NIP stage. Amendments if any, can then be made. Capability enhancement of the officials and monitoring body on hazardous waste and in particular those concerned with PCB management is required in order to implement the rules and regulations.

7.2 Preparation of PCBs Inventory in India

The area of great concern is the stockpiles of PCB and PCB contaminated waste if any. Such stockpiles and contaminated sites need to be identified for which a good investigation methodology has to be formulated in the NIP.

A track on the import of PCB and the distribution of imported PCB has to be monitored. In addition to legal import those if at all through illegal trade have to be identified and stopped. Total number of PCB containing transformer and capacitors in use and those defunct has to be identified.

A detailed list of total application containing PCB has to be made including the quantity used in them, waste generated and means for its safe disposal.

Field visits in the 5 zones revealed that detailed investigation on priority basis has to be carried out to have an inventory of stock of PCB and mode of its handling and management in the NIP. The areas that are of prime concern and could be considered for investigation are Mumbai and Nagpur in Maharashtra, Korba in Chattisgarh, Ernakulam in Kerala, Ahmedabad & Vadodara in Gujarat, Salem

7.3 Creation of PCBs monitoring capability in India

First and foremost, since carrying out analysis of PCB is not mandatory in India, no good technical data is available in the country. In addition to this there is no standard method hence, no good authentic and qualitative information could be gathered.
The current monitoring capability of PCB is inadequate. There are limited numbers of laboratories that can carryout analysis on PCB. Further, analysis of PCB concentration has not been made compulsory.
Accredited and approved laboratories having existing facilities and capability for estimation of PCBs need to be upgraded with requisite facilities for analyzing PCB.
Protocols for PCB as accepted by the international body have to be made available to all the laboratories and stakeholders.
At least one laboratory should be set up in each zone and should be responsible for complete analysis of PCB. Preferably OCP analyzer facility can be geared up for this.
A regulatory body has to be formed that can keep a monitor and evaluate the concentration of PCB in India.

7.4 Identification and risk evaluation of PCBs pollution sites in India

Due to lack of awareness and non-implementation of rules and regulation, stakeholders do not know the harmful effects of PCBs. The probable sites are the ship breaking yards, storage place of used PCB containing oils, the re-processing industries and open application of PCBs. Hence, it is significant to carry out identification of sources of PCBs and risk evaluation due to its pollution in India. A good methodology and research programme is essential during the implementation of NIP.

7.5 Status of PCBs usages in India and its potential impacts on the environment.

There is no effective PCB oriented research activity in the country to ascertain the pollution status. As the final aim and objective of the Stockholm Convention is to control and reduce pollution due to PCB to protect its effect on human and the environment, well-planned investigation on PCB impact has to be carried out.

There are few reports stating concentration level of PCBs in milk, breast milk, air, soil, water and in the hazardous waste disposal sites. Scanty reports on the impact of its on health are available. However, the prevailing literature is insufficient to understand the complete extent of PCB impact in India. Therefore, environmental pollution on account of PCB has to be investigated as soon as possible from all probable PCB sources. Regular monitoring of PCB in different samples types is essential. Investigation on the concentration of PCB in food, human, animals, impact on agriculture and soil has to be carried out.

These research activities will form the basis for estimating and assessing means for elimination of PCB contamination and to meet the objective of Stockholm Convention.

7.6 Development of PCBs disposal technology and destruction of PCBs processing capability in India

PCBs are an environmental issue and final solution to PCBs is to destroy it thoroughly. Therefore, the development of domestic PCBs disposal technique and capability construction is a key task for India to execute the convention in earnest. However, great gap exists between India and international advanced level of PCB disposal technologies in many aspects such as the central control of incineration system, on-line monitoring of incineration tail gas, characteristic identification and analysis of factory entry wastes and security emergency treatment. Definite difficulties also exist in performing the obligation of convention. In addition, India also lacks corresponding technical and equipment supports in PCBs collection, transportation and concentrative safety storage. Therefore, aiming at present situation of PCBs disposal techniques in India, improving and developing PCBs disposal techniques (including relevant collection, transportation, safety and storage) and analyzing the demand of relevant disposal capability construction are also a activity of executing preferentially the convention.

7.7 Awareness through people participation for elimination of PCBs in India

The PCBs pollution control and elimination in India will firstly involve owners of PCBs storage sites and direct pertinent persons in regulatory agencies, involve with a number of relevant parties in PCBs storage sites and their circumferences, and also

involve with extensive masses affected directly or indirectly. Therefore, conducting propaganda and education of PCBs pollution control policies and actions, raising the consciousness of general public for PCBs and strengthening public's obligation and sense of responsibility in executing the POPs convention should be considered as the important preferential actions during the performance process.

7.8 Strategic selection of eliminating PCBs in India

The Convention puts up the total strategy of cutting down and eliminating PCBs. Various countries prepare their concrete procedures and measures according to their concrete situations in present PCBs management situation, relevant technical level, and economic bearing capability. Therefore, based on above research achievements, considering domestic practical situation, the working-out of concrete strategies and action plan for eliminating PCBs pollution in India is an important component for India to execute the Convention.

8. STRATEGY AND PROGRAMME ON REDUCTION AND PHASE OUT OF PCB IN INDIA

8.1 Objectives

The objective of this project is to develop an inventory methodology based on results of pilot projects and a draft strategy on approaches and options for disposal/reduction of PCB. The draft strategy will provide an assessment of current PCB disposal, reduction, management, policy and regulation and identification of approaches and options (or course of actions) that are suitable for India. Both the inventory methodology and the draft strategy will be integrated into the development of a PCB Action Plan in the NIP. MOEF and relevant departments such as the Power Sector and industry associations will be fully involved in the project.

8.2 Recommendation for proper handling and disposal of PCB Waste

a) Labelling of products and Wastes

Modern electric transformers and large capacitors should undertake retrospective labeling, wherever possible. The strict maintenance procedure for PCBs filled units are required in comparison to units filled with hydrocarbon oils.

b) Storage and containment

The bulk liquid PCBs and waste liquid PCBs must be adequately sealed and well labeled and stored in heavy duty containers, but not in standard drums. In case of highly chlorinated type PCBs used in transformers, the manufacturers should use appropriate labeling. The PCBs for reclamation from PCBs based material should be stored in sealed containers to avoid contamination of external environment.

c) Handling

Appropriate housekeeping is mandatory, when PCBs are utilized for any product manufacturing. The transfer of liquid PCBs should have to be appropriately conducted to ensure, that it should not be a residual source of pollution. Where large quantities of PCBs are still used, the bunds, dump tanks should be provided to prevent PCBs passing into the drains, if the dielectric fluid is mishandled. Strict precautions should be taken to ensure that PCBs do not enter into sewerage system or watercourse particularly from old disused transformer dump yard or storage place.

9 Inventory Methodologies

9.1 Proposed Project Activities

Inception Activities

a. Preparation of a detailed work plan of the project with timelines. The work plan will be used the basic document for planning and coordination of all project activities and will be subject to regular reviews and revisions as the project progress.
b. Organization of international inception workshop to discuss of the overall work plan.

9.2 Development of a PCB inventories methodology

The inventory methodology will enable India to collect a comprehensive PCB inventory, which will provide a quantitative information base for initiating development of an Action Plan for PCBs in the National Implementation Plan. Activities planned for this output include the following:

a. Data and information collection, preliminary instructions preparation and training.
i) Formation of working teams:

- An expert teams responsible for the development of inventory methodology; and

• Investigation working groups for collection of inventories and PCB management;

ii) Identification of two pilot zones that have reasonable statistics on PCBs in equipment in use, production (if any) and use of new PCBs, PCB contaminated equipment stored as waste equipment, PCB storage. PCB management and management of contaminated sites;

iii) Collection of historical data and information on PCB's those are currently available from the relevant departments/agencies on PCBs management.
Data and information will include (list may not be exclusive) –

- Regulation of the use of PCBs and the management of PCB contaminated waste.
- Production of PCBs or PCB-containing products.
- Data on imported equipment applicable to PCB and particularly PCB containing equipment and products,
- Possible guidelines for identification and management of PCB containing equipment prepared by government agencies, trade organizations, power companies etc.
- Possible surveys of PCBs in equipment prepared by power companies, and other potential major users of PCB-containing equipment (e.g. lighting fixture and electrical appliances manufacturers).
- Information held by power companies and the main suppliers of transformers and capacitors,
- Existence of laboratories that carry out analyses of PCBs in transformer oil or other PCB-containing fluids,
- Level of PCB management within the existing hazardous waste management system.
- Facilities of storage and destruction of PCBs, etc.

iv) Preparation of instructions containing practical information for those who are going to do the inventory work. This will help to ensure a consistent approach and maximize efficiency of the resources deployed. The guideline should be effective.

10. Existing policies, laws and regulations

The Constitution of the Republic of India covers the principles of environmental protection. The State's responsibility with regard to environmental protection has been laid down under Article 48-A of the Constitution, which reads as follows *"The State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country"*. Environmental protection is a fundamental duty of every citizen of this country under Article 51-A(g) of the Constitution which reads as follows ***"It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures."***

Table 13. Subjects related to environment in the seventh schedule of the Constitution

List	Entries	
Union list		
	52	Industries
	53	Regulation and development of oil fields and mineral oil resources
	54	Regulation of mines and mineral development
	56	Regulation and development of inter-State rivers and river valleys
	57	Fishing and fisheries beyond territorial waters
State list		
	6	Public health and sanitation
	14	Agriculture, protection against pest and prevention of plant diseases
	18	Land, colonisation, etc.
	21	Fisheries
	23	Regulation of mines and mineral development subject to the provisions of List-I
	24	Industries subject to the provisions of List-I
Common or Concurrent List		
	17A	Forests
	17B	Protection of wild animals and birds
	20	Economic and social planning
	20A	Population control and family planning

The Environment (Protection) Act, 1986 was introduced as an umbrella legislation that provides a holistic framework for the protection and improvement for the environment. In terms of responsibilities, the Act and the associated Rules requires for obtaining environmental clearances for specific types of new/expansion projects (addressed under Environmental Impact Assessment Notification, 1994) and for submission of an environmental statement to the State Pollution Control Board annually. Environmental clearance is not applicable to hydro projects. Environmental Impact Assessment has to be carried out for all projects as a standard management procedure as laid down in The Environment (Protection) Act, 1986 and also functions within permissible standards of ambient air quality and noise levels as prescribed by national laws and international regulations.

1. The **Pollution Control laws** in India are as follows:
   - The Water (Prevention and Control of Pollution) Act, 1974
   - The Water (Prevention and Control of Pollution) Rules, 1975 – Schedules
   - Central Board for the Prevention and Control of Water Pollution (Procedure for Transaction of Business) Rules, 1975
   - The Water (Prevention and Control Of Pollution) CESS Act, 1977
   - The Water (Prevention and Control of Pollution) CESS Rules, 1978 and Annexures
   - Central Water Laboratory
   - The Water (Prevention and Control of Pollution) Cess (Amendment) Act, 2003
   - The Air (Prevention and Control of Pollution) Act, 1981
   - The Air (Prevention and Control of Pollution) Rules, 1982 and Schedules
   - The Air (Prevention and Control of Pollution) (Union Territories) Rules, 1983 and Form
   - The Environment (Protection) Act, 1986
   - The Environment (Protection) Rules, 1986 and Schedules
   - The Environment (Protection) Third Amendment Rules, 2002
   - Rules for the Manufacture, Use, Import, Export and Storage of Hazardous Micro Organisms Genetically Engineered Organisms or Cells, 1989
   - Hazardous Wastes (Management and Handling) Rules, 1989
   - The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989
   - Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules, 2000, Draft Notification
   - Bio-Medical Waste (Management and Handling) Rules, 1998
   - Hazardous wastes (Management and handling) amendment rules, 2000
   - Hazardous Wastes (Management and Handling) Amendment Rules, 2002

- S.O.979(E), [27/8/2003] - Amendments to S.O.763(E) dates 14/9/1999 Dumping and disposal of fly ash discharged from coal or lignite based thermal power plants on land
- Municipal Solid Wastes (Management & Handling) Rules, 2000
- Battery (Management and Handling) Rules, 2000
- The Noise Pollution (Regulation and Control) Rules, 2000
- The Noise Pollution (Regulation and Control) Rules, May, 2002
- Re-cycled Plastics Manufacture and Usage Rules, 1999
- Re-cycled Plastics Manufacture and Usage Amendment Rules, 2002
- The Recycled Plastics Manufacture and Usage (Amendment) Rules, 2003
- Ozone Depleting Substances (Regulation) Rules, 2000

2. Some **important notifications** are as follows:
   - Delegation of Powers to the Central Pollution Control Board
   - Environmental Impact Assessment Notifications
   - Public Hearing Notifications
   - The Coastal Regulation Zone Notifications
   - Coastal Regulation Zone Notification dated May 21st 2002
   - Aquaculture Authority – Notifications
   - Eco-labelling Notifications
   - Notification Concerning Open Burning Oil
   - Notification Concerning Ban on Import of Hazardous Wastes
   - Constitution of Appellate Authorities

3. **The Hazardous Waste (HW) Rule, 1989**, issued under the provision of Environmental (Protection) Act, 1986, controls and regulates the import of the hazardous wastes into the country. As per Rule 11 of the Hazardous Waste Rule, import of waste from any country to India shall not be permitted for dumping and disposal. However, the import of such wastes is allowed for processing and re-use as raw material, after each case has been examined on merit by the State Pollution Control Board (SPCB). The HW Rule was amended in 6 January 2000 to improve its applicability and implementation. The Hazardous Wastes (Management and Handling) Amendment Rules, 2003 classify used mineral oil as hazardous waste under the Hazardous Waste (Management & Handling) Rules, 2003 that requires proper handling and disposal. Organization will seek authorization for disposal of hazardous waste from concerned State Pollution Control Boards (SPCB) as and when required (Please mention the recent notification).

4. India is a party to the Basel Convention. It signed the Convention on 15 March 1990, ratified it on 26 June 1992, and acceded to the Convention on 22 September 1992. Ratification of this instrument represents India's commitment to solving, in a collective manner through international cooperation, the problem of transboundary movement and disposal or dumping of dangerous and unwanted hazardous wastes.

5. PIL 657/95 (filed on 18 September 1995) deals specifically with the import of hazardous wastes into the country in violation of the provisions of the Basel Convention. Despite the Convention, traders and industrial units in the country have been importing, for several years, large quantities of hazardous and non-hazardous wastes, and the mixture of both, for purposes of dumping instead of recycling for their own use. All hazardous wastes listed under Annexure VIII of the Basel Convention are banned for import as per the order dated 5 May 1997 of the Supreme Court in the above mentioned petition. As per section 11 of the HW Rules, 1989, the MOEF is responsible for the overall control of hazardous wastes import and the import applications are processed by the concerned SPCB. MOEF and SPCB are also responsible to oversee the environmentally sound and safe handling at the time of off-loading of hazardous wastes through the appropriate port authorities.

6. Polychlorinated Biphenyls (PCB) are classified under Schedule II, Class A chemical notified by the Government of India under its notification entitled Hazardous Materials (Management, Handling and Transboundary Movement) Rules 2007 . In spite of the fact that PCBs were banned for import by MOEF Notification dated 13 October 1998, their import might still happen.

7. Poly Chlorinated Biphenyls have been used in various applications. It is use as liquid dielectric was in bulk quantities. This material has never been manufactured in the country. Most of it is imported as pure dielectric or in the form of equipments which contain this.

In India there are constitutional provisions for protection and improvement of the environment. In the Directive Principles of State Policy of the Constitution, Article 48-A of Chapter IV enjoins the state to make endeavor for protection

and improvement of the environment and for safeguarding the forest and wild life of the Country.

Though the provisions are available but lacked the teeth for regulatory control. Lack of technical and financial resource assignment for the management of hazardous wastes in the past had led to the unscientific disposal of hazardous wastes in India and most of the times it is not brought to the notice of regulatory agencies. The threat would be disastrous and in view of large geographical area, long rivers, agrarian population would cause irreparable and large scale environmental disasters if accidentally spilled in large quantities in strategic areas.

However it is to be noted that, in order to manage hazardous waste (HW), mainly solids, semi-solid and other Industrial wastes which are not covered by the Water & Air Acts, and also to enable the authorities to control handling, treatment, transport and disposal of waste in an environmentally sound manner, Ministry of Environment & Forests (MoEF). Government of India has notified the Hazardous Waste (Management & Handling) Rules (HWM Rules) on July 28, 1989 under the provisions of the Environment (Protection) Act, 1986 and was further amended in the year 2000 & 2003. Another important notification published in the Gazette of India in the year 2008 handles the issue of hazardous waste management in a very systematic manner. The notification clearly defines the various hazardous wastes in categorised manner including the contamination limits and their classifications. The clauses clearly define the trans-boundary movement, import export, illegal traffic of hazardous waste and material. Procedures have been clearly laid for export with prior informed consent, import for recycling, free importable materials for recycling. Clear cut procedures for recycling, reuse, handling, storage and transportation has also been made. Treatment, storage, disposal facility for hazardous wastes are also subjected to strict norms described. The details of formats for all these aspects are also given under the notification Unlike earlier notifications, poly chlorinated biphenyl has been mentioned as a hazardous material under schedule II, A16 and concentration limit as ≥ 50 mg/kg for contamination.

However, under schedule III part A components having this material has been allowed to be imported under prior information. Basel No. A1180 and under A4110 Electrical and electronic waste assemblies or scrap containing PCB capacitors or contaminated with polychlorinated biphenyl to an extent that they do not exhibit hazard characteristics.

Similar aspect is also noted under Schedule III part B, wherein list of hazardous materials for import and export not requiring prior informed consent unless otherwise contains or contaminated with list A materials to the extent exhibiting schedule III part B characteristics. This is listed under the Basel No. B1040 for Scrap assemblies from electrical power generation not contaminated with lubricating oil, PCB or PCT to an extent that they do not possess any of the constituents mentioned in Schedule II to the extent of concentration limits specified therein. Same is the case with Basel No. B1110 for Waste electrical and electronic assemblies scrap containing PCB capacitors or Poly chlorinated biphenyl. However provisions have been made for the user to establish the non hazardous nature of these imports and necessary intimation to the regulatory agencies.

These clarities will essentially help in sound management of PCB and equipments containing the same. However, provisions made for import under schedule 3 can be diluted to some extent and or can be misinterpreted to get the hazardous materials imported.

It may also be viewed that special notification about the declaration of PCB equipment owners before decided date, which otherwise should call for heavy penalty clauses. The same has to be given wide publicity so that all the PCB equipment owners will volunteer the information so that all the material available in the country will be inventorized and will be taken up for the next step viz., environmentally sound management.

8. Waste oils are regarded as hazardous wastes as they may contain toxic heavy metals, PCBs, chlorinated solvents, etc. PCBs are added to waste oils by intentional or accidental mixing. Because their oily appearance and mineral oil miscibility, they are mixed with other waste oils. In many cases, PCB owners deliberately mix PCBs with other waste oils intended for recovery, in

order to hide PCBs, thus saving expenses for the disposal of PCBs as hazardous wastes. Based on a letter dated 22 August 1997 from the MOEF, the Department of Revenue, Ministry of Finance (MOF) of the Government of India, has recommended by circular No.60/97-CUS that if on sampling, the concentration of PCBs in the imported waste oil is >5mg/l, the consignments can be released to the importers on submission of required details in Form 6 (HW Rules, 1989).

9. Similarly, importing ocean liners for ship-breaking can release several hazardous materials such as asbestos, PCBs, etc. Based on the reports from the ship-breaking yards of Alang, Gujarat State notified in several occasions that imported vessels had hundreds of tonnes of materials contaminated with PCBs. One of the last incidents was reported in 2006 by an inspection team consisting of a Technical Experts from MOEF, Central Pollution Control Board (CPCB) and Gujarat Maritime Board. The inspection team confirmed the presence of PCBs. Such incidents show that the technical capacity to manage such dangerous materials and to protect their workers should be strengthened.

11. PCBs elimination technologies

India has not carried out PCBs pollutants elimination or replacement work on electrical equipment containing PCBs, and lacks related technologies. Since a large quantity of PCBs, PCB containing equipment and wastes have been inventorized under the present investigations, there is an urgent need to dispose of identified PCBs and its stocks in an environmentally sound manner. The prevailing state-of-the-art non burn technology adopting BAT/BEP has been described at **Annexure 1.** The broad methodology to be adopted for disposal of PCB as per ESM guidelines is also discussed.

12. Research data

India has not conducted systematic monitoring of PCBs in the environment and has only conducted research monitoring in some areas. Some of the monitoring results are shown in Table 14. Research shows that PCBs exist in sediments of a few estuaries and marine coastal areas.

Table 14: Studies including PCBs loads in aquatic species

Location	Tissue Samples	PCBs means(range)ng/g	References
Tamil Nadu (1987-91)	Fish Turtle Crab	(0.75-40) (3.4-6.9) (2.9-29)	Ramesh 1992
Delhi(1989-93)	Fish	(0.77-110)	Kannan 1995
Bombay(1989-93)	Fish	(0.38-6.8)	Kannan 1995
Kolkata(1989-93)	Fish	(1.6-9.5)	Kannan 1995
Patana(1989-93)	Fish	(20)	Kannan 1995
Ganges(1988-92)	Dolphin	(4.6-620)	Kannan 1994
Ganges(1988-92)	Fish	(20	Senthilkumar 1999
Ganges(1993-96)	Benthic Invertebrates	(34-47)	Senthilkumar 1999
North India(NA)	Dolphin	(8.4-123.48)	Senthilkumar 2001a
South India(NA)	Fish	(2.18-4.12)	Senthilkumar 2001a

13. Strategy and Action Plan

The objective of the Stockholm Convention on Persistent Organic Pollutants (POPs) is to reduce, eliminate and prevent the health and environmental risks posed by POPs through effective implementation of the Stockholm Convention, helping to maintain healthy development of humans, safeguarding ecological environmental safety, promoting sustainable development, and building a harmonious society.

Sincere efforts to ensure the implementation of the NIP shall be pursued through a coherent implementation framework put in place by the Government as well as by coordination and cooperation among all the stakeholders.

Based on the actual situation analysis, improved and modified policies, acts, rules and regulations and with strengthened capacity, the strategies and actions would be

carried out to implement the obligation under the Convention with the ultimate goal to achieve the environmentally sound management of currently used equipment containing PCBs in demonstration states and identified PCBs containing equipment in use and in stores (non-operational) by 2015.

14. Priority Areas

Besides other, the following are the priority areas for the management of PCBs under the National Implementation Plan in India.

1. Improve and revise the national policies, acts, rules and regulations required for Convention implementation and
2. strengthen institutional capacity;
3. update the inventories of electrical equipment containing PCBs and wastes containing PCBs and develop inventory of PCBs from other sources;
4. Undertake demonstration projects and replication programs for safe disposal of PCBs and PCBs containing wastes; and
5. Strengthen capacity building and establish a long-term, effective mechanism to control POPs releases.

In order to address the problems identified in the NIP, it is imperative to define the actions into short term and long term which can be achieved in 5 years and 15 years timeframe respectively.

Short term planning

1. Developing a mechanism for owners of PCBs for self declaration, registration and environmentally sound management of currently used equipment containing PCBs.
2. Undertaking the Environmentally Sound Management and disposal of PCBs wastes in demonstration areas by 2015.
3. Steps to eliminate the use of PCBs in currently used equipment containing PCBs.

Long term planning

To ensure safe removal and disposal of PCBs and PCBs containing equipments and wastes including the health protection measures from all sources in the country, safe

transport to temporary storage sites and ultimately to the site of final disposal through a Environmentally Sound Management manner. This would be achieved through proper identification; labelling and handling of all currently used equipment, sources containing PCBs and eliminate uses of PCBs and wastes by 2025.

15. Action Plan

The NIP has identified to destroy 1700 tons of pure PCB and 6000 tons of PCB waste over a period of five years. The objective of this programme is to demonstrate ESM of PCBs in 3 pilot states. The methodology adopted in these programme will be replicated in other parts of the country for destruction of PCB as per ESM guidelines. The activities undertaken for PCBs inventory preparation and the status of PCBs in India for developing its National Implementation Plan critically analysed the situation and brought out the following action plan:

1. **Strengthening policy and regulatory framework to comply with the obligations under the Stockholm Convention**

   Objective: Improve, strengthen and revise laws, rules, regulations and policies pertaining to management of PCBs. Implementation of established legal and regulatory framework at the targeted states in the country.

   This would be achieved through

   a. ***Reviewing legal and regulatory framework for the ESM of PCBs***
      i. Evaluation of existing national legal and regulatory framework
      ii. Evaluation of gaps between Stockholm Convention requirements and existing legal/regulatory framework
      iii. Recommendations to legislative bodies for new and/or revised laws to implement Stockholm Convention requirements
      iv. Recommendations to regulatory bodies for new and/or revised regulations and guidelines to implement Stockholm Convention requirements

   b. ***Establishing/upgrading legal and regulatory framework at the national level***

i. Enactment of new and/or revised laws to implement Stockholm Convention requirements
ii. Issuance of new and/or revised regulations to implement Stockholm Convention requirements

c. ***Enforcement of national laws and regulations at the field level.***

i. Evaluation of existing State enforcement of PCB management related laws and regulations
ii. Identification of gaps between State implementation and National and Stockholm Convention requirements
iii. Support for State adoption of revised and/or new measures to ensure environmentally safe management and disposal of PCB contaminants

Under this, there is need to evaluate the gaps between Stockholm Convention requirements and existing legal / regulatory frame work and recommend the legislative bodies for implementation.

The above process would be done at the national level and extend the same at state level subsequently. For undertaking this there would be a need to survey the existing practice adopted at present.

In this connection there would be a need to have PCB Management as per the ESM guidelines, the details of which are placed at **Annexure-2**. This should also take care of Centralized authority, to make laws and to implement them, give permission and certificate in the process of ESM of PCB's.

2. Building national capacity

Strengthening the institutional capacity for ESM of PCB-containing equipment and wastes. Strengthening is required for sampling, analysis and monitoring of PCBs.

This would be achieved through

a. Evaluation of institutional capacity for ESM of PCB-containing equipment and wastes

i. Identification of stakeholders to be targeted in institutional capacity building efforts

ii. Evaluation of current stakeholder institutional capacity for ESM of PCB-containing equipment and wastes

iii. Identification of stakeholder capacity building needs

b. Building capacity for awareness raising on the adverse effect of PCBs.

The end-users of PCB are mainly utilities, industries etc. There is an urgent need to educate and bring in awareness on the harmful aspects of PCB at all levels of the organization. A dedicated management team should exist wherever PCB exists to properly handle the situation. Hence, there is a need to build capacity for awareness of PCBs risks.

It is, therefore, necessary to raise awareness and educate the stakeholders including policy makers, regulators, scientists, engineers, handlers and public on the harmful aspects of PCBs. First and foremost job is to evaluate the institutional capacity of ESM of PCB containing equipment and wastes. Institutional capacity for ESM of PCB containing equipment and waste need to be assessed and strengthened. In this process guideline for the method of storage, keeping inventory record, addressing emergency situations like spills, knowledge about certifying authorities, etc. should also be included. There is a need to establish the web based management system to keep track of the inventory and status of implementation of ESM of PCBs.

This would be achieved through

Awareness rising by providing

i. Information on PCB risks and risk minimization disseminated through print media

ii. Information on PCB risks and risk minimization disseminated through online sources

iii. Information on PCB risks and risk minimization disseminated through televised public service announcements
iv. Public awareness raising through targeted workshops
v. Policy makers awareness building

c. ***Organizing training workshops for key stakeholders***

i. Developing training manuals and guidelines on ESM
ii. Organizing workshops/trainings on PCBs phase-out and treatment methods
iii. Strengthening capacity for workplace safety monitoring

There is a need to train the trainers on PCB-phase out and disposal methods. This would be augmented through organizing regional and national workshops/ training programmes and theses programmes would cover the following aspects:

iv. Planning and organization of PCB phase out and treating methods to be developed.
v. Safe monitoring by safety engineers.
vi. Identification and labelling of PCB equipment.
vii. PCB monitoring kits.

Training workshop would cover the information available on the latest destruction technologies for PCB's.

From the available data, it is estimated that in the total inventory of 10,000 tonnes of PCB is known to exist in transformers operating in utilities and industries in which 30% is found to be pure PCB liquid.

Steel sector alone is found to have pure PCB around 1700 tonnes. While disposing of the PCB in the operating transformers, it is very much necessary that the process should not affect the normal business of the end user.

Incase, if we decide to destroy the transformers, its implication in terms of replacement cost need to be addressed first. The method to be adopted treatment of

pure PCB filled transformers either by total disposal or by retrofilling has to be finalized.

From the operational convenience in case of static plant, suitable location has to be identified with a provision of providing basic requirement of land, building, water and power etc., Further for operation and maintenance of the facility a operating entity has to be chosen.

The operational logistics with operating entity has to be clarified for the mobile platform also.

The target under POST NIP is 1700 tonnes of PCB and 6000 tonnes of PCB wastes. Before taking up the task, allowable maximum limit of PCB in oil and in other wastes products like metallic components of the transformers have to be finalized.

As the above said exercise is only for the demonstration project the practical issues of technology transfer for PCB treatment and development of local skill to meet the requirement of treating remaining part PCB to ultimately meet the objectives of Stockholm convention needs to be addressed.

3. Management of PCB , PCB contaminated equipment and wastes:

From the available data, it is estimated that in the total inventory of 10,000 tonnes of PCB is known to exist in transformers operating in utilities and industries in which 30% is found to be pure PCB liquid. Steel sector alone is found to have pure PCB around 1700 tonnes. While disposing of the PCB in the operating transformers, it is very much necessary that the process should not affect the normal business of the end user.

Incase, if decided to dispose the transformers, its implication in terms of replacement cost need to be addressed first. The method to be adopted treatment of pure PCB filled transformers either by total disposal or by retrofilling has to be finalized. From the operational convenience in case of static plant, suitable location has to be identified with a provision of providing basic requirement of land, building, water and

power etc., Further for operation and maintenance of the facility a operating entity has to be chosen. The operational logistics with operating entity has to be clarified for the mobile platform also. Before starting PCB disposal, allowable maximum limit of PCB in oil and in other wastes products like metallic and non metallic components of the transformers have to be established.

The NIP emphasise the need to improve the environmental management system for PCBs including the management procedures and the requirements for the declaration, registration, online operation, emergency response and off-line disposal of electrical equipment containing PCBs; establish upto date inventory and tracking management mechanisms so as to avoid release in the environment; and prohibit the use of PCBs in electrical equipment and other processes. In order to meet this, there are number of other actions that need to be taken at the national level and are as follows:

a. **Identification, elimination and environmentally sound management of electrical equipment containing PCBs in use through establishing an improved system for environmentally sound management of PCBs.**
b. **Strengthening the capacity of management institutions including power sector and other industries with regard to self declaration, registration, safe disposal, etc.**
c. **Updating of national inventory of PCBs and PCBs containing equipment and wastes to comply with the requirements under the Convention.**
d. **Implementation of ESM of PCBs, PCB containing equipment and wastes through establishing dedicated facilities at the demonstration sites in selected states.**
e. **Strengthening regional capacity for final treatment and disposal of PCBs, PCB containing equipment and wastes in an ESM.**

4. **Enhancing Monitoring**

In order to understand properly the release sources, the content of PCBs and its movement there is a need to establish a monitor mechanism and the following actions are suggested:

a. **Augmenting the PCBs monitoring system for identification and control of PCBs release into the environment.**
b. **Monitoring the PCBs levels in the soil, water and sediment.**
c. **Monitoring the PCBs levels in the food crops, aquatic fauna, poultry, animal feed, higher mammals including human beings, etc.**
d. **Monitoring PCBs contaminated sites and its remediation measures.**

5. **R&D actions**

Identification of technologically acceptable and economically viable alternatives to the PCBs.

16. CONCLUSIONS:

16.1 Details of PCB's Inventory

The inventorization on PCB's was under taken covering all the 28 states and 7 Union territories. This was done through letters containing addressed to all utilities throughout the country including the major industries namely steel, cement fertiliser sugar, paper, ship breaking as well transformer manufacturers (for more details see Annexure – 3).

Out of 1800 letter sent responses received from 1500 respondents. Ten industries voluntarily declared PCB containing transformers in their organization. It is observed that though some utilities are having transformers with PCB or with PCB contamination, some major findings are also in certain sector like steel industry, power utilities and other heavy industries. From the data collected so far, it is observed that pure PCBs of 3000 tones and

contaminated PCBs above 500ppm is 6717.557 tonnes and PCBs stored in drums 120 tonnes for maintenance and servicing is shown in Table16

Table: 16: Details on PCB's present in India

Sl.No.	PCB' Concentration	Total Tonnes
1	Pure PCBs (100%)	3000.03
2	Contaminated PCBs Above 500ppm	6717.557
3	PCBs stored in drums for maintenance.	120.00
	Total	9837.587

16.2 Establishment of test facilities at CPRI

The analytical facilities of CPRI including GC-ECD/Ms with auto sampler has been utilised for testing. The equipment has capability to detect PCB at 10 ppb and above levels.

16.3 Awareness Programs

Two Brain storming sessions and 30 awareness programme have been conducted at various places though out the country since January 2009. The response was found to good and interactive. Nodal officers for all the states have been identified from electricity boards and pollution control boards. It is observed that awareness about harmful effects of PCB among the utilities, Industries is very poor. This has been experienced where we interacted personally with seniors officials of utilities and industries.

16.4 Regulations:

The Environment (Protection) Act, 1986 was introduced as an umbrella legislation that provides a holistic framework for the protection and improvement for the environment. In terms of responsibilities, the Act and the associated Rules requires for obtaining environmental clearances for specific types of new/expansion projects

(addressed under Environmental Impact Assessment Notification, 1994) and for submission of an environmental statement to the State Pollution Control Board annually. Environmental clearance is not applicable to hydro projects. Environmental Impact Assessment has to be carried out for all projects as a standard management procedure as laid down in The Environment (Protection) Act, 1986 and the recent gazette notification 2007 also functions within permissible standards of ambient air quality and noise levels as prescribed by national laws and international regulations.

How ever there is a lacuna in the existing laws, hence the laws should be strengthened and gaps should be identified, so that the usage of PCBs can be completely avoided.

There is an immediate need to address the issues about the environmental laws to safe guard the environment from the release of PCBs.

16.5 Implementation / Action Plan

The action plan is to demonstrate ESM of PCBs by disposing 1700 tons of pure PCB and 6000 tons of PCB waste over a period of five years. The methodology adopted will be replicated country wide for disposal of PCBs in consonance with ESM guidelines.

The activities undertaken for PCBs inventory preparation and the status of PCBs in India for developing its National Implementation Plan is critically analysed the findings and brought out in report.

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Annexure 1

NON-COMBUSTION TECHNOLOGIES FOR THE DESTRUCTION OF PCB's AND/ OR DECONTAMINATION OF PCB's CONTAMINATED MATERIALS

Retrofilling is an economical and simple solution for the removal of PCB-containing mineral oil from in-service equipment. Depending on the original PCB level in the mineral oil of the contaminated transformer, retro-filling may have to be repeated to achieve the usually less than 50 ppm target level. Based on industry experience, transformers with PCB in the liquid that contain between 50 and 700 ppm will require just one retro-filling process to achieve a final PCB concentration of less than 50 ppm. Transformers that contain between 700 and 2,000 ppm will require two retro-fillings to achieve less than 50 ppm target. However, transformers than contain between 2,000 and 10,000 pm will require retrofilling to be applied 3 times to achieve less than 50 ppm.

Because most of the mineral oil electrical transformers contaminated with PCBs contain less than 700 ppm, then it is expected that one retrofilling application will be required to convert most of the PCB-containing transformers into PCB-free units. Retrofilling, when applied to PCB-containing mineral oil transformers is a sound and economical solution for the elimination of PCBs from electrical systems.

In order to economically apply the retrofilling solution to mineral oil PCB-containing transformer, it is necessary to have access to a dechlorination unit that can treat the mineral oil and selectively destroy the PCBs. The dechlorination system however has to be able to yield a mineral oil that can be suitable for re-use in the electrical transformer.

Distribution of the PCB in transformers shows that most of the PCBs are in the dielectric fluid and in the absorbed porous components namely insulating paper and wood spacers. A very small fraction of PCBs in a transformer is contained in the metallic components. Specifically, PCBs or oil-containing PCBs are held on the surface of the inert metallic (steel) and imbedded in the varnish that may be coating the conductor (copper wiring). Degreasing solvents have been used to dissolve the

PCBs from the metallic surfaces, rendering a PCB-containing solvent and a PCB-free metal.

Aggressive solvents such as Perchloroethylene and other chlorinated materials are being used to decontaminate porous materials and metals from PCB-containing transformers. Technologies based on solvent extraction require a method to reclaim the solvent. Because of the significant difference of the boiling point between the chosen solvent and the PCBs, distillation has been commonly used for this purpose.

In the context of the proposed PCB project in India, however, where a smaller number of PCB-containing transformers will require metal cleaning, it is conceived that rather than using the normal degreasing solvent such as Perchloroethylene, hot mineral oil can be used as PCB dissolvent agent. The hot oil will be able to dissolve the PCBs from the metallic surfaces and lowering the contamination level to lower than 50 mg/kg or other acceptable standard. The PCB-containing oil recovered from the metal cleaning activity will then be treated in the dechlorination unit, destroying selectively the PCBs and rendering a dielectric fluid suitable for re-use in transformers or for cleaning additional metallic components.

The vast extent of the PCB contamination problem in India represents a significant economical and environmental challenge for the Indian government and PCB users to meet the commitments made under the Stockholm Convention.

In order to assist countries like India to deal with the disposal of obsolete POPs, including PCBs, the GEF, concurrent with its mandate to support innovative and environmentally sound approaches and technologies, will support the demonstration and replication of innovative and cost-effective practices and technologies, in particular non-combustion technologies. Based on waste streams, some of these non-combustion technologies have proven to be superior to incineration, not only economically, but also from the environmental and social points of view.

The proposed project aims at establishing decontamination/treatment facilities for the environmentally sound dechlorination and reclamation of PCB-containing mineral oil

as well as at the decontamination, reclamation and recycling of copper and steel recovered from PCB-containing mineral oil transformers, specifically through:

- Establishment of facilities to drain, dismantle and decontaminate metal components from PCB-containing transformers.
- Establishment of dechlorination plants to reclaim PCB-containing mineral oil. These plants could be made fixed or mobile and would be used to clean PCB-containing mineral oil from in-service transformers, as well as to clean the mineral oil used to clean the metallic components of surplus PCB-containing transformers.

It is foreseen that the establishment of these facilities will provide India with:

- Within the country, long-term, best economical solution for dealing with PCB disposal problem. Decontamination of PCB mineral oil using dechlorination methods is less expensive than shipping and incinerating the waste in European incinerators. In addition, the mineral oil in dechlorination systems is reclaimed and reused in transformers, unlike incineration where it is totally destroyed and has to be replaced by new oil to fill the empty transformers.
- Best environmental solution, as only the small fraction of PCB within the waste matrix, is selectively destroyed without the need to destroy the whole matrix as incineration would do. This approach not only reduces the potential generation of carbon dioxide, but allows the recovery and recycling of valuable commodities such as transformer mineral oil, copper and steel.
- Best social solution, as sustainable jobs are created within India to maintain the facilities and the PCB services being offered.

The following proposed criteria were applied to the PCB destruction/dechlorination technologies considered for this project:

A. Complete destruction of the PCB contaminant without destruction of the mineral oil.
B. Commercially available and proven track record
C. Prevent the formation of dioxins, furans and other by-product POPs.

D. Not generate any wastes with POPs characteristics.

Based on the above-mentioned criteria, the following technologies are considered suitable for use in the proposed project for India:

- Based Catalysed Dechlorination (BCD)
- Sodium Reduction Processes
- CDP Process

1. Base Catalyzed Decomposition (BCD)

The chemical dehalogenation (dechlorination), is a chemical process used to remove halogens (usually chlorine) from a chemical contaminant by hydrogen or a reducing radical containing hydrogen donor.

The Base Catalyzed Decomposition process was initially developed for remediating PCB-contaminated soil, but it was demonstrated that it is also applicable to soil contaminated with other chlorinated as well as non-chlorinated organics. The technologies have the following important characteristics:
The additions of sodium bicarbonate to promote lower temperature desorption and partial destruction of chlorinated organics.
Steam sweep to create an inert atmosphere above the hot soil. The inert gas suppresses the formation of oxidative combustion products like dioxin and eliminates the possibility of combustion occurring in the rotary reactor.
A novel control system to allow a wet electrostatic precipitor (WESP) in the off-gas treatment system to operate without the danger of a fire or explosion.

Compounds such as PCBs, which may react with oxygen at elevated temperatures to form even more hazardous compounds such as dioxins, are specially suited to the BCD. The inert stream atmosphere in the rotary reactor and throughout the air capture system excludes most of the oxygen. The sodium bicarbonate breaks down, releasing carbon dioxide and water to add additional inert gases to the system. Semi volatile water-soluble organics are captured in the water through solubilisation. The carbon at the end of the air system captures volatile organics non-water soluble and

residual PCB vapours. The total quantity of organics released in the rotary reactor is an important factor in the overall economics of the system. As the bicarbonate causes only partial destruction of PCBs, all the condensable organics released will be contaminated with PCBs. This contaminated residual must be disposed offsite, typically by incineration. Factors that may limit and interfere with the effectiveness of chemical dehalogenation are high clay or water content, acidity, or high natural organic content of the soil. In practice, the formation of salt within the treated mixture can limit the concentration of halogenated material able to be treated. In addition, in the process the organic contaminants volatilized in the reactor must be collected and treated and the off-gas must be collected. The BCD process offers many advantages over existing chemical dechlorination methods, including the potential for significant cost savings. The operating costs of a full scale. BCD systems are projected to be less than one-fourth the operating costs of incineration, currently the most common destruction process.

As the BCD process essentially involves stripping chlorine from the waste compound, the treatment process may result in an increased concentration of lower chlorinated species (e.g., higher congeners are replaced by lower congeners). This is of potential concern in the treatment of dioxins and furans, where the lower congeners are significantly more toxic than the higher congeners. It is therefore essential that the process be appropriately monitored to ensure that the reaction continues to completion.

Total destruction efficiency of greater than 99.9999% for pure PCBs have been achieved.

2. Sodium reduction process

The sodium based reaction for the dechlorination of electrical insulating oils contaminated with low levels of polychlorinated biphenyls is dependent on the reaction of active sodium with the chlorine in the PCB molecule, under carefully controlled conditions, to form sodium chloride and hydrocarbon residues.

The principle reaction in the process is the direct removal of the chlorine atoms from the PCB molecule by sodium. Important side reactions which occur during the dechlorination process include the reaction of sodium with trace water or with acidic organic oxidation products formed while the oils were in service. These side reactions render undesirable acidic oil components insoluble and therefore assist in their removal in subsequent centrifuging and filtering stages.

The sodium based reaction for the dechlorination of PCB contaminated mineral oil can be designated as a batch or a continuous process. In a batch process the reaction vessel remains close until bath analytical data confirms all PCBs in the reactor has been destroyed. Once the PCB destruction has been confirmed, the reaction vessel is purged with nitrogen during the neutralization of the excess sodium used in the reaction. Obviously, the same level of control cannot be achieved on a continuous process.

The sodium-based reaction as most PCB destruction reaction, it is an exothermic process. The heat of reaction is quite significant and depending on PCB concentration, cold generate enough heat to increase the temperature of the reaction mixture well over the mineral oil flash point. This is more important when destroying high level of PCB liquid waste.

Air emissions include nitrogen and hydrogen gas. Air emission of organic by product is low due to that these facilities have air pollution control systems that include activated charcoal filter.

The sodium reduction method has been applied for the decontamination of mineral oil containing PCBs above 50ppm to the destruction of pure PCBs(100%).
Total destruction efficiency of greater than 99.9999% for pure PCBs have been reported.

3. Chemical dechlorination Process

The process is connected to the transformer and is in continuous mode and closed circuit, with circulation of warm oil, without requiring the draining, even partial of the transformers, re-establishing the chemical-physical features of the oil to the same conditions of new oil and reclassifying it PCBs free in accordance with required standards.

In this process, granulated solid reagent not mixable with oil, formed by mixtures of polyethylene glycols and solid polypropylene glycols with high molecular weight, a mixture of bases and a radical initiator or other catalysers.

During the continuous circulation, the liquid insulating oil is heated at a temperature between 80 and 100oC and undergoes:

- Chemical dehalogenation by percolation under pressure on the solid reagent, pre-prepared in filtering cartridges contained in appropriate containers.
- Depolarisation by percolation under pressure on adsorbent particle supports with a high surface
- Degassing, dehumidification under vacuum and micro filtration.

The destruction efficiency as high as 99.99% can be achieved by this process.

METHODOLOGY TO BE ADOPTED FOR THE DISPOSAL OF PCB AS PER ESM GUIDELINES

In view of the toxic nature of PCB and as required under the Stockholm Convention, there is a need to dispose of PCB as per ESM guidelines in a limited time frame by a method which is based on the Best Environmental Practices and Best Available Technology (BEP & BAT) which is economically viable and sustainable in the long run.

To start with the PCB inventories are presented in two forms:

1) Stockpiles (Stored in drums etc)
2) PCB and PCB Contaminated oil in operating transformers.

In this connection we may have two options like:

1) Static facility
2) Mobile Platform for the treatment of PCB.

Taking into consideration of constrains in the operating transformers it would be appropriate to choose retrofilling method and detailed procedure to be adopted in this process would depend on the level of contamination eg: slightly contaminated (< 500 ppm), heavily contaminated (500 - 2000ppm) and Pure PCBs.(100%).

In the case of Stockpiles, for stored PCBs the trivial solution would be transporting the oil to the static facility for further treatment and ultimate disposal.

In India's context where the types of PCBs inventory may vary from site to site we need to address the issue case by case.

It should be underlined that procedure adopted should be such that it will not affect the normal business of the end user. For implementation of disposal of PCBs, the following steps are required.

a) The service provider (SP) should be aware of the ESM guidelines, regulations of the land, and adopt only such procedures which are in consonance with the existing laws related to ESM of PCBs.

b) The SP shall be in possession of the state of art technologies for the disposal of PCBs.

c) The SP should have the required logistical support for the transportation and intermediate storage of the PCB- PCB wastes to the treatment facility.

d) SP should have adequate infrastructure in terms of man power and other facilities who are well trained in the activities related to ESM of PCBs.

e) On demand of the end user the service provider should be able to provide solutions as a total package on chargeable basis.

f) The SP shall be able to provide service support for the end user in the treatment of PCB as total package solution over a period of minimum 20 years.

g) The local service provider who works under the guidelines of a foreign collaboration shall ensure that foreign collaboration should have demonstrated similar work earlier in other countries.

Annexure-2

GUIDELINES FOR THE MANAGEMENT OF POLYCHLORINATED BIPHENYLS (PCB'S)

(*Source: Guide for The Identification of PCB's and materials containing PCB's, United Nations Environmental Protection, Publication 693, May 2000*)

These guidelines are primarily intended for people who store, handle, use or transport material or waste containing PCB's. It is designed to assist these people with their responsibilities for managing PCB's in India.

These guidelines outline the requirements in India for the management of Polychlorinated Biphenyls (PCB's)

What are PCBs?

PCBs are a group of chemical substances known as polychlorinated biphenyls. Where people have been exposed to PCBs over long periods of time, potential health effects have included irritation of the nose, lung and skin. PCB's are also classified as probable human carcinogens. PCB's are persistent in the environment and can build up in the food chain. (Due to concerns about health effects, the importation and manufacture of PCB's in many countries have been banned since the 1970's. Phase-out of equipment containing PCB's has been ongoing since this time).

Where are PCB's Found?

PCB's were widely used in electrical equipment due to their good insulating, fire resistant and dielectric properties. PCB containing material may still be found in some electrical supply and telecommunications equipment, such as transformers, generators and capacitors.

PCB containing equipment in buildings, generally predating 1980, may include ballasts in fluorescent light fittings, electric motors, ceiling fans and dishwashers.

PCB Management framework.

In India a framework of measures to manage industrial wastes including PCB's has to be established. Within the statutory framework, PCB's are any material or waste containing PCB's at a concentration of more than 50 mg/kg. This includes equipment that contains PCB's at concentration more than 50 mg/kg.

A National Management Plan should provide guidance on the safe management and phase-out of PCBs, setting minimum standards for storage, handling, use and disposal of PCB containing materials.

In summary, the aim of the PCB management framework in India is to:

- Protect human health and the environment.
- Manage and Phase out all remaining equipment and materials containing PCBs consistent with the objectives of the National Management Plan.
- Ensure that PCBs are stored, handled, transported, treated and disposed of in a safe and proper manner.
- Minimize contamination of others materials with PCB's.
- Make publicity accessible, through a register, known quantities, concentrations and locations of PCBs of premises where the total quantity is greater than 10 kg of PCB's in material and waste, at or in excess of the threshold concentration and quantity of 50 mg/kg and 50 g.

The use, sale, storage, handling, transport, treatment and disposal of PCB should be regulated under the Environment Protection Act.

Under these statutory controls, waste PCB's are prescribed industrials waste. Any facility that stores, treats, reprocesses or disposes of waste PCB's requires to be operated under some act/regulation including those facilities that have generated the waste PCBs at the premises. Facilities must be designed and operated in compliance with all requirements under the act including subordinate legislation.

The transport of waste PCBs must be in a permitted vehicle using transport certificates.

The statutory act should be established under which PCBs are notifiable chemicals and should provide a statutory basis for implementation of the National Management Plan. The Act/regulation should prohibit, subject to conditions, the storage, handling, use, scale or supply of PCB's. PCBs that are in use, products or equipment containing PCBs and waste PCB's are subject to the Act/regulation.

Under the Act/regulation, the sale, supply and dilution of PCB's are to be prohibited without the written consent of the competent authority (i.e., Central Pollution Control Board (CPCB))

The statutory Act/regulation shall requires that the occupier of any premises that stores, treats, destroys, disposes of or otherwise handles PCB's must have an Environment Improvement Plan (EIP) approved by competent authority in order to undertake any of these activities. The EIP must meet the objectives outlined in the National Management Plan.

This means occupiers of premises that have equipment containing PCB's or undertake any activities associated with PCBs must submit an EIP for CA (Concerned Authority) approval which demonstrates compliance with the Act/regulation all relevant legislation and is consistent with the objectives of the National Management Plan.

Contravention of the order, including undertaking activities not in accordance with an approved EIP should be considered as an offence under the proposed ACT and may attract penalties.

Sale or Supply:

The sale or supply of PCBs is prohibited without the written consent of the CA. Consent must be obtained form CA prior to sale or supply.

The EIP should identify the types of circumstances when sale or supply may be envisaged. Provided relevant information is included in the EIP, and CA has approved the EIP, this will constitute written consent to sale or supply PCB's. Information must include estimated PCB concentration and quantity, and the transporters and intended licensed destination premises if these are known.

Where an EIP has not been approved by CA, the person who intends to sell or supply PCB's must complete an application form. This form must be submitted to CA for approval. The Competent Authority (CA) will issue a consent number if sale or supply is approved. In seeking consent information must be provided to CA including the estimated PCB concentration, quantity, proposed transporter and CA license number of the intended destination premises.

Estimates of the quantities and concentrations of PCBs can be based on the outcomes of the risk based strategy and statistical survey procedure outlined in the National Management Plan. Where analyses have been undertaken, analytical results should be included.

Emergency situation, such as transport accidents involving PCBs, may necessitate the sale or supply of PCBs, for emergency situations, contact procedure with CA through the emergency services should be established.

For interstate movement of waste, application for a consignment number to allow for transport must be made in accordance with the national Environmental Protection Measure for the Movement of Controlled wastes between States and territories. A consignment number is to be issued by the transport of waste. The procedure for interstate movement of waste PCBs is detailed as follows:

DILUTION

Dilution of PCBs prior to disposal is prohibited without the written consent of CA. Dilution without written consent is a contravention of the Order and an offence under the Act and should attract penalties.

The CA should identify the type of circumstances when dilution may be envisaged. Provided relevant information is included in an CA, and CA has approved the EPI, this will constitute written consent for dilution of PCBs, but only in accordance with the CA.

Dilution may be accepted, and CA may give its consent, where it is to enable destruction of PCBs at a facility licensed to do so. Dilution of PCBs to less than the threshold concentration of 50 mg/kg (from 'scheduled PCB' to 'non-scheduled PCB' as outlined in the National Management Plan) may only be permitted for the purpose of the PCBs.

Dilution of PCBs from the concentration range between the threshold concentration of 50mg/kg and 2 mg/kg('non-scheduled PCB') to less than 2 mg/kg ('PCB-free' as described in the National Management Plan) to enable energy recovery may be permitted, but must only occur with written CA consent. Only licensed premises or premises with an approved EIP will be permitted to undertake energy recovery of fuels derived from PCB waste or to prepare PCB wastes for this purpose. An EIP for these activities must include quality assurance and quality control programs, and measures for monitoring these programs.

ENVIRONMENT IMPROVEMENT PLAN

This means that if any end user, use or transport PCBs they must have an EIP for their premises and activities approved by CA

End user must ensure their CA meets the requirements of the Order and all relevant legislation and is consistent with the objective of the National Management Plan.

The EIP must be signed by the occupier of the premises, or by an officer authorized by the occupier. The EIP must specify how PCBs will be managed and must include:

- Provision for equipment removal, transportation, storage, treatment and disposal of PCBs
- A schedule for equipment removal, treatment and disposal/destruction of PCBs (where relevant).

- A record keeping system for tracking PCBs.
- A system that enables notification of CA the quantities, concentration and location of PCBs above the notification quantity and concentration.

Where they have an existing EMS, EIP, license, or transport permit, the EIP for PCB management should be integrated into these existing for EIP for PCB management must be submitted to CA for approval.

Guidance on what to include in an EIP is provided below

Management, transport, storage, treatment and disposal

The EIP must demonstrate that the management, transportation, storage, treatment and disposal of PCBs will occur in accordance with all statutory requirements, by providing details on all relevant aspects of these activities.

Transport of waste PCBs must be in accordance with relevant regulations, including the use of waste transport certificates, and transport in vehicles permitted by CA to transport the stated category and concentration of PCBs.

The CA shall list transporters permitted to transport waste PCB's and facilities licensed by CA (Concerned Authority) to accept PCB containing waste for a given concentration range.

If end user are intending to have PCBs stored treated, reprocessed or disposed of their EIP should specify the facility that they intend to use for this purpose.

Disposal of solid waste PCBs to landfill for example, PCB contaminated soil, must only occur where the concentration of the solid is within the limits prescribed in the landfill license. Landfills are only licensed to accept solid waste with a PCB concentration of 50 mg/kg or less. Therefore solid waste with a PCB concentration of greater than 50 mg/kg will require treatment, treatment, which must take place at facilities licensed to undertake these activities. Disposal of liquid PCBs to landfill is prohibited.

The National Management Plan (NMP) shall provide guidance on the management and phase-out of equipment containing PCB's (see also 'Schedule for destruction and disposal). If their premise has equipment containing PCB's their EIP must detail and demonstrate management programs that meet the requirements of the NMP, including equipment surveys and risk management plans.

Guidance on the survey, testing and removal of equipment shall outline in the NMP. Equipment survey is required to identify likely locations, quantities and concentrations of PCBs in their premises. Appropriately qualified staff must be used to carry out the survey. Where analysis of PCB containing material is required, this must be carried out by laboratories that are accredited by National Accreditation Board of Laboratories (NABL).

The EIP must also include information on relevant equipment maintenance and inspection programs, emergency containment and clean up procedures, and associated staff training.

Schedule for destruction and disposal

If their premises have equipment containing PCBs their EIP must include the strategy for PCB management and schedule for equipment phase-out for their premises consistent with the objectives of the NMP.
The National Management Plan provides guidance on a risk based strategy for the management and phase out of equipment containing PCB's.

Any containers or equipment likely to contain PCB's that are found to be leaking or in poor condition must be removed or repaired, with any associate contaminated soil safely disposed of as soon as practicable, Consistent with the objectives of the NMP.

Record keeping

Records must be kept by the occupiers of premises involved in the management of PCBs to enable tracking of PCBs from the point of generation through any handling, including transport, storage treatment to final destruction or disposal.

Record keeping for each premise must record: Probable or known PCB location, concentrations and quantities: the transporter and the eventual disposal route (s) (e.g.: transport certificates with this information may be considered an adequate record) and certificates of destruction or disposal. Record keeping must link the results of equipment surveys with the phase-out and removal of PCBs from premises with PCB containing equipment.

All Premises must have adequate record keeping systems to be able to confirm estimated concentrations of each load of PCBs consigned for removal from the premises.

Record keeping must also allow end user to account for and notify CA of notifiable quantities of PCBs (See details under para 'Notifiable Quantity), and update CA annually of any changes.

A description of record keeping systems must be included in the EIP. An officer from CA may ask for records to be produced upon request

Notifiable Quantity

As on specified date the occupier of a premises that contains greater than a total quantity of 10 kg of PCB's in material and waste at or in excess of the threshold concentration and quantity of 50 mg/kg and 50 g ('Scheduled PCB' as outlined in the NMP) must notify CA of quantity, concentration and location of the PCB's as CA must be advised annually before a specified date.

The basis on which the notifiable quantity was determined should accompany the notification.

Notification does not apply to the transportation of individual loads of the notifiable quantity.

Record keeping must enable an inventory to be maintained for your premises for this purpose.

Certificates of destruction or disposal

A facility receiving PCBs is obliged to issue a Certificate of Destruction or Disposal upon their destruction or disposal to the occupier of the premises consigning the PCBs. The occupier of the premises consigning the PCBs must ensure that they obtain a Certificate of Destruction or Disposal.

The facility receiving the PCBs must include information in the Certificate of Destruction or Disposal, including stating if the PCBs have been destructed, or where the PCBs have been disposed to if they have been consigned to another facility.

A copy of the Certificate of Destruction and Disposal is also to be forwarded to the CA.

Records of the Certificates of Destruction or Disposal must be maintained and made available to the CA officers upon request.

Annexure – 3

Methodology for Inventory of PCB.

In the development of the inventory the first step involved is the identification of sources where PCBs are located. As it is well known that major inventory of PCB would be in power sector, hence a list of addresses of utilities and energy intensive industries covering different sectors like steel, cement, fertilizer, paper etc., were compiled.

In this process data was requested only for those transformers installed before 1985 as transformers installed after 1985 are expected to be PCB free. The information obtained in response to the request letter were analyzed and following procedure are adopted for the estimation of PCB

In case the nameplate declares that the transformers were filled with PCB, from the data available the quantity of PCB was estimated.

In case of transformers installed before 1985 the oil samples were collected and tested for PCBs contamination, and contaminated quantity of oil estimated. The flow chart for the building PCB inventory data is shown below:

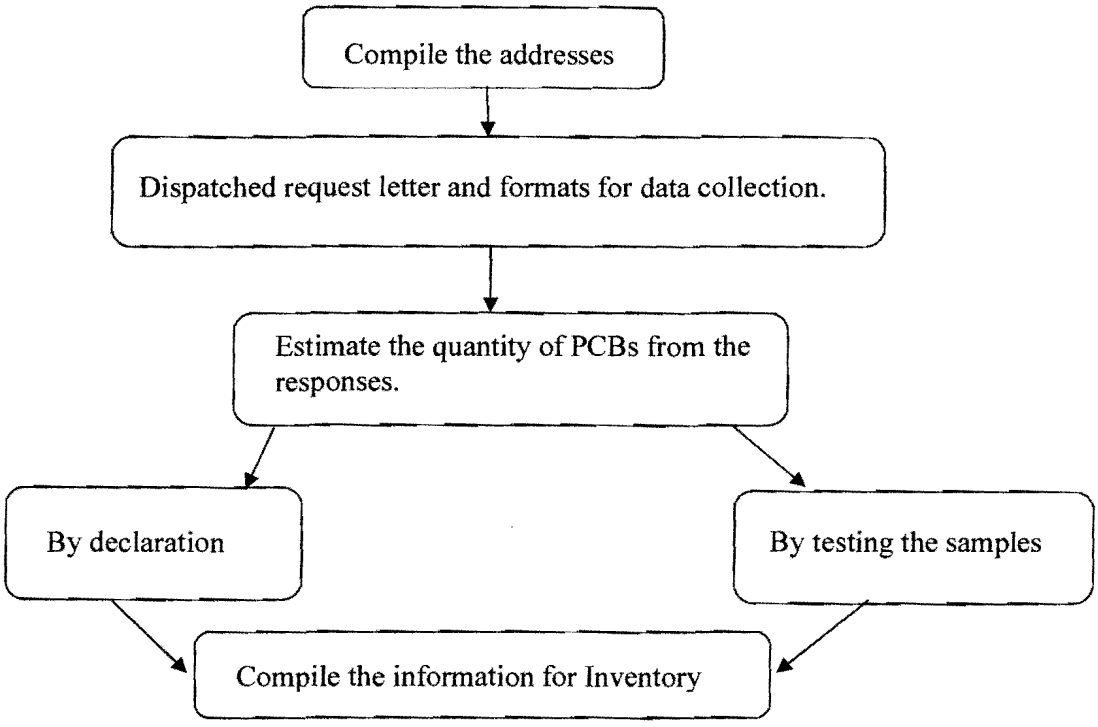

FIG: Flow Chart for the building the PCB inventory data