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# Guideline for Polychlorinated Biphenyls (PCBs), PCBs - Containing Equipment, Packaging and Transportation



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## 1. FOREWORDS

Polychlorinated Biphenyls (PCBs) are very stable compounds which are characterized by extremely low flammability and a very high dielectric coefficient. Due to these properties, PCBs were mainly used in dielectric fluids of the transformers and other electrical equipment. Therefore, PCBs do not directly represent a fire or explosion hazard, which makes their transportation and packaging less problematic than other hazardous substances.

However, PCBs are extremely toxic when exposed to fire or high temperature. Their destruction presents the risk of generating extremely toxic dibenzodioxins and dibenzofurans through partial oxidation. The release of PCBs caused due to an accident during transportation, loading or unloading may result in adverse long term effects to the environment and human health.

This hazardous waste is classified as:

1. Dielectric oil contaminated by PCBs
2. Electrical equipment containing PCBs.
3. And in some cases, PCBs contaminated soil.

These are, therefore, subjected to the National and International obligations concerning the transport of hazardous waste.

However, electrical equipment consisting of PCBs may not be a waste. The Stockholm convention allows the temporary use of electrical equipment consisting of PCBs, which is “*intact and non-leaking equipment and only in areas where the risk from environmental release can be minimized*”. Therefore, the transportation of PCBs containing equipment occurs locally for different purposes rather than disposal.

The main purpose of this document is to provide practical indications, in compliance with the Indian regulations and the International Conventions, for the packaging and transportation of waste and electrical equipment consisting of PCBs in India. This activity is a part of the UNIDO/GEF project “Environmentally Sound Management and Final Disposal of PCBs in India” (hereafter the “India PCBs project”).

## 2. INTERNATIONAL CONVENTIONS ON POPS AND HAZARDOUS WASTE

### 2.1. STOCKHOLM CONVENTION

India is a member and signatory to the Stockholm Convention on Persistent Organic Pollutants (POPs). Annex A (Elimination), Part II of this Convention states:

*Action will be taken in accordance with the following priorities:*

- *Make determined efforts to identify, label and remove the use of equipment containing polychlorinated biphenyls about 2 ppm.*
- *Endeavour to identify and remove the use of equipment containing greater than 50 ppm of polychlorinated biphenyls*

**Definition of PCBs:** The Stockholm Convention sets the following definition of PCBs under Annex C (Unintentional Production), Part IV: “*Polychlorinated biphenyls*” means aromatic compounds formed in such a manner that the hydrogen atoms on the biphenyl molecule (two benzene rings bonded together by a single carbon-carbon bond) may be replaced by up to ten chlorine atoms”.

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No specific requirements on packaging and transportation of PCBs equipment and PCBs waste have been set by the Stockholm Convention.

### 2.2. BASEL CONVENTION

India is a Party to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. The overarching objective of this Convention is to protect human health and the environment against the adverse effects of hazardous wastes. Its scope of application covers a wide range of wastes defined as “hazardous wastes” based on their origin and/or composition and their characteristics (Article 1 and Annexures I, III, VIII and IX), as well as two types of wastes defined under “other wastes” (household waste and incinerator ash; Article 1 and Annexure II).

The provisions of the Convention are centered at the following principal aims:

- the reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes, in all the places of disposal;
- the restriction of transboundary movements of hazardous wastes except where it is perceived to be in accordance with the principles of environmentally sound management; and
- a regulatory system applying to cases where transboundary movements are permissible.

Annex I of the Convention summarizes the Categories of Waste to be controlled.

List A1 and A3 in the Annex VIII of the Convention lists the Metal and Metal-Bearing Wastes and the Wastes Containing Principally Organic Constituents which may contain Metals and Inorganic Materials respectively, and A1180 and A3180 describes the one applicable to PCBs, PCTs or PBBs.

### 2.3. UN ADR

The European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR Rules), established by the United Nations Economic Commission for Europe, represents the standard international reference for packaging, transportation and consignment of hazardous goods.

India is not a contracting party of the ADR. There is an agreement between the States, but there is no overall enforcing authority. In practice, checks carried out by the Contracting Parties may result in legal action by the national authorities against the offenders.

ADR applies to transport operations performed on the territory of at least two Contracting Parties. However, Annexures A and B (the technical part) of ADR have also been adopted by some Contracting Parties (all the EU Member States) as the basis for regulation of the carriage of dangerous goods by road within and between their territories (Directive 2008/68/EC on the inland transport of dangerous goods). A number of non-EU countries have also adopted Annexes A and B of ADR as the basis for their national legislation.

Whenever detailed standards on the transportation of PCBs are not established by the local regulation, Annexures A and B of the ADR rules may represent a suitable technical reference.

ADR rules establish standards, requirements and technical specification on:

- Classification of goods, including classification criteria and relevant test methods;
- Use of packaging (including mixed packing);
- Use of tanks (including filling);
- Consignment procedures (including marking and labeling of packages and placarding and marking of means of transport as well as documentation and information required);

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- Use of means of transport (including loading, mixed loading and unloading) and checking of the transported goods;
- Emergency procedures and Training.

Under the ADR rules, hazardous goods are classified into 9 classes and several sub-classes. PCBs are classified in Class 9 (Miscellaneous Dangerous Substance and Articles). The following sub-classes also apply to PCBs:

1. M2: substance and apparatus which, in the event of fire, may form dioxins;
2. M6: Pollutant to the aquatic environment, liquid.

The ADR rules specify the maximum total quantity per transport unit which can be transported by adopting simplified provisions. However, these simplified provisions do not apply for PCBs. The ADR rules also specify procedures for loading and unloading, as well as the requirements for the transporter and the transportation vehicle.

The ADR rules also set procedures to be followed in case of accidents, including the type of information that has to be passed on to the relevant authorities.

### 2.4. GLOBALLY HARMONIZED SYSTEM OF CLASSIFICATION AND LABELLING OF CHEMICALS (GHS)

The Globally Harmonized System of Classification and Labeling of Chemicals (GHS) is a logical and comprehensive approach to define health, physical and environmental hazards of chemicals; creating classification processes that use available data on chemicals for comparison with the defined hazard criteria; and communicating hazard information as well as protective measures on Labels and Safety Data Sheets. Table 1 shows the GHS classification & hazard phrases for PCBs

**Table 1: GHS classification and hazard phrases for PCBs**

Substance Identification	Name: Polychlorinated Biphenyls; PCBs.	EC Number: 215-648-1 CAS Number: 1336-36-3
Hazard classification and category codes.	STOT RE 2. Aquatic Acute. Aquatic Chronic.	May cause damage to organs through prolonged or repeated exposure. Very toxic to aquatic life. Very toxic to aquatic life with long lasting effect.
Hazard statement (code).	H373. H400. H410.	H373: May cause damage to organs through prolonged or repeated exposure. H400: Very toxic to aquatic life. H410: Very toxic to aquatic life with long lasting effect.
Pictogram and sign warning codes.	GHS08., GHS09. Wng.	
Specific Concentration Limit.	STOT RE 2, H 373: C ≥ 0,005%	
Note	C	The supplier must state on the label whether the substance is a specific isomer or a mixture of isomers.

India currently uses a combination of lists and laws to classify chemicals and govern their storage and handling, including the law concerning the Manufacture, Storage and Import of Hazardous Chemical Rules, 1989, which does not conform to GHS.

The Ministry of Environment and Forests, Government of India has notified the draft titled 'Hazardous Substances (Classification, Packaging and Labeling) Rules', 2011 for public information. The salient features of the draft rules are:

- These rules shall apply to hazardous substances and hazardous chemicals, dangerous goods as specified in the list of chemicals.
- The responsibilities of occupier and consigner have been prescribed. They are required to assign hazard classes, use proper shipping name, suitable packaging, requisite label, marking and use of updated Safety Data Sheet for transportation. The Rules mandate training of persons engaged in handling, storage and transport of dangerous goods.
- Various classes of hazardous substances have been specified viz. explosives, gases, flammable liquids and solids, oxidizing substances, toxic and infectious substances, radioactive materials, corrosive substances and miscellaneous dangerous substances.
- The assignment of UN number and proper shipping names has been prescribed as per its hazard classification and composition. Packaging provisions have been assigned for handling of hazardous substances. Labelling provisions viz. trade name, substance name, Chemical Abstract Name, gross weight, name and address of manufacturer, importer, supplier, emergency contact number, hazard class, packing group and play card etc. have been provided.

### 3. INDIAN LEGISLATION

#### 3.1. THE HAZARDOUS WASTE RULES

Under the Hazardous Waste Rules, 2008, Chapter IV (Import and Export of Hazardous Wastes), Article 12 (Import and export (transboundary movement) of hazardous wastes states:

*The Ministry of Environment and Forest shall be the nodal Ministry to deal with the trans-boundary movement of the hazardous wastes and to grant permission for transit of the hazardous wastes through any part of India.*

Article 13 (Import and export of hazardous wastes) states:

1. *No import of the hazardous wastes from any country to India for disposal shall be permitted.*
2. *The import of hazardous waste from any country shall be permitted only for the recycling or recovery or reuse.*
3. *The export of hazardous wastes from India may be allowed to an actual user of the wastes or operator of a disposal facility with the Prior Informed Consent of the importing country to ensure environmentally sound management of the hazardous waste in question.*
4. *No import or export of the hazardous wastes specified in Schedule VI shall be permitted.*

Chapter VI (Packaging, Labeling and Transport of Hazardous Waste),

Article 19 (Packaging and Labeling) states:

1. *The occupier or operator of the Treatment, Storage and Disposal Facility or recycler shall ensure that the hazardous waste are packaged and labeled, based on the composition in a manner suitable for safe handling, storage and transport as per the guidelines issued by the Central Pollution Control Board from time to time.*
2. *The labeling and packaging shall be easily visible and be able to withstand physical conditions and climatic factors.*

Article 20 (Transportation of hazardous waste) states:

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1. *The transporter of the hazardous wastes shall be in accordance with the provisions of these rules and the rules made by the Central Government under the Motor Vehicle Act. 1988 and other guidelines issued from time to time in this regard.*
2. *The occupier shall provide the transporter with the relevant information regarding the hazardous nature of the wastes and measures to be taken in case of an emergency and shall mark the hazardous wastes containers.*
3. *In case of transport of hazardous wastes for the final disposal to a facility for treatment, storage and disposal existing in a State other than the State where the hazardous waste is generated, the occupier shall obtain 'No Objection Certificate' from the State Pollution Control Board of the both States.*
4. *In case of transportation of hazardous wastes through a State other than the State of origin or destination, the occupier shall intimate the concerned State Pollution Control Boards before he/she hands over the hazardous wastes to the transporter.*

Article 21 (Manifesto system (Movement document to be used within the country only)) states:

1. *The occupier shall prepare six copies of the manifesto comprising of color code indicated below and all six copies shall be signed by the transporter.*

Copy number with color code	Purpose
Copy 1 (White)	<i>To be forwarded by the occupier to the State Pollution Control Board or Committee.</i>
Copy 2 (Yellow)	<i>To be carried by the occupier after taking signature on it form the transporter and the rest of the four copies to be carried by the transporter.</i>
Copy 3 (Pink)	<i>To be retained by the operator of the facility after signature.</i>
Copy 4 (Orange)	<i>To be returned to the transporter by the operator of facility/recycler after accepting waste.</i>
Copy 5 (Green)	<i>To be returned by the operator of the facility to State Pollution Control Board /Committee after treatment and disposal of waste.</i>
Copy 6 (Blue)	<i>To be returned by the operator of the facility to the occupier after treatment and disposal of hazardous waste /materials.</i>

2. *The occupier shall forward copy 1(white) to the State Pollution Control Board, and in case the hazardous wastes is likely to be transported through any transit State, the occupier shall prepare an additional copy each for intimation to such State and, forward the same to the concerned State Pollution Control Board before he hands over the hazardous wastes to the transporter.*
3. *No transporter shall accept hazardous wastes from an occupier for transport unless it is accompanied by copies 3 to 6 of the manifesto.*
4. *The transporter shall submit copies 3 to 6 of the manifesto duly signed with date to the operator of the facility along with the waste consignment.*
5. *Operator of the facility upon completion of treatment and disposal operations of the hazardous waste shall forward copy 5 (green) to the State Pollution Control Board and copy 6 (blue) to the occupier and the copy 3 (pink) shall be retained by the operator of the facility.*

Under the Hazardous Waste (Management, Handling & Transboundary Movement) Rules, 2008, Schedule II, waste containing 50 ppm or more of PCBs is considered as hazardous waste of Class A.

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Under the Hazardous Waste (Management, Handling & Transboundary Movement) Rules, 2008, Schedule VI (Hazardous Wastes Prohibited for Import and Export) states:

The Import and Export of *Waste, Substances and articles containing, consisting of or contaminated with polychlorinated biphenyls (PCB) and/or polychlorinated terphenyls, (PCT) and/or polychlorinated naphthalene (PCN) and/or polybrominated biphenyls (PBB) or any other polybrominated analogues of these compounds* is prohibited.

### 3.2. THE 'MOTOR VEHICLE ACT', (1988) AND THE 'CENTRAL MOTOR VEHICLE RULES', (1989)

The 'Motor Vehicle Act' (MVA) was issued in 1988 to consolidate and amend the laws relating to motor vehicles and the 'Central Motor Vehicle Rules' (CMVR) was first issued in 1989, which represents the practical rules about driving, licensing, motor vehicle registration traffic rules, insurance, penalties, etc. Some of the important provisions of the Motor Vehicles Bill which are relevant to the transportation of hazardous good include:

- a) *Stricter procedures relating to grant of driving licences and the period of validity thereof;*
- b) *Enabling provision for updating the system of registration marks;*
- c) *Liberalised schemes for grant of stage carriage permits on non nationalised routes, all-India Tourist permits and also national permits for goods carriages;*
- d) *Provision for payment of compensation by the insurer to the extent of actual liability to the victims of motor accidents irrespective of the class of vehicles;*
- e) *Maintenance of State registers for driving licences and vehicle registration;*
- f) *Constitution of Road Safety Councils.*

Rules 134 to 137 of the CMVR establish the regulations for the transportation of hazardous goods. These rules contain information about the specification related to the vehicle transporting the hazardous goods, instructions for the drivers carrying dangerous goods, obligation of reporting accidents, classification of substances and hazardous goods. These rules are reported in Table 2.

**Table 2: Rules 134 to 137 of the Central Motor Vehicles Rules**

#### **Rule 134: Emergency Information Panel.**

1. Every goods carriage used for transporting any dangerous or hazardous goods shall be legibly and conspicuously marked with an emergency information panel in each of the three places indicated in the Table below so that the emergency information panel faces to each side of the carriage and to its rear end and such panel shall contain the following information, namely:—
  - i) the correct technical name of the dangerous or hazardous goods in letters should not be less than 50 millimetres high;
  - ii) the United Nations class number for the dangerous or hazardous goods as given in Column 1, Table 1 appended with rule 137, in numerals not less than 100 millimetres high;
  - iii) the class label of the dangerous or hazardous goods of the size of not less than 250 millimetres square;
  - iv) the name and telephone number of the emergency services to be contacted in the event of fire or any other accident in letters and numerals that are not less than 50 millimetres high and the name and telephone number of the consignor of the dangerous or hazardous goods or of some other person from whom expert information and advice can be obtained concerning the measures that should be taken in the event of an emergency involving such goods.
  - v) The information contained in sub-rule (1) shall also be displayed on the vehicle by means of a



sticker relating to the particular dangerous or hazardous goods carried in that particular trip.

Every class label and emergency information panel shall be marked on the goods carriage and shall be kept free and clean from obstructions at all times.

**Rule 135: Drivers to be instructed.**

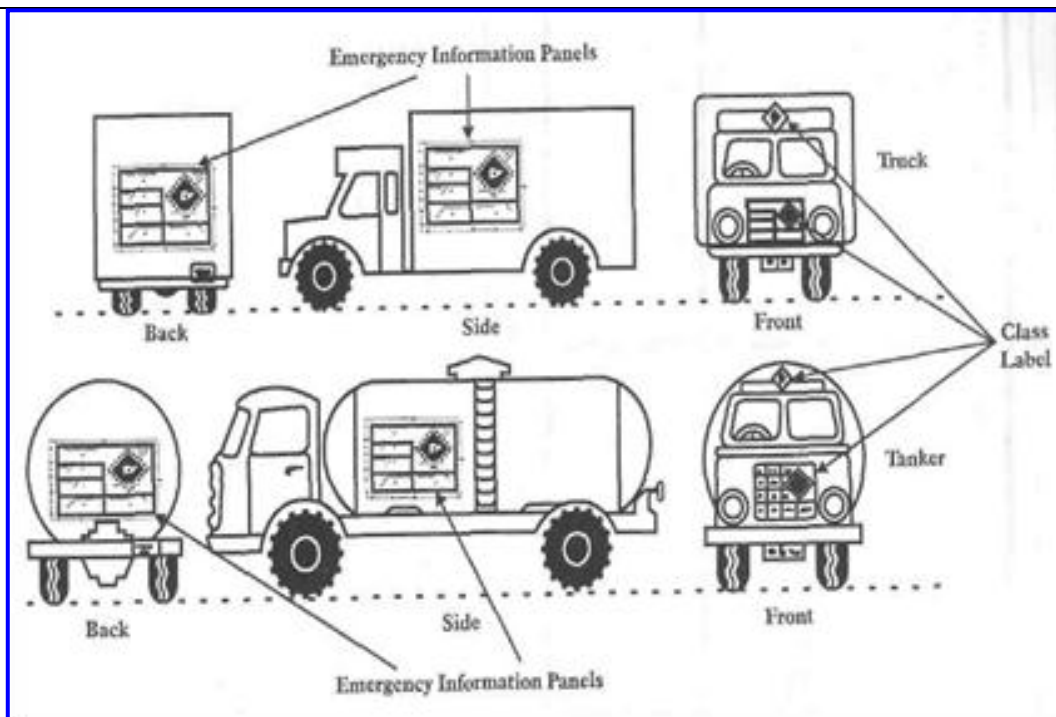
The owner of every goods carriage transporting dangerous or hazardous goods shall ensure to the satisfaction of the consignor that the driver of the goods carriage has received adequate instructions and training to enable him to understand the nature of the goods being transported by him, the nature of the risks arising out of such goods, precautions he should take while the goods carriage is in motion or stationary and the action he has to take in case of any emergency.

**Rule 136: Driver to report to the police station about accident.**

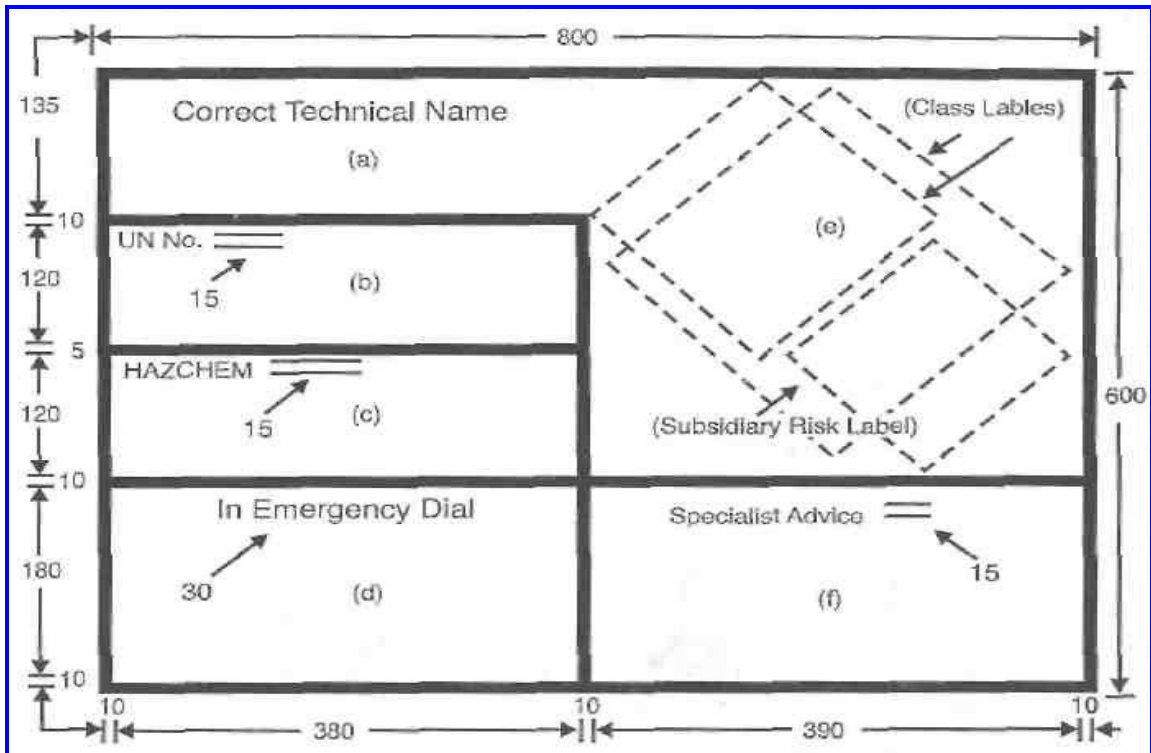
The driver of a goods carriage transporting any dangerous or hazardous goods shall, on the occurrence of an accident involving any dangerous or hazardous goods transported by this carriage, report forthwith to the nearest police station and also inform the owner of the goods carriage or the transporter regarding the accident.

**Rule 137: Class Labels.**

Rule 137 provides the classification of hazardous goods to be transported. UN Class from 1 to 8 are listed in column I; criteria for classifying hazardous goods are listed in column II and column III contains the list of Hazardous Goods, which however does not include PCBs.



**Figure 1: Position of the Emergency Information Panels as per Rule 134**



**Figure 2: Content of the Emergency Information Panels as per Rule 134**

### 3.3. RELATIONSHIP BETWEEN HAZARDOUS WASTE RULES AND CENTRAL MOTOR VEHICLE RULES

Under Hazardous Waste Rules, 2008, Chapter VI (Packaging, Labeling and Transport of Hazardous Waste),

Article 19 (Packaging and Labeling) states:

*The hazardous waste are packaged and labeled, based on the composition in a manner suitable for safe handling, storage and transport as per the guidelines issued by the Central Pollution Control Board from time to time.*

Article 20 (Transportation of Hazardous waste) states:

*The transport of the hazardous wastes shall be in accordance with the provisions of these rules and the rules made by the Central Government under the Motor Vehicles Act, 1988, and other guidelines issued from time to time in this regard.*

Furthermore, PCBs are not classified as hazardous goods under the classification scheme established by the Central Motor Vehicles Rules. This is because:

- Table I (Class of Labels) in Rule 137 contains the first 8 UN ADR classes, but not class 9 (Miscellaneous Dangerous Substances and Articles) to which PCBs pertain;
- None of the criteria listed in Table II (Indicative Criteria) of Rule 137 fits the features of PCBs;
- PCBs are not listed among the hazardous goods listed in Table III (List of Hazardous Goods).

Therefore, although the CMVR establishes important rules for the transportation of hazardous goods, apparently these do not apply to equipment containing PCBs or waste. Article 79 (Grant of Goods Carriage Permit) of MVA states:

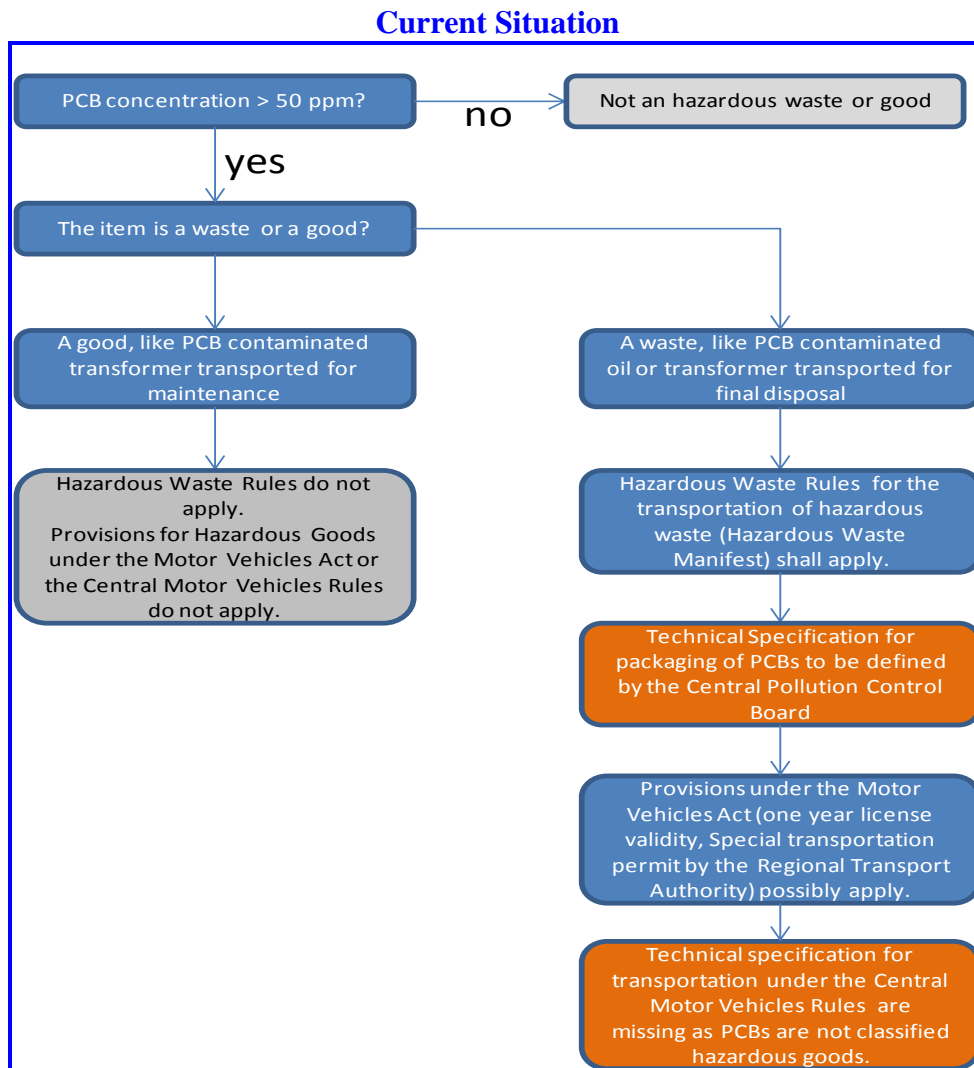
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A Regional Transport Authority may, on an application made to it under section 77, grant a goods carriage permit to be valid throughout the State or in accordance with the application or with such modifications as it deems fit or refuse to grant such a permit. The conditions for the issuance of that permit may include conditions relating to the packaging and carriage of goods of dangerous or hazardous nature to human life.

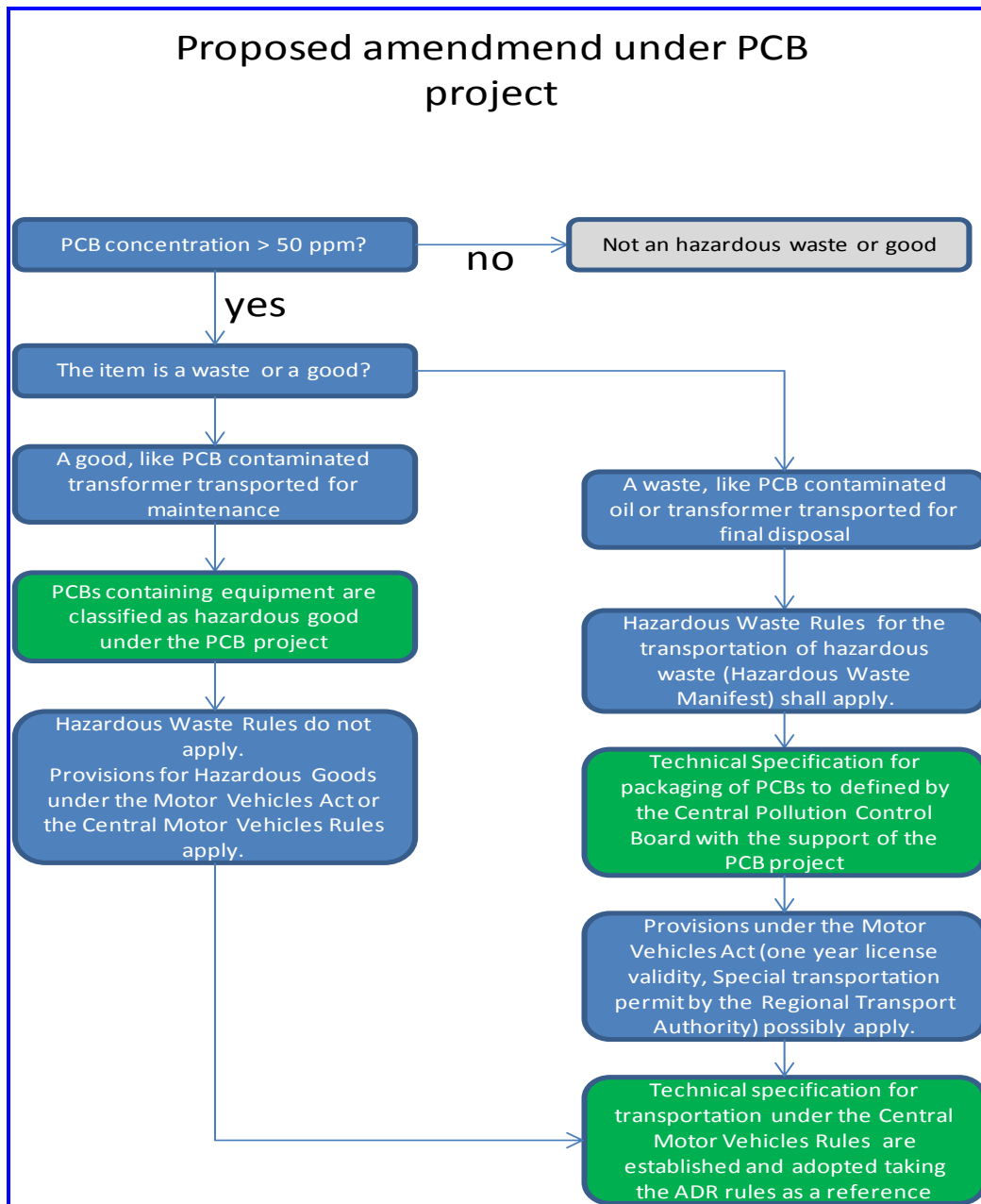
For filling the gaps in the technical requirements for packaging and transporting of PCBs under the India PCB project, a possible solution could be to adopt the Central Motor Vehicle Rules for hazardous goods, integrated by the ADR rules, as a voluntary demonstration scheme.

In the current situation, for equipment containing PCBs which is not a waste (like PCBs contaminated transformers transported for maintenance) neither the provisions transportation of hazardous goods under the Hazardous Waste Rules nor the ones under the Motor Vehicles act or Central Motor Vehicles Rules would apply. Under the India PCBs project, a voluntary amendment of the current legislative framework has been proposed to be adopted such that the PCBs containing equipment can be classified under hazardous goods and to be subjected to provisions for transportation of hazardous goods under motor vehicle act and Central Motor Vehicle Rules.

A graphical summary of the current situation and the proposed amendment is reported in Figure 3 and Figure 4 respectively.



**Figure 3: Application of the Hazardous Waste Rules and the Motor Vehicles Act – Current Situation**



**Figure 4: Application of the Hazardous Waste Rules and the Motor Vehicles Act – Proposed Amendment under the PCB project.**

#### 4. HAZARD CLASSIFICATION FOR PCBs

To prevent the risk of PCBs, some measures should be adopted in their packaging and transportation.

The hazardous properties of PCBs are summarized below.

- Chemical Identification:** Polychlorinated Biphenyls (CAS number 1336-36-3) are a class of chlorine substituted biphenyls with 209 possible isomers. Usually, PCBs are found in commercial mixtures made by several PCBs isomers differing from their level of chlorine substitution. For instance, Aroclor mixtures may contain PCBs with an average chlorine content (as weight percentage) ranging from 21% (for the Aroclor 1221) to 68% (for the Aroclor 1268).

- **Chemical and Physical Properties:** Depending on the level of chlorination, the molecular weight of PCBs ranges from 188.72 (for the Chloro-Biphenyl) to 498.66 for the fully chlorine-substituted Decachloro Biphenyl. Several physical and chemical properties of PCBs vary with the level of chlorination.
- **Water solubility:** PCBs are non-polar compounds. Their non-polar nature makes them only slightly soluble in water. In general the water solubility of PCBs is very low and decreases with the increase of chlorine substitution. It ranges from an order of magnitude of 1 mg/L for dichloro biphenyls, to an order of magnitude of around 0.01 mg/L for the pentachloro biphenyls.
- **Vapor pressure:** The vapor pressure of PCBs is very low and decreases with the increase of chlorine substitution. It ranges from around  $1.5 \times 10^{-6}$ - $4.2 \times 10^{-6}$  for dichlorinated biphenyls to  $2.9 \times 10^{-11}$ - $6.9 \times 10^{-8}$  for hexachlorinated biphenyls.
- **Lipophilicity:** PCBs are readily adsorbed by organic compounds. The Octanol / Water partition coefficient ( $K_{OW}$ ) is very high and increase with the increase of chlorine substitution. Experimental values range from a log  $K_{OW}$  of 5.55 for Tetrachloro Biphenyl to a log  $K_{OW}$  of 7.52 for Nonachloro Biphenyl.
- **Flammability:** PCBs are known for their very low flammability and chemical stability to high temperatures.
- **Electrical conductivity:** PCBs are known for being excellent dielectric compound, due to the almost null value of electrical conductivity.
- **Toxicity:** Evidence of PCB toxicity was found in experimental animals. The toxic effects include skin disorders, weight loss, endocrine and reproductive disorders, carcinogenesis (liver carcinoma), etc. A number of studies investigating the carcinogenicity of PCBs highlighted their low genotoxicity. Therefore, they are thought to be cancer-promoting rather than cancer-initiating agents. No clear evidence was found with respect to the correlation between exposure to environmental levels of PCBs and cancer risk to humans or animals.

PCB mixtures show a wide range of toxic effect. Coplanar PCBs, also called “dioxin-like” PCBs, have toxic effect which are similar to those caused by 2,3,7,8-tetrachlorodibenzo-p-dioxin. For such a category of PCBs, relative toxicities were determined on the basis of experimental studies.

PCBs classification and hazard phrases are reported in Table 1 under the GHS.

## 5. PACKAGING OF PCBs

### 5.1. PURE PCB OIL AND PCB CONTAMINATED MINERAL OIL

Dielectric oil and other fluids containing more than 50 ppm of PCBs are considered as hazardous waste. Therefore, their transport in India is subject to the Indian Hazardous Waste Rules, 2008 (including the provisions concerning hazardous waste manifest). Under the PCBs project, it is proposed that pure PCB oil and PCB contaminated mineral oil are subjected to the Rules 134 to 137 of the Central Motor Vehicles Rules, 1989.

Under the ADR norms, mineral oil containing polychlorinated biphenyls or terphenyls, or polyhalogenated biphenyls or terphenyls, shall always be classified under Class 9 (Miscellaneous Dangerous Substances and Articles).

Under the ADR norms, PCB liquid is classified under the UN number 2315. For this class of compounds, the ADR norms prescribe the following packaging requirements:

**Table 3: ADR requirements for packaging of liquid PCBs**

UN NUMBER		UN 2315
NAME AND DESCRIPTION		POLYCHLORINATED BIPHENYLS, LIQUID
CLASS		9
CLASSIFICATION CODE		M2
PACKING GROUP		II
LABELS		9
SPECIAL PROVISIONS		305
LIMITED QUANTITY		1L
EXPECTED QUANTITY		E2
PACKING INSTRUCTIONS		P906 AND IBC02
SPECIAL PACKING PROVISIONS		-
MIXED PACKING PROVISIONS		MP15
PORTABLE TANKS AND BULK CONTAINERS	INSTRUCTIONS	T4
	SPECIAL PROVISION	TP1

Packaging Instructions and special provisions as per the ADR rules are as follows:

**Table 4: Technical specification for the packaging of liquid PCBs – Single Packaging (P001 – Packing Instruction (Liquid))**

Single packagings	Maximum capacity for packing Group II
<b>Drums</b> Steel, non removable heads (1A1). Steel, removable heads (1A2). Aluminum, non removable heads (1B1). Aluminum, removable heads (1B2). Metal other than steel or aluminium, non removable heads (1N1). Metal other than steel or aluminium, removable heads (1N2). Plastic, non removable heads (1H1). Plastic, removable heads (1H2).	450 L.

<p><b>Jerricans</b></p> <p>Steel, non removable heads (3A1).</p> <p>Steel, removable heads (3A2).</p> <p>Aluminum, non removable heads (3B1).</p> <p>Aluminum, removable heads (3B2).</p> <p>Plastic, non removable heads (3H1).</p> <p>Plastic, removable heads (3H2).</p>	60 L.
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**Table 5: Technical specification for the packaging of liquid PCBs – Composite Packaging (P001 – Packing Instruction (Liquid))**

Composite Packaging	Maximum capacity for packing Group II
<p>Plastics receptacle with outer steel or aluminium drum (6HA1, 6HB1)</p> <p>Plastics receptacle with outer fibre, plastics or plywood drum (6HG1, 6HH1, 6HD1).</p>	250 L.
<p>Plastic receptacle wit outer steel or aluminium crate or box or plastics receptacle with outer wooden, plywood, fibreboard or solid plastics box (6HA2, 6HB2, 6HCm 6HD2, 6HG2 or 6HH2).</p> <p>Glass receptacle with outer steel, aluminium, fibreboard, plywood, solid plastics or expanded plastics drum (6PA1, 6BP1, 6PG1, 6PD1, 6PH1 or 6PH2) or with outer steel or aluminium crate or box or with outer wooden or fibreboard box or with outer wickerwork hamper /6PA2, 6PB2, 6PC, 6PG2 or 6PD2).</p>	60 L.

**Table 6: Technical specification for the packaging of liquid PCBs – Combination Packaging (P001 – Packing Instruction (Liquid))**

Combination Packaging		Maximum capacity /net mass for packing Group II
<p>Glass 10 L</p> <p>Plastics 30 L</p> <p>Metal 40 L</p>	<p><b>Drums</b></p> <p>Steel (1A2)</p> <p>Aluminum (1B2)</p> <p>Metal other than steel or aluminium (1N2)</p> <p>Plastics (1H2)</p> <p>Plywood (1D)</p> <p>Fiber (1G)</p>	400 kg.

<p>Glass 10 L Plastics 30 L Metal 40 L</p>	<p><b>Boxes</b> Steel (4A). Aluminum (4B). Natural wood (CC1, 4C2). Plywood (4D). Reconstituted wood (4F). Fibreboard (4G). Expanded plastic (4H1). Solid plastic (4H2).</p>	<p>400 kg except Expanded plastics (60kg).</p>
<p>Glass 10 L Plastics 30 L Metal 40 L</p>	<p><b>Jerricans.</b> Steel (3A2). Aluminum (3B2). Plastics (3H2).</p>	<p>120 kg.</p>

Under the ADR norms, the Packing Instruction IBC02 states:

*The following Intermediate Bulk Containers (IBC) can be used:*

- *Metal (31A, 31B and 31N).*
- *Rigid plastics (31H1 and 31H2).*
- *Composite (31HZ1).*

In addition to the above, the ADR norms under Chapter 6 for Portable Tank Provisions specifies the applicable minimum test pressure, the minimum shell thickness (in mm reference steel), the bottom opening of the equipment and the pressure-relief as following:

**Minimum test pressure:** 1.5 bar.

**Minimum shell thickness:** *The cylindrical portion ends (heads) and manhole covers of shells not more than 1.80 m in diameter shall not be less than 5 mm thick in the reference steel or of equivalent thickness in the metal to be used. Shells more than 1.80 m in diameter shall be not less than 6 mm thick in the reference steel or of equivalent thickness in the metal to be used, except that for powdered or granular solid substances of packing group II or III the minimum thickness requirement may be reduced to not less than 5 mm thick in the reference steel or of equivalent thickness in the metal to be used.*

**Bottom openings:** *Bottom discharge outlets for portable tanks carrying certain solid, crystallizable or highly viscous substances shall be equipped with not less than two serially fitted and mutually independent shut-off devices. The design of the equipment shall be to the satisfaction of the competent authority or its authorized body and shall include:*

- (a) *an external stop-valve, fitted as close to the shell as reasonably practicable, and so designed as to prevent any unintended opening through impact or other inadvertent act; and*
- (b) *a liquid tight closure at the end of the discharge pipe, which may be a bolted blank flange or a screw cap.*

**Pressure relief:** *Every portable tank with a capacity not less than 1900 liters and every independent compartment of a portable tank with a similar capacity shall be provided with one or more pressure – relief devices of the spring-loaded type.*



**5.2. TRANSFORMERS, CAPACITORS AND OTHER PCBs CONTAINING EQUIPMENT**

Transformers, capacitors and other equipment containing PCB may be considered as “solid PCBs”, and are assigned the UN Number 3432. Under the ADR norms, the following packaging instructions apply:

**Table 7: Technical specifications for the packaging of solid PCBs – Single Packaging.**

Single packaging	Maximum capacity for packing Group II
<b>Drums</b> Steel (1A1 or 1A2). Aluminum (1B1 or 1B2). Metal other than steel or aluminum (1N1 or 1N2). Plastics (1H1 or 1H2). Fiber (1G) . Plywood (1D) .	400 kg.
<b>Jerricans</b> Steel (3A1 or 3A2). Aluminum (3B1 or 3B2). Plastics (3H1 or 3H2).	120 kg.

**Table 8: Technical specifications for the packaging of solid PCBs – Combination Packaging.**

Combination Packaging	Maximum capacity /net mass for packing Group II
Glass 10 kg. Plastics <sup>a</sup> 50 kg. Metal 50 kg. Paper <sup>a,b</sup> 50kg. Fibre <sup>a,b</sup> 50Kg.  <sup>a</sup> These inner packaging shall be sift proof <sup>b</sup> These inner packagings shall	<b>Drums</b> Steel (1A2). Aluminum (1B2). Metal other than steel or aluminum (1N2). Plastic (1H2). Plywood (1D). Fiber (1G).  <b>Boxes</b> Steel (4A).
	400 kg
	400 kg except Expanded plastics (60kg).

not be used when the substances being carried may become liquid during carriage	Aluminum (4B). Natural wood (CC1, 4C2). Plywood (4D). Reconstituted wood (4F). Fiberboard (4G). Expanded plastic (4H1). Solid plastic (4H2).	
	<b>Jerricans</b> Steel (3A2). Aluminum (3B2). Plastics (3H2).	120 kg.

Under the ADR norms, Part 4 – Packing Instruction P906 states:

*For transformers and condensers and other devices: Leak proof packaging which are capable of containing, in addition to the devices, at least 1.25 times the volume of the liquid PCBs or polyhalogenated biphenyls or terphenyls present in them. There shall be sufficient absorbent material in the packaging to absorb at least 1.1 times the volume of liquid which is contained in the devices. In general, transformers and condensers shall be packed in leak-proof metal packaging's which are capable of holding, in addition to the transformers and condensers, at least 1.25 times the volume of the liquid present in them.*

*Notwithstanding the above, liquids and solids not packaged in accordance with P001 and P002 and unpackaged transformers and condensers may be carried in cargo transport units fitted with a leakproof metal tray to a height of at least 800mm, containing sufficient inert absorbent material to absorb at least 1.1 times the volume of any free liquid.*

*Additional requirement: Adequate provisions shall be taken to seal the transformers and condensers to prevent leakage during normal conditions of carriage.*

### 5.3.MARKING AND LABELLING OF PACKAGES.

The words “PCBs, Polychlorinated Biphenyls”, and the UN number corresponding to the PCBs (2315 for PCB liquids or 3432 for solid PCBs, preceded by the letters “UN”), should be clearly and durably marked on each package. All package markings should be readily visible and legible, and should be able to withstand open weather exposure without a substantial reduction in effectiveness.

Intermediate bulk containers of more than 450 liter capacity and large packages should be marked on both sides. Packages should be durably marked with the UN environmentally hazardous substance mark in addition to the hazard mark specific for substances. Information concerning the specific hazard presented by the PCBs waste / goods transported should also be mentioned in the label. Emergency number to be called, in case of emergency, should also be clearly mentioned.

In Figure 5, a proposed label for PCBs containing packages, developed on the basis of the graphical indication provided by Rule 134 of the Central Motor Vehicles Rules, along with the

UN marks and labels indicated for PCBs as per the UN ADR standard is reported. Instead of the HazChem number, which is not available for PCBs in India, the Basel Convention code Y10 is proposed.

<p>Poly Chlorinated Biphenyls PCB</p>		
<p>UN No. 2315</p>		
<p>HazChem Y10*</p>		
<p>In Emergency Dial 0091 11 123456789</p>	<p>May cause damage to respiratory system through prolonged or repeated exposure. Very toxic to aquatic life with long lasting effect</p>	

Figure 5: Proposed label for PCBs containing packages

## 6. TRANSPORTATION OF PCBs

### 6.1. VEHICLE AND DRIVER REQUIREMENTS

The vehicle used for transporting PCBs should comply with the relevant rules established under the Motor Vehicle Act and the Central Motor Vehicles Rules.

The drivers of the vehicle transporting the PCBs should have passed a training course on the transportation of hazardous waste and on PCBs.

The drivers of the vehicle undertaking the transportation of PCBs should possess relevant driving license as required under the Motor Vehicle Act. As per Article 14 of the MVA, the driving license is “*effective for a period of one year and renewal thereof shall be subject to the condition that the driver undergoes one day refresher course of the prescribed syllabus*”

According to Article 79 (Grant of Goods Carriage Permit) of the Motor Vehicle Act and also under the Hazardous Waste Rules, 2008, Chapter II (Procedure for Handling Hazardous Wastes),

Article 5 (Grant of authorization for handling hazardous wastes) states:

*Every person who is engaged in generation, processing, treatment, package, storage, transportation, use, collection, destruction, conversion, offering for sale, transfer or the like of*

*the hazardous waste shall require to obtain an authorization from the State Pollution Control Board.*

In compliance with article 146 of the MVA, “*in the case of a vehicle carrying, or meant to carry, dangerous or hazardous goods, there shall also be a policy of insurance under the Public Liability Insurance Act, 1991 (6 of 1991)*”

Vehicle for the transportation of PCBs should be equipped with GPS, mobile phone and radio transmitter, so that the driver can easily communicate the position of the truck.

Vehicle for the transportation of PCBs should be equipped with the proper firefighting equipment, as well as all the equipment necessary for containing the accidental spill of PCBs, including proper PPEs.

### 6.2. ROUTE AND DRIVING REQUIREMENTS

- (a) Route for the transportation of PCBs should be planned in advance and communicated to the shipper and the addressee of the PCBs. Route planning should include positioning along the route with the following points of interest:
  - Local public security;
  - Hospitals;
  - Fuel station (select the ones that are far from populated areas);
  - Suitable parking lots and storage areas.
- (b) The planned route should be clearly described in the Hazardous Waste Manifesto carried by the driver and any deviation from the planned route should be reported.
- (c) The driving time should be alternated for a sufficient rest time, as per the relevant regulations in India.
- (d) The use of GPS is highly recommended to facilitate planning of the trip and communication of the position.
- (e) Areas within temporary storage terminals, temporary storage sites, vehicle depots, berthing areas and marshalling yards used for the temporary storage during carriage of PCBs should be properly secured, well lit and, where possible and appropriate, not accessible to the general public.

## 7. TRAINING

The training should be approved by the competent authority, on the basis of the submission of a detailed training programme, inclusive of the qualification of the training personnel.

The training should be arranged in the following way:

**General awareness:** The personnel should be familiar with the general requirements of provisions for packaging and transportation of PCBs.

**Function-specific training:** The personnel should receive training commensurate with their duties and responsibilities in the chain of packaging and transportation of PCBs.

**Safety training:** The personnel should be trained in the hazards and dangers presented by PCBs, with specific reference to the operation of packaging, filling, draining, loading and unloading.

**Training for Drivers :** Drivers of vehicles carrying PCBs should attend a specific training course structured as follows: safety drive rules, hazards related to the handling and transport of PCBs, emergency response: what to do in case of an accident occurred during the transportation of PCBs (first aid, road safety, use of PPEs, etc.), use of positioning and radio devices, precaution

to be taken during loading and unloading of PCBs, civil liability, security awareness, the hazardous waste manifest system.

### 8. EMERGENCY RESPONSE

In case of accidents like combustion, explosion, leakage, poisoning, stolen or loss, the driver and escorting personnel should:

- i) Immediately report to the local public security department, firefighting corps, if necessary, and the transport enterprises on the accident status, name of the goods, harm and first-aid measures;
- ii) Take all possible alarming measures on site and
- iii) Actively cooperate with the relevant departments for disposal.

Transport enterprises should immediately start the emergency plans.

This means that the transportation team, before transportation, should collect the relevant contact numbers of the nearest public security departments and nearest rescue along the route, so that the intervention time in case of accident is minimized.

For the management of an emergency situation, the following practical consideration should be kept in mind:

1. PCBs are not flammable. However, if exposed to fire or high temperature, they can generate dioxins. Therefore, to prevent the contact of PCBs with fire represents a high priority.
2. PCBs are not flammable; however, PCBs contaminated oil is flammable. The burning of highly contaminated PCBs oil represents a worst case in terms of immediate danger to the life coupled with long term danger caused due to the release of dioxins generated.
3. PCBs do not have a high vapor pressure, and usually the direct exposure to PCBs vapors does not represent an immediate risk to life. However, due to their long term toxicity, in case of PCBs leakage proper respiratory mask should be worn.
4. PCBs may easily enter the body through contact with the skin. Dermal exposure to PCBs represents the most probable cause of human exposure.
5. PCBs cannot be easily removed by water due to their very low water solubility. However, PCBs can be easily removed by using suitable adsorbent materials with high organic content, like sawdust, soil with high organic matter content, organic solvents, greases.

The following PPEs should always be available during any transportation of PCBs (one suit for any component of the vehicle crew).

- Chemical protective clothing provides protection to the full body against airborne solid particulates (Type 5 protective clothing in compliance with EN ISO 13982-1) and filtering half masks / filtering face pieces (in compliance with EN 149, Class FFP2 and FFP3 or EN 143, Class P2 and P3) while moving or packaging PCB contaminated soil;
- Disposable protective clothing (in compliance with EN 14605 Type – 3: Liquid tight protective overalls, EN 14605 Type – 4: Spray tight protective overalls, EN ISO 13982-1) provides additional protection to the full body against liquid chemicals / aerosols and mask equipped with anti-dust filters and filters against gas / vapors (in compliance with EN 149 Class FFP2 and A-1 class filter) while draining or filling barrels with PCB and packaging PCB capacitors and transformers.
- Safety goggles.
- Heavy duty rubber gloves (neoprene or butyl).

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- Reinforced safety shoes.
- Overshoes.
- Helmet.
- Warning vest.

The following additional material should always be available during transportation of PCBs:

- Adsorbent material (like sawdust).
- A shovel.
- A drain seal.
- First Aid Kit, including Eye rinsing liquid.
- Fire Extinguishers.
- Self-standing warning sign.



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