REPORT OF THE TASK FORCE

ON

ENVIRONMENTALLY SOUND MANAGEMENT

OF

MERCURY IN FLUORESCENT LAMPS

MINISTRY OF ENVIRONMENT & FORESTS

GOVERNMENT OF INDIA

NEW DELHI

May, 2008

FOREWORD

Recent years have witnessed exponential growth in use of Compact Fluorescent Lamps (CFLs) and Fluorescent Tube Lights (FTLs). This is a positive development as it contributes to energy conservation. However, CFLs and FTLs contain mercury, which is potentially toxic and, hence there is an urgent necessity for evolving a policy for safe management of mercury in Fluorescent Lamps (FLs).

2. The Ministry of Environment and Forests (MoEF), Government of India constituted a Task Force for addressing this challenge. The Task Force under my chairmanship had senior representatives of Central Pollution Control Board (CPCB) & MoEF; Union Ministries of Power, Health & Family Welfare and Commerce & Industry; and Independent Experts, Director General, Bureau of Energy Efficiency; Director, National Institute of for Occupational Health (NIOH); Director, Industrial Toxicology Research Centre (ITRC); Chairman, National Poisons Information Centre, AIIMS. The Task Force interacted with representatives of the manufacturers of CFLs and FTLs. The Task Force greatly benefited from the report of a Technical Committee, headed by the Chairman, CPCB; and constituted by MoEF to address technical issues related to the Fluorescent Lamp Sector. The report of the technical Committee, covering the draft Guidelines on 'Environmentally Sound Mercury Management in Fluorescent Lamp Sector' and other suggestive measures on administrative, legal, fiscal & awareness related aspects, was discussed in Task Force meetings and its recommendations were taken on board. Efforts were made to evolve consensus on the strategy for evolving a policy for safe management of mercury in FLs. The Task Force held six meetings in which detailed discussions took place.

3. The report of the Task Force makes number of recommendations which include policy decisions and regulatory measures. The report of the Technical Committee has been incorporated in the Task Force report as it is an extremely useful document which makes an analysis of the various factors that have been taken into consideration while framing the

Guidelines. The Task Force report has a section on Guidelines for 'Environmentally Sound Management in Fluorescent Lamp Sector' based on its deliberations and the inputs of the Technical Committee. Some of the key recommendations of the Task Force include:-

(i) Prescribing minimum required content of mercury in fluorescent lamps and development of a standard method for measurement of mercury by Bureau of Indian Standards (BIS);
(ii) Evolving mechanism for proper collection, transportation, recycling and disposal of fused FLs;
(iii) Developing of financial mechanism for operationalization of the entire recycling process;
(iv) Framing of rules and regulations for strict implementation of the recommendations by State Departments of Environment/State Pollution Control Boards/Pollution Control Committees of Union Territories.

4. The Task Force acknowledges the complexity of the challenge and the need for its adopting an approach which will constantly evolve by incorporating best global practices, changing technology and better understanding amongst different stakeholders.

5. I would like to place on record the valuable contributions made by all members of the Task Force and the Technical Committee. I would like to particularly record the valuable contributions made by DG, BEE; Chairman, CPCB; and the inputs by Manufacturers' Associations of CFLs/FTLs. The preparation of this report would not have been possible without invaluable contributions made by Shri R.K. Vaish, Joint Secretary, MOEF and Member Secretary of the Task Force; Shri M. Subba Rao, Director, MOEF, Shri Keyur Shah, Environmental Engineer, CPCB; and Dr. R. Sridhar, Deputy Director, MOEF.

(R. H. KHWAJA)

TABLE OF CONTENTS

ACRONYMS

APCS	Air Pollution Control System
BEE	Bureau of Energy Efficiency
BIS	Bureau of Indian Standards
ELCOMA	Electric Lamp Components Manufacturers' Association.
ESLMA	Energy Saving Lamp Manufacturers Association
FAISLCOMA	Federation of All India Small Scale Lamps & Components Manufacturers Association
FTL	Fluorescent Tube Light
GHS	Greenhouse Gases
GLS	General Lighting Service (incandescent lamps)
HEPA	High Efficiency Particulate Arrestor
HID	High Intensity Discharge
IDLH	Immediately Dangerous to Life or Health
LEDs	Light Emitting Diodes
LRU	Lamp Recycling Unit
PCC	Pollution Control Committee
RoHS	Restriction on Hazardous Substances
SPCB	State Pollution Control Board
WEEE	Waste Electrical & Electronics Equipment

*****

EXECUTIVE SUMMARY

Fluorescent Lamps (FLs), including the Fluorescent Tube Lights (FTLs) and the Compact Fluorescent Lamps (CFLs), are now the preferred choice compared to the conventional General Lamps due to their energy-saving potential and many other advantages over the conventional lamps.

2. However, most of these energy-saving lamps use mercury as a vital component for their functioning, which, if not disposed of properly, has potential of causing damage to the public health.

3. The Lighting industry has witnessed an annual growth rate of about 12% per annum in the last four years. Amongst the various products, the consumption of CFLs has increased at a very large growth rate, as high as 50%, in the year 2006. Similarly, the fluorescent tube lights market has shown a growth rate of 10% in 2006. However, the mercury management practices adopted at both, the manufacturer and consumer levels in India are not adequate from the point of view of the environmentally sound disposal and management of mercury in the FL Sector. This necessitates the urgency for having an environmentally safe management of mercury in the FL sector in order to minimize the impact of improper disposal of mercury.

4. Ministry of Environment & Forests (MoEF), Government of India, constituted a Task Force, under the chairmanship of Sh. R H Khwaja, Additional Secretary in MoEF in August, 2007. The main objective of the Task Force was to evolve a policy for safe management of mercury in CFLs and the policy was to elaborate on safety in manufacture, usage and disposal of CFLs, besides creation of public awareness. The scope of the Task Force was widened from CFLs, in the first meeting of

the Task Force, to cover the entire FL sector in view of the associated mercury-related problems.

5. A Technical Committee headed by Sh. J M Mauskar, Chairman, Central Pollution Control Board (CPCB), was constituted by the MoEF simultaneously to consider the issues relating to environmentally sound management of mercury in Compact Fluorescent Lamps. Later, the scope of this Committee was widened further to cover the entire FL sector. The report of the Technical Committee covering draft Guidelines on 'Environmentally Sound Mercury Management in FL Sector', and other suggestive measures on administrative, legal, fiscal & awareness related issues, was submitted to the Task Force in February 2008.

6. The Task Force held six meetings. Some representatives of the Task Force also interacted with the concerned associations manufacturing CFLs and Fluorescent Tube Lights (FTLs). The Task Force analyzed various issues related to the measures required for collection, transportation, treatment/recycling and disposal of the used lamps at the consumer level, besides the fiscal incentives required for affecting proper management of mercury. The Task Force discussed about the roles and responsibilities of various government and non-government agencies, FL manufacturers and consumers for the safe management of mercury in order to minimize the impact of mercury releases on the public health.

7. The following salient recommendations are made by the Task Force:

(i) The Guidelines on 'Environmentally Sound Management of Mercury in the Fluorescent Lamp Sector', as prepared by the

Technical Committee, may be adopted for the management of mercury in the fluorescent lamp sector.

(ii) The onus of operationalizing the used lamp recycling mechanism (covering collection, transportation, treatment/recycling & disposal), as per the measures delineated in the guidelines, could rest with the lamp manufactures and importers as per the '*Precautionary Approach'*, '*Extended Producers Responsibility*' and '*Polluter Pays' principles*.

(iii) The entire lamp recycling mechanism should be funded through a tax imposed on each CFL/FTL (manufactured in the country as well as the imported lamps) to cover the charges for operationaliztion of the lamp recycling mechanism at society level. The Ministries of Finance and Commerce may be requested to devise a suitable mechanism for this purpose. Alternatively the manufacturers and importers can build in their prices the charges for operationalizing the lamp recycling mechanism.

(iv) The Govt. of India may consider extending some incentives to the manufacturers and importers of FLs for setting up lamp recycling facilities at least for a period of initial few years, for catalyzing their efforts on successful operation of the lamp recycling mechanism. The above incentives may include capital subsidy on sharing basis by the Central and the State Governments, as in the case of similar assistance extended for setting up of the Treatment, Storage and Disposal Facilities (TSDFs) for hazardous wastes.

(v) The State Governments may consider making land available at a concessional price to the recyclers for enhancing the viability of such recycling facilities. Banks may consider making available

the required finances to the recyclers, to encourage such recycling facilities to be set up.

(vi) There should be a scheme for registration of importers of CFLs in the country and importers along with the manufacturers of CFLs should be made responsible for the entire process of lamp recycling mechanism individually or jointly.

(vii) The BIS may be requested to develop regulations for controlling the levels of mercury in fluorescent lamps and also to prescribe the methodology for mercury measurement in fluorescent lamps. The performance standards for CFL/FTL, prescribed by BIS, should be strictly implemented.

(viii) In the process of collection of used CFLs/FTLs, the role of informal sector, such as, ragpickers, *kabariwalas* and residents welfare associations should be recognised.

(ix) Public awareness, being important tool for attaining success in safe handling of mercury-bearing lamps, should be taken up by the concerned government and non-government organizations.

(x) The Government may earmark separate funds for undertaking Research and Development in the FL sector and also for transfer of advanced technology in this sector.

(xi) There should be separate regulation, in due course of time, developed under the Environment (Protection) Act 1986 to enforce collection, transportation of used/broken FLs and their environmentally sound management in special recycling facilities set up for the purpose by the manufacturers and importers either individually or jointly.

*****

1.0 INTRODUCTION

1.1 Mercury in Fluorescent Lamp Sector:

1.1.1 Lighting industry has witnessed an annual growth rate of about 12% per annum in the last 4 years. Amongst the various products, the consumption of Compact Fluorescent Lamps (CFLs) has increased at a very large growth rate, as high as 50% during the year 2006. General Lamp Sector (GLS) production has, further, increased by more than 20% during the year 2006. Similarly, the fluorescent tube lights (FTLs) market has also shown a growth rate of 10% in the year 2006.

1.1.2 CFLs have many advantages over the conventional GLS (incandescent) lamps including huge energy-saving potential consuming only about one-fourth of energy consumed by GLS lamps, better luminescence and longer life-span. Hence, they are being promoted by the Government of India and some State Governments. The power saving is estimated to be as high as 12000 MW per annum, if all the GLS lamps in the country are replaced by the CFLs. This is expected to result in big savings on the requirement for infrastructure and the fossil fuels, resulting in huge reduction in emissions, particularly of greenhouse gases, and several other such co-benefits.

1.1.3 Most of the energy-saving lamps (fluorescent, compact fluorescent, mercury vapour, sodium vapour and metal multi-vapours and mixed), however, use mercury as a vital component for their functioning, which has the potential of causing damage to the public health if not disposed properly. Mercury

concentration in these lamps varies considerably depending on the manufacturer, the type of lamp and the manufacturing year. The mercury consumption in Indian Fluorescent Lamps (FLs), i.e., in FTLs & CFLs is found to be higher than that observed in some developed countries, due to the improper mercury dosing techniques.

1.1.4 As estimated based on the available data, the total mercury consumption in FTL sector is around 7.5 MT Hg /annum, considering about 250 million units /annum of production and an average of 30 mg of mercury in each FTL. Similarly, the total estimated mercury consumption in CFL sector is around 0.5 MT Hg /annum, considering about 100 million units/annum of production and an average of 5 mg of mercury in each CFL. There are, reportedly, no imports of FTLs into the country, whereas there is an import of CFLs and CFL components to the tune of about 300 million units/annum at present. This leads to a rough estimation of 3.0-3.6 MT of Hg/annum in the imported lamps, considering mercury levels in the range 10–13 mg/CFL as informed by Manufacturers' Association.

1.2 **Present Mercury Management in FL Sector:**

1.2.1 At the lamp manufacturing level, fluorescent lamp manufacturing units in India have varied levels of waste management practices. Some have adopted the practice of proper crushing under vacuum extraction, followed by segregation of glass (with or without mercury contamination), phosphor powder and liquid/vapour mercury. The mercury vapour is collected and adsorbed on an activated carbon pad. Most others have very

crude way of handling and disposing mercury-bearing wastes generated from the manufacturing process. Such crude set up, for handling of mercury-contaminated materials, is expected to result in mercury emissions in to environment from such waste handling facilities. There has not been enough thrust given on the recovery of mercury in such facilities. Also in India, there is no specific norm prescribed for the mercury emission in respect of FL sector, at present.

1.2.2 As per the present observed practice at the consumer level in the society at large, often, the used lamps are collected by the *kabariwalas* from the households and collectively handed over to the glass recyclers for the recovery of glass material. This is all operative in a highly unorganized sector. It has, also, been observed that the used lamps are thrown into the garbage bins and finally into the municipal garbage dumpsites, contaminating air, water and soil. Most of the used lamps are broken either at the transit garbage bins provided by the local civic authority or broken during transport of the same to the final disposal site. A portion of the mercury, in vapour form, is released into the air; whereas rest of the mercury is released onto the soil with further possibility of getting the same into the surface and/or ground water bodies through leachate from the soil.

1.3 International Practices for Mercury Management in FL Sector:

1.3.1 As per the available information in the international scenario on collection, handling, transportation, treatment and disposal of mercury-bearing lamps, most western countries follow the WEEE

(Waste Electrical & Electronics Equipment) Directives based on the concept of Extended Producers' Responsibility. However, the USA has independent market-oriented system, where the consumer is required to pay money and put efforts, both, for collection, transportation, treatment and disposal at the recycling centres recognized by the concerned regulatory authority.

Germany follows *The Recovery and Disposal Act* for recycling the used FLs, in the special Lamp Recycling Facilities developed under the '*Law of Waste Production and Consumption'*. However, the exact details, on the actual system of collection & recycling process and the agency responsible for this, could not be accessed. As per the *'Waste Ordinance'* in Sweden, the responsibility for the collection, treatment, recycling and disposal of used FLs rests with the producers. In Finland, as per the WEEE Directive being followed, the Municipalities have an obligation to arrange collection of FLs and other Hg containing wastes from households and the waste lamps are being treated only by a company authorized for handling hazardous waste.

Japan follows the '*Law for Promotion of Effective Utilization of Resources',* with the collection of used lamps through local governing bodies and treatment/disposal through common authorized lamp recycling facilities. China follows the '*Law of Environmental Protection';* however, the exact details on the system for recycling process could not be accessed. *The Waste Disposal Act* is implemented in Taiwan for the recycling of used fluorescent lamps. As per this Act, the Retailers are responsible for the operation of collection centres, whereas authorized

recycling facilities are responsible for the lamp recycling/disposal process.

1.3.2 Most developed countries have proper legal back up to support environmentally safe disposal of mercury-contaminated used lamps, particularly at community level, e.g. WEEE Directive for European Union, Universal Waste Rules for USA, etc.

1.4 Need for Proper Mercury Management in FL Sector:

1.4.1 Mercury is a proven neuro-toxic substance and linked to a wide range of health effects, including irreversible damage to the human nervous system. The severity of health effects from mercury exposure is influenced by the following factors:

(i) Chemical form of mercury, i.e., inorganic or organic mercury,
(ii) Dose,
(iii) Age of the person exposed,
(iv) Duration of exposure,
(v) Route of exposure i.e., inhalation, ingestion, dermal contacts, and
(vi) Health of the person exposed.

1.4.2 The mercury-bearing lamps, towards the end-of-life span, have a significant hazard potential due to the likely release of mercury and hence, must be properly disposed of. As the use of fluorescent lamps (FLs), including Fluorescent Tube Lights (FTLs) and Compact Fluorescent Lamps (CFLs), is increasing due to its energy efficiency over the conventional incandescent lamps, the quantity of FLs that have to be treated is also growing, too.

Though, these FLs release relatively less quantity of mercury when disposed as compared to other mercury-based products, they remain of major concern due to the large and further growing number of FLs in service, particularly, in the domestic sector.

1.4.3 The present set-up of improper mercury management in the country and the ever-increasing number of mercury-bearing lamps justify the exigency for environmentally sound management of mercury in the fluorescent lamp sector.

******

2.0 OBJECTIVE & SCOPE OF THE TASK FORCE

2.1 Ministry of Environment & Forests (MoEF) in the Government of India constituted a Task Force, under the chairmanship of Sh. R H Khwaja, Additional Secretary in MoEF; in August, 2007 in view of the exigency for ensuring environmentally sound disposal of the used mercury-bearing lamps, particularly, with the exponential rise in the demand for CFLs and, also, the thrust being put by the Government of India and other State governments for promotion of CFLs due to their energy-saving potential.

2.2 The main objective of the Task Force was to evolve a policy for environmentally safe management of mercury in CFLs.

2.3 The scope of the Task Force, as perceived, was to suggest a policy and strategy for environmentally safe & sound management of mercury in CFL sector, at all the levels of handling of CFLs. The strategy, for its successful implementation, would incorporate all administrative, managerial, legal, financial and awareness measures as required to fulfil the objective. The strategy, thus, prepared would mainly aim at the proper operationalization of the mechanism for proper collection, transportation, treatment/recycling & disposal of the used CFLs generated from the society. The scope of the Task Force was widened from CFLs in the first meeting of the Task Force, to cover the entire fluorescent lamp sector in view of the associated mercury-related problems.

2.4 The tenure of the Task Force, which was initially for a period of six months, was also extended by another three months i.e. up to May '08 considering the complexity of the issues related to the mercury management in this sector.

2.5 Office Order No.23-20/2007-HSMD dated 14.8.2007, issued by MoEF on the constitution of the Task Force, is placed at **Appendix-1**.

*****

3.0 BRIEF NOTE ON THE TECHNICAL COMMITTEE

3.1 A Technical Committee, headed by Sh. J. M. Mauskar, Chairman, CPCB, was also constituted by the MoEF, along with the Task Force in August 2007, to consider the issues relating to safe management of mercury in CFLs (the scope was, later, widened to cover entire FL sector) and recommend measures, standards and guidelines for (a) safe usage, (b) disposal, and (c) public campaign & awareness building.

The Committee consisted of senior officials from MoEF, CPCB, Ministry of Health & Family Welfare and other technical experts from various institutes covering Industrial Toxicological Research Centre (ITRC), Bureau of Energy Efficiency (BEE), and National Institute of Occupational health (NIOH).

3.2 The task of the Technical Committee, involving mainly the development of Guidelines on 'Environmentally Sound Mercury Management in FL sector', was accomplished with a defined approach of data collection, inspection of selected fluorescent lamp manufacturing facilities, interaction with the concerned Manufacturing Associations, survey of Indian & international practices for mercury management in this sector, study of various technological options for environmentally safe disposal of used lamps at, both, manufacturer and consumer level, etc.

3.3 The Technical Committee submitted its comprehensive report, along with the draft Guidelines on 'Environmentally Sound Mercury Management in FL sector' to the MoEF and Chairman, Task Force in February 2008. The report, along with the

Guidelines, was discussed and accepted by the Task Force during the third meeting of the Task Force held on 27.2.2008. The report also covered, apart from the Guidelines, some suggestions on various administrative, legal, financial and awareness measures for proper implementation of the technical measures suggested in the Guidelines.

3.4 The Guidelines prepared by the Technical Committee cover all the technical facets of mercury management in the FL Sector. The Guidelines delineate the measures that are required for safe handling and environmentally sound management of mercury in this sector, involving all levels of handlers of mercury-bearing lamps, i.e., the manufacturers, the consumers, used lamp collectors, transporters and lamp treatment/recycling operators.

3.5 The administrative measures suggested by the Technical Committee, covered the mechanism for proper collection, transportation, treatment, recycling and final disposal of used lamps, apart from the suggestions on the roles & responsibilities of various stakeholders, legislature back-up and some fiscal incentives for making such mechanism more effective.

3.6 The Report of the Technical Committee, in brief, is placed at **Appendix-2** and the Guidelines on 'Environmentally Sound Mercury Management in FL Sector' are placed at **Appendix-3** of this Report.

******

4.0 APPROACH OF THE TASK FORCE

4.1 The Task Force adopted the following approach for arriving at a strategy to ensure an environmentally sound mercury management in FL sector:

a. Discussion among the Task Force Members on issues related to:

- Guidelines on 'Environmentally Sound Mercury Management in Fluorescent Lamp Sector', as prepared by the Technical Committee.
- Administrative mechanism for the collection, transportation, treatment/recycling and disposal of the used lamps generated at consumer level.
- Legislative issues and Fiscal Incentives for effecting proper management of mercury at consumer level.
- Roles and responsibilities of various government & non-government agencies, FL Manufacturers, and consumers, etc.

b. Discussion with the representatives of FL Manufacturers and, also, three known Manufacturers' Associations, namely: Electrical Lamp Components Manufactures' Association of India (ELCOMA), Federation of All-India Small Scale Lamps & Components Manufacturers' Association (FAISLCOMA) and Energy Saving Lamp Manufacturers Association (ESLMA)

c. Study of system for such management in developed countries.

4.2 The following is the gist of proceedings carried out by the Task Force:

4.2.1 The Task Force, primarily, focused on the issues related to various measures to be taken for collection, transportation, treatment/recycling and disposal of the used Florescent Lamps (FLs) at the consumer level, besides legal aspects & the fiscal incentives for effecting proper management of mercury. Further, the Task Force, also, discussed about the roles and responsibilities of various government and non-government organizations /agencies including the FL manufacturers and consumers for safe management of mercury.

4.2.2 The Task Force conducted six meetings during September 2007 to May 2008 to discuss various issues related to the mercury management in the FL sector.

4.2.3 The first meeting of the Task Force was held on 12.09.2007. The Bureau of Energy Efficiency, Ministry of Power informed that a mammoth scheme of the Bachat Lamp Yojana (BLY) & Demand Side Management (DSM) was initiated to promote energy-efficient alternative to the incandescent lamp. The Task Force also discussed the issue related to import of CFLs as well as the fate of fused CFLs and responsibilities of the importer in collection and disposal of such fused CFLs. Further, the discussions were held among the members, with respect to institutional arrangements for the Buy Back Policy, creation of awareness and BIS standards/norms for mercury content in the CFLs. It was suggested that the Technical Committee on Mercury, a specialized body formed for the purpose, would consider all the issues relating to management of mercury from

CFLs, recommend measures, develop guidelines, standards for usage and would be guided by the Task Force.

It was also decided in the first meeting that in addition to CFLs, the Task Force as well as the Technical Committee would consider other sources of mercury emissions, such as, fluorescent tube lights to cover the entire fluorescent lamp (FL) sector.

4.2.4 In the second meeting of the Task Force held on 19.10.2007 it was informed that as per the observations of the team which had visited some manufacturing units of CFLs, the methodology and technology being adopted by them was far from satisfactory and they were required to take adequate care for the mercury management. The discussions related to the international practices and standards were held.

It was suggested that a statutory warning should be indicated on the CFLs regarding the risk and hazards of mercury contained in the CFLs as well as for safe handling of the broken lamps. Also, the issues related to the *Bachat Lamp Yojana*, a scheme to be introduced by the govt. of India, were discussed at length, in light of the increase in number of FLs in the market and their environmental implications.

4.2.5 The third meeting of the Task Force was held on 27.02.2008; wherein the report, along with the draft Guidelines, submitted by the Technical Committee on 'Environmentally Sound Mercury Management in Fluorescent Lamp Sector' was discussed. It was informed that the report was prepared with a well-defined approach and detailed discussions in four meetings of the

Technical Committee. The report, along with the Guidelines, was accepted after a threadbare discussion.

The Technical Committee had, also, made some suggestions on administrative, legal, fiscal & awareness measures for the effective implementation of the technical measures suggested through the Guidelines. The Task Force decided to interact with the concerned industries' Associations for arriving at an acceptable mechanism for the effective collection, transportation, and treatment/recycling (in line with the measures recommended through the Guidelines) of the used lamps. Members also discussed the issues related to requirement of separate regulations, the onus of mercury monitoring, BIS guidelines and standards, imported CFLs, authorization/registration for Recyclers of CFLs, etc. It was suggested that the BIS should undertake vigorous investigation with regard to illegal manufacturing of CFLs and such units should be closed down.

4.2.6 The Task Force in its 4th meeting, held on 20.03.2008, had discussions with the representatives of the Electric Lamp & Component Manufacturers' Association of India (ELCOMA) on developing mechanism for proper collection, transportation and treatment/recycling of the used lamps generated at society level. The ELCOMA mentioned that in Europe and USA, the responsibility of recycling of fused CFLs was given to the authorized recycling units, since specialized equipments and trained manpower with specialized skills were required by such authorized units. In USA, mercury lamp recycling is a commercial venture. ELCOMA was of the view that for installing a recycling unit of about 5,500 lamps per hour, about Rs.3.5 crores of capital investment was required. ELCOMA also

submitted that land may be given free along with other incentives to encourage the prospective recycling units in India.

However, it was informed by the Task Force to the ELCOMA that the ultimate responsibility for collection, transportation, recycling and disposal of used FLs lied with the FL manufacturers, based on *'Polluter Pays'* principle and also as per the *'Precautionary Approach'*.

It was informed that under the scheme of the MoEF for setting up of hazardous waste Treatment, Storage and Disposal Facility (TSDF), a central subsidy up to an amount of Rs.2.00 crores was provided to the TSDF developer, with an equal matching grant by the concerned State Govt. Similar financial support for recyclers of FLs might also be considered. Such recyclers should to be registered with the concerned authority, as opined by Task Force. The subsidies could, also, be considered under CDM benefits sought by the CFL manufacturers, as discussed.

It was decided in the meeting that the relevant extracts from the draft Guidelines prepared by the Technical Committee would be transmitted to the ELCOMA and other Associations, so as to receive the response from the manufacturers of FLs, both Indian and Multinationals.

4.2.7 The fifth meeting of the Task Force was held on 7.4.2008 to ascertain the views of the manufacturers of CFLs/FTLs in respect of safe collection, transportation, recycling, treatment and disposal of the used FLs, in line with the Guidelines so as to minimize the adverse impacts of mercury and various other waste components on the environment.

Only one of the manufacturing Associations viz. the ELCOMA attended the meeting. They were of the view that it is practically not possible for the manufacturers to collect the used lamps from consumers/dealers and put up a recycling plant in every town. They mentioned that there are 50-60 different brands of CFLs available in the market and each one putting up a recycling plant will not be a viable proposition. They suggested that a third party, who can be duly authorised and appointed to take up the responsibility for recycling of CFLs and FTLs of all the brands available in the market. The ELCOMA also suggested that BIS should prepare standards to specify the maximum mercury contents in FLs, which would help minimize mercury emissions from fluorescent lamps.

The Task Force decided that the Member Secretary of Task Force may hold separate discussions with all the manufacturers association to ascertain their views in the matter. Accordingly, discussions were held with the representatives of the three known Manufacturers' Associations, namely, Electrical Lamp Components Manufactures' Association of India (ELCOMA), Federation of All-India Small Scale Lamps & Components Manufacturers' Association (FAISLCOMA) and Energy Saving Lamp Manufacturers Association (ESLMA).

4.2.8 The ESLMA members expressed that a big lot of sub-standard CFLs was being manufactured, particularly using imported CFL components, and sold in the Indian market illegally without the BIS mark and the same must be stopped. The ESLMA members suggested that import of CFLs and their components should be allowed only to the manufacturers having the BIS licence. They were of the view that the Government may adopt a business

model for the purpose of collection, transportation, treatment and recycling of the used /broken lamps.

4.2.9 The FAISLCOMA members mentioned that in India, power fluctuation was the main reason for short life span of CFLs/FTLs. Also, the self-ballast CFLs were not suitable for Indian conditions due to frequent power fluctuation and in such a situation, even if a CFL was fused only due to the electronic component (not due to the shell portion), the entire set became useless and turned into a waste. In view of this, the separate-ballast CFLs would result into less generation of waste and they should be promoted. They opined that, consumer awareness was very important in order to make the system effective.

4.2.10 In general, the CFL and FTL Manufacturing Associations expressed their view that they could not take full responsibility for collection, transportation, treatment and recycling of used/broken CFLs/FTLs generated from the society. For collecting the used/broken lamps from the consumers, the Associations suggested that role of rag-pickers, *kabariwalas*, residents welfare associations (RWAs) and NGOs may be promoted. However, the Task Force representatives explained to the members of the Associations that, in view of the potential impacts of mercury releases and the growing number of FLs in the society due to their energy-saving potential, there was an exigency for having the mechanism for proper collection, transportation & treatment/recycling and the onus of operationalization of such mechanism could rest only with manufacturers. However, the Government could explore all possible options to extend the subsidies, soft loans and other such assistance for such objectives, in pursuance to the prevalent policies in the country.

4.2.11 The draft report of the Task Force was circulated to all its members to have their suggestions and views for the discussion in the final meeting of the Task Force.

4.2.12 The Task Force in its final meeting held on 13-5-2008 broadly agreed to the recommendations made through the draft report. It was agreed that, the manufacturers needed to be made responsible in one way or the other for collection, transportation of fused/broken CFLs and for setting up of the recycling facilities individually or jointly. The need for having separate legislation, for the purpose, was discussed at length.

The Task Force decided to recommend to the Ministry of Finance to develop a mechanism for imposing some sort of additional import duty/cess at the import stage in order to cover the collection and recycling charges of used imported CFLs. It was, also, decided to recommend that the CFLs/FTLs produced in India, too, could be considered for some kind of taxation with or without the internalization of the cost, for recovery of the cost of operationalization of lamp recycling mechanism. However, the handlers of used lamps, at each stage, could be considered for some kind of incentives at least for initial stage for catalyzing the efforts for success of such mechanism. It was suggested to the BIS that the life span of the lamps also be considered while finalizing the norms, in order to avoid frequent replacement of the same by the consumers.

******

5.0 RATIONALE FOR THE RECOMMENDATIONS

5.1 There has been no proper system for environmentally safe disposal of used mercury-bearing lamps generated at community level in India. There is no proper treatment/recycling system provided at the manufacturing level. Considering the anticipated public health impact of mercury due to such improper disposal, the Task Force is of the view that there was urgency for an environmentally sound management of mercury in the mercury-bearing lamp sector. Hence, the Guidelines on 'Environmentally Sound Mercury Management in Fluorescent Lamp Sector', as prepared by the Technical Committee, are expected to serve the purpose for a better mercury-free environment.

5.2 The measures suggested in the Guidelines, particularly for the manufacturing units, require modification in the existing mercury recycling practices almost at all the manufacturing units. This could be enforced through the existing consent mechanism applicable for such manufacturing activities. It may, here, be noted that, the basic technology for the treatment/recycling of mercury-bearing wastes remains same in the lamp recycling facilities to be provided, both, at manufacturer and consumer levels.

5.3 Though the FL manufacturers had agreed, in principle, on the measures suggested through the Guidelines prepared by the Technical Committee, there were some points of disagreements during discussions with various manufacturers' Associations by the members of the Task Force. The disagreements in general,

raised by the manufacturers, were related to the cost of managing such mechanism (of used lamp collection, transportation, treatment /recycling & disposal) and sharing of such cost with the importers (particularly those, that are involved in trading the imported components of CFLs to some unscrupulous manufactures), import/manufacturing of sub-standard quality of CFLs, developing analytical facilities for checking mercury levels in FLs, etc.

5.4 There are three categories of FL (particularly, in CFL) importers in the country which came out during various interactions in the meeting of the Task Force viz., Manufacturer-Importer, Assembler-Importer and Trader-Importer. The first category of importer was found to be operative, by & large, at a scale larger than other two categories. Nearly 70% of import (of lamp shell & ballast) was attributed to the first two categories, which were supposed to be registered and certified by BIS of the quality requirements. However, most manufacturers of CFLs, importing the CFLs through the third category were reported as unscrupulous and they produced nearly around 100 million numbers of such CFLs (with nearly 30% of imported lamp goods) which were, expectedly, not subject to any quality requirement and any taxation either.

5.5 Among the Indian manufacturers, a lion share of manufacturing of FLs is appropriated by major multi-national lamp manufacturing companies, like Osram, Philips, etc. These multi-national companies were expected to be law-abiding and complying with the requirement for proper mercury-bearing

lamp disposal in other developed nations, where they had set up their manufacturing facilities. Hence, these manufacturers were expected not to have any problems in satisfying such requirements in India, too. Even, the exporting (CFL components or full CFLs) parties were, also, expectedly law-abiding in their respective countries and hence, they, too, should be willing to comply with all such requirements (related to proper disposal of mercury-bearing lamps) in India. The Indian small-scale manufacturing sector, too, cannot defy their responsibility (of proper disposal of mercury-bearing lamps) on account of the potential health impact (on public health and other living-being in the eco-chain) envisaged from the improper disposal of such lamps. No concession could be granted to the small-scale manufacturers on this account. In view of this, it is the manufacturers and importing traders, who had to contribute towards the management of the entire mercury recycling mechanism.

5.6 The manufacturers preferred for development of lamp recycling mechanism as market-based business model (by identifying parties interested in such recycling projects and cost to be recovered from the consumers) as per the discussions with the concerned Associations. However, the Task Force is of the view that the entire mechanism should be funded through a kind of corpus, a carefully designed financial instrument, wherein the fund contribution could be made by imposing some sort of tax, to be collected on each FL being manufactured or imported (either FL as a whole or in form of a shell meant to produce a CFL out of it). Alternatively, the manufactures and importers can

build in their prices, the charges for operationalizing the lamp recycling mechanism.

5.7 Consumption of mercury in the FLs and the life of FLs are significant issues, particularly at a small-scale manufacturer level, which have large bearing upon the release of mercury into the environment. The responsibility of formulating regulations in respect of these issues lies with the Bureau of Indian Standards (BIS). Though, BIS has already prescribed performance standards (including that for minimum life span) for a variety of mercury-bearing lamps, it is yet to develop the regulation for controlling the level of mercury in the lamp. The regulation on the mercury levels should be suitably considered based on the present dosing mechanism, global norms and time & economy involved in changing over to better techniques (for better regulated mercury dosing), etc.

5.8 The used FLs, though containing mercury, do not necessarily form hazardous wastes, as per the prevailing Hazardous Waste Management Rules, 2003. However, this waste requires consideration for a separate recognition as a potential hazardous waste and, hence, there is a need for introducing a separate regulation in view of the potential hazards involved in handling mercury from such used lamps, grass-root penetration of the mercury bearing lamps, present crude way of handling such wastes and level of awareness of the people.

5.9 The successful operation of such mechanism requires some kind of fiscal incentives at each level of operation, i.e. consumer (for

returning the fused lamps), primary collector (even from informal sector) and the treatment facility operator, at least for some initial years of operation, so as to push the concept well in the minds of the stakeholders. These incentives could be imparted from the corpus fund and/or the funds likely to be available to combat greenhouse gases (GHG), as the FLs are considered to be more energy efficient than the conventional GLS lamps, thereby helping reduction in emission of GHGs.

In addition to the above incentives, the common treatment/ recycling facilities, that are required to be installed as a part of such mechanism could be considered, on request basis, for extension capital subsidies and/or soft loans as per the prevailing policies of the Government of India and the State governments. In this context, the mercury-waste treatment facilities (capable of complying with the provisions of the suggested Guidelines), provided at some of the manufacturing units, could, also (in addition to the independent units meant for recycling at common level), be utilized for the purpose of safe recycling of the used lamps generated from the community.

5.10 Mercury due to its toxic effects on human health, requires awareness among the people handling it. At present FTLs and CFLs are more widespread in urban areas than the rural areas, who are not educated on the potential impact of mercury used in FLs. Also, with the drive to combat global issues like climate change, thrust is now shifting from old GLS lamp to current energy saving fluorescent lamps. Hence public awareness at all levels of used lamp handlers is understood to be a key element

for successful operation of lamp recycling mechanism. This can be well achieved with the use of audio-visual media, leaflets, booklets, proper labelling of FL products, training of common public and the handlers for handling mercury-contaminated lamps, holding special awareness camps, etc. This could be done through identified agencies, including government and non-government organisations.

******

6.0 RECOMMENDATIONS OF THE TASK FORCE

6.1 The Task Force was of the view that specific and focussed actions are needed to achieve environmentally sound management of mercury. The recommendations made by the Task Force, if properly implemented, would result in proper disposal of used CFLs & FTLs and eventually lead to reductions of mercury releases into the environment. The recommendations presented here are especially important in addressing critical knowledge gaps regarding mercury releases, transport, and exposure and also in guiding public health outreach. With these objectives, the Task Force makes the following recommendations:

6.1.1 The Guidelines for 'Environmentally Sound Mercury Management in Fluorescent Lamp Sector', as prepared by the Technical Committee, may be adopted for the management of mercury in fluorescent lamp sector, which cover all the levels of handlers, including the manufacturers, importers, individual households, bulk consumers, primary collectors and treatment/recycling operators for the effective prevention and control of the releases of mercury from this sector.

6.1.2 There should be a separate regulation developed, in due course of time, under the Environment (Protection) Act 1986 to enforce proper collection, transportation of fused/broken CFLs and FTLs and for their environmentally sound recycling which may be set up for the purpose by the manufacturers and importers either individually or jointly. In the regulations, provisions may be made for regulating the activities of collection, transportation and recycling of CFLs/FTLs, with the targets of achieving 60%

recycling of the used CFLs and FTLs in the country in the course of next three years and 90% in the course of next 5 years.

6.1.3 The onus of operationalizing the used lamp recycling mechanism (covering collection, transportation, treatment/recycling & disposal), as per the measures delineated in the guidelines, may rest with the lamp manufactures and importers as per the '*Precautionary Approach*' and '*Polluter Pays Principle*'. They are also responsible, in this regard, as per the extended responsibility of producers.

6.1.4 The entire lamp recycling mechanism should be funded through a mechanism of taxation, imposed on each CFL/FTL (manufactured or assembled in the country) covering the charges for collection of used/fused/broken CFLs and FTLs and their recycling in special recycling facilities to be set up by the manufacturers of CFLs and FTLs, individually or jointly. The Ministries of Finance and Commerce may be requested to devise a suitable mechanism for this purpose. Alternatively, the manufacturers may be allowed to build into the price structure the charges for collection and recycling of fused/broken CFLs and FTLs.

6.1.5 In the process of collection of used CFLs/FTLs and their transportation, the role of informal sector, such as, rag-pickers, *kabariwallahs* and residents welfare associations, should be recognised in the regulations to be drawn up in respect of the CFLs and FTLs.

6.1.6 The Govt. of India may consider extending incentives to the manufacturers and importers of CFLs and FTLs for setting up lamp recycling facilities at least for a period of initial few years, for catalyzing their efforts for successful operation of the lamp

recycling mechanism. The above incentives may include capital subsidy on sharing basis by the Central government and the State government as in the case of similar financial assistance extended for setting up of the Treatment, Storage and Disposal Facility (TSDF) for hazardous substances. The subsidy to be considered by the Govt. to cover the charges on account of collection and recycling of the used CFLs and FTLs, as built in the price structure and the extent of subsidy to be given may be decided separately.

6.1.7 There should be a scheme for registration of importers of CFLs in the country and importers along with the manufacturers of CFLs should be made responsible for the entire process of lamp recycling mechanism individually or jointly.

6.1.8 The State governments may also consider making land available at concessional price to the recyclers for enhancing the viability of such recycling facilities. Further, to encourage such recycling facilities to be set up, banks may also consider making available the required finances to the recyclers.

6.1.9 The Bureau of Indian Standards (BIS) may be requested to develop regulations for controlling the levels of mercury in fluorescent lamps and to standardise the methodology for mercury measurement in fluorescent lamps.

The BIS may, also, prescribe some measures to be taken by the manufacturers including a special type of logo to mark the presence of mercury in the lamp and prescription of clean-up procedure for handling the broken mercury-bearing lamp, for the awareness of public.

The BIS may develop performance standards to increase the CFL life span upto 10,000 to 15,000 hrs. The BIS performance standards for CFLs should be strictly implemented by concerned. In the light of the reports of availability of sub-standard CFLs in the market, based on imported components available at cheaper prices with no assurance for the shelf life, these standards should be implemented strictly by the concerned State industry department, including other law enforcing agencies.

6.1.10 Public awareness, being important tool for attaining success in safe handling of mercury-bearing lamps, the same may be taken up in association with the concerned government and non-government organizations. Moreover, all the consumers, individual domestic consumers and bulk consumers (offices, institutions, large residential complexes, etc.) should be made fully aware about the potential health impacts of mercury-bearing lamps, through audio-visual media and the product leaflets. The precautions, to be taken while cleaning up the broken FLs should, also, be known to the consumers.

6.1.11 The Central government may also earmark separate funds for undertaking Research and Development in the FL sector also for transfer of advanced technology in this sector, with a view to make quality products of CFLs and FTLs and their availability at reasonable prices in the market.

6.1.12 The recyclers of FLs should obtain registration from the concerned government agency to ensure that they have adequate facilities for recycling.

******

Appendix-1

23-20/2007-HSMD
Government of India
Ministry of Environment & Forests
(HSM Division)
*****

Paryavaran Bhawan,
CGO Complex, Lodhi Road,
New Delhi-110003
Dated: 14.8.2007

OFFICE ORDER

Sub: Task Force on Mercury.

This Ministry of Environment & Forests, Government of India, hereby constitutes a Task Force to evolve a policy for safe management of mercury from Compact Fluorescent Lamps (CFL). The Task Force shall consist of the following members:-

1.	Shri R. H. Khwaja Additional Secretary, Ministry of Environment & Forests	-	Chairman
2.	Shri J. M. Mauskar Joint Secretary / Chairman, CPCB Ministry of Environment & Forests	-	Member
3.	Representative of Ministry of Power Shram Shakti Bhawan, New Delhi-110001.	-	Member
4.	Representative of Department of Industrial Policy & Promotion Ministry of Industry 11, Talkatora Road New Delhi-110001	-	Member
5.	Representative of Ministry of Health & Family Welfare Nirman Bhavan, Maulana Azad Road New Delhi – 110011	-	Member
6.	Mr. Ajay Mathur Director General Bureau of Energy Efficiency Ministry of Power Shram Shakti Bhavan, New Delhi – 110011.	-	Member

Contd…2/-

7. Dr. Ashwani Kumar - Member
Director
Indian Toxicology Research Centre
Lucknow - 226011

8. Dr. Sudhir Dave - Member
Director
National Institute for Occupational Health
Meghani Nagar, Ahmedabad 380016

9. Dr. Y. K. Gupta
Chairman
National Poisons Information Centre
All India Institute of Medical Science (AIIMS)
New Delhi – 110 029

10. Sh. R. K. Vaish - Member Secretary
Joint Secretary
Ministry of Environment & Forests

2. The Terms of Reference of the Task Force shall be to evolve a policy for safe management of mercury in Compact Fluorescent Lamps. The policy shall elaborate on safety in manufacture, usage and disposal and creation of public awareness.

3. The tenure of the Task Force shall be for a period of six months.

4. The Task Force shall meet as often as may be necessary.

5. The Task Force shall submit an interim report within 3 months of the constitution of the Task Force and the final report within six months.

6. TA/DA of non-official members attending the meeting will be borne by the Ministry of Environment & Forests as per the Government of India rules.

6. Sitting charges Rs.1000/- will be paid to each participating non-official member of the Task Force.

7. This issues with the approval of Secretary(E&F).

Sd/-
(Dr. Indrani Chandrasekharan)
Director (HSMD) 14.8.2007

Copy to:

1. All the Members.
2. PS to Secretary(E&F), 3. PS to AS(RHK), 4. JS(RKV), 5. IFD/GC/Spare

Appendix-2

SUMMARY REPORT

OF

TECHNICAL COMMITTEE

ON

ENVIRONMENTALLY SOUND MERCURY MANAGEMENT IN FLUORESCENT LAMP SECTOR

CENTRAL POLLUTION CONTROL BOARD
MINISTRY OF ENVIRONMENT OF FORESTS
PARIVESH BHAVAN, EAST ARJUN NAGAR,
DELHI- 110032
WEB SITE: www.cpcb.nic.in

1.0 OBJECTIVE OF TECHNICAL COMMITTEE

1.1 Mercury-bearing lamps (fluorescent, compact fluorescent, mercury vapor, sodium vapor and metal multi-vapors and mixed) use mercury as a vital component for their functioning. Mercury concentration in these lamps varies considerably depending on the manufacturer, the type of lamp and the manufacturing year.

1.2 Lighting industry has seen an annual growth of about 12% per annum in the last 4 years. Amongst the various products, the consumption of CFLs has contributed a very large growth rate, as high as 50% in 2006. GLS production has further increased by more than 20% during 2006. Similarly, the fluorescent lamp market has shown a growth of 10% in 2006. HID lamp segment has equally shown good results of 24% growth in 2006.

1.3 These lamps, towards the end of life span, have a significant hazard potential due to the release of mercury and, hence, must be properly disposed of. As the use of fluorescent lamps (FLs), including Fluorescent Tube Light (FTL) and Compact Fluorescent Lamp (CFL), is increasing due to its energy efficiency over the conventional incandescent lamps; the amount of FLs that have to be treated is growing, too. Though these FLs release relatively less quantity of mercury, when disposed as compared to other mercury lamps; they remain of major concern due to the large & further growing number of FLs in service, particularly, in domestic sector.

1.4 Therefore, the Ministry of Environment & Forests, Government of India has constituted a Task Force for evolving a policy for management of mercury and a Technical Committee, headed by

the Chairman CPCB. The ToR of the Committee is to consider issues relating to safe management of mercury in Compact Fluorescent Lamps and recommend measures, standards and guidelines for (a) Safe usage (b) disposal (c) standards for CFL and (d) content for public campaign and awareness building. In fact, the initial scope of the Task Force and Committee was only in respect of CFL; which was, however, widened later to cover the entire fluorescent lamp sector. These guidelines are applicable, in principle, to other mercury-bearing lamps, as well.

1.0 APPROACHES FOR THE DEVELOPMENT OF GUIDELINES

1.1 The approach adopted by the Technical Committee, for the development of guidelines on Environmentally Sound Mercury Waste Management in Fluorescent Lamp Sector, is as below:

- Collection of information pertaining to - inventory of FL manufacturing units, mercury usage, quantum of mercury-contaminated wastes and treatment & disposal theirof in the FL manufacturing units - from SPCBs/PCCs.
- Collection of information pertaining to mercury emissions from other industrial sectors like Thermal power, Chlor-alkali, VCM manufacturing, pesticides, Steel & Cement, etc. for comparative assessment.
- Inspection of selected Fluorescent lamp manufacturing facilities by CPCB, Delhi and MoEF, apart from inspections carried out by CPCB zonal offices located at Vadodara, Lucknow, Bangalore and, also, by some SPCBs for study of mercury management practices.
- Survey the current used lamp collection, handling & disposal practices at individual consumer and community levels.
- Inputs from the concerned lamp manufacturing Associations.

- Study of used FL collection, handling, treatment & disposal practices at international level.
- Study of various technological options for Mercury recovery from the used FLs.
- Development of Draft Guidelines on Environmentally sound mercury management in FL sector.

1.2 Four Meetings of Technical Committee on Mercury have taken place at Ministry of Environment & Forests, New Delhi during September '07 – February '08, to discuss the Mercury Management in Fluorescent Lamp Sector.

3.0 OBSERVATIONS OF THE TECHNICAL COMMITTEE

3.1 The Technical Committee made following broad observations, based on the information collected, site inspections and the technical discussion among the Members:

3.1.1 There has been an incremental growth in the production and usage of the fluorescent lamps (FLs) in the recent years, even, requiring import of lamps in the country. This is expected to result in an ever increasing number of used FL (mercury-contaminated waste) to be disposed into the environment. However, there is no proper infrastructure available in the country to handle such waste, neither at manufacture level nor at consumer level.

3.1.2 The mercury consumption in FLs i.e. FTL & CFL is found to be higher than that observed in some advanced countries. There are different mercury dosing systems like liquid mercury dosing and pill dosing in the manufacturing of FLs. Most CFL

manufacturing facilities inspected were found having pill dosing system, where as most FTL producers were found to have liquid dosing system, which is expected to result in higher (than required) mercury consumption in the lamp.

Most FL manufacturing facilities were found to have the Argon flushing system in the process. Though proper information was not available in this regard, some units are believed to be having mercury-flushing system as well, as informed. This kind of system is expected to result in higher consumption and release of mercury in the process.

3.1.3 At the lamp manufacturing level, fluorescent lamp manufacturing units have varied level of waste management practices. Some have adopted practice of proper crushing, under vacuum extraction, followed by segregation of glass (with & without mercury contamination), phosphor powder and liquid/vapor mercury. The mercury vapor is collected and adsorbed on an activated carbon pad. Most others have very crude way of handling and disposing mercury-bearing wastes generated from the process. Many manufacturing units have crude type of distillation facility for the purification of raw mercury obtained from the Market. The residue obtained from the distillation of raw mercury is reportedly sent to TSDF.

Such crude set up, for handling of mercury-contaminated materials, is expected to result in mercury emissions from such waste handling facilities. There has not been enough thrust given on the recovery of mercury at such facilities, as observed. Also in India, there is no specific norm prescribed for the mercury emission in FL sector at present.

3.1.4 As per the present observed practice at consumer level, often, the used lamps are collected by the *kabari* from the households and collectively handed over to the glass recyclers for the recovery of glass material. This is all operative in a highly unorganized sector. It has, also, been observed that, the used lamps are thrown in the garbage bins and finally into the municipal garbage dumpsites, contaminating air, water and soil. Most of the used lamps are broken either at transit solid waste bins (provided by local civic authority) or broken during the transport to the final disposal site. A portion of the mercury, in vapor form, is released into the air; whereas rest of the mercury is released onto the soil with further possibility of getting into the surface and/or ground water bodies through the leachate from soil.

3.1.5 As per the available information on the international scenario on collection, handling, transportation, treatment and disposal of mercury-bearing lamps, most western countries follow WEEE (Waste Electrical & Electronics Equipment) Directives based on the concept of Extended Producers' Responsibility. The US has independent market-oriented system, where the consumer is required to pay money and efforts, both, for collection, treatment and disposal at the centers recognized by the concerned regulatory authority. There is no proper information available in respect of China and Japan, in this regard.

3.1.6 Most advanced countries have proper legal back up to support environmentally safe disposal of mercury-contaminated used lamps, particularly at consumer level, e.g. WEEE Directive for European Union, Universal Waste Rules for USA, etc. There is a

requirement of such legal back up in our country, as well, for environmentally sound disposal of used FLs.

3.1.7 Used lamp mercury recovery and/or safe disposal at consumer level may not be in an economically viable preposition, unless some kind of fiscal incentives are incorporated.

3.2 The Technical Committee has prepared a set of draft Guidelines for Environmentally Sound Mercury Management in FL sector considering the above observations.

4.0 RECOMMENDATIONS OF THE TECHNICAL COMMITTEE

Followings are recommendations based on the above observations:

4.1 The Task Force may consider the draft set of Guidelines, as prepared by the Technical Committee for publicizing, in order to have environmentally sound mercury management in Fluorescent Lamp sector.

4.2 It is suggested that, the entire task of environmentally sound collection, transportation, treatment and disposal of used FLs generated at consumer level may be financed & organized by the fluorescent lamp manufacturing sector (either on individual or on association basis), in pursuance to the principles delineated in the National Environmental Policy, 2006 by the Government of India.

The suggested action points on the administrative issues related to the mechanism for the collection, transportation and disposal (of used lamps at consumer level), may be deliberated amongst

the Members of Task Force and other concerned stakeholders, since it involves multi-departmental approach, to arrive at a consensus for a proper system.

4.3 The Task Force may consider various Rules and Regulations to be evolved for the purpose of supporting the requirements as described in the draft Guidelines for the environmentally safe disposal of mercury-contaminated used FLs. The suggestions on legislative requirements and fiscal incentives are given below:

Legislative Requirement

(i) The Bureau of Indian Standards (BIS) may prescribe norms & the technology for achieving optimum Mercury content in CFLs & FLs.

(ii) The MoEF/CPCB may consider prescription of necessary statutes for effective collection, transportation, treatment/recycling & disposal of used FLs, as suggested in previous sections, which are applicable at individual house hold, commercial complexes, institutions, local self Governments, Lamp Recycling units (LRU) & all other agencies involved in handling of used FLs.

FISCAL Incentives

Fiscal Incentives for two measures may be considered:

(i) Incentive/Disincentive as per the Mercury content in FLs, for manufacturers and

(ii) Incentive for collection, treatment & disposal of used FLs at various levels e.g. individual, Handlers, Recycler, etc.

4.4 The Task Force may, also, consider the roles & responsibilities of the concerned stakeholders, as suggested briefly below for the proper implementation of the concerned regulations and the Guidelines, in this regard:

Manufacturers / Manufacturing Association:

They have to play a key role to finance, organize & operate the network for collection, transportation, treatment and disposal of the used FLs in an environmentally sound manner, so as to minimize the impact of various waste components (particularly, mercury used in the lamp) over the environment.

MoEF:

MoEF may notify the Rules & Norms for effective implementation of the measures suggested in the foregoing sections for environmentally sound mercury management - Develop strategies for effective implementation.

CPCB/SPCBs:

CPCB: to develop strategies for effective implementation of the Rules.

SPCBs: to implement the Rules & Norms notified by MoEF, in respect of individual manufacturing unit

NGOs:

NGOs can play very important role in implementing the mercury management in FL sector they can undertake responsibilities like transportation of used lamps to dumping areas, processing used

lamp as Registered recycler/ handling agencies, creating employment by training and deputing rag pickers.

BIS:

BIS may prescribe norms & the technology for achieving optimum Mercury content in CFLs & FLs.

BEE:

BEE may advise the best available practices for the manufacturing of CFLs & FLs with the advanced environmentally sound technology, also, help in public awareness programs for the purpose.

4.5 The consumer awareness programs, about the use of hazardous substances in fluorescent lamps, may be instituted by various government agencies (e.g. Bureau of Energy Efficiency), Lamp manufacturing Associations and/or NGOs, through a message on the wrapper, media coverage, posters, handbills, banners, school debates, office notices, etc.

4.6 The present practice of using used FLs as raw materials at the sites of existing glass recyclers may be allowed only with the compliance to the requirements as specified in the draft Guidelines.

****

Appendix-3

GUIDELINES
FOR
ENVIRONMENTALLY SOUND
MERCURY MANAGEMENT
IN
FLUORESCENT LAMP SECTOR

CENTRAL POLLUTION CONTROL BOARD

MINISTRY OF ENVIRONMENT OF FORESTS

PARIVESH BHAVAN, EAST ARJUN NAGAR,

DELHI- 110032

WEB SITE: www.cpcb.nic.in

OBJECTIVE

Mercury-bearing lamps (fluorescent, compact fluorescent, mercury vapor, sodium vapor and metal multi-vapors and mixed) use mercury as a vital component for their functioning. Mercury concentration in these lamps varies considerably depending on the manufacturer, the type of lamp and the manufacturing year.

Once the life time of these lamps have ended, they generate a hazardous waste due to the release of mercury, which must be properly disposed of. As the use of fluorescent lamps (FLs), including Fluorescent Tube Light (FTL) and Compact Fluorescent Lamp (CFL), is increasing due to its energy efficiency over the conventional incandescent lamps; the amount of FLs that have to be treated is growing, too. Though these FLs release relatively less quantity of mercury, when disposed as compared to other mercury lamps; they remain of major concern due to the large & further growing number of FLs in service, particularly, in domestic sector.

Therefore, the Ministry of Environment & Forests, Government of India has constituted a Task Force for evolving a policy for management of mercury and a Technical Committee to suggest a set of Guidelines, recommending measures & standards, for environmentally sound management of mercury in fluorescent lamp sector. These guidelines are applicable, in principle, to other mercury-bearing lamps, as well.

1.0 BACKGROUND

1.1 NATURE, OCCURRENCE, DISTRIBUTION & CHEMISTRY OF MERCURY IN THE ENVIRONMENT

Mercury is the only metal element, which is liquid at ambient temperature and also called *Quicksilver* because of its silvery white appearance. It rarely occurs free in nature and mainly found as bright red crystalline solid *Cinnabar Ore (HgS)***.**

Mercury is odourless, lustrous liquid metal that sinks in water and falls under heavy metals category. It is mobile, ductile and converts into malleable mass on being solidified at –39 ^{0}C, which may be cut with a knife. Each and every atom of mercury is capable bio-chemically to disable an enzyme or other critical protein in our body. Thus, mercury has the potential to produce significant health effects through series of bio chemical reactions in our body.

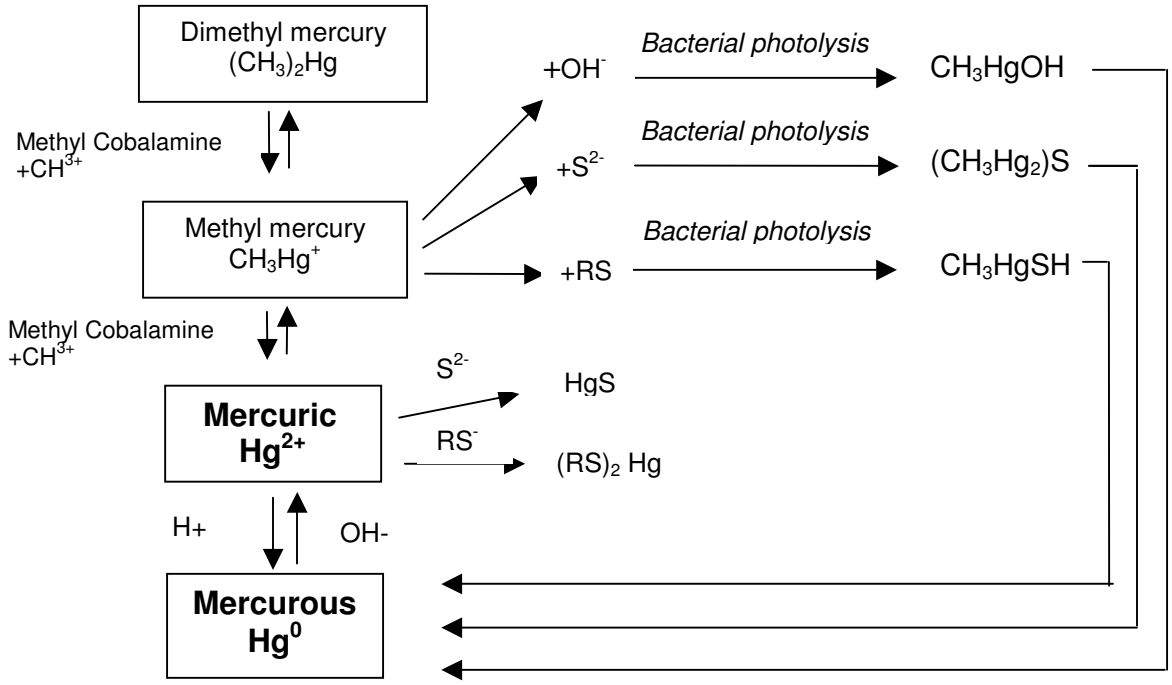
Physical Chemistry of Mercury	
Chemical Symbol	Hg (Hydrargyrum)
Atomic Weight	200.61
Atomic Number	80
Valency	+1, +2
Density	13.456
Boiling Point	356.9 ^{0}C
Solidity	-39 ^{0}C

Mercury is a natural component of the earth. Average abundance is assumed to be 0.05 gm/kg in the earth's crust but can vary significantly in different areas. It can be mobilized by volcanic activity and weathering of rocks. From the 25 known mercury minerals, only cinnabar deposits have been harvested for the extraction of mercury, a large number of them located in the Mediterranean basin. It occupies only 2-3% of the earth's surface but contains about 65% of world's mercury resources. The three biggest deposits are located in Spain, Slovenia and Italy, representing two thirds of the annual global mercury production.

In nature, mercury is rather found within compounds or as inorganic salts, when the mercuric ions (Hg^{+2}) combine with inorganic ligands. Some of them, like mercuric chloride ($HgCl_2$), are sufficiently volatile to exist as atmospheric gases, but due to water solubility and chemical reactivity of the gases they are more rapidly deposited from the atmosphere than elemental mercury gas. They show shorter atmospheric lifetimes. Combined with carbon, various organic mercury compounds are formed. The most common is methyl mercury Hg $(CH_3)_2$.

Besides its elemental form (Hg^0), mercury can be found in the nature in different speciation conditions. One of them is ionic mercury, that is, under certain environmental conditions, able to originate organic compounds known as organo-mercury. Mercury can exist as a cationic species because of the oxidation of the elemental mercury, producing mercurous ((Hg^{+1})) and mercuric ((Hg^{+2})) ions. Such ions can cause irreversible damages to

several organs, when animals and human organisms, are exposed to them. Even worse, they could lead the organism to death. As well as the inhalation of mercury vapors, the ingestion of food containing organo-mercury, especially methyl mercury (CH_3Hg^+), represents great health risks.



ENVIRONMENTAL CHEMISTRY OF MERCURY

1.2 LIGHTING INDUSTRY IN INDIA

Lighting industry has an annual growth of about 12% per annum in the last 4 years. Amongst the various products, the consumption of CFLs has contributed a very large growth rate, as high as 50% in 2006. This product segment has registered total quantity of > 100 million pieces during 2006 and as per the estimates; the figure is likely to cross 140 million pieces this year i.e. year 2007. A lot of new plants have been put up in CFL

in the last one year and today the CFL manufacturing capacity in India has crossed 100 million.

Incandescent lamp (GLS) production has further increased by more than 20% during 2006. Similarly, the fluorescent lamp market has shown a growth of 10% in 2006. HID lamp segment has equally shown good results of 24% growth in 2006. It is estimated that the luminaries market has been growing at least 25 to 30% per annum for the last two years.

Mercury is an essential ingredient for most energy efficient lamps. Fluorescent lamps and high intensity discharge (HID) lamps are the two most common types of lamps that utilize mercury. Fluorescent lamps provide lighting for most schools, office buildings, and stores. HID lamps, which include mercury-vapor, metal halide, and high-pressure sodium lamps, are used for streetlights, floodlights, and entertainment, sports and industrial lighting. Followings types of lamps contain mercury:

(i) Fluorescent Tube Lamps (FTL)
(ii) Compact Fluorescent Lamps (CFLs)
(iii) High Intensity Discharge (HID) Lamps, including Mercury Vapour, Metal halide and high Pressure Sodium
(iv) Neon Lamps (some use mercury and phosphor powder)

[High Pressure Mercury Lamps]

[Mercury Blended Reflector Lamp]

Fluorescent Lamps containing Mercury

Fluorescent Tube Lights (FTLs)

A 40-watt fluorescent tube emits 2,150 lumens as compared to 455 lumens by a standard incandescent 40-watt bulb. In addition, fluorescent tubes typically last longer and create much less heat than incandescent lamps. The newer generation, in fluorescent tube contains, T-8 and T-5 tube lights, especially with tri-band phosphor and is highly energy efficient.

Compact Fluorescent Lamps (CFLs)

Compact fluorescent lamp is energy efficient as most of the electric energy used is converted into light rather than heat. CFL are simply small fluorescent tubes with attached electronic ballast. When compared to standard incandescent bulbs, they consume 80% less electricity and last ten times longer.

Light Emitting Diodes (LEDs)

LEDs are new entrant to the field of lighting and are causing lighting revolution in areas where lighting intensity required is not very high. These LEDs have about 11 years of life, a real advance in lighting technology. This small light has no element to break, no glass to shatter and is not affected by heat or cold and can be lit up using ordinary batteries or very low voltages. These are at present used in a big way in automobile industry and for traffic lights. Research is going on to improve upon the quality of LED for its use in lighting applications.

Due to heavy electrification in villages during the last financial year, the Incandescent Lamp has seen unprecedented growth of over 20% during the year 2006. CFL however continues to grow @ about 40% p.a. Similarly, another Energy Efficient Product like Metal Halide Lamp has also been growing between 20 to 24% per annum. Fluorescent Tube Light continues to enjoy market growth of over 10% on regular basis. It is estimated that all Energy

Efficient Products shall continue to grow at the same speed for the next 3 years at least.

Table: WORLD CFL PRODUCTION vs. INDIAN CFL CONSUMPTION

Year	World (million pcs) Production	%growth	Total Indian Consumption (million pcs)	% growth
2001	820	-	27	-
2002	880	7	34	26
2003	1144	30	36	6
2004	1500	31	43	27
2005	1930	29	67	56
2006	2650	37	100	49
2009 (Estimated)	**6000**		**220**	

Source: ELECTRIC LAMP AND COMPONENT MANUFACTURERS ASSOCIATION OF INDIA (ELCOMA)

1.3 ROLE OF MERCURY IN FLORESCENT LAMPS

A Fluorescent lighting system consists of two or three main components: The fluorescent lamp, The Ballast, and the Starter system. The basic concept behind a fluorescent lamp is that a flow of electrical current occurs between two metal conductors placed in a glass tube, a process also known as arcing. That current flow passes through the gases in the tube (argon and a small amount of mercury in a gaseous phase) and excites the mercury atoms in the gas phase. The excited atoms emit photons, some of which are vibrating at ultraviolet frequency.

The ultraviolet light strikes a phosphor coating on the inner part of the glass. The phosphor responds to the ultraviolet light by producing a bright visible light. For a fluorescent lamp to start working, the potential of the electricity provided to the electrical conductors (called cathodes) inside the lamp must be greater than the initial electrical resistance of the gas in the lamp so that the electricity may begin arcing through the gas. The amount of mercury required is very small, typically measured in milligrams, and varies by lamp type, date of manufacture, manufacturing plant and manufacturer.

A fluorescent lamp mainly contains argon gas. When a flow of electrical current passes through argon gas, several wavelengths of light are produced, including short-wave ultraviolet light. However, argon gas, alone, doesn't produce sufficient short-wave ultraviolet to greatly excite the phosphors used in most fluorescent tubes. The fluorescent powder i.e. phosphor consists of calcium phosphate, Al_2O_3, Polyethylene oxide, dispersion agent etc., in water.

To generate more ultraviolet, a small amount of mercury is added to each lamp. Although the mercury is in liquid form when the lamp is not operating and the lamp is at room temperature, the mercury vaporizes when the electrical flow through the argon gas starts, and the presence of gaseous mercury greatly increases the ultraviolet light produced.

Mercury also helps increasing the amount of current that can flow through the gas, and in turn that helps generate even more ultraviolet light. This ultraviolet light strikes a layer of phosphor that is coating the inner part of the fluorescent lamp, and in turn the phosphor blocks most of the ultraviolet light. Because of the ultraviolet light, the phosphor emits various frequencies of visible light. Manufacturers blend phosphors to produce various shades or colors of visible light. In some cases, the glass that the lamp tubing is made of is also tinted to provide the desired light color. Some manufacturers build fluorescent lamps that produce several shades of white as well as colors like red, yellow, blue and green. Some phosphors are brighter than others, so depending on the materials used, a fluorescent lamp can produce different levels of light, despite consuming the same amount of electricity. Other design factors can affect the efficiency and life expectancy of a fluorescent lamp.

1.4 MANUFACTURING PROCESS OF FLUORESCENT LAMPS

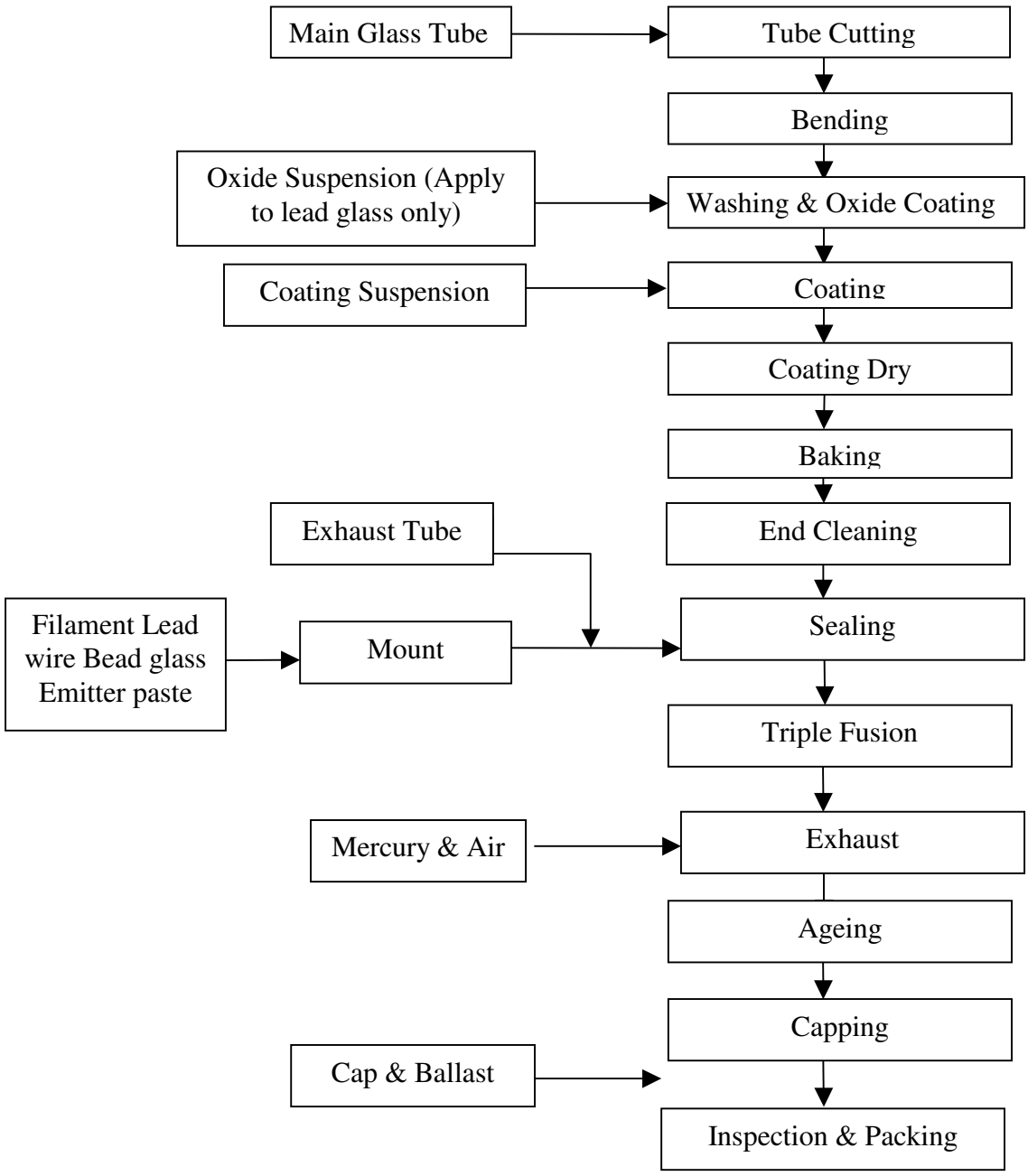
Straight glass shells are cut to required size and bend to U shape. Later these tubes are washed with DM water at 65-75 ^{0}C temperature and then dried by hot air at 70-80 ^{0}C for about 25 minutes. After drying they are coated with fluorescent powder coating prepared with a binder and DM water. The coated tubes are again dried by hot air at temperature 70-80 ^{0}C for about 25 minutes.

These tubes are transferred to backing machine, and are subjected to a temperature of about 550 ^{0}C for about 3 minutes. There after they are transferred to end wiping and ends are wiped. These shells are loaded to sealing machine with mounts on one side of each U tube. The sealed tubes are then transferred to machine for making make U tube.

Sealed and used tube groups are then transferred to Exhaust Machine, for evacuation, Cathodes are heated and required quantity of mercury is introduced. Cathode heating and activation is continued. Required quantity of inert gas is injected in the tubes and the tubes are vacuum – sealed by using tipping burners. These lamps are subjected to Aging process. Thereafter these lamps are pasted with PVC covers lamps are backed at 120 ^{0}C for about 1 ½ Minutes to make a good binding between PVC cover and glass. The wires are inserted into the ballast and soldered. These lamps are tested and base fitting process is done. Total lamp is rechecked and aluminum caps are fitted and soldered on top. The PVC base and cap is crimped by tool and Quality Assurance (QA) department inspects these lamps. After checking they are sent for packing and dispatch.

A common process flow-chart for producing fluorescent lamps is presented below:

PROCESS FLOW CHART FOR
MANUFACTURE OF FLUORESCENT LAMPS



1.5 MERCURY CONSUMPTION IN INDIAN INDUSTRY

Mercury is used in small amounts per lamp in a number of different types of discharge lamps, with fluorescent tubes and compact fluorescent lamps (CFLs).

Range of Mercury Consumption in different types of FLs

The concentration of mercury in different type of lamps may vary and it depends upon the type of technology, used in the dosing of mercury i.e. liquid mercury & pill technology. The typical mercury concentration in mercury bearing lamp sectors is given in the table:

Typical Mercury Concentration in Mercury bearing Lamp

S No.	Type of Lamps	Mercury Content (mg/lamp)	Country/ Region for data
1	Fluorescent Tubes (double end)	15 (1997) 10(2002) 15-45 10-22 23-46 15-60	European Union Russia USA Canada India
2	Compact Fluorescent Lamp	5 10 12-30	European Union Canada Russia

		3-12	India*
3	Mercury Vapor & Metal Halide Lamp	~ 20 (75 W) ~ 250 (1000 W)	Global
4	High Pressure Sodium Lamp	~ 8.3 (50 W) ~ 25 (1000W)	Global

Source: UNEP - Toolkit for identification and quantification of Mercury release - November 2005.

*On the basis of inspections and information collected from the manufacturers.

It is estimated that total Mercury consumption in FTL sector is around 7.5 MT Hg /annum, considering about 250 million units/annum of production and average 30 mg of Mercury in each FTL.

It is estimated that total Mercury consumption in CFL sector is around 0.5 MT Hg /annum, considering about 100 million units /annum of production and average 5 mg of Mercury in each CFL.

2.0 MERCURY MANAGEMENT IN FL SECTOR

2.1 MERCURY EMISSION

The major sources of mercury release are as follows:

(i) Vent attached to Hg dosing machine.
(ii) Used/broken lamps/cut glass tubes used in dosing of Hg in the process.

(iii) Mercury distillation.
(iv) Mercury spills.

The mercury release (into the environment) from the fluorescent lamp sector is estimated at around 8 MT (considering the entire lot of FLs being manufactured in the country as replacement of used lamps), of which approximately 2 MT of mercury is estimated to be released into air environment.

The permissible level of mercury, as per Factories Act 1948, in workspace air is 0.1 mg/m^3; whereas IDLH (Immediately Dangerous to Life or Health Concentration) value is 10 mg/m^3.

2.2 WASTE GENERATION

Following types of wastes are generated from the fluorescent lamp sector:

(i) Glass waste (with & without mercury).
(ii) Waste Phosphor Powder.
(iii) Waste Mercury (in liquid & vapor phase).
(iv) Waste Electronic & plastic components.
(v) Residue from Mercury distillation facility.
(vi) Waste from air pollution control system.

The estimated weight of a typical CFL is 0.04 kg without base, which is expected to contain around 20% of waste (by weight) as mercury-contaminated waste. The typical 1.2-metre

fluorescent lamps contain approximately 0.26 kg of glass, 0.02 kg of combined metals and 0.01 kg of phosphor powder.

2.3 PRESENT TREATMENT & DISPOSAL PRACTICES IN INDIA

Manufacturer's Level:

At the lamp manufacturing level, fluorescent lamp manufacturing units have varied level of waste management practices. Some have adopted practice of proper crushing, under vacuum extraction, followed by segregation of glass (with & without mercury contamination), phosphor powder and liquid/vapor mercury. The mercury vapor is collected and adsorbed on an activated carbon pad. Most others have very crude way of handling and disposing mercury-bearing wastes generated from the process. Many manufacturing units have crude type of distillation facility for the purification of raw mercury obtained from the Market. The residue obtained from the distillation of raw mercury is reportedly sent to TSDF.

Such crude set up, for handling of mercury-contaminated materials, is expected to result in mercury emissions from such waste handling facilities. There has not been enough thrust given on the recovery of mercury at such facilities, as observed. Also in India, there is no specific norm prescribed for the mercury emission in FL sector at present.

Consumer Level:

As per the present observed practice at consumer level in the society at large, often, the used lamps are collected by the kabari from the households and collectively handed over to the glass recyclers for the recovery of glass material. This is all operative in a highly unorganized sector.

It has, also, been observed that, the used lamps are thrown in the garbage bins and finally into the municipal garbage dumpsites, contaminating air, water and soil. Most of the used lamps are broken either at transit solid waste bins (provided by local civic authority) or broken during the transport to the final disposal site. A portion of the mercury, in vapor form, is released into the air; whereas rest of the mercury is released onto the soil with further possibility of getting into the surface and/or ground water bodies through the leachate from soil.

2.4 INTERNATIONAL SCENARIO FOR COLLECTION, TREATMENT & DISPOSAL OF USED FLUORESCENT LAMPS

As per the available information on the international scenario on collection, handling, transportation, treatment and disposal of mercury-bearing lamps, most western countries follow WEEE (Waste Electrical & Electronics Equipment) Directives based on the concept of Extended Producers' Responsibility. The US has independent market-oriented system, where the consumer is required to pay money and efforts, both, for collection,

treatment and disposal at the centers recognized by the concerned regulatory authority. There is no proper information available in respect of China and Japan, in this regard.

The current practices for collection, treatment & disposal of used FLs, as adopted by various countries, are presented in the following Table:

Sr. No.	Country	Collection of Used lamps	Disposal/ recycling	Regulation
1	USA	Generator has to hand over Handler or Authorised Recycler	Authorised Recycling Unit	Universal Waste Rule
2	European Union (EU)	Producers to set up collection system for households and other end users	Authorised Treatment Facility	Waste Electrical and Electronic Equipment (WEEE) and Restriction on Hazardous Substances Directives (RoHS) Directives
3	Germany	Collection Centers	Lamp Recycling Facilities	Recovery and disposal Act
4	Sweden	Producers' responsibility for the collection, Treatment & Disposal	Producers responsibility for recycling	Waste Ordinance
5	Russia	DNA	DNA	Federal Law – Waste of Production and Consumption

6	Taiwan	Retailers as Collection Centers	Authorized Recycling facilities	Waste Disposal Act
7	Finland	Municipalities have an obligation to arrange collection of FLs and other Hg containing waste from households	Waste lamps may only be treated by a company authorized for handling hazardous waste	WEEE Directive
9.	China	DNA	DNA	Law of Environmental Protection
10.	Japan	DNA	DNA	Law for Promotion of Effective Utilization of Resources

DNA: Details not available

Most advanced countries have proper legal back up to support environmentally safe disposal of mercury-contaminated used lamps, particularly at community level, e.g. WEEE Directive for European Union, Universal Waste Rules for USA, etc.

3.0 EFFECTS OF MERCURY ON HUMAN HEALTH:

Mercury is very toxic and linked with a wide range of health effects including irreversible damage to the human nervous system. The severity of health effects from mercury exposures is influenced by the following factors:

(i) Chemical form of mercury i.e. inorganic or organic mercury,

(ii) Dose,

(iii) Age of the person exposed (the foetus is the most susceptible),

(iv) Duration of exposure,

(v) Route of exposure i.e. inhalation, ingestion, dermal contacts, and

(vi) Health of the person exposed

Table: Health Effects of mercury

Sr. No	Mercury Form	Sources of environmental contamination	Environmental effects	Source of human contamination	Toxicity related health effect
1.	Methyl mercury	Mercury disposed off in water bodies	Tendency to bio-magnify in the food chain, contaminating fish and marine mammals	Consumption of contaminated fish and marine mammals	Methyl mercury is classified as a possible human carcinogens
2.	Mercury	Combustion of coal, incineration of mercury bearing waste	Deposit in the environment and sometimes travel long distances	Deposit in water bodies and also falls with rain water	Enters body via food
3.	Mercury vapours	-	-	Ambient air, dental amalgam	Dangerous if inhaled or ingested

Followings are the routes of mercury exposure:

Inhalation:

Mercury vapor is highly toxic via inhalation. It can cause severe respiratory tract damage. Symptoms of mercury toxicity include sore throat, coughing, pain, tightness in chest, breathing difficulties, shortness of breath, headache, muscle weakness, anorexia, and gastrointestinal disturbance, ringing in the ear, liver changes, fever, bronchitis and pneumonitis. Mercury can be absorbed through inhalation with symptoms similar to those appearing after ingestion.

Ingestion:

Ingestion (through mouth) of mercury may cause burning of the mouth and pharynx, abdominal pain, vomiting, corrosive ulceration, bloody diarrhea. Ingestion may be followed by a rapid and weak pulse, shallow breathing, paleness, exhaustion, tremors and collapse.

Skin Contact:

Contact of mercury with skin causes irritation and burns to skin. Symptoms include redness and pain. It May cause skin allergy and sensitization. Mercury can be absorbed through the skin with symptoms parallel to ingestion.

Eye Contact:

Contact of mercury with eye causes irritation and burns to eyes. Symptoms include redness, pain, blurred vision; may cause

serious and permanent eye damage, also depending upon exposure.

Chronic Exposure:

Chronic exposure of mercury through any route can produce central nervous system disorders. It may cause muscle tremors, personality and behavior changes, memory loss, metallic taste, loosening of the teeth, digestive disorders, skin rashes, brain damage and kidney damage. Mercury can cause skin allergies and accumulate in the body. Repeated skin contact with mercury can cause the skin to turn gray in color. Mercury is a suspected reproductive hazard; may damage the developing foetus and decrease fertility in males and females.

4.0 GUIDELINES ON MERCURY MANAGEMENT AT VARIOUS LEVELS

4.1 MANUFACTURER'S LEVEL:

The manufacturers may adopt such practices for fluorescent lamp manufacturing, so that the mercury can be handled properly in order to have minimized impact upon the environment.

4.1.1 Mercury Consumption:

Mercury content in fluorescent lamps, which has been observed to be in the range 3-12 mg per lamp in CFL sector and 15-60 mg per lamp in FTL sector, may be reduced to an optimized level, using internationally best available technology.

4.1.2 **Process Technology:**

The manufacturers of FLs may adopt the internationally best available technologies, including mercury dosing & lamp flushing techniques such as:

(i) Pill dosing techniques, in place of direct dosing of liquid mercury, for desired optimum content of mercury in the Lamp, and

(ii) Argon flushing, in place of mercury flushing, in order to have less consumption of mercury in the process;

The above techniques help prevent losses of mercury to the environment at various stages of mercury handling and control of mercury releases in compliance to the prevailing norms.

The Bureau of Indian Standards (BIS) may evolve the standards for mercury consumption and dosing technologies, so as to minimize the consumption of mercury in the process of fluorescent lamp manufacturing.

4.1.3 **Raw Mercury Distillation:**

The distillation set up, if required to be used for purification of raw mercury and the recycled mercury recovered from the process, may be completely leak proof and operating under proper vacuum. The provision of a proper fume extraction system may be made to take care of fumes or mercury vapors generated, if any, around the distillation set up. The outlet of such extraction system may be connected to a proper Air

Pollution Control System (APCS) as described in the subsequent section.

4.1.4 On-site Storage, Treatment & Disposal of Mercury-bearing Wastes

The on-site storage, treatment & disposal of mercury bearing wastes may be done, in compliance to the conditions prescribed in the Consent/Authorization document issued by the respective State Pollution Control Board/PCC, so as not to contaminate air, water and soil.

The manufacturing facilities shall make necessary provisions, as mentioned below, for the proper on-site storage, treatment and disposal of mercury-contaminated wastes:

4.1.5 On-Site Storage:

All the solid wastes, including mercury-contaminated wastes, may be stored in a segregated manner. The mercury-contaminated wastes may be stored on a concrete platform under a shed, as per the provisions made under Hazardous waste Rules, 2003, so as to prevent the release of mercury from the waste storage site into the air/water environment.

4.1.6 Treatment & Disposal:

(i) All mercury-contaminated used lamps & cut glass tips (used for mercury filling) may be treated / recycled either in a Recycling Unit developed at the production site or at

any authorized Lamp Recycling Unit (LRU). Such LRU shall comply with all the requirements as specified, separately, in this Section.

(ii) All emission sources (attached to the unit operations, involving handling of mercury) and the exhaust system covering the production floor shall be connected to proper air pollution control system (APCS) for removal of mercury vapors, if any. The APCS may be either HEPA (High Efficiency Particulate Arrestor) Filter system or Activated Carbon Filter system or any other equivalent efficient (for removal of mercury) system. This may, also, be connected to APCS of the Recycling Unit, if it exists on-site.

(iii) All the emission outlets shall comply with the norms prescribed for mercury in the Consent document. The norm for mercury emission may be considered as 0.2 mg/Nm3, as also prescribed under EP Act for mercury emission from other categories of industries.

(iv) The Mercury, trapped in the water through cut glass tips or broken FLs, may be recovered through a proper distillation system. This can be done, even, through a proper distillation set up provided for the distillation of raw mercury or distillation set up provided for recovery of Mercury from the phosphor powder.

(v) The manufacturer shall maintain records related to all the wastes, including mercury-contaminated wastes,

generated from the manufacturing facility. The records, also, related to the recovery of mercury and other useable components from the processing (if practiced on-site) of mercury-contaminated wastes shall be maintained.

All the unrecoverable wastes from the FL manufacturing site shall be disposed properly. The waste(s) shall be sent to a TSDF site, if found hazardous based on the provisions (compliance with contents mentioned in schedule II) under HWM Rules, 2003. The FL manufacturing unit may have to become a member of a TSDF site, accordingly. The records, pertaining to the generation, storage, treatment, transportation and disposal of such unrecoverable wastes shall, also, be maintained properly.

(vi) All the metal wastes generated from above Recycling Unit shall be sold out to the authorized metal recyclers.

The SPCBs/PCCs may incorporate above requirements in the Consent/ Authorizations as conditions and may, also, like to stipulate other such conditions, in this regard.

4.1.7 **<u>Lamp Recycling Unit</u> (LRU)**

4.1.8 A Lamp Recycling Unit (LRU) shall have an environmentally sound Treatment-cum-Recycling facility for the used mercury-bearing fluorescent lamps and other such wastes, to be provided either at FL manufacturer's site or as a common facility at

community level. Such facility shall aim at maximizing recovery of mercury, phosphor powder, other metals and plastics, etc., apart from controlling the release of pollutants. Such facility may cover at least following systems:

(i) Lamp Crushing System, under vacuum, for separation of mercury-contaminated Phosphor powder & mercury vapors from other crushed components, so as not cause release of any pollutant, including mercury vapor – Segregation of metals, electronic components and plastics from crushed components for recovery.

(ii) System for segregation of Mercury vapour from the phosphor powder.

(iii) Proper Air Pollution Control System (APCS) for mercury release control (in compliance to the prescribed norms) - APCS may be either HEPA (High Efficiency Particulate Arrestor) Filter system or Activated Carbon Filter system or any other equivalent efficient (for removal of mercury) system for separation of mercury vapor from mercury-contaminated phosphor powder - Proper disposal of mercury-contaminated filter pads to TSDF.

(iii) Distillation system – for proper separation & recovery of mercury from mercury-contaminated phosphor powder.

(iv) On-line Mercury monitoring system, to have check on emission of mercury, which has to be in compliance to the consented norms.

4.1.9 The LRU shall have following capabilities, in addition to the provision of above facility:

(i) The LRU must get registered with the concerned authority and fulfill the requirements as mentioned above. It shall carry valid Consent & Authorization documents that will cover collection & Transportation operations, as well.

(ii) The emission outlet shall comply with the norms for mercury prescribed in the Consent document. The norm for mercury emission may be considered as 0.2 mg/Nm3, as also prescribed under EP Act for mercury emission from other categories of industries.

(iii) The LRU must appoint properly trained manpower to handle hazardous substances, in respect of treatment/recycling.

(iv) The LRU may dispose all the unrecoverable wastes from the treatment site, either to a TSDF site or municipal waste disposal site, depending upon the hazard potential left in them. The hazard potential can be ascertained in the light of provisions (compliance with contents mentioned in schedule II) under HWM Rules, 2003. The LRU may have to become a member of a TSDF site, accordingly.

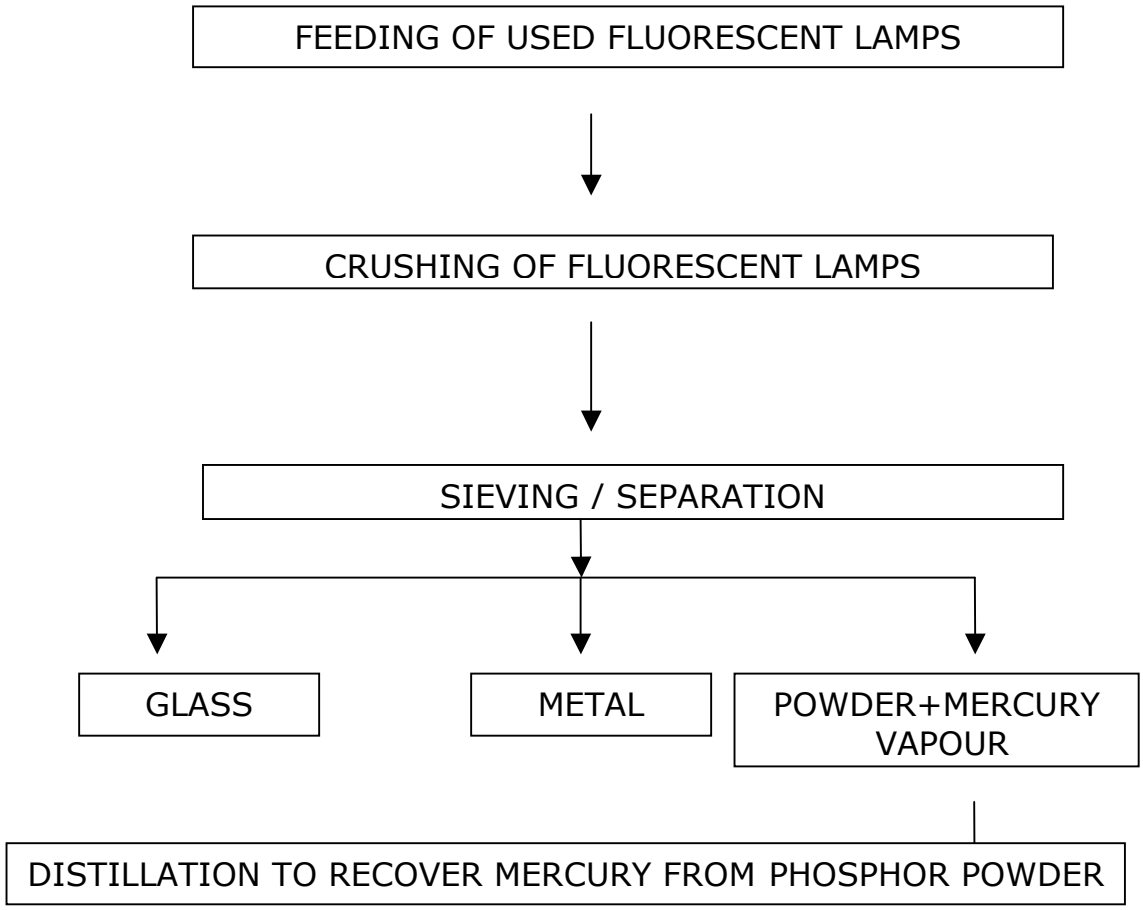
(v) The LRU may maintain proper records of used FLs collected & recycled, recovery of mercury and other components. It shall, also, maintain the records pertaining to the generation, storage, transport and disposal of the wastes generated from LRU.

(vi) The LRU may take up ambient air quality monitoring, particularly, in reference to mercury levels with a specified

frequency. The source emission monitoring may be taken up once in a month through a recognized laboratory, for third party verification.

4.1.10 The schematic for such LRU is as depicted below:

SCHEMATIC FOR A LAMP RECYCLING UNIT



4.1.11 **Mercury Handling:**

The following precautions may be taken in addition to observing some good practices, while handling the mercury at manufacturing stage:

(i) The breakage of lamps, which has potential of releasing the mercury, must be avoided, to the extent possible.

(ii) Due care must be taken for proper cleanup of broken CFLs & FTLs within the premises, for the possible recovery of the spilled mercury. All the broken lamp parts should be picked up carefully, so as to collect entire lot of spilled mercury. The mercury, thus collected, may be stored separately in a closed bin, along with other mercury-bearing wastes, for further recovery (purification & reuse) of mercury by distillation. A detailed note of guidance, on mercury spillage control, is provided in next sub-section.

(iii) Secondary containers (Catch Basins and Pans) should be made of impervious material (e.g. plastic or smooth finish paint) with edge lips. Steep lips are more effective than gentle rises in trapping spilled mercury.

(iv) Adequate vapor-containment systems should be in place, wherever mercury is handled. All such systems, including the room exhaust system, should be connected to proper air pollution control system for removal of mercury vapors, if any. This would help avoid, to a very large extent, building up of mercury vapors in process area.

(v) The distillation set-up, used for the purification of raw or impure mercury, must be operated under proper vacuum-

sealed condition, so as not to release any mercury vapors during the distillation.

(vi) Concrete floors sealed with epoxy and working surfaces with no crevices are preferred for working with mercury. Vinyl flooring may be used in laboratories. Tiled floors/table tops should not be used in areas where mercury is used.

(vii) Avoid storing or handling mercury near sinks. Spilled mercury could run into the sink, lodge in the trap, ruin the pipe by amalgamating with and weakening the metal, and then be released into the environment or a retention tank system designed only for dilute solutions in rinse water.

(viii) Mercury should always be stored in tightly closed bottles that do not shatter on impact (i.e. avoid soda glass bottles and if glass bottles have to be used they should have a secondary containment). The bottles should be kept in locked cupboards, placed in a cool, well ventilated room, with restriction on access. Bottles containing mercury should always be properly labeled, identifying the substance and the hazards involved.

(ix) The manufacturers may, also, put a leaflet in the packing of CFL and FTL, which would narrate the details of precautions to be taken at the user end, in case of breakage of lamp resulting in spill of mercury, at domestic level.

4.1.12 **Mercury Spill Management at Manufacture's Facility:**

If a mercury spill occurs at the manufacturing site, the following precautions may be taken:

a. Mercury Spill Control Kits should be available in areas where mercury is used. Mercury Spill Control Kits should contain gloves, protective glasses, Hg absorb powder, mercury sponges, and a disposal bag. A special Mercury Vacuum Cleaner may also be made available for cleaning mercury spills; mercury decontamination may be carried out using water soluble mercury de-contaminants like polysulphides.

Mercury Spill Control Kit

Special Mercury Vacuum

b. Train all the workers involved for the proper handling of mercury which may include the use of spill control kit. The workers should use appropriate personal protective clothing and equipment that must be carefully selected, used, and maintained to be effective in preventing skin contact with mercury vapor. The selection of the appropriate personal protective equipment (PPE) (e.g. gloves, sleeves,

encapsulating suits) should be based on the extent of the employee's potential exposure to mercury vapor. Small spills of metallic mercury usually can be cleaned up safely by the workers involved, if they have had the proper training of using the Mercury Spill Control Kits.

c. Avoid walking on or touching surfaces contaminated with mercury.

d. Promptly notify the plant/factory Safety Officer of spill if any.

e. Spread plastic sheets over surfaces onto which mercury could drop or run during spill cleanup. Tape the sides of the sheets to the floor. NOTE: such plastic sheets, and other clean up items, must be disposed of as mercury contaminated hazardous waste.

f. Remove any dust or oil, which may have become contaminated with mercury during spill and cleanup. Use detergent or a solvent to remove oil or grime, or use a vacuum, to remove dust. Be certain to adhere to all appropriate controls during spill cleanup.

g. Use mercury kits with hand-powered miniature vacuums or sponges to clean up spills whenever practical. Replace mercury kit items after use.

h. To avoid the spread of contamination, never sweep mercury contaminated material or blow it off of surfaces with compressed-air nozzles. Instead, vacuum or seal it off in place. Use a specially designed and dedicated vacuum for cleaning up large mercury spills.

4.2 CONSUMER LEVEL

Handling of Used/Broken Fluorescent Lamps (FLs):

The consumers may handle and dispose the used lamps as described below:

4.2.1 **Domestic Consumers**:

(i) The consumer must ensure that (s)he does not throw used lamps in the general trash bin but hands them over (in a properly packed form) to a kabari (an individual) or a collection agency identified by an authorized Lamp Recycling Unit for proper recycle / disposal of used FLs.

(ii) The used intact FLs may be stored either in the same boxes in which new lamps are brought or other boxes of similar size. They should be stored upright. The due precaution may be taken while packing more than one used lamp, so as not cause the possibility of breakage during the storage and transportation.

(iii) Even, the broken FLs, after due clean up as mentioned in section 4.2.3, may be handed over for safe recycling and disposal.

4.2.2 **Bulk Consumers:**

(i) The bulk consumers must ensure that used lamps are not disposed in the general trash bin but handed over (in a properly packed form) to an authorized Lamp Recycling

Unit (for proper recycle / disposal of used FLs) either direct or through a collection agency identified by such facility.

(ii) The bulk consumers must create special type of disposal bins (suitable for the purpose) at site for depositing the used lamps only. The management of the institute may issue necessary instructions, to ensure this, to staff and workers handling lamps.

(iii) The used intact FLs, as collected above, may be stored either in the same boxes in which new lamps are brought or other boxes of similar size. They should be stored upright. The due precaution may be taken while packing more than one used lamp, so as not cause the possibility of breakage during the storage and transportation.

(iv) Even, the broken FLs, after due clean up, as mentioned in section 4.2.3, may be handed over for safe recycling and disposal.

(v) The concerned official of the Institute may inform the authorized Lamp Recycling Unit, for the timely disposal of the used lamps. Such used lamps should not, preferably, be stored exceeding a period of one year.

4.2.3 **Guidelines for Cleanup of Broken FLs:**

The amount of mercury in a CFL is very small, about five milligrams, or the size of the tip of a ball point pen. If a CFL bulb breaks, a small amount of the mercury vapor will be released in the air. It is important, though, to carefully clean up and dispose of a broken CFL to avoid spreading around the phosphorus powder, glass and any remaining mercury.

Here are some guidelines for cleaning up a broken CFL:

(i) Open a window and leave the room (restrict access) for at least 15 minutes. If you have fans, place the fans in the windows and blow the air out of the room. Note: If the room has no windows, open all doors to the room and windows outside the room and use fans to move the air out of the room and to the open windows.

(ii) Remove all materials you can without using a vacuum cleaner:
- Wear disposable rubber gloves, if available (do not use your bare hands)
- Carefully scoop up the fragments and powder with stiff paper or cardboard
- Wipe the area clean with a damp paper towel or disposable wet wipe
- Sticky tape (such as duct tape) can be used to pick up small pieces and powder

(iii) Place all cleanup materials in a plastic bag and seal it, and then place in a second sealed plastic bag, dispose it properly and wash your hands after disposing of the bags.

(iv) The first time you vacuum the area where the bulb was broken, remove the vacuum bag once done cleaning the area (or empty and wipe the canister) and put the bag and/or vacuum debris, as well as the cleaning materials, in two sealed plastic bags in the outdoor trash or protected outdoor location for normal disposal.

4.2.4 **Consumer Awareness:**

All the consumers, individual domestic consumers and bulk consumers (offices, institutions, large residential complexes, etc.) should get fully aware about the potential health impact of mercury-bearing lamps, through audio-visual media and the product leaflets. The precautions, to be taken while cleaning up the broken FLs should, also, be known to the consumers.

As a part of such awareness programs, the consumers, even at individual level, are expected to participate actively with constructive suggestions and provide the feedback, for the overall success of mercury management in fluorescent lamp sector.

4.3 **Collection, Transport, Treatment & Disposal of Used FLs:**

The fluorescent lamp manufacturers (either on individual or on association basis) may either develop or identify Lamp Recycling Unit(s) and establish a network of such LRUs across the country, for environmentally sound collection, transport, treatment, recycling and disposal of used FLs from the consumers. Such identified LRU, to be operating on common basis for the consumers in a defined region, shall have the set up as described under Section 4.1.6 for proper treatment/recycling and, also, a complete set up for collection & transportation of used FLs.

The following may be considered, at various stages of collection, transportation, treatment and disposal of used FLs at consumer level:

4.3.1 **Collection & Transportation**

The persons or agencies (duly authorized by the concerned authority for the purpose) involved in collection and transportation of used FLs may be recognized as Handlers.

Collection:

The collection of used lamps may be done mainly by two ways:

(i) Collection of used lamp (FLs) from bulk consumers may either be arranged by the management of above set-up (institutions, etc.) for direct disposal to LRU or by the LRU which may arrange to pick up used lamps from such collection sites through an identified collection agency.

(ii) Collection of used lamps (FLs) from individual domestic consumer may be arranged by the LRU, either through *kabaris* (individuals appointed for the purpose by LRU) or an identified collection agency for door to door pickup.

Transportation:

(i) The Handler (e.g. Kabari or representative of LRU) of used FLs in transit should take care of selection of proper

vehicle and carriage so as to minimize breakage of used FLs.

(ii) There should not be any intermediate transfer of materials in the transit stage. The collected used FLs should be straight transported to the LRF for further processing.

(iii) The Handler should be trained to take care of mercury spills, if any, that takes place en-route the journey to LRU.

4.3.2 **Treatment, Recycling, and Disposal:**

A Lamp Recycling Unit (LRU), developed as a common facility for the environmentally sound collection, transport, treatment, recycling and disposal of used FLs from the consumers, shall have the set up as described under Section 4.1.6 for the treatment-cum-recycling, in addition to the set up required for proper collection and transportation of used FLs.

Such LRU may have following facilities, in addition to that required as mentioned above:

- Adequate used lamp Storage facilities, with stacking on a pucca platform, preferably under a shed
- Mercury spill collection system for further treatment on-site, as described under Section 4.1.12.
- Mechanical feeding system, if possible, to have better check on the breakage of lamps
- Training of the Handlers, covering manpower (either *kabaris* or a collection agency) engaged for the collection and transportation of used lamps to the treatment site.

****