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IL&FS | Environment

TECHNICAL EIA GUIDANCE MANUAL
FOR
COMMON HAZARDOUS WASTE TREATMENT STORAGE AND DISPOSAL FACILITIES

Prepared for

The Ministry of Environment and Forests
Government of India







by

IL&FS Ecosmart Limited
Hyderabad

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ACRONYMS

AAQ	Ambient Air Quality
AET	Actual Evapo-transpiration
APCD	Air Pollution Control Devices
B/C	Benefits Cost Ratio
BAT	Best Available Technology
BDAT	Best Demonstrated Available Technology
BIS	Bureau of Indian Standards
BOD	Biological Oxygen Demand
BOQ	Bill of Quantities
BOT	Build Operate Transfer
BOOT	Build Own Operate Transfer
CCA	Conventional Cost Accounting
CEN	European Committee for Standardization
CER	Corporate Environmental Reports
CEAA	Canadian Environmental Assessment Agency
CFE	Consent for Establishment
CI	Cone Index
CO	Carbon Monoxide
CPCB	Central Pollution Control Board
CREP	Corporate Responsibility for Environmental Protection
CR/O	Coefficient of Runoff
CRZ	Coastal Regulatory Zone
DfE	Design for Environment
DMP	Disaster Management Plan
DRE	Destruction and Removal Efficiency
EAC	Expert Appraisal Committee
ECI	Environmental Condition Indicators
EcE	Economic-cum-Environmental
EIA	Environmental Impact Assessment
EIS	Environmental Information System
EMA	Environmental Management Accounting
EMP	Environmental Management Plan
EMS	Environmental Management System
EPI	Environmental Performance indicators
EPR	Extended Producers Responsibilities
EPZ	Export Processing Zones

ES	Environmental Statements
FCA	Full Cost Assessment
FHP/CH	Falling Head Permeability/Constant Head
FS	Flexural Strength
GHG	Green House Gases
HAZOP	Hazard and Operability Studies
HDPE	High-Density Polyethylene
HTL	High Tide Level
IL&FS	Infrastructure Leasing and Financial Services
IVI	Importance Value Index
ISO	International Standard Organization
LCA	Life Cycle Assessment
LDAR	Leak Detection and Repair
LOI	Loss of Ignition
LTL	Low Tide Level
MCA	Maximum Credible Accident
MoEF	Ministry of Environment & Forests
MTA	Metric Tonnes per Annum
NAQM	National Air Quality Monitoring
NGO	Non-Government Organizations
O&M	Operation and Maintenance
OECD	Organization for Economic Co-operation and Development
PCC	Pollution Control Committee
PFLT	Paint Filter Liquid Test
PM	Particulate Matter
POHC	Principal Organic Hazardous Constituent
PPA	Participatory Poverty Assessment
PRA	Participatory Rural Appraisal
PSA	Particle Size Analysis
PUCC	Pollution under Control Certificate
PVC	Poly Vinyl Chloride
QA/QC	Quality Assurance/Quality Control
QRA	Quantitative Risk Assessment
RO	Reverse Osmosis
SEA	Strategic Environmental Assessment
SEAC	State Level Expert Appraisal Committee
SEIAA	State Level Environment Impact Assessment Authority
SEZ	Special Economic Zone

SIA	Social Impact Assessment
SME	Small and Medium Scale Enterprises
SPCB	State Pollution Control Board
SPM	Suspended Particulate Matter
TA	Technology Assessment
TCA	Total Cost Assessment
TCLP	Toxicity Characteristic Leaching Procedure
TEQM	Total Environmental Quality Movement
TGM	Technical EIA Guidance Manual
TOC	Total Organic Carbon
ToR	Terms of Reference
TSDF	Common Hazardous Waste Treatment, Storage and Disposal Facility
UCS	Unconfined Compressive Strength
USEPA	United States Environmental Protection Agency
UT	Union Territory
UTEIAA	Union Territory Level Environment Impact Assessment Authority
UTPCC	Union Territory Pollution Control Committee
WDD	Wet-Dry Durability

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Acknowledgement

The Notification issued on the prior environmental clearance process by the Ministry of Environment and Forests (MoEF) on September 14, 2006 delegated substantial powers to the State Level Environment Impact Assessment Authorities (SEIAA) to grant environmental clearance for certain categories of developmental activities/projects. It was felt that proper guidance to the stakeholders would enhance appreciation of environmental impacts of proposed projects and possible mitigation measures. Further, such a guidance would also help ensure that decision making authorities across different States and Union Territories could adopt similar considerations and norms with due weightage for site-specific considerations.

We feel privileged to be part of the interventions being spearheaded by Sh. Jairam Ramesh, Hon'ble Minister, MoEF, Government of India, to mainstream environmental considerations in the decision making process. IL&FS Ecosmart as part of this important initiative, prepared Technical EIA Guidance Manuals for 27 identified development activities. In view of the diversity of 27 developmental activities entrusted to IL&FS Ecosmart Ltd., in consultation with the MoEF, an expert Peer and Core Committee was constituted to review and finalize each of the draft Manuals. The Manuals prepared by IL&FS were technically reviewed and up-dated by the respective sector-specific expert resource persons.

The Manuals designed by the Expert Committee have benefitted from the advise and feedback received from MoEF. The Manuals are designed to provide readers with an in-depth understanding of the environmental clearance mechanism, developmental activity specific environmental impacts with possible mitigation measures, environmentally compliant manufacturing/ production processes and pollution control technologies, etc.

IL&FS Ecosmart hopes that these Manuals are a step forward to realize the MoEF's desired objective of enhancing functional efficiency and effectiveness in the environmental clearance process. We hope the stakeholders will find the Manuals useful.

We take this opportunity to convey our appreciation to the MoEF team under the leadership of Mr. J.M. Mauskar, Additional Secretary, for the technical inputs, guidance and support extended throughout the project period for successful completion of the project. The technical guidance and support extended by the Expert Peer and Core Committee under the Chairmanship of Dr. V. Rajagopalan, former Chairman, Central Pollution Control Board and inputs of the sector-specific resource persons are gratefully acknowledged.

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15th November 2010

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FOREWORD

The Ministry of Environment & Forests (MOEF) introduced the Environmental Impact Assessment (EIA) Notification 2006 on 14th September 2006, which not only reengineered the entire environment clearance (EC) process specified under the EIA Notification 1994, but also introduced a number of new developmental sectors which would require prior environmental clearance. The EIA Notification 2006 has notified a list of 39 developmental sectors which have been further categorised as A or B based on their capacity and likely environmental impacts. Category B projects have been further categorised as B1 and B2. The EIA Notification 2006 has further introduced a system of screening, scoping and appraisal and for the setting up of Environment Impact Assessment Authority (EIAA) at the Central level and State Level Environment Impact Assessment Authorities (SEIAAs) to grant environmental clearances at the Central and State level respectively. The Ministry of Environment & Forests is the Environment Impact Assessment Authority at the Central level and 25 State Level Environment Impact Assessment Authorities (SEIAAS) have been set up in the various States/UTs. The EIA Notification 2006 also stipulates the constitution of a multi-disciplinary Expert Appraisal Committee (EAC) at the Centre and State level Expert Appraisal Committees (SEACs) at State/UT Level for appraisal of Category A or B projects respectively and to recommend grant/rejection of environmental clearance to each project/activities falling under the various sectors to the EIAA/SEIAAs respectively.

Although the process of obtaining environmental clearance consisting of Screening, Scoping and Appraisal and for undertaking public consultation including the process of conduct of Public Hearing has been elaborated under the EIA Notification 2006, the Notification itself provides for bringing out guidelines from time to time on the EIA Notification 2006 and the EC process with a view to bringing clarity on the EC process for expediting environmental clearance. This need was further reinforced after the constitution of SEIAAs and SEACs in various States, who were assigned the task for the first time and for addressing the concerns of standardization of the quality of appraisal and in reducing inconsistencies between SEACs/SEIAAs in granting ECs for similar projects in different States.

The Technical Guidance Manual of **"Common Hazardous Waste Treatment Storage and Disposal Facilities"** sector describes types of EIA, process and pollution control technologies, operational aspects of EIA with model TOR of that Sector, and waste

minimization techniques, monitoring of environmental quality, post clearance monitoring protocol, related regulations, and procedure of obtaining EC.

The study of the dangers of handling hazardous waste materials varies considerably depending on the specific material properties, subdivided into the phases of collection, transport and treatment/disposal. Environmentally acceptable special waste management process must take these factors into account. Various types of hazard must be distinguished in terms of their effects on man and the environment. It is vital to be able to identify hazardous wastes at the place of generation and to have knowledge of the associated hazard potential, in order to control these hazards effectively within the framework of waste management planning and to put the planning into practice. India's industrial competitiveness and environmental future depends on Industries such as Common Hazardous Waste Treatment Storage and Disposal Facilities adopting energy and resource efficient technologies. Recycling and reuse of materials is critical.

To keep pace with changing technologies and needs of sustainable development, the manual would require regular updating in the future. The manual will be available on the MoEF website and we would appreciate receiving responses from stakeholders for further improvements.

I congratulate the entire team of IL&FS Ecosmart Ltd., experts from the sector who were involved in the preparation of the Manuals, Chairman and members of the Core and Peer Committees of various sectors and various Resource Persons whose inputs were indeed valuable in the preparation and finalization of the Manuals.

(Jairam Ramesh)

1. INTRODUCTION TO THE TECHNICAL EIA GUIDANCE MANUALS PROJECT

Environmental Impact Assessment (EIA) is a process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made. These studies integrate the environmental concerns of developmental activities into the process of decision-making.

EIA has emerged as one of the successful policy innovations of the 20th Century in the process of ensuring sustained development. Today, EIA is formalized as a regulatory tool in more than 100 countries for effective integration of environmental concerns in the economic development process. The EIA process in India was made mandatory and was also given a legislative status through a Notification issued by the Ministry of Environment and Forests (MoEF) in January 1994. The Notification, however, covered only a few selected industrial developmental activities. While there are subsequent amendments, the Notification issued on September 14, 2006 supersedes all the earlier Notifications, and has brought out structural changes in the clearance mechanism.

The basic tenets of this EIA Notification could be summarized into the following:

- Pollution potential as the basis for prior environmental clearance instead of investment criteria; and
- Decentralization of clearing powers to the State/Union Territory (UT) level Authorities for certain developmental activities to make the prior environmental clearance process quicker, transparent and effective.

Devolution of the power to grant clearances at the state level for certain category of the developmental activities / projects is a step forward to fulfill the basic tenets of the re-engineering *i.e.*, quicker, transparent and effective process but many issues impede/hinder its functional efficiency. These issues could be in technical and operational domains as listed below:

Technical issues

- Ensuring level playing ground to avoid arbitrariness in the decision-making process
- Classification of projects which do not require public hearing and detailed EIA (Category B2)
- Variations in drawing Terms of Reference (ToR) of EIA studies for a given developmental activity across the States/UTs
- Varying developmental-activity-specific expertise requirement for conducting EIA studies and their appraisal
- Availability of adequate sectoral experts and variations in competency levels
- Inadequate data verification, cross checking tools and supporting institutional framework

- Meeting time targets without compromising with the quality of assessments/ reviews
- Varying knowledge and skill levels of regulators, consultants and experts
- Newly added developmental activities for prior environmental clearance, *etc*.

Operational issues

- State level/UT level EIA Authorities (SEIAA/UTEIAA) are formulated for the first time and many are functioning
- Varying roles and responsibilities of involved organizations
- Varying supporting institutional strengths across the States/UTs
- Varying manpower availability, *etc*.

1.1 Purpose

The purpose of developing the sector-specific technical EIA guidance manuals (TGM) is to provide clear and concise information on EIA to all the stakeholders *i.e*., the project proponent, the consultant, the reviewer, and the public. The TGMs are organized to cover following:

Chapter 1 (Introduction): This chapter provides a brief introduction on the EIA, basic tenets of EIA Notification, technical & operational issues in the process of clearance, purpose of the TGMs, project implementation process and additional information.

Chapter 2 (Conceptual facets of an EIA): Provides an overall understanding to the conceptual aspects of control of pollution and EIA for the developmental projects. This basic understanding would set the readers at same level of understanding for proper interpretations and boundaries for identifying the environmental interactions of the developmental projects and their significance for taking measures of mitigation. This chapter covers the discussion on environment in EIA context *i.e.,* sustainable development, pollution control strategies, preventive environmental management tools, Objectives of EIA, types and basic principles of EIA, project cycle for TSDF, understanding on type of environmental impacts and the criteria for the significance analysis.

Chapter 3 (TSDF): The purpose of this chapter is to provide the reader precise information on all the relevant aspects of the industry, which is essential to realize the likely interaction of such developmental activities on the receiving environment. Besides, this Chapter gives a holistic understanding on the sources of pollution and the opportunities of the source control.

The specific coverage which provides precise information on the industry include (i) hazardous waste definition and characteristics, (ii) hazardous waste management options, (iii) hazardous waste generation, (iv) hazardous waste recycling opportunities, (v) hazardous waste transportation, (vi) hazardous waste storage, (vii) common hazardous waste incineration facilities, (viii) common hazardous waste disposal in secured landfill and (ix) the summary of applicable national regulation for this developmental activity.

Chapter 4 (Operational aspects): The purpose of this chapter is to facilitate the stakeholders to extend clear guidance on coverage of legislative requirements, sequence of procedures for obtaining the EIA clearance and each step-wise provisions and considerations.

The coverage of the Chapter include provisions in the EIA Notification regarding TSDF, screening (criteria for categorization of B1 and B2, siting guidelines, *etc.*), scoping (pre-feasibility report, guidance for filling form 1, identification of valued environmental components, identification of impacts, *etc*.), arriving at terms of reference for EIA studies, impact assessment studies (EIA team, assessment of baseline quality of environment, impact prediction tools, significance of impacts), social impact assessment, risk assessment considerations, typical mitigation measures, designing considerations for environmental management plan, structure of EIA report for incorporation of study findings, process of public consultation, project appraisal, decision making process and post-clearance monitoring protocol.

Chapter 5 (Roles and responsibilities of various organizations involved in the process of prior environmental clearance): The purpose of this Chapter is to brief the stakeholders on the institutional mechanism and roles & responsibilities of the stakeholders involved in the process of prior environmental clearance. The Coverage of the Chapter include (i) roles and responsibilities of the stakeholders, (ii) organization specific functions, (iii) constitution, composition and decision making process of SEIAA and (iv) EAC & SEAC and (v) other conditions which may be considered.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue. Text within each section was researched from many sources, and was usually condensed from more detailed sources pertaining to specific topics.

The contents of the document are designed with a view to facilitate in addressing the relevant technical and operational issues as mentioned in the earlier section. Besides, facilitates various stakeholders involved in the EIA clearance process *i.e.*

- Project proponents will be fully aware of the procedures, common ToR for EIA studies, timelines, monitoring needs, *etc*., in order to plan the projects/studies appropriately.
- Consultants across India will gain similar understanding about a given sector, and also the procedure for EIA studies, so that the quality of the EIA reports gets improved and streamlined
- Reviewers across the states/UTs will have the same understanding about a given sector and would able to draw a benchmark in establishing the significant impacts for the purpose of prescribing the ToR for EIA studies and also in the process of review and appraisal.
- Public who are concerned about a new or expansion projects, can use this manual to get a basic idea about the manufacturing/production details, rejects/wastes from the operations, choice of cleaner/control technologies, regulatory requirements, likely environmental and social concerns, mitigation measures, *etc*., in order to seek clarifications appropriately in the process of public consultation. The procedural clarity in the document will further strengthen them to understand the stages involved in clearance and roles and responsibilities of various organizations.
- In addition, these manuals would substantially ease the pressure on reviewers at the scoping stage and would bring in functional efficiency at the central and state levels.

1.2 Project Implementation

The Ministry of Environment & Forests (MoEF), Government of India took up the task of developing sector-specific technical EIA guidance manuals for all the developmental activities listed in the re-engineered EIA Notification. The Infrastructure Leasing and Financial Services (IL&FS) Ecosmart Limited (Ecosmart), has been entrusted with the task of developing these manuals for 27 industrial and related sectors. Common hazardous waste treatment, storage and disposal facilities (TSDFs), is one of these sectors, for which this manual is prepared.

The ability to design comprehensive EIA studies for specific industries depends on the knowledge of several interrelated topics. Therefore, it requires expert inputs from multiple dimensions *i.e.*, administrative, project management, technical, scientific, social, economic, risk *etc*., in order to comprehensively analyze the issues of concern and to draw logical interpretations. Thus, Ecosmart has designed a well-composed implementation framework to factor inputs of the experts and stakeholders in the process of finalization of these manuals.

The process of manual preparation involved collection & collation of the secondary available information, technical review by sectoral resource persons and critical review & finalization by a competent Expert Committee composed of core and sectoral peer members.

The MoEF appreciates the efforts of Ecosmart, Expert Core and Peer Committee, resource persons and all those who have directly and indirectly contributed to this Manual.

1.3 Additional Information

This TGM is brought out by the MoEF to provide clarity to all the stakeholders involved in the 'Prior Environmental Clearance' process. As such, the contents and clarifications given in this document do not withstand in case of a conflict with the statutory provisions of the Notifications and Executive Orders issued by the MoEF from time-to-time.

TGMs are not regulatory documents. Instead, these are the tools designed to assist in successful completion of an EIA.

For the purpose of this project, the key elements considered under TGMs are: conceptual aspects of EIA; developmental activity-specific information; operational aspects; and roles and responsibilities of involved stakeholders.

This manual is prepared considering the Notification issued on September 14, 2006 and the updates on 1st December 2009. For recent updates, if any, may please refer the website of the MoEF, Government of India *i.e.,* http://moef.nic.in/index.php

2. CONCEPTUAL FACETS OF EIA

It is an imperative requirement to understand the basic concepts concerned to the pollution control and the environmental impact assessment in an overall objective of the sustainable development. This Chapter highlights the pollution control strategies and their tools besides the objectives, types & principles of EIA, type of impacts their significance analysis, in order to provide consistent understanding to the reader before assessing the development of activity-specific environmental concerns in Chapter 3 and identification & prediction of significant impacts in order to design mitigation measures as detailed in Chapter 4.

2.1 Environment in EIA Context

"Environment" in EIA context mainly focuses, but is not limited to physical, chemical, biological, geological, social, economical, and aesthetic dimensions along with their complex interactions, which affect individuals, communities and ultimately determines their forms, character, relationship, and survival. In EIA context, 'effect' and 'impact' can often be used interchangeably. However, 'impact' is considered as a value judgment of the significance of an effect.

Sustainable development is built on three basic premises *i.e.*, economic growth, ecological balance and social progress. Economic growth achieved in a way that does not consider the environmental concerns, will not be sustainable in the long run. Therefore, sustainable development needs careful integration of environmental, economic, and social needs in order to achieve both an increased standard of living in short term, and a net gain or equilibrium among human, natural, and economic resources to support future generations in the long term.

"It is necessary to understand the links between environment and development in order to make choices for development that will be economically efficient, socially equitable and responsible, as well as environmentally sound."

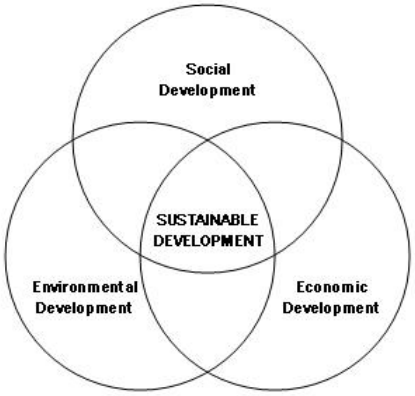


Figure 2-1: Inclusive Components of Sustainable Development

2.2 Pollution Control Strategies

Pollution control strategies can be broadly categorized in to preventive and reactive. The reactive strategy refers to the steps that may be applied once the wastes are generated or contamination of the receiving environment takes place. The control technology or a combination of technologies to minimize the impact due to the process rejects/wastes varies with quantity and characteristics, desired control efficiency and economics.

Many combinations of techniques could be adopted for treatment of a specific waste or the contaminated receiving environment, but are often judged based on techno-economic feasibility. Therefore, the best alternative is to take all possible steps to avoid pollution it self. This preventive approach refers to a hierarchy that involves i) prevention & reduction; ii) recycling and re-use; iii) treatment; and iv) disposal, respectively.

Therefore, there is a need to shift the emphasis from the reactive to preventive strategy *i.e.,* to promote preventive environmental management. Preventive environmental management tools may be grouped into management based tools, process based tools and product based tools, which are given below:

Management Based Tools	Process Based Tools	Product Based Tools
Environmental Management System (EMS)	Environmental Technology Assessment	Industrial Ecology
Environmental Performance Evaluation	Toxic Use Reduction	Extended Producers Responsibility
Environmental Audits	Best Operating Practices	Eco-labeling
Environmental Reporting and Communication	Environmentally Best Practice	Design for Environment
Total Cost Accounting	Best Available Technology (BAT)	Life Cycle Assessment (LCA)
Law and Policy	Waste Minimization	
Trade and Environment	Pollution Prevention	
Environmental Economics	Cleaner Production	
	4-R Concept	
	Cleaner Technology	
	Eco-efficiency	

2.3 Tools for Preventive Environmental Management

The tools for preventive environmental management can be broadly classified into following three groups.

- Tools for assessment and analysis - risk assessment, life cycle assessment, total cost assessment, environmental audit / statement, environmental benchmarking, environmental indicators
- Tools for action - environmental policy, market based economic instruments, innovative funding mechanism, EMS and ISO certification, total environmental quality movement, eco-labeling, cleaner production, eco-efficiency, industrial ecosystem or metabolism, voluntary agreements
- Tools for communication - state of environment, corporate environmental reporting

Specific tools under each group are discussed precisely in next sections.

2.3.1 Tools for assessment and analysis

2.3.1.1 Risk assessment

Risk is associated with the frequency of failure and consequence effect. Predicting such situations and evaluation of risk is essential to take appropriate preventive measures. The major concern of the assessment is to identify the activities falling in a matrix of high & low frequencies at which the failures occur and the degree of its impact. The high frequency, low impact activities can be managed by regular maintenance *i.e*, LDAR (Leak detection and repair) programmes. Whereas, the low frequency, high impact activities are of major concern (accidents) in terms of risk assessment. As the frequency is low, often the required precautions are not realized or maintained. However, risk assessment identifies the areas of major concerns, which require additional preventive measures; likely consequence distances considering domino effects, which will give the possible casualties and ecological loss in case of accidents. These magnitudes demand the attention for preventive and disaster management plans (DMP). Thus is an essential tool to ensure safety of operations.

2.3.1.2 Life cycle assessment

A broader approach followed to deal with environmental impacts during the entire processing is called LCA. This approach recognizes that environmental concerns are associated with every step of the processing w.r.t manufacturing of products and also examines environmental impacts at all stages of the project life cycle. LCA includes project design, development, manufacturing, packaging, distribution, usage and disposal. LCA is concerned with reducing environmental impacts at all the stages and considering the total picture rather than just one stage of the production process.

Industries and firms may apply this concept; firms can minimize costs incurred on the environmental conservation throughout the project life cycle.

2.3.1.3 Total cost assessment

Total Cost Assessment (TCA) is an enhanced financial analysis tool that is used to assess the profitability of alternative courses of action *ex*. raw material substitution to reduce the costs of managing the wastes generated by process; an energy retrofit to reduce the costs of energy consumption. This is particularly relevant for pollution prevention options. These options because of their nature, often produce financial savings that are overlooked in conventional financial analysis, either because they are misallocated, uncertain, and hard to quantify, or occur more than three to five years after the initial investment. TCA includes all of the relevant costs and savings associated with an option so that it can compete for scarce capital resources fairly, on a level playing field. The assessments are often beneficial w.r.t the following:

- Identification of costly resource inefficiencies
- Financial analysis of environmental activities/projects such as investment in cleaner technologies
- Prioritization of environmental activities/projects
- Evaluation of product mix and product pricing
- Benchmarking against the performance of other processes or against the competitors

A comparison of cost assessments is given below:

- Conventional cost accounting (CCA): Direct and indirect financial costs + recognized contingent costs
- Total cost assessment (TCA): A broader range of direct, indirect, contingent and less quantifiable costs
- Full cost assessment (FCA): TCA + external social costs borne by society

2.3.1.4 Environmental audit/statement

Key objectives of an environmental audit includes compliance verification, problem identification, environmental impact measurement, environmental performance measurement, conforming effectiveness of EMS, providing a database for corrective actions and future actions, developing company's environmental strategy, communication and formulating environmental policy.

The MoEF, Government of India issued Notification on '*Environmental Statements*' (ES) in April, 1992 and further amended in April 1993 – As per the Notification, the industries are required to submit environmental statements to the respective State Pollution Control Board (SPCB). ES is a proactive tool for self-examination of the industry itself to reduce/minimize pollution by adopting process modifications, recycling and reusing of the resources. The regular submission of ES will indicate the systematic improvement in environmental pollution control being achieved by the industry. In other way, the specific points in ES may be used as environmental performance indicators for relative comparison, implementation and to promote better practices.

2.3.1.5 Environmental benchmarking

Environmental performance and operational indicators could be used to navigate, manage and communicate the significant aspects and give enough evidence of good environmental house keeping. Besides the existing prescribed standards, an insight to identify the performance indicators and prescribing schedule for systematic improvement in performance of these indicators will yield better results.

Relative indicators may be identified for different industrial sectors and be integrated in companies and organizations to monitor and manage the different environmental aspects of the company, to benchmark and compare two or more companies from the same sector. These could cover water consumption, wastewater generation, energy consumption, solid/hazardous waste generation, chemical consumption *etc*., per tonne of final product. Once these bench marks are developed, the industries which are below them may be guided and enforced to reach them while those which are better than the benchmark may be encouraged further by giving incentives *etc*.

2.3.1.6 Environmental indicators

Indicators can be classified in to environmental performance indicators (EPI) and environmental condition indicators (ECI). The EPIs can be further divided into two categories *i.e.,* operational performance indicators and management performance indicators.

The operational performance indicators are related to the process and other operational activities of the organisation. These would typically address the issue of raw material consumption, energy consumption, water consumption in the organisation, the quantities of waste water generated from the organization *etc*.

Management performance indicators are related to the management efforts to influence the environmental performance of the organizations operations.

The environmental condition indicators provide information about the environment. These indicators provide information about the local, regional, national or global condition of the environment. This information helps the organization to understand the environmental impacts of its activities and thus helps in taking decisions to improve the environmental performance.

Indicators basically used to evaluate environmental performance against the set standards and thus indicate the direction in which to proceed. Selection of type of indicators for a firm or project depends upon its relevance, clarity and realistic cost of collection and its development.

2.3.2 Tools for action

2.3.2.1 Environmental policy

An environmental policy is a statement of an organization's overall aim and principles of action w.r.t the environment, including compliance with all relevant regulatory requirements. It is a key tool in communicating environmental priorities of the organisations to all its employees. To ensure organization's commitment towards a formulated environmental policy, it is essential for the top management to be involved in the process of formulating the policy and setting priorities. Therefore, the first step is to get the commitment from the higher levels of management. The organization should then conduct an initial environmental review and draft an environmental policy. This draft should be discussed and approved by the board of directors and finally the approved environmental policy statement should then be communicated internally among all its employees and must also be made available to the public.

2.3.2.2 Market-based economic instruments

Market based instruments are regulations that encourage behavior through market signals rather than through explicit directives regarding pollution control levels. These policy instruments such as tradable permits, pollution charge are often described as harnessing market forces. Market based instruments can be categorized into the following four major categories which are discussed below.

- **Pollution charge:** Charge system will assess a fee or tax on the amount of pollution a firm or source generates. It is worthwhile for the firm to reduce emissions to the point, where its marginal abatement costs is equal to the tax rate. Thus firms control pollution to different degrees *i.e.* high cost controllers – less; low-cost controllers-more. The charge system encourages the industries to further reduce the pollutants. The collected charges can form a fund for restoration of the environment. Another form of pollution charge is a deposit refund system, where, consumers pay a surcharge when purchasing a potentially polluting product, and receive a refund on return of the product after useful life span at appropriate centers. The concept of extended producers' responsibility brought in to avoid accumulation of dangerous products in the environment.
- **Tradable permits:** Under this system, firms that achieve the emission levels below their allotted level may sell the surplus permits. Similarly, the firms, which are

required to spend more to attain the required degree of treatment/allotted levels, can purchase permits from others at lower costs and may be benefited.

- **Market barrier reductions:** Three known market barrier reduction types are as follows:
  - Market Creation: Measures that facilitate the voluntary exchange of water rights and thus promote more efficient allocation of scarce water supplies
  - Liability Concerns: Encourage firms to consider potential environmental damages of their decisions
  - Information Programmes: Eco-labeling and energy- efficiency product labeling requirements
- **Government subsidy reduction:** Subsidies are the mirror images of taxes and, in theory, can provide incentive to address environmental problems. However, it has been reported that the subsidies encourage economically inefficient and environmentally unsound practices, and often leads to market distortions due to differences in the area. However, these are important to sustain the expansion of production, in the national interests. In such cases, the subsidy may be comparable to the net social benefit.

2.3.2.3 Innovative funding mechanism

There are many forums under which the fund is made available for the issues which are of global/regional concern (GEF, OECD, Deutch green fund, *etc*.) *i.e.,* climate change, Basal Convention and further fund sources are being explored for the Persistent Organic Pollutants Convention. Besides the global funding mechanism, there needs to be localized alternative mechanisms for boosting the investment in environmental pollution control. For example, in India the Government has established mechanism to fund the common effluent treatment plants, which are specifically serving the small and medium scale enterprises *i.e.,* 25% share by the State Government, matching grants from the Central Government and surety for 25% soft loan. It means that the industries need to invest only 25% initially, thus encouraging voluntary compliance.

There are some more options *i.e.,* if the pollution tax/charge is imposed on the residual pollution being caused by the industries, municipalities *etc*., fund will automatically be generated, which in turn, can be utilized for funding the environmental improvement programmes. The emerging concept of build-operate-transfer (BOT) is an encouraging development, where there is a possibility to generate revenue by application of advanced technologies. There are many opportunities which can be explored. However, what is required is the paradigm shift and focused efforts.

2.3.2.4 EMS and ISO certification

EMS is that part of the overall management system, which includes the organizational structure, responsibilities, practices, procedures, process and resources for determining and implementing the forms of overall aims, principles of action w.r.t the environment. It encompasses the totality of organizational, administrative and policy provisions to be taken by a firm to control its environmental influences. Common elements of an EMS are the identification of the environmental impacts and legal obligations, the development of a plan for management & improvement, the assignment of the responsibilities and monitoring of the performance.

2.3.2.5 Total environmental quality movement

Quality is regarded as

- A product attribute that had to be set at an acceptable level and balanced against the cost
- Something delivered by technical systems engineered by experts rather than the organization as a whole
- Assured primarily through the findings and correction of mistakes at the end of the production process

One expression of the total environment quality movement (TEQM) is a system of control called Kaizen. The principles of Kaizen are:

- Goal must be continuous improvement of quality instead of acceptable quality
- Responsibility of the quality shall be shared by all members of an organization
- Efforts should be focused on improving the whole process and design of the products

With some modifications, TEQM approach can be applied in the improvement of corporate environmental performance in both process and product areas.

2.3.2.6 Eco-labeling

Eco-labeling is the practice of supplying information on the environmental characteristics of a product or service to the general public. These labeling schemes can be grouped into three types:

- Type I: Multiple criteria base; third party (Govt. or non-commercial private organizations) programme claims overall environmental preferability.
- Type II: Specific attribute of a product; often issued by a company/industrial association
- Type III: Agreed set of indices; provide quantified information; self declaration

Among the above, Type I are more reliable because they are established by a third party and considers the environmental impacts of a product from cradle to grave. However, the labeling program will only be effective if linked with complementary program of consumer education and up on restriction of umbrella claims by the producers.

2.3.2.7 Cleaner production

Cleaner production is one of the tools, which has lot of bearing on environmental pollution control. It is also seen that the approach is changing with time *i.e.,* dumping-to-control-to-recycle-to-prevention. Promotion of cleaner production principles involves an insight into the production processes not only to get desired yield but also to optimize on raw material consumption *i.e.,* resource conservation and implications of the waste treatment and disposal.

2.3.2.8 4-R concept

The concept endorses utilization of the wastes as a by-product to the extent possible *i.e.,* Re-cycle, Recover, Reuse, Recharge. Recycling refers to using the wastes/by-products in

the process again as a raw material to maximize the production. Recovery refers to engineering means such as solvent extraction, distillation, precipitation *etc*. to separate the useful constituents of the wastes, so that these recovered materials can be used. Re-use refers to the utilization of waste from one process as a raw material to other. Recharging is an option in which the natural systems are used for renovation of waste for further use.

2.3.2.9 Eco-efficiency

The World Business Council on sustainable development (WBCSD) defines eco-efficiency as "the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with earth's carrying capacity". The business implements the eco-efficiency on four levels *i.e*. optimized processes, recycling of wastes, eco-innovation and new services. Fussler (1995) defined six dimensions of eco efficiency, which are given below to understand/examine the system.

- **Mass:** There is an opportunity to significantly reduce mass burdens (raw materials, fuels, utilities consumed during the life cycle)
- **Reduce energy use:** The opportunity is to redesign the product or its use to provide significant energy savings
- **Reduce environmental toxins:** This is concern to the environmental quality and human health. The opportunity here is to significantly control the dispersion of toxic elements.
- **Recycle when practical:** Designing for recyclibility is important
- **Working with mother nature:** Materials are borrowed and returned to the nature without negatively affecting the balance of the ecosystem
- **Make it last longer:** It relates to useful life and functions of products. Increasing the functionality of products also increase their eco efficiency

The competitiveness among the companies and long-term survival will continue and the successful implementation of eco efficiency will contribute to their success. There is a need to shift towards responsible consumerism equal to the efficiency gains made by corporations – doing more with less.

2.3.2.10 Industrial ecosystem or metabolism

Eco-industrial development is a new paradigm for achieving excellence in business and environmental performance. It opens up innovative new avenues for managing business and conducting economic development by creating linkages among local 'resources', including businesses, non-profit groups, Governments, unions, educational institutions, and communities. They can creatively foster the dynamic and responsible growth. Antiquated business strategies based on isolated enterprises are no longer responsive enough to market, environmental and community requirements.

Sustainable eco-industrial development looks systematically at development, business and environment, attempting to stretch the boundaries of current practice - on one level. It is as directly practical as making the right connections between the wastes and resources needed for production and at the other level, it is a whole new way of thinking about doing business and interacting with communities. At a most basic level, it is each

organization seeking higher performance within it self. However, most eco-industrial activity is moving to a new level by increasing the inter connections between the companies.

Strategic partnership networked manufacturing and performed supplier arrangements are all the examples of ways used by the businesses to ensure growth, contain costs and to reach out for new opportunities.

For most businesses, the two essentials for success are the responsive markets and access to cost-effective, quality resources for production or delivering services. In absence of these two factors, virtually, every other incentive becomes a minor consideration.

Transportation issues are important at two levels, the ability to get goods to market in an expeditious way is essential to success in this day of just in time inventories. The use of least impact transportation with due consideration of speed and cost supports business success and addresses the concerned in the community.

Eco-industrial development works because it consciously mixes a range of targeted strategies shaped to the contours of the local community. Most importantly, it works because the communities want nothing less than the best possible in or near their neighborhoods. For companies, it provides a path towards significantly higher operating results and positive market presence. For our environment, it provides great hope that the waste will be transformed into valued product and that the stewardship will be a joint pledge of both businesses and communities.

2.3.2.11 Voluntary agreements

Voluntary environmental agreements among the industries, government, public representatives, NGOs and other concerned towards attaining certain future demands of the environment are reported to be successful. Such agreements may be used as a tool where Government would like to make the standards stringent in future (phase-wise-stringent). These may be used when conditions are temporary and require timely replacement. Also these may be used as supplementary/ complimentary in implementation of the regulation. The agreements may include:

- Target objectives (emission limit values/standards)
- Performance objectives (operating procedures)
- R&D activities – Government and industry may have agreement to establish better control technologies.
- Monitoring & reporting of the agreement conditions by other agents (NGOs, public participants, civil authority *etc*.)

In India, the MoEF has organized such programme, popularly known as the corporate responsibility for environment protection (CREP) considering identified 17 categories of high pollution potential industrial sectors. Publication in this regard, is available with Central Pollution Control Board (CPCB).

2.3.3 Tools for communication

2.3.3.1 State of environment

The Government of India has brought out the state of environment report for entire country and similar reports available for many of the states. These reports are published at regular intervals to record trends and to identify the required interventions at various levels. These reports consider the internationally accepted DPSIR framework for the presentation of the information. DPSIR refers to

- D – Driving forces – causes of concern *i.e.* industries, transportation *etc*.
- P – Pressures – pollutants emanating from driving forces *i.e.* emission
- S – State – quality of environment *i.e.* air, water & soil quality
- I – Impact – impact on health, eco-system, materials, biodiversity, economic damage *etc*.
- R – Responses – action for cleaner production, policies (including standards/ guidelines), targets *etc*.

Environment reports including the above elements gives a comprehensive picture of specific target area in order to take appropriate measures for improvement. Such reports capture the concerns, which could be considered in EIAs.

2.3.3.2 Corporate environmental reporting

Corporate environmental reports (CERs) are only one form of environmental reporting defined as publicly available, stand alone reports, issued voluntarily by the industries on their environmental activities. CER is just a means of environmental improvement and greater accountability, not an end in itself.

Three categories of environmental disclosure are:

- Involuntary Disclosure: Without its permission and against its will (env. Campaign, press *etc*.)
- Mandatory Disclosure: As required by law
- Voluntary Disclosure: The disclosure of information on a voluntary basis

2.4 Objectives of EIA

Objectives of EIA include the following:

- To ensure environmental considerations are explicitly addressed and incorporated into the development decision-making process
- To anticipate and avoid, minimize or offset the adverse significant biophysical, social and other relevant effects of development proposals
- To protect the productivity and capacity of natural systems and the ecological processes which maintain their functions; and
- To promote development that is sustainable and optimises resource use as well as management opportunities

2.5 Types of EIA

Environmental assessments could be classified into four types *i.e*. strategic environmental assessment, regional EIA, sectoral EIA and project level EIA. These are precisely discussed below:

Strategic environmental assessment

Strategic Environmental Assessment (SEA) refers to systematic analysis of the environmental effects of development policies, plans, programmes and other proposed strategic actions. SEA represents a proactive approach to integrate environmental considerations into the higher levels of decision-making – beyond the project level, when major alternatives are still open.

Regional EIA

EIA in the context of regional planning integrates environmental concerns into development planning for a geographic region, normally at the sub-country level. Such an approach is referred to as the economic-cum-environmental (EcE) development planning. This approach facilitates adequate integration of economic development with management of renewable natural resources within the carrying capacity limitation to achieve sustainable development. It fulfils the need for macro-level environmental integration, which the project-oriented EIA is unable to address effectively. Regional EIA addresses the environmental impacts of regional development plans and thus, the context for project-level EIA of the subsequent projects, within the region. In addition, if environmental effects are considered at regional level, then cumulative environmental effects of all the projects within the region can be accounted.

Sectoral EIA

Instead of project-level-EIA, an EIA should take place in the context of regional and sectoral level planning. Once sectoral level development plans have the integrated sectoral environmental concerns addressed, the scope of project-level EIA will be quite minimal. Sectoral EIA helps in addressing specific environmental problems that may be encountered in planning and implementing sectoral development projects.

Project level EIA

Project level EIA refers to the developmental activity in isolation and the impacts that it exerts on the receiving environment. Thus, it may not effectively integrate the cumulative effects of the development in a region.

From the above discussion, it is clear that EIA shall be integrated at all the levels *i.e.* strategic, regional, sectoral and the project level. Whereas, the strategic EIA is a structural change in the way the things are evaluated for decision-making, the regional EIA refers to substantial information processing and drawing complex inferences. The project-level EIA is relatively simple and reaches to meaningful conclusions. Therefore in India, project-level EIA studies take place on a large scale and are being considered. However, in the re-engineered Notification, provisions have been incorporated for giving a single clearance for the entire industrial estate for *e.g*., Leather parks, pharma cities *etc*., which is a step towards the regional approach.

As we progress and the resource planning concepts emerge in our decision-making process, the integration of overall regional issues will become part of the impact assessment studies.

2.6 Basic EIA Principles

By integrating the environmental impacts of the development activities and their mitigation early in the project planning cycle, the benefits of EIA could be realized in all stages of a project, from exploration and planning, through construction, operations, decommissioning, and beyond site closure.

A properly-conducted-EIA also lessens conflicts by promoting community participation, informing decision makers, and also helps in laying the base for environmentally sound projects. An EIA should meet at least three core values:

- Integrity: The EIA process should be fair, objective, unbiased and balanced
- Utility: The EIA process should provide balanced, credible information for decision-making
- Sustainability: The EIA process should result in environmental safeguards

Ideally an EIA process should be:

- Purposive - should inform decision makers and result in appropriate levels of environmental protection and community well-being.
- Rigorous - should apply 'best practicable' science, employing methodologies and techniques appropriate to address the problems being investigated.
- Practical - should result in providing information and acceptable and implementable solutions for problems faced by proponents.
- Relevant - should provide sufficient, reliable and usable information for development planning and decision making.
- Cost-effective - should impose the minimum cost burdens in terms of time and finance on proponents and participants consistent with meeting accepted requirements and objectives of EIA.
- Efficient - should achieve the objectives of EIA within the limits of available information, time, resources and methodology.
- Focused - should concentrate on significant environmental effects and key issues; *i.e.,* the matters that need to be taken into account in making decisions.
- Adaptive - should be adjusted to the realities, issues and circumstances of the proposals under review without compromising the integrity of the process, and be iterative, incorporating lessons learned throughout the project life cycle.
- Participative - should provide appropriate opportunities to inform and involve the interested and affected publics, and their inputs and concerns should be addressed explicitly in the documentation and decision making.
- Inter-disciplinary - should ensure that the appropriate techniques and experts in the relevant bio-physical and socio-economic disciplines are employed, including use of traditional knowledge as relevant.

- Credible - should be carried out with professionalism, rigor, fairness, objectivity, impartiality and balance, and be subject to independent checks and verification.
- Integrated - should address the interrelationships of social, economic and biophysical aspects.
- Transparent - should have clear, easily understood requirements for EIA content; ensure public access to information; identify the factors that are to be taken into account in decision making; and acknowledge limitations and difficulties.
- Systematic - should result in full consideration of all relevant information on the affected environment, of proposed alternatives and their impacts, and of the measures necessary to monitor and investigate residual effects.

2.7 Project Cycle

The generic project cycle including that of TSDF has six main stages:

1. Project concept
2. Pre-feasibility
3. Feasibility
4. Design and engineering
5. Implementation
6. Monitoring and evaluation

It is important to consider the environmental factors on an equal basis with technical and economic factors throughout the project planning, assessment and implementation phases. Environmental considerations should be introduced at the earliest in the project cycle and must be an integral part of the project pre-feasibility and feasibility stage. If the EIA environmental considerations are given due respect in site selection process by the project proponent, the subsequent stages of the environmental clearance process would get simplified and would also facilitate easy compliance to the mitigation measures throughout the project life cycle.

A project's feasibility study should include a detailed assessment of significant impacts, and the EIA include a detailed prediction and quantification of impacts and delineation of Environmental Management Plan (EMP). Findings of the EIA study should preferably be incorporated in the project design stage so that the project as well as the site alternatives is studied and necessary changes, if required, are incorporated in the project design stage. This practice will also help the management in assessing the negative impacts and in designing cost-effective remedial measures. In general, EIA enhances the project quality and improves the project planning process.

2.8 Environmental Impacts

Environmental impacts resulting from proposed actions can be grouped into following categories:

- Beneficial or detrimental
- Naturally reversible or irreversible
- Repairable via management practices or irreparable
- Short term or long term

- Temporary or continuous
- Occurring during construction phase or operational phase
- Local, regional, national or global
- Accidental or planned (recognized before hand)
- Direct (primary) or Indirect (secondary)
- Cumulative or single

The category of impact as stated above, and the significance will facilitate the Expert Appraisal Committee (EAC)/State Level EAC (SEAC) to take a look at the ToR for EIA studies, as well as, in decision making process about the developmental activity.

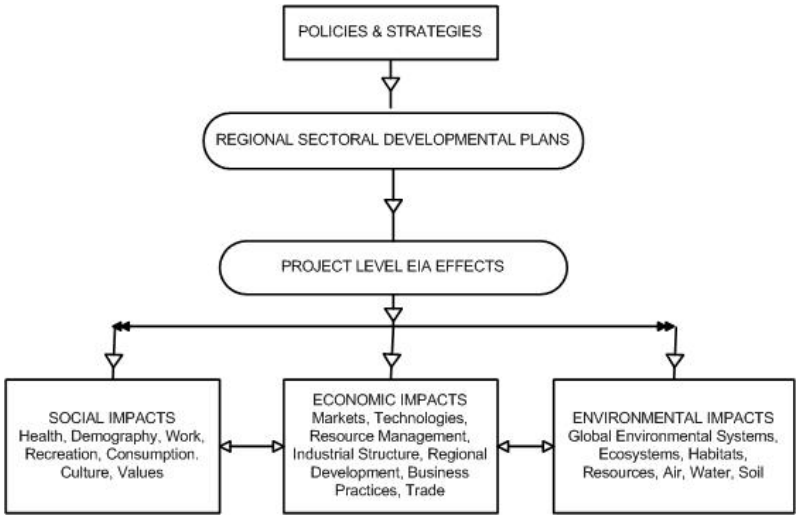


Figure 2-2: Types of Impacts

The nature of impacts could fall within three broad classifications *i.e.,* direct, indirect and cumulative, based on the characteristics of impacts. The assessment of direct, indirect and cumulative impacts should not be considered in isolation or considered as separate stages in the EIA. Ideally, the assessment of such impacts should form an integral part of all stages of the EIA. The TGM does not recommend a single method to assess the types of impacts, but suggests a practical framework/approach that can be adapted and combined to suit a particular project and the nature of impacts.

2.8.1 Direct impacts

Direct impacts occur through direct interaction of an activity with an environmental, social, or economic component. For example, a discharge of leachate containing toxic substances from TSDF into a near by water body may lead to a contamination of surface and ground water quality.

2.8.2 Indirect impacts

Indirect impacts on the environment are those which are not a direct result of the project, often produced away from or as a result of a complex impact pathway. The indirect impacts are also known as secondary or even tertiary level impacts. For example, enhanced traffic, loss of property values, poor aesthetics *etc*. Some of the impacts are characterized as socio-economic (third level) impacts. The indirect impacts may also include growth-inducing impacts and other effects related to induced changes to the pattern of land use or additional road network, population density or growth rate. In the

process, air, water and other natural systems including the ecosystem may also be affected.

2.8.3 Cumulative impacts

Cumulative impact consists of an impact that is created as a result of the combination of the project evaluated in the EIA together with other projects in the same vicinity, causing related impacts. These impacts occur when the incremental impact of the project is combined with the cumulative effects of other past, present and reasonably foreseeable future projects. Figure 2-3 depicts the same. Respective EAC may exercise their discretion on a case-by-case basis for considering the cumulative impacts.

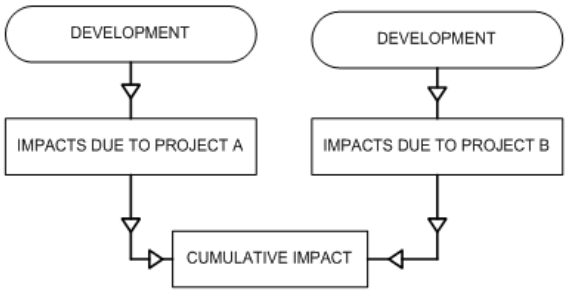


Figure 2-3: Cumulative Impact

2.8.4 Induced impact

The cumulative impacts can be due to induced actions of projects and activities that may occur if the action under assessment is implemented such as growth-inducing impacts and other effects related to induced changes to the pattern of future land use or additional road network, population density or growth rate (*e.g.*, certain segment of society may not prefer to be in close proximity thus social stratification takes place *etc.*). Induced actions may not be officially announced or be part of any official announcement/plan. Increase in workforce and nearby communities contributes to this effect.

They usually have no direct relationship with the action under assessment, and represent the growth-inducing potential of an action. New roads leading from those constructed for a project, construction of new service facilities are examples of induced actions.

However, the cumulative impacts due to induced development or third level or even secondary indirect impacts are difficult to be quantified. Because of higher levels of uncertainties, these impacts cannot normally be assessed over a long time horizon. An EIA practitioner usually can only guess as to what such induced impacts may be and the possible extent of their implications on the environmental factors. Respective EAC may exercise their discretion on a case-by-case basis for considering the induced impacts.

2.9 Significance of Impacts

This TGM establishes the significance of impacts first and proceeds to delineate the associated mitigation measures. So the significance here reflects the "worst-case scenario" before mitigation is applied, and therefore provides an understanding of what may happen if mitigation fails or is not as effective as predicted. For establishing significance of different impacts, understanding the responses and interaction of the

environmental system is essential. Hence, the impact interactions and pathways are to be understood and established first. Such an understanding will help in the assessment process to quantify the impact as accurately as possible. Complex interactions, particularly in the case of certain indirect or cumulative impacts, may give rise to non-linear responses which are often difficult to understand and therefore their significance is difficult to assess. It is hence understood that indirect or cumulative impacts are more complex than the direct impacts. Currently the impact assessments are limited to direct impacts. In case mitigation measures are delineated before determining significance of the effect, the significance represents the residual effects.

However, the ultimate objective of an EIA is to achieve sustainable development. The development process shall invariably cause some residual impacts even after implementing an EMP effectively. Environmentalists today are faced with a vital, not-easy-to-answer question—"What is the tolerable level of environmental impact within the sustainable development framework?" As such, it has been recognized that every ecosystem has a threshold for absorbing deterioration and a certain capacity for self-regeneration. These thresholds based on concept of carrying capacity are as follows:

- Waste emissions from a project should be within the assimilative capacity of the local environment to absorb without unacceptable degradation of its future waste absorptive capacity or other important services.
- Harvest rates of renewable resource inputs should be within the regenerative capacity of the natural system that generates them; depletion rates of non-renewable inputs should be equal to the rate at which renewable substitutes are developed by human invention and investment.

The aim of this model is to curb over-consumption and unacceptable environmental degradation. But because of limitation in available scientific basis, this definition provides only general guidelines for determining the sustainable use of inputs and outputs. To establish the level of significance for each identified impact, a three-stage analysis may be referred:

- First, an impact is qualified as being either negative or positive.
- Second, the nature of impacts such as direct, indirect, or cumulative is determined using the impact network
- Third, a scale is used to determine the severity of the effect; for example, an impact is of low, medium, or high significance.

It is not sufficient to simply state the significance of the effect. This determination must be justified, coherent and documented, notably by a determination methodology, which must be described in the methodology section of the report. There are many recognized methodologies to determine the significance of effects.

2.9.1 Criteria/methodology to determine the significance of the identified impacts

The criteria can be determined by answering some questions regarding the factors affecting the significance. This will help the EIA stake-holders, the practitioner in particular, to determine the significance of the identified impacts eventually. Typical examples of such factors include the following:

- Exceeding threshold Limit: Significance may increase if a threshold is exceeded. *e.g*., particulate matter emissions exceed the permissible threshold.
- Effectiveness of mitigation: Significance may increase as the effectiveness of mitigation measures decreases. *e.g*., control technologies, which may not assure consistent compliance to the requirements.
- Size of study area: Significance may increase as the zone of effects increases.
- Incremental contribution of effects from action under review: Significance may increase as the relative contribution of an action increases.
- Relative contribution of effects of other actions: Significance may decrease as the significance of nearby larger actions increase.
- Relative rarity of species: Significance may increase as species becomes increasingly rare or threatened.
- Significance of local effects: Significance may increase as the significance of local effects is high.
- Magnitude of change relative to natural background variability: Significance may decrease if effects are within natural assimilative capacity or variability.
- Creation of induced actions: Significance may increase as induced activities also highly significant.
- Degree of existing disturbance: Significance may increase if the surrounding environment is pristine.

For determining significance of impacts, it is important to remember that secondary and higher order effects can also occur as a result of a primary interaction between a project activity and the local environment. Wherever a primary effect is identified, the practitioner should always think if secondary or tertiary effects on other aspects of the environment could also arise.

The EIA should also consider the effects that could arise from the project due to induced developments, which take place as a consequence of the project. *Ex.* Population density and associated infrastructure and jobs for people attracted to the area by the project. It also requires consideration of cumulative effects that could arise from a combination of the effects due to other projects with those of other existing or planned developments in the surrounding area. So the necessity to formulate a qualitative checklist is suggested to test significance, in general.

3. ABOUT COMMON HAZARDOUS WASTE TREATMENT, STORAGE AND DISPOSAL FACILITIES INCLUDING BEST PRACTICES AND POLLUTION CONTROL TECHNOLOGIES

3.1 Hazardous Waste

The Hazardous Wastes (Management and Handling) Rules, 1989, notified under the Environment (Protection) Act, 1986 and subsequent amendments in 2000, 2003, 2008 and 2009 as the Hazardous Wastes (Management, Handling and Trans-boundary Movement) Rules, regulate management of hazardous wastes generated within the country as well as export/import of such wastes. These rules refer to effective management of hazardous waste, mainly solids, semi-solids and other industrial wastes, which do not come under the purview of Water (Prevention and Control of Pollution) Act and Air (Prevention and Control of Pollution) Act and also to enable Authorities to control storage, transportation, treatment and disposal of waste in an environmentally sound manner.

Any waste, by virtue of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances is defined as hazardous. The amendments are aimed to bring greater clarity to the classification of hazardous wastes by linking generation of waste streams to specific industrial processes. Simultaneously, threshold levels for concentration of specified constituents in wastes were laid down to distinguish between hazardous and other wastes. The coverage of hazardous wastes as per MoEF Notification issued on 24th September, 2008 includes:

- Wastes listed in Column 3 of Schedule I
- Wastes having constituents listed in Schedule II, if their concentration is equal to or more than the limit indicated in the said schedule
- Wastes listed in List 'A', and 'B' of Schedule III (Part-A) applicable only in case(s) of import and export of hazardous wastes in accordance with to Rules 12, 13 and 14 if they possess any of the hazardous characteristics listed in Part-B of Schedule III.

Schedule I & Schedule II are given in **Annexure I.**

For regulating imports and exports, wastes have been classified as either 'banned' or 'restricted'. The procedure for registration of recyclers/reprocessors with environmentally sound management facilities for processing waste categories, such as used lead acid batteries, non-ferrous metal wastes and used oil, respectively, has also been laid down. Further, separate rules have also been notified to regulate handling and management of biomedical wastes as well as used lead acid batteries.

The present document aims at common hazardous waste treatment storage and disposal facilities (referred as TSDF hereafter, in this document) for management of hazardous waste. This does not consider biomedical waste management facilities.

3.1.1 Definition of hazardous wastes – its applicability

From the viewpoint of application of the HW (M&H) Rules, waste can be classified as hazardous, if the waste substance is solid, semi-solid or non-aqueous liquid which because of its quantity, concentration or characteristics in terms of physical, chemical, infectious quality:

- can cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitate reversible illness, or
- pose a substantial present or potential hazard to human health or environment when it is improperly treated, stored, transported, disposed off or otherwise managed

Thus, a waste is hazardous if it exhibits whether alone or when in contact with other wastes or substances, any of the characteristics identified below:

- corrosivity
- reactivity
- ignitability
- toxicity
- explosive
- acute toxicity
- infectious property

3.1.2 Hazardous waste characterization

3.1.2.1 Corrosivity

Waste exhibits characteristics of corrosivity if a representative sample of waste has either of the following properties:

- any liquid which has a pH less than or equal to 2 or greater than or equal to 12.5, as determined by the standard test procedure
- waste, which can corrode steel at a rate greater than 6.35 mm per year at a test temperature of 55°C as determined by the standard test procedure

3.1.2.2 Reactivity

Waste exhibits the characteristics of reactivity, if a representative sample of the waste has any of the following properties:

- normally unstable and readily undergoes violent change without detonating
- reacts violently with water
- forms potentially explosive mixture with water
- cyanide or sulphide bearing waste which when exposed to pH conditions between 2 and 12.5 can generate toxic gases, vapours or fumes in a quantity sufficient to pose danger to human health or environment is an explosive

3.1.2.3 Ignitability

Waste exhibits the characteristics of ignitability if a representative sample of the waste has any of the following properties:

- It is a liquid other than an aqueous solution containing less than 24% organic solvents by volume and has flash point less than 60°C as determined by a Pensky Martins closed cup tester using the standard test method
- It is not a liquid and is capable under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes, and when ignited burns so vigorously and persistently that it creates a hazard
- Any oxidizing substance, when in contact with moisture or other materials/wastes, results in spontaneous fire or combustion

3.1.2.4 Toxicity

A solid waste exhibits the characteristics of toxicity if leachate from the representative sample by Toxicity Characteristics Leaching Procedure (TCLP) test method (as followed by USEPA, vide No: S.W 46, till Indian standards are notified by MoEF/CPCB) contains any of the contaminants listed in Table 3-1 below in excess of the concentration limits mentioned there upon.

Table 3-1: TCLP Test Limits

S. No.	Contaminant	TCLP Limit (mg/l)
01.	Arsenic	5.0
02.	Barium	100
03.	Benzene	0.5
04.	Cadmium	1.0
05.	Carbon tetrachloride	0.5
06.	Chlordane	0.03
07.	Chlorobenzene	100.0
08.	Chloroform	6.0
09.	Chromium	5.0
10.	o-Cresol	200.0[a]
11.	m-Cresol	200.0[a]
12.	p-Cresol	200.0[a]
13.	Cresol	200.0[a]
14.	2,4-D	10.0
15.	1,4-Dichlorobenzene	7.5
16.	1,2-Dichloroethane	0.5
17.	1,1-Dichloroethylene	0.7
18.	2,4-Dinitrotoluene	0.13

S. No.	Contaminant	TCLP Limit (mg/l)
19.	Endrin	0.02
20.	Heptachlor (and its epaoxide)	0.008
21.	Hexachlorobenzene	0.1[b]
22.	Hexachlorobutadiene	0.5
23.	Hexachloroethane	3.0
24.	Lead	5.0
25.	Lindane	0.4
26.	Mercury	0.2
27.	Methoxychlor	10.0
28.	Methyl ethyl ketone	200.0
29.	Nitrobenzene	2.0
30.	Pentachlorophenol	100.0
31.	Pyridine	5.0
32.	Selenium	1.0
33.	Silver	5.0
34.	Tetrachloroethylene	0.7
35.	Toxaphene	0.5
36.	Trichloroethylene	0.5
37.	2,4,5-Trichlorophenol	400.0
38.	2,4,6-Trichlorophenol	2.0
39.	2,4,5-TP (Silvex)	1.0
40.	Vinyl Chloride	0.2

Notes:

[a]. *If o, m, p cresols concentration cannot be differentiated, the total cresol concentration is used. Total cresol concentration regulatory level: 200 mg/l*

[b]. *If the quantification limit is greater than calculated regulatory level, quantification limit becomes the regulatory limit*

1. These limits shall be applicable till the notification of leachate standards (including test method) under the E (P) Act, 1986

2. Best Demonstrated Available Technology (BDAT) standards shall be employed for parameters not mentioned.

3. Leachate collected shall be treated and disposed as liquid effluent in compliance of the standards notified under the E (P) Act, 1986.

Source: Central Pollution Control Board

3.1.2.5 Explosive

Solid waste exhibits the characteristics of sudden, almost instantaneous release of gas, heat, and pressure, accompanied by loud noise when subjected to a certain amount of shock, pressure, or temperature.

3.1.2.6 Acute toxicity

Waste exhibits the characteristics of being acutely hazardous if a representative sample contains any of the following:

- wastes generated in the manufacturing process of halogenated phenols and other halogenated compounds
- wastes generated in the manufacturing/formulating process of pesticides or pesticide derivatives
- wastes generated during the manufacturing process of halogenated benzene under alkaline conditions
- off-specification or discarded products generated from the above processes
- containers used for handling hazardous/toxic substances/wastes

3.1.2.7 Infectious property

Wastes containing viable micro-organisms or their toxins which are known or suspected to cause disease in animal or humans fall under this category.

3.2 Hazardous Waste Management Options

While there are a number of ways to classify the hazardous waste based on its characteristics. It is more appropriate in the given context to classify in respect of its end treatment/disposal. The hierarchy of options for hazardous waste management is presented in Figure 3-1.

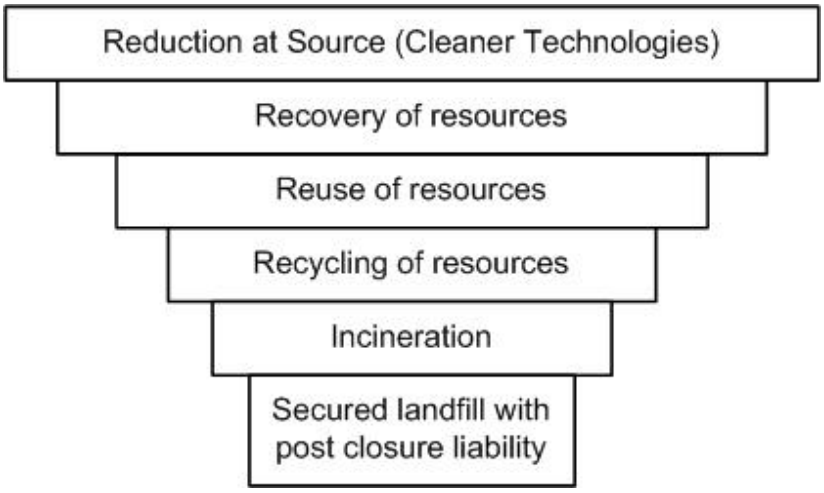


Figure 3-1: Hierarchy of Options for Hazardous Waste Management

Defining certain waste as recyclable, incinerable or suitable for secured landfill requires scientific criteria based on techno-economic feasibility considerations. Recyclability is often decided based on economic feasibility (availability of end user, technological ease, price of recovery, transportation, and legal requirements *etc*.). Incinerable waste is often classified based on calorific value of the waste and reference in this regard is the acceptable criteria for secured landfill. Similarly, what is not suitable for other options is considered for disposal into the secured landfill. However, the criteria set for acceptable characteristics of hazardous waste for disposal into secured landfill warrants prior treatment *i.e*., stabilization, *etc*. Criteria for treatment and disposal options for wastes listed in Schedule I, as brought out by the Maharashtra Pollution Control Board, is given in **Annexure II**.

3.3 Hazardous Waste Generation

Industry-wise sources of hazardous waste generation

Sources of hazardous waste streams vary from industry-to-industry depending on its operations. Certain industrial processes are already listed in Schedule 1, which provides generic criteria to classify the wastes as hazardous. A compilation of common sources of hazardous wastes, which is largely applicable for many industries, is given in the following Table 3-2.

Table 3-2: Generic Industrial Hazardous Waste Streams

Waste streams
Waste Oil/Used Oil/ Skimmed oil /oily sludge
ETP Sludge (Primary)
Sludge from Water Treatment Plants
Discarded Containers used for Chemicals and Hazardous substances
Date expired/off specific/Discarded Chemicals and Products
Ash from Waste Incineration
Sludge generation during processing of Waste waters for recovery/ reuse / recycle
Miscellaneous wastes like used cotton, gloves, gum boots,
Contaminated filters/filter bags
Contaminated Centrifuge bags
Spent Activated Carbon and any other
Tank Bottoms
Spent Catalyst
Process dust
Dust/Particulate from exhaust gas/flue gas treatment
Sulphur Sludge
Oil contaminated earth
Resin residues

Waste streams
Asbestos containing wastes
Sludge from solar ponds
Spent/Used Lead Acid Batteries
Alkaline / and acidic/and paint sludge
Floor Sweeping waste (House Keeping Waste)
Spent resins from DM Plant
Distillation Residues / Tarry Waste
Cooling water sludge
Drain Sludge
Others (Solid Waste)

The amendments made to the Hazardous Waste (Management and Handling) Rules, for focused attention and distinct categorization are based on characterisation of waste, necessitated re-inventorisation of the hazardous waste. The new inventorisation exercise brought out more detailed information in terms of total quantum of waste generated *vis-à-vis* its composition in terms of recyclable/reusable, landfill-disposable and incinerable components to form the basis for planning TSDF facilities to be developed.

Reasonably reliable estimates based on process and product-wise generation of waste will facilitate planning the type of on-site and off-site storage/treatment to be provided before disposal of waste in an environment-friendly manner depending on the characteristics and quantity of waste generation.

A recent publication of CPCB reveals that a total of 36,165 hazardous waste generating industries, generate 62,32,507 tonnes per annum (TPA) of hazardous wastes. Break up of this total hazardous waste from the disposal point-of-view is as follows:

- Recyclable HW - 30,88,387 TPA
- Incinerable HW - 4,15,794 TPA
- Landfillable HW – 27,28,326 TPA

Recyclable Hazardous Waste

The inventory clearly shows that 49.55% of hazardous wastes generated could be recycled. Efforts in this direction will substantially relieve pressure on incineration and secured landfills. The 6.67 % of incinerable hazardous waste requires careful handling due to its associated properties and requires higher level of knowledge and skills in order to achieve proper disposal. In absence, the process demands stabilization before disposal into secured landfills posing higher disposal costs and enhanced future liability. The portion that requires secured landfill disposal is about 43.78 %.

Gujarat, Maharashtra and Andhra Pradesh generate maximum share of hazardous waste *i.e.*, 28.76 %, 25.16 % and 8.93 % respectively totaling to 62.85% of the total generation. If we also consider the contributions from Chhattisgarh (4.74 %), Rajasthan (4.38 %), West Bengal (4.17 %) and Tamil Nadu (4.15 %) the total amount of hazardous waste generated accounts to 80.29 % of total hazardous waste generation in the country.

TSDFs are operating at 22 locations in 10 States *i.e.*, Gujarat, Maharashtra, Uttar Pradesh, Andhra Pradesh, Himachal Pradesh, Madhya Pradesh, West Bengal, Punjab, Rajasthan and Tamil Nadu. Total disposal capacity of these facilities, is 15,00,568 TPA, clearly indicating the need for additional capacity/facilities.

Incinerable hazardous waste

Maharashtra and Gujarat contribute 36.75% and 26.12% respectively, totaling to 62.87%. If the contributions from Andhra Pradesh (7.61 %), Rajasthan (5.54 %), Uttar Pradesh (3.78%), Punjab (3.57 %), West Bengal (3.03 %) and Tamil Nadu (2.68%) are also considered, it rises to 89.08 % of the total incinerable hazardous waste in the country.

Common incineration facilities are operating at 13 locations in six states. Besides, there are about 127 individual industry-owned incinerators located in 12 states. Total capacity of these incinerators is 3,27,705 TPA while the present generation of incinerable hazardous waste is 4,15,794 TPA, indicating the need for augmentation of capacities/new facilities.

Details of state-wise number of hazardous waste generating industries are given in Table 3-3. State-wise recyclable, incinerable and landfill disposable wastes are given in Table 3-4. The state-wise landfillable hazardous waste generation, distribution of TSDF facilities, capacities, and adequacy are provided in Table 3-5. Details of state-wise incinerable waste generation, status of incineration facilities, adequacy are given in Table 3-6.

Table 3-3: State-wise Hazardous Waste Generating Industries in India

S. No.	Name of State/ UTs	No. of HW Generating units
1	Andhra Pradesh	1739
2	Assam	55
3	Bihar	41
4	Chhattisgarh	174
5	Delhi (unverified data)	1995
6	Gujarat	7751
7	Goa	630
8	Haryana	1419
9	H.P.	1331
10	J.&K.	291
11	Jharkhand	435
12	Karnataka	2076
13	Kerala	524
14	Madhya Pradesh	1093
15	Maharashtra	4909
16	Manipur	264

S. No.	Name of State/ UTs	No. of HW Generating units
17	Meghalaya	43
18	Mizorum	44
19	Nagaland	3
20	Orissa	335
21	Punjab	3023
22	Rajasthan	442
23	Tripura	135
24	Tamil Nadu	2532
25	Uttar Pradesh	1915
26	Uttaranchal	70
27	West Bengal	609
Union Territories		
1	Daman, Diu, Dadra & Nagar Haveli	1937
2	Pondicherry	90
3	Chandigarh	260
TOTAL		36165

Table 3-4: State-wise Status of Hazardous Waste Generation (as in February 2009)**

S. No	Name of State/ UTs	Quantity of Hazardous waste generation (MTA)			
		Land fillable	Incinerable	Recyclable	Total
1	Andhra Pradesh	211442	31660	313217	556319
2	Assam	3252		7480	10732
3	Bihar	3357	9	73	3439
4	Chhattisgarh	5277	6897	283213	295387
5	Delhi (unverified)	3338	1740	203	5281
6	Gujarat	1107128	108622	577037	1792787
7	Goa	10763	8271	7614	26648
8	Haryana	30452	1429	4919	36800
9	HP	35519	2248	4380	42147
10	J&K	9946	141	6867	16954
11	Jharkhand	23135	9813	204236	237184
12	Karnataka	18366	3713	54490	76569
13	Kerala	59591*	223	23085	82899

S. No	Name of State/ UTs	Quantity of Hazardous waste generation (MTA)			
		Land fillable	Incinerable	Recyclable	Total
14	Madhya Pradesh	34945	5036	127909	167890
15	Maharashtra	568135	152791	847442	1568368
16	Manipur	-	115	137	252
17	Meghalaya	19	697	6443	7159
18	Mizorum	90	Nil	12	102
19	Nagaland	61	Nil	11	72
20	Orissa	74351	4052	18427	96830
21	Punjab	13601	14831	89481	117913
22	Rajasthan	165107	23025	84739	272871
23	Tripura	0	30	237	267
24	Tamil Nadu	157909	11145	89593	258647
25	Uttar Pradesh	36370	15697	117227	169294
26	Uttaranchal	17991	580	11	18582
27	West Bengal	120598	12583	126597	259777
U.T.					
1	Daman, Diu, Dadra & Nagar Haveli	17219	421	56350	73990
2	Pondicherry	132	25	36235	36392
3	Chandigarh	232	-	723	955
TOTAL		2728326 (43.78%)	415794 (6.67%)	3088387 (49.55%)	6232507 (100%)

Note

** This figure of Kerala includes other wastes (8066.745 MTA) from IRE and FACT also.*

*** As reported by SPCBs/PCCs*

Source: CPCB documents on 'National Inventory of Hazardous Waste Generating Industries and Hazardous Waste Management in India' as on February 2009. For further details please refer to CPCB website i.e. www.cpcb.nic.in.

Table 3-5: State-wise Status of Common Hazardous Waste Treatment, Storage and Disposal Facilities - Landfill Capacities vis-à-vis HW Generation

S. No.	Name/Location of TSDF	Secured landfill (SLF) Capacity in MPA	Total SLF Capacity in MTA**	General Land Disposal HW in MTA	Surplus Capacity / Deficit in capacity
I.	Andhra Pradesh				

S. No.	Name/Location of TSDF	Secured landfill (SLF) Capacity in MPA	Total SLF Capacity in MTA**	General Land Disposal HW in MTA	Surplus Capacity / Deficit in capacity
1	TSDF Dundigal	150000	350000	211442	138558 (Surplus)
2	TSDF, Visakhapatnam*	200000			
II.	Gujarat				
3	NEIL. Nandesari, Vadodara	21667	447401	1107128	-659727 (Deficit)
4	GEPIL, Surat	100000			
5	TSDF, Odhav, Ahmedabad	71667			
6	TSDF at Vatva, Ahmedabad	63067			
7	BEIL, Ankleshwar	120000			
8	TSDF, Vapi	48000			
9	TSDF, Alang	23000			
III.	Karnataka				
10	TSDF, Debaspet	40,000	40,000	18,000	22000(Surplus)
IV.	Kerala				
11	TSDF, Ambalmughal, Earnakulam	50,000	50,000	51,524	-1524 (Deficit)
V.	Himachal Pradesh				
12	TSDF at Baddi	50000	50000	35519	14481 (Surplus)
VI.	Madhya Pradesh				
13	MP Waste Management Project , Pithampur	90000	90000	34945	55055 (Surplus)
VII.	Maharashtra				
14	Mumbai Waste Management Ltd. at Taloja	120000	250000	568135	-318135 (Deficit)
15	Trans Thane Creek Waste Management Association TSDF at New Mumbai	10000			
16	TSDF at Butibori	60000			
17	TSDF at Ranjangaon	60000			
VIII.	Punjab				
18	Punjab Waste Management Project TSDF at Nimbua, Derabassi	13000	13000	13601	-601 (Deficit)
IX.	Rajasthan				
19	Rajasthan Waste Management Project TSDF at Gudli, Udaipur	20000	20000	165107	-145107 (Deficit)

S. No.	Name/Location of TSDF	Secured landfill (SLF) Capacity in MPA	Total SLF Capacity in MTA**	General Land Disposal HW in MTA	Surplus Capacity / Deficit in capacity
X.	Tamil Nadu				
20	Tamil Nadu Waste Management Ltd. TSDF at Gummadipoondi	100000	100000	157909	-57909 (Deficit)
XI.	Uttar Pradesh				
21	Uttar Waste Management Project TSDF, Kumbhi, Kanpur Dehat	17500	60167	36370	23797 (Surplus)
22	TSDF at Banthar, Unnao	20667			
23	TSDF at Rooma, Kanpur	22000			
XII.	West Bengal				
24	West Bengal Waste Management Ltd. TSDF, Purba Shrikrishnapr, East Midnapur	120000	120000	120598	-598 (Deficit)
XIII.	Daman, Diu, Dadra & NH:				
25	TSDF, Motarandha, Silavasa, Dadra & Nagar Haveli	7500	7500	17219	-9719 (Deficit)
Total		1,598,068	1,598,068	2,537,497	-939429 (Deficit)

Note: **Proposed to be relocated*

***Total capacity is excluding captive landfill capacity*

Table 3-6: State-wise Incinerable Waste Generation and Facilities

S. No.	Name of State /UT	Nos. of Common hazardous Waste Incinerators	Capacity in MTA	Nos. of Captive hazardous Waste Incinerators	Capacity of captive Incinerators in MTA	Total Capacity MTA	Incinerable Waste Generation in the State MTA	Surplus capacity
1	Andhra Pradesh	2	18000	26	29823	47823	31660	16163 (Surplus)
2	Gujarat	4	32872	35	128425	161297	108622	52675 (Surplus)
3	H.P.	----	----	7	5082	5082	2248	2834 (Surplus)
4	Karnataka	3	5100	7	2743	7843	3713	4130 (Surplus)
5	Kerala		250	1	1500	1750	223	1527 (Surplus)
6	Madhya	1 (awaiting	----	7	2940	2940	5036	-2096

S. No.	Name of State /UT	Nos. of Common hazardous Waste Incinerators	Capacity in MTA	Nos. of Captive hazardous Waste Incinerators	Capacity of captive Incinerators in MTA	Total Capacity MTA	Incinerable Waste Generation in the State MTA	Surplus capacity
	Pradesh	clearance)						(Deficit)
7	Maharashtra	2	30000			30000	152791	-122791 (Deficit)
8	Punjab	----	----	17	35250	35250	14831	20419 (Surplus)
9	Pondicherry	----	----	1	2700	2700	25	2675 (Surplus)
10	Rajasthan	----	----	5	15500	15500	23025	-7525 (Deficit)
11	Uttar Pradesh	1	1200	13	5340	6540	15697	-9157 (Deficit)
12	West Bengal	1	10800	4		10800	12583	-1783 (Deficit)
13	Daman, Diu, Dadra & NH	----	----	4	180	180	421	-241 (Deficit)
	TOTAL	13	98222	127	229483	327705	370875	-43170 (Deficit)

3.4 Hazardous Waste Recycling Opportunities

There are opportunities to recycle hazardous waste. However, all these opportunities are sensitive to the characteristics of waste. For instance, efforts shall be made by industries and the TSDF operators at specific instances where waste lime received at TSDFs can be used as raw material for conversion to gypsum and for production of bricks (Fal-G Bricks) in combination with fly ash. As a result, lime finds good reception at cement kilns.

CPCB/SPCBs advocate the usage of waste lime in cement kilns and many steps are initiated in this regard. The Maharashtra Pollution Control Board directed all the waste lime generators to send their waste to the existing TSDFs and from there is sent to various cement industries. This decision was intended to centralize, track and control the movement of hazardous waste.

However, the acceptance of hazardous wastes in cement kilns is restricted to the waste with high calorific values, which is neither corrosive nor contains salts and can be used as alternate fuel.

Efforts were also made to promote utilisation of high temperature flue gases from incinerators for power generation. However, such efforts were not successful due to the presence of higher volumes of salts in particular chlorides in the flue gases leading to corrosive effects and deposition on heat exchanger tubes in the boilers.

If the present status in the country is of any indication, recycling and reuse of hazardous waste demands high level of (R&D)

3.5 Hazardous Waste Transportation

In order to optimize and facilitate proper operations at TSDF, the generator of hazardous waste shall be responsible for managing hazardous waste before being sent to the TSDF for further treatment and disposal. Responsibilities of the generator are listed as under:

- Waste minimization, reuse of waste to the maximum extent before sending to TSDF
- Comprehensive waste characterization
- Segregation of hazardous and non-hazardous waste to reduce the quantity of waste for disposal at TSDF, appropriate labeling of all containers and storage aspects
- Proper handling of waste at source
- Other requirements as discussed in subsequent sub-sections

3.5.1 Requirements for transportation of hazardous wastes for disposal

Transportation is one of the most important areas of concern associated with the handling of hazardous waste. Considering the toxic, flammable, explosive or corrosive characteristics of hazardous waste, its transport has to be planned in such a way that this waste does not cause danger to health or environment, when handled individually or when in contact with other wastes or substances during transportation. Hence, its transportation is expected to:

- Satisfy the needs of occupier and handlers/transporters
- Meet national and, if necessary, international requirements, *e.g.*, United Nation's, safety labeling requirements

The packaging and method of transport determines the safety of hazardous wastes during the transit without any accident or spillage. In addition, proper and rapid identification of a spilled substance determines how effectively and safely the situation can be controlled. Spill risk is high during loading, transportation and unloading. This is the reason why the transportation of hazardous waste is required to be regulated. Hazardous waste transportation regulations cover the transportation of hazardous waste outside an installation, *e.g.* on the pathway from the waste generator's premises to the TSDF. The off-site transportation requirements involve proper awareness about the following:

- Container: Specially designed container considering the fact that the hazardous wastes are corrosive/abrasive in nature, the container shall be made of appropriate leak-proof material with mechanical stability for 3 (three) years
- Labeling of the container: to identify the waste, describe the possible hazard, and the remedial measures/first-aid required in case of any accidental spills
- Transportation vehicle: to identify the waste displaying the possible hazard, the remedial measures/first-aid required in case of accidental spills, telephone number of the contact person/controlling agency in case of emergency, *etc*. through labeling
- Collector/transporter selection: to have technical competence and relevant skills and other requirements

- License/manifest: to carry application and 'No objection certificate (NOC)' documents
- Emergency procedures: to have knowledge about actions to be taken in case of spills or accidents
- Fees and fines: to be paid for not having license, or not abiding to the regulations

On-site transportation typically involves carrying of small amounts of materials over short distances. On-site transportation does; however, pose a significant risk from the frequency of activity and the lack of observance of prescribed regulations.

Regulatory requirements for packaging, labeling of individual containers and transportation of hazardous wastes are provided under Rule 7 of the Hazardous Wastes (Management & Handling) Rules, 1989 as amended, and notified under the Environment (Protection) Act, 1986. It is the responsibility of the generator or operator of a facility to ensure that the hazardous wastes are packaged, based on the composition in a manner suitable for handling, storage and transport. Labeling and packaging is required to be easily visible and to withstand physical conditions and climatic factors. CPCB has also enunciated guidelines for Transportation of Hazardous Wastes, HAZWAM/33/2005-2006.

These guidelines are issued to facilitate safe transportation (on-site & off-site) of the hazardous wastes in compliance with the regulations.

3.5.2 Packaging

The containers must be able to withstand normal handling and retain integrity for at least six months. In general, packaging for hazardous waste must meet the following requirements:

- All packaging material including containers shall be of such strength, construction and type that they would not break open or become defective during transportation
- All packaging material including containers shall be packaged and sealed in such a way that those spillages of hazardous wastes/substances are prevented during transportation due to jerks and vibrations caused by uneven road surface
- Re-packaging materials including that used for fastening must not be affected by the contents or form a dangerous combination with them
- Packaging material should be such that there will be no significant chemical or galvanic action among any of the material in the package

The containers when used for packaging of hazardous wastes shall meet the following requirements:

- Container shall be of mild steel with suitable corrosion-resistant coating and roll-on roll-off cover, which may either be handled by articulated crane or by a hook lift system comfortably for a large variety of wastes. Other modes of packaging, like collection in 200-litre plastic drums, cardboard cartons, PP and HDPE/LDPE containers, *etc*., may also be used for a variety of wastes. However, all such containers should hold up mechanical handling.
- They should be leak proof.

- In general, the containers for liquid hazardous waste should be completely closed, in fact sealed. There should be no gas generation due to any chemical reaction within the container, and hence, there should not be any need for air vents; expansion due to increase/decrease in temperature normally does not need air vents.
- Container should be covered with a solid lid or a canvas to avoid emissions of any sort including spillage, dust, *etc*., and to minimise odour generation both at the point of loading as well as during transportation.
- Container used for transportation of waste should be able to withstand the shock loads due to vibration effect/undulations of pavements, *etc*.,
- Container should be easy to handle during transportation and also emptying.
- Manual handling of containers should be minimised to the extent possible. Appropriate material handling equipment is to be used to load, transport and unload containers. This equipment includes drum, dollies, forklifts, drum handling equipment, lift gates and pallets. Drums should not be rolled on off vehicles.
- Where two-tier or three-tier storage is envisaged, the frame should have adequate strength to hold the containers.
- One-way containers (especially 160-litre drums) are also allowed. The multi-use containers should be reusable provided it should be cleaned and free from deterioration or defects.
- Loads are to be properly placed on vehicles. Hazardous waste containers are not to overhang, perch, lean or be placed on any unstable base. Load should be secured with straps, clamps, braces or other measures to prevent movement and loss. Design of the container should be such that it can be safely accommodated on the transport vehicle.
- Dissimilar wastes shall not be collected in the same container. Wastes shall be segregated and packed separately. This is necessary to ensure that each waste finds its way to the right disposal point.
- Generator of hazardous waste shall not resort to the dilution of wastes (predominantly organic wastes).

3.5.3 Labeling

There are two types of labeling requirements:

- Labeling of individual transport containers (ranging from a pint-size to a tank), and
- Labeling of transport vehicles

All hazardous waste containers must be clearly labeled showing all its contents. The labels must be waterproof and firmly stuck to the containers, so that they cannot be removed. Previous content labels shall be obliterated when the contents are changed. Proper marking of containers is essential.

Containers storing hazardous waste shall be labeled with the words "HAZARDOUS WASTE" in vernacular language, Hindi/English. The information on the label must include the code number of waste, waste type, origin (name, address, telephone number of generator), hazardous property (*e.g*. flammable), and the symbol for the hazardous property (*e.g*. the red square with flame symbol).

The label must withstand the effects of rain and sun. Labeling of containers is important for tracking the wastes from the point of generation up to the final point of disposal. The following are the requirements for labeling:

- The label should contain the name and address of the generator and operator of the facility where it is being sent for treatment and final disposal *i.e*., labeling of container shall be provided with a general label as per Form 8 of HW (M&H) Rules, 1989 and as amended).
- Emergency contact phone numbers shall be prominently displayed *viz*. the phone number of concerned Regional Officer of the SPCB/PCC, Fire Station, Police Station and other agencies concerned.

Explanation: As a general rule, the label has to state the origin/generator of the waste. The HW generator alone is responsible and shall know, in case of any accident/spillage, *etc*., the kind of wastes it contained, the kind of hazard that may occur and the measures to be taken. The second in the line is the collector/transporter, who needs to know the risk and what to do to minimise risks and hazards.

3.5.4 Collection and transportation of hazardous waste

Safe transportation of hazardous waste to the TSDF is a collective responsibility of the waste generator, operator of a facility for treatment and disposal of hazardous waste and the transporter. Apart from the guidelines mentioned in packaging and labeling in the above sections, the following additional guidelines shall be followed before handing over the waste to the transporter:

- Measures may be taken for proper placement of an online tracking system for movement of the hazardous waste from generators to the final disposal so as to ensure safe disposal of hazardous wastes in India
- Transport of hazardous wastes shall be in accordance with the provisions of the rules made by the Central Government under the Motor Vehicles Act, 1988 and other guidelines issued from time to time
- All hazardous waste containers shall be provided with a general label as given in Form 8 in Hazardous Waste (Management & Handling) Rules, 1989, as amended
- Transporter shall not accept hazardous wastes from an occupier (generator) unless six-copies (with colour codes) of the manifest (Form 9) as per Rule 7 of the HW (M & H) Rules, 1989 and as amended are provided by the generator. The transporter shall give a copy of the manifest signed and dated to the generator and retain the remaining four copies to be used for further necessary action prescribed in the Hazardous Wastes (Management & Handling) Rules, 1989, as under:
  - Copy 1 (White): To be forwarded to the SPCB/PCC by the occupier
  - Copy 2 (Yellow): To be signed by the transporter and retained by the occupier
  - Copy 3 (Pink): To be retained by the operator of a facility
  - Copy 4 (Orange): To be returned to the transporter by the operator of facility after accepting waste
  - Copy 5 (Green): To be forwarded to the SPCB/PCC by the operator of facility after disposal.

  - Copy 6 (Blue): To be returned to the occupier by the operator of the facility after disposal.

- In case of interstate transportation of waste, the occupier (waste generator) shall strictly follow the manifest system as stipulated under Rule 7 (5) of the HW (M & H) Rules, 1989 and amendments made there under.
- In case of transport of hazardous wastes to a facility for treatment, storage and disposal existing in a state other than the state where wastes are generated, the generator shall obtain necessary "No Objection Certificate" from the concerned State Pollution Control Board or Pollution Control Committee of the UT where the facility is located (As stipulated under Rule 7 (6) of HW (M & H) Rules).
- The generator shall provide the transporter with relevant information in Form 10, *i.e.* Transport Emergency (TREM) Card regarding the hazardous nature of the wastes and measures to be taken in case of an emergency.
- The operator of a facility (registered recyclers or re-processors of hazardous waste) while collecting the wastes from the waste collections points or Ports or ICDs, shall also follow the manifest system as per Rule 7 of the HW (M & H) Rules.

3.5.5 Test report and information

Generators sending hazardous waste to the facility for treatment, storage or disposal are required to provide necessary test report of hazardous waste to the operator along with the information on the process(s) of its generation, so as to facilitate the determination of pathway for treatment and disposal. Test report shall be submitted to the operator along with a copy marked to the SPCB. The generator for utilizing the facility is to provide details of hazardous waste as mentioned below:

- Details about the waste and its characteristics regarding presence of explosive/ ignitable/corrosive/toxic/odour compounds in the manifest provided to the transporter for safe transportation and disposal
- Parameters of comprehensive analysis test report of waste is given below:
  - Calorific value
  - Flash point
  - % Moisture content (Loss on ignition at 105^{o}C)
  - % organic Content (Loss on ignition at 550^{o}C)
  - Paint filter liquid test (PFLT)
  - pH
  - Reactive cyanide (PPM)
  - Total Cyanide
  - Reactive sulphide (ppm)
  - Sulphur elemental
  - Concentration of individual inorganics
  - Oil and grease
  - Extractable organics
  - Percentage carbon, percentage nitrogen, percentage sulphur, percentage hydrogen
  - Concentration of individual organics
  - TCLP concentrations of individual material and organic tests
- Parameters of Finger print analysis test report of waste (please refer **Annexure III**) is given below:

- Physical state of the waste
- Identification of different phase of waste
- Colour and texture
- Specific gravity
- Viscosity
- Flash point
- Percentage moisture content (Loss on ignition at 105^{o}C)
- Percentage organic content (Loss on ignition at 550^{o}C)
- Paint filter liquid test (PFLT)
- Liquid release test
- pH
- Reactive Cyanide (ppm)
- Reactive Sulphide (ppm)

Based on the analysis report/waste characterization, TSDF operator shall decide the suitable pathway for treatment/storage/disposal.

3.5.6 Responsibilities of the hazardous waste transporter

The TSDF operator shall be responsible for transportation of hazardous waste as "transporter". The transportation vehicles and containers shall be suitably designed to handle the hazardous wastes. The transporter shall carry/display the TREM card during transportation of the hazardous wastes and comply with the provisions under Motor Vehicles Act (MVA), 1988, as amended, and rules made there under. Transporter of hazardous wastes shall be responsible for:

- Cleanup operators in case of spillage, leakage or any other accidental/incidental discharge of hazardous wastes and shall keep the SPCB suitably informed
- Obtaining permission from SPCB/PCC for transport of hazardous waste [in addition to any other permission that may be required under the Motor Vehicles (Amendment) Act of 1988]
- Design of suitable transport vehicles to handle and transport the hazardous wastes of various characteristics

Following are all the rules pertaining to transportation of hazardous waste as stipulated under HW (M&H) Rules, 1989 and as amended

- Transporting the wastes in closed containers at all times
- Delivering the wastes at designated points only
- Informing SPCB/PCC or local authority, occupier/operator of a facility, and others concerned immediately in case of spillage, leakage or other accidents during transportation
- Training the driver with regard to the emergency response measures to be taken during the transportation of waste
- Cleanup in case of contamination
- Cleaning of vehicles at designated places *i.e.* either at TSDF/CETPs *etc.*, or where there are facilities to treat such wastewaters

3.5.7 Transportation requirement

Following are the requirements pertaining to the transportation of hazardous wastes:

- Vehicle used for transportation shall be in accordance with the provisions under the Motor Vehicles Act, 1988, and rules made there under.
- Transporter shall possess requisite copies of the certificate (valid authorization obtained from the concerned SPCB/PCC for transportation of wastes by the waste generator and operator of a facility) for transportation of hazardous waste.
- Transporter should have valid "Pollution under Control Certificate" (PUCC) during the transportation of HW and shall be properly displayed.
- Vehicles shall be painted preferably in blue colour with white strip of 15 to 30 cm width running centrally all over the body to facilitate easy identification.
- Vehicle should be fitted with mechanical handling equipment for safe handling and transportation of wastes.
- The words "HAZARDOUS WASTE" shall be displayed on all sides of the vehicle in vernacular language, Hindi, and English.
- Name of the generator or the transporter, as the case may be, shall be displayed.
- Emergency phone numbers and TREM Card in Form 10 of HW (M&H) Rules, 1989 and as amended shall be displayed properly.
- Vehicle shall be fitted with roll-on/roll-off covers if the individual containers do not possess the same.
- Carrying of passengers is strictly prohibited except for the waste haulers. Access to these waste haulers shall be restricted to the cabins only.
- Transporter shall carry documents of manifest for the wastes during transportation as required under Rule 7 of the Hazardous Waste (M&H) Rules, 1989, as amended.
- The trucks shall be dedicated for transportation of hazardous wastes and they shall not be used for any other purpose.
- Each vehicle shall carry first-aid kit, spill control equipment and fire extinguisher.
- HW transport vehicle shall run only at a speed specified under Motor Vehicles Act in order to avoid any eventuality during the transportation of HW.
- The driver of the transport vehicle shall at least have cleared the SSC exam (10^{th} standard) and shall have valid driving license for heavy vehicles from the State Road Transport Authority and shall have experience in transporting the chemicals.
- Driver(s) shall be properly trained for handling the emergency situations and safety aspects involved in the transportation of hazardous wastes.
- The design of the trucks shall be such that there is no spillage during transportation.

3.5.8 Responsibilities of the TSDF operator

The TSDF operator would be responsible for:

- Accepting hazardous wastes at TSDF from the generators authorised by SPCB/PCC

- Establishing a system for optimal movement of hazardous wastes transportation, treatment and disposal operations, which may include resource recovery/recycling as the case may be
- Fingerprinting analysis to confirm the wastes shall be the responsibility of the operator
- Operating the TSDF as per conditions stipulated in the authorisation
- Ensuring waste treatment and/or disposal as per Hazardous Waste (M&H) rules, 1989, as amended
- Undertake cleanup operation in case of contamination resulting from TSDF
- Pollution and the odour arising out of TSDF operations and subsequent abatement
- Compliance of regulations concerning occupational safety and health of TSDF employees
- In the event, there are differences in the analysis results, the generator may either accept the results of operator or send their samples to a mutually agreed third party analysis at their own cost

3.6 Hazardous Waste Storage

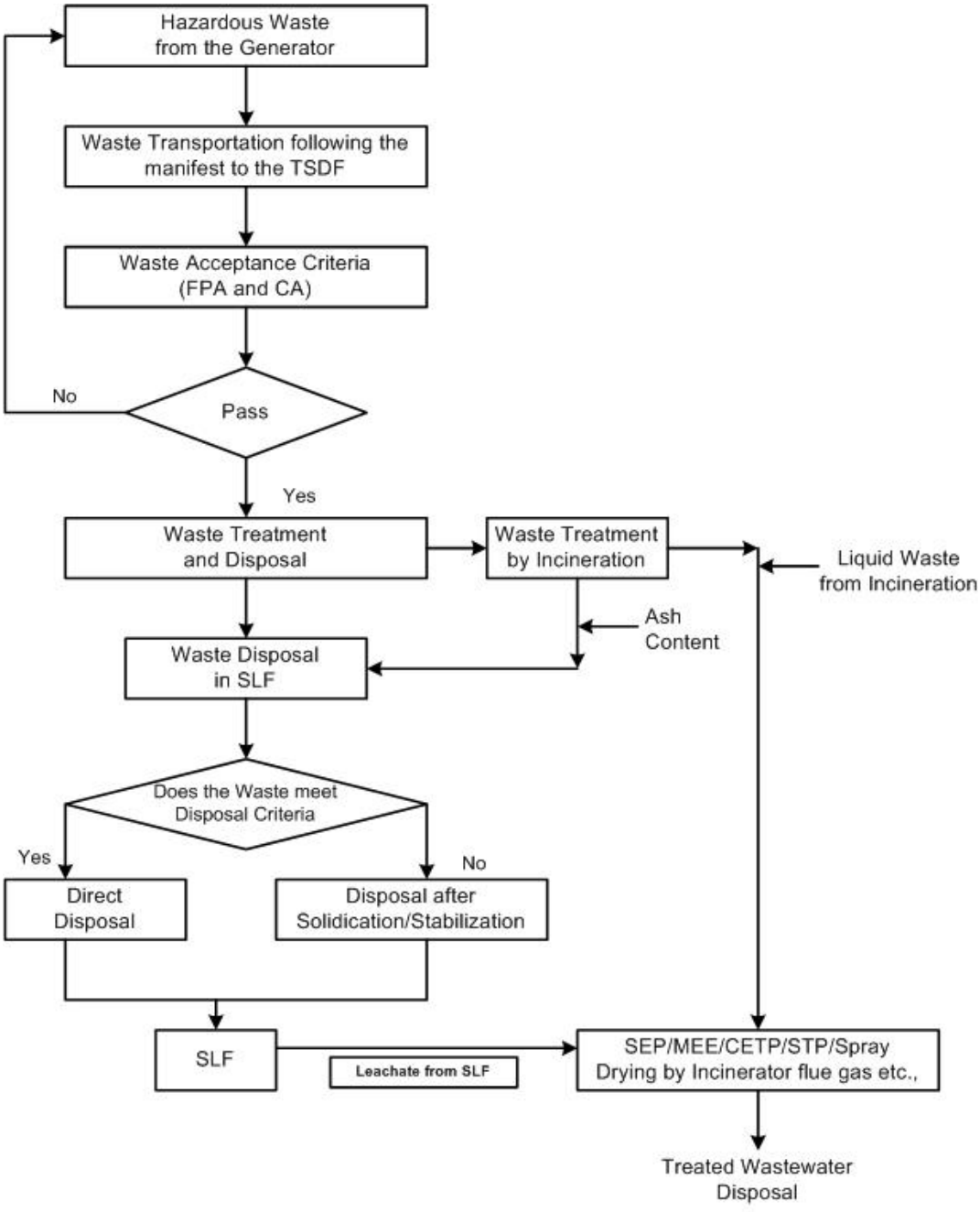
3.6.1 Waste acceptance

Suggested sequence of the operations at TSDF is as follows:

- The TSDF operator shall receive a comprehensive report on analysis of waste from the generator
- The TSDF operator shall examine the report and plan pathway for waste treatment and disposal
- Upon confirmation of the same by TSDF operator to the generator, waste shall be dispatched to the TSDF accompanied by transport manifest
- Upon receipt at the facility, the wastes shall be weighed and properly logged
- Waste shall then undergo a visual inspection to confirm the physical appearance
- A representative sample of waste shall be collected and sent to on-site laboratory for finger print analysis (**Annexure III**)
- The results of fingerprinting analysis shall be compared with the results of earlier analysis. If the results do not match with the previous test results the waste will be returned to the generator and the same will be informed to the SPCB
- Upon confirmation, waste shall then be sent for TSDF operations according to the identified pathway

The general procedure which could be followed by the TSDFs starting from receipt of wastes from generators to the final disposal is shown in Figure 3-2**.**

TSDF operators shall be equipped with adequate laboratory facilities in order to carry out the monitoring and analysis of all required parameters. These laboratories may be accredited as per the Environment (Protection) Act, 1986 and ISO 17025 through NABL system.



LEGEND:

FPA: Finger Print Analysis
CA: Comprehensive Analysis
SEP: Solar Evaporation Pond
MEE: Multiple Effect Evaporator
CETP: Common Effluent Treatment Plant
STP: Sewage Treatment Plant

Figure 3-2: Criteria for Waste Acceptance and Disposal

3.6.2 Guidelines to be adopted for storage facilities

The TSDF operator shall store the waste in lined containers solely for the purpose of the accumulation of quantities of hazardous waste as necessary to facilitate proper recovery, treatment or disposal for which economically viable treatment/disposal techniques are presently not available at or outside the facility. Each container shall be clearly marked to identify its contents and the date(s) of accumulation at the facility and such information for each consignment is recorded and maintained in the operating records at the facility. The general guidelines that are to be adopted in establishing the storage facility include earmarking of a separate area for storing hazardous waste at TSDF. The storage area may consist of different cells for storing different kinds of hazardous waste. In designing these cells, the following points may be taken into consideration:

- The storage area should have a proper containment system. The containment system should have a collection area to collect and remove any leak, spill or precipitation
- It should be designed in such a way that the floor level of the storage area is at least 150 millimetres (mm) above the maximum flood level
- Provision of adequate storage capacity in the premises
- No open storage is permissible and the designated hazardous waste storage area shall have proper enclosures, including safety requirements
- Proper stacking of drums with wooden frames shall be practiced
- Incase of spills/leaks, cotton shall be used for cleaning instead of water
- Signboards showing precautionary measures to be taken in case of normal and emergency situations shall be displayed at appropriate locations.
- Manual operations with in storage area are to be avoided to the extent possible. In case of personnel use, proper precautions need to be taken, particularly during loading /unloading of liquid hazardous waste in drums
- The TSDF operator should put in place a system for inspection of the storage area to check the conditions of the containers, spillages, leakages, *etc*., and maintain proper records as specified by the SPCB/PCC for operation of a TSDF.
- The hazardous wastes should not be stored for more than two weeks at this temporary storage area.

Proper guidelines should be followed for the requirement of type of drums to be used for storage of incinerable wastes, spillage or leakage control measures to be adopted in the event of any leakages or spillages, record keeping and maintenance, requirement of fire detection, protection and safety measures. Safety audits must also be carried out every year by the TSDF operator and by a reputed expert agency at least once in two years.

If the waste is not in accordance with the authorization issued by the SPCB/PCC to the generator, the TSDF operator shall reject the waste for further treatment and disposal. Information to this effect shall be immediately sent to the SPCB/PCC for advice.

The existing guidelines of CPCB for storage of incinerable hazardous wastes, the revised guidelines for storage and handling of incinerable hazardous wastes (Guidelines for storage of incinerable hazardous waste by the operators of Common TSDF and Captive HW Incinerators, Nov 2008) may be followed for compliance and are discussed in subsequent sections.

3.6.3 Storage area (storage shed)

- Huge quantum of incinerable hazardous wastes (organic wastes) should not be kept haphazardly without any labeling at the location/proposed location of incinerators
- Automatic smoke, heat detection system should be provided in the sheds. Adequate fire fighting systems should be provided for the storage area, along with the areas in the facility.
- In storage of wastes, general criteria for compatibility of selected waste should be followed as given in **Annexure IV**.
- While storing or mixing of incinerable wastes to optimise the feed, compatibility of wastes has to be considered and tested.
- Flammable, ignitable, reactive and incompatible wastes should be stored separately and never should be stored in the same storage shed.
- Storage area may consist of different sheds for storing different kinds of incinerable hazardous wastes and sheds should be provided with suitable openings.
- Adequate storage capacity (*i.e*. 50 % of the annual capacity of the hazardous waste incinerator) should be provided in the premises.
- Storage area should be designed to withstand the load of material stocked and any damage from the material spillage.
- Storage area should be provided with the flameproof electrical fittings and it should be strictly adhered to.
- There should be at least 15 m distance between the storage sheds.
- Loading and unloading of wastes in storage sheds should be done under the supervision of the well trained and experienced staff only.
- Fire break of at least 04 meter between two blocks of stacked drums should be provided in the storage shed. Storage capacity of one block of drum should not exceed 300 MT.
- Minimum of 1 m clear space should be left between two adjacent rows of drums in pair for inspection.
- The storage and handling should have at least two routes to escape in the event of any fire in the area.
- Doors and approaches of the storage area should be of suitable sizes for entry of fork lift and fire fighting equipment
- The exhaust of the vehicles used for the purpose of handling, lifting and transportation within the facility such as forklifts or trucks should be fitted with the approved type of spark arrester.
- In order to have appropriate measures to prevent percolation of spills, leaks, *etc*. to the soil and ground water, the storage area should be provided with concrete floor or steel sheet depending on the characteristics of waste handled and the floor must be structurally sound and chemically compatible with wastes.
- Measures should be taken to prevent entry of runoff into the storage area.
- The storage area shall be designed in such a way that the floor level is at least 150 mm above the maximum flood level.

- Floor in the storage area should be provided with secondary containment such as proper slopes as well as collection pit so as to collect wash water and the leakages/spills, *etc*.
- All the storage yards should be provided with proper peripheral drainage system connected with the sump in order to collect accidental spills, if any, on roads or within the storage yards as well as any accidental flow due to fire fighting.

3.6.4 Storage drums/containers

- The container shall be made or lined with suitable material, which will not react with, or in other words compatible with the hazardous wastes proposed to be stored.
- The stacking of drums in the storage area should be restricted to three high on pallets (wooden frames). Necessary precautionary measures should be taken so as to avoid stack collapse. However, for waste having flash point less than 65.5 ^{O}C, the drums should not be stacked more than one height.
- No drums should be opened in the storage sheds for sampling, *etc*., and such activity should be done in designated places out side the storage areas
- Drums containing wastes stored in the storage area should be labeled properly indicating mainly type, quantity, characteristics, source and date of storing, *etc*.

3.6.5 Spillage/leakage control measures

The storage areas should be inspected daily for detecting any signs of leaks or deterioration, if any. Leaking or deteriorated containers should be removed and ensured that such contents are transferred to a sound container.

- The storage areas should be inspected daily for detecting signs of leaks or deterioration, if any. Leaking or deteriorated containers should be removed and ensured that such contents are transferred to a sound container
- In case of spills/leaks, dry adsorbents/cotton should be used for cleaning instead of water
- Proper slope with collection pits should be provided in the storage area in order to collect the spills/leakages
- Storage areas should be provided with adequate number of spill kits at suitable locations. The spill kits should be provided with compatible sorbent material in adequate quantity

3.6.6 Record keeping and maintenance

Proper records on industry-wise type of waste received, characteristics of waste, location of waste storage area, waste treatment and disposal methods for every specific industry at the facility has to be maintained.

3.6.7 Recommended storage time and quantity of incinerable hazardous wastes

Hazardous wastes must not be stored for more than six months at the incinerator site.

3.6.8 Hazard analysis and safety audit

For every storage facility, a preliminary hazard analysis should be conducted. Internal Safety Audit by the Operator every year & externally once in two years by a reputed expert agency should be carried out and same should be submitted to the SPCB/PCC.

Such conditions should be stipulated by SPCBs while granting authorization under Hazardous Waste (Management, Handling & Trans-boundary Movement) Rules, 2008 to the incinerator operators.

For Occupational safety and health considerations, may please refer the following web link:

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=9765.

3.6.9 Miscellaneous

- Smoking shall be prohibited in and around the storage areas
- Only those vehicles with spark proof should be allowed
- Good house keeping has to be maintained around the storage areas
- Signboards showing precautionary measures to be taken in case of normal and emergency situations should be displayed at appropriate locations
- To the extent possible, manual operations with in storage area are to be avoided. In case of manual operation, proper precautions need to be taken, particularly during loading/unloading of liquid hazardous waste in drums
- A system for inspection of storage area to check the condition of containers, spillages, leakages, *etc*., should be established and proper records should be maintained
- The wastes containing volatile solvents or other low vapor pressure chemicals should be adequately protected from direct exposure to sunlight and adequate ventilation should be provided
- Tanks for storage of liquid waste should be properly dyked and should be provided with adequate transfer systems
- Storage sites should have adequate and prompt emergency response equipment systems for the hazardous waste stored on-site. This should include fire fighting arrangement based on the risk assessment, spill management, evacuation and first aid
- Immediately on receipt of hazardous waste, it should be analysed and depending upon its characteristics its storage should be finalised
- Only authorized personnel trained in hazardous waste handling procedures should have access to the storage site
- Mock drill for on-site emergency should be conducted regularly and records should be maintained

3.7 Common Hazardous Waste Incineration Facilities

Thermal oxidation through incinerator is one of the proven technologies for destruction of hazardous waste in all the forms *i.e,* solid/semi-solid/liquid and gaseous, based on the

feeding system, so as to render them innocuous in the form of non-toxic and non-hazardous residues. Destruction of complex hazardous waste requires knowledge to judge the compatibility of various wastes for the purpose of homogenisation of waste to be fed to the incinerator. Operation & maintenance of thermal processes and pollution control devices at the incinerator demands skill and experience w.r.t compliance with the environmental regulations prescribed for the common hazardous waste incineration facilities (**Annexure IV)**.

The common incineration facilities are, in principle, expected to handle the hazardous waste in solid and liquid forms having high degree of variation in respect of characteristics due to different nature of member industries, which will have direct bearing on efficiency of combustion system and pollution control devices. Therefore, experience in other parts of the world, particularly in case of handling hazardous waste in solid form, drive us to adopt rotary kilns followed by secondary combustion chambers as a set-up for combustion part of the incineration system, unless other combinations demonstrate equally in delivering required efficiency.

Common hazardous waste incineration facilities are those which handle hazardous waste from more than one industry either installed as an integral part or located elsewhere.

Various components of common incineration facility include proper transportation, storage, analytical laboratory facilities, feeding mechanism, incineration system (rotary kiln & post combustion chamber), gas cleaning system, tail-gas monitoring facilities with automatic on-line monitoring & control facilities, ash/slag management, bleed/scrubber liquor management and measures for health protection of workers. CPCB has enunciated "Guidelines for Common Hazardous Waste Incineration", HAZWAM/30/2005-2006.

3.7.1 Analytical laboratory facilities

- Generators sending hazardous waste to the incineration facility are required to provide necessary test report of hazardous waste to the operator along with the information on the process(s) of its generation.
- The tests to be conducted at incineration facility shall be with an objective to study i) Storage & feeding requirements; ii) Operating conditions of the furnaces; iii) Feed concentration within the efficiency levels of air pollution control devices to comply with flue gas standards. The activity specific relevant parameters are indicated below:
  - **Storage & feeding requirements:** Physical form of waste, pH, hazardous waste properties such as inflammability, reactivity, compatibility with other wastes *etc*. for segregating the waste and to store accordingly, in order to suit feeding mechanism.
  - **Operating conditions of the furnaces:** viscosity, moisture content, total organic carbon, calorific value, volatility of the waste, special incompatible wastes, inorganic salts, and metals, *etc*.
  - **Air pollution control devices:** chlorides, other halogens, sulphur, nitrates, mercury and other heavy metals, *etc*.

Therefore, relevant parameters may be analysed while accepting the waste.

- The laboratory shall give clear directions to the operators regarding types of waste to be incinerated on a particular date and their properties, at least two days in advance

- The laboratory at the incineration facilities shall be capable of monitoring all the above parameters

3.7.2 Waste feeding mechanisms

- Methods of mixing hazardous waste for optimizing the incineration should include satisfactory arrangements
- Mixing of hazardous waste for incineration based on weight, calorific value and chemical characteristics for optimising the feed should consider the compatibility of various wastes. General criteria for compatibility of selected waste for mixing are provided in **Annexure IV**
- Maintaining designed heat capacity of the combustion chambers under varying calorific values of the hazardous waste fed in to the incinerator demands skill. In absence of proper hands-on training and adequate knowledge, the minimum negative pressure could not be maintained at all times. This may lead to diffused emissions from rotary kilns, which in turn may cause puffing into the secondary combustion chambers constraining the retention time resulting in poor efficiency. Besides, these temperature fluctuations will also have negative bearing on refractory and insulation material
- Therefore, continuous feeding of homogeneous waste having same or similar calorific value to the combustion chambers is a desired choice. However, often maintaining homogeneous feed of waste is not feasible due to incompatibility of different wastes for mixing. Conventionally, hazardous wastes in solid form are fed through a hydraulic ram feeding system, which has two automatic gates. Once the outside plate is closed, the plate on the inner side is opened and hazardous waste mass is hydraulically pushed inside the kiln. The outer plate opens only after the plate on the inner side is closed, so that the next batch of solid waste may be fed. This system, besides negative pressure in the combustion chambers is required to ensure safety and to prevent workmen exposure to thermal radiation.
- Thus, the waste-feeding mechanism plays an important role to achieve desired combustion efficiencies. For example, the variety of wastes received from the member industries can be classified into following for better control of combustion:

Table 3-7: Waste in Solid Form

Property	Options
High calorific value containing waste (organic residues)	▪ Quantity of solid mass feeding may be reduced in each charging to contain temperature shoot-ups. ▪ Besides, following are used in specific cases: ▪ Low calorific value liquid waste may be parallelly injected; and/or ▪ Steam may be parallelly injected
Reactive waste, which can not be mixed with others	▪ Sealed drums, as such, may be charged into the kilns or into drum pyrolysing system ▪ Depending on calorific value, size of the drum / container may be specified to the member industry for such waste.
Other mixable solid waste having moderate calorific value	▪ May be homogenized to the extent possible and charged to the kilns at desired quantity of packets and frequency.
Specific materials which melts on heating	▪ Here, the possibility would be to ask the member industry to store in required capacity of the container, which can be directly

	injected with out heating; or to provide a system by which such drums can be heated-up and can be charged through closed-loop pressurized nitrogen.

Table 3-8: Waste in Semi-solid Form

Property	Options
Very high solids concentration	Fully shelled (to prevent diffused emissions) screw pumps may be a choice
Relatively low conc. of solids / low viscosity	Pumps similar to the one used for cement concrete charging may be used.

Table 3-9: Waste in Liquid Form

Property	Options
Highly reactive / inflammable liquids	May be directly injected into combustion chambers without mixing with other wastes. The charging from the containers may be through closed loop nitrogen pressure purging.
Liquids having high calorific value (ex. contaminated solvents)	Can replace auxiliary fuel requirement conventionally in the secondary chamber, once the combustion chambers reaches to its designed temperatures.
Liquids having properties similar to that of auxiliary fuel	Once it is established, these liquids can be used for raising the initial temperature of the combustion chambers. However, specific tests in support of such claims be produced by a recognized credible third party.
Liquids having low calorific values	These may be injected in to kilns to suppress the temperature shoot-ups due to high calorific solid/ other special liquid waste feeds.

- Depending on type of wastes received, the scheme shall be established by the common incineration facility and the member industry shall place the corresponding code number/sticker. Code number is to be verified by analytical laboratory of common incineration facility to ensure appropriate feeding by operator of the facility.
- While charging the liquid hazardous waste, filtering the liquids may be required to avoid chocking of pumps.
- Hazardous wastes which are not easily pumpable (*e.g.*, Wastes with high viscocity, wastes having high solids content, *etc*.) may require pressurised nitrogen purging for charging the liquid to the combustion chambers.
- In case of emptying liquid waste containing drums by inserting suction pumps & induced draft (hoods and ducts), set-up above such drum emptying area for collection of volatile organic compounds (VOCs) must be ensured. These collected diffused emissions must be controlled / routed to the combustion chambers.
- Feeding pipeline and equipment are to be cleaned before a new type of waste is fed to the combustion system to avoid undesired reactions.

3.7.3 Combustion chambers (rotary kiln and secondary combustion chamber)

- Incineration plants shall be designed, equipped, built and operated in such a way that the gas resulting from the process is raised, after the last injection of combustion air, in a controlled and homogenous fashion
- Incineration plant shall be equipped with at least one auxiliary burner. This burner must be switched on automatically with the temperature of the combustion gases after the last injection of combustion air falls below specified temperature. It shall also be used during plant start-up and shut-down operations in order to ensure that minimum specified temperature is maintained at all times during these operations and as long as unburnt waste is in the combustion chamber
- During the start-up and shut-down or when the temperature of the combustion gas falls below specified minimum temperature, the auxiliary burner shall not be fed with fuels, which can cause higher emissions than those resulting from burning of gas oil/ liquefied gas/natural gas
- The burners may be pressure-atomised type with approved certification from the Bureau of Indian Standards (BIS) or equivalent
- In case of low calorific value liquid fuels are proposed to be injected into kiln, then double fuel injection burners may carry auxiliary fuel or equivalent liquid waste in one injection tube and low calorific value waste feed in other
- Kiln and secondary combustion chamber of the incinerator may be made of mild steel conforming to IS: 2062 and of suitable thickness lined with high-grade refractory and insulation, so as not to buckle in or bulge out
- Combustion chambers (kiln & secondary combustion chamber) shall be supplied with excessive air to ensure complete burning of wastes. The blower shall have the capability to provide appropriate supply of combustion air
- An inventory of fuel for a continuous operation of the incineration facility for five days may be kept in reserve
- Incinerator facility shall have a window fitted with safety view glass to view the kiln (axially) and flame in secondary combustion chambers
- As the common incineration systems will be handling wastes having varying heat value, and while ensuring TOC and LOI requirements in the ash/slag, there are possibilities for sudden rise of temperatures in the kiln. Therefore, the facilities may like to have thermal refractory bricks and insulation capable of withstanding a minimum temperature of 1,300°C (typically, corundum/chromium bricks). In some cases, water spray systems are installed to reduce temperature and kiln operations are avoided during the slagging mode
- In case of high-pressure development in the furnace, proper safety arrangement must be provided
- Interlocking arrangements for Carbon monoxide (CO) and temperature controls (in primary and secondary chamber) with feeding devices shall also be provided
- All the burners are to be equipped with flame control system (if no flame is detected, fuel injection has to be stopped, automatically – use of fast-stop-valve)
- Whenever the pressure in the combustion chambers becomes positive, the feeding of waste should be stopped immediately and needful measures should be taken to restore negative pressure

- Exit doors shall be provided at suitable places, one each on the primary kiln and the secondary chamber of the incinerator for ease in inspection and maintenance

3.7.3.1 Rotary Kiln

- To maintain designed heat capacity of the kiln, quantity of the solid waste injection package (kg/single injection) shall be adjusted w.r.t. calorific value of the waste feed.
- When a high calorific value possessing solid waste is injected in packets, the size of each injection may be reduced, such that the peak CO concentration in the kiln does not exceed too high in the initial stage, creating shooting of emissions to the secondary chamber, thereby crisis in ensuring the required retention time.
- Appropriate slope (in general, 3 degrees), rotation rates (around 10/hr) and solid waste residence time (1-10 hrs) may be adjusted for the kilns, in order to achieve total organic carbon (TOC) and loss on ignition (LOI) requirements in the ash/slag.
- To ensure life of refractory and insulation bricks, it is a practice to feed silica and glass in appropriate ratios to the kilns to form a cover over the refractory lining, as and when the thickness of the layer reduces.
- It has been reported that reduction of outside surface temperature of the rotary kiln enhances the life of refractory bricks and lining. Thus may be explored, where feasible.
- In the rotary kiln, the temperature shall be maintained at 850 ± 50°C in order to ensure complete burning of solid waste. Controlled flow of air shall be maintained for complete volatilisation of solid waste.

3.7.3.2 Secondary combustion chamber

- Minimum temperature requirement in the secondary combustion chamber is 1100^{o}C. This may be ensured by averaging the temperature measurement of three detectors (not exactly positioned in the burner flame) at the same time within the combustion chamber
- The design and operating conditions shall demonstrate a minimum of two-second residence time in the secondary combustion chambers, under critical feed conditions, so as to bring complete combustion of volatile matter evolved from the primary combustion chamber
- In case the consistent compliance with standards based on continuous monitoring results over a period of two weeks, under critical feed conditions, is successfully demonstrated, then SPCB/PCC, can recommend the proposal made by the incineration facility for relaxation in temperature and residence time. In any case, should not be less than 950°C and 1.5 seconds, for the consideration and approval of the Central Board

3.7.4 Pollution control devices

- Pollution control devices are required to comply with prescribed standards for particulate matter, HCl, SO_2, CO, Total Organic Carbon, HF, NOx (NO and NO_2 expressed as NO2), Hydrocarbons, Dioxins/Furans, Cd +Th (and its compounds), Hg (and its compounds), Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V (and their compounds). Besides the above, SPCB/PCC can prescribe additional parameters, as deem fit, in consultation with the CPCB

- Incineration facility shall explore ways for heat recovery, to the extent possible
- There are many combinations of treatment units installed for gas cleaning and removal of air pollutants, to comply with the standards. Designed treatment scheme shall comprise of following equipment, in combination, with adequate efficiencies to meet the emission standards:
  - **Dioxins**: Keeping De-novo synthesis in the backdrop, steps must be taken to prevent reformation of dioxins by rapidly lowering the flue gas temperatures, particularly from 500^{o}C to less than 200^{o}C by adopting rapid quench / catalyst / adsorption by activated carbon, *etc*.
  - **Particulate matter:** Fine particulates in the flue gases require specific dust separation technologies such as bag filters, electrostatic precipitator *etc*., in order to meet flue gas standard. In case of electrostatic precipitators, special care is required to avoid electric sparks due to the dust to avoid reformation of dioxins and adsorption to the fine dust.
  - **Mercury:** If the feeding waste contains mercury and its compounds, there is every chance of these emissions to get airborne. Therefore, requires specific treatment for control of these emissions. (*e.g.,* activated carbon, conversion into mercuric chloride and then to mercuric sulphide, *etc*.)
  - **SO_2:** Sulphur present in the feeding waste, upon thermal oxidation forms sulphur dioxide, which requires control measures to meet the standard. Conventional method followed is scrubbing by alkali (alkali dry/wet scrubber with hydrated lime or sodium hydroxide injection)
  - **HCL & HF:** In order to control halogen emissions to the desired level, in particular chlorides and fluorides, conventionally water/alkali scrubbers are in use
  - **Mist:** Often there is a need to eliminate the mist in the stack emissions, therefore, where necessary de-mister may be provided
- Stack height
  - Stack height shall not be less than 30 meters, in any case.
  - Stack height requirement based on SO_2 emissions by using the equation – stack height = 14 $(Q)^{0.3}$ [where, Q is the emission rate of SO_2 in kg/hr]
  - By using simple Gaussian plume model to maintain ambient air quality requirements for all concerned parameters, in the receiving environment

The required stack height shall be the maximum of the above three considerations.

3.7.5 Monitoring and on-line display requirements

- The online monitoring systems attached with the incinerators require periodic calibration
- Sampling platform shall be provided as per CPCB norms to collect stack samples from the chimney for monitoring the air pollutants, as and when required. Holes need to be provided on chimney as per standard CPCB norms, following diametric calculations
- Frequency of monitoring for various parameters is given below:

Table 3-10: Frequency of Monitoring of Various Parameters

S.No.	Parameter	Location	Frequency
1	Temperature	Secondary combustion chamber, stack emissions	Continuous monitoring
2	Carbon monoxide	Stack emissions	Continuous
3	Excess oxygen	Secondary combustion chamber, stack emissions	Continuous
4	Pressure	Combustion chambers	Continuous
5	Total particulate matter	Stack emissions	Continuous
6	HCl	Stack emissions	Continuous
7	HF	Stack emissions	Once in every month, initially for first year. If the correlation with HCL scrubbing efficiency is established, the frequency may be relaxed by the State Boards/ Pollution Control Committees appropriately
8	SO_2	Stack emissions	Continuous
9	NOx	Stack emissions	Continuous
10	TOC	Stack emissions	Continuous
		Residues from the combustion processes (slag / ash)	Once in every week (pooled sample), initially for first year. If there is consistency in meeting the standard, may be relaxed to once in a month (pooled sample)
11	Loss on ignition (LOI)	Residues from the combustion processes (slag/ash)	-do-
12	Mercury	Stack emissions	Twice a year, under critical operating conditions
13	Heavy metals	Stack emissions,	Twice a year, under critical operating conditions
14	Dioxins and furans	Stack emissions, ash/dust, scrubber liquors, quench liquor	Twice a year under critical operating conditions

- Access shall be provided online, to see the continuous monitoring data by the local regulatory Board/Committee and annual environmental report giving complete details of operation and compliance with regulatory requirements. These details need to be published and made available to the public.
- Formula to calculate the emission concentration at standard percentage of oxygen concentration

$$Es = \frac{(21 - Os)}{(21 - Om)} \quad (Em)$$

Where,

Es = Calculated emission conc. at the std. Percentage oxygen concentration

Em = Measured emission concentration

Os = Standard oxygen concentration

Om = Measured oxygen concentration

- The above correction to the measured concentrations is to be done only when the measured % oxygen conc. is higher than the standard % oxygen conc. (*i.e.* 11%)
- Dibenzo-p-dioxins and dibenzofurans: Analysis of dioxins and furans as well as reference measurement methods to calibrate automated measurement systems shall be carried out as given by European Committee for Standardization (CEN)-standards. If CEN-standards are not available, ISO standards, National or International Standards, which will ensure the provision of data of an equivalent scientific quality, shall apply.

The total concentration of dioxins and furans is to be calculated by multiplying mass concentrations of following Dibenzo-p-dioxins and dibenzofurans with their toxic equivalence factors, before summing:

Table 3-11: Toxic Equivalence Factor

Name of congener	Toxic equivalence factor
2,3,7,8 Tetrachlorodibenzodioxin	1.0
1,2,3,7,8 Pentachlorodibenzodioxin	0.5
1,2,3,4,7,8 Hexachlorodibenzodioxin	0.1
1,2,3,6,7,8 Hexachlorodibenzodioxin	0.1
1,2,3,7,8,9 Hexachlorodibenzodioxin	0.1
1,2,3,4,6,7,8 Heptachlorodibenzodioxin	0.01
Octachlorodibenzodioxin	0.001
2,3,7,8 Tetrachlorodibenzofuran	0.1
2,3,4,7,8 Pentachlorodibenzofuran	0.5
1,2,3,7,8 Pentachlorodibenzofuran	0.05
1,2,3,4,7,8 Hexachlorodibenzofuran	0.1
1,2,3,6,7,8 Hexachlorodibenzofuran	0.1
1,2,3,7,8,9 Hexachlorodibenzofuran	0.1
2,3,4,6,7,8 Hexachlorodibenzofuran	0.1
1,2,3,4,6,7,8 Heptachlorodibenzofuran	0.01
1,2,3,4,7,8,9 Heptachlorodibenzofuran	0.01
Octachlorodibenzofuran	0.001

3.7.6 Ash/slag management

- Water locking arrangements shall be provided for removal of ash/slag from the combustion chambers
- Where appropriate, options may be explored for recycling of ash/slag either within the facility or outside. Depending on the soluble fraction of the slag, as approved by concerned authority, slag can be used for utilization of metals, as road construction material *etc*.
- Dry slag and ash (residues from combustion processes, boiler dust, residues from treatment of combustion gases *etc*.) shall be placed in closed bags, containers, *etc*., to prevent diffused emissions

3.7.7 Quench/scrubber liquor management

- Appropriate treatment to the wastewaters from the cleaning of exhaust gases may be provided.
- The treated wastewater shall confirm to the disposal specific effluent standards.
- If forced evapouration is considered as a treatment option for quench/ scrubber liquor, the organic emissions, if any, shall be collected and returned to incinerator.
- Re-feeding of these liquors into the system may enhance the concentration levels therefore, adequate sink capacity shall be ensured.

3.7.8 Organisational structure

The Chief Executive Officer of the facility is responsible for all the activities at the incineration facility. He can establish an appropriate organisational structure and suitably allocate the responsibilities. This organisational structure shall be made available on-site to regulatory officials. A typical organisational structure for reference is shown in Figure-3-3.

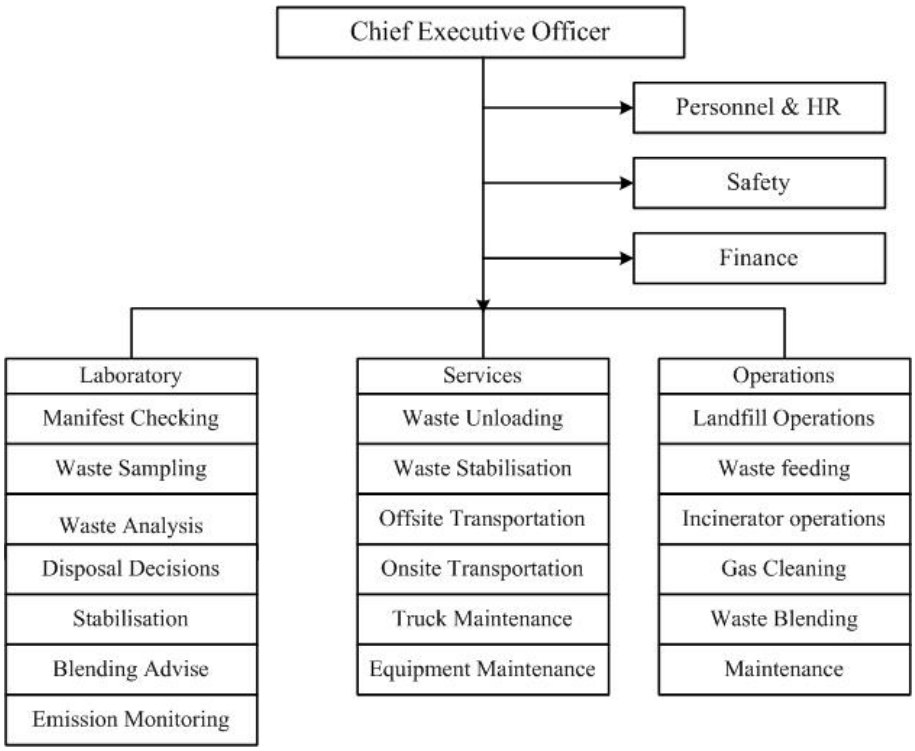


Figure 3-3: A Typical Organizational Structure

3.7.9 Other requirements

- Proper sign boards shall be placed at all concerned areas
- An emergency protocol shall be established and followed. All operating staff shall be trained, accordingly. Inter-locking systems and alarm systems shall be provided at all reasonably possible areas
- Abnormal operations and emergency situations should immediately be brought into the notice of the local regulatory Board/Committee
- While handling odourous wastes, care shall be taken (sealed containers, vapour balancing, nitrogen blanketing *etc*.) to avoid smell nuisance
- Efforts must be made to provide diffused emissions collection and control/routing to combustion chambers
- Medical camps/health check-ups of all the workmen of the incineration facility shall be conducted quarterly by registered medical practitioners
- Adequately qualified and trained staff shall be deputed for the operations, being sensitive in nature. No ad-hoc appointments be made or no unskilled personnel shall be engaged for operation of the incinerators. All the personnel involved in handling of hazardous waste and incineration shall be on pay roll
- The incinerator shall incorporate all safety measures to provide complete protection to the operator and the unit against all possible operational/machinery failures
- Dedicated back-up power facility shall be provided with arrangement to automatically start functioning immediately, in case of power failures

- The whole equipment, (not necessarily kiln) may be painted with two coats of heat resistant (aluminum) paint

3.8 Common hazardous waste disposal in secured landfill

Landfills have to be designed and constructed as a secured facility to contain the waste material and any leachate generated during the process. To meet these requirements, the base, slope, *etc*., of the landfill should be constructed as per the guidelines given by MoEF and CPCB (CPCB documents: Guidelines for Setting up of Operating Facility - Hazardous Waste Management, HAZWAMS/11/98-99, and Criteria for Hazardous Waste Landfills, HAZWAMS/17/2000-01) and conditions stipulated by SPCB in the authorization to operate TSDF. Prior to the placement of waste, an engineered capping over the surface shall be placed after completion of work daily so as to minimise the infiltration of rainfall.

The baseliner and capping shall be a composite system comprising compacted clay layer and synthetic membrane as may be approved by the SPCB. A leachate collection drainage system is to be constructed in the base of the landfill, immediately above the liner to ensure that the head of leachate will not exceed 300 mm during any season of the year.

The following objectives have to be considered in the design of an engineered landfill:

- Minimization of the possibility of contamination of surface and/or groundwater
- Control over gaseous emissions
- Prevention and control of any other possible adverse impact(s) on the environment
- Utilisation of excavated soil as cover material
- Harvest of upstream rainwater flowing into the fill
- Preferred use of clay with plasticity index between 10 and 30, which is well-graded having at least 30% passing through 75 micron. Clay fraction shall be kept at greater than 15% or more whereas gravel fraction shall be less than 50% of clay lining.
- Clay having clod size less than 50 mm may be compacted to optimum moisture content using a sheep foot roller.

Placement of wastes in a landfill would have to be done judiciously as it may cause impact(s) throughout the active life of the waste in the landfill. Therefore, waste disposal into the landfill may be restricted as per the concentration limits/criteria for acceptance of hazardous waste in secured landfill as presented at **Annexure V** besides the restrictions for waste placement into landfill stipulated by the SPCB.

Placing bulk, containerized, or non-containerized liquid hazardous wastes carrying free liquids (whether or not adsorbents have been added) in any landfill are prohibited by some SPCBs. Please refer 3.5 for hazardous waste transportation and 3.6 for hazardous waste storage.

3.8.1 Waste disposal at a TSDF

Waste received at landfill site can be handled in different ways *i.e.*,

- Direct disposal into landfill

- Treatment/stabilisation of wastes and then disposal into landfill
- Direct incineration/pre-treatment and incineration/pre-treatment, incineration and disposal of incineration ash in landfill
- Waste processed for fuel/industrial by-products for recycling
- Others

3.8.2 Pathway of wastes accepted for direct disposal

Wastes accepted for direct disposal shall conform to the concentration limit/criteria. Depending upon the characteristics of wastes and the reactivity of the wastes with each other as well as with the liner system, the wastes which could be allowed are identified. The wastes coming to the facility for the disposal must be de-watered up to the level of 60 - 70% solids, from the stability point of view; the following listed wastes should not be allowed to dispose off directly into the landfill facility unless an appropriate treatment is provided:

- Waste, which is a fluid, slurry or paste
- Waste, which is delivered under pressure or under vacuum
- Waste, which has an obnoxious odour
- Waste, which reacts with moisture to produce considerable amount of heat or gases
- Waste, which is highly inflammable (flash point < 55^0C)
- Waste, which contains shock sensitive substances
- Waste, which contains very strong oxidizing agents
- Waste, which contains volatile substances of significant toxicity
- Waste, which falls below a pH value of 4 and exceeds the value of 13, if evaluated in distilled water in the ratio of 1: 10
- Waste, which has a calorific value of more than 3200 Kcal/kg. These wastes have to go for authorised energy recovery or for incineration

In addition to above, the criteria for disposal of hazardous waste into secured landfill facility as recommended in the CPCB guidelines, is given as **Annexure V.**

3.8.2.1 Comprehensive analysis for waste acceptance for direct disposal

Generators of hazardous wastes shall identify and provide analysis report including CRIT criteria of the waste consignments. The generator should provide the TSDF with information regarding:

- Throughput and process that generates the waste with quantities
- Physical and chemical description of waste as per parameters given in **Annexure VI**
- Analytical procedures and interpretation of results used to characterise the waste or process knowledge documentation
- Hazardous waste codes are placed as per Schedule 2 of the Hazardous Material (Management, Handling and Trans-boundary Movement) Rules, 2008, as amended.

The operator at TSDF, so as to ascertain direct disposal into a landfill, shall perform the following fingerprinting analysis:

- Free liquid content (Paint Filter Liquids Test and Liquid Release Test)
- pH
- Calorific value
- Flash point
- Reactive sulfide
- Reactive cyanide
- Chemical compatibility
- Any other specific parameter, which may be decided on the merit of each case.

The waste shall be placed at the toe of the working face and spread evenly by mechanical equipment in layers of approximately 0.5 metre thickness. Spreading and compaction is an important part in the operation to achieve maximum waste density within the landfill. After everyday's operation, soil cover of at least 100 mm thickness shall be placed over the waste to complete the layer. The placement and compaction is continued to uniformly raise the level of the cell. At the point of reaching the final design height, the final cover is placed over that section, as the work proceeds.

3.8.3 Pathway for hazardous wastes not accepted for direct disposal

Hazardous waste that cannot be accepted for direct disposal into landfill has to be either treated/stabilized before disposal into a landfill, or has to be incinerated, or otherwise managed as per the conditions stipulated by the SPCB.

3.8.3.1 Waste treatment/stabilization

Waste treatment/stabilization is a process designed to convert hazardous wastes in the form of non-aqueous liquids, semi-solids or reactive solids into less leachable solids that can then be deposited directly into the secured landfill in compliance with the concentration limits/criteria stipulated by SPCB. The treatment/stabilisation operations will be carried out for all wastes identified for the purpose, so as to minimise their contaminant leaching potential. This will change the nature of these wastes to a less hazardous category. Treatment/stabilisation involves immobilisation of leachable materials by fixation as non-reactive solids, reduction of volume, reducing contaminant level of organic/inorganic components. Selection of technology would depend on the nature of waste, physical properties, options for technology applications, cost, *etc*. Suggested flow chart for screening the wastes going to treatment/stabilization for developing treatment plant is given in the CPCB document Hazwams/17/2000-01. The treated wastes before disposal in the landfill shall be assessed for compatibility with other wastes as well as with liner system.

The term treatment/stabilization intends to cover a number of mechanisms including:

- Immobilisation/chemical fixation - the chemical binding of contaminants within a cementing structure to reduce the mobility or leachability of the waste constituents
- Encapsulation - the occlusion or entrapment of contaminant particles within a solid matrix
- Solidification - the conversion of slurries that do not readily de-water into solids by addition of solidification and adsorption agents.

Typical reagents that would be used for the stabilization process may include lime, fly-ash, bentonite (clay), cement, saw dust, *etc*., in combination with sodium silicate solution, if required to create additional binding properties of the wastes.

General operations for waste treatment/stabilisation shall include:

- Receiving waste for its storage in appropriate/designated place
- Adding of reagents as per the pre-estimated quantities
- Mixing and curing
- Thermal treatment to remove moisture, organics, *etc*.
- Analysis of the stabilized sample (TCLP)
- Transfer of stabilised material to landfill

The above process operations generally have the potential to create gaseous and particulate emissions into the air. This can be controlled by various management practices as stipulated by SPCB including masking (and would have to be properly managed).

Also ambient odour near facility coming from industrial estates has to be neutralised in the following manner by the operator:

Placing bulk, containerised, or non-containerised liquid hazardous wastes containing free liquids (whether or not absorbents have been added, liquids that have been absorbed in biodegradable materials and liquids that have been stabilized by sorbents but will release liquids when compressed under normal pressure that might occur during and after land-filling) in any landfill is prohibited regardless of the length of time, presence of liners or leachate collection system.

Hence, TSDF shall use the paint filter liquid test (PFLT) to comply with this requirement. This test determines whether the waste can be accepted to landfill subject to its passing the PFLT. The waste is not subject to a ban if it passes the PFLT. However, it if does not, it must be treated before it can be placed in the landfill.

Waste treatment/stabilization would have to be performed on all wastes that find their final disposal into a landfill but do not meet the landfill disposal criteria. Typical analysis protocol for waste treatment/stabilization would be as indicated in **Annexure VI** (comprehensive analysis). Finger printing analysis for the same would be as indicated in **Annexure III**.

3.8.3.2 Identification parameters required for waste treatment/stabilization

Waste treatment/stabilisation parameters shall include both physical and chemical tests. Physical tests shall be performed to characterise wastes before and after stabilisation/solidification/treatment. The chemical tests shall primarily be the leaching tests, which will be conducted to evaluate the performance of specific treatment processes. The analysis shall be in line with the parameters as indicated in **Annexure VI.**

3.8.3.3 Analysis protocol to confirm treatment/stabilisation of waste

The TSDF operator has to conduct and document the results of the following physical tests applicable to incoming waste as well as on treated/stabilized hazardous waste.

The physical tests shall be classified as provided in the following table.

Table 3-12: Categories of Physical Tests

TEST	PURPOSE
Index Property Tests	
Particle size analysis (PSA)	To determine the particle size distribution of a material
Moisture Content	
Paint filter liquid test (PFLT)	To determine the presence of free liquids in a representative sample of bulk or non-containerized waste.
Density Testing	
Bulk density	To determine the in-place density
Compaction testing	
Moisture density relations	To determine the relation between moisture content and density of the waste
Permeability Testing	
Falling head permeability/ constant head (FHP/CH)	To measure the rate at which water will pass through a stabilized waste
Strength testing	
Unconfined compressive strength (UCS)	To evaluate how cohesive the stabilized materials behave under mechanical stress
Flexural strength (FS)	To evaluate the stabilized wastes ability to withstand loads over a large area
Cone index (CI)	To evaluate a stabilized wastes stability and bearing capacity
Durability Testing	
Wet-dry durability (WDD)	To determine how the stabilized waste behaves or degrades after repeated wet-dry cycles.

Chemical tests

Leaching tests shall be used in evaluating the performance of treatment/ stabilisation/solidification processes for wastes as per the recommended TCLP procedure for the identified chemical constituents in the stabilised waste. The waste stabilised should meet the BDAT standards of USEPA before their disposal to the landfill till the BDAT standards are notified/stipulated under the Environment (Protection) Act, 1986, and rules made there under.

3.8.4 Design, construction and operation of secured landfill

A secured landfill is designed and constructed as a secure facility to contain hazardous waste material and any leachate, which is formed by the entrapped moisture or by infiltration of rainfall. To meet these requirements the base of the landfill has to be designed as an engineered liner constructed prior to the placement of waste and also an engineered capping over the surface after completion of filling to minimise the infiltration of rainfall. Typically various barriers/liners are used to achieve the above objectives and include clay and synthetic liners. Requisite characteristics of the same are indicated in the following sub-sections here below:

3.8.4.1 Clay liner

Clay consists of varying proportions of hydrated aluminum silicates (*e.g.,* Kaolinite, bentonite, illite and montmorillonite) which, when properly compacted, from a soil mass with a very low hydraulic conductivity. The clay material for use as the liner at a landfill has to be analysed and permeability testing is to be carried out to ascertain its low permeability. Design permeability of the clay liner has been fixed at 10^{-09} metres per second (m/s). The composite layer after attaining the required thickness should be checked for its composite permeability. Further, clay shall be kept moist to ensure that it does not dry up and cause cracks to the lining system. To ensure this, clay must be kept at +4% wet of optimum moisture content.

3.8.4.2 Synthetic liners

Various synthetic flexible membrane liners have been considered for use as liner. Both polyvinyl chloride (PVC) and high-density polyethylene (HDPE) liners are generally suitable for the landfill. Tensile strength is a fundamental design consideration in order to assess the ability of the liner to resist uniaxial and biaxial strains, which occurs in the landfill. Another stress strain consideration is the coefficient of thermal expansion. Considering various membrane properties HDPE is the most suitable liner for Indian environmental conditions. Following are the advantages:

- Adequate strength to withstand mechanical strength during construction, placement and operation
- Acceptable weathering performance
- Superior physical properties under chemical and environmental exposure to wastes
- Capability to withstand the seaming process

The hydraulic conductivity of HDPE is of the order of 0.5×10^{-16} m/s, which is effectively impermeable. Construction of the seam welding process has to be subjected to strict QA/QC measures to ensure the integrity of the liner.

Adoption of single liner system or double liner system

Adoption of single liner system or double liner system depends upon the rainfall, type of sub-soil and the water table beneath the base of the landfill. In a place where rainfall is high and/or sub-soil is highly permeable (*e.g.,* gravel, sand, silty sand) and/or the water table is within 2.0 m to 6.0 m, the guidelines suggest to adopt double composite liner. The specifications of the single composite liner, double composite liner system and cover system are given below:

(i) Specifications of the single composite liner system:

- a leachate collection layer of thickness 30 centimetre (cm) or more and coefficient of permeability in excess of 10^{-2} cm/sec (10^{-4} m/sec).
- A single composite liner comprising of
  - A HDPE geomembrane of thickness 1.5 millimetre (mm) or more and
  - A compacted clay (or compacted amended soil) layer of thickness 150 cm or more having a coefficient of permeability of 10^{-7} cm/sec (10^{-9} m/sec) or less. At locations where availability of clay is limited, amended soil will be constituted by

mixing bentonite or any other suitable clay to locally available soil to achieve the desired permeability.

(ii) Specifications of double composite liner system:

- primary leachate collection layer of thickness 30 cm or more and co-efficient of permeability in excess of 10^{-2} cm/sec (10^{-4} m/sec).
- A primary composite liner comprising
  - A HDPE geomembrane of thickness 1.5 mm or more
  - A compacted clay (or compacted amended soil) layer of thickness 45 cm or more having a coefficient of permeability of 10^{-7} cm/sec (10^{-9} m/sec) or less
- a secondary leachate collection layer (also called leak detection layer) of thickness 30 cm or more and co-efficient of permeability in excess of 10^{-3} cm/sec (10^{-5} m/sec)
- a secondary composite liner comprising
  - A HDPE geomembrane of thickness 1.5 mm or more
  - A compacted clay layer of thickness 45 cm or more having a co-efficient of permeability of 10^{-7} cm/sec (10^{-9} m/sec) or less

(iii) Specifications of cover system:

The minimum specifications of the cover system given below are from top surface downwards to the waste:

- Surface layer of local top solid of thickness not less than 60 cm, which should support self-sustaining vegetation
- a drainage layer of thickness 30 cm or more having a coefficient of permeability in excess of 10^{-2} cm/sec (10^{-4} m/sec)
- single composite barrier comprising
  - HDPE geomembrane of thickness 1.5 mm or more and
  - compacted clay (or compacted amended soil) layer of thickness 60 cm or more having a coefficient of permeability of 10^{-7} cm/sec (10^{-9} m/sec) or less. At locations where availability of clay is limited, amended soil will be constituted by mixing bentonite or any other suitable clay to locally available soil to achieve the desired permeability.
- A regulatory layer (optional) of thickness 30 cm having coefficient of permeability greater than 10^{-2} cm/sec (10^{-4} m/sec). Such a layer shall be provided whenever there is requirement of (i) gas collection or (ii) transition filter between waste and soil

3.8.4.3 Leachate collection system

The leachate collection system comprises a network of drainage pipes, which is located directly over the liner system and is covered with a sand/gravel drainage layer. Leachate shall be collected by a network of lateral and header pipes embedded in a drainage layer, all of which shall eventually drain into a leachate collection sump. The collected leachate shall be transferred to a leachate treatment system. Leachate, thus collected shall be transferred to the effluent treatment plant. The leachate collection system in an engineered landfill takes the form of an under-drain beneath the waste material. It is required to ensure that there is no more than a limited head of pressure above the base

liner to cause leakage of liquid from the base of the landfill. The maximum pressure head in the proposed landfill shall be limited to 300 mm. Drainage is affected by a highly permeable layer of about 300 mm thickness made of graded sand/gravel. Within this layer a network of HDPE pipes are placed to collect leachate and conduct it quickly to the collection sump for removal from landfill. The pipes are typically perforated only over the upper half to allow the leachate to enter the pipe and thereafter to be contained within the pipe network system. The layout of pipe network generally includes sufficient redundancy to ensure that if a blockage occurs somewhere in the network the leachate simply backs-up a little then flows into the system a little further up-gradient. Two layers of the leachate collection system shall be provided one over the other. Slotting area of the pipe shall be done only on the top 120^0 portion of the pipe and to an extent of 100 square centimetre (cm^2) per running meter of the pipe.

Key design features of a typical leachate collection system comprise the following:

- A network of semi perforated HDPE pipes laid out directly over the primary and secondary liners and graded towards the collection sump at no less that of 2% slope, with a slotting area of 100 cm^2 per running meter of the pipe.
- A drainage layer 300 mm thick of graded sand/gravel placed over the entire base of the landfill, covering the pipe network (16-32 mm grade 4 material).
- A geo-textile placed over the primary liner serving the purpose of filter/barrier between the waste and the drainage media.

The pipe shall have sufficient strength to withstand the load imposed by the overlying waste and the earth moving activities associated with the placement and the compaction of the waste (Min 10 Kg/cm^2). The main pipe (headers) feeding leachate to the sump shall have the capability to be cleaned out in case of clogging. However, the design shall include sufficient redundancy of pipe work to ensure alternative drainage paths are available in the event of localised clogging of any part of the system. Leachate treatment plant design is discussed in the subsequent section.

Quantification of leachate generation from landfill:

$I = P – P (CR/O) - AET +/- S$

Where,

- I - Rate of Infiltration
- P - Precipitation
- CR/O- Coefficient of Runoff
- AET - Actual Evapo-transpiration
- S - Soil Moisture Content Retention Capacity

Empirically,

For Capped portion of Landfill: $I = 0.01P$

For Uncapped Portion of landfill: $I = 0.7 P$

Landfill with temporary cover: $I = 0.3 P$

Landfill design specifications

The following are the design specifications which may be considered before designing a landfill:

- appropriate sizing of the landfill and related facilities based on the projected waste quantities
- visual barrier and enhanced environmental acceptability of the facilities, and contamination attenuation zone as required for a natural attenuation site
- soil and material balance towards daily, intermediate and final cover of the fill, and other operation and maintenance (O&M) related issues
- selection of appropriate earth moving equipment, compactors, and waste transportation trucks, *etc*.
- grade plan and phased development plan of the landfill (cell by cell) which identifies the earth works and other works related to daily operations, interim cover over the completed cells, *etc*.
- design of stormwater (drainage) management systems to divert rainwater away from the wastes and collect, treat and discharge into natural systems
- leachate collection and management plans, leachate recirculation.
- design of a liner system depending on the type of engineering systems required at the site and the anticipated change in waste characteristics and waste quantities.
- design waste placement and cover systems to ensure stability and safety
- selecting construction techniques and materials
- designing & monitoring wells and establishing surface water and groundwater monitoring programs
- design of a monitoring plan for monitoring the post-project quality of air, soil and water
- design of receiving area, inspection area and temporary storage area *etc*.
- designing site access roads and transportation systems
- provision of appropriate analytical methods and providing specifications for monitoring instruments
- to minimise the possibility of contaminating surface and groundwater
- to have control over gaseous emissions
- to maximise resource productivity

Slopes in the cells and collection pipes:

The slopes of base of cells and leachate collection pipes shall meet the following basic requirements:

- The base of each cell shall slope towards the leachate collection sump
- The lateral collection pipes shall slope towards the main collection pipe and the main pipe shall slope towards the sump

- The slope of the excavations which are not sealed with the landfill liner shall be away from the waste. Separate sumps for collecting and removing uncontaminated storm water shall be provided

Leachate treatment and disposal

The TSDF shall use the spray evaporative drier only to vapourise the leachate from the landfill activity and scrubber blow down from incinerator. Besides the leachate quantity, quality and the variations associated properties, it is also essential to identify components of the leachate that are to be treated or removed such as:

- Removal of high concentrations of degradable organic compounds
- Removal of high concentrations of non-degradable organic compounds
- Removal of varying concentrations of specific hazardous organics
- Removal of varying concentrations of specific hazardous inorganic
- Removal of ammonia
- Denitrification of nitrates/nitrites
- Removal of odours including sulphides
- Removal of suspended solids and
- Disinfection (if required)

TSDF operations shall comply with the consent conditions stipulated by the SPCB/PCC under the provisions of the Water (Prevention and Control of Pollution) Act, 1974, with reference to collection, treatment and disposal of leachate originating from the secured landfill (Table 3-13).

Monitoring of gaseous emissions and ground water

Gaseous emissions from vents of capped cells shall be monitored for total VOCs, H_2S and other concerned. In addition to it, regular groundwater monitoring around the capped secured landfills should also be taken up by the TSDF operators.

3.8.4.4 Method of filling

After preparation of cell to the design requirements, filling of the material will be under taken in accordance with the procedures described below. Waste shall be dumped at the toe of working face and spread evenly by mechanical plant in approximately 0.5m layers. Spreading and compaction is an important part of operation of the landfill. The objective here is to achieve maximum waste density within the fill. After everyday's operation it is advisable to place soil cover of at least 100 mm thickness over the waste. The placement and compaction is continued to uniformly raise the level of the cell. At the point of reaching the final design height, the final cover is placed over that section, as the work proceeds.

Spreading & compaction

The waste shall be spread in uniform layers and compacted as soon as possible. The previous layer shall not be disturbed and should be kept in good condition during the spreading of waste. During the filling operation, the surface of each layer shall be kept parallel to the surface of the sub-grade. Except at places necessary, the outer 1m of the fill shall be raised so as to prevent uncontrolled flow of water during the batter. Prior to cessation of work each day, the top of the fill shall be shaped and compacted to minimise

damage resulting from wet weather. Compaction shall be done using mechanical equipment. Mechanical compaction is to be used on the waste in horizontal layers. The equipment makes several passes over the waste until the desired density is achieved.

Daily cover

Covering of the waste shall be done at the end of each day's operation using mechanical equipment. Soil cover material shall be stock piled near the operating cell wherever possible. Soil that has been previously excavated from the cell will be used as cover material thereby reducing the amount of soil which must be imported to the site. The thickness of daily cover shall be arrived at, considering the precipitation, percolation, soil available and cost factors but shall be a minimum of 100 mm.

Dust suppression

Proper care shall be taken to avoid dust being liberated into the atmosphere during the operation of the landfill. Material used for the formation of temporary roads within the facility shall be selected so that dust generated during the movement of heavy vehicles is minimised. Wherever possible, it is advisable to sprinkle water to suppress the dust.

3.8.4.5 Closure and post-closure requirements

- The occupier/operator of all hazardous waste management facilities to store, treat and disposal of hazardous wastes shall apply in writing, at least one year in advance, seeking approval for the closure of the facility. The application must be accompanied with details of the closure plan, which should be approved by the SPCB/PCC.
- The closure plan should indicate all steps to perform partial and/or final closure of the facility. The minimum action shall include:
  - description of how each hazardous waste management unit at the facility will be closed
  - the closure schedule
  - detailed description of the steps needed to remove or decontaminate all hazardous waste residues and contaminated containment system components, equipment, structures and soils during the closure including procedures for clearing equipment and removing contaminated soils.
  - details of post-closure care including monitoring of the facility, groundwater quality, *etc*.,
  - chronological list of different types of wastes disposed off in low facility site.
- The capping system should comprise of:
  - 150-mm soil cover
  - 150-mm Gas collection layer
  - A clay cap – 600mm thick with permeability $<10^{-9}$m/s
  - 1.5 mm HDPE with permeability $<10^{-14}$ m/s
  - A geo Textile
  - 200-mm Drainage media
  - 300-mm top soil
  - 300-mm vegetative soil
  - Vegetation with well-prepared skirting storm water drainage all around the landfill facility with retention pond.

Location-specific requirements

SPCB/PCC shall specify site-specific requirements, if any, in line with the local regulations and site conditions under the 'Consent' granted.

3.9 Summary of Applicable National Regulations

3.9.1 General description of major statutes

A compilation of legal instruments, which are applicable for TSDFs is provided as **Annexure VII**.

Rules/Standards and guidelines which are applicable for common hazardous waste treatment, storage and disposal facilities & common hazardous waste incinerators are given as follows:

Rules/standards applicable for TSDF/HW incinerators

- Environmental Impact Assessment Notification S.O.1533 (E) dated 14th September 2006
- Hazardous Waste (Management, Handling & Transboundary Movement) Rules 2008 notified on 24th September 2008
- Gaseous Emission Norms for Common Hazardous Waste Incinerators notified as Environment (Protection) Fifth Amendment Rules, 2008 dated 26 June 2008
- Norms for DG set, The Noise Pollution (Regulation and Control) Rules, 2000, Effluent Discharge norms, surface/ground water norms and Ambient Air Quality norms
- General standards for discharge of environmental pollutants Part – A: Effluents notified vide G.S.R. 422 (E) dated 19th May 1993 and published in the Gazette No. 174, dated 19th May 1993 under the Environment (Protection) Act, 1986 and rules made there under, shall also be applicable for disposal of leachate into sewage treatment plant, common effluent treatment plant, inland surface water bodies or coastal areas

Guidelines applicable for TSDFs

- Management of Hazardous Waste - Pre-Requisites for Issuing Authorization by SPCB/PCC (Hazardous Waste Management Series: HAZWAMS/31/2005-2006)
- Guidelines for Conducting Environmental Impact Assessment: Site Selection for Common Hazardous Waste Management Facility (Hazardous Waste Management Series: HAZWAMS/25/2003-4)
- Management of Hazardous Waste - Guidelines for Transportation of Hazardous waste (Hazardous Waste Management Series: HAZWAMS/33/2005-2006)
- Manual on Sampling, Analysis and Characterisation of Hazardous Wastes (Laboratory Analytical Technique Series: LATS/16/2002-2003)
- Criteria for Hazardous Waste Landfills (Hazardous Waste Management Series: HAZWAMS/17/2000-01)

- Manual for Design, Construction and Quality Control of Liners and Covers for Hazardous Waste Landfills
- Guidelines for Common Hazardous Waste Incineration (Hazardous Waste Management Series: HAZWAMS/30/2005-06)
- Management of Hazardous Waste - Guidelines for storage of incinerable hazardous waste by the Operators of Common Hazardous Waste Treatment, Storage and Disposal Facilities and Captive Hazardous Waste Incinerators" (Hazardous Waste Management Series: HAZWAMS/2008-2009) (*i.e*. under publication)
- Management of Hazardous Waste - Guidelines for Proper Functioning and Upkeep of Disposal Sites (Hazardous Waste Management Series: HAZWAMS/32/2005-2006)

3.9.2 General standards for discharge of environmental pollutants

General standards are applicable wherever industry-specific standards are not mentioned or notified. General standards for discharge of environmental pollutants as per CPCB are given in **Annexure VIII**.

3.9.3 Industry-specific standards

Leachate disposal standards

Proposed leachate disposal standards in addition to the general standards for discharge of environmental pollutants are shown in Table 3-13.

Table 3-13: Leachate Disposal Standards

S. No.	Parameter	Standards (in mg/l)			
		Inland Surface	STP	CETP	Marine Coastal Areas
1.	Absorbable Organic Halogens (AOX)	0.50	-	-	0.50
2.	Poly Aromatic Hydrocarbons (PAH) each	0.059	-	-	0.059
3.	Benzene	0.14	-	-	0.14
4.	Toluene	0.08	-	-	0.08
5.	Xylene (Sum of o,m,p-xylene)	0.32	-	-	0.32

Notes:

1. In addition to the above, General Standards for discharge of environmental pollutants Part-A: Effluents notified, vide G.S. R. 422 (E), dated 19.5.1993 and published in the Gazette No. 174, dated 19.5.1993 under the Environment (Protection) Act, 1986, and rules made there under, shall also be applicable for disposal of leachate into sewage treatment plant, common effluent treatment plant, Inland surface water bodies or coastal areas.

2. For each Common Effluent Treatment Plant (CETP) and its constituent units, the SPCB/PCC shall prescribe standards as per the local needs and conditions; these can be more stringent than

those prescribed above. However, in case of clusters of units, the SPCB/PCC may prescribe suitable limits.

3. The Bioassay test shall be substituted by 'Fish Toxicity' test, and a dilution factor of 2 (two) may be considered.

Flue gas emissions standards for common hazardous waste incinerators

Treated flue gas emissions discharge through stack to atmosphere shall always be less than or equal to the parameter specific standards. These standards for common hazardous waste incinerator as per Environment (Protection) Act, 1986 are given in the following Table 3-14.

Table 3-14: Air Emission Standards for Common Hazardous Waste Incinerator

Industry	Parameter	Standard	
Common Hazardous Waste Incinerator	**A. Emission**		
		Limiting Concentration in mg/Nm^3	Sampling Duration in (minutes) unless stated
	Particulate matter	50	30
	HCl	50	30
	SO_2	200	30
	CO	100	30
		50	24 hours
	Total Organic Carbon	20	30
	HF	4	30
	NOx (NO and NO_2 expressed as NO_2)	400	30
	Total dioxins and furans	0.1 ngTEQ/Nm^3	8 hours
	Cd +Th + their compounds	0.05	2 hours
	Hg and its compounds	0.05	2 hours
	Sb + As + Pb + Co + Cr + Cu + Mn + Ni +V + their compounds	0.50	2 hours

Notes:

i. All monitored values shall be corrected to 11% oxygen on dry basis.

ii. The CO_2 concentration in tail gas shall not be less than 7 %.

iii. In case, halogenated organic waste is less than 1 % by weight in input waste, all the facilities in twin chamber incinerators shall be designed to achieve a minimum temperature of 950^{o}C in secondary combustion chamber and with a gas residence time in secondary combustion not less than two seconds.

iv. In case halogenated organic waste is more than 1 % by weight in input waste, waste shall be incinerated only in twin chamber incinerators and all the facilities shall be designed to achieve a minimum temperature of 1100 ^{o}C in secondary combustion chamber not less than two seconds.

v. Incineration plants shall be operated (combustion chambers) with such temperature, retention time and turbulence, as to achieve Total Organic Carbon (TOC) content in the slag and bottom ashes less than 3 %, or their loss on ignition is less than 5 % of the dry weight.

Operating Standards for an Incinerator

- All the facilities shall be designed to achieve a minimum temperature of 1100°C in secondary combustion chamber and with a gas residence time in secondary combustion chamber not less than 2 (two) seconds.
- The incineration facilities after initial operation of minimum one year, as per the guidelines and standards, can submit a proposal for relaxation in temperature and retention time requirement if it can be demonstrated that the flue gas standards and operation standards can be complied with at lower temperatures and residence times. The SPCB/PCC, upon successful demonstration of compliance with flue gas standards by the facility, can recommend the proposal made by the incineration facility for relaxation in temperature and residence time, but in any case not less than 950°C and 1.5 seconds, for the consideration and approval of the Central Board.
- Incineration plants shall be operated (combustion chambers) with such temperature, retention time and turbulence, so as to achieve Total Organic Carbon (TOC) content in the slag and bottom ashes less than 3%, or their loss on ignition is less than 5% of the dry weight of the material.
- Guidelines published by the Central Board from time to time for common incineration facilities shall be referred for implementation.
- All the project proposals submitted for establishment of the common incineration facilities shall be examined and cleared by the Task Force constituted by the Central Board.
- Notification of compliance: The operator of the incinerator shall undertake comprehensive performance test. Within 90 days of completion of comprehensive performance test, the operator shall issue a notification of compliance documenting compliance or non-compliance, as the case may be, for public information / notice.

4. OPERATIONAL ASPECTS OF EIA

Prior environmental clearance process has been revised in the Notification issued on 14th September, 2006, into following four major stages *i.e.*, screening, scoping, public consultation and appraisal. Each stage has certain procedures to be followed. This section deals with all the procedural and technical guidance, for conducting objective-oriented EIA studies, their review and decision-making. Besides, the Notification also classifies projects into Category A, which requires prior environmental clearance from MoEF and Category B from SEIAA/UTEIAA.

Consistency with other requirements

- Clearance from other regulatory bodies is not a pre-requisite for obtaining the prior environmental clearance and all such clearances will be treated as parallel statutory requirements.
- Consent for Establishment (CFE) and Prior environmental clearance are two different legal requirements; a project proponent should acquire. Therefore, these two activities can be initiated and proceeded with simultaneously.
- If a project falls within the purview of CRZ and EIA Notifications, then the project proponent is required to take separate clearances from the concerned Authorities.
- Rehabilitation and Resettlement (R&R) issues need not be dealt under the EIA Notification as other statutory bodies deal with these issues. However, socio-economic studies may be considered while taking environmental decisions.

4.1 Coverage of TSDF under the Purview of Notification

All TSDFs including expansion and modernization require prior environmental clearance. Based on pollution potential, these projects are classified into Category A and Category B *i.e.*

- Category A: all integrated facilities having incineration facility and landfill facility; or incineration facility alone
- Category B: facilities having only landfill facility

Category B project will be treated as Category A project when any of the General Conditions are found applicable. Details of General Conditions are discussed in subsequent sections.

The sequence of steps in the process of prior environmental clearance for Category A projects and the Category B projects are shown in Figure 4.1 and Figure 4.2 respectively. The timelines indicated against each stage are the maximum permissible time lines set in the Notification for said task. In case the said task is not cleared/objected by the concerned Authority, within the specified time, said task is deemed to be cleared, in accordance to the proposal submitted by the proponent. Each stage in the process of prior environmental clearance for the TSDFs is discussed in subsequent sections.

In case of expansion or modernization of the developmental activity:

- Any developmental activity, which was issued EIA clearance (existing facility), when undergoes expansion or modernisation (change in process or technology) with increase in handling capacity is required to submit new application for EIA clearance.
- Any TSDF, after expansion due to increase in the number of incinerators used at the facility, falls under the purview of Category A, which would require clearance from the MoEF.
- In case of integrated TSDF, [with both secured landfill and incineration facilities] if the expansion is intended for the secured landfill facility, but not for the incineration facility, then prior environmental clearance for such expansion shall be sought from the MoEF, being an already 'Category A' project.

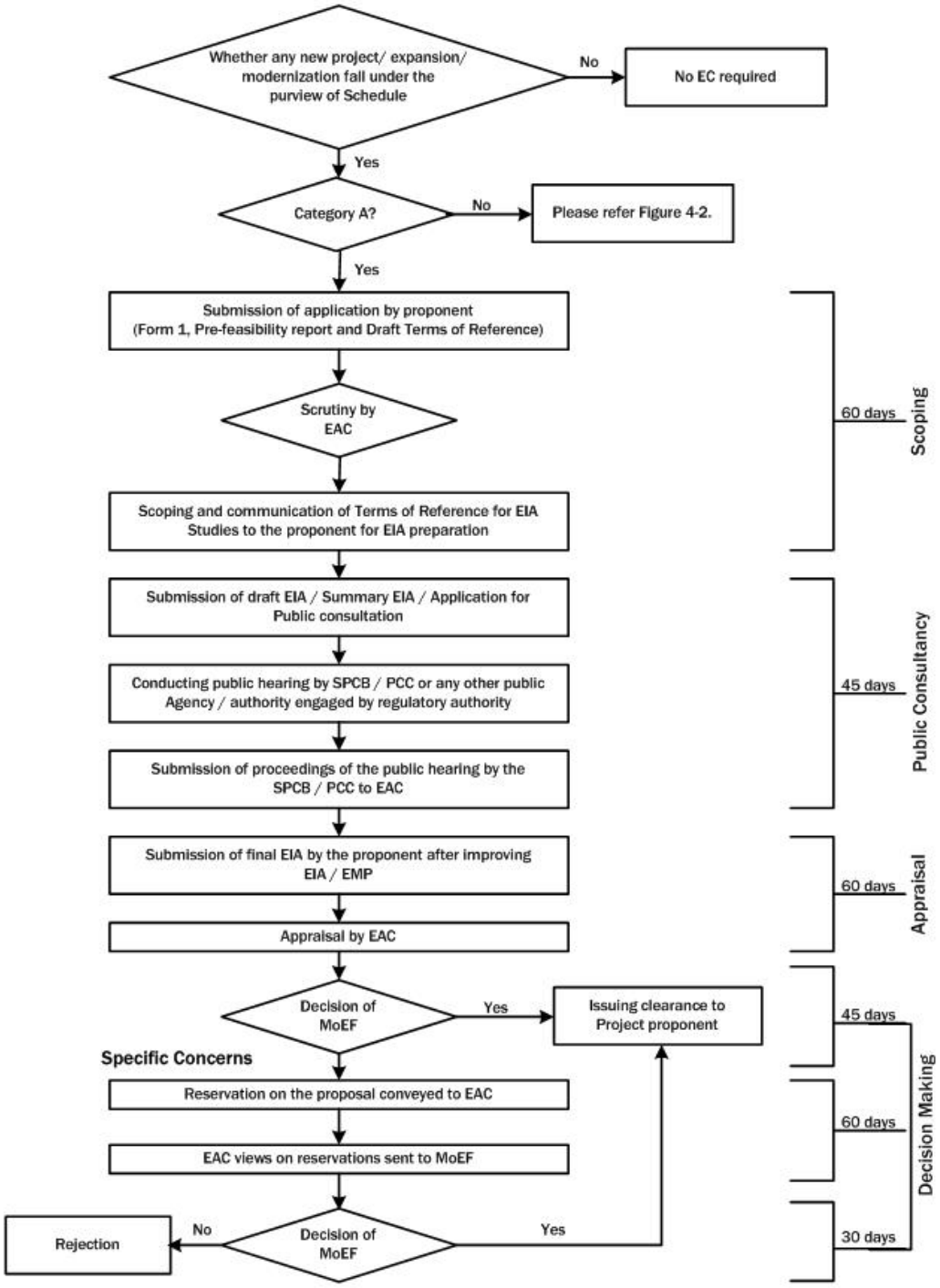


Figure 4-1: Prior Environmental Clearance Process for Activities Falling Under Category A

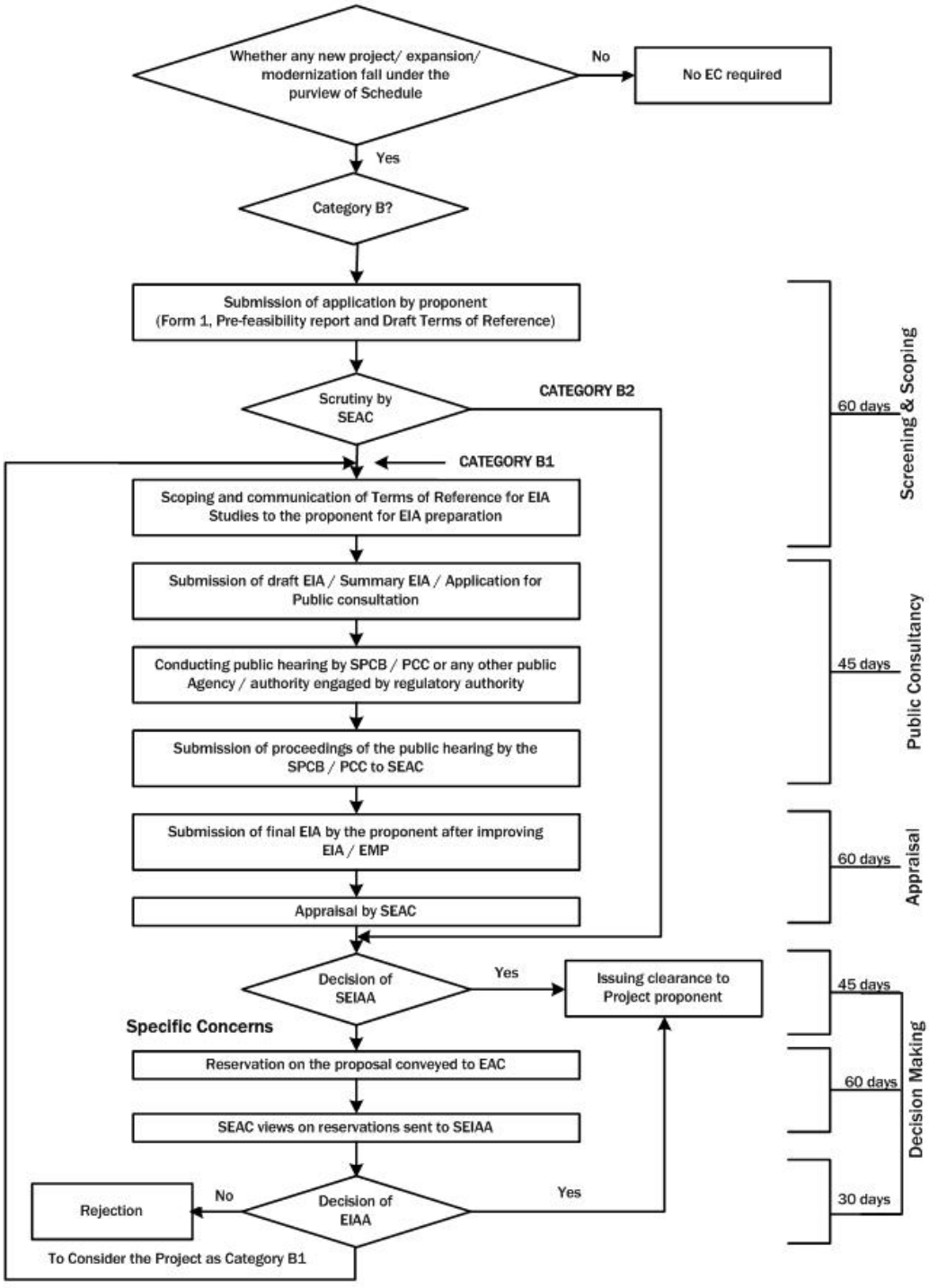


Figure 4-2: Prior Environmental Clearance Process for Activities Falling Under Category B

4.2 Screening

Screening of the project shall be performed at the initial stage of the project development so that proponents are aware of their obligations before deciding on the budget, project design and execution plan.

This stage is applicable only for Category 'B' developmental activity *i.e.* if general conditions are applicable for a Category B project, then it will be treated as Category A project. Besides, screening also refers to the classification of Category B projects into either Category B1 or Category B2. Category B1 projects require to follow all stages applicable for a Category A project, but are processed at the SEIAA/UTEIAA. Category B2 projects, on the other hand, do not require either EIA or public consultation.

As per the Notification, classification of the Category B projects falls under the purview of the SEAC. This manual provides certain guidelines to the stakeholders to understand the criteria for classification of a project into Category B1 and Category B2.

4.2.1 Applicable conditions for Category B projects

General conditions:

- Any TSDF (only with secured land fill(s), usually under Category B) will be treated as Category A, if located in whole or in part within 10 km from the boundary of:
  - Protected areas notified under the Wild Life (Protection) Act, 1972,
  - Critically polluted areas as notified by the CPCB from time to time
  - Eco-sensitive areas notified under section 3 of the E(P) Act, 1986, such as Mahabaleshwar Panchgani, Matheran, Panchmarhi, Dahanu, Doon valley and
  - Inter-State boundaries and international boundaries - provided that the requirement regarding distance of 10 km of the inter-state boundaries can be reduced or completely done away with by an agreement between the respective States/UTs sharing the common boundary.
- If any of the conditions listed in above general condition applies, then a Category B project will be treated as Category A
- The SEIAA shall base its decision on the recommendations of a State/UT level EAC for the purpose of environmental clearance.
- In absence of a duly constituted SEIAA or SEAC, a Category B project shall be appraised at the Central level *i.e.* at the MoEF.
- The EAC at the State/UT level shall screen the projects or activities falling in Category B. SEAC shall meet at least once every month
- If any Category B TSDF, after proposed expansion (addition of incineration facility or modification of incineration facilities), falls under the purview of Category A then clearance is required from the Central Government.

4.2.2 Criteria for classification of Category B1 and B2 projects

The classification of Category B projects or activities into B1 or B2 (except the project or activities listed in item 8(b) in the schedule to the EIA Notification, 2006) will be determined based on whether or not the project or activity requires further environmental studies for preparation of an EIA for its appraisal prior to the grant of environmental

clearance. The necessity of which will be decided, depending upon the nature and location specificity of the project, by SEAC after scrutiny of the applications seeking environmental clearance for Category B projects or activities.

The projects requiring an EIA report shall be included in Category B1 and remaining projects will fall under Category B2 and will not require an EIA report and public consultation.

Situations which could be considered for Category B2 are:

- Expansion/modernization of existing secured landfill module for additional 10% capacity, for one time may be considered as Category B2, if the EAC/SEAC is satisfied by the methodologies/technologies proposed by the project proponent and control of the significant impacts on the surrounding environment.
- If the project proponent proposes any additional flue gas treatment technologies with higher removal efficiencies, better combustion efficiency equipment, or better leachate treatment facilities or better stabilisation facilities for waste or other pollution control, and if the proposition does not cause any additional treatment, storage, capacities and disposal, emission of pollutants and/or does not increase pollution loads and includes scope for expansion of safety facilities and utilities, the SEAC upon satisfactory assessment, may consider such modernisation/expansion as category B2.

4.2.3 Application for prior environmental clearance

- The project proponent, after identifying the site and carrying out a pre-feasibility study, is required to apply for the prior environmental clearance using Form 1 given in **Annexure IX**. The proponent has to submit the filled in Form 1 along with the pre-feasibility report and draft ToR for EIA studies to the concerned Authority *i.e.,* MoEF, Government of India for Category A projects and the SEIAA in case of Category B projects. Please refer subsequent sections for the information on how to fill the Form 1, contents of pre-feasibility report and sector-specific ToRs.
- Prior environmental clearance is required before starting any construction work, or preparation of land on the identified site/project or activity by the project management, except for securing the land.
- If the application is made for a specific developmental activity, which has an inherent area development component as a part of its project proposal and the same project also attracts the construction and area development provisions under 8a and 8b of the Schedule, then the project will be seen as a developmental activity other than 8a and 8b of the Schedule.

4.2.4 Siting guidelines

These are the guidelines, stakeholders may consider while siting the developmental projects, to minimize the associated possible environmental impacts. In some situations, adhering to these guidelines is difficult and unwarranted. Therefore, these guidelines may be kept in the background, as far as possible, while taking the decisions. Site may preferably be proposed in an industrial zone. Setting up of such facilities in critically polluted areas identified by MoEF from time-to-time may be avoided to the maximum extent possible. Please refer **Annexure X** for details of critically polluted industrial areas and clusters/potential impact zone; as well as the preliminary criteria and rejection or knock out criteria for siting of TSDF.

4.3 Scoping for EIA Studies

Scoping exercise is taken-up soon after the project contours are defined. The primary purpose of scoping is to identify the concerns and issues which may affect the project decisions. Besides, scoping defines requirements and boundaries of an EIA study.

Scoping refers to the process by which the EAC, in case of Category 'A' projects or activities, and SEAC in the case of Category 'B1' projects, including applications for expansion and/or modernization of existing projects, determine ToR for EIA studies addressing all relevant environmental concerns for the preparation of an EIA Report for a particular project.

- Project proponent shall submit the application to the concerned Authority. The application (Form 1 as given in annexure IX) shall be attached with pre-feasibility report and proposed ToR for EIA Studies. The proposed sequence to arrive at the draft ToR is discussed below:
  - Pre-feasibility report summarises the project details and also the likely environmental concerns based on secondary information, which will be availed for filling the Form 1.
  - From pre-feasibility report and the Form 1, valued environmental components (VECs) may be identified for a given project (the receiving environment/social components, which are likely to get affected due to the project operations/activities).
  - Once the project details from the pre-feasibility report & Form 1; and VECs are identified, a matrix establishing the interactions which can lead to the effects/impacts could be developed (Qualitative analysis).
  - For each identified possible effect in the matrix, significance analysis could be conducted to identify the impacts, which needs to be studied further (quantitative analysis) in the subsequent EIA studies. All such points will find a mention in the draft ToR to be proposed by the project proponent along with the application form. The draft ToR shall include applicable baseline parameters (refer annexure XIII) and impact prediction tools (refer annexure XV) proposed to be applied.
  - The information to be provided in pre-feasibility report, guidelines for filling Form 1 and guidelines for developing draft ToR is summarized in the subsequent sections.
  - Authority consults the respective EAC/SEAC to reply to the proponent. The EAC/SEAC concerned reviews the application form, pre-feasibility report and proposed draft ToR by the proponent and make necessary additions/deletions to make it a comprehensive ToR that suits the statutory requirements for conducting the EIA studies.
- The concerned EAC/SEAC may constitute a sub-committee for a site visit, if considered necessary. The sub-committee will act up on receiving a written approval from chairperson of the concerned EAC/SEAC. Project proponent shall facilitate such site visits of the sub-committees.
- EAC/SEAC shall provide an opportunity to the project proponent for presentation and discussions on the proposed project and related issues as well as the proposed ToR for EIA studies. If the State Government desires to present its views on any specific project in the scoping stage, it can depute an officer for the same at the scoping stage to EAC, as an invitee but not as a member of EAC. However, non-appearance of the

representative of the State Government before EAC/SEAC at any stage will not be a ground for rejection of the application for the prior environmental clearance.

- In case of a new or expansion project in an identified problem area by the CPCB, then the Ministry may invite representative of SEIAA to present their views, if any at the stage of scoping, to the EAC.
- The final set of ToR for EIA Studies shall be conveyed to the proponent by the EAC/ SEAC within sixty days of the receipt of Form 1 and pre-feasibility report. If the finalized ToR for EIA studies are not conveyed to the proponent within sixty days of the receipt of Form 1, the ToR for EIA studies suggested by the proponent shall be deemed as the final and will be considered as approved for the EIA studies.
- Final ToR for EIA Studies shall be displayed on the website of the MoEF/SEIAA.
- Applications for prior environmental clearance may be rejected by the concerned Authority based on the recommendations by the concerned EAC or SEAC at the scoping stage itself. In case of such rejection, the decision together with reasons for the same shall be communicated to the proponent in writing within sixty days of the receipt of the application.
- The final EIA report and the other relevant documents submitted by the applicant shall be scrutinized by the concerned Authority strictly with reference to the approved ToR for EIA studies.

4.3.1 Pre-feasibility report

The pre-feasibility report should include, but not limited to highlight the proposed project information, keeping in view the environmental sensitivities of the selected site, technology options, leachate treatment, *etc*. Information required in pre-feasibility report varies from case to case even in the same sector depending upon the local environmental setting within which the facility is located/proposed. However, the information which may be furnished in the pre-feasibility report may include as under:

I. Executive summary

II. Project details: Description of the project including in particular;

- a description of the main characteristics of the production processes, for instance, nature and quantity of materials used
- an estimate, by type and quantity, of expected residues and emissions (water, air and soil pollution, noise, vibration, heat, *etc.*) resulting from the operation of the proposed project
- a description of the physical characteristics of the whole project and the land-use requirements during the construction and operational phases

III. Selection of site based on least possible impacts

- An outline of the main alternatives studied by the developer and an indication of the main reasons for this choice, taking into account the environmental effects.

IV. Anticipated impacts based on project operations on receiving environment

- A description of the aspects of the environment likely to be significantly affected by the proposed project, including, in particular, population, fauna, flora, soil, water, air,

climatic factors, material assets, including the architectural and archaeological heritage, landscape and the inter-relationship between the above factors.

- A description of the likely significant effects of the proposed project on the environment resulting from:
  - existence of the project
  - use of natural resources
  - emission of pollutants, the creation of nuisances and the elimination of waste,
  - project proponent's description of the forecasting methods used to assess the effects on the environment

V. Proposed broad mitigation measures which could effectively be internalized as project components to have environmental and social acceptance of the proposed site

- A description of the key measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment

VI. An indication of any difficulties (technical deficiencies or lack of know-how) encountered by the developer in compiling the required information

Details of the above listed points which may be covered in pre-feasibility report are listed in **Annexure XI**.

4.3.2 Guidance for providing information in Form 1

The information given in specifically designed pre-feasibility report for this developmental activity may also be availed for filling Form 1.

Form 1 is designed to help users identify the likely significant environmental effects of proposed projects right at the scoping stage. There are two stages for providing information under two columns:

- First - identifying the relevant project activities from the list given in column 2 of Form 1. Start with the checklist of questions set out below and complete Column 3 by answering:
  - Yes - if the activity is likely to occur during implementation of the project
  - No - if it is not expected to occur
  - May be - if it is uncertain at this stage whether it will occur or not
- Second - Each activity for which the answer in Column 3 is "Yes" the next step is to refer to the fourth column which quantifies the volume of activity which could be judged as significant impact on the local environmental characteristics, and identify the areas that could be affected by that activity during construction /operation / decommissioning of the project. The Form 1 requires information within 15 km around the project, whereas actual study area for EIA studies will be as prescribed by respective EAC/SEAC. Information will be needed about the surrounding VECs in order to complete this Form 1.

4.3.3 Identification of appropriate valued environmental components

VECs are components of natural resources and human world that are considered valuable and are likely to be affected by the project activities. Value may be attributed for economic, social, environmental, aesthetic or ethical reasons. VECs represent the

investigative focal point for further EIA process. The indirect and/or cumulative effects can be concerned with indirect, additive or even synergistic effects due to other projects or activities or even induced developments on the same environmental components as would be considered direct effects. But such impacts tend to involve larger scale VECs such as within entire region, river basins or watersheds; and, broad social and economic VECs such as quality of life and the provincial economy. Once VECs are identified then appropriate indicators are selected for impact assessments on the respective VECs.

4.3.4 Methods for identification of impacts

There are a various factors which influence the approach adopted for the assessment of direct, indirect, cumulative impacts, *etc*. for a particular project. The method should be practical and suitable for the project given the data, time and financial resources available. However, the method adopted should be able to provide a meaningful conclusion from which it would be possible to develop, where necessary, mitigation measures and monitoring. Key points to be considered when choosing the method(s) include:

- Nature of the impact(s)
- Availability and quality of data
- Availability of resources (time, finance and staff)

The method chosen should not be complex; instead it should aim at presenting the results in a way that can be easily understood by the developer, decision maker and the public. A comparative analysis of major impact identification methods is given in the following table 4-3:

Table 4-1: Advantages and Disadvantages of Impact Identification Methods

	Description	Advantages	Disadvantages
Checklists	▪ Annotate the environmental features that need to be addressed when identifying the impacts of activities in the project	▪ Simple to understand and use ▪ Good for site selection and priority setting ▪ Simple ranking and weighting	▪ Do not distinguish between direct and indirect impacts ▪ Do not link action and impact ▪ The process of incorporating values can be controversial
Matrices	▪ Identify the interaction between project activities (along one axis) and environmental characteristics (along other axis) using a grid like table ▪ Entries are made in the cells which highlights impact severity in the form of symbols or numbers or descriptive comments	▪ Link action to impact ▪ Good method for displaying EIA results	▪ Difficult to distinguish direct and indirect impacts ▪ Significant potential for double-counting of impacts
Networks	▪ Illustrate cause effect relationship of project activities and environmental characteristics	▪ Link action to impact ▪ Useful in simplified form	▪ Can become very complex if used beyond simplified version

	Description	Advantages	Disadvantages
	▪ Useful in identifying secondary impacts ▪ Useful for establishing impact hypothesis and other structured science based approaches to EIA	for checking for second order impacts ▪ Handles direct and indirect impacts	
Overlays	▪ Maps the impacts spatially and display them pictorially ▪ Useful for comparing site and planning alternatives for routing linear developments ▪ Can address cumulative effects ▪ Information incentive	▪ Easy to understand ▪ Good to display method ▪ Good siting tool	▪ Address only direct impacts ▪ Do not address impact duration or probability
GIS	▪ Maps the impacts spatially and display them pictorially ▪ Useful for comparing site and planning alternatives for routing linear developments ▪ Can address cumulative effects ▪ Information incentive	▪ Easy to understand ▪ Good to display method ▪ Good siting tool ▪ Excellent for impact identification and analysis	▪ Do not address impact duration or probability ▪ Heavy reliance on knowledge and data ▪ Often complex and expensive

The project team made an attempt to construct an impact matrix considering major project activities (generic operations) and stage-specific likely impacts which is given in Table 4-2.

While the impact matrix is project-specific, Table 4-4 may facilitate the stakeholders in identifying a set of components and phase-specific project activities for determination of likely impacts. However, the location-specific concerns may vary on a case-to-case basis. Therefore, the components even without likely impacts are also retained in the matrix for the location-specific reference.

Table 4-2: Matrix of Impacts

			PHASE I					PHASE II						PHASE III																
			Pre Construction					Construction/ Establishment						Operation and Maintenance																
			TSDF Facility					Landfill and Incinerator						Landfill											Incineration					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ENVIRONMENT	Component	Project Activities / Parameter/ factor	Detailed topographic survey	Land Acquisition	Site Cleaning	Burning of waste s, refuse and cleared vegetation	Site Preparation / Change in Topography	Civil works such as earth moving and building of structures including temporary structures	Heavy equipment operations	Disposal of construction waste	Generation of sewerage	Influx of construction workers	Deforestation	Transportation of waste to facility from member industry	Storage of waste and stabilization	Water Requirement	Waste material storage/Transport	Waste material handling	Fugitive emissions	Solid/Hazardous waste disposal	Leachate storage and handling	Spills and leaks	Transport of workers	Movement of vehicles	Utilities	Effluent Discharge	Gaseous Emissions	Shutdown /startup	Equipment failure	Plant operations
Physical	Soil	Erosion Risks			*								*																	
		Contamination/ quality													*						*	*								
		Consolidation																		*										
	Resources	Construction material-stone, aggregates						*		*		*																		
		Land especially undeveloped or agricultural land		*	*	*	*	*					*																	
	Water	Water quality									*					*	*	*		*	*	*			*	*			*	
		Alteration of Hydraulic Regime						*																						
		Alteration of surface					*	*		*			*																	

			PHASE I					PHASE II						PHASE III															
			Pre Construction					Construction/ Establishment						Operation and Maintenance															
			TSDF Facility					Landfill and Incinerator						Landfill										Incineration					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		run off and interflow																											
		Alteration of Aquifers														*													
	Air	Air quality				*			*					*	*		*	*	*			*	*	*	*		*	*	*	*
	Air	Noise and odour				*			*						*		*	*	*	*		*		*	*		*	*	*	*
Biological	Terrestrial Flora	Terrestrial ecology land use			*	*	*	*									*										*			*
Biological	Aquatic Biota	Aquatic Ecology			*		*	*			*		*			*	*						*				*			*
Biological	Terrestrial Fauna	Disturbance of habitats by noise or vibration			*	*	*	*	*				*		*															
Biological	Terrestrial Fauna	Environmental hazards												*	*	*	*	*	*	*	*	*		*	*	*	*	*	*	*
Social	Economy	Creation of new economic activities and status						*	*					*		*							*	*						*
Social	Economy	Commercial value of properties					*	*					*	*	*					*	*			*			*			*
Social	Economy	Conflict due to negotiation and/ compensation payments		*	*	*	*																							
Social	Economy	Generation of temporary and permanent jobs						*	*					*									*	*						*
Social	Economy	Effect on crops																		*	*						*			

			PHASE I					PHASE II						PHASE III															
			Pre Construction					Construction/ Establishment						Operation and Maintenance															
			TSDF Facility					Landfill and Incinerator						Landfill										Incineration					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		Reduction of farmland productivity												*						*	*								*
	Education	Training in new technologies and new skills to workers						*	*	*				*	*		*	*	*	*	*	*			*	*	*	*	*	*
	Public Order	Political Conflicts		*			*							*			*	*	*	*	*	*				*	*			*
		Unrest, Demonstrations & Social conflicts		*			*					*		*	*		*	*	*	*	*	*	*			*	*		*	*
	Infrastructure and Services	Conflicts with projects of urban, commercial or Industrial development												*		*	*	*		*		*	*	*	*	*	*	*	*	*
	Security and	Road and fire accidents caused by												*	*								*	*						
	Health	Temporary				*								*	*		*	*	*		*	*			*	*	*			*
		Acute												*	*		*	*	*		*	*			*	*	*			*
		Chronic												*	*		*	*	*		*	*			*	*	*			*
	Cultural	Land use and quality														*	*	*		*	*	*				*		*	*
		Recreation				*	*	*					*		*		*													
		Aesthetics and human interest												*	*				*		*	*	*	*	*	*	*			*
		Cultural status					*					*	*										*				*			*

Note:

1. The above table represents a model for likely impacts, which will have to be arrived case-to-case basis considering VECs and significance analysis (Ref Section 2.9).

2. Project activities are shown as indicative. However, in Form 1 (application for EIA Clearance), for any question for which answer is 'Yes', then the corresponding activity shall reflect in project activities. Similarly 'parameters'/'factors' will also be changed within a component in order to reflect the target species of prime concern in the receiving environment.

4.3.5 Testing the Significance of Impacts

The following set of conditions may be used as the checklist for testing the significance of the impacts and also to provide information in Column IV of Form 1.

- Will there be a large change in environmental conditions?
- Will new features be out-of-scale with the existing environment?
- Will the effect be unusual in the area or particularly complex?
- Will the effect extend over a large area?
- Will there be any potential for trans-frontier impact?
- Will many people be affected?
- Will many receptors of other types (fauna and flora, businesses, facilities) be affected?
- Will valuable or scarce features or resources be affected?
- Is there a risk that environmental standards will be breached?
- Is there a risk that protected sites, areas, and features will be affected?
- Is there a high probability of the effect occurring?
- Will the effect continue for a long time?
- Will the effect be permanent rather than temporary?
- Will the impact be continuous rather than intermittent?
- If it is intermittent will it be frequent rather than rare?
- Will the impact be irreversible?
- Will it be difficult to avoid, or reduce or repair or compensate for the effect?

For each "Yes" answer in column 3, the nature of effects and reasons for it should be recorded in the column 4. The questions are designed so that an "Yes" answer in column 3, will generally point towards the need for analyzing for the significance and requirement for conducting impact assessment for the effect.

4.3.6 Terms of reference for EIA studies

To bring in clarity, separate ToR for EIA studies are drafted for following:

- Common hazardous waste treatment, storage and secured landfill facilities; and
- Common hazardous waste treatment, storage and incineration facilities

It is pertinent to mention that in case of availing the cement kilns for incineration purpose, the existing clearance given to the cement plants will be amended accordingly upon the suitability, for which the TGM on Cement plants may be referred. The specific concerns in such case include: (i) calorific value of waste (ii) quantities and characteristics that interface with quality of product/operations (iii) flue gas emissions from co-incineration plants should meet the notified standards of cement and common hazardous waste incineration facilities (till specific standards for co-incineration are developed) for concerned parameters.

In case of integrated TSDFs proposing to have both, secured landfill and incinerator facilities, the relevant points in both the ToRs may be considered.

4.3.6.1 Common hazardous waste treatment, storage and disposal in secured landfill facilities

ToR for EIA studies for common hazardous waste treatment, storage and disposal in secured landfill facilities may include, but not limited to the following:

1. Executive summary of the project – giving a *prima facie* idea of the objectives of the proposal, use of resources, justification, *etc*. In addition, it should provide a compilation of EIA report including EMP and the post-project monitoring plan in brief.

Project description

2. Details on consideration for selection of specific site.
3. Justification for selecting the proposed hazardous waste handling and disposal capacity.
4. Land requirement for the facility including its break up for various purposes, its availability and optimization.
5. Details of proposed layout clearly demarcating various activities such as security, weighbridge, laboratory facility, temporary hazardous waste storage areas, stabilization units, landfill, vehicle tyre wash areas, leachate collection ponds, solar evaporation ponds and others such as admin building, canteen, worker's room, health centers, vehicle cleaning areas/ maintenance areas, greenbelt, internal roads, *etc*.
6. Details on hazardous waste inventory, segregation at source for compatibility with transportation system and subsequent treatment.
7. Details of waste inventorisation
8. Details on compliance program to the manifestation corresponding to waste transportation from source to TSDF – adequate number of trucks, authorized dealers if any, features of the vehicles, trained manpower, health and safety measures, identification of transportation routes by avoiding vulnerable installations, frequency of truck movements, *etc*.
9. Details on proposed protocol for waste acceptance (verifying the waste quantity through weigh bridge, frequency of calibration of weighing machine, system for sampling, testing parameters, analysis methods, time lags, criteria for identifying the wastes which require stabilization prior to the landfill, number of people, qualifications, manifestation systems, *etc*.)
10. Details of the laboratory facilities and statement on adequacy including proposals for accreditation, *etc*.
11. Design details of hazardous waste storage facilities (capacities, protocol for storing the segregated hazardous waste, compliance to the statutory requirements and proposed safety precautions).
12. Details on proposed protocol for establishing the requirement of stabilization for various types of hazardous waste.

13. Details of stabilization process (step by step procedure, proposed structures, equipments, operations, general list of chemicals/material use, handling, personal protective equipments, occupational health and safety measurers, emergency preparedness, *etc*.
14. Details of the secured landfill (design, construction, operational and post closure maintenance) including waste volume, landfill capacity, phase-wise landfill capacity development and utilization plan, groundwater table, slope stability, compaction levels, liners, waste layers, capping arrangement, gas collection, leachate collection, equipments, stability considerations, trouble shooting mechanism, peizometric wells, health and safety measures, *etc*.
15. Details on landfill gas collection system and its management.
16. Details of leachate collection system – leachate generation rates, leachate collection network within the landfill, external collection ponds, treatment and disposal options (recirculation, evaporation, treatment, discharge, *etc*.) including solar evaporation ponds, overflow control measures during flood/heavy rains, *etc*.
17. Details on landfill closure and its post closure monitoring plan including leachate, landfill gas, *etc*.
18. Details of the proposed overall safety and health protection measures during the project design, construction and operation phases.
19. Details on surface/storm water management.
20. Details on source of water and power to the facility.
21. Details of the existing access road(s)/walkways to the development site and its layout.
22. Details of vehicular traffic management within and outside the project area during waste transportation.
23. Proposed financial model, creation of fund for future liabilities till 30 years of post closure including monitoring, *etc*.
24. In case of expansion of projects, compliance to the issued EIA clearance conditions and consent for operation conditions for existing facility.
25. Any legal cases pending against the existing plant related to the environmental pollution and impacts in the last three years, if so. Details thereof.
26. Details on site closure and its management.

Description of the environment

27. The study area shall be up to a distance of 5 km for air quality details and 10 km for soil, surface and ground water quality from the boundary of the proposed project site.
28. Location of TSDF, township and nearest villages with distances from the facility to be demarcated on a toposheet (1: 50000 scale).
29. Landuse based on satellite imagery including location specific sensitivities such as national parks / wildlife sanctuary, villages, industries, *etc*. within the study area.
30. Demography details of all the villages falling within the study area.
31. Survey and topography details of the project area with appropriate contour interval.
32. Baseline data to be collected from the study area w.r.t. different components of environment *viz*. air, noise, water, land, biology and socio-economics (please refer

Section 4.4.2 for guidance for assessment of baseline components and identify attributes of concern). Actual monitoring of baseline environmental components shall be strictly according to the parameters prescribed in the ToR after considering the proposed coverage of parameters by the proponent in draft ToR and shall commence after finalization of ToR by the competent Authority.

33. Details on geological and hydro-geological features of the project area such as type of soil, nature of soils, soil quality, soil properties including compressive strength, soil bearing capacity, consolidation, *etc*.

34. Surface water quality of nearby water sources and other surface drains. Details on groundwater such as water depth, water quality, drainage pattern, yield potential, etc. Water quality parameters may include pH*, TDS*, COD*, BOD*, DO*, Cl-*, SO_4-*, NO_3-*, PO_4*, T.Alk*, Ca*, Mg*, F*, *etc*. (* - as applicable)

35. Details on existing ambient air quality and expected emissions for SO_2*, NOx*, PM10*, PM 2.5*, VOC*, Methane*, CO_2*, *etc*., and evaluation of the adequacy of the proposed pollution control devices to meet standards for point sources and to meet AAQ standards. (* - as applicable)

36. Details on noise levels at sensitive/commercial receptors.

37. One season site-specific meteorological data excluding monsoon.

38. Proposed baseline monitoring network for the consideration and approval of the Competent Authority.

39. Ecological status (terrestrial and aquatic) of the study area such as habitat type and quality, species, diversity, rarity, fragmentation, ecological linkage, age, abundance, *etc*.

40. If any incompatible land use attributes fall within the study area, proponent shall describe the sensitivity (distance, area and significance) and propose the additional points based on significance for review and acceptance by the EAC/SEAC. Incompatible land use attributes include:

    - Public water supply areas from rivers/surface water bodies, from ground water
    - Scenic areas/tourism areas/hill resorts
    - Religious places, pilgrim centers that attract over 10 lakh pilgrims a year
    - Protected tribal settlements (notified tribal areas where industrial activity is not permitted)
    - Monuments of national significance, World Heritage Sites
    - Cyclone, Tsunami prone areas (based on last 25 years)
    - Airport areas
    - Any other feature as specified by the State or local government and other features as locally applicable, including prime agricultural lands, pastures, migratory corridors, *etc*.

41. If ecologically sensitive attributes fall within the study area, proponent shall describe the sensitivity (distance, area and significance) and propose the additional points based on significance for review and acceptance by the EAC/SEAC. Ecological sensitive attributes include:

    - National parks
    - Wild life sanctuaries
    - Tiger reserve/elephant reserve/turtle nesting ground
    - Mangrove area
    - Wetlands

- Reserved and protected forests
- Any other closed/protected area under the Wild Life (Protection) Act, 1972.
- Any other eco- sensitive areas *etc,*.

42. If the location falls in Valley, specific issues connected to the natural resources are to be studied and a details should be presented in the report
43. If the location falls in CRZ area: A CRZ map duly authenticated by one of the authorized agencies demarcating LTL, HTL, CRZ area, location of the project and associate facilities w.r.t. CRZ, coastal features such as mangroves, if any.
    - Provide the CRZ map in 1:10000 scale in general cases and in 1:5000 scale for specific observations.
    - Fisheries study should be done w.r.t. Benthos and Marine organic material and coastal fisheries.

Anticipated environmental impacts and mitigation measures

44. Anticipated generic environmental impacts due to TSDF are indicated in Table 4-2, which may be evaluated for significance and based on corresponding likely impacts VECs may be identified. Baseline studies may be conducted for all the concerned VECs and likely impacts will have to be assessed for their magnitude in order to identify mitigation measures (please refer Chapter 4 of the manual for guidance).
45. Tools as given in Section 4.4.3 may be referred for the appropriate assessment of environmental impacts and same may be submitted in draft ToR for consideration and approval by EAC/SEAC.
46. While identifying the likely impacts, also include the following for analysis of significance and required mitigation measures:
    - impacts due to hazardous waste carrying trucks movement
    - impacts due to leachate on surface water, soil and groundwater
    - impacts due to air pollution including landfill gas
    - impacts due to odour pollution
    - impacts due to noise
    - impacts due to fugitive emissions
    - impact on health of workers due to proposed hazardous waste processing and disposal activities
47. Proposed odour control measures
48. In case of likely impact from the proposed facility on the surrounding reserve forests, Plan for the conservation of wild fauna in consultation with the State Forest Department.
49. Action plan for the greenbelt development – species, width of plantations, planning schedule *etc*.. in accordance to MoEF/CPCB published guidelines.
50. For identifying the mitigation measures, please refer Chapter III for source control and treatment. Besides typical mitigation measures which may also be considered are discussed in Table 4-5. These mitigation measures shall bring the likely impacts into acceptable level. Some of the areas require specific mitigation measures which are as follows:
    - Proposed measures for occupational health and safety of the workers
    - Proposed mitigation measures to control the fugitive emissions and odour
    - Scheme for stormwater management.

- Leachate management to prevent contamination
- Noise control measures during landfill operations

Analysis of alternative resources and technologies

51. Comparison of alternate sites considered, and the reasons for selecting the proposed site. Conformity of the site with the prescribed guidelines in terms of CRZ, river, highways, railways, *etc*.
52. Details on pollution control and monitoring technologies.
53. Details of improved technologies and better operating practices.
54. Details on proposed recovery and recycling options, if any.

Environmental monitoring program (Post-EIA Clearance)

55. Monitoring of pollution control at source – relocation of waste (in case of existing waste), base preparation, liners, drainage layers, leachate collection system, storm water management system, waste placement in landfill, gas vent system, *etc*.
56. Monitoring of pollutants at receiving environment for all the appropriate notified parameters – air quality, groundwater, surface water, leachate, gas quality, *etc*. during operational phase of the project
    - Leachate within the landfill and after treatment
    - Groundwater quality around the landfill
    - Surface water quality
    - Gas quality within landfill (VOCs, H_2S, *etc*.)
    - Air quality above landfill
57. Details on monitoring of qualitative parameters – air quality, groundwater, surface water, leachate, gas quality, *etc*. – location, frequency, parameters, *etc*. for all the appropriate notified parameters for monitoring after landfill closure
    - Leachate quality after treatment and at receiving environment
    - Groundwater quality around the capped landfill
    - Surface water quality
    - Air quality above landfill and at gas vents
58. Specific programme to monitor safety and health protection of workers.
59. Appropriate monitoring network has to be designed and proposed for regulatory compliance and to assess the possible residual impacts.
60. Details of in-house monitoring capabilities and the recognized agencies if proposed for conducting monitoring.

Additional studies

61. Risk assessment and damage control during different phases of the project.
62. Details on socio-economic development activities such as commercial property values, generation of jobs, education, social conflicts, cultural status, accidents, *etc*.

Environmental management plan

63. Administrative and technical organizational structure to ensure proposed post-project monitoring programme for approved mitigation measures.

64. EMP devised to mitigate the adverse impacts of the project should be provided along with item-wise cost of its implementation (Capital and recurring costs).
65. Allocation of resources and responsibilities for plan implementation.
66. Details of the emergency preparedness plan and on-site and off-site disaster management plan.

4.3.6.2 Common hazardous waste treatment, storage and disposal through incineration facilities

ToR for EIA studies for common hazardous waste treatment, storage and disposal through incineration facilities may include, but not limited to the following:

1. Executive summary of the project – giving a prima facie idea of the objectives of the proposal, use of resources, justification, *etc*. In addition, it should provide a compilation of EIA report including EMP and the post-project monitoring plan in brief.

Project description

2. Justification for selecting the proposed capacity of the incineration facility.
3. Land requirement for the facility including its break up for various purposes, its availability and optimization.
4. Details of proposed layout clearly demarcating various activities such as security, weighbridge, laboratory facility, temporary hazardous waste storage areas, mixing of feeding wastes for consistency in calorific values, incinerator facility, bleed management area, ash storage/disposal area, vehicle tyre wash areas, and others such as admin building, canteen, worker's room, health centers, vehicle cleaning areas/ maintenance areas, greenbelt, *etc*.
5. Details on hazardous waste inventory, segregation at source for compatibility with transportation system and subsequent treatment.
6. Details on compliance program to the manifestation corresponding to waste transportation from source to incineration facility – adequate number of trucks, authorized dealers, if any, features of the vehicles, trained manpower, health and safety measures, identification of transportation routes by avoiding vulnerable installations, frequency of truck movements, *etc*.
7. Details on proposed protocol for waste acceptance (verifying the waste quantity through weigh bridge, frequency of calibration of weighing machine, system for sampling, testing parameters, analysis methods, time lags, criteria for identifying the wastes which require stabilization prior to the incineration, number of people, qualifications, manifestation systems, *etc*.)
8. Details of the laboratory facilities and statement on adequacy including proposals for accreditation, *etc*.
9. Design details of incinerable waste storage facilities (capacities, protocol for storing the segregated hazardous waste, compliance to the statutory requirements and proposed safety precautions).
10. Details on waste type, characteristics, handling, storage, segregation and waste blending/processing/feeds organization at the facility.

11. Details of the arrangement for carrying out mixing of hazardous waste to feed into rotary kiln for optimizing the designed capacity (step by step procedure, proposed structures, equipments, operations, general list of chemicals/material use, handling, personal protective equipments, occupational health and safety measurers, emergency preparedness, *etc*.)
12. Design details of the complete incineration system – a statement on the compliance to the CPCB guidelines for common hazardous waste incinerators in respect of waste feed cutoffs, operating parameters of combustion chambers, flue gas cleaning, ash handling, scrubber bleed management and continuous emission monitoring systems, *etc*.
13. Details on fuel requirement for incineration.
14. Details on control and monitoring systems during combustion process.
15. Details on flue gas emissions discharge through stack and proposed pollution control technologies.
16. Details on residue/ash generation, reuse and management.
17. Details of waste heat utilization, if any.
18. Details on wastewater management.
19. Details on online monitoring equipments attached with incinerators and periodic calibration of the equipments.
20. Details of the proposed process monitoring protocol in tune with CPCB guidelines.
21. Details of the proposed overall safety and health protection measures during project design, construction and operations.
22. Details on source of water and power to the facility.
23. Details of the existing access road(s)/walkways to the designed operations in the site and its layout.
24. Details of vehicular traffic management within and outside the project area due to waste transportation.
25. Proposed financial model, creation of fund for future liabilities.
26. In case of expansion of projects, compliance to the issued EIA clearance conditions and consent for operation conditions for existing facility.
27. Any legal cases pending against the existing facility related to the environmental pollution and impacts in the last three years, if so, details thereof.

Description of the environment

28. The study area shall be up to a distance of 5 km from the boundary of the proposed project site.
29. Location of the incineration facility and nearest habitats with distances from the facility to be demarcated on a toposheet (1: 50000 scale).
30. Landuse map based on satellite imagery including location specific sensitivities such as national parks / wildlife sanctuary, villages, industries, *etc*. for the study area.
31. Demography details of all the villages falling with in the study area.
32. Topography details.

33. Baseline data to be collected from the study area w.r.t. different components of environment *viz.* air, noise, water, land, and biology and socio-economics (please refer Section 4.4.2 for guidance for assessment of baseline components and identify attributes of concern). Actual monitoring of baseline environmental components shall be strictly according to the parameters prescribed in the ToR after considering the proposed coverage of parameters by the proponent in draft ToR and shall commence after finalization of ToR by the competent Authority.
34. Geological features and geo-hydrological status of the facility.
35. Surface water quality of nearby water sources and other surface drains.
36. Details on proposed groundwater monitoring wells, locations, frequency of monitoring, parameters, *etc*.
37. Proposed baseline monitoring network for the consideration and approval of the Competent Authority.
38. One season site-specific meteorological data excluding monsoon.
39. Existing ambient air quality, expected emissions and evaluation of the adequacy of the proposed pollution control devices to meet standards for point sources and to meet AAQ standards.
40. Ecological status (terrestrial and aquatic) of the study area such as habitat type and quality, species, diversity, rarity, fragmentation, ecological linkage, age, abundance, *etc*.
41. If any incompatible land use attributes fall within the study area, proponent shall describe the sensitivity (distance, area and significance) and propose the additional points based on significance for review and acceptance by the EAC/SEAC. Incompatible land use attributes include:

    – Public water supply areas from rivers/surface water bodies, from ground water
    – Scenic areas/tourism areas/hill resorts
    – Religious places, pilgrim centers that attract over 10 lakh pilgrims a year
    – Protected tribal settlements (notified tribal areas where industrial activity is not permitted)
    – Monuments of national significance, World Heritage Sites
    – Cyclone, Tsunami prone areas (based on last 25 years)
    – Airport areas
    – Any other feature as specified by the State or local government and other features as locally applicable, including prime agricultural lands, pastures, migratory corridors, *etc*.

42. If ecologically sensitive attributes fall within the study area, proponent shall describe the sensitivity (distance, area and significance) and propose the additional points based on significance for review and acceptance by the EAC/SEAC. Ecological sensitive attributes include:

    – National parks
    – Wild life sanctuaries
    – Tiger reserve/elephant reserve/turtle nesting ground
    – Mangrove area
    – Wetlands
    – Reserved and protected forests
    – Any other closed/protected area under the Wild Life (Protection) Act, 1972.
    – Any other eco – sensitive areas *etc,*.

43. If the location falls in Valley, specific issues connected to the natural resources are to be studied and documented in the report
44. If the location falls in CRZ area: A CRZ map duly authenticated by one of the authorized agencies demarcating LTL, HTL, CRZ area, location of the project and associate facilities w.r.t. CRZ, coastal features such as mangroves, if any.
    - Provide the CRZ map in 1:10000 scale in general cases and in 1:5000 scale for specific observation
    - Fisheries study should be done w.r.t. Benthos and Marine organic material and coastal fisheries

Anticipated environmental impacts and mitigation measures

45. Anticipated generic environmental impacts due to incineration are indicated in Table 4-2, which may be evaluated for significance and based on corresponding likely impacts VECs may be identified. Baseline studies may be conducted for all the concerned VECs and likely impacts will have to be assessed for their magnitude in order to identify mitigation measures (please refer Chapter 4 of the manual for guidance).
46. Tools as given in Section 4.4.3 may be referred for appropriate assessment of environmental impacts and same may be submitted in draft ToR for consideration and approval by EAC/SEAC.
47. While identifying the likely impacts, also include the following for analysis of significance and required mitigation measures:
    - impacts due to hazardous waste carrying trucks movement
    - impacts due to air pollution including flue gases
    - impacts due to odour pollution
    - impacts due to noise
    - impacts due to fugitive emissions
    - impact on health of workers due to proposed hazardous waste processing and disposal activities
    - Impacts due to spills, leaks on soil and surface/ground water bodies
    - Impacts due to fire/explosion
    - Impacts due to power shut downs
    - Impacts due to puffs / injection of high vapour pressure material into the kiln such as solvents
    - Impacts due to failure of each of the unit in an incineration system
    - Impacts due to ash disposal, *etc.*
48. In case of likely impact from the proposed facility on the surrounding reserve forests, Plan for the conservation of wild fauna in consultation with the State Forest Department.
49. For identifying the mitigation measures, please refer Chapter III for source control and treatment. Besides typical mitigation measures which may also be considered are discussed in Table 4-5.
50. Action plan for the greenbelt development – species, width of plantations, planning schedule, *etc*., in accordance to CPCB published guidelines.

Analysis of alternative resources and technologies

51. Comparison of alternate sites, if any, considered and the reasons for selecting the proposed site. Conformity of the site with the prescribed guidelines in terms of CRZ rules and others.
52. Details on pollution control technologies and monitoring equipments.
53. Details on improved technologies / equipments / operating practices.

Environmental monitoring program

54. Details on monitoring of pollutants at source – waste feed mixing/management, performance of the incinerator including operating hours, fuel consumption, operating parameters (Combustion chamber – temperature, pressure, TOC of residues, loss on ignition of residues; Stack – temperature, carbon monoxide, excess oxygen, total particulate matter, HCl, HF, SO_2, NOx, TOC, mercury, heavy metals, dioxins and furans *etc*), managing carbon monoxide in flue gases as a measure on combustion operations, operation of burners, stack emissions, calibration of instruments, air pollution control systems (such as quencher, dry-sorption, bag filters, scrubbers, mist eliminators, stack, *etc*.) , wastewater management, *etc*.
55. Details on monitoring of pollutants at receiving environment for all the notified parameters of ambient air quality and also for the notified stack emissions in the ambient air, groundwater, surface water, soil samples at likely contamination sites.
56. Stack and fugitive emissions may be monitored for SPM, PM10, PM2.5, HCl, SO_2, CO, total organic carbon, HF, NOx, Total Dioxins & Furans, Cd + Th + Their compounds, Hg and its compounds, Sb + As + Pb + Cr+ Co+ Cu + Mn + Ni + V + their compounds *etc*.
57. Specific programme to monitor safety and health protection of workers.
58. Appropriate monitoring network has to be designed and proposed, to assess the possible residual impacts.
59. Details of in-house monitoring capabilities and the recognized agencies proposed for conducting the monitoring.

Additional studies

60. Details on risk assessment and damage control during different phases of the project.
61. Details on socio-economic development activities such as commercial property values, generation of jobs, education, social conflicts, cultural status, accidents, *etc*.

Environmental management plan

62. Administrative and technical organizational structure to ensure proposed post-project monitoring programme for approved mitigation measures.
63. EMP devised to mitigate the adverse impacts of the project should be provided along with item-wise cost of its implementation (Capital and recurring costs).
64. Allocation of resources and responsibilities for plan implementation.
65. Details of the emergency preparedness plan and on-site & off-site disaster management plan.

Note:

Above points shall be adequately addressed in the EIA report at corresponding chapters, in addition to the contents given in the reporting structure (Table: 4-6).

4.4 Environmental Impact Assessment

The generic approach for accomplishing EIA studies is shown in Figure 4.3. Each stage is discussed, in detail in subsequent sections.

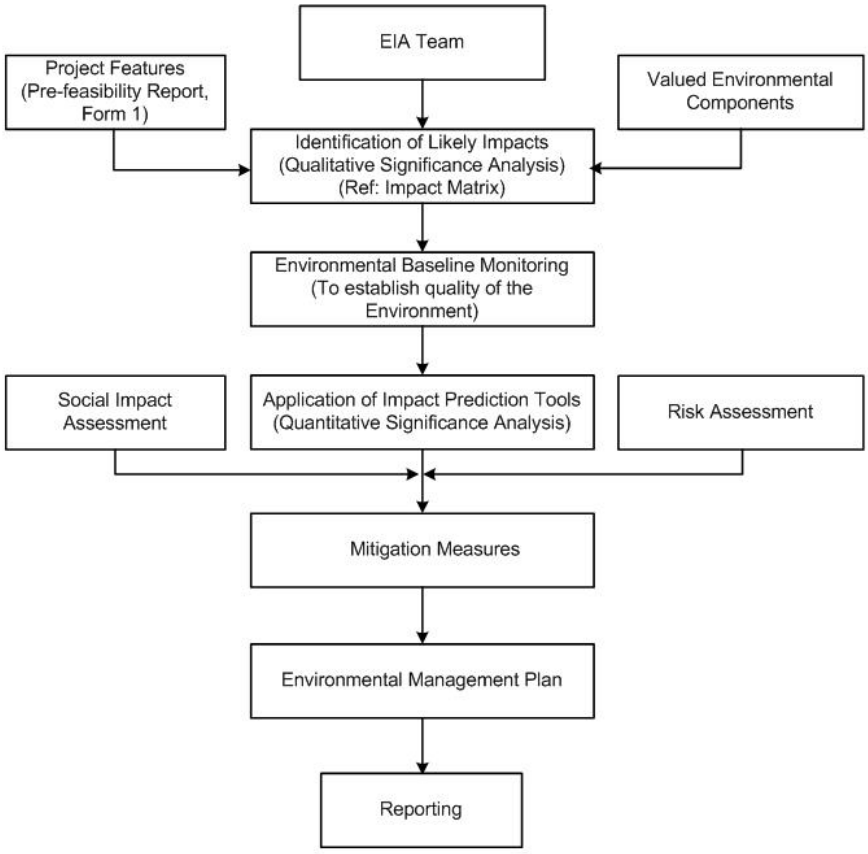


Figure 4-3: Approach for EIA Study

4.4.1 EIA team

The success of a multi-functional activity like an EIA primarily depends on constitution of a right team at the right time (preferable at the initial stages of an EIA) in order to assess the significant impacts (direct, indirect as well as cumulative impacts).

The professional Team identified for a specific EIA study should consist of qualified and experienced professionals from various disciplines in order to address the critical aspects identified for the specific project. Based on the nature and the environmental setting, following professionals may be identified for EIA studies:

- Environmental management specialist/regulator
- Environmental landuse planner
- Air quality expert
- Organic chemistry
- Toxicology/occupational health specialist

- Geology/geo-hydrology specialist
- Ecologist
- Transportation specialist
- Safety and risk assessment specialist
- Radioactivity specialist
- Chemical engineer
- Thermal/mechanical engineer (in case of incinerator)
- Civil engineer
- Social scientist, *etc.*

4.4.2 Baseline quality of the environment

EIA Notification 2006 specifies that an EIA Report should contain a description of the existing environment that would be or might be affected directly or indirectly by the proposed project. Environmental Baseline Monitoring (EBM) is a very important stage of EIA. On one hand EBM plays a very vital role in EIA and on the other hand it provides feedback about the actual environmental impacts of a project. EBM, during the operational phase, helps in judging the success of mitigation measures in protecting the environment. Mitigation measures, in turn are used to ensure compliance with environmental standards, and to facilitate the needed project design or operational changes.

Description of the existing environment should include the natural, cultural, socio-economic systems and their interrelationships. The intention is not to describe all baseline conditions, but to focus the collection and description of baseline data on those VECs that are important and are likely to be affected by the proposed industrial activity.

4.4.2.1 Objectives of EBM in EIA context

The term 'baseline' refers to conditions existing before development. EBM studies are carried out to:

- identify environmental conditions which might influence project design decisions (*e.g.*, site layout, structural or operational characteristics)
- identify sensitive issues or areas requiring mitigation or compensation
- provide input data to analytical models used for predicting effects
- provide baseline data against which the results of future monitoring programs can be compared

At this stage of EIA process, EBM is primarily discussed in the context of first purpose wherein the feedback from EBM programs may be used to:

- determine available assimilative capacity of different environmental components within the designated impact zone and whether more or less stringent mitigation measures are needed; and
- improve the predictive capability of EIAs

There are many institutional, scientific, quality control, and fiscal issues that must be addressed in implementation of an environmental monitoring program. Careful consideration of these issues in the design and planning stages will help avoid many of the pitfalls associated with environmental monitoring programs. Such major issues are discussed in the following sections.

4.4.2.2 Environmental monitoring network design

Monitoring refers to the collection of data through a series of repetitive measurements of environmental parameters (or, more generally, to a process of systematic observation). Design of the environmental quality monitoring programme design depends up on the monitoring objectives specified for the selected area of interest. Types of monitoring and network design considerations are discussed in **Annexure XII**.

4.4.2.3 Baseline data generation

List of important physical environmental components and indicators of EBM are given in Table 4-5

Table 4-3: List of Important Physical Environment Components and Indicators of EBM

Environmental Component	Environmental Indicators
Climatic variables	▪ Rainfall patterns – mean, mode, seasonality ▪ Temperature patterns ▪ Extreme events ▪ Climate change projections ▪ Prevailing wind - direction, speed, anomalies ▪ Relative humudity ▪ Stability conditions and mixing height, *etc*.
Topography	▪ Slope form ▪ Landform and terrain analysis ▪ Specific landform types, *etc*.
Drainage	▪ Surface hydrology ▪ Natural drainage pattern and network ▪ Rainfall runoff relationships ▪ Hydrogeology ▪ Groundwater characteristics – springs, *etc*.
Soil	▪ Type and characteristics ▪ Porosity and permeability ▪ Sub-soil permeability ▪ Run-off rate ▪ Infiltration capacity ▪ Effective depth (inches/centimeters) ▪ Inherent fertility ▪ Suitability for method of sewage disposal, *etc*.
Geology	▪ Underlying rock type, texture ▪ Surgical material ▪ Geologic structures (faults, shear zones, *etc*.) ▪ Geologic resources (minerals, *etc*.) *etc*
Water quality	▪ Raw water availability ▪ Water quality ▪ Surface water (rivers, lakes, ponds, gullies) – quality, water depths, flooding areas, *etc*. ▪ Ground water – water table, local aquifer storage capacity, specific yield, specific retention, water level depths and fluctuations, *etc*. ▪ Coastal ▪ Floodplains, *etc*.

Environmental Component	Environmental Indicators
Air quality	▪ Ambient ▪ Respirable ▪ Airshed importance ▪ Odour levels, *etc*.
Noise	▪ Identifying sources of noise ▪ Noise due to traffic/transportation of vehicles ▪ Noise due to heavy euipment operations ▪ Duration and variations in noise over time, *etc*.
Biology	▪ Species composition of flora and fauna ▪ Flora – type, density, exploitation, *etc*. ▪ Fauna – distribution, abundance, rarity, migratory, species diversity, habitat requirements, habitat resilience, economic significance, commercial value, *etc*. ▪ Fisheries – migratory species, species with commercial/ recreational value, *etc.*
Landuse	▪ Landuse pattern, ,*etc.*

Guidance for assessment of baseline components and attributes describing sampling network, sampling frequency, method of measurement is given in **Annexure XIII**.

Infrastructure requirements for EBM

In addition to devising a monitoring network design and monitoring plans/program, it is also necessary to ensure adequate resources in terms of staffing, skills, equipment, training, budget, *etc*., for its implementation. Besides assigning institutional responsibility, reporting requirements, QA/QC plans and its enforcement capability are essential. A monitoring program that does not have an infrastructural support and QA/QC component will have little chance of success.

Defining data statistics/analyses requirements

The data analyses to be conducted are dictated by the objectives of the environmental monitoring programme. Statistical methods used to analyse the data should be described in detail prior to data collection. This is important because repetitive observations are recorded in time and space. Besides, the statistical methods could also be chosen so that uncertainty or error estimates in the data can be quantified. For *e.g.,* statistical methods useful in an environmental monitoring program include:

- frequency distribution analysis
- analysis of variance
- analysis of covariance
- cluster analysis
- multiple regression analysis
- time series analysis
- the application of statistical models

Use of secondary data

The EBM program for EIA can at best address temporal and/or spatial variations limited to a limited extent because of cost implications and time limitations. Therefore analysis

of all available information or data is essential to establish the regional profiles. So all the relevant secondary data available for different environmental components should be collated and analyzed.

To facilitate stakeholders, IL&FS Ecosmart Ltd, has made an attempt to compile the list of information required for EIA studies and the sources of secondary data, which are given in **Annexure XIVA** and **Annexure XIVB**.

4.4.3 Impact prediction tools

The scientific and technical credibility of an EIA relies on the ability of EIA practitioners to estimate the nature, extent, and magnitude of change in environmental components that may result from project activities. Information about predicted changes is needed for assigning impact significance, prescribing mitigation measures, and designing & developing EMPs and monitoring programs. The more accurate the predictions, the more confident the EIA practitioner will be in prescribing specific measures to eliminate or minimize the adverse impacts of development project.

Choice of models/methods for impact predictions in respect of each of air, noise, water, land, biological and social environment are precisely tabulated in **Annexure XV**.

4.4.4 Significance of the impacts

Evaluating the significance of environmental effects is perhaps the most critical component of impact analysis. The interpretation of significance bears directly on the subsequent EIA process and also during environmental clearance on project approvals and condition setting. At an early stage, it also enters into screening and scoping decisions on what level of assessment is required and which impacts and issues will be addressed.

Impact significance is also a key to choosing among alternatives. In total, the attribution of significance continues throughout the EIA process, from scoping to EIS review, in a gradually narrowing "cone of resolution" in which one stage sets up the next. But at this stage it is the most important as better understanding and quantification of impact significance is required.

One common approach is based on determination of the significance of predicted changes in the baseline environmental characteristics and compares these w.r.t regulatory standards, objective criteria and similar 'thresholds' as eco-sensitivity, cultural /religious values. Often, these are outlined in guidance. A better test proposed by the CEAA (1995) is to determine if 'residual' environmental effects are adverse, significant, and likely (given under). But at this stage, the practice of formally evaluating significance of residual impacts, *i.e.,* after predicting the nature and magnitude of impacts based on before-versus-after-project comparisons, and identifying measures to mitigate these effects is not being followed in a systematic way.

i. Step 1: Are the environmental effects adverse?

Criteria for determining if effects are "adverse" include:

- effects on biota health
- effects on rare or endangered species

- reductions in species diversity
- habitat loss
- transformation of natural landscapes
- effects on human health
- effects on current use of lands and resources for traditional purposes by aboriginal persons; and
- foreclosure of future resource use or production

ii. Step 2: Are the adverse environmental effects significant?

Criteria for determining 'significance' are to judge that the impacts:

- are extensive over space or time
- are intensive in concentration or proportion to assimilative capacity
- exceed environmental standards or thresholds
- do not comply with environmental policies, landuse plans, sustainability strategy
- adversely and seriously affect ecologically sensitive areas
- adversely and seriously affect heritage resources, other landuses, community lifestyle and/or indigenous peoples traditions and values

iii. Step 3: Are the significant adverse environmental effects likely?

Criteria for determining 'likelihood' include:

- probability of occurrence, and
- scientific uncertainty

4.5 Social Impact Assessment

Social Impact Assessment (SIA) is an instrument used to analyze social issues and solicit stakeholder views for the design of projects. SIA helps in making the project responsive to social development concerns, including options that enhance benefits for poor and vulnerable people while mitigating risk and adverse impacts. It analyzes distributional impacts of intended project benefits on different stakeholder groups, and identifies differences in assets and capabilities to access the project benefits.

The scope and depth of SIA should be determined by the complexity and importance of the issues studied, taking into account the skills and resources available. SIA should include studies related to involuntary resettlement, compulsory land acquisition, impact of imported workforces, job losses among local people, damage to sites of cultural, historic or scientific interest, impact on minority or vulnerable groups, child or bonded labour, use of armed security guards. However, SIA may primarily include the following:

Description of the socio-economic, cultural and institutional profile

Conduct a rapid review of available sources of information to describe the socio-economic, cultural and institutional interface in which the project operates.

Prediction of social impacts to be carried out, like property price depreciation representing external 'cost' of waste disposal and treatment facilities. Property values are also affected by their proximity to a new landfill. The other adverse impact includes stress

arising from fear to risk to health, *etc*. However, as a result of such projects, there would be employment generation, business generation, infrastructure development, *etc*.

Socio-economic and cultural profile: Describe the most significant social, economic and cultural features that differentiate social groups in the project area.

- Describe their different interests in the project, and their levels of influence.
- In particular, explain any particular effects the project may have on the poor and underprivileged.
- Identify any known conflicts among groups that may affect project implementation.

Institutional profile:

- Describe the institutional environment
- Consider both the presence and function of public, private and civil society institutions relevant to the operation.
- Are there important constraints within existing institutions *e.g*. disconnect between institutional responsibilities and the interests and behaviors of personnel within those institutions?
- Are there opportunities to utilize the potential of existing institutions? *e.g.* private or civil society institutions, to strengthen implementation capacity.

Legislative and regulatory considerations

To review laws and regulations governing the project's implementation and access of poor and excluded groups to goods, services and opportunities provided by the project. In addition, review the enabling environment for public participation and development planning. SIA should build on strong aspects of legal and regulatory systems to facilitate program implementation and identify weak aspects while recommending alternative arrangements.

Key social issues

SIA provides the baseline information for designing the social development strategy. The analysis should determine the key social and institutional issues which affect the project objectives; identify the key stakeholder groups in this context and determine how relationships between stakeholder groups will affect or be affected by the project; and identify expected social development outcomes and actions proposed to achieve those outcomes.

Data collection and methodology

Describe the design and methodology for social analysis. In this regard:

- Build on existing data;
- Clarify the units of analysis for social assessment: intra-household, household level, as well as communities/settlements and other relevant social aggregations on which data is available or will be collected for analysis;
- Choose appropriate data collection and analytical tools and methods, employing mixed methods wherever possible; mixed methods include a mix of quantitative and qualitative methods.

Strategy to achieve social development outcomes

Identify the likely social development outcomes of the project and propose a Social development strategy, including recommendations for institutional arrangements to achieve them, based on the findings of the social assessment. The social development strategy could include measures that:

- strengthen social inclusion by ensuring that both poor and excluded groups and intended beneficiaries are included in the benefit stream; and offer access to opportunities created by the project
- empower stakeholders through their participation in the design and implementation of the project, their access to information, and their increased voice and accountability (*i.e*. a participation framework); and
- enhance security by minimizing and managing likely social risks and increasing the resilience of intended beneficiaries and affected persons to socioeconomic shocks

Implications for analysis of alternatives

Review proposed approaches for the project, and compare them in terms of their relative impacts and social development outcomes. Consider what implications the findings of the social assessment might have on those approaches. Should some new components be added to the approach, or other components to be reconsidered or modified?

If SIA and consultation processes indicate that alternative approaches may have better development outcomes, such alternatives should be described and considered, along with the likely budgetary and administrative effects these changes might have.

Recommendations for project design and implementation arrangements

Provide guidance to project management and other stakeholders on how to integrate social development issues into project design and implementation arrangements. As much as possible, suggest specific action plans or implementation mechanisms to address relevant social issues and potential impacts. These can be developed as integrated or separate action plans, for example, as Resettlement Action Plans, Indigenous Peoples Development Plans, Community Development Plans, *etc*.

Developing a monitoring plan

Through SIA process, a framework for monitoring and evaluation should be developed. To the extent possible, this should be done in consultation with key stakeholders, especially beneficiaries and affected people.

The framework shall identify expected social development indicators, establish benchmarks, and design systems and mechanisms for measuring progress and results related to social development objectives. The framework shall identify organizational responsibilities in terms of monitoring, supervision, and evaluation procedures. Wherever possible, participatory monitoring mechanisms shall be incorporated. The framework should establish:

- a set of monitoring indicators to track the progress achieved. The benchmarks and indicators should be limited in number, and should combine both quantitative and qualitative types of data. The indicators for outputs to be achieved by the social development strategy should include indicators to monitor the process of stakeholder participation, implementation and institutional reform

- indicators to monitor social risk and social development outcomes; and indicators to monitor impacts of the project's social development strategy. It is important to suggest mechanisms through which lessons learnt from monitoring and stakeholder feedback can result in changes to improve the operation of the project. Indicators should be of such a nature that results and impacts can be disaggregated by gender and other relevant social groups
- define transparent evaluation procedures. Depending on context, these may include a combination of methods, such as participant observation, key informant interviews, focus group discussions, census and socio-economic surveys, gender analysis, Participatory Rural Appraisal (PRA), Participatory Poverty Assessment (PPA) methodologies, and other tools. Such procedures should be tailored to the special conditions of the project and to the different groups living in the project area; Estimate resource and budget requirements for monitoring and evaluation activities, and a description of other inputs (such as institutional strengthening and capacity building) needs to be carried out

4.6 Risk Assessment

Industrial accidents results in great personal and financial loss. Managing these accidental risks in today's environment is the concern of every industry including TSDFs, because either real or perceived incidents can quickly jeopardize the financial viability of a business. Many facilities involve various manufacturing processes that have the potential for accidents which may be catastrophic to the plant, work force, environment, or public.

The main objective of risk assessment study is to propose a comprehensive but simple approach to carry out risk analysis and conducting feasibility studies for industries and planning and management of industrial prototype hazard analysis study in Indian context.

Risk analysis and risk assessment should provide details on Quantitative Risk Assessment (QRA) techniques used world-over to determine risk posed to people who work inside or live near hazardous facilities, and to aid in preparing effective emergency response plans by delineating a Disaster Management Plan (DMP) to handle on-site and off-site emergencies. Hence, QRA is an invaluable method for making informed risk-based process safety and environmental impact planning decisions, as well as being fundamental to any decision while siting a facility. QRA whether, site-specific or risk-specific for any plant is complex and needs extensive study that involves process understanding, hazard identification, consequence modeling, probability data, vulnerability models/data, local weather and terrain conditions and local population data. QRA may be carried out to serve the following objectives.

- Identification of safety areas
- Identification of hazard sources
- Generation of accidental release scenarios for escape of hazardous materials from the facility
- Identification of vulnerable units with recourse to hazard indices
- Estimation of damage distances for the accidental release scenarios with recourse to Maximum Credible Accident (MCA) analysis
- Hazard and Operability studies (HAZOP) in order to identify potential failure cases of significant consequences
- Estimation of probability of occurrences of hazardous event through fault tree analysis and computation of reliability of various control paths

- Assessment of risk on the basis of above evaluation against the risk acceptability criteria relevant to the situation
- Suggest risk mitigation measures based on engineering judgment, reliability and risk analysis approaches
- Delineation / upgradation of DMP
- Safety Reports: with external safety report/ occupational safety report

The risk assessment report may cover the following in terms of the extent of damage with resource to MCA analysis and delineation of risk mitigations measures with an approach to DMP.

- Hazard identification – identification of hazardous activities, hazardous materials, past accident records, *etc*.
- Hazard quantification – consequence analysis to assess the impacts
- Risk presentation
- Risk mitigation measures
- DMPs

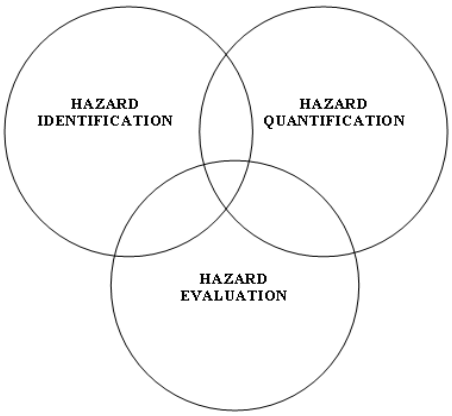


Figure 4-4: Risk Assessment – Conceptual Framework

Methods of risk prediction should cover all the design intentions and operating parameters to quantify risk in terms of probability of occurrence of hazardous events and magnitude of its consequence. Table 4-6 provides the choice of models available to predict impacts of the risk.

Table 4-4: Choice of Models for Impact Predictions: Risk Assessment

Name	Application	Remarks
EFFECT	Consequence analysis for visualization of accidental chemical release scenarios & its consequence	Heat load, press wave & toxic release exposure neutral gas dispersion
WHAZAN	Consequence analysis for visualization of accidental chemical release scenarios & its consequence	
EGADIS	Consequence analysis for visualization of accidental chemical release scenarios & its consequence	Dense gas dispersion
HAZOP and Fault Tree Assessment	For estimating top event probability	Failure frequency data is required

Pathways reliability and protective system hazard analysis	For estimating reliability of equipments and protective systems	Markov models
Vulnerability Exposure models	Estimation of population exposure	Uses probit equation for population exposure
F-X and F-N curves	Individual / Societal risks	Graphical Representation

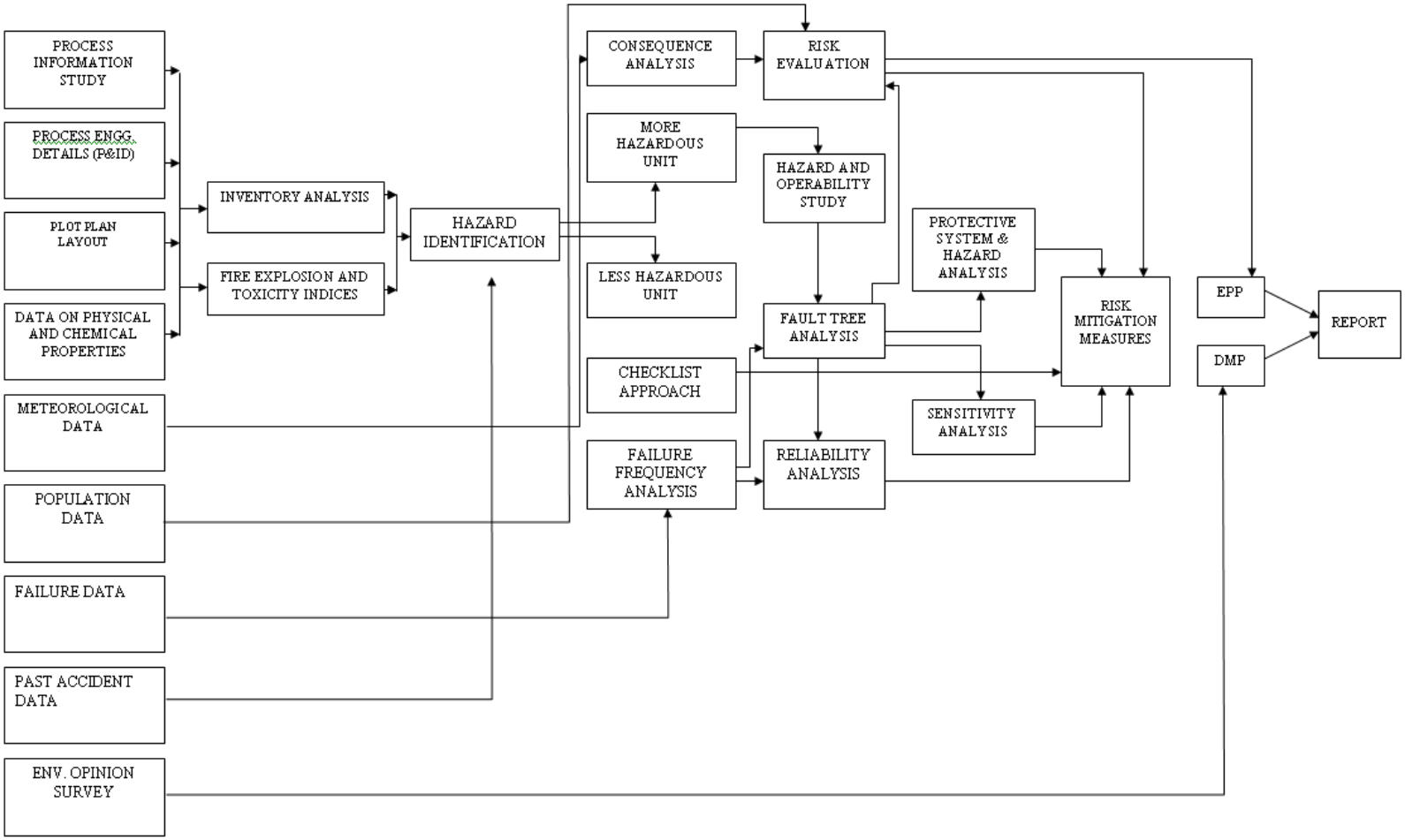


Figure 4-5: Comprehensive Risk Assessment - At a Glance

4.6.1 Storage and handling of hazardous materials

Both hazardous and non-hazardous materials generated within the manufacturing units in the project facility shall be temporarily accommodated in designated storage units within the project facility built/made in line with the safety, health and environmental standards.

Size of these temporary units would depend on the quantity and type of hazardous waste materials like asbestos, PCB, oils, fuels, *etc*., with appropriate storage capacities placed in the project facility in compliance with the Hazardous Waste Management and Handling Rules. In case of radioactive wastes, storage and handling should be based on Rules for Management of Radioactive Waste under AERB. Also, if gas cylinders must be stored in the facility, rules applicable for gas cylinders under the Explosives Act shall be followed. Later, these materials must be disposed off at a centralized disposal facility with utmost care following safety norms. Each unit in the facility should be have fire hydrant system to handle fire hazards.

4.6.2 Hazard identification

Hazard is the characteristic of any system or process which has the potential for accident. Identification of hazards, in presence of any hazardous waste generating units within the project facility is of primary significance in the analysis, quantification and cost-effective control of accidents involving chemicals and process.

Hence, all components of a system/unit need to be thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident.

Typical methods for hazard identification employed are:

- Identification of major hazardous units based on Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 of Government of India (as amended in 2000)
- Identification of hazardous units and segments of plants and storage units based on relative ranking technique, viz. Fire-Explosion and Toxicity Index (FE&TI).

Hazardous substances may be classified into three main categories namely flammable, unstable and toxic substances. Flammable substances require interaction with air for their hazard to be realized. Under certain circumstances, vapours arising from flammable substances when mixed with air may become explosive, especially in confined spaces. However, if present in sufficient quantity, such clouds may explode in open air also. Unstable substances are liquids or solids, which may decompose with such violence giving rise to blast waves. Besides, toxic substances are dangerous and cause substantial damage to life when released into the atmosphere. The ratings for a large number of chemicals based on flammability, reactivity and toxicity are provided in NFPA Codes 49 and 345 M.

4.6.3 Hazard assessment and evaluation

A preliminary hazard analysis shall be carried out to identify major hazards associated with storages in the facility. This is followed by consequence analysis to quantify these hazards. Finally the vulnerable zones are plotted for which risk reducing measures are deduced and implemented.

Frequent causes of accidents

- Fire and explosion: explosives, flammable material
- Being struck by falling objects
- Caught in/compressed
- Snapping of cables, ropes, chains, slings
- Handling heavy objects
- Electricity (electrocution)
- Poor illumination
- Falls from height inside industrial units or on the ground
- Struck by moving objects
- Slipping on wet surfaces
- Sharp objects
- Oxygen deficiency in confined spaces
- Lack of personal protective equipment (PPE), housekeeping practices, safety signs
- Hackles, hooks, chains
- Cranes, winches, hoisting and hauling equipment;

Hazardous substances and wastes

- Heavy and toxic metals (lead, mercury, cadmium, copper, zinc, *etc*.)
- Organometallic substances (tributyltin, *etc*.)
- Lack of hazard communication (storage, labelling, material safety data sheets)
- Batteries, fire-fighting liquids
- PCBs and PVC (combustion products)
- Welding fumes
- Volatile organic compounds (solvents)
- Inhalation in confined and enclosed spaces
- Physical hazards
- Noise
- Extreme temperatures
- Vibration
- Radiation (UV, radioactive materials)

Physical hazards

- Noise
- Extreme temperatures
- Vibration
- Radiation (UV, radioactive materials)

Mechanical hazards

- Trucks and transport vehicles
- Scaffolding, fixed and portable ladders
- Impact by tools, sharp-edged tools
- Power-driven hand tools, saws, grinders and abrasive cutting wheels
- Failure of machinery and equipment
- Poor maintenance of machinery and equipment
- Lack of safety guards in machines
- Structural failure

Biological hazards

- Toxic marine organisms (If the project facility is located in Coastal Regions)
- Risk of communicable diseases transmitted by pests, vermin, rodents, insects and other animals that may infest the project facility.
- Animal bites
- Vectors of infectious diseases (TB, malaria, dengue fever, hepatitis, respiratory infections, others)

Ergonomic and psychosocial hazards

- Repetitive strain injuries, awkward postures, repetitive and monotonous work, excessive workload
- Long working hours, shift work, night work, temporary employment
- Mental stress, human relations (aggressive behaviour, alcohol and drug abuse, violence)
- Poverty, low wages, minimum age, lack of education and social environment

General concerns

- Lack of safety and health training
- Poor work organization
- Inadequate housing and sanitation
- Inadequate accident prevention and inspection
- Inadequate emergency, first-aid and rescue facilities
- Lack of medical facilities and social protection

4.6.4 Disaster management plan

A disaster is a catastrophic situation in which suddenly, people are plunged into helplessness and suffering and, as a result, need protection, clothing, shelter, medical & social care and other necessities of life.

The Disaster Management Plan (DMP) is aimed to ensure safety of life, protection of environment, protection of installation, restoration of production and salvage operations in this same order of priorities. For effective implementation of DMP, it should be widely circulated and a personnel training is to be provided through rehearsals/drills.

To tackle the consequences of a major emergency inside the plant or immediate vicinity of the plant, a DMP has to be formulated and this planned emergency document is called DMP.

The objective of the DMP is to make use of the combined resources of the plant and the outside services to achieve the following:

- Effective rescue and medical treatment of casualties
- Safeguard other people
- Minimize damage to property and the environment
- Initially contain and ultimately bring the incident under control
- Identify any dead
- Provide for the needs of relatives
- Provide authoritative information to the news media

- Secure the safe rehabilitation of affected area
- Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the emergency

In effect, it is to optimize operational efficiency to rescue rehabilitation and render medical help and to restore normalcy.

The DMP should include emergency preparedness plan, emergency response team, emergency communication, emergency responsibilities, emergency facilities, and emergency actions

4.6.4.1 Emergency preparedness plan

Incidents, accidents and contingency preparedness should be accounted during construction and operation process. This shall be a part of EMS. Emergency Preparedness Plan (EPP) should be prepared following the National Environmental Emergency Plan and OSHA guidelines. According to these guidelines, an environmental emergency plan would essentially provide the following information:

- Assignment of duties and responsibilities among the authorities, participating agencies, response team, their coordinators and/or those responsible for the pollution incident
- Relationship with other emergency plans
- A reporting system that ensures rapid notification in the event of a pollution incident
- The establishment of a focal point for coordination and directions connected to the implementation of the plan
- Response operations should always cover these four phases:
  - Discovery and alarm
  - Evaluation, notification and plan invocation
  - Containment and counter measures
  - Cleanup and disposal
- Identification of expertise and response resources available for assistance for the implementation of plan
- Directions on the necessary emergency provisions applicable to the handling, treatment or disposal of certain pollutants
- Link to the local community for assistance, if necessary
- Support measures, such as procedures for providing public information, carrying out surveillance, issuing post-incident reports, review and updating of the plan, and periodic exercising of the plan.

4.6.4.2 Emergency response

Various units within the project facility are always subjected to accidents and incidents of many a kind. Therefore, a survey of potential incidents and accidents is to be carried out. Based on this, a plan for response to incidents, injuries and emergencies should be prepared. Response to emergencies should ensure that:

- The exposure of workers should be limited as much as possible during the operation

- Contaminated areas should be cleaned and, if necessary disinfected
- Limited impact on the environment at the extent possible.

Written procedures for different types of emergencies should be prepared and the entire workforce should be trained in emergency response. All relevant emergency response equipment should also be readily available.

With regard to dangerous spills, associated cleanup and firefighting operations should be carried out by specially allocated and trained personnel.

4.6.4.3 Response team

It is important to setup an Emergency Organization. A senior executive who has control over the affairs of the plant would be heading the Emergency Organization. He would be designated at Site Controller. Manager (Safety) would be designated as the Incident Controller. In case of stores, utilities, open areas, which are not under control of the Production Heads, Senior Executive responsible for maintenance of utilities would be designated as Incident Controller. All the Incident Controllers would be reporting to the Site Controller.

Each Incident Controller organizes a team responsible for controlling the incidence with the personnel under his control. Shift in charge would be the reporting officer, who would bring the incidence to the notice of the Incidence Controller and Site Controller.

Emergency Coordinators would be appointed who would undertake the responsibilities like firefighting, rescue, rehabilitation, transport and provide essential & support services. For this purposes, Security In charge, Personnel Department, Essential services personnel would be engaged. All these personnel would be designated as key personnel.

In each shift, electrical supervisor, electrical fitters, pump house in charge, and other maintenance staff would be drafted for emergency operations. In the event of power or communication system failure, some of staff members in the office/facility would be drafted and their services would be utilized as messengers for quick passing of communications. All these personnel would be declared as essential personnel.

4.6.4.4 Response to injuries

Based on a survey of possible injuries, a procedure for response to injuries or exposure to hazardous substances should be established. All staff should have minimum training to such response and the procedure ought to include the following:

- Immediate first aid, such as eye splashing, cleansing of wounds and skin, and bandaging
- Immediate reporting to a responsible designated person
- If possible, retention of the item and details of its source for identification of possible hazards
- Rapid additional medical care from medical personnel
- Medical surveillance

- Recording of the incident
- Investigation, determination and implementation of remedial action

It is vital that incident reporting should be straightforward so that reporting is actually carried out.

4.6.4.5 Emergency communication

Whoever notices an emergency situation such as fire, growth of fire, leakage, *etc*. would inform his immediate superior and Emergency Control Center. The person on duty in the Emergency Control Center, would appraise the Site Controller. Site Controller verifies the situation from the Incident Controller of that area or the Shift In charge and takes a decision about an impending On-site Emergency. This would be communicated to all the Incident Controllers, Emergency Coordinators. Simultaneously, the emergency warning system would be activated on the instructions of the Site Controller.

4.6.4.6 Emergency responsibilities

Responsibilities of the following key personnel should be defined:

- Site controller
- Incident controller
- Emergency coordinator - rescue, fire fighting
- Emergency coordinator-medical, mutual aid, rehabilitation, transport and communication
- Emergency coordinator - essential services
- Employers responsibility

4.6.4.7 Emergency facilities

- Emergency Control Center – with access to important personnel, telephone, fax, telex facility, safe contained breathing apparatus, hand tools, emergency shut down procedures, duties and contact details of key personnel and government agencies, emergency equipments, *etc*.
- Assembly Point – with minimum facilities for safety and rescue
- Emergency Power Supply – connected with diesel generator, flame proof emergency lamps, *etc*.
- Fire Fighting Facilities – first aid fire fighting equipments, fire alarms, *etc*.
- Location of wind Stock – located at appropriate location to indicate the direction of wind for emergency escape
- Emergency Medical Facilities – Stretchers, gas masks, general first aid, emergency control room, breathing apparatus, other emergency medical equipment, ambulance

4.6.4.8 Emergency actions

- Emergency warning
- Evacuation of personnel
- All clear signal

- Public information and warning
- Coordination with local authorities
- Mutual aid
- Mock drills

4.7 Mitigation Measures

The purpose of mitigation is to identify measures that safeguard the environment and the community affected by the proposal. Mitigation is both a creative and practical phase of the EIA process. It seeks to find the best ways and means of avoiding, minimizing and remedying impacts. Mitigation measures must be translated into action in right way and at the right time, if they are to be successful. This process is referred to as impact management and takes place during project implementation. A written plan should be prepared for this purpose, and should include a schedule of agreed actions. Opportunities for impact mitigation will occur throughout the project cycle.

4.7.1 Important considerations for mitigation methods

The responsibility of project proponents to 'internalize' the full environmental costs of development proposals is now widely accepted under "Polluter Pay" principle. In addition, many proponents have found that good design and impact management can result in significant savings applying the principles of cleaner production to improve their environmental performance.

- The predicted adverse environmental as well as social impacts for which mitigation measures are required should be identified and briefly summarized along with cross referencing them to the significance, prediction components of the EIA report or other documentation.
- Each mitigation measure should be briefly described w.r.t the impact of significances to which it relates and the conditions under which it is required (for example, continuously or in the event of contingencies). These should also be cross-referenced to the project design and operating procedures which elaborate on the technical aspects of implementing the various measures.
- Cost and responsibilities for mitigation and monitoring should be clearly defined, including arrangements for co-ordination among various Authorities responsible for mitigation.
- The proponent can use the EMP to develop environmental performance standards and requirements for the project site as well as supply chain. An EMP can be implemented through EMS for the operational phase of the project.

Prior to selecting mitigation plans it is appropriate to study the mitigation alternatives for cost-effectiveness, technical and socio-political feasibility. Such mitigation measures could include:

- avoiding sensitive areas such as eco-sensitive area *e.g.* fish spawning areas, dense mangrove areas or areas known to contain rare or endangered species
- adjusting work schedules to minimize disturbance
- engineered structures such as berms and noise attenuation barriers
- pollution control devices such as scrubbers and electrostatic precipitators

- changes in fuel feed, manufacturing, process, technology use, or waste management practices, *etc.*

4.7.2 Hierarchy of elements of mitigation plan

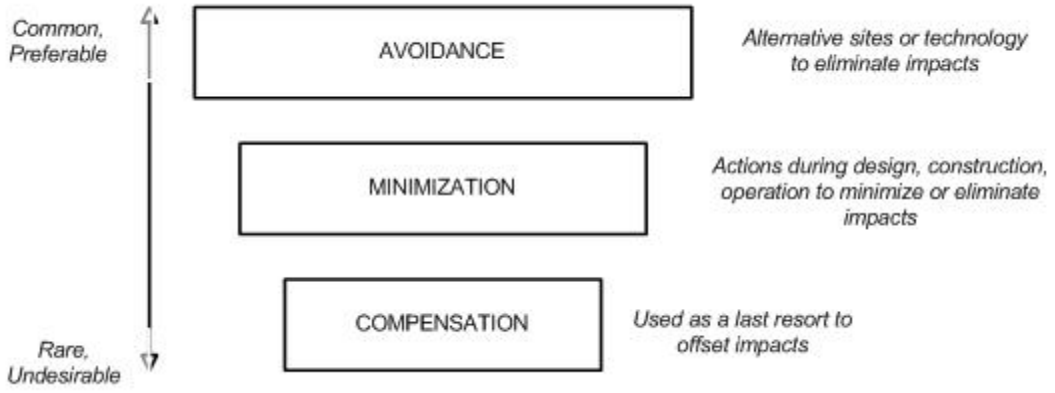


Figure 4-6: Elements of Mitigation

A good EIA practice requires technical understanding of relevant issues and the measures that work in such given circumstances: The priority of selection of mitigation measures should be in the order:

Step One: Impact avoidance

This step is most effective when applied at an early stage of project planning. It can be achieved by:

- not undertaking certain projects or elements that could result in adverse impacts
- avoiding areas that are environmentally sensitive; and
- putting in place the preventative measures to stop adverse impacts from occurring, for example, release of water from a reservoir to maintain a fisheries regime

Step Two: Impact minimization

This step is usually taken during impact identification and prediction to limit or reduce the degree, extent, magnitude, or duration of adverse impacts. It can be achieved by:

- scaling down or relocating the proposal
- redesigning elements of the project; and
- taking supplementary measures to manage the impacts

Step Three: Impact compensation

This step is usually applied to remedy unavoidable residual adverse impacts. It can be achieved by:

- rehabilitation of the affected site or environment, for example, by habitat enhancement and restocking fish
- restoration of the affected site or environment to its previous state or better, as typically required for mine sites, forestry roads and seismic lines

- replacement of the same resource values at another location. For example, by wetland engineering to provide an equivalent area to that lost to drainage or infill

Important compensation elements

Resettlement Plans: Special considerations apply to mitigation of proposals that displace or disrupt people. Certain types of projects, such as reservoirs and irrigation schemes and public works, are known to cause involuntary resettlement. This is a contentious issue because it involves far more than re-housing people; in addition, income sources and access to common property resources are likely to be lost. Almost certainly, a resettlement plan will be required to ensure that no one is worse off than before, which may not be possible for indigenous people whose culture and lifestyle is tied to a locality. This plan must include the means for those displaced to reconstruct their economies and communities and should include an EIA of the receiving areas. Particular attention should be given to indigenous, minority and vulnerable groups who are at higher risk from resettlement.

In-kind compensation

When significant or net residual loss or damage to the environment is likely, in kind compensation is appropriate. As noted earlier, environmental rehabilitation, restoration or replacement have become standard practices for many proponents. Now, increasing emphasis is given to a broader range of compensation measures to offset impacts and assure the sustainability of development proposals. These include impact compensation 'trading', such as offsetting CO_2 emissions by planting forests to sequester carbon.

4.7.3 Typical mitigation measures

Choice of location for the developmental activity plays an important role in preventing the adverse impacts on the surrounding environment. Detailed guidelines on siting of industries are provided in Section 4.2. However, if the developmental activity produces any more adverse impacts, mitigation measures should be taken.

Previous subsections of the Section 4.7 could be precisely summarized into following:

- Impacts from a developmental project could have many dimensions. As most of the direct impacts are caused by releases from developmental projects, often control at source is the best opportunity to either eliminate or mitigate the impacts, in case these are cost-effective. In other words, the best way to mitigate impacts is to prevent them from occurring. Choice of raw materials/technologies/processes which produce least impact would be one of the options to achieve it.
- After exploring cost-effective feasible alternatives to control impacts at source, various interventions to minimize the adverse impacts may be considered. These interventions, primarily aim at reducing the residual impacts on the valued environmental components of the receiving environment to the acceptable concentrations.
- Degree of control at source and external interventions differs from situation-to - situation and is largely governed by techno-economic feasibility. While the regulatory bodies stress for further source control (due to high reliability), the project proponents bargain for other interventions which may be relatively cost-effective than further control at source (in any case project authority is required to meet the industry-specific standards by adopting the best practicable technologies. However,

if the location demands further control at source, then the proponents are required to adopt further advanced control technologies *i.e*. towards best available control technologies). After having discussions with the project proponent, EAC/SEAC reaches to an agreed level of source control+other interventions (together called as mitigation measures in the given context) that achieve the targeted protection levels for the VECs in the receiving environment. These levels will become the principle clearance conditions.

- Chapter 3 of this TGM offers elaborate information on cleaner technologies, waste minimization opportunities, and control technologies for various kinds of polluting parameters that emanate from TSDF. This information may be used to draw appropriate control measures applicable at source.

The choice of interventions for mitigation of impacts may also be numerous and depend on various factors. Mitigation measures based on location-specific suitability and some other factors are discussed in sub-sections 4.7.1 and 4.7.2. A few typical measures which may also be explored for mitigation of impacts are listed in Table 4-7.

Table 4-5: Typical Mitigation Measures

Impacts	Typical Mitigation Measures
Soil erosion	▪ Windscreens, maintenance, and installation of ground cover ▪ Installation of drainage ditches ▪ Runoff and retention ponds ▪ Minimize disturbances and scarification of the surface ▪ Usage of appropriate monitoring and control facilities for construction equipments deployed ▪ Methods to reuse earth material generated during excavation, *etc*.
Resources – fuel/construction material, *etc*.	▪ Optimization of resource use ▪ Availing resources with least impact – eco-efficiency options are applicable ▪ Availing the resources which could be replenished by natural systems, *etc.*
Deforestation	▪ Planting or creating similar areas ▪ Initiating a tree planning program in other areas ▪ Donating land to conservationalist groups, *etc*.
Water pollution	▪ Conjunctive use of ground/surface water, to prevent flooding/water logging/depletion of water resources. Included are land use pattern, land filling, lagoon/reservoir/garland canal construction, and rainwater harvesting and pumping rate. ▪ Minimise flow variation from the mean flow ▪ Storing of oil wastes in lagoons should be minimised in order to avoid possible contamination of the ground water system. ▪ All effluents containing acid/alkali/organic/toxic wastes should be properly treated ▪ Collection and treatment of lechate, sewage and storm water run-off ▪ Increased recycling of treated lechate ▪ Monitoring of ground waters ▪ Use of biodegradable or otherwise readily treatable additives ▪ Neutralization and sedimentation of wastewaters, where applicable ▪ Dewatering of sludges and appropriate disposal of solids ▪ Construction of liners before disposing waste ▪ In case of oil waste, oil separation before treatment and discharge into the environment

Impacts	Typical Mitigation Measures
	▪ Controlling discharge of sanitary sewage and industrial waste into the environment ▪ By avoiding the activities that increases erosion or that contributes nutrients to water (thus stimulating alga growth) ▪ For wastes containing high TDS, treatment methods include removal of liquid and disposal of residue by controlled landfilling to avoid any possible leaching of the fills ▪ All surface runoffs around mines or quarries should be collected treated and disposed. ▪ Treated wastewater (such as sewage, industrial wastes, or stored surface runoffs) can be used as cooling water makeup. ▪ Wastewater carrying radioactive elements should be treated separately by means of de-watering procedures, and solids or brine should be disposed of with special care. ▪ Develop spill prevention plans in case of chemical discharges and spills ▪ Develop traps and containment system and chemically treat discharges on site, *etc*.
Air Pollution	▪ Attenuation of pollution/protection of receptor through green belts/green cover ▪ Use of particulate removal devices such as cyclones, setting chambers, scrubbers, electrostatic precipitators, bag houses, *etc*. ▪ Use of gas removal devices using absorption (liquid as a media), adsorption (molecular sieve), and catalytic converters ▪ Use of protected, controlled equipments such as oxygen masks, *etc*. ▪ Control of stationary source emission (including evaporation, incineration, absorption, condensation, and material substitution) ▪ Dilution of odourant (dilution can change the nature as well as strength of an odour), odour counteraction or neutralise (certain pairs of odours in appropriate concentrations may neutralise each other), odour masking or blanketing (certain weaker malodours may be suppressed by a considerably stronger good odour). ▪ Regular monitoring of air polluting concentrations, *etc*.
Dust pollution	▪ Wetting of roadways to reduce traffic dust and reentrained particles ▪ Installation of windscreens to breakup the wind flow ▪ Burning of refuse on days when meteorological conditions provide for good mixing and dispersion ▪ Providing dust collection equipment at all possible points ▪ Maintaining dust levels within permissible limits ▪ Provision for masks when dust level exceeds, *etc*.
Noise pollution	▪ Use of heavy duty muffler systems on heavy equipment ▪ Limiting certain activities ▪ By using damping, absorption, dissipation, and deflection methods ▪ Use of common techniques such as constructing sound enclosures, applying mufflers, mounting noise sources on isolators, and/or using materials with damping properties ▪ Performance specifications for noise represent a way to insure the procured item is controlled ▪ Use of ear protective devices ▪ In case of steady noise levels above 85-dB (A), initiation of hearing conservation measures, *etc*.
Biological	▪ Installation of systems to discourage nesting or perching of birds in dangerous environments

Impacts	Typical Mitigation Measures
	▪ Increased employee awareness to sensitive areas
Social	▪ Health and safety measures for workers ▪ Development of traffic plan that minimizes road use by workers ▪ Upgradation of roads and intersections ▪ Provide suffiecient counselling and time to the affected population for relocation ▪ Discuss and finalize alternate arrangements and associated infrastructure in places of religious importance ▪ Exploration of alternative approach routes in consultation with local community and other stakeholders ▪ Provision of alternate jobs in unskilled and skilled categories, *etc*.
Occupational health and safety	▪ Provision of worker camps with proper santiation and medical facilities, as well as making the worker camps self- sufficient with resources like water supply, power supply, etc ▪ Arrangement of periodic health check-ups for early detection and control of communicatble diseases. ▪ Arrangement to dispose off the wastes at approved disposal sites. ▪ Provide preventive measures for potentital fire hazards with requisite fire detection, fire-fighting facilities and adequate water storage, *etc*.
Construction	▪ Have a Transport Management Plan in place in order to prevent/minimize the disturbance on surrounding habitats ▪ Initiate traffic density studies, *etc*.

4.8 Environmental Management Plan

A typical EMP shall be composed of the following:

1. summary of potential impacts of the proposal
2. description of recommended mitigation measures
3. Description of monitoring programme to ensure compliance with relevant standards and residual impacts
4. allocation of resources and responsibilities for plan implementation
5. Implementation schedule and reporting procedures
6. contingency plan when impacts are greater than expected

Summary of impacts: The predicted adverse environmental and social impacts for which mitigation measures are identified in earlier sections to be briefly summarized with cross referencing to the corresponding sections in EIA report.

Description of mitigation measures: Each mitigation measure should be briefly described w.r.t the impact to which it relates and the conditions under which it is required. These should be accompanied by, or referenced to, project design and operating procedures which elaborate on the technical aspects of implementing various measures.

Description of monitoring programme to ensure compliance with relevant standards and residual impacts: Environmental monitoring refers to compliance monitoring and residual impact monitoring. Compliance monitoring refers to meeting the industry-specific statutory compliance requirements (Ref. Applicable National regulations as detailed in Chapter 3).

Residual impact monitoring refers to monitoring of identified sensitive locations with adequate number of samples and frequency. The monitoring programme should clearly indicate the linkages between impacts identified in the EIA report, measurement indicators, detection limits (where appropriate), and definition of thresholds that will signal the need for corrective actions.

Allocation of resources and responsibilities for plan implementation: These should be specified for both the initial investment and recurring expenses for implementing all measures contained in the EMP, integrated into the total project costs, and factored into loan negotiation.

The EMP should contain commitments that are binding on the proponent in different phases of project implementation *i.e.,* pre-construction or site clearance, construction, operation, decommissioning.

Responsibilities for mitigation and monitoring should be clearly defined, including arrangements for co-ordination between various factors responsible for mitigation. Details should be provided w.r.t the deployment of staff (detailed organogram), monitoring network design, parameters to be monitored, analysis methods, associated equipments, *etc*.

Implementation schedule and reporting procedures: The timing, frequency and duration of mitigation measure should be specified in an implementation schedule, showing links with overall project implementation. Procedures to provide information on progress and results of mitigation and monitoring measures should also be clearly specified.

Contingency Plan when the impacts are greater than expected: There shall be a contingency plan for attending the situations where the monitoring results shows residual impacts are higher than expected. It is an imperative requirement for all project Authorities to plan additional programmes to deal with the situation, after duly intimating the concerned local regulatory bodies.

4.9 Reporting

Structure of the EIA report (Appendix III of the EIA Notification), applicable to the TSDFs is given in Table 4-8. Each task prescribed in ToR shall be incorporated appropriately in the contents in addition to the contents described in the Table.

Table 4-6: Structure of EIA Report

S.NO	EIA STRUCTURE	CONTENTS
1.	Introduction	▪ Purpose of the report ▪ Identification of project & project proponent ▪ Brief description of nature, size, location of the project and its importance to the country, region ▪ Scope of the study – details of regulatory scoping carried out (As per the ToR)
2.	Project Description	Condensed description of those aspects of the project (based on project feasibility study), likely to cause environmental effects. Details should be provided to give clear picture of the following: ▪ Type of project

S.NO	EIA STRUCTURE	CONTENTS
		▪ Need for the project ▪ Location (maps showing general location, specific location, project boundary & project site layout) ▪ Size or magnitude of operation (incl. Associated activities required by or for the project) ▪ Proposed schedule for approval and implementation ▪ Technology and process description ▪ Project description including drawings showing project layout, components of project *etc*. Schematic representations of the feasibility drawings which give information important for EIA purpose ▪ Description of mitigation measures incorporated into the project to meet environmental standards, environmental operating conditions, or other EIA requirements (as required by the scope) ▪ Assessment of New & untested technology for the risk of technological failure
3.	Description of the Environment	▪ Study area, period, components & methodology ▪ Establishment of baseline for VECs, as identified in the scope ▪ Base maps of all environmental components
4.	Anticipated Environmental Impacts & Mitigation Measures	▪ Details of Investigated Environmental impacts due to project location, possible accidents, project design, project construction, regular operations, final decommissioning or rehabilitation of a completed project ▪ Measures for minimizing and / or offsetting adverse impacts identified ▪ Irreversible and irretrievable commitments of environmental components ▪ Assessment of significance of impacts (Criteria for determining significance, assigning significance) ▪ Mitigation measures
5.	Analysis of Alternatives (Technology & Site)	▪ Incase, the scoping exercise results in need for alternatives: ▪ Description of each alternative ▪ Summary of adverse impacts of each alternative ▪ Mitigation measures proposed for each alternative and selection of alternative
6.	Environmental Monitoring Program	▪ Technical aspects of monitoring the effectiveness of mitigation measures (incl. Measurement methodologies, frequency, location, data analysis, reporting schedules, emergency procedures, detailed budget & procurement schedules)
7.	Additional Studies	▪ Public consultation ▪ Risk assessment ▪ Social impact assessment, R&R action plans
8.	Project Benefits	▪ Improvements in the physical infrastructure ▪ Improvements in the social infrastructure ▪ Employment potential –skilled; semi-skilled and unskilled ▪ Other tangible benefits
9.	Environmental Cost Benefit Analysis	▪ If recommended at the Scoping stage
10.	EMP	▪ Description of the administrative aspects that ensure proper implementation of mitigative measures and their

S.NO	EIA STRUCTURE	CONTENTS
		effectiveness monitored, after approval of the EIA
11.	Summary & Conclusion (This will constitute the summary of the EIA Report)	▪ Overall justification for implementation of the project ▪ Explanation of how, adverse effects have been mitigated
12.	Disclosure of Consultants engaged	▪ Names of the Consultants engaged with their brief resume and nature of Consultancy rendered

4.10 Public Consultation

Public consultation refers to the process by which the concerns of local affected people and others who have plausible stake in the environmental impacts of the project or activity are ascertained.

- Public consultation is not a decision taking process, but is a process to collect views of the people having plausible stake. If the SPCB/Public agency conducting public hearing is not convinced with the plausible stake, then such expressed views need not be considered.
- Public consultation involves two components, one is public hearing, and other one is inviting written responses/objections through Internet/by post, *etc*., by placing the summary of EIA report on the website.
- All Category A and Category B1 projects require public hearing except the following:
  - Once prior environmental clearance is granted to an industrial estates/SEZs/EPZs *etc*., for a given composition (type and capacity) of industries, then individual units will not require public hearing
  - Expansion of roads and highways, which do not involve any further acquisition of land.
  - All building/ construction projects/ area development projects/townships
  - All Category B2 projects
  - All projects concerning national defense and security or involving other strategic considerations as determined by the Central Government
- Public hearing shall be carried out at the site or in its close proximity, district-wise, for ascertaining concerns of local affected people.
- Project proponent shall make a request through a simple letter to the Member–Secretary of the SPCB or UTPCC to arrange public hearing.
- Project proponent shall enclose with the letter of request, at least 10 hard copies and 10 soft copies of the draft EIA report including the summary EIA report in English and in official language of the state/local language prepared as per the approved scope of work, to the concerned Authority.
- Simultaneously, project proponent shall arrange to send, one hard copy and one soft copy, of the above draft EIA report along with the summary EIA report to the following Authorities within whose jurisdiction the project will be located:
  - District magistrate/District Collector/Deputy Commissioner(s)
  - Zilla parishad and municipal corporation or panchayats union
  - District industries office

- Urban local bodies (ULBs)/PRIs concerned/development authorities
- Concerned regional office of the MoEF/SPCB

- Above mentioned Authorities except regional office of MoEF shall arrange to widely publicize the draft EIA report within their respective jurisdictions requesting the interested persons to send their comments to the concerned regulatory Authorities. They shall also make draft EIA report for inspection electronically or otherwise to the public during normal office hours till the public hearing is over.
- Concerned regulatory Authority (MoEF/SEIAA/UTEIA) shall display the summary of EIA report on its website and also make full draft EIA report available for reference at a notified place during normal office hours at their head office.
- SPCB or UTPCC concerned shall also make similar arrangements for giving publicity about the project within the State/UT and make available the summary of draft EIA report for inspection in select offices, public libraries or any other suitable location, *etc*. They shall also additionally make available a copy of the draft EIA report to the above five authorities/offices as mentioned above.
- The Member–Secretary of the concerned SPCB or UTPCC shall finalize the date, time and exact venue for the conduct of public hearing within seven days of the date of the receipt of the draft EIA report from the project proponent and advertise the same in one major National Daily and one regional vernacular Daily/Official State Language.
- A minimum notice period of 30 (thirty) days shall be provided to the public for furnishing their responses.
- No postponement of the date, time, venue of the public hearing shall be undertaken, unless some untoward emergency situation occurs. only in case of emergencies and up on recommendation of the concerned District Magistrate/District Collector/Deputy Commissioner, the postponement shall be notified to the public through the same National and Regional vernacular dailies and also prominently displayed at all the identified offices by the concerned SPCB or UTPCC.
- In the above exceptional circumstances fresh date, time and venue for the public consultation shall be decided by the Member–Secretary of the concerned SPCB or UTPCC only in consultation with the District Magistrate/District Collector/Deputy Commissioner, and notified afresh as per the procedure.
- The District Magistrate/District Collector/Deputy Commissioner, or his or her representative not below the rank of an Additional District Magistrate assisted by a representative of SPCB/UTPCC, shall supervise and preside over the entire public hearing process.
- The SPCB/UTPCC shall arrange to video film the entire proceedings. A copy of the videotape or a CD shall be enclosed with the public hearing proceedings while forwarding it to the Regulatory Authority concerned.
- The attendance of all those who are present at the venue shall be noted and annexed with the final proceedings
- There shall be *no quorum* required for attendance for starting the proceedings
- Persons present at the venue shall be granted the opportunity to seek information or clarifications on the project from the proponent. The summary of the public hearing proceedings accurately reflecting all the views and concerns expressed shall be recorded by the representative of the SPCB/UTPCC and read over to the audience at the end of the proceedings explaining the contents in the local/vernacular language

and the agreed minutes shall be signed by the District Magistrate/District Collector/Deputy Commissioner, or his or her representative on the same day and forwarded to the SPCB/UTPCC concerned.

- A statement of the issues raised by the public and the comments of the proponent shall also be prepared in the local language or the official State language, as the case may be, and in English and annexed to the proceedings.
- The proceedings of the public hearing shall be conspicuously displayed at the office of the Panchayats within whose jurisdiction the project is located, office of the concerned Zilla Parishad, District Magistrate/District Collector/Deputy Commissioner, and the SPCB/UTPCC. The SPCB or UTPCC shall also display the proceedings on its website for general information. Comments, if any, on the proceedings, may be sent directly to the concerned regulatory authorities and the applicant concerned.
- The public hearing shall be completed within a period of forty five (45) days from date of receipt of the request letter from the applicant. Therefore the SPCB/UTPCC concerned shall send the public hearing proceedings to the concerned regulatory authority within 8 (eight) days of the completion of the public hearing. Simultaneously, a copy will also be provided to the project proponent. The proponent may also directly forward a copy of the approved public hearing proceedings to the regulatory authority concerned along with the final EIA report or supplementary report to the draft EIA report prepared after the public hearing and public consultations incorporating the concerns expressed in the public hearing along with action plan and financial allocation, item-wise, to address those concerns.
- Upon receipt of the same, the Authority will place executive summary of the report on the website to invite responses from other concerned persons having a plausible stake in the environmental aspects of the project or activity.
- If SPCB/UTPCC is unable to conduct the public hearing in the prescribed time, the Central Government incase of Category A projects and State Government or UT administration in case of Category B projects at the request of the SEIAA can engage any other agency or Authority for conducting the public hearing process within a further period of 45 days. The respective governments shall pay the appropriate fee to the public agency for conducting public hearing.
- A public agency means a non-profit making institution/body such as technical/ academic institutions, government bodies not subordinate to the concerned Authority.
- If SPCB/Public Agency authorized for conducting public hearing informs the Authority, stating that it is not possible to conduct the public hearing in a manner, which will enable the views of the concerned local persons to be freely expressed, then Authority may consider such report to take a decision that in such particular case, public consultation may not have the component of public hearing.
- Often restricting the public hearing to the specific district may not serve the entire purpose, therefore, NGOs who are local and registered under the Societies Act in the adjacent districts may also be allowed to participate in public hearing, if they so desire.
- Confidential information including non-disclosable or legally privileged information involving intellectual property right, source specified in the application shall not be placed on the website.

- The Authority shall make available on a written request from any concerned person the draft EIA report for inspection at a notified place during normal office hours till the date of the public hearing.
- While mandatory requirements will have to be adhered to, utmost attention shall be given to the issues raised in the public hearing for determining the modifications needed in the project proposal and the EMP to address such issues.
- Final EIA report after making needed amendments, as aforesaid, shall be submitted by the applicant to the concerned Authority for prior environmental clearance. Alternatively, a supplementary report to draft EIA and EMP addressing all concerns expressed during the public consultation may be submitted.

4.11 Appraisal

Appraisal means the detailed scrutiny by the EAC or SEAC of the application and the other documents like the final EIA report, outcome of the public consultation including public hearing proceedings submitted by the applicant for grant of environmental clearance.

- The appraisal shall be made by EAC to the Central Government or SEAC to SEIAA.
- Project proponent either personally or through consultant can make a presentation to EAC/SEAC for the purpose of appraising the features of the project proposal and also to clarify the issues raised by the members of the EAC/SEAC.
- On completion of these proceedings, concerned EAC/SEAC shall make categorical recommendations to the respective Authority, either for grant of prior environmental clearance on stipulated terms & conditions, if any, or rejection of the application with reasons.
- In case EAC/SEAC needs to visit the site or obtain further information before being able to make categorical recommendations, EAC/SEAC may inform the project proponent accordingly. In such an event, it should be ensured that the process of environmental clearance is not unduly delayed to go beyond the prescribed timeframe.
- Upon the scrutiny of the final report, if EAC/SEAC opines that ToR for EIA studies finalized at the scoping stage are covered by the proponent, then the project proponent may be asked to provide such information. If such information is declined by the project proponent or is unlikely to be provided early enough so as to complete the environmental appraisal within prescribed time of 60 days, the EAC/SEAC may recommend for rejection of the proposal with the same reason.
- Appraisal shall be strictly in terms of ToR for EIA studies finalized at the scoping stage and the concerns expressed during public consultation.
- This process of appraisal shall be completed within 60 days from the receipt of the updated EIA and EMP reports, after completing public consultation.
- The EIA report will be typically examined for following:
  - Project site description supported by topographic maps & photographs – detailed description of topography, land use and activities at the proposed project site and its surroundings (buffer zone) supported by photographic evidence.
  - Clarity in description of drainage pattern, location of eco-sensitive areas, vegetation characteristics, wildlife status - highlighting significant environmental

attributes such as feeding, breeding and nesting grounds of wildlife species, migratory corridor, wetland, erosion and neighboring issues.

- Description of the project site – how well the interfaces between the project related activities and the environment have been identified for the entire project cycle *i.e*. construction, operation and decommissioning at the end of the project life.
- How complete and authentic are the baseline data pertaining to flora and fauna and socio-economic aspects?
- Citing of proper references, with regard to the source(s) of baseline data as well as the name of the investigators/ investigating agency responsible for collecting the primary data.
- How consistent are the various values of environmental parameters with respect to each other?
- Is a reasonable assessment of the environmental and social impact made for the identified environmental issues including project affected people?
- To what extent the proposed environmental plan will mitigate the environmental impact and at what estimated cost, shown separately for construction, operation and closure stages and also separately in terms of capital and recurring expenses along with details of agencies that will be responsible for the implementation of environmental plan/ conservation plan.
- How well the concerns expressed/highlighted during the Public hearing have been addressed and incorporated in the EMP giving item wise financial provisions and commitments (in quantified terms)?
- How far the proposed environmental monitoring plan will effectively evaluate the performance of the EMP? Are details for environmental monitoring plan provided in the same manner as the EMP?
- Identification of hazard and quantification of risk assessment and whether appropriate mitigation plan has been included in the EMP?
- Does the proposal include a well formulated time bound green belt development plan for mitigating environmental problems such as fugitive emission of dust, gaseous pollutants, noise, odour, *etc*.
- Does EIA make a serious attempt to guide the project proponent for minimizing the requirement of natural resources including land, water energy and other non renewable resources?
- How well has the EIA statement been organized and presented so that the issues, their impact and environmental management strategies emerge clearly from it and how well organized was the power point presentation made before the expert committee?
- Is the information presented in the EIA adequately and appropriately supported by maps, imageries and photographs highlighting site features and environmental attributes?

4.12 Decision Making

The Chairperson reads the sense of the Committee and finalizes the draft minutes of the meeting, which are circulated by the Secretary to all expert members invited to the meeting. Based on the response from the members, the minutes are finalized and signed

by the Chairperson. This process for finalization of the minutes should be so organized that the time prescribed for various stages is not exceeded.

Approval / Rejection / Reconsideration

- The Authority shall consider the recommendations of concerned appraisal Committee and convey its decision within 45 days of the receipt of recommendations.
- If the Authority disagrees with the recommendations of the Appraisal Committee, then reasons shall be communicated to concerned Appraisal Committee and applicant with in 45 days from the receipt of the recommendations. The Appraisal Committee concerned shall consider the observations of the Authority and furnish its views on the observations within further period of 60 days. The Authority shall take a decision within the next 30 days based on the views of appraisal Committee.
- If the decision of the Authority is not conveyed within the time, then the proponent may proceed as if the environmental clearance sought has been granted or denied by the regulatory authority in terms of the final recommendation of the concerned appraisal Committee. For this purpose, the decision of the Appraisal Committee will be public document, once the period specified above for taking the decision by the Authority is over.
- In case of Category B projects, application shall be received by the Member–Secretary of the SEIAA and clearance shall also be issued by the same SEIAA.
- Deliberate concealment and/or submission of false or misleading information or data which is material to screening or scoping or appraisal or decision on the application shall make the application liable for rejection, and cancellation of prior environmental clearance granted on that basis. Rejection of an application or cancellation of a prior environmental clearance already granted, on such ground, shall be decided by the regulatory authority, after giving a personal hearing to the applicant, and following the principles of natural justice.

If approved

- The concerned MoEF/SEIAA will issue a prior environmental clearance for the project.
- The project proponent should make sure that the award of environmental clearance is properly publicized in at least two local newspapers of the district or state where the proposed project is located. For instance, the executive summary of the environmental clearance may be published in the newspaper along with the information about the location (website/office where it is displayed for public) where the detailed environmental clearance is made available. The MoEF and SEIAA/UTEIAA, as the case may be, shall also place the environmental clearance in the public domain on Government Portal. Further copies of the environmental clearance shall be endorsed to the Heads of local bodies, Panchayats and Municipal bodies in addition to the relevant offices of the Government.
- The environmental clearance will be valid from the start date to actual commencement of the production of the developmental activity.
- Usual validity period will be 5 years from the date of issuing environmental clearance, unless specified by EAC/SEAC.

- A prior environmental clearance issued to a project proponent can be transferred to another legal person entitled to undertake the project, upon application by the transferor to the concerned Authority or submission of no-objection of the transferor by the transferee to the concerned Authority for the concurrence. In this case, EAC/SEAC concurrence is not required, but approval from the concerned authority is required to avail the same project configurations, validity period transferred to the new legally entitled person to undertake the project.

4.13 Post-clearance Monitoring Protocol

The MoEF, Government of India will monitor and take appropriate action under the EP Act, 1986.

- In respect of Category A projects, it shall be mandatory for the project proponent to make public the environmental clearance granted for their project along with the environmental conditions and safeguards at their cost by advertising it at least in two local newspapers of the district or State where the project is located and in addition, this shall also be displayed in the project proponents website permanently.
- In respect of Catgeory B projects, irrespective of its clearance by MoEF/SEIAA, the project proponent shall prominently advertise in the newspapers indicating that the project has been accorded environment clearance and the details of MoEF website where it is displayed.
- The MoEF and the SEIAA/UTEIAA, as the case may be, shall also place the environmental clearance in the public domain on Government Portal.
- Copies of environmental clearance shall be submitted by the project proponents to the Heads of the local bodies, Panchayats and Municipal bodies in addition to the relevant offices of the Government who in turn have to display the same for 30 days from the date of receipt.

The project proponent must submit quarterly compliance reports in respect of the stipulated prior environmental clearance terms and conditions in hard and soft copies to the regulatory authority concerned, on 1st June and 1st December of each calendar year.

All such compliance reports submitted by the project management shall be public documents. Copies of the same shall be given to any person on application to the concerned regulatory authority. Such latest compliance report shall also be displayed on the web site of the concerned regulatory Authority

The SPCB shall incorporate EIA clearance conditions into consent conditions in respect of Category A and Category B projects and in parallel shall monitor and enforce the same.

For performance evaluation of TSDFs with common hazardous waste incinerators, certain basic information has to be provided by the operator of facility (operator) at the time of setting up of the facility or prior to the commissioning of the facility. This would be a one-time exercise. Format for basic information which needs to be submitted by the operator of the facility is given in **Annexure XVI.**

Information on operation of TSDF on quarterly basis is required to be submitted by the facility operator to SPCB/PCC (with a copy to CPCB and MoEF) within fifteen days of end of the quarter. The format of the periodic information is placed at **Annexure XVII.**

Monitoring protocol to be followed for the TSDFs with secured landfills/incinerators/both during the operation phase is placed at **Annexure XVIII.**

5. STAKEHOLDERS' ROLES AND RESPONSIBILITIES

Prior environmental clearance process involves many stakeholders *i.e.*, Central Government, State Government, SEIAA, EAC at the National Level, SEAC, Public Agency, SPCB, the project proponent, and the public.

- Roles and responsibilities of the organisations involved in different stages of prior environmental clearance are given in Table 5-1.
- Organization-specific functions are listed in Table 5-2.

In this Chapter, constitution, composition, functions, *etc*., of the Authorities and the Committees are discussed in detail.

Table 5-1: Roles and Responsibilities of Stakeholders Involved in Prior Environmental Clearance

Stage	MoEF/ SEIAA	EAC/ SEAC	Project Proponent	EIA Consultant	SPCB/ Public Agency	Public and Interest Group
Screening	Receives application and takes advise of EAC/ SEAC	Advises the MoEF/ SEIAA	Submits application (Form 1) and provides necessary information	Advises and assists the proponent by providing technical information		
Scoping	Approves the ToR, communicates the same to the project proponent and places the same in the website	Reviews the ToR, visits the proposed site, if required and recommends the ToR to the MoEF/ SEIAA	Submits the draft ToR to SEIAA and facilitates the visit of the EAC/SEAC members to the project site	Prepares ToR		
EIA Report & Public Hearing	Reviews and forwards copies of the EIA report to SPCB /public agency for conducting public hearing Places the		Submits detailed EIA report as per the finalized ToR Facilitates the public hearing by arranging presentation on the project, EIA and EMP – takes note of objections and updates the	Prepares the EIA report Presents and appraises the likely impacts and pollution control measures proposed in the public hearing	Reviews EIA report and conducts public hearing in the manner prescribed Submits proceedings and views of SPCB, to	Participates in public hearings and offers comments and observations. Comments can be sent directly to SEIAA through

Stage	MoEF/ SEIAA	EAC/ SEAC	Project Proponent	EIA Consultant	SPCB/ Public Agency	Public and Interest Group
	summary of EIA report in the website Conveys objections to the project proponent for update, if any		EMP accordingly		the Authority and the project proponent as well	Internet in response to the summary placed in the website
Appraisal and Clearance	Receives updated EIA Takes advice of EAC/ SEAC, approves EIA and attaches the terms and conditions	Critically examines the reports, presentation of the proponent and appraises MoEF/ SEIAA (recommendations are forwarded to MoEF/ SEIAA)	Submits updated EIA, EMP reports to MoEF/SEIAA. Presents the overall EIA and EMP including public concerns to EAC/SEAC	Provides technical advise to the project proponent and if necessary presents the proposed measures for mitigation of likely impacts (terms and conditions of clearance)		
Post-clearance Monitoring			Implements environmental protection measures prescribed and submits periodic monitoring results	Conducts periodic monitoring	Incorporates the clearance conditions into appropriate consent conditions and ensures implementation	

Table 5-2: Organization-specific Functions

Organization	Functions
Central Government	▪ Constitutes the EAC ▪ Considering recommendations of the State Government, constitutes the SEIAA & SEAC ▪ Receives application from the project proponent in case of Category A projects or Category B projects attracting general condition ▪ Communicates the ToR finalized by the EAC to the project proponent. ▪ Receives EIA report from the project proponent and soft copy of summary of the report for placing in the website

Organization	Functions
	▪ Summary of EIA report will be placed in website. Forwards the received responses to the project proponent ▪ Engages other public agency for conducting public hearings in cases where the SPCB does not respond within time ▪ Receives updated EIA report from project proponent incorporating the considerations from the proceedings of public hearing and responses received through other media ▪ Forwards updated EIA report to the EAC for appraisal ▪ Either accepts the recommendations of EAC or asks for reconsideration of specific issues for review by the EAC. ▪ Takes the final decision – acceptance/ rejection – of the project proposal and communicates the same to the project proponent
State Government	▪ Identifies experts as per the composition specified in the Notification and subsequent guidelines to recommend to the the Central Government. ▪ Extends funding support to fulfill the functions of SEIAA/SEAC ▪ Engages other public agency for conducting public hearings in cases where the SPCB does not respond within time ▪ State Governments will suitably pay the public agency for conducting such activity
EAC	▪ Reviews Form 1 and its attachments ▪ Visits site(s), if necessary ▪ Finalises ToR and recommends to the Central Government, which in turn communicates the finalized ToR to the project proponent, if not exempted by the Notification ▪ Reviews EIA report, proceedings and appraises their views to the Central government ▪ If the Central Government has any specific views, then the EAC reviews again for appraisal
SEIAA	▪ Receives application from the project proponent ▪ Considers SEAC's views for finalization of ToR ▪ Communicates the finalized ToR to the project proponent ▪ Receives EIA report from project proponent ▪ Uploads the summary of EIA report in the website in cases of Category B projects ▪ Forwards the responses received to the project proponent ▪ Receives updated EIA report from project proponent incorporating the considerations from the proceedings of public hearing and responses received through other media ▪ Forwards updated EIA report to SEAC for appraisal ▪ Either accepts the recommendations of SEAC or asks for reconsideration of specific issues for review by SEAC. ▪ Takes the final decision and communicates the same to the project proponent
SEAC	▪ Reviews Form 1 ▪ If necessary visits, site(s) for finalizing the ToR ▪ Reviews updated EIA - EMP report and ▪ Appraises the SEIAA
SPCB	▪ Receives request from project proponent and conducts public hearing in the manner prescribed. ▪ Conveys proceedings to concerned authority and project proponent
Public Agency	▪ Receives request from the respective Governments to conduct public hearing ▪ Conducts public hearing in the manner prescribed. ▪ Conveys proceedings to the concerned Authority/EAC /Project proponent

5.1 SEIAA

- SEIAA is constituted by the MoEF to take final decision regarding the acceptance/rejection of prior environmental clearance to the project proposal for all Category 'B' projects.
- The state government may decide whether to house them at the Department of Environment or at any other Board for effective operational support.
- State Governments can decide whether the positions are permanent or part-time. The Central Government (MoEF) continues to follow the model of paying fee (TA/DA, accommodation, sitting fee) to the Chairperson and the members of EAC. As such, the State Government is to fund SEIAA & SEAC and decide the appropriate institutional support for them.

A. Constitution

- SEIAA is constituted by the Central Government comprising of three members including a Chairperson and Member–Secretary to be nominated by the State Government or UT Administration concerned.
- The Central Government will notify as and when the nominations (in order) are received from the State Governments, within 30 days from the date of receipt.
- The Chairperson and the non-official member shall have a fixed term of three years, from the date of Notification by the Central Government constituting the Authority.

The form used by the State Governments to submit nominations for Notification by the Central Government is provided in **Annexure XIX**.

B. Composition

- Chairperson shall be an expert in the EIA process
- Member–Secretary shall be a serving officer of the concerned State Government/ UT Administration familiar with the environmental laws.
- Member–Secretary may be of a level equivalent to the Director, Dept. of Environment or above – a full time member.
- All the members including the Chairperson shall be the experts as per the criteria set in the Notification.
- The Government servants can only serve as the Member–Secretary to SEIAA and the Secretary to SEAC. All other members including Chairperson of the SEIAA and SEAC shall not be comprised of serving Government Officers; industry representatives; and the activists.
- Serving faculty (academicians) is eligible for the membership in the Authority and/or the Committees, if they fulfill the criteria given in Appendix VI to the Notification.
- This is to clarify that the serving Government officers shall not be nominated as professional/expert member of SEIAA/SEAC/EAC.
- Professionals/Experts in the SEIAA and SEAC shall be different.
- Summary regarding the eligibility criteria for Chairperson and Members of the SEIAA is given in Table 5-3.

C. Decision-making process

- The decision of the Authority shall be arrived through consensus.
- If there is no consensus, the Authority may either ask SEAC for reconsideration or may reject the approval.
- All decisions of the SEIAA shall be taken in a meeting and shall ordinarily be unanimous. In case a decision is taken by majority, details of views, for and against the decision, shall be clearly recorded in minutes of meeting and a copy thereof shall be sent to MoEF.

Table 5-3: SEIAA: Eligibility Criteria for Chairperson/ Members/ Secretary

S. No.	Attribute	Requirement			
		Members		Member–Secretary	Chairperson
1	Professional qualification as per the Notification		Compulsory	Compulsory	Compulsory
2	Experience (Fulfilling any one of a, b, c)	a	Professional Qualification + 15 years of experience in one of the expertise area mentioned in the Appendix VI	Professional Qualification + 15 years of experience in one of the expertise area mentioned in the Appendix VI	Professional Qualification + 15 years of experience in one of the expertise area mentioned in the Appendix VI
		b	Professional Qualification +PhD+10 years of experience in one of the expertise area mentioned in Appendix VI	Professional Qualification +PhD+10 years of experience in one of the expertise area mentioned in the Appendix VI	Professional Qualification +PhD+10 years of experience in one of the expertise area mentioned in the Appendix VI
		c	Professional Qualification +10 years of experience in one of the expertise area mentioned in the Appendix VI + 5 years interface with environmental issues, problems and their management	Professional Qualification +10 years of experience in one of the expertise area mentioned in the Appendix VI + 5 years interface with environmental issues, problems and their management	----------
3	Test of independence (conflict of interest) and minimum grade of the Secretary of the Authority	Shall not be a serving government officer Shall not be a person engaged in industry and their associations Shall not be a person associated with environmental activism		Only serving officer from the State Government (DoE) familiar with environmental laws not below the level of Director	Shall not be a serving government officer Shall not be a person engaged in industry and their associations Shall not be a person associated with environmental activism

S. No.	Attribute	Requirement		
		Members	Member–Secretary	Chairperson
4	Age	Below 67 years at the time of Notification of the Authority	As per State Government Service Rules	Below 72 Years at the time of the Notification of the Authority
5	Other memberships in Central/State Expert Appraisal Committee	Shall not be a member in any SEIAA/EAC/SEAC	Shall not be a member in any SEIAA/EAC/SEAC	Shall not be a member in any SEIAA/EAC/SEAC
6	Tenure of earlier appointment (continuous)	Only one term before this in continuity is permitted	Not applicable	Only one term before this in continuity is permitted
7	Eminent environmental expertise with understanding on environmental aspects and impacts	Desirable	Desirable	Compulsory
8	Expertise in the environmental clearance process	Desirable	Desirable	Compulsory

Note:

1. A member after continuous membership in two terms (6 years) shall not be considered for further continuation. His/her nomination may be considered after a gap of one term (three years), if other criteria meet.

2. Chairperson/Member once notified may not be removed prior to the tenure of three years without cause and proper enquiry.

5.2 EAC and SEAC

EAC and SEAC are independent Committees to review each developmental activity and offer its recommendations for consideration of the Central Government and SEIAA respectively.

A. Constitution

- EAC and SEAC shall be constituted by the Central Government comprising a maximum of 15 members including a Chairperson and Secretary. In case of SEAC, the State Government or UT Administration is required to nominate the professionals/experts for consideration and Notification by the Central Government.
- The Central Government will notify as and when the nominations (inorder) are received from the State Governments, within 30 days from the date of receipt.
- The Chairperson and the non-official member shall have a fixed term of three years, from the date of Notification by the Central Government.

- The Chairperson shall be an eminent environmental expert with understanding on environmental aspects and environmental impacts. The Secretary of the SEAC shall be a State Government officer, not below the level of a Director/Chief Engineer.
- The members of the SEAC need not be from the same State/UT.
- In case the State Governments/ Union Territories so desire, the MoEF can form regional EAC to serve the concerned States/Union Territories.
- State Governments may decide to their convenience to house SEAC at the Department of Environment or at SPCB or at any other department, to extend support to the SEAC activities.

B. Composition

- Composition of EAC/SEAC as per the Notification is given in **Annexure XX**.
- Secretary to EAC/SEAC may invite a maximum of two professionals/experts with the prior approval of the Chairperson, if desired, for taking the advisory inputs for appraisal. In such case, the invited experts will not take part in the decision making process.
- The Secretary of each EAC/SEAC preferably be an officer of the level equivalent to or above the level of Director, MoEF, GoI.

C. Decision making

The EAC and SEAC shall function on the principle of collective responsibility. The Chairperson shall endeavour to reach a consensus in each case, and if consensus cannot be reached, the view of the majority shall prevail.

D. Operational issues

- Secretary may deal with all correspondence, formulate agenda and prepare agenda notes. Chairperson and other members may act only for the meetings.
- Chairperson of EAC/SEAC shall be one among the expert members having considerable professional experience with proven credentials.
- EAC/SEAC shall meet at least once every month or more frequently, if so needed, to review project proposals and to offer recommendations for the consideration of the Authority.
- EAC/SEAC members may inspect the site at various stages *i.e*. during screening, scoping and appraisal, as per the need felt and decided by the Chairperson of the Committee.
- The respective Governments through the Secretary of the Committee may pay/reimburse the participation expenses, honorarium *etc*., to the Chairperson and members.

i. Tenure of EAC/SEIAA/SEAC

The tenure of Authority/Committee(s) shall be for a fixed period of three years. At the end of the three years period, the Authority and the committees need to be re-constituted. However, staggered appointment dates may be adopted to maintain continuity of members at a given point of time.

ii. Qualifying criteria for nomination of a member to EAC/SEIAA/SEAC

While recommending nominations and while notifying the members of the Authority and Expert Committees, it shall be ensured that all the members meet the following three criteria:

- Professional qualification
- Relevant experience/Experience interfacing with environmental management
- Absence of conflict of interest

These are elaborated subsequently.

a) Professional qualification

The person should have at least (i) 5 years of formal University training in the concerned discipline leading to a MA/MSc Degree, or (ii) in case of Engineering/Technology/ Architecture disciplines, 4 years formal training in a professional training course together with prescribed practical training in the field leading to a B.Tech/B.E./B.Arch. Degree, or (iii) Other professional degree (*e.g.* Law) involving a total of 5 years of formal University training and prescribed practical training, or (iv) Prescribed apprenticeship/articleship and pass examinations conducted by the concerned professional association (*e.g.* MBA/IAS/IFS). In selecting the individual professionals, experience gained by them in their respective fields will be taken note of.

b) Relevant experience

- Experience shall be related to professional qualification acquired by the person and be related to one or more of the expertise mentioned for the expert members. Such experience should be a minimum of 15 years.
- When the experience mentioned in the foregoing sub-paragraph interfaces with environmental issues, problems and their management, the requirement for the length of the experience can be reduced to a minimum of 10 years.

c) Absence of conflict of interest

For the deliberations of the EAC/SEAC to be independent and unbiased, all possibilities of potential conflict of interests have to be eliminated. Therefore, serving government officers; persons engaged in industry and their associations; persons associated with the formulation of development projects requiring environmental clearance, and persons associated with environmental activism shall not be considered for membership of SEIAA/ SEAC/ EAC.

iii. Age

Below 70 years for the members and below 72 years for the Chairperson of the SEIAA/SEAC/EAC. The applicability of the age is at the time of the Notification of the SEIAA/SEAC/EAC by the Central Government.

Summary regarding the eligibility criteria for Chairperson and Members of the EAC/SEAC is given in Table 5-4.

Table 5-4: EAC/SEAC: Eligibility Criteria for Chairperson / Members / Secretary

S. No.	Attribute		Requirement		
			Expert members	Secretary	Chairperson
1	Professional qualification as per the Notification		Compulsory	Compulsory	Compulsory
2	Experience (Fulfilling any one of a, b, c)	a	Professional Qualification + 15 years of experience in one of the expertise area mentioned in the Appendix VI	Professional Qualification + 15 years of experience in one of the expertise area mentioned in the Appendix VI	Professional Qualification + 15 years of experience in one of the expertise area mentioned in the Appendix VI
		b	Professional Qualification +PhD+10 years of experience in one of the expertise area mentioned in the Appendix VI	Professional Qualification +PhD+10 years of experience in one of the expertise area mentioned in the Appendix VI	Professional Qualification +PhD+10 years of experience in one of the expertise area mentioned in Appendix VI
		c	Professional Qualification +10 years of experience in one of the expertise area mentioned in the Appendix VI + 5 years interface with environmental issues, problems and their management	Professional Qualification +10 years of experience in one of the expertise area mentioned in the Appendix VI + 5 years interface with environmental issues, problems and their management	----------
3	Test of independence (conflict of interest) and minimum grade of the Secretary of the Committees		Shall not be a serving government officer Shall not be a person engaged in industry and their associations Shall not be a person associated with environmental activism	In case of EAC, not less than a Director from the MoEF, Government of India Incase of SEAC, not below the level of Director/Chief Engineer from the State Government (DoE)	Shall not be a serving government officer Shall not be a person engaged in industry and their associations Shall not be a person associated with environmental activism
4	Age		Below 67 years at the time of Notification of the Committee	As per state Government Service Rules	Below 72 Years at the time of the Notification of the Committee
5	Membership in Central/State Expert Appraisal Committee		Only one other than this nomination is permitted	Shall not be a member in other SEIAA/EAC/SEAC	Shall not be a member in any other SEIAA/EAC/SEAC
6	Tenure of earlier appointment (continuous)		Only one term before this in continuity is permitted	Not applicable	Only one term before this in continuity is permitted

S. No.	Attribute	Requirement		
		Expert members	Secretary	Chairperson
7	Eminent environmental expertise with understanding on environmental aspects and impacts	Desirable	Not applicable	Compulsory

Notes:

1. A member after continuous membership in two terms (six years) shall not be considered for further continuation. His/her nomination may be reconsidered after a gap of one term (three years), if other criteria meet.

2. Chairperson/Member once notified may not be removed prior to the tenure of 3 years with out cause and proper enquiry. A member after continuous membership in two terms (6 years) shall not be considered for further continuation. The same profile may be considered for nomination after a gap of three years, i.e., one term, if other criteria are meeting.

E. Other conditions that may be considered

- An expert member of one State/UT, can have at the most another State/UT Committee membership, but in no case more than two Committees at a given point of time.
- An expert member of a Committee shall not have membership continuously in the same committee for more than two terms, *i.e.*, six years. They can be nominated after a gap of three years, *i.e.*, one term. When a member of Committee has been associated with any development project, which comes for environmental clearance, he/she may not participate in the deliberations and the decisions in respect to that particular project.
- At least four members shall be present in each meeting to fulfill the quorum
- If a member does not consecutively attend six meetings, without prior intimation to the Committee his/her membership may be terminated by the Notifying Authority. Prior information for absence due to academic pursuits, career development and national/state-endorsed programmes may be considered as genuine grounds for retention of membership.

ANNEXURE I
Hazardous Wastes Listed in Schedule I and II

Schedule I

[See rules 3 (l)]

List of processes generating hazardous wastes

S.No.	Processes	Hazardous Waste *
1.	Petrochemical processes and pyrolytic operations	1.1 Furnace/reactor residue and debris 1.2 Tarry residues 1.3 Oily sludge emulsion 1.4 Organic residues 1.5 Residues from alkali wash of fuels 1.6 Still bottoms from distillation process 1.7 Spent catalyst and molecular sieves 1.8 Slop oil from wastewater
2.	Drilling operation for oil and gas production	2.1 Drill cuttings containing oil 2.2 Sludge containing oil 2.3 Drilling mud and other drilling wastes
3.	Cleaning, emptying and maintenance of petroleum oil storage tanks including ships	3.1 Oil-containing cargo residue, washing water and sludge 3.2 Chemical-containing cargo residue and sludge 3.3 Sludge and filters contaminated with oil 3.4 Ballast water containing oil from ships.
4.	Petroleum refining/re-processing of used oil/recycling of waste oil	4.1 Oily sludge/emulsion 4.2 Spent catalyst 4.3 Slop oil 4.4 Organic residues from process 4.5 Spent clay containing oil
5.	Industrial operations using mineral/synthetic oil as lubricant in hydraulic systems or other applications	5.1 Used/spent oil 5.2 Wastes/residues containing oil
6.	Secondary production and/or industrial use of zinc	6.1 Sludge and filter press cake arising out of production of Zinc Sulphate and other Zinc Compounds. 6.2 Zinc fines/dust/ash/skimmings (dispersible form) 6.3 Other residues from processing of zinc ash/skimmings 6.4 Flue gas dust and other particulates
7.	Primary production of zinc/lead/copper and other non-ferrous metals except aluminium	7.1 Flue gas dust from roasting 7.2 Process residues 7.3 Arsenic-bearing sludge 7.4 Non ferrous metal bearing sludge and residue. 7.5 Sludge from scrubbers

8.	Secondary production of copper	8.1 Spent electrolytic solutions 8.2 Sludges and filter cakes 8.3 Flue gas dust and other particulates
9.	Secondary production of lead	9.1 Lead bearing residues 9.2 Lead ash/particulate from flue gas
10.	Production and/or industrial use of cadmium and arsenic and their compounds	10.1 Residues containing cadmium and arsenic
11.	Production of primary and secondary aluminium	11.1. Sludges from off-gas treatment 11.2. Cathode residues including pot lining wastes 11.3. Tar containing wastes 11.4. Flue gas dust and other particulates 11.5. Wastes from treatment of salt slags and black drosses
12.	Metal surface treatment, such as etching, staining, polishing, galvanising, cleaning, degreasing, plating, etc.	12.1 Acid residues 12.2 Alkali residues 12.3 Spent bath/sludge containing sulphide, cyanide and toxic metals 12.4 Sludge from bath containing organic solvents 12.5 Phosphate sludge 12.6 Sludge From staining bath 12.7 Copper etching residues 12.8 Plating metal sludge
	Production of iron and steel including other ferrous alloys (electric furnaces; steel rolling and finishing mills; Coke oven and by product plant)	13.1 Sludge from acid recovery unit 13.2 Benzol acid sludge 13.3 Decanter tank tar sludge 13.4 Tar storage tank residue
14.	Hardening of steel	14.1 Cyanide-, nitrate-, or nitrite-containing sludge 14.2 Spent hardening salt
15.	Production of asbestos or asbestos-containing materials	15.1 Asbestos-containing residues 15.2 Discarded asbestos 15.3 Dust/particulates from exhaust gas treatment.
16.	Production of caustic soda and chlorine	16.1 Mercury bearing sludge 16.2 Residue/sludges and filter cakes 16.3 Brine sludge containing mercury

17.	Production of mineral acids	17.1 Residues, dusts or filter cakes 17.2 Spent catalyst
18.	Production of nitrogenous and complex fertilizers	18.1 Spent catalyst 18.2 Spent carbon 18.3 Sludge/residue containing arsenic 18.4 Chromium sludge from water cooling tower
19.	Production of phenol	19.1 Residue/sludge containing phenol
20.	Production and/or industrial use of solvents	20.1 Contaminated aromatic, aliphatic or napthenic solvents may or may not be fit for reuse. 20.2 Spent solvents 20.3 Distillation residues
21.	Production and/or industrial use of paints, pigments, lacquers, varnishes, plastics and inks	21.1 Process wastes, residues & sludges 21.2 Fillers residues
22.	Production of plastic raw materials	22.1 Residues of additives used in plasticsmanufacture like dyestuffs, stabilizers, flame retardants, etc. 22.2 Residues and waste of platicisers 22.3 Residues from vinylchloride monomer production 22.4 Residues from acrylonitrile production 22.5 Non-polymerised residues
23.	Production and/or industrial use of glues, cements, adhesive and resins	23.1 Wastes/residues (not made with vegetable or animal materials)
24.	Production of canvas and textiles	24.1 Chemical residues
25.	Industrial production and formulation of wood preservatives	25.1 Chemical residues 25.2 Residues from wood alkali bath
26.	Production or industrial use of synthetic dyes, dye-intermediates and pigments	26.1 Process waste sludge/residues containing acid or other toxic metals or organic complexes 26.2 Dust from air filtration system

27.	Production of organo-silicone compounds	27.1 process residues
28.	Production/formulation of drugs/ pharmaceuticals & health care product	28.1. Process Residues and wastes 28.2 Spent catalyst / spent carbon 28.3 Off specification products 28.4 Date-expired, discarded and off-specification drugs/ medicines 28.5. Spent organic solvents
29.	Production, and formulation of pesticides including stock-piles	29.1 Process wastes/residues 29.2 Chemical sludge containing residue pesticides 29.3 Date-expired and off-specification pesticides
30.	Leather tanneries	30.1 Chromium bearing residues and sludges
31.	Electronic Industry	31.1 Process residues and wastes 31.2 Spent etching chemicals and solvents
32.	Pulp & Paper Industry	32.1 Spent chemicals 32.2 Corrosive wastes arising from use of strong acid and bases 32.3 Process sludge containing adsorbable organic halides [AOx]
33.	Disposal of barrels / containers used for handling of hazardous wastes / chemicals	33.1 Chemical-containing residue arising from decontamination. 33.2 Sludge from treatment of waste water arising out of cleaning / disposal of barrels / containers 33.3Discarded containers / barrels / liners contaminated with hazardous wastes/chemicals
34.	Purification and treatment of exhaust air, water & waste water from the processes in this schedule and common industrial effluent treatment plants (CETP's)	34.1 Flue gas cleaning residue 34.2 Spent ion exchange resin containing toxic metals 34.3 Chemical sludge from waste water treatment 34.4 Oil and grease skimming residues 34.5 Chromium sludge from cooling water

35.	Purification process for organic compounds/solvents	35.1 Filters and filter material which have organic liquids in them, e.g. mineral oil, synthetic oil and organic chlorine compounds 35.2 Spent catalyst 35.3 Spent carbon
36.	Hazardous waste treatment processes, e.g. incineration, distillation, separation and concentration techniques	36.1 Sludge from wet scrubbers 36.2 Ash from incineration of hazardous waste, flue gas cleaning residues 36.3 Spent acid from batteries 36.4 Distillation residues from contaminated organic solvents

*** The inclusion of wastes contained in this Schedule does not preclude the use of Schedule 2 to demonstrate that the waste is not hazardous. In case of dispute, the matter would be referred to the Technical Review Committee constituted by MoEF.**

Note: *The high volume low effect wastes such as fly ash, phosphogypsum, red mud, slags from pyrometallurgical operations, mine tailings and ore beneficiation rejects are excluded from the category of hazardous wastes. Separate guidelines on the management of these wastes shall be issued by CPCB.*

Schedule II

[*See* rule 3(l)]

List of Waste Constituents with Concentration Limits*

Class A

Concentration limit: 50 mg/kg

A1 Antimony and antimony compounds
A2 Arsenic and arsenic compounds
A3 Beryllium and beryllium compounds
A4 Cadmium and cadmium compounds
A5 Chromium (VI) compounds
A6 Mercury and mercury compounds
A7 Selenium and selenium compounds
A8 Tellurium and tellurium compounds
A9 Thallium and thallium compounds
A10 Inorganic cyanide compounds
A11 Metal carbonyls
A12 Napthalene
A13 Anthracene
A14 Phenanthrene
A15 Chrysene, benzo (a) anthracene, fluoranthene, benzo (a) pyrene, benzo (K) fluoranthene, indeno (1, 2, 3-cd) pyrene and benzo (ghi) perylene
A16 halogenated compounds of aromatic rings, e.g. polychlorinated biphenyls, polychloroterphenyls and their derivatives
A17 Halogenated aromatic compounds
A18 Benzene
A19 Organo-chlorine pesticides
A20 Organo-tin Compounds

Class B

Concentration limit: 5, 000 mg/kg

B1 Chromium (III) compounds
B2 Cobalt compounds
B3 Copper compounds
B4 Lead and lead compounds
B5 Molybdenum compounds
B6 Nickel compounds
B7 Inorganic Tin compounds
B8 Vanadium compounds
B9 Tungsten compounds
B10 Silver compounds
B11 Halogenated aliphatic compounds
B12 Organo phosphorus compounds

B13 Organic peroxides
B14 Organic nitro-and nitroso-compounds
B15 Organic azo-and azooxy compounds
B16 Nitriles
B17 Amines
B18 (Iso-and thio-) cyanates
B19 Phenol and phenolic compounds
B20 Mercaptans
B21 Asbestos
B22 Halogen-silanes
B23 Hydrazine (s)
B24 Flourine
B25 Chlorine
B26 Bromine
B27 White and red phosphorus
B28 Ferro-silicate and alloys
B29 Manganese-silicate
B30 Halogen-containing compounds which produce acidic vapours on contact with humid air or water, e.g. silicon tetrachloride, aluminium chloride, titanium tetrachloride

Class C
Concentration limit; □ 20, 000 mg/kg

C1 Ammonia and ammonium compounds
C2 Inorganic peroxides
C3 Barium compounds except barium sulphate
C4 Fluorine compounds
C5 Phosphate compounds except phosphates of aluminium, calcium and iron
C6 Bromates, (hypo-bromites)
C7 Chlorates, (hypo-chlorites)
C8 Aromatic compounds other than those listed under A12 to A18
C9 Organic silicone compounds
C10 Organic sulphur compounds
C11 Iodates
C12 Nitrates, nitrites
C13 Sulphides
C14 Zinc compounds
C15 Salts of per-acids
C16 Acid amides
C17 Acid anhydrides

Class D
Concentration limit: □ 50, 000 mg/kg

D1 Total Sulphur

D2 Inorganic acids
D3 Metal hydrogen sulphates
D4 Oxides and hydroxides except those of hydrogen, carbon, silicon, iron, aluminum, titanium, manganese, magnesium, calcium
D5 Total hydrocarbons other than those listed under A12 to A18
D6 Organic oxygen compounds
D7 Organic nitrogen compounds expressed as nitrogen
D8 Nitrides
D9 Hydrides

Class E

Regardless of concentration limit, Classified as hazardous wastes if the waste exhibits any of the following Characteristics.

E1 Flammable

Flammable wastes with flash point 65.6^{o}c or below.

E2 Explosive

Wastes which may explode under the effect of flame, heat or photochemical conditions. Any other waste of explosive materials included in the Indian Explosive Act.

E3 Corrosive

Wastes which may be corrosive, by chemical action, will cause severe damage when in contact with living tissue.

E4 Toxic

Wastes containing or contaminated with established toxic and or eco- toxic constituents.

E5 Carcinogenicity, Mutagenecity and Endocrine disruptivity

Wastes contaminated or containing established carcinogens, mutagens and endocrine disruptors.

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*Waste constituents and their concentration limits given in this list are based on erstwhile BAGA (the Netherlands Environment Protection Agency) List of Hazardous Substances. In order to decide whether specific wastes listed above is hazardous or not, following points be taken into consideration:

(i) If a component of the waste appears in one of the five risk classes listed above (A,B,C,D or E) and the concentration of the component is equal to or more than the limit for the relevant risks class, the material is then classified as hazardous waste.

(ii) If a chemical compound containing a hazardous constituent is present in the waste, the concentration limit does not apply to the compound, but only to the hazardous constituent itself.

(iii) If multiple hazardous constituents from the same class are present in the waste, the concentrations are added together.

(iv) If multiple hazardous constituents from different classes are present in the waste, the lowest concentration limit corresponding to the constituent(s) applies.

(v) For determining the concentration of the hazardous constituents in the waste "Toxicity Characteristics Leaching Procedure (TCLP) as per ASTM-D5233-92 should be adopted.

ANNEXURE II
Criteria for Treatment and Disposal Options for Wastes Listed in Schedule – I and II

TREATMEI T / DISPOSAL OPTIOI S FOR SCHEDULE – 1 WASTES

Sr. I o.	Processes		Waste Streams	Treatment disposal / options			
				Ch/ph treatment	Incineration	Landfill	Recycle
1	Petrochemical processes and pyrolytic operations	1.1	Furnace / reactor residue and debris*	*	*	1	*
		1.2	Tarry residue	*	1	*	*
		1.3	Oily sludge emulsion	*	1	*	1
		1.4	Organic residue	*	1	*	*
		1.5	Residue from alkali wash of fuels	1	*	1	*
		1.6	Still bottoms from distillation process	*	1	*	2
		1.7	Spent catalyst and molecular sieves	2	*	3	1
		1.8	Slop oil from waste water	*	1	*	1
		1.9	ETP sludge containing hazardous constituents	1	*	2	*
2	Drilling operation for oil and gas productions	2.1	Drill cuttings containing oil	1	*	2	1
		2.2	Sludge containing oil	1	1	2	*
		2.3	Drilling mud and other drilling waste*	1	*	2	*

3	Cleaning, emptying and maintenance of petroleum oil storage tanks including ships	3.1	Oil containing cargo residue and sludge	1	1	2	1
		3.2	Chemical containing cargo residue and sludge	*	1	*	1
		3.3	Sludge and filters contaminated with oil	*	1	*	1
		3.4	Ballast water containing oil from ships	1	1	*	1
4	Petroleum refining / refining of used oil/recycling of waste oil	4.1	Oily sludge / emulsion	*	1	*	1
		4.2	Spent catalyst	2	*	3	1
		4.3	Slop oil	*	1	*	1
		4.4	Organic residue from process	*	1	*	1
		4.5	Chemical sludge from waste water treatment	1	*	2	*
		4.6	Spent clay containing oil	1	2	2	*
5	Industrial operations using mineral / synthetic oil as lubricant in hydraulic system or other applications	5.1	Used / spent oil	*	*	*	1
		5.2	Wastes / residue containing oil	1	3	*	3
6	Secondary production and / or use of zinc	6.1	Sludge and filter press cake arising out of zinc sulphate production	2	*	3	1
		6.2	Zinc fines/dust/ash/skimming (dispersible form)	2	*	3	1

		6.3	Other residues from processing of zinc ash / skimming	2	*	3	1
		6.4	Flue gas dust and other particulates*	*	*	2	1
7	Primary production of zinc /lead copper and other non ferrous metals except aluminum	7.1	Flue gas dust from roasting*	2	*	3	1
		7.2	Process residue	1	*	2	*
		7.3	Arsenic-bearing sludge	1	*	2	*
		7.4	Metal bearing sludge and residue including jarosite	1	*	2	*
		7.5	Sludge from ETP and scrubbers	1	*	2	*
8	Secondary production of copper	8.1	Spent electrolytic solutions	1	*	2	*
		8.2	Sludge's and filter cakes	1	*	2	*
		8.3	Flue gas dust and other particulates*	2	*	3	1
9	Secondary production of lead	9.1	Lead slag / lead bearing residue	1	*	2	*
		9.2	Lead ash / particulate from flue gas	2	*	3	1
10	Production and / or use of cadmium and arsenic and their compounds	10.1	Residues containing cadmium and arsenic	1	*	2	*

11	Production of primary and secondary aluminum	11.1	Sludge's from gas treatment	1	*	2	*
		11.2	Cathcde residue including pot lining wastes	1	*	2	*
		11.3	Tar containing wastes	*	1	2	*
		11.4	Flue gas dust and other particulates*	2	*	3	1
		11.5	Wastes from treatments of salt slag's and black drosse's*	1	*	2	*
12	Metal surface treatment such as etching, staining, polishing, galvanizing, cleaning, degreasing, plating etc	12.1	Acid residue	1	*	2	*
		12.2	Alkali residue	1	*	2	*
		12.3	Spent bath / sludge containing sulphide, cyanide and toxic metals	1	*	2	*
		12.4	Sludge from bath containing organic solvents	*	1	2	*
		12.5	Phosphate sludge	1	*	2	*
		12.6	Sludge from staining bath	1	*	2	*
		12.7	Copper etching residue	1	*	2	*
		12.8	Plating metal sludge	1	*	2	*
		12.9	Chemical sludge from waste water treatment	1	*	2	*

13	Production of iron and steel including other ferrous alloys (electric rolling and finishing mills, coke oven and product plant)	13.1	Process dust*	1	*	2	*
		13.2	Sludge from acid recovery unit	1	*	2	*
		13.3	Benzol and sludge	*	1	*	*
		13.4	Decanter tank tar sludge	*	1	*	*
		13.5	Tar storage tank residue	*	1	*	*
14	Hadening of steel	14.1	Cyanide-nitrate-or nitrate-containing sludge	1	*	2	*
		14.2	Spent hardening salt	1	*	2	*
15	Production of asbestos containing materials	15.1	Asbestos containing residue	*	*	1	*
		15.2	Discarded asbestos	*	*	1	*
		15.3	Dust/particulates from exhaust gas treatment	*	*	2	1
16	Production of caustic soda and chlorine	16.1	Mercury bearing sludge	1	*	2	*
		16.2	Residue / sludge's and filter cakes's*	*	*	1	*
		16.3	Brine sludge containing mercury	1	*	2	*

17	Production of acids	17.1	Residues, dusts or filter cakes*	1	*	2	*
		17.2	Spent catalyst*	2	*	3	1
18	Production of nitrogenous and complex fertilizers	18.1	Spent catalyst*	*	*	2	1
		18.2	Spent carbon*	*	1	2	*
		18.3	Sludge / residue containing arsenic	1	*	2	*
		18.4	Chromium sludge from water cooling tower	1	*	2	*
		18.5	Chemical sludge from waste water treatment	1	*	2	*
19	Production of Phenols	19.1	Residue / sludge containing Phenol	*	1	*	*
20	Production and/or industrial use of solvents	20.1	Contaminated aromatic, aliphatic or napthenic solvents not fit for originally intended use	*		*	*
		20.2	Spent solvents	*	1	*	1
		20.3	Distillation solvents	*	1	*	*
21	Production and/or industrial use of paints, pigments, lacquers, varnishes, plastics and inks	21.1	Wastes and residue	*	1	*	*
		21.2	Filters residues	*	1	*	*

22	Production of plastic raw material	22.1	Residues of additives used in plastic manufacture like dyestuffs, stabilizers, flame retardants etc.	1	*	2	*
		22.2	Residue of plasticizers	*	1	*	*
		22.3	Residues from vinyl chloride monomer production	*	1	*	*
		22.4	Residues from acrylonirile production	*	1	*	*
		22.5	Non-polymerised residue	*	1	*	*
23	Production and/or industrial use glues, cements, adhesive and resins	23.1	Wastes / residue (not made with vegetable or animal materials)*	*	1	*	*
24	Production of canvas and textiles	24.1	Textile chemical residue*	1	*	1	*
		24.2	Chemical sludge from waste water treatment	1	*	2	*
25	Industrial production and formulation of wood preservatives	25.1	Chemical sludge from waste water treatment	1	*	1	*
		25.2	Residues from wood alkali bath	1	*	1	*
26	Production or industrial use of synthetic dyes, dye-intermediates and pigments	26.1	Process waste sludge / residue containing acid or other toxic metals or organic complexes	1	1	2	*
		26.2	Chemical sludge from waste water treatment	1	*	2	*
		26.3	Dust from air filtration system	*	*	1	1

27	Production or industrial use of materials made with organosilicone compounds	27.1	Silicone containing residues	*	1	1	*
		27.2	Silicone oil residue	*	1	*	*
28	Production / formulation of drugs / pharmaceuticals	28.1	Residue and wastes*	1	1	2	*
		28.2	Spent catalyst / spent carbon	2	*	3	1
		28.3	Off specification products	1	*	2	*
		28.4	Date expired, discarded and off-specification drugs / medicines	1	*	2	*
		28.5	Spent mother liquor	*	1	*	*
		28.6	Spent organic solvents	*	2	*	1
29	Production, use and formulation of pesticides including stockpiles	29.1	Waste / residues containing pesticides	*	1	*	*
		29.2	Chemicals sludge from waste water treatment	*	1	2	*
		29.3	Date expired and off-specification pesticides	*	1	*	*
30	Leather tanneries	30.1	Chromium bearing residue and sludge	1	*	2	*
		30.2	Chemicals sludge from waste water treatment	1	*	2	*
31	Electronic industry	31.1	Residue and wastes*	1	1	2	*
		31.2	Spent etching chemicals and solvents	*	1	2	*

32	Pulp and paper industry	32.1	Spent chemicals	1	*	2	*
		32.2	Corrosive wastes arising from use of strong acid and bases	1	*	2	*
		32.3	Sludge containing adsorb able organic halides	*	1	*	*
33	Disposal of barrels / containers used for handling of hazardous wastes / chemicals	33.1	Chemical containing residue from decontamination and disposal	*	1	*	*
		33.2	Sludge from treatment of waste water arising out of cleaning/disposal of barrels / containers	1	1	2	*
		33.3	Discarded containers / barrels / liners used for hazardous wastes / chemicals	1	1	2	*
34	Purification process for air and water	34.1	Flue gas cleaning residue*	1	*	2	*
		34.2	Toxic metal containing residue from used ion exchange materials in water purification	1	*	2	*
		34.3	Chemical sludge from waste water treatment	1	*	2	*
		34.4	Chemical sludge, oil and grease skimming residues from common industrial effluent treatment plants (CETP's) and industry specific effluent treatment plant (ETP's)	1	1	2	*
		34.5	Chromium sludge from cooling water treatment	1	*	2	*

35	Purification process for organic compounds / solvents	35.1	Filters and filter material which have organic liquids in them e.g. mineral oil, synthetic oil and organic chlorine compounds	*	1	*	*
		35.2	Spent catalyst*	2	*	3	1
		35.3	Spent Carbon*	*	1	2	*
36	Waste treatment processes e.g. incineration, distillation, separation and concentration techniques	36.1	Sludge from wet scrubbers	*	*	1	*
		36.2	Ash from incineration of hazardous waste, flue gas cleaning residue	*	*	1	*
		36.3	Spent acid from batteries	1	*	2	*
		36.4	Distillation residue from contaminated organic solvents	*	1	*	*

- 1,2,3 indicates Order of preference for the Treatment/Disposal option.
- A number appearing twice indicates possible treatment by both options depending upon merits.
- Sign '*' Indicates Not possible to treat by this option.

TREATMEI T / DISPOSAL OPTIOI S FOR SCHEDULE – 2 WASTES

	Class A	**CH. / PH TR.**	**IỊ C**	**SLF**	**RCL**
A1	Antimony and antimony compounds	1	*	2	*
A2	Arsenic and arsenic compounds	1	*	2	*
A3	Beryllium and beryllium compounds	1	*	2	*
A4	Cadmium and cadmium compounds	1	*	2	*
A5	Chromium (VI) compounds	1	*	2	*
A6	Mercury and mercury compounds	1	*	2	*
A7	Selenium and selenium compounds	1	*	2	*
A8	Tellurium and tellurium compounds	1	*	2	*
A9	Thallium and thallium compounds	1	*	2	*
A10	Inorganic cyanide compounds	1	*	2	*
A11	Metal carbonyls	*	1	*	*
A12	Napthalene	*	1	*	*
A13	Anthracene	*	1	*	*
A14	Phenanthrene	*	1	*	*
A15	Chrysene, Benzo (a) anthracene, fluoranthene, benzo (a) pyrene, benzo (k) fluoranthene, indeno (1,2,3-cd) pyrene and benzo (ghi) perylene	*	1	*	*
A16	Halogenated compounds of aromatic rings, e.g. polychlorinated biphenyls, polychloroterphenyls and their derivatives	*	1	*	*
A17	Halogenated aromatic compounds	*	1	*	1
A18	Benzene	*	1	*	1
A19	Organo – chlorine pesticides	*	1	*	*
A20	Organo-tin Compounds	*	1	2	*
	Class B				
B1	Chromium (III) compounds	1	*	2	*
B2	Cobalt compounds	2	*	3	1
B3	Copper compounds	2	*	3	1
B4	Lead and lead compounds	2	*	3	1
B5	Molybdenum compounds	2	*	3	1
B6	Nickel compounds	2	*	3	1
B7	Inorganic Tin compounds	2	*	3	1
B8	Vanadium compounds	2	*	3	1
B9	Tungsten compounds	1	*	2	*
B10	Silver compounds	2	*	3	1
B11	Halogenated aliphatic compounds	*	1	*	1
B12	Organo phosphorus compounds	*	1	*	*

B13	Organic peroxides	1	1	*	*
B14	Organic nitro-and nitroso - compounds	*	2	*	1
B15	Organic azo-and azooxy compounds	*	1	*	*
B16	Nitriles	*	1	*	*
B17	Amines	*	1	*	*
B18	(Iso-and thio-) cyanates	*	1	*	*
B19	Phenol and phenolic compounds	*	2	*	1
B20	Mercaptans	*	1	*	*
B21	Asbestos	2	*	3	1
B22	Halogen - silanes	1	*	2	*
B23	Hydrazine (s)	*	1	*	*
B24	Flourine	1	*	2	2
B25	Chlorine	1	*	2	2
B26	Bromine	1	*	2	2
B27	White and red phosphorus	*	1	*	*
B28	Ferro – silicate and alloys	?	?	?	?
B29	Manganese – silicate	?	?	?	?
B30	Halogen – containing compounds which produce acidic vapours on contact with humid air or water, e.g. silicon tetrachloride, aluminium chloride, titanium tetrachloride	1	*	2	*
	Class C				
C1	Ammonia and ammonium compounds	1	*	*	1
C2	Inorganic peroxides	1	*	2	*
C3	Barium compounds except barium sulphate	1	*	2	*
C4	Fluorine compounds	1	*	2	*
C5	Phosphate compounds except phosphates of aluminium, calcium and iron	*	*	1	2
C6	Bromates, (hypo – bromites)	1	*	2	*
C7	Chlorates, (hypo – chlorites)	1	*	2	*
C8	Aromatic compounds other than those listed under A12 to A18	1	*	2	*
C9	Organic silicone compounds	*	1	*	1
C10	Organic sulphur compounds	*	1	*	*
C11	Iodates	1	*	2	*
C12	Nitrates, nitrites	*	1	*	*
C13	Sulphides	1	*	2	*
C14	Zinc compounds	1	*	2	*
C15	Salts of per - acids	2	*	3	1
C16	Acid amides	*	1	*	*

C17	Acid anhydrides	*	1	*	*
	Class D				
D1	Total Sulphur	1	1	*	*
D2	Inorganic acids	1	*	2	*
D3	Metal Hydrogen sulphates	1	*	2	*
D4	Oxide and hydroxides except those of hydrogen, carbon, silicon, iron, aluminum, titanium, magnesium, calcium	1	*	2	*
D5	Total hydrocarbons other than those listed under A12 to A18	*	1	*	1
D6	Organic oxygen compounds	*	1	*	*
D7	Organic nitrogen compounds	*	1	*	*
D8	Nitrides	1	*	2	*
D9	Hydrides	1	*	2	*
	Class E				
E1	Flammable substances	*	1	*	*
E2	Substances which generate hazardous quantities of flammable gases on contact with water or damp air	*	1	*	*

Ị ote : **CH/PH TR** : Chemical-Physical Treatment prior to further Disposal
SLF : Secure Landfill
IỊ C : Incineration
RCL : Recycle

- 1,2,3 indicates Order of preference for the Treatment/Disposal option.
- A number appearing twice indicates possible treatment by both options depending upon merits.
- Sign '*' Indicates Not possible to treat by this option.

ANNEXURE III
Fingerprint Analysis Requirements for Hazardous Wastes

Fingerprint Analysis Requirement for Hazardous Waste Treatment Storage and Disposal Facilities

Parameters concerned for Fingerprint Analysis by the Operators of TSD Facilities	**Method of Analysis**
Physical Analysis	
Physical State of the waste (liquid/slurry/sludge/semi-solid/solid: inorganic/organic/metallic)	
Identification of different phases of the wastes (in cases of solid wastes contained in aqueous/non-aqueous liquids/solutions for slurries and sludge)	
Colour & Textures	
Specific Gravity	
Viscosity in case of liquid waste	
Flash Point	USEPA, SW-846; Method 1010 and 1020
Loss on drying at 105˚ C in case of solids	
Loss on ignition at 550˚ C	
Calorific Value in case loss on ignition ≥ 20 %	
Paint Filter Liquid Test (PFLT) for liquids	USEPA, SW-846; Method 9095
Liquid Release Test (LRT) for liquids	USEPA, SW-846; Method 9096
Chemical Analysis	
pH	USEPA, SW-846; Method 9040, 9041 and 9045
Reactive Cyanide (ppm)	USEPA, SW-846; Vol. 1C Part II; Test Method to determine HCN released from Wastes
Reactive Sulfide (ppm)	USEPA, SW-846; Vol. 1C Part II; Test Method to determine H_2S released from Wastes

ANNEXURE IV
Compatibility of Selected Hazardous Waste

Compatibility of Selected Hazardous Waste

1	Oxidizing Mineral Acids	1										
2	Caustics	H	2									
3	Aromatic Hydrocarbons	H_F		3								
4	Halogenated Organics	H_F	H_{GF}		4							
5	Metals	GF H F			H_F	5						
6	Toxic Metals	S	S				6					
7	Sat Aliphatic Hydro-carbons	H_F						7				
8	Phenols and Creosols	H_F							8			
9	Strong Oxidizing Agents		H	H_F		H_F		H		9		
10	Strong Reducing Agents	H_F GT			H_{GT}				GF_H	H_F	10	
11	Water and Mixtures containing water	H			H_E		S				GF_{GT}	11
12	Water reactive Substances			Extremely reactive, do not mix with any chemical or waste material								12

Legend:

E	-	Explosive
F	-	Fire
GF	-	Flammable Gas
GT	-	Toxic Gas
H	-	Heat Generation
S	-	Solubilisation of Toxins

ANNEXURE V
Criteria for Direct Disposal of Hazardous Waste into Secured Landfill

Leachate Quality	Concentration
pH	4-12
Total Phenols	<100 mg./l.
Arsenic	<1 mg./l.
Lead	<2 mg./l.
Cadmium	<0.2 mg /l.
Chromium-VI	<0.5 mg./l.
Copper	<10 mg./l.
Nickel	<3 mg./l.
Mercury	<0.1 mg./l.
Zinc	<10 mg./l.
Fluoride	<50 mg./l.
Ammonia	<1,000 mg./l.
Cyanide	<2 mg./l
Nitrate	<30 mg./l
Adsorbable organic bound Chlorine	<3 mg./l
Water soluble compounds except salts	<10 %
Strength	
Transversal Strength (Vane Testing)	>25 KN/m^2
Unconfined Compression Test	>50 KN/m^2
Axial Deformation	<20 %
Degree of Mineralization or Content of Organic Materials (original sample)	
Annealing loss of the dry residue at 550° C	<20 Wt. % (for non-biodegradable waste) <5 Wt. % (for biodegradable waste)
Extractable Lipophylic contents (Oil & Grease)	<4 Wt. %

Note: 1). ***leachate quality is based on water leachate test (i.e Leachability tests are conducted by preparing a suspension of waste and water (i.e taking 100 gm of waste and filling up to 1 liter with distilled water), stirring or shaking for 24 hrs, filtering the solids and analyzing the filtrate)***

2) ***Calorific value of the landfillable hazardous wastes should be less than 2500 K. Cal/Kg***

ANNEXURE VI
Comprehensive Analysis Requirements for Hazardous Wastes – Generator /TSDF

Comprehensive Analysis Requirement for Hazardous Waste – Generator/TSDF Operator

Comprehensive Analysis to be submitted by the Generators of Hazardous Wastes	**Method of Analysis**
Physical Analysis	
Physical State of the waste (liquid / slurry / sludge / Semi-solid / solid: inorganic, organic, metallic)	
Description of different phases of the wastes (in cases of solid wastes slurries and sludge) contained in aqueous / non-aqueous liquids / solutions	
Colour and Texture	
Specific Gravity	
Viscosity in case of liquids	
Calorific Value in case of organic wastes	
Flash Point	USEPA, SW-846; Method 1010 and 1020
% Moisture content (loss on drying at 105˚C)	
% Organic content (loss on ignition at 550 ˚C)	
Paint Filter Liquid Test (PFLT)	USEPA, SW-846; Method 9095
Chemical Analysis	
pH	USEPA, SW-846; Methods 9040, 9041 and 9045
Inorganic Parameters Analysis	
Cyanide (ppm)	USEPA; SW-846; Vol. 1C Part II; Test Method to determine HCN released from Wastes

Comprehensive Analysis to be submitted by the Generators of Hazardous Wastes	**Method of Analysis**
Sulfide (ppm)	USEPA; SW-846; Vol. 1C Part II; Test Method to determine H_2S released from wastes
Sulphur (elemental)	USEPA; SW-846; 9010, 9011, 9012
Concentration of relevant inorganic [as per Schedule 2 of HW (M, H & TM) Rules, 2008 and amendments made thereof].	USEPA; SW-846; Vol. 1A, 1B, 1C and Vol. 2
Organic Parameters Analysis	
Oil & Grease Extractable Organic (in special cases only)	
% Carbon	
% Nitrogen	
% Sulphur	
% Hydrogen	
Compatibility tests	
Concentration of relevant individual organics [as per Schedule 2 of HW (M, H & TM) Rules, 2008 and amendments made thereof]	USEPA; SW-846; Vol. 1A, 1B, 1C and Vol. 2
Toxicity Characteristics Leaching Procedure (For the listed parameters relevant to the process as presented in Method 1311 of SW 846; USEPA) for landfillable wastes	USEPA; SW-846; Method 1311, 1330

ANNEXURE VII
A Compilation of Legal Instruments

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/ Pollutants	Objective of Legislation	Relevant Articles/Provisions
1	Air (Prevention and Control of Pollution) Act, 1981 amended 1987	Central Pollution Control Board and State Pollution Control Boards	Air pollutants from chemical industries	The prevention, control and abatement of air pollution	Section 2: Definitions Section 21: Consent from State Boards Section 22: Not to allow emissions exceeding prescribed limits Section 24: Power of Entry and Inspection Section 25: Power to Obtain Information Section 26: Power to Take Samples Section 37-43: Penalties and Procedures
2	Air (Prevention and Control of Pollution) (Union Territories) Rules, 1983	Central Pollution Control Board and State Pollution Control Boards	Air pollutants from chemical industries	The prevention, control and abatement of air pollution	Rule 2: Definitions Rule 9: Consent Applications
3	Water (Prevention and Control of Pollution) Act, 1974 amended 1988	Central Pollution Control Board and State Pollution Control Boards	Water Pollutants from water polluting industries	The prevention and control of water pollution and also maintaining or restoring the wholesomeness of water	Section 2: Definitions Section 20: Power to Obtain Information Section 21: Power to Take Samples Section 23: Power of Entry and Inspection Section 24: Prohibition on Disposal Section 25: Restriction on New Outlet and New Discharge Section 26: Provision regarding existing discharge of sewage or trade effluent Section 27: Refusal or withdrawal of consent by state boards Section 41-49: Penalties and Procedures
4	Water (Prevention and Control of Pollution) Rules, 1975	Central Pollution Control Board and State Pollution Control Boards	Water Pollutants from water polluting industries	The prevention and control of water pollution and also maintaining or restoring the wholesomeness of water	Rule 2: Definitions Rule 30: Power to take samples Rule 32: Consent Applications

5	The Environment (Protection) Act, 1986, amended 1991	Ministry of Environment and Forests, Central Pollution Control Board and State Pollution Control Boards	All types of environmental pollutants	Protection and Improvement of the Environment	Section 2: Definitions Section 7: Not to allow emission or discharge of environmental pollutants in excess of prescribed standards Section 8: Handing of Hazardous Substances Section 10: Power of Entry and Inspection Section 11: Power to take samples Section 15-19: Penalties and Procedures
6	Environmental (Protection) Rules, 1986 (Amendments in 1999, 2001, 2002, 2002, 2002, 2003, 2004)	Ministry of Environment and Forests, Central Pollution Control Board and State Pollution Control Boards	All types of Environmental Pollutants	Protection and Improvement of the Environment	Rule 2: Definitions Rule 3: Standards for emission or discharge of environmental pollutants Rule 5: Prohibition and restriction on the location of industries and the carrying on process and operations in different areas Rule 13: Prohibition and restriction on the handling of hazardous substances in different areas Rule 14: Submission of environmental statement
7	Hazardous Waste (Management and Handling) Rules, 1989 amended 2000 and 2003	MoEF, CPCB, SPCB, DGFT, Port Authority and Customs Authority	Hazardous Wastes generated from industries using hazardous chemicals	Management & Handling of hazardous wastes in line with the Basel convention	Rule 2: Application Rule 3: Definitions Rule 4: Responsibility of the occupier and operator of a facility for handling of wastes Rule 4A: Duties of the occupier and operator of a facility Rule 4B: Duties of the authority Rule 5: Grant of authorization for handling hazardous wastes Rule 6: Power to suspend or cancel authorization Rule 7: Packaging, labeling and transport

					of hazardous wastes Rule 8: Disposal sites Rule 9: Record and returns Rule 10: Accident reporting and follow up Rule 11: Import and export of hazardous waste for dumping and disposal Rule 12: Import and export of hazardous waste for recycling and reuse Rule 13: Import of hazardous wastes Rule 14: Export of hazardous waste Rule 15: Illegal traffic Rule 16: Liability of the occupier, transporter and operator of a facility Rule 19: Procedure for registration and renewal of registration of recyclers and re-refiners Rule 20: Responsibility of waste generator
8	Manufacture Storage and Import of Hazardous Chemicals Rules, 1989 amended 2000	Ministry of Environment & Forests, Chief Controller of Imports and Exports, CPCB, SPCB, Chief Inspector of Factories, Chief Inspector of Dock Safety, Chief Inspector of Mines, AERB, Chief Controller of Explosives, District Collector or District Emergency Authority, CEES under DRDO	Hazardous Chemicals - Toxic, Explosive, Flammable, Reactive	Regulate the manufacture, storage and import of Hazardous Chemicals	Rule 2: Definitions Rule 4: responsibility of the Occupier Rule 5: Notification of Major Accidents Rule 7-8: Approval and notification of site and updating Rule 10-11: Safety Reports and Safety Audit reports and updating Rule 13: Preparation of Onsite Emergency Plan Rule 14: Preparation of Offsite Emergency Plan Rule 15: Information to persons likely to get affected Rule 16: Proprietary Information Rule 17: Material Safety Data Sheets Rule 18: Import of Hazardous Chemicals
9	Chemical Accidents (Emergency Planning,	CCG, SCG, DCG, LCG and MAH	Hazardous Chemicals - Toxic, Explosive, Flammable,	Emergency Planning Preparedness and Response	Rule 2: Definitions Rule 5: Functions of CCG

	Preparedness and Response) Rules, 1996	Units	Reactive	to chemical accidents	Rule 7: Functions of SCG Rule 9: Functions of DCG Rule 10: Functions of LCG
10	Ozone Depleting Substances (Regulation and Control) Rules, 2000	Ministry of Environment & Forests	Ozone depleting substances	Regulate the production, import, use, sale, purchase and phase-out of the ODS	Rule 2: Definitions Rule 3: Regulation of production and consumption of ozone depleting substances Rule 4: Prohibition on export to or import from countries not specified in Schedule VI Rule 5: Ozone depleting substances are to be exported to or imported from countries specified in Schedule VI under a license Rule 6: Regulation of the sale of ozone depleting substances Rule 7: Regulation on the purchase of ozone depleting substances Rule 8: Regulation on the use of ozone depleting substance Rule 9: Prohibition on new investments with ozone depleting substances Rule 10: Regulation of import, export and sale of products made with or containing ozone depleting substances Rule 11: Regulation on reclamation and destruction of ozone depleting substances Rule 12: Regulation on manufacture, import and export of compressors Rule 13: Procedure for registration, cancellation of registration and appeal against such orders Rule 14: Monitoring and reporting requirements
11	EIA Notification, 2006	MoEF, SPCB	For all the identified developmental activities in the notification	Requirement of environmental clearance before establishment of or modernization / expansion of identified developmental	Requirements and procedure for seeking environmental clearance of projects

				projects.	
12	Batteries (Management and Handling) Rules, 2001.	SPCB, CPCB and MoEF	Lead Acid Batteries	To control the hazardous waste generation (lead waste) from used lead acid batteries	Rule 2: Application Rule 3: Definitions Rule 4: Responsibilities of manufacturer, importer, assembler and re-conditioner Rule 5: Registration of Importers Rule 7: Responsibilities of dealer Rule 8: Responsibilities of recycler Rule 9: Procedure for registration / renewal of registration of recyclers Rule 10: Responsibilities of consumer or bulk consumer Rule 11: Responsibilities of auctioneer Rule 14: Computerization of Records and Returns
13	Public Liability Insurance Act, 1991 amended 1992	Ministry of Environment & Forests, District Collector	Hazardous Substances	To provide immediate relief to persons affected by accident involving hazardous substances	Section 2: Definitions Section 3: Liability to give relief in certain cases on principle of no fault Section 4: Duty of owner to take out insurance policy Section 7A: Establishment of Environmental Relief Fund Section 14-18: Penalties and Offences
14	Public Liability Insurance Rules, 1991 amended 1993	Ministry of Environment & Forests, District Collector	Hazardous Substances	To provide immediate relief to persons affected by accident involving hazardous substances and also for Establishing an Environmental Relief fund	Rule 2: Definitions Rule 6: Establishment of administration of fund Rule 10: Extent of liability Rule 11: Contribution of the owner to environmental relief fund
15	Factories Act, 1948	Ministry of Labour, DGFASLI and Directorate of Industrial Safety and Health/Factories Inspectorate	Chemicals as specified in the Table	Control of workplace environment, and providing for good health and safety of workers	Section 2: Interpretation Section 6: Approval, licensing and registration of factories Section 7A: General duties of the occupier Section 7B: General duties of manufacturers etc., as regards articles and substances for use in factories

					Section 12: Disposal of wastes and effluents Section 14: Dust and fume Section 36: Precautions against dangerous fumes, gases, etc. Section 37: Explosion or inflammable dust, gas, etc. Chapter IVA: Provisions relating to Hazardous processes Section 87: Dangerous operations Section 87A: Power to prohibit employment on account of serious hazard Section 88: Notice of certain accident Section 88A: Notice of certain dangerous occurrences Chapter X: Penalties and procedures
16	The Explosives Act, 1884	Ministry of Commerce and Industry (Department of Explosives)	Explosive substances as defined under the Act	To regulate the manufacture, possession, use, sale, transport, export and import of explosives with a view to prevent accidents	Section 4: Definition Section 6: Power for Central government to prohibit the manufacture, possession or importation of especially dangerous explosives Section 6B: Grant of Licenses
17	The Explosive Rules, 1983	Ministry of Commerce and Industry and Chief Controller of Explosives, port conservator, customs collector, railway administration	Explosive substances as defined under the Act	To regulate the manufacture, possession, use, sale, transport, export and import of explosives with a view to prevent accidents	Rule 2: Definition Chapter II: General Provisions Chapter III: Import and Export Chapter IV: Transport Chapter V: Manufacture of explosives Chapter VI: Possession sale and use Chapter VII: Licenses
18	The Static and Mobile Pressure Vessels (Unfired) Rules, 1981	Ministry of Commerce and Industry and Chief Controller of Explosives, port conservator, customs collector, DGCA,	Gases (Toxic, non toxic and non flammable, non toxic and flammable, Dissolved Acetylene Gas, Non toxic and flammable liquefiable gas other than LPG, LPG	Regulate the import, manufacture, design, installation, transportation, handling, use and testing of mobile and static pressure vessels (unfired) with a view to prevent accidents	Rule 2: Definition Chapter III: Storage Chapter IV: Transport Chapter V: Licenses

		DC, DM, Police (sub inspector to commissioner)			
19	The Motor Vehicle Act, 1988	Ministry of Shipping, Road Transport and Highways	Hazardous and Dangerous Goods	To consolidate and amend the law relating to motor vehicles	Section 2: Definition Chapter II: Licensing of drivers of motor vehicle Chapter VII: Construction equipment and maintenance of motor vehicles
20	The Central Motor Vehicle Rules, 1989	Ministry of Shipping, Road Transport and Highways	Hazardous and Dangerous Goods	To consolidate and amend the law relating to motor vehicles including to regulate the transportation of dangerous goods with a view to prevent loss of life or damage to the environment	Rule 2: Definition Rule 9: Educational qualification for driver's of goods carriages carrying dangerous or hazardous goods Rule 129: Transportation of goods of dangerous or hazardous nature to human life Rule 129A: Spark arrestors Rule 130: Manner of display of class labels Rule 131: Responsibility of the consignor for safe transport of dangerous or hazardous goods Rule 132: Responsibility of the transporter or owner of goods carriage Rule 133: Responsibility of the driver Rule 134: Emergency Information Panel Rule 135: Driver to be instructed Rule 136: Driver to report to the police station about accident Rule 137: Class labels

ANNEXURE VIII
General Standards for Discharge of Environmental Pollutants as per CPCB

Table: Water Quality Standards

S. No.	Parameter	Standards			
		Inland Surface Water	Public Sewer	Land for Irrigation	Marine Coastal Areas
1.	2.	3.			
		(a)	(b)	(c)	(d)
1.	Colour and odour	See Note-1	—	See Note-1	See Note-1
2.	Suspended Solids, mg/l, Max	100	600	200	(a) For process waste water-100 (b) For cooling water effluent-10 per cent above total suspended matter of influent cooling water.
3.	Particle size of suspended solids	Shall pass 850 micron IS Sieve	—	—	(a) Floatable solids, Max 3 mm (b) Settleable solids Max 850 microns.
4.	Dissolved solids (inorganic), mg/a, mac	2100	2100	2100	—
5.	pH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
6.	Temperature ^{o}C, Max	Shall not exceed 40 in any section of the stream within 15 meters down stream from the effluent outlet	45 at the point of discharge	—	45 at the point of discharge
7.	Oil and grease, mg/l, max	10	20	10	20
8.	Total residual chlorine, mg/l, Max.	1.0	—	—	1.0
9.	Ammonical nitrogen (as N), mg/l, Max.	50	50	—	50
10.	Total Kjeldahl nitrogen (as N), mg/l, Max.	100	—	—	100
11.	Free Ammonia (as NH3), mg/l, Max.	5.0	—	—	5.0
12.	Biochemical Oxygen Demand (5 days at 20^{o}C) Max.	30	350	100	100
13.	Chemical Oxygen Demand, mg/l, Max.	250	—	—	250
14.	Arsenic (as As), mg/l, Max.	0.2	0.2	0.2	0.2
15.	Mercury (as Hg), mg/l, Max.	0.01	0.01	—	0.01
16.	Lead (as Pb), mg/l, Max.	0.1	1.0	—	1.0
17.	Cadmium (as Cd), mg/l, Max.	2.0	1.0	—	2.0

18.	Hexavalent chromium (as Cr+6) mg/l, Max.	0.1	2.0	—	1.0
19.	Total chromium as (Cr), mg/l, Max.	2.0	2.0	—	2.0
20.	Copper (as Cu), mg/l, Max.	3.0	3.0	—	3.0
21.	Zinc (as Zn), mg/l, Max.	5.0	15	—	15
22.	Selenium (as Se), mg/l, Max.	0.05	0.05	—	0.05
23.	Nickel (as Ni), mg/l, Max.	3.0	3.0	—	5.0
24.	Boron (as B), mg/l, Max.	2.0	2.0	2.0	—
25.	Percent Sodium, Max.	—	60	60	—
26.	Residual sodium carbonate, mg/l, Max.	—	—	5.0	—
27.	Cyanide (as CN), mg/l, Max.	0.2	2.0	0.2	0.2
28.	Chloride (as Cl), mg/l, Max.	1000	1000	600	(a)
29.	Fluoride (as F), mg/l, Max.	2.0	15	—	15
30.	Dissolved Phosphates (as P), mg/l, Max.	5.0	—	—	—
31.	Sulphate (as SO4), mg/l, Max.	1000	1000	1000	—
32.	Sulphide (as S), mg/l, Max.	2.0	—	—	5.0
33.	Pesticides	Absent	Absent	Absent	Absent
34.	Phenolic compounds (as C_6H_5OH), mg/l, Max.	1.0	5.0	—	5.0
35.	Radioactive materials (a) Alpha emitters MC/ml, Max. (b) Beta emitters uc/ml, Max.	10^{-7} 10^{-6}	10^{-7} 10^{-6}	10^{-8} 10^{-7}	10^{-7} 10^{-6}

Note :-

1. All efforts should be made to remove colour and unpleasant odour as far as practicable.
2. The standards mentioned in this notification shall apply to all the effluents discharged such as industrial mining and mineral processing activities municipal sewage etc.

Table: Noise Standards

Ambient air quality standards in respect of noise

Area Code	Category of Area	Limits in dB (A) Leq	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence zone	50	40

Note :

1. Day time is reckoned in between 6.00 AM and 9.00 PM
2. Night time is reckoned in between 9.00 PM and 6.00 AM
3. Silence zone is defined as areas upto 100 meters around such premises as hospitals, educational institutions and courts. The Silence zones are to be declared by the Competent Authority.
4. Use of vehicular horns, loudspeakers and bursting of crackers shall be banned in these zones.
5. Mixed categories of areas should be declared as one of the four above mentioned categories by the Competent Authority and the corresponding standards shall apply.

Standards/Guidelines for Control of Noise Pollution from Stationary Diesel Generator (DG) Sets

(A) Noise Standards for DG Sets (15-500 KVA)

The total sound power level, Lw, of a DG set should be less than, 94+10 log10 (KVA), dB (A), at the manufacturing stage, where, KVA is the nominal power rating of a DG set.

This level should fall by 5 dB (A) every five years, till 2007, i.e. in 2002 and then in 2007.

(B) Mandatory acoustic enclosure/acoustic treatment of room for stationary DG sets (5 KVA and above)

Noise from the DG set should be controlled by providing an acoustic enclosure or by treating the room acoustically.

The acoustic enclosure/acoustic treatment of the room should be designed for minimum 25 dB(A) Insertion Loss or for meeting the ambient noise standards, whichever is on the higher side (if the actual ambient noise is on the higher side, it may not be possible to check the performance of the acoustic enclosure/acoustic treatment. Under such circumstances the performance may be checked for noise reduction upto actual ambient noise level, preferably, in the night time). The measurement for Insertion Loss may be done at different points at 0.5m from the acoustic enclosure/room, and then averaged.

The DG set should also be provide with proper exhaust muffler with Insertion Loss of minimum 25 dB(A).

(C) Guidelines for the manufacturers/users of DG sets (5 KVA and above)

1. The manufacturer should offer to the user a standard acoustic enclosure of 25 dB(A) Insertion Loss and also a suitable exhaust muffler with Insertion Loss of 25 dB(A).

2. The user should make efforts to bring down the noise levels due to the DG set, outside his premises, within the ambient noise requirements by proper siting and control measures.
3. The manufacturer should furnish noise power levels of the unlicensed DG sets as per standards prescribed under (A)
4. The total sound power level of a DG set, at the user's end, shall be within 2 dB(A) of the total sound power level of the DG set, at the manufacturing stage, as prescribed under (A).
5. Installation of a DG set must be strictly in compliance with the recommendation of the DG set manufacturer.
6. A proper routine and preventive maintenance procedure for the DG set should be set and followed in consultation with the DG set manufacturer which would help prevent noise levels of the DG set from deteriorating with use.

Order of the Lt. Governor of Delhi in respect of D.G. Sets (5th December, 2001)

In exercise of the powers conferred by section 5 of the Environment (Protection) Act, 1986, (29 of 1986), read with the Government of India, Ministry of Home Affairs notification S.O. 667 (E) bearing No. F.No. U-11030/J/91-VTL dated 10th September, 1992, the Lt. Governor of Government of National Capital of Delhi hereby directs to all owners/users of generators sets in the National Capital Territory of Delhi as follows :-

1. that generator sets above the capacity of 5 KVA shall not be operated in residential areas between the hours of 10.00 PM to 6.00 AM;
2. that the generator sets above the capacity of 5 KVA in all areas residential/commercial/industrial shall operate only with the mandatory acoustic enclosures and other standards prescribed in the Environment (Protection) Rules, 1986;
3. that mobile generator sets used in social gatherings and public functions shall be permitted only if they have installed mandatory acoustic enclosures and adhere to the prescribed standards for noise and emission as laid down in the Environment (Protection) Rules, 1986.

The contravention of the above directions shall make the offender liable for prosecution under section 15 of the said Act which stipulates punishment of imprisonment for a term which may extend to five years with fine which may extend to one lakh rupees, or with both, and in case the failure of contravention continues, with additional fine which may extend to five thousand rupees for every day during which such failure or contravention continues after the conviction for the first such failure or contravention and if still the failure or contravention continues beyond a period of one year after the date of contravention, the offender continues beyond a period of one year after the date of contravention, the offender shall be punishable with imprisonment for a term which may extend to seven years.

Order Dated: 21st June, 2002

In exercise of the powers conferred by section 5 of the Environment (Protection) Act, 1986 (29 of 1986) read with the Govt. of India, Ministry of Home Affairs notification S.O. 667(E) bearing No. U-11030/J/91-VTL dated the 10th September, 1992, the Lt. Governor Govt. of the National Capital Territory of Delhi hereby makes the following amendment/modification in his order dated the 5th December, 2001 regarding the operation of generator sets, namely:-

Amendments/modifications

In the above said order, for clause(1), the following shall be substituted, namely:-

"(1) that the generator sets above 5KVA shall not be operated in residential areas between the hours from 10.00 p.m. to 6.00 a.m. except generator sets of Group Housing Societies and Multi-storey residential apartments".

DIESEL GENERATOR SETS: STACK HEIGHT

The minimum height of stack to be provided with each generator set can be worked out using the following formula:

$H = h + 0.2 \times \sqrt{KVA}$

H = Total height of stack in metre

h = Height of the building in metres where the generator set is installed

KVA = Total generator capacity of the set in KVA

Based on the above formula the minimum stack height to be provided with different range of generator sets may be categorized as follows:

For Generator Sets	Total Height of stack in metre
50 KVA	Ht. of the building + 1.5 metre
50-100 KVA	Ht. of the building + 2.0 metre
100- 150 KVA	Ht. of the building + 2.5 metre
150-200 KVA	Ht. of the building + 3.0 metre
200-250 KVA	Ht. of the building + 3.5 metre
250-300 KVA	Ht. of the building + 3.5 metre

Similarly for higher KVA ratings a stack height can be worked out using the above formula

Source: Evolved By CPCB

[Emission Regulations Part IV: COINDS/26/1986-87]

ANNEXURE IX
Form 1 (Application for Obtaining EIA Clearance)

FORM 1

(I) Basic Information

S. No.	Item	Details
1.	Name of the project/s	
2.	S.No. in the schedule	
3.	Proposed capacity/area/length/tonnage to be handled/command area/lease area/number of wells to be drilled	
4.	New/Expansion/Modernization	
5.	Existing Capacity/Area etc.	
6.	Category of Project i.e., 'A' or 'B'	
7.	Does it attract the general condition? If yes, please specify.	
8.	Does it attract the specific condition? If yes, Please specify.	
9.	Location	
	Plot/Survey/Khasra No.	
	Village	
	Tehsil	
	District	
	State	
10.	Nearest railway station/airport along with distance in kms.	
11.	Nearest Town, city, District headquarters along with distance in kms.	
12.	Village Panchayats, Zilla Parishad, Municipal Corporation, Local body (complete postal addresses with telephone nos. to be given)	
13.	Name of the applicant	
14.	Registered Address	
15.	Address for correspondence:	
	Name	
	Designation (Owner/Partner/CEO)	
	Address	
	Pin Code	
	E-mail	
	Telephone No.	

S. No.	Item	Details
	Fax No.	
16.	Details of alternative Sites examined, if any location of these sites should be shown on a toposheet.	Village-District-State 1. 2. 3.
17.	Interlined Projects	
18.	Whether separate application of interlined project has been submitted	
19.	If yes, date of submission	
20.	If no, reason	
21.	Whether the proposal involves approval/clearance under: if yes, details of the same and their status to be given. (a) The Forest (Conservation) Act, 1980 ? (b) The Wildlife (Protection) Act, 1972 ? (c) The C.R.Z. Notification, 1991 ?	
22.	Whether there is any Government Order/Policy relevant/relating to the site?	
23.	Forest land involved (hectares)	
24.	Whether there is any litigation pending against the project and/or land in which the project is propose to be set up (a) Name of the Court (b) Case No. (c) Orders/directions of the Court, if any and its relevance with the proposed project.	

(II) Activity

1. Construction, operation or decommissioning of the Project involving actions, which will cause physical changes in the locality (topography, land use, changes in water bodies, etc.)

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
1.1	Permanent or temporary change in land use, land cover or topography including increase in intensity of land use (with respect to local land use plan)		
1.2	Clearance of existing land, vegetation and		

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
	buildings?		
1.3	Creation of new land uses?		
1.4	Pre-construction investigations e.g. bore houses, soil testing?		
1.5	Construction works?		
1.6	Demolition works?		
1.7	Temporary sites used for construction works or housing of construction workers?		
1.8	Above ground buildings, structures or earthworks including linear structures, cut and fill or excavations		
1.9	Underground works including mining or tunneling?		
1.10	Reclamation works?		
1.11	Dredging?		
1.12	Offshore structures?		
1.13	Production and manufacturing processes?		
1.14	Facilities for storage of goods or materials?		
1.15	Facilities for treatment or disposal of solid waste or liquid effluents?		
1.16	Facilities for long term housing of operational workers?		
1.17	New road, rail or sea traffic during construction or operation?		
1.18	New road, rail, air waterborne or other transport infrastructure including new or altered routes and stations, ports, airports etc?		
1.19	Closure or diversion of existing transport routes or infrastructure leading to changes in traffic movements?		
1.20	New or diverted transmission lines or pipelines?		
1.21	Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers?		
1.22	Stream crossings?		
1.23	Abstraction or transfers of water form ground or surface waters?		

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
1.24	Changes in water bodies or the land surface affecting drainage or run-off?		
1.25	Transport of personnel or materials for construction, operation or decommissioning?		
1.26	Long-term dismantling or decommissioning or restoration works?		
1.27	Ongoing activity during decommissioning which could have an impact on the environment?		
1.28	Influx of people to an area in either temporarily or permanently?		
1.29	Introduction of alien species?		
1.30	Loss of native species or genetic diversity?		
1.31	Any other actions?		

2. Use of Natural resources for construction or operation of the Project (such as land, water, materials or energy, especially any resources which are non-renewable or in short supply):

S.No.	Information/checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
2.1	Land especially undeveloped or agricultural land (ha)		
2.2	Water (expected source & competing users) unit: KLD		
2.3	Minerals (MT)		
2.4	Construction material – stone, aggregates, sand / soil (expected source – MT)		
2.5	Forests and timber (source – MT)		
2.6	Energy including electricity and fuels (source, competing users) Unit: fuel (MT), energy (MW)		
2.7	Any other natural resources (use appropriate standard units)		

3. Use, storage, transport, handling or production of substances or materials, which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health.

S.No	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
3.1	Use of substances or materials, which are hazardous (as per MSIHC rules) to human health or the environment (flora, fauna, and water supplies)		
3.2	Changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)		
3.3	Affect the welfare of people e.g. by changing living conditions?		
3.4	Vulnerable groups of people who could be affected by the project e.g. hospital patients, children, the elderly etc.,		
3.5	Any other causes		

4. Production of solid wastes during construction or operation or decommissioning (MT/month)

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
4.1	Spoil, overburden or mine wastes		
4.2	Municipal waste (domestic and or commercial wastes)		
4.3	Hazardous wastes (as per Hazardous Waste Management Rules)		
4.4	Other industrial process wastes		
4.5	Surplus product		
4.6	Sewage sludge or other sludge from effluent treatment		
4.7	Construction or demolition wastes		
4.8	Redundant machinery or equipment		
4.9	Contaminated soils or other materials		
4.10	Agricultural wastes		
4.11	Other solid wastes		

5. Release of pollutants or any hazardous, toxic or noxious substances to air (kg/hr)

S.No	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
5.1	Emissions from combustion of fossil fuels from stationary or mobile sources		
5.2	Emissions from production processes		
5.3	Emissions from materials handling including storage or transport		
5.4	Emissions from construction activities including plant and equipment		
5.5	Dust or odours from handling of materials including construction materials, sewage and waste		
5.6	Emissions from incineration of waste		
5.7	Emissions from burning of waste in open air (e.g. slash materials, construction debris)		
5.8	Emissions from any other sources		

6. Generation of Noise and Vibration, and Emissions of Light and Heat:

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data with source of information data
6.1	From operation of equipment e.g. engines, ventilation plant, crushers		
6.2	From industrial or similar processes		
6.3	From construction or demolition		
6.4	From blasting or piling		
6.5	From construction or operational traffic		
6.6	From lighting or cooling systems		
6.7	From any other sources		

7. Risks of contamination of land or water from releases of pollutants into the ground or into sewers, surface waters, groundwater, coastal waters or the sea:

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
7.1	From handling, storage, use or spillage of hazardous materials		
7.2	From discharge of sewage or other effluents to water or the land (expected mode and place of discharge)		
7.3	By deposition of pollutants emitted to air into the land or into water		
7.4	From any other sources		
7.5	Is there a risk of long term build up of pollutants in the environment from these sources?		

8. Risk of accidents during construction or operation of the Project, which could affect human health or the environment

S.No	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
8.1	From explosions, spillages, fires etc from storage, handling, use or production of hazardous substances		
8.2	From any other causes		
8.3	Could the project be affected by natural disasters causing environmental damage (e.g. floods, earthquakes, landslides, cloudburst etc)?		

9. Factors which should be considered (such as consequential development) which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality

S. No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data

9.1	Lead to development of supporting facilities, ancillary development or development stimulated by the project which could have impact on the environment e.g.: ▪ Supporting infrastructure (roads, power supply, waste or waste water treatment, etc.) ▪ housing development ▪ extractive industries ▪ supply industries ▪ other		
9.2	Lead to after-use of the site, which could have an impact on the environment		
9.3	Set a precedent for later developments		
9.4	Have cumulative effects due to proximity to other existing or planned projects with similar effects		

(III) Environmental Sensitivity

S.No.	Areas	Name/ Identity	Aerial distance (within 15 km.) Proposed project location boundary
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value		
2	Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests		
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration		
4	Inland, coastal, marine or underground waters		
5	State, National boundaries		
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas		
7	Defence installations		
8	Densely populated or built-up area		
9	Areas occupied by sensitive man-made land uses *(hospitals, schools, places of worship,*		

	community facilities)		
10	Areas containing important, high quality or scarce resources *(ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)*		
11	Areas already subjected to pollution or environmental damage. *(those where existing legal environmental standards are exceeded)*		
12	Areas susceptible to natural hazard which could cause the project to present environmental problems (*earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions*)		

(IV) PROPOSED TERMS OF REFERENCE FOR EIA STUDIES

"I hereby given undertaking that the data and information given in the application and enclosures are true to the best of my knowledge and belief and I am aware that if any part of the data and information submitted is found to be false or misleading at any stage, the project will be rejected and clearance give, if any to the project will be revoked at our risk and cost.

Date:_____
Place:_____

Signature of the applicant
With Name and Full Address
(Project Proponent / Authorized Signatory)

NOTE:

1. The projects involving clearance under Coastal Regulation Zone Notification, 1991 shall submit with the application a C.R.Z. map duly demarcated by one of the authorized agencies, showing the project activities, w.r.t. C.R.Z. (at the stage of TOR) and the recommendations of the State Coastal Zone Management Authority (at the stage of EC). Simultaneous action shall also be taken to obtain the requisite clearance under the provisions of the C.R.Z. Notification, 1991 for the activities to be located in the CRZ.
2. The projects to be located within 10 km of the National Parks, Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals, the project proponent shall submit the map duly authenticated by Chief Wildlife Warden showing these features vis-à-vis the project location and the recommendations or comments of the Chief Wildlife Warden thereon (at the stage of EC)."
3. All corrspondence with the Ministry of Environment & Forests including submission of application for TOR/Environmental Clearance, subsequent clarifications, as may be requried from time to time, participation in the EAC Meeting on behalf of the project proponent shall be made by the authorized signatory only. The authorized signatory should also submit a document in support of his claim of being an authorized signatory for the specific project."

ANNEXURE X
Critically Polluted Industrial Areas and Clusters/Potential Impact Zones

Table 1: Details of Critically Polluted Industrial Areas and Clusters / Potential Impact Zone (Ref: Office Memorandum No. J-11013/5/2010-IA.II(I) Dated 13.1.2010)

S. No.	Critically Polluted Industrial Area and CEPI	Industrial Clusters/ Potential Impact Zones
1.	Ankeshwar (Gujarat) CEPI-88.50(Ac_Wc_Lc)	▪ GIDC Ankeshwar and GIDC, Panoli
2	Vapi (Gujarat) CEPI-88.09(Ac_Wc_Lc)	▪ GIDC Vapi
3	Ghaziabad (Uttar Pradesh) CEPI-87.37(Ac_Wc_Lc)	Sub-cluster A ▪ Mohan nagar industrial area ▪ Rajinder nagar industrial area ▪ Sahibabad industrial area Sub-cluster B ▪ Pandav nagar industrial area ▪ Kavi nagar industrial area ▪ Bulandshahar road industrial area ▪ Amrit nagar ▪ Aryanagar industrial area Sub-cluster C ▪ Merrut road industrial are Sub-cluster D ▪ Loni industrial area ▪ Loni Road industrial area ▪ Roop nagar industrial area Sub-cluster E ▪ Hapur Road industrial area ▪ Dasna ▪ Philkura Sub-cluster F (Other scattered industrial areas) ▪ South side of GT road ▪ Kavi Nagar ▪ Tronica city ▪ Anand Nagar ▪ Jindal Nagar ▪ Prakash Nagar ▪ Rural industrial estate
4	Chandrapur (Maharashtra) CEPI-83.88 (Ac_Wc_Lc)	▪ Chandrapur (MIDC Chandrapur, Tadali, Ghuggus, Ballapur)
5	Kobra (Chhatisgarh) CEPI-83.00 (Ac_Ws_Lc)	▪ Industrial areas and their townships of NTPC, BALCO, CSEB (East) & CSEB (West) ▪ Korba town
6	Bhiwadi (Rajasthan) CEPI-82.91 (Ac_Wc_Ls)	▪ RIICO industrial areas Phase I to IV ▪ Bhiwadi town ▪ Other surrounding industrial areas: Chopanki, Rampura Mundana, Khuskhera Phase I to III
7	Angul Talcer(Orissa) CEPI-82.09 (Ac_Wc_Lc)	▪ MCL Coal mining area, Augul – Talcer region ▪ Industrial area (60 km x 45 km) Following blocks of Augul district: ▪ Kohina block ▪ Talcher block

		▪ Angul block ▪ Chhendipada block ▪ Banarpal block ▪ Odapada block of Dhenkamal district
8	Vellore (North Arcot) (Tamil Nadu) CEPI-81.79 (Ac_Wc_Lc)	▪ Ranipet, SIPCOT industrial complex
9	Singrauli (Uttar Pradesh) CEPI-81.73 (Ac_Wc_Ls)	Sonebhadra (UP) ▪ Dala-Tola ▪ Obra ▪ Renukoot ▪ Anpara ▪ Renusagar ▪ Kakri ▪ Dudhichuwa ▪ Bina ▪ Khadia ▪ Shakti nagar ▪ Rihand nagar ▪ Bijpur Sigrauli (Madhya Pradesh) Vindhyachal nagar and Jaynat, Nigahi, Dudhichua, Amlohri & Jhingurdah townships
10	Ludhiana (Punjab) CEPI-81.66 (Ac_Wc_Ls)	Ludhiana municipal limits covering industrial clusters: ▪ Focal point along with NH-I- Total eight phase ▪ Industrial area-B- from sherpur chowk to Gill road & Gill road to Miller Kotla road (left side of road) ▪ Mixed industrial area – right side of Gill road ▪ Industrial area –C (near Juglana village) ▪ Industrial area A & extension: area between old GT road and Ludhiana bypass road ▪ Industrial estate: near Dholwal chowk ▪ Mixes industrial area (MIA) Miller gunj ▪ MIA – bypass road ▪ Bahdur industrial area ▪ Tejpur industrial complex
11	Nazafgarh drain basin, Delhi CEPI-79.54 (As_Wc_Lc)	▪ Industrial areas: Anand Parvat, Naraina, Okhla and Wazirpur
12	Noida (Uttar Pradesh) CEPI-78.90 (Ac_Wc_Lc)	Territorial Jurisdiction of: ▪ Noida Phase-1 ▪ Noida Phase-2 ▪ Noida Phase-3 ▪ Surajpur industrial area ▪ Greater Noida industrial area ▪ Village- Chhaparaula
13	Dhanbad (Jharkhand) CEPI-78.63 (Ac_Ws_Lc)	Four blocks of Dhanbad district: ▪ Sadar (Dhanbad Municipality) ▪ Jharia (Jharia Municipality, Sindri industrial area) ▪ Govindpur (Govindpur industrial estate) ▪ Nirsa
14	Dombivalli (Maharashtra) CEPI-78.41 (Ac_Wc_Ls)	▪ MIDC Phase- I, Phase- II

15	Kanpur (Uttar Pradesh) CEPI-78.09 (Ac_Wc_Ls)	Industrial areas: ▪ Dada nagar ▪ Panki ▪ Fazalganj ▪ Vijay nagar ▪ Jajmau
16	Cuddalore (Tamil Nadu) CEPI-77.45 (As_Wc_Lc)	▪ SIPCOT industrial complex, Phase I & II
17	Aurangabad (Maharashtra) CEPI-77.44 (Ac_Wc_Ls)	▪ MIDC Chikhalthana, MIDC Waluj, MIDC Shendra, and Paithan road industrial area
18	Faridabad (Haryana) CEPI-77.07 (Ac_Ws_Lc)	▪ Sector 27-A, B, C, D ▪ DLF phase- 1, sector 31,32 ▪ DLF phase- 2, sector 35 ▪ Sector 4, 6, 24, 27, 31, 59 ▪ Industrial area Hatin ▪ Industrial model township
19	Agra (Uttar Pradesh) CEPI-76.48 (As_Wc_Ls)	▪ Nunihai industrial estate, Rambag nagar, UPSIDC industrial area, and Runukata industrial area
20	Manali (Tamil Nadu) CEPI-76.32 (Ac_Ws_Ls)	▪ Manali industrial area
21	Haldia (West Bengal) CEPI-75.43 (As_Wc_Ls)	▪ 5 km wide strip (17.4 x 5.0 km) of industrial area on the southern side of the confluence point of Rivers Hugli and Rupnarayan, covering ▪ Haldia municipal area & Sutahata block – I and II
22	Ahmedabad (Gujarat) CEPI-75.28 (Ac_Ws_Ls)	▪ GIDC Odhav ▪ GIDC Naroda
23	Jodhpur (Rajasthan) CEPI-75.19 (As_Wc_Ls)	▪ Industrial areas including Basni areas (phase-I & II), industrial estate, light & heavy industrial areas, industrial areas behind new power house, Mandore, Bornada, Sangariya and village Tanwada & Salawas. ▪ Jodhpur city
24	Greater Cochin (Kerala) CEPI-75.08 (As_Wc_Ls)	▪ Eloor-Edayar industrial belt, ▪ Ambala Mogal industrial areas
25	Mandi Gobind Garh (Punjab) CEPI-75.08 (Ac_Ws_Lc)	▪ Mandi Govindgarh municipal limit and khanna area
26	Howrah (West Bengal) CEPI-74.84 (As_Ws_Lc)	▪ Liluah-Bamangachhi region, Howrah ▪ Jalan industrial complex-1, Howrah
27	Vatva (Gujarat) CEPI-74.77 (Ac_Wc_Ls)	▪ GIDC Vatva, Narol industrial area (Villages Piplaj, Shahwadi, Narol)
28	Ib Valley (Orissa) CEPI-74.00 (Ac_Ws_Ls)	▪ Ib Valley of Jharsuguda (Industrial and mining area)
29	Varansi-Mirzapur (Uttar Pradesh) CEPI-73.79 (As_Wc_Ls)	▪ Industrial estate, Mirzapur ▪ Chunar ▪ Industrial estate, Chandpur, Varansi ▪ UPSIC, industrial estate, Phoolpur ▪ Industrial area, Ramnagar, Chandauli
30	Navi Mumbai (Maharashtra) CEPI-73.77 (Ac_Ws_Ls)	▪ TTC industrial area, MIDC, Navi Mumbai (including Bocks-D, C, EL, A, R, General, Kalva)

31	Pali (Rajasthan) CEPI-73.73 (As_Wc_Ls)	▪ Existing industrial areas: Mandia road, Puniyata road, Sumerpur ▪ Pali town
32	Mangalore (Karnataka) CEPI-73.68 (Ac_Ws_Ls)	▪ Baikampady industrial area
33	Jharsuguda (Orissa) CEPI-73.34 (Ac_Ws_Ls)	▪ Ib valley of Jharsuguda (Industrial and mining area)
34	Coimbatore (Tamil Nadu) CEPI-72.38 (Ac_Ws_Ln)	▪ SIDCO, Kurichi industrial Clusters
35	Bhadravati (Karnataka) CEPI-72.33 (Ac_Ws_Ln)	▪ KSSIDC Industrial area, Mysore paper mill & VISL township complex
36	Tarapur (Maharashtra) CEPI-72.01 (Ac_Ws_Ls)	▪ MIDC Tarapur
37	Panipat (Haryana) CEPI-71.91 (As_Ws_Ls)	▪ Panipat municipal limit and its industrial clusters
38	Indore (Madhya Pradesh) CEPI-71.26 (As_Ws_Ls)	Following 09 industrial area: ▪ Sanwer road ▪ Shivaji nagar ▪ Pologround ▪ Laxmibai nagar ▪ Scheme no.71 ▪ Navlakha ▪ Pipliya ▪ Palda ▪ Rau Indore city Other surrounding industrial areas: Manglia, Rajoda, Asrawad, Tejpur Gadwadi
39	Bhavnagar (Gujarat) CEPI-70.99 (As_Ws_Ls)	▪ GIDI Chitra, Bhavnagar
40	Vishakhapatnam (Andhra Pradesh) CEPI-70.82 (As_Ws_Ls)	▪ Bowl area (the area between Yarada hill range in the south to Simhachalam hill range in the north and sea on the east and the present NH-5 in the west direction)
41	Junagarh (Gujarat) CEPI-70.82 (As_Ws_Ls)	Industrial areas: ▪ Sabalpur ▪ Jay Bhavani ▪ Jay Bhuvneshwari ▪ GIDC Junagarh (I&II)
42	Asansole (West Bengal) CEPI-70.20 (As_Ws_Ls)	▪ Bumpur area surrounding IISCO
43	Patancheru - Bollaram (Andhra Pradesh) CEPI-70.07 (As_Ws_Ls)	Industrial area: ▪ Patancheru ▪ Bollaram

Note:

Names of identified industrial clusters/potential impact zones are approximate location based on rapid survey and assessment and may alter partially subject to the detailed field study and monitoring. Detailed mapping will be made available showing spatial boundaries of the identified industrial clusters including zone of influence/ buffer zone, after in depth field study.

ANNEXURE XI
Pre-Feasibility Report: Points for Possible Coverage

Table 1: Points for Possible Coverage in Pre-feasibility Report

S. No.	Contents	Points of Coverage in Pre-feasibility Report
I.	**Executive summary**	▪ A miniature report of entire pre feasibility report.
II.	**Project Details**	
	Need/Justification of the Project	▪ Need for establishing TSDF ▪ Alternatives to meet the need ▪ Post project scenario, *etc*.
	Capacity of TSDF Facility	▪ Inventarisation of hazardous waste, suitability of waste for different modes i.e., 1. recoverable, 2. Incinerable, 3. Directly landfillable, 4. landfillable after stabilization. ▪ Capacities of various units in the proposed TSDF i.e storage, recyclables, stabilization, Incineration, landfill, leachate collection and treatment etc,.
	Process technology	▪ Analysis of all suitable technologies and better operating practices. ▪ Analysis of various possible configurations for each technology or a combination of these technologies for waste management ▪ Broad specifications for the proposed facility including but not limited to: ▪ General facility layout showing all the units, *etc*. ▪ Design, construction, operation process flow diagrams for each alternative ▪ In case of landfill, details on landfill type, construction and phases, waste storage, leachate management, landfill gas management, stormwater management, *etc*. ▪ Incase of incinerator provide complete details in accordance to the guidelines for common hazardous waste incinerator published document by CPCB ▪ Equipments used at the facility for handling waste.
	Resources	▪ Manpower ▪ Equipments for handling waste ▪ Transportation vehicles ▪ Construction material ▪ Infrastructure development ▪ Source of water for utilities, domestic, *etc*. ▪ Electric power, *etc*.
	Rejects (Pollution potential)	▪ Water pollution – leachate, scrubber liquor, vehicle washing *etc*,. ▪ Air emissions – methane, CO2, HCl, SO2, CO, total organic carbon, HF, NOx, Total Dioxins & Furans, Cd + Th + Their compounds, Hg and its compounds, Sb + As + Pb + Cr+ Co+ Cu + Mn + Ni + V + their compounds etc,. ▪ Noise – transportation of vehicles, activities at the facility, *etc*. ▪ Odour, *etc*.
	Technical profile	▪ Various activities of the facility ▪ Construction details ▪ Estimated duration ▪ Number of construction workers including migrating workers ▪ Construction equipment

		▪ Vehicular traffic ▪ Source, mode of transportation and storage of construction material ▪ Traffic that would arise during different phases of the project and transportation mechanism to handle such traffic ▪ New facilities needed ▪ Technical parameters of the facility & equipments to be used ▪ Waste storage and associated transportation system, *etc*.
	Project schedule	▪ project implementation schedule and procurement arrangement including contract packaging
	Future prospects	▪ Ascertain the costs and benefits of the proposed project for project life ▪ Technical and logistic constraints/requirements of project sustainability, *etc*.
III.	**Selection of site based on least possible impacts**	
i.	**Choice of site selection**	
	Major techno-economic feasibility considerations	▪ Land availability & its development ▪ Demand for disposal of hazardous waste around the selected site ▪ Access to site for transportation of equipments/ construction machinery, material, *etc*. ▪ Water availability and consumptive use ▪ Infrastructure availability at selected site ▪ Inter-state issue, if any, *etc*.
	Incompatible landuse and ecologically sensitive attributes with respect to identified suitable sites	▪ If any incompatible landuse attributes fall within the study area, the following details has to be provided: ▪ Public water supply areas from rivers/surface water bodies, from groundwater ▪ Scenic areas/tourism areas/hill resorts ▪ Religious places, pilgrim centers that attract over 10 lakh pilgrims a year ▪ Protected tribal settlements (notified tribal areas where industrial activity is not permitted); CRZ ▪ Monuments of national significance, World Heritage Sites ▪ Cyclone, Tsunami prone areas (based on last 25 years); ▪ Airport areas ▪ Any other feature as specified by the State or local government and other features as locally applicable, including prime agricultural lands, pastures, migratory corridors, etc. ▪ If ecologically sensitive attributes fall within the study area, please give details. Ecologically sensitive attributes include ▪ National parks ▪ Wild life sanctuaries Game reserve ▪ Tiger reserve/elephant reserve/turtle nesting ground ▪ Mangrove area ▪ Wetlands ▪ Reserved and protected forests ▪ Endangered species of flora and fauna ▪ Any other eco-sensitive areas etc.

	Social aspects	▪ Corporate social responsibilities ▪ Employments and infrastructure added in the vicinity of the plant ▪ Status of land availability, current and post project land use variation ▪ Social sensitivity and likely project affected people, *etc*.
ii.	**Details of selected site**	
	Land details	▪ Land requirement and availability ▪ Land ownership details such as Government, private, tribal, non-tribal, etc. ▪ Total area of the project/site ▪ Prevailing land cost details, *etc*.
	Location	▪ Geographical details - Longitude & latitude, village, taluka, district, state, *etc*. ▪ Approach to site – roads, railways and airports ▪ Distance from nearest residential and industrial areas ▪ Distance from nearest water bodies such as river, canal, dam, *etc* ▪ Distance from ecologically sensitive areas ▪ In case of flood prone areas, HFL of the site ▪ In case of seismic areas, seismic zone, active faults, occurrence on earthquakes, etc. ▪ Proximity from infrastructural facilities, *etc*.
	Physical characteristics	▪ Demography ▪ Meteorological data ▪ Landuse pattern such as agricultural, barren, forest, *etc.* and details thereof ▪ Topography of the area ▪ Drainage patterns ▪ Soil condition and soil investigation results ▪ Ground profile and levels, *etc*.
IV.	**Anticipated impacts based on project operations on receiving environment**	▪ Population ▪ Flora and fauna ▪ Water ▪ Soil ▪ Air ▪ Climate ▪ Landscape, *etc.*
V.	**Proposed broad mitigation measures which could effectively be internalized as project components to have environmental and social acceptance of the proposed site**	▪ Preventive measures ▪ Source control measures ▪ Mitigation measures at the receiving environment ▪ Health and safety measures of workers, *etc*.
VI.	**An indication of any difficulties (technical deficiencies or lack of know-how) encountered by the developer in compiling the required information.**	

The above listing is not exhaustive. Thus the proponent may provide additional necessary information, felt appropriate, to include in the pre-feasibility study report in support of selecting the site for the proposed developmental activities. The Concerned EAC/SEAC during scrutiny, may specifically ask for any additional information/data required to substantiate the requirement to prescribe the ToR for EIA studies. However, it is to make clear that all the required further information by EAC/SEAC may be mentioned in one single letter, within the prescribed time.

ANNEXURE XII
Types of Monitoring and Network Design Considerations

TYPES OF MONITORING AND NETWORK DESIGN CONSIDERATIONS

A. Types of Monitoring

Monitoring refers to the collection of data using a series of repetitive measurements of environmental parameters (or, more generally, to a process of systematic observation). The environmental quality monitoring programme design will be dependent upon the monitoring objectives specified for the selected area of interest. The main types of EIA monitoring activities are:

- Baseline monitoring is the measurement of environmental parameters during the pre-project period for the purpose of determining the range of variation of the system and establishing reference points against which changes can be measured. This leads to the assessment of the possible (additional available) assimilative capacity of the environmental components in pre-project period w.r.t. the standard or target level.
- Effects monitoring is the measurement of environmental parameters during project construction and implementation to detect changes which are attributable to the project to provide the necessary information to:
  - verify the accuracy of EIA predictions; and
  - determine the effectiveness of measures to mitigate adverse effects of projects on the environment.
  - Feedback from environmental effect monitoring programs may be used to improve the predictive capability of EIAs and also determine whether more or less stringent mitigation measures are needed
- Compliance monitoring is the periodic sampling or continuous measurement of environmental parameters to ensure that regulatory requirements and standards are being met.

Compliance and effects monitoring occurs during the project construction, operation, and abandonment stages. The resources and institutional set-up should be available for the monitoring at these stages. All large-scale construction projects will require some construction stage monitoring. To control the environmental hazards of construction as specified in the EIA, a monitoring program should be established to ensure that each mitigation measure is effectively implemented. There are numerous potential areas for monitoring during operations.

The scope of monitoring topics discussed in this chapter is limited to Baseline and Effects monitoring. In addition, this chapter will also discuss the Compliance monitoring during the construction phase. Post-project monitoring requirements are discussed in the EMP.

Before any field monitoring tasks are undertaken there are many institutional, scientific, and fiscal issues that must be addressed in the implementation of an environmental monitoring program. Careful consideration of these issues in the design and planning stages will help avoid many of the pitfalls associated with environmental monitoring programs. Although these issues are important but the discussions here are confined to the monitoring network design component.

B. Network Design

Analysis of Significant Environmental Issues

At the outset of planning for an environmental monitoring network, the EIA manager may not know exactly what should be monitored, when monitoring should begin, where it should monitor, which techniques should be employed, and who should take responsibility for its conduct. Because there are usually a number of objective decisions associated with network design to be made, it is important to start with an analysis of environmental issues. The scoping phase of an EIA is designed to identify and focus on the major issues. Scoping should provide a valuable source of information on the concerns that need to be addressed by the monitoring network design. These are project specific as well as specific to the environmental setting of the location where the project is proposed to be located

Hence, the network designs are associated with questions like:

- What are the expected outputs of the monitoring activity?
- Which problems do we need to address to? *etc*.

Defining the output will influence the design of the network and optimize the resources used for monitoring. It will also ensure that the network is specially designed to optimize the information on the problems at hand

What to Monitor?

The question of what to monitor is associated with the identification of VECs.

VECs are generally defined as environmental attributes or components of the environment that are valued by society as identified during the scoping stage of the project. They are determined on the basis of perceived public concerns. For example, changes to water quality and quantity could have implications on fish by affecting habitat, food supply, oxygen, and contaminant uptake. Similarly, employment and business, and economies are both VECs that serve as pathways.

The choice of VECs is also related to the perceived significant impact of the project implementation on important environmental components. In general, the significance or importance of environmental components is judged based on:

- legal protection provided (for example, rare and endangered species)
- political or public concerns (for example, resource use conflicts and sustainable development)
- scientific judgment (for example, ecological importance); or
- commercial or economic importance

However, in addition to their economic, social, political or ecological significance, the chosen VEC should also have unambiguous operational ease, be accessible to prediction and measurement; and be susceptible to hazard. Once the VECs are defined, the VECs may be directly measured (for example, extent of habitat for an endangered species). In cases where it is impossible or impractical to directly measure the VECs, the chosen measurement endpoints or environmental indicators must correspond to, or be predictive of assessment endpoints.

The chosen environmental indicators must be: 1) measurable; 2) appropriate to the scale of disturbance/ contamination; 3) appropriate to the impact mechanism; 4) appropriate

and proportional to temporal dynamics; 5) diagnostic; and 6) standardized; as well as have: 1) a low natural variability; 2) a broad applicability; and 3) an existing data series.

Where, How and How Many Times to Monitor?

These are the other components of Monitoring Network Design. These questions are best answered based on local field conditions, capacity and resources available, prevailing legal and regulatory priorities, *etc*. For this, screening or reconnaissance surveys of the study area are also necessary. This may also include some simple inexpensive measurements and assimilative/dispersion modeling. The data will give some information on the prevailing special and temporal variations, and the general background air pollution in the area. The number of monitoring stations and the indicators to be measured at each station in the final permanent network may then be decided upon based on the results of the screening study as well as on the knowledge of the sources of the proposed development and prevailing local environmental/meteorological conditions. The best possible definition of the air pollution problem, together with the analysis of the resources: personnel, budget and equipment available, represent the basis for the decision on the following questions:

- What spatial density (number) of sampling stations is required? How many samples are needed and during what period (sampling (averaging) time and frequency)?
- Where should the stations be located?
- What kind of equipment should be used?
- What additional background information is needed?
  - meteorology
  - topography
  - population density
  - emission sources and emission rates
  - effects and impacts
- How will the data be made available/communicated?

C. Site Selection

When considering the location of individual samplers, it is essential that the data collected are representative for the location and type of area without the undue influence from the immediate surroundings. In any measurement point in the study area the total ambient concentration is the representative of:

- natural background concentration
- regional background
- impact of existing large regional sources such as industrial emissions

To obtain the information about the importance of these different contributions it is therefore necessary to locate monitoring stations so that they are representative for different impacts. In addition to the ambient pollution data, one would often need other data governing the variations such as meteorological data for air pollution, to identify and quantify the sources contributing to the measurements.

ANNEXURE XIII
Guidance for Assessment of Baseline Components and Attributes

GUIDANCE FOR ASSESSMENT OF BASELINE COMPONENTS AND ATTRIBUTES*

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
A. Air				
▪ Meteorological ▪ Wind speed ▪ Wind direction ▪ Dry bulb temperature ▪ Wet bulb temperature ▪ Relative humidity ▪ Rainfall ▪ Solar radiation ▪ Cloud cover	Minimum 1 site in the project impact area requirements Other additional site(s) are required depending upon the model applied or site sensitivities	Min: 1 hrly observations from continuous records	Mechanical / automatic weather station Rain gauge As per IMD As per IMD	IS 5182 Part 1-20 Sit-specific primary data is essential Secondary data from IMD, New Delhi for the nearest IMD station
Pollutants ▪ SPM ▪ RPM ▪ SO_2 ▪ NO_2 ▪ CO ▪ H_2S* ▪ $NH*_3$ ▪ HC* ▪ Fluoride* ▪ Pb* ▪ VOC-PAH* ▪ Mercury* (parameters to be proposed by the proponent, in draft ToR, which will be reviewed and approved by EAC/SEAC)	10 to 15 locations in the project impact area	24 hrly twice a week 8 hrly twice a week 24 hrly twice a week	▪ Gravimetric (High – Volume) ▪ Gravimetric (High – Volume with Cyclone) ▪ EPA Modified West & Gaeke method ▪ Arsenite Modified Jacob & Hochheiser ▪ NDIR technique ▪ Methylene-blue ▪ Nessler's Method ▪ Infra Red analyzer ▪ Specific lon meter	**Monitoring Network** ▪ Minimum 2 locations in upwind side, more sites in downwind side / impact zone ▪ All the sensitive receptors need to be covered **Measurement Methods** As per CPCB standards for NAQM, 1994
B. Noise				
Hourly equivalent noise levels	Same as for Air Pollution	At lest one day continuous in	Instrument : Sensitive Noise	Min: IS: 4954- 1968 as adopted

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
	along with others Identified in study area	each season on a working and non-working day	level meter (preferably recording type)	by CPCB
Hourly equivalent noise levels	Inplant (1.5 m from machinery or high emission processes)	Same as above for day and night	Instrument : Noise level metre	CPCB / OSHA
Hourly equivalent noise levels	Highways (within 500 metres from the road edge)	Same as above for day and night	Instrument : Noise level meter	CPCB / IS : 4954-1968
Peak particle velocity	150- 200m from blast site	Based on hourly observations	PPV meter	
C. Water				
Parameters for water quality ▪ Ph, temp, turbidity, magnesium hardness, total alkalinity, chloride, sulphate, nitrate, fluoride, sodium, potassium salinity ▪ Total nitrogen, total phosphorus, DO, BOD, COD, Phenol ▪ Heavy metals ▪ Total coliforms, faecal coliforms ▪ Phyto plankton ▪ Zooplankton ▪ Fish & other aquatic flora & fauna (parameters are given in ToR for EIA studies based on nature of project, raw material & process technology, location-nature/activities within of air basin)	Set of grab samples during pre and post-monsoon for ground and surface water for the whole study zone. For lab. Analysis the samples should be preserved for transport safe	Diurnal and season-wise	Samples for water quality should be collected and analyzed as per: IS: 2488 (Part 1-5) methods for sampling and testing of industrial effluents Standard methods for examination of water and waste water analysis published by American Public Health Association. International standard practices for benthos and aquatic flora & fauna	
For Surface Water Bodies				
▪ Total Carbon ▪ PH ▪ Dissolved Oxygen	Monitoring locations should include up-stream, on site, down stream of	Yield & impact on water sources to be measured during critical	Samples for water quality should be collected and	Historical data should be collected from relevant offices such as central water

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
▪ Biological Oxygen ▪ Demand ▪ Free NH_4 ▪ Boron ▪ Sodium Absorption ratio ▪ Electrical Conductivity	proposed discharge point. Besides sampling should cover width of the river in case water quality modeling is proposed. Standard methodology for collection of surface water (BIS standards) At least one grab sample per location per season	season River Stretch within project area be divided in grids (say 1 km length and 1/3 width) and samples should be from each grid at a time when the wastewater discharged by other sources of pollution is expected to be maximum	analyzed as per: IS: 2488 (Part 1-5) methods for sampling and testing of industrial effluents Standard methods for examination of water and wastewater analysis published by American Public Health Association.	commission, state and central ground water board, Irrigation dept.
Parameters for wastewater characterization				
▪ Temp, colour, odour, turbidity, TSS, TDS ▪ PH , alkalinity as $CaCO_3$, p value, M value, tatal hardness as $CaCO_3$, chloride as cl, sulphate as $S0_4$, Nitrate as NO_3, Floride as F, Phosphate as $P0_4$, Chromium as Cr (Hexavalent, total) Ammonical Nitrogen as N, TKN, % sodium, BOD at 20 C, COD, DO, total residual chlorine as Cl_2, oil and grease, sulphide, phenolic compound	Implant Source depending upon the different waste streams the parameters can be optimized Grab and composite sampling representing avg of different process operations as well as worst emission scenario should be represented	Different operational cycles as well as raw material variations should be reflected in the analysis	Samples for water quality should be collected and analyzed as per: IS: 2488 (Part 1-5) methods for sampling and testing of industrial effluents Standard methods for examination of water and wastewater analysis published by American Public Health Association.	All plant sources categorized as: ▪ Different Process waste streams as well as run-off conditions ▪ ETP wastewater ▪ Domestic/ sanitary wastewater
D. Land Environment				
▪ Soil ▪ Particle size distribution ▪ Texture ▪ pH ▪ Electrical conductivity ▪ Caution exchange capacity	One surface sample from each landfill and/or hazardous waste site (if applicable) and prime villages, (soil samples be collected as per BIS	Season-wise	Collected and analyzed as per soil analysis reference book, M.I.Jackson and soil analysis reference book by C.A. Black	The purpose of impact assessment on soil (land environment) is to assess the significant impacts due to leaching of wastes or accidental releases and contaminating

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
▪ Alkali metals ▪ Sodium Absorption Ratio (SAR) ▪ Permeability ▪ Porosity	specifications) in the study area			
Landuse / Landscape				
▪ Location code ▪ Total project area ▪ Topography ▪ Drainage (natural) ▪ Cultivated, forest plantations, water bodies, roads and settlements	At least 20 points along with plant boundary and general major land use categories in the study area.	Drainage once in the study period and land use categories from secondary data (local maps) and satellite imageries	▪ Global positioning system ▪ Topo-sheets ▪ Satellite Imageries ▪ (1:25,000) ▪ Satellite Imageries ▪ (1:25,000)	Drainage within the plant area and surrounding is very important for storm water impacts. From land use maps sensitive receptors (forests, parks, mangroves etc.) can be identified
E. Hazardous Waste				
▪ Permeability and porosity ▪ Moisture pH ▪ Electrical conductivity ▪ Loss on ignition ▪ Phosphorous ▪ Total nitrogen ▪ Caution exchange capacity ▪ Particle size distribution ▪ Heavy metal ▪ Ansonia ▪ Fluoride	Grab and Composite samples. Recyclable components have to analyzed for the recycling requirements	Process wise or activity wise for respective raw material used.	Analysis IS 9334 : 1979 IS 9235 : 1979 IS 10158 : 1982	Impacts of hazardous waste should be performed critically depending on the waste characteristics and place of discharge. For land disposal the guidelines should be followed and impacts of accidental releases should be assessed
F. Biological Environment Aquatic				
▪ Primary productivity ▪ Aquatic weeds ▪ Enumeration of ▪ phytoplankton, zooplankton and benthos	Considering probable impact, sampling points and number of samples to be decided on established guidelines on ecological	Season changes are very important	Standards techniques (APHA et. Al. 1995, Rau and Wooten 1980) to be followed for sampling and measurement	Seasonal sampling for aquatic biota One season for terrestrial biota, in addition to vegetation studies during monsoon season

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
▪ Fisheries ▪ Diversity indices ▪ Trophic levels ▪ Rare and endangered species ▪ Sanctuaries / closed areas / Coastal regulation zone (CRZ) ▪ Terrestrial ▪ Vegetation – species, list, economic importance, forest produce, medicinal value ▪ Importance value index (IVI) of trees ▪ Wild animals	studies based on site eco-environment setting within 10/25 km radius from the proposed site Samples to collect from upstream and downstream of discharge point, nearby tributaries at down stream, and also from dug wells close to activity site			Preliminary assessment Microscopic analysis of plankton and meiobenthos, studies of macrofauna, aquatic vegetation and application of indices, viz. Shannon, similarity, dominance IVI etc Point quarter plot-less method (random sampling) for terrestrial vegetation survey.
Avifauna ▪ Rare and endangered species ▪ Sanctuaries / National park / Biosphere reserve	For forest studies, chronic as well as short-term impacts should be analyzed warranting data on micro climate conditions			Secondary data to collect from Government offices, NGOs, published literature Plankton net Sediment dredge Depth sampler Microscope Field binocular
G. Socio Economic				
▪ Demographic structure ▪ Infrastructure resource base ▪ Economic resource base ▪ Health status: Morbidity pattern ▪ Cultural and aesthetic attributes	Socio-economic survey is based on proportionate, stratified and random sampling method	Different impacts occurs during construction and operational phases of the project	Primary data collection through R&R surveys (if require) or community survey are based on personal interviews and questionnaire	Secondary data from census records, statistical hard books, toposheets, health records and relevant official records available with Govt. agencies

* Project Specific concerned parameters needs to be identified by the project proponent and shall be incorporated in the draft ToR, to be submitted to the Authority for the consideration and approval by the EAC/SEAC.

ANNEXURE XIV
Sources of Secondary Data

Annexure XIVA: Potential Sources of Data For EIA

	Information	Source
	Air Environment	
1.	Meteorology- Temperature, Rainfall, Humidity, Inversion, Seasonal Wind rose pattern (16 point compass scale), cloud cover, wind speed, wind direction, stability, mixing depth	⑨ Indian Meteorology Department, Pune
2.	Ambient Air Quality- 24 hourly concentration of SPM, RPM, SO_2, NO_x, CO	⑨ Central Pollution Control Board (CPCB), ⑨ State Pollution Control Board (SPCB), ⑨ Municipal Corporations ⑨ Ministry of Environment and Forests (MoEF) ⑨ State Department of Environment (DoEN)
	Water Environment	
3.	Surface water- water sources, water flow (lean season), water quality, water usage, Downstream water users Command area development plan Catchment treatment plan	⑨ Central Water Commission (CWC), ⑨ Central Pollution Control Board (CPCB), ⑨ State Pollution Control Board (SPCB), Central Water and Power Research Institute (CWPRS), Pune ⑨ State Irrigation Department ⑨ Hydel Power generation organizations such as NHPC, State SEBs
4.	Ground Water- groundwater recharge rate/withdrawal rate, ground water potential groundwater levels (pre monsoon, post monsoon), ground water quality, changes observed in quality and quantity of ground water in last 15 years	⑨ Central Ground Water Board (CGWB) ⑨ Central Ground Water Authority (CGWA) ⑨ State Ground Water Board (SGWB) ⑨ National Water Development Authority (NWDA)
5.	Coastal waters- water quality, tide and current data, bathymetry	⑨ Department of Ocean Development, New Delhi ⑨ State Maritime Boards ⑨ Naval Hydrographer's Office, Dehradun ⑨ Port Authorities ⑨ National Institute of Oceanography (NIO), Goa
	Biological Environment	
6.	Description of Biological Environment- inventory of flora and fauna in 7 km radius, endemic species, endangered species, Aquatic Fauna, Forest land, forest type and density of vegetation, biosphere, national parks, wild life sanctuaries, tiger reserve, elephant reserve, turtle nesting ground, core zone of biosphere reserve, habitat of migratory birds, routes of migratory birds	⑨ District Gazetteers ⑨ National Remote Sensing Agency (NRSA), Hyderabad ⑨ Forest Survey of India, Dehradun ⑨ Wildlife Institute of India ⑨ World Wildlife Fund ⑨ Zoological Survey of India ⑨ Botanical Survey of India ⑨ Bombay Natural History Society, (BNHS), Mumbai ⑨ State Forest Departments ⑨ State Fisheries Department ⑨ Ministry of Environment and Forests ⑨ State Agriculture Departments ⑨ State Agriculture Universities
	Land Environment	
7.	Geographical Information-Latitude, Longitude, Elevation (above MSL)	⑨ Toposheets of Survey of India, Pune ⑨ National Remote Sensing Agency (NRSA), Hyderabad ⑨ Space Application Centre (SAC), Ahmedabad

	Information	Source
8.	Nature of Terrain, topography map indicating contours (1:2500 scale)	⑨ Survey of India Toposheets ⑨ National Remote Sensing Agency (NRSA), Hyderabad ⑨ State Remote Sensing Centre, ⑨ Space Application Centre (SAC), Ahmedabad
9.	Hydrogeology- Hydrogeological report (in case of ground water is used/area is drought prone/wastewater is likely to discharged on land) Geomorphological analysis (topography and drainage pattern) Geological analysis (Geological Formations/Disturbances- geological and structural maps, geomorphological contour maps, structural features, including lineaments, fractures, faults and joints) Hydrogeological analysis (disposition of permeable formations, surface-ground water links, hydraulic parameter determination etc) Analysis of the natural soil and water to assess pollutant absorption capacity	⑨ NRSA, Hyderbad ⑨ Survey of India Toposheets ⑨ Geological Survey of India ⑨ State Geology Departments ⑨ State Irrigation Department ⑨ Department of Wasteland Development, Ministry of Rural Areas ⑨ National Water Development Authority (NWDA)
10.	Nature of Soil, permeability, erodibility classification of the land	⑨ Agriculture Universities ⑨ State Agriculture Department ⑨ Indian Council for Agriculture Research ⑨ State Soil Conservation Departments ⑨ National Bureau of Soil Survey and Landuse Planning ⑨ Central Arid Zone Research Institute (CAZRI), Jodhpur
11.	Landuse in the project area and 10 km radius of the periphery of the project	⑨ Survey of India- Toposheets ⑨ All India Soil and Landuse Survey; Delhi ⑨ National Remote Sensing Agency (NRSA), Hyderabad ⑨ Town and County Planning Organisation ⑨ State Urban Planning Department ⑨ Regional Planning Authorities (existing and proposed plans) ⑨ Village Revenue Map- District Collectorate ⑨ Directorate of Economics and Statistics-State Government ⑨ Space Application Centre, Ahmedabad
12.	Coastal Regulation Zones- CRZMP, CRZ classification, Demarcation of HTL and LTL*	⑨ Urban Development Department ⑨ State Department of Environment ⑨ State Pollution Control Board ⑨ Space Application Centre* ⑨ Centre for Earth Sciences Studies, Thiruvanthapuram* ⑨ Institute of Remote Sensing, Anna University Chennai* ⑨ Naval Hydrographer's Office, Dehradun* ⑨ National Institute of Oceanography, Goa* ⑨ National Institute of Ocean Technology, Chennai ⑨ Centre for Earth Science Studies

* *Agencies authorized for approval of demarcation of HTL and LTL*

	Information	Source
	Social	
13.	Socioeconomic - population, number of houses and present occupation pattern within 7 km from the periphery of the project	⑨ Census Department ⑨ District Gazetteers- State Government ⑨ District Statistics- District Collectorate ⑨ International Institute of Population Sciences, Mumbai (limited data) ⑨ Central Statistical Organisation
14.	Monuments and heritage sites	District Gazetteer Archeological Survey of India, INTACH District Collectorate Central and State Tourism Department State Tribal and Social Welfare Department
	Natural Disasters	
15.	Seismic data (Mining Projects)- zone no, no of earthquakes and scale, impacts on life, property existing mines	⑨ Indian Meteorology Department, Pune ⑨ Geological Survey of India
16.	Landslide prone zone, geomorphological conditions, degree of susceptibility to mass movement, major landslide history (frequency of occurrence/decade), area affected, population affected	⑨ Space Application Centre
17.	Flood/cyclone/droughts- frequency of occurrence per decade, area affected, population affected	⑨ Natural Disaster Management Division in Department of Agriculture and Cooperation ⑨ Indian Meteorological Department
	Industrial	
18.	Industrial Estates/Clusters, Growth Centres	⑨ State Industrial Corporation ⑨ Industrial Associations ⑨ State Pollution Control Boards ⑨ Confederation Indian Industries (CII) ⑨ FICCI
19.	Physical and Chemical properties of raw material and chemicals (Industrial projects); fuel quality	⑨ Material and Safety Data Sheets ⑨ ENVIS database of Industrial Toxicological Research Centre, Lucknow ⑨ Indian Institute Petroleum
20.	Occupational Health and Industrial Hygiene- major occupational health and safety hazards, health and safety requirements, accident histories	⑨ Central Labour Institute, Mumbai ⑨ Directorate of Industrial Safety ⑨ ENVIS Database of Industrial Toxicological Research Centre, Lucknow ⑨ National Institute of Occupational Health, Ahmedabad
21.	Pollutant release inventories (Existing pollution sources in area within 10 km radius)	⑨ Project proponents which have received EC and have commenced operations
22.	Water requirement (process, cooling water, DM water, Dust suppression, drinking, green belt, fire service)	⑨ EIA Reports ⑨ National and International Benchmarks

Annexure XIVB: Summary of Available Data with Potential Data Sources for EIA

	Agency	Information Available
1.	Archaeological Survey of India Department of Culture Government of India Janpath, New Delhi - 110011 Asi@del3.vsnl.net.in	⑨ Inventory of monuments and sites of national importance- Listing and documentation of monuments according to world heritage, pre historic, proto historic and secular, religious places and forts
2.	Botanical Survey Of India P-8, Brabourne Road Calcutta 700001 Tel#033 2424922 Fax#033 2429330 Email: envis@cal2.vsnl.net.in. . RO - Coimbatore, Pune, Jodhpur, Dehradun, Allahabad, Gantok, Itanagar, Port Blair	⑨ Photodiversity documentation of flora at National, State and District level and flora of protected areas, hotspots, fragile ecosystems, sacred groves etc ⑨ Identification of threatened species including endemics, their mapping, population studies ⑨ Database related to medicinal plants, rare and threatened plant species ⑨ Red data book of Indian plants (Vol 1,2, and 3) ⑨ Manual for roadside and avenue plantation in India
3.	Bureau of Indian Standards Manak Bhawan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002 Tel#3230131, 3233375, 3239402 (10 lines) Fax : 91 11 3234062, 3239399, 3239382 Email- bis@vsnal.com	⑨ Bureau of Indian Standards Committees on Earthquake Engineering and Wind Engineering have a Seismic Zoning Map and the Wind Velocity Map including cyclonic winds for the country
4.	Central Water Commission (CWC) Sewa Bhawan, R.K.Puram New Delhi - 110066 cmanoff@niccwc.delhi.nic.in RO- Bangalore, Bhopal, Bhubaneshwar, Chandigarh, Coimbatore/Chennai, Delhi, Hyderabad, Lucknow, Nagpur, Patna, Shillong, Siliguri and Vadodara	⑨ Central Data Bank -Collection, collation and Publishing of Hydrological, Hydrometeorological, Sediment and Water Quality data-. ⑨ Basin wise Master Plans ⑨ Flood atlas for India ⑨ Flood Management and Development and Operation of Flood Forecasting System- CWC operate a network of forecasting stations Over 6000 forecasts are issued every year with about 95% of the forecasts within the permissible limit. ⑨ Water Year Books, Sediment Year Books and Water Quality Year Books. ⑨ Also actively involved in monitoring of 84 identified projects through National, State and Project level Environmental Committees for ensuring implementation of environmental safeguards
5.	Central Ground Water Board (HO) N.H.IV, New CGO Complex, Faridabad - 121001 RO - Guwahati, Chandigarh, Ahemadabad, Trivandrum, Calcutta, Bhopal, Lucknow, Banglore, Nagpur, Jammu, Bhubneshwar, Raipur, Jaipur, Chennai, Hyderabad, Patna	⑨ surveys, exploration, monitoring of ground water development

[16] *Based on web search and literature review*

6.	Central Pollution Control Board Parivesh Bhawan, CBD-cum-Office Complex East Arjun Nagar, DELHI - 110 032 INDIA E-mail : cpcb@alpha.nic.in	⑨ National Air Quality Monitoring Programme ⑨ National River Water Quality Monitoring Programme- Global Environment Monitoring , MINARS ⑨ Zoning Atlas Programme ⑨ Information on 17 polluting category industries (inventory, category wise distribution, compliance, implementation of pollution control programmes
7.	Central Arid Zone Research Institute, Jodhpur Email : cazri@x400.nicgw.nic.in Regional Centre at Bhuj in Gujarat	⑨ AGRIS database on all aspects of agriculture from 1975 to date ⑨ Also have cell on Agriculture Research Information System; ⑨ Working on ENVIS project on desertification ⑨ Repository of information on the state of natural resources and desertification processes and their control ⑨ The spectrum of activities involves researches on basic resource inventories; monitoring of desertification, rehabilitation and management of degraded lands and other areas
8.	Central Inland Capture Fisheries Research Institute, Barrackpore-743101, Tel#033-5600177 Fax#033-5600388 Email : cicfri@x400.nicgw.nic.in	⑨ Data Base on Ecology and fisheries of major river systems of India. Biological features of commercially important riverine and estuarine fish species. Production functions and their interactions in floodplain wetlands. ⑨ Activities - Environmental Impact Assessment for Resource Management ; Fisheries Resource surveys
9.	Central Institute of Brackish Water Aquaculture 141, Marshalls Road, Egmore , Chennai - 600 008, Tel# 044-8554866, 8554891, Director (Per) 8554851 Fax#8554851,	⑨ Repository of information on brackish water fishery resources with systematic database of coastal fishery resources for ARIS ⑨ Agricultural Research Information System (ARIS) database covers State wise data on soil and water quality parameters, land use pattern, production and productivity trends, ⑨ Social, economic and environmental impacts of aquaculture farming, ⑨ Guidelines and effluent standards for aquaculture farming
10.	Central Marine Fisheries Research Institute (CMFRI), Cochin	⑨ Assessing and monitoring of exploited and un-exploited fish stocks in Indian EEZ ⑨ Monitoring the health of the coastal ecosystems, particularly the endangered ecosystems in relation to artisanal fishing, mechanised fishing and marine pollution ⑨ The institute has been collecting data on the catch and effort and biological characteristics for nearly half a century based on scientifically developed sampling scheme, covering all the maritime States of the country ⑨ The voluminous data available with the institute is managed by the National Marine Living Resources Data Centre (NMLRDC)
11.	Central Water and Power Research Station, Pune Tel#020-4391801-14; 4392511; 4392825 Fax #020-4392004,4390189	⑨ Numerical and Physical models for hydro-dynamic simulations
12.	Central Institute of Road Transport, Bhosari, Pune 411 026, India. Tel : +91 (20) 7125177, 7125292, 7125493, 7125494	⑨ Repository of data on all aspects of performance of STUs and a host of other related road transport parameters

13.	Department of Ocean Development	⑨ Assessment of environment parameters and marine living resources (primary and secondary) in Indian EEZ (Nodal Agency NIO Kochi) ⑨ Stock assessment, biology and resource mapping of deep sea shrimps, lobsters and fishes in Indian EEZ (Nodal agency-Fisheries Survey of India) ⑨ Investigations of toxical algal blooms and benthic productivity in Indian EEZ (Nodal agency- Cochin University of Science and technology) ⑨ Coastal Ocean Monitoring and Prediction System (COMAP) - monitoring and modelling of marine pollution along entire Indian coast and islands. Parameters monitored are temp, salinity, DO, pH, SS, BOD, inorganic phosphate, nitrate, nitrite, ammonia, total phosphorus, total nitrite, total organic carbon, petroleum hydrocarbons, pathogenic vibros, pathogenic E.coli, shigella, salmonella, heavy metals (Cd, Hg, Pb) and pesticide residues (DDT, BHC, Endosulfan). Monitoring is carried out along the ecologically sensitive zones and urban areas (NIO Mumbai- Apex coordinating agency). ⑨ Sea Level Measurement Programe (SELMAM)- sea level measurement at selected stations (Porbandar, Bombay, Goa, Cochin, Tuticorin, Madras, Machilipatnam, Visakhapatnam, Paradeep, Calcutta and Kavaratti (Lakshadweep Island)) along Indian coast and islands using modern tide gauges ⑨ Detailed coastal maps through Survey of India showing contour at 1/2 a metre interval in the scale of 1:25000. (Nellore- Machhalipatnam work already over) ⑨ Marine Data Centre (MDC) IMD for Ocean surface meteorology, GSI for marine geology, SOI for tide levels, Naval Hydrographic Office for bathymetry, NIO Goa for physical chemical and biological oceanography, NIO Mumbai for marine pollution, CMFRI for coastal fisheries, Institute of Ocean Management Madras for coastal geomorphology ⑨ DOD has setup Indian National Centre for Ocean Information Services (INCOIS) at Hyderabad for generation and dissemination of ocean data products (near real time data products such as sea surface temperature, potential fishing zones, upwelling zones, maps, eddies, chlorophyll, suspended sediment load etc). MDC will be integrated with INCOIS ⑨ Integrated Coastal and Marine Area Management (ICMAM) programme - GIS based information system for management of 11 critical habitats namely Pichavaram, Karwar, Gulf of Mannar, Gulf of Khambat, Gulf of Kutch, Malvan, Cochin, Coringa mangroves, Gahirmata, Sunderbans and Kadamat (Lakshadeep) ⑨ Wetland maps for Tamil Nadu and Kerala showing the locations of lagoons, backwaters, estuaries, mudflats etc (1:50000 scale) ⑨ Coral Reef Maps for Gulf of Kachch, Gulf of Mannar, Andaman and Nicobar and Lakshadeep Islands (1:50,000 scale) indicating the condition of corals, density etc
14.	Environment Protection Training and Research Institute Gachibowli, Hyderabad - 500 019, India Phone: +91-40-3001241, 3001242, 3000489 Fax: +91-40- 3000361 E-mail: info@eptri.com	⑨ Environment Information Centre- has appointed EPTRI as the Distributed Information Centre for the Eastern Ghats region of India. EIC Collaborates with the Stockholm Environment Institute Sweden Database on Economics of Industrial Pollution Prevention in India Database of Large and Medium Scale Industries of Andhra Pradesh Environmental Status of the Hyderabad Urban Agglomeration Study on 'water pollution-health linkages' for a few Districts of A.P

		⑨ Environment Quality Mapping Macro level studies for six districts in the State of Andhra Pradesh Micro level studies for two study zones presenting the permissible pollutant load and scoping for new industrial categories Zonation of the IDA, Parwada which helped APIIC to promote the land for industrial development Disaster management plan for Visakhapatnam Industrial Bowl Area
15.	Forest Survey of India (FSI) Kaulagarh Road, P.O., IPE Dehradun - 248 195 Tel# 0135-756139, 755037, 754507 Fax # 91-135-759104 E-Mail : fsidir@nde.vsnl.net.in fsihq@nde.vsnl.net.in RO- Banglore, Calcutta, Nagpur and Shimla	⑨ State of Forest Report (Biannual) ⑨ National Forest Vegetation Map (Biannual exercise) (on 1: 1 million scale) ⑨ Thematic mapping on 1:50,000 scale depicting the forest type, species composition, crown density of forest cover and other landuse National ⑨ Basic Forest Inventory System ⑨ Inventory survey of non forest area ⑨ Forest inventory report providing details of area estimates, topographic description, health of forest, ownership pattern, estimation of volume and other growth parameters such as height and diameter in different types of forest, estimation of growth, regeneration and mortality of important species, volume equation and wood consumption of the area studied
16.	Geological Survey of India 27 Jawaharlal Nehru Road, Calcutta 700 016, India Telephone +91-33-2496941 FAX 91-33-2496956 gsi_chq@vsnl.com	⑨ Environmental hazards zonation mapping in mineral sector ⑨ Codification of base line information of geo-environmental appreciation of any terrain and related EIA and EMP studies ⑨ Lineament and geomorphological map of India on 1:20,000 scale. ⑨ Photo-interpreted geological and structural maps of terrains with limited field checks.
17.	Indian Council of Agriculture Research, Krishi Bhawan, New Delhi, Tel#011-338206 – ICAR complex, Goa- Agro metrology – Central Arid Zone Research Institute- Agro forestry – Central Soil salinity Research Institute, – Indian Institute of Soil Science – Central Soil and Water Conservation Research and Training Institute – National Bureau of Soil Survey and Landuse Planning	⑨ A total of 80,000 profiles at 10 kms grid across the country were analyzed to characterize the soils of India. ⑨ Detailed soil maps of the Country (1:7 million), State (1:250,000) and districts map (1:50,000) depicting extent of degradation (1:4.4 millions) have been prepared. ⑨ Thematic maps depicting soil depth, texture drainage, calcareousness, salinity, pH, slope and erosion have been published ⑨ Agro-climate characterization of the country based on moisture, thermal and sunshine regimes ⑨ Agro-ecological zones (20) and sub-zones (60) for the country were delineated based on physiography, soils, climate, Length of Growing Period and Available Water Content, and mapped on 1:4.4 million scale. ⑨ Digitization of physiography and soil resource base on 1:50,000 scale for 14 States have been completed. ⑨ .Soil fertility maps of N,P,K,S and Zn have also been developed ⑨ Water quality guidelines for irrigation and naturally occurring saline/sodic water ⑨ Calibration and verification of ground water models for predicting water logging and salinity hazards in irrigation commands
18.	Indian Bureau of Mines Indira Bhawan, Civil Lines Nagpur Ph no - 0712-533 631, Fax- 0712-533 041	⑨ National mineral inventory for 61 minerals and mineral maps ⑨ Studies on environmental protection and pollution control in regard to the mining and mineral beneficiation operations ⑨ Collection, processing and storage of data on mines, minerals and mineral-based industries, collection and maintenance of world mineral intelligence, foreign mineral legislation and other related matters

19.	Indian Meteorology Department Shivaji nagar, Pune 41100 RO- Mumbai, Chennai, Calcutta, New Delhi, Nagpur, Guwahati	⑨ Meteorological data ⑨ Background air quality monitoring network under Global Atmospheric Watch Programme (operates 10 stations) ⑨ Seismicity map, seismic zoning map; seismic occurrences and cyclone hazard monitoring; list of major earthquakes ⑨ Climatological Atlas of India , Rainfall Atlas of India and Agroclimatic Atlas of India ⑨ Monthly bulletin of Climate Diagnostic Bulletin of India ⑨ Environmental Meteorological Unit of IMD at Delhi to provide specific services to MoEF
20.	INTACH Natural Heritage, 71 Lodi Estate, New Delhi-110 003 Tel. 91-11-4645482, 4632267/9, 4631818, 4692774, 4641304 Fax : 91-11-4611290 E-mail : nh@intach.net	⑨ Listing and documentation of heritage sites identified by municipalities and local bodies (Listing excludes sites and buildings under the purview of the Archaeological Survey of India and the State Departments of Archaeology)
21.	Industrial Toxicology Research Centre Post Box No. 80, Mahatma Gandhi Marg, Lucknow-226001, Phone: +91-522-221856,213618,228227; Fax : +91-522 228227 Email: itrc@itrcindia.org	⑨ Activities include health survey on occupational diseases in industrial workers, air and water quality monitoring studies, ecotoxicological impact assessment, toxicity of chemicals, human health risk assessment ⑨ Five databases on CD-ROM in the area of environmental toxicology viz: TOXLINE, CHEMBANK, POISINDEX, POLTOX and PESTBANK. The Toxicology Information Centre provides information on toxic chemicals including household chemicals ⑨ ENVIS centre and created a full-fledged computerized database (DABTOC) on toxicity profiles of about 450 chemicals
22.	Indian Institute of Forest Management Post Box No. 357, Nehru Nagar Bhopal - 462 003 Phone # 0755-575716, 573799, 765125, 767851 Fax # 0755-572878	⑨ Consultancy and research on joint forest management (Ford Foundation, SIDA, GTZ, FAO etc)
23.	Indian Institute of Petroleum Mohkampur , Dehradun, India, 248005 0135- 660113 to 116 0135- 671986	⑨ Fuel quality characterisation ⑨ Emission factors
24.	Ministry of Environment and Forest	⑨ Survey of natural resources ⑨ National river conservation directorate ⑨ Environmental research programme for eastern and western ghats ⑨ National natural resource management system ⑨ Wetlands conservation programme- survey, demarcation, mapping landscape planning, hydrology for 20 identified wetlands National ⑨ wasteland identification programme
25.	Mumbai Metropolitan Regional Development Authority	⑨ Mumbai Urban Transport Project ⑨ Mumbai Urban Development Project ⑨ Mumbai Urban Rehabilitation Project ⑨ Information on MMR; statistics on councils and corporations Regional ⑨ Information Centre- Basic data on population, employment, industries and other sectors are regularly collected and processed

26.	Municipal Corporation of Greater Mumbai	⑨ Air Quality Data for Mumbai Municipal Area ⑨ Water quality of lakes used for water supply to Mumbai
27.	Ministry of Urban Development Disaster Mitigation and Vulnerability Atlas of India Building Materials & Technology Promotion Council G-Wing,Nirman Bhavan, New Delhi-110011 Tel: 91-11-3019367 Fax: 91-11-3010145 E-Mail: bmtpc@del2.vsnl.net.in	⑨ Identification of hazard prone area ⑨ Vulnerability Atlas showing areas vulnerable to natural disasters ⑨ Land-use zoning and design guidelines for improving hazard resistant construction of buildings and housing ⑨ State wise hazard maps (on cyclone, floods and earthquakes)
28.	Natural Disaster Management Division in Department of Agriculture and Cooperation	⑨ Weekly situation reports on recent disasters, reports on droughts, floods, cyclones and earthquakes
29.	National Bureau Of Soil Survey & Land Use Planning P.O. Box No. 426, Shankar Nagar P.O., Nagpur-440010 Tel#91-712-534664,532438,534545 Fax#:91-712-522534 RO- Nagpur, New Delhi, Banglore, Calcutta, Jorhat, Udaipur	⑨ NBSS&LUP Library has been identified as sub centre of ARIC (ICAR) for input to AGRIS covering soil science literature generated in India ⑨ Research in weathering and soil formation, soil morphology, soil mineralogy, physicochemical characterisation, pedogenesis, and landscape-climate-soil relationship. ⑨ Soil Series of India- The soils are classified as per Soil Taxonomy. The described soil series now belong to 17 States of the country. ⑨ Landuse planning- watershed management, land evaluation criteria, crop efficiency zoning ⑨ Soil Information system is developed state-wise at 1:250,000 scale. Presently the soil maps of all the States are digitized, processed and designed for final output both digital and hardcopy. The thematic layers and interpreted layers of land evaluation (land capability, land irrigability and crop suitability), Agro-Ecological Zones and soil degradation themes are prepared. ⑨ Districts level information system is developed for about 15 districts at 1: 50, 000 scale. The soil information will be at soil series level in this system. Soil resource inventory of States, districts water-sheds (1:250,000; 1:50,000; 1:10,000/8000)
30.	National Institute of Ocean Technology, Velacherry-Tambaram main road Narayanapuram Chennai, Tamil Nadu Tel#91-44-2460063 / 2460064/ 2460066/ 2460067 Fax#91-44-2460645	⑨ Waste load allocation in selected estuaries (Tapi estuary and Ennore creek) is one the components under the Integrated Coastal and Marine Area Management (ICMAM) programme of the Department of Ocean Development ICMAM is conducted with an IDA based credit to the Government of India under the Environmental Capacity Building project of MoEF (waste assimilation capacity of Ennore creek is over) ⑨ Physical oceanographic component of Coastal & Ocean monitoring Predictive System (COMAPS) a long term monitoring program under the Department of Ocean Development ⑨ Identification of suitable locations for disposal of dredge spoil using mathematical models & environmental criteria ⑨ EIA Manual and EIA guidelines for port and harbour projects
31.	National Institute of Oceanography, Goa RO- Mumbai, Kochi	⑨ Coastal Ocean Monitoring and Predictions(COMAP)-Monitoring of coastal waters for physicochemical and biological parameters including petroleum hydrocarbons, trace metals, heavy metals, and biomass of primary (phytoplankton) and secondary (zooplankton, microbial and benthic organisms) ⑨ Marine Biodiversity of selected ecosystem along the West Coast of India

32.	National Botanical Research Institute, Post Box No 436 Rana Pratap Marg Lucknow- 226001, Tel: (+91) 522 271031-35 Fax: (+91) 522 282849, 282881 Lucknow	⑨ Dust filtering potential of common avenue trees and roadside shrubs has been determined, besides studies have also been conducted on heavy-metals accumulation potential of aquatic plants supposedly useful as indicators of heavy metal pollution in water bodies and capable of reducing the toxic metals from water bodies. ⑨ Assessment of bio-diversity of various regions of India
33.	National Geophysical Research Institute, Uppal Road, Hyderabad Telephone:0091-40-7171124, FAX:0091-40-7171564	⑨ Exploration, assessment and management of ground water resources including ground water modelling and pollution studies
34.	National Environmental Engineering Research Institute, Nagpur RO- Mumbai, Delhi, Chennai, Calcutta, Ahmedabad, Cochin, Hyderabad, Kanpur	⑨ National Air Quality Monitoring (NAQM) for CPCB ⑨ Database on cleaner technologies of industrial productions
35.	National Hydrology Institute, Roorkee RO- Belgaum (Hard Rock Regional Centre), Jammu (Western Himalayan Regional Centre), Guwahati (North Eastern Regional Centre), Kakinada (Deltaic Regional Centre), Patna (Ganga Plains North Regional Centre), and Sagar (Ganga Plains South)	⑨ Basin studies, hydrometeorological network improvement, hydrological year book, hydrological modelling, regional flood formulae, reservoir sedimentation studies, environmental hydrology, watershed development studies, tank studies, and drought studies.
36.	National Institute Of Urban Affairs, India Habitat Centre, New Delhi	⑨ Urban Statistics Handbook
37.	National Institute of Occupational Health Meghaninagar, Ahmedabad RO- Banglore, Calcutta	⑨ epidemiological studies and surveillance of hazardous occupations including air pollution, noise pollution, agricultural hazards, industrial hazards in organised sectors as well as small scale industries, carcinogenesis, pesticide toxicology, etc ⑨ WHO collaborative centre for occupational health for South East Asia region and the lead institute for the international programme on chemical safety under IPCS (WHO)
38.	NRSA Data Centre Department of Space, Balanagar, Hyderabad 500 037 Ph- 040-3078560 3078664 sales@nrsa.gov.in	⑨ Satellite data products (raw data, partially processed (radiometrically corrected but geometrically uncorrected), standard data (radiometrically and geometrically corrected), geocoded data(1:50,000 and 1:25000 scale), special data products like mosaiced, merged and extracted) available on photographic (B?W and FCC in form of film of 240 mm X 240mm or enlargements/paper prints in scale varying between 1:1M and 1:12500 and size varying between 240mm and 1000mm) and digital media (CD-ROMs, 8 mm tapes)
39.	Rajiv Gandhi National Drinking Water Mission	⑨ Database for groundwater using remote sensing technology (Regional Remote Sensing Service Centre involved in generation of ground water prospect maps at 1:50,000 scale for the State of Kerala, Karnataka, AP, MP and Rajasthan for RGNDWM)
40.	Space Application Centre Value Added Services Cell (VASC) Remote Sensing Application Area Ahmedabad 380 053 079-676 1188	⑨ National Natural Resource Information System ⑨ Landuse mapping for coastal regulation zone (construction setback line) upto 1:12500 scale ⑨ Inventory of coastal wetlands, coral reefs, mangroves, seaweeds ⑨ Monitoring and condition assessment of protected coastal areas

	Fax- 079-6762735	⑨ Wetland mapping and inventory ⑨ Mapping of potential hotspots and zoning of environmental hazards ⑨ General geological and geomorphological mapping in diverse terrain ⑨ Landslide risk zonation for Tehre area
41.	State Pollution Control Board	⑨ State Air Quality Monitoring Programme ⑨ Inventory of polluting industries ⑨ Identification and authorization of hazardous waste generating industries ⑨ Inventory of biomedical waste generating industries ⑨ Water quality monitoring of water bodies receiving wastewater discharges ⑨ Inventory of air polluting industries ⑨ Industrial air pollution monitoring ⑨ Air consent, water consent, authorization, environment monitoring reports
42.	State Ground Water Board	
43.	Survey of India	⑨ Topographical surveys on 1:250,000 scales, 1:50,000 and 1:25,000 scales ⑨ Digital Cartographical Data Base of topographical maps on scales 1:250,000 and 1:50,000 ⑨ Data generation and its processing for redefinition of Indian Geodetic Datum ⑨ Maintenance of National Tidal Data Centre and receiving/ processing of tidal data of various ports. ⑨ Coastal mapping along the Eastern coast line has been in progress to study the effect of submergence due to rise in sea-level and other natural phenomenon. Ground surveys have been completed for the proposed coastal region and maps are under printing. ⑨ District planning maps containing thematic information (135 maps) have been printed out of 249 maps covering half the districts of India. Districts planning maps for remaining half of the area are being processed by National Atlas and Thematic Mapping Organisation (NATMO)
44.	Town and Country Planning Organisation	⑨ Urban mapping - Thematic maps and graphic database on towns (under progress in association with NRSA and State town planning department)
45.	Wildlife Institute of India Post Bag No. 18, Chandrabani Dehradun - 248 001, Uttaranchal Tel#0135 640111 -15, Fax#0135 640117 email : wii@wii .	⑨ Provide information and advice on specific wildlife management problems. ⑨ National Wildlife Database
46.	Zoological Survey of India Prani Vigyan Bhawan 'M' Block, New Alipore Calcutta - 700 053 Phone # 91-33-4786893, 4783383 Fax # 91-33-786893 RO - Shillong, Pune, Dehradun, Jabalpur, Jodhpur, Chennai, Patna, Hyderabad, Canning, Behrampur, Kozikode, Itanagar, Digha, Port Bliar, Solan	⑨ Red Book for listing of endemic species ⑨ Survey of faunal resources

ANNEXURE XV
Impact Prediction Tools

Table 1: Choice of Models for Prediction of Impacts: Air Environment *

Model	Application	Remarks
ISCST 3	▪ Appropriate for point, area and line sources ▪ Application for flat or rolling terrain ▪ Transport distance up to 50 km valid ▪ Computes for 1 hr to annual averaging periods	▪ Can take up to 99 sources ▪ Computes concentration on 600 receptors in Cartesian on polar coordinate system ▪ Can take receptor elevation ▪ Requires source data, meteorological and receptor data as input
AERMOD with AERMET	▪ Settling and dry deposition of particles ▪ Building wake effects (excluding cavity region impacts) ▪ Point, area, line, and volume sources ▪ Plume rise as a function of downwind distance ▪ Multiple point, area, line, or volume sources ▪ Limited terrain adjustment ▪ Long-term and short-term averaging modes ▪ Rural or urban modes ▪ Variable receptor grid density and ▪ Actual hourly meteorology data	▪ Can take up to 99 sources ▪ Computes concentration on 600 receptors in Cartesian on polar coordinate system ▪ Can take receptor elevation ▪ Requires source data, meteorological and receptor data as input
PTDIS	▪ Screening model applicable for a single point source ▪ Computes maximum pollutant concentration and its occurrences for the prevailing meteorological conditions	▪ Require source characteristics ▪ Average met data (wind speed, temperature, stability class *etc*.) required ▪ Used mainly to see likely impact of a single source
MPTER	▪ Appropriate for point, area and line sources applicable for flat or rolling terrain ▪ Transport distance up to 50 km valid ▪ Computes for 1 hr to annual averaging periods ▪ Terrain adjustment is possible	▪ Can take 250 sources ▪ Computes concentration at 180 receptors up to 10 km ▪ Requires source data, meteorological data and receptor coordinates
CTDM PLUS (Complex Terrain Dispersion Model)	▪ Point source steady state model, can estimate hrly average concentration in isolated hills/ array of hills	▪ Can take maximum 40 Stacks and computes concentration at maximum 400 receptors ▪ Does not simulate calm met conditions ▪ Hill slopes are assumed not to exceed 15 degrees ▪ Requires sources, met and terrain

Model	Application	Remarks
		characteristics and receptor details
OCD (Offshore and coastal Dispersion Model)	▪ It determines the impact of offshore emissions from point sources on the air quality of coastal regions ▪ It incorporates overwater plume transport and dispersion as well as changes that occur as the plume crosses the shore line ▪ Most suitable for overwater sources shore onshore receptors are below the lowest shore height	▪ Requires source emission data ▪ Require hrly met data at offshore and onshore locations like water surface temperature; overwater air temperature; relative humidity *etc*.
FDM (Fugitive Dust Model)	▪ Suitable for emissions from fugitive dust sources ▪ Source may be point, area or line (up to 121 source) ▪ Require particle size classification max. up to 20 sizes ▪ Computes concentrations for 1 hr, 3hr, 8hr, 24hr or annual average periods	▪ Require dust source particle sizes ▪ Source coordinates for area sources, source height and geographic details ▪ Can compute concentration at max. 1200 receptors ▪ Require met data (wind direction, speed, Temperature, mixing height and stability class) ▪ Model do not include buoyant point sources, hence no plume rise algorithm
RTDM (Rough Terrain Diffusion Model)	▪ Estimates GLC is complex/rough (or flat) terrain in the vicinity of one or more co-located point sources ▪ Transport distance max. up to 15 km to up to 50 km ▪ Computes for 1 to 24 hr. or annual ave5rage concentrations	▪ Can take up to 35 co-located point sources ▪ Require source data and hourly met data ▪ Computes concentration at maximum 400 receptors ▪ Suitable only for non reactive gases ▪ Do not include gravitational effects or depletion mechanism such as rain/ wash out, dry deposition

Table 2: Choice of Models for Prediction of Impacts: Noise Environment *

Model	Application
FHWA (Federal Highway Administration)	Noise Impact due to vehicular movement on highways
Dhwani	For predictions of impact due to group of noise sources in the industrial complex (multiple sound sources)
Hemispherical sound wave propagation Air Port	Fore predictive impact due to single noise source For predictive impact of traffic on airport and rail road

Table 3: Choice of Methods for Prediction of Impacts: Water Environment *

Model	Application	Remarks
Estuary models/ estuarial Dynamic model	It is simulates tides, currents, and discharge in shallow, vertically mixed estuaries excited by ocean tides, hydrologic influx, and wind action Tides, currents in estuary are simulated	Dynamic model
Dynamic Water Quality Model	▪ It simulates the mass transport of either conservative or non-conservative quality constituents utilizing information derived from the hydrodynamic model Bay-Delta model is the programme generally used. ▪ Up to 10 independent quality parameters of either conservative or non-conservative type plus the BOD-DO coupled relationship can be handled	Dynamic model
HEC -2	To compute water surface profiles for stead7y, gradually: varying flow in both prismatic & non- prismatic channels	
SMS	Lake circulation, salt water intrusion, surface water profile simulation model	Surface water Modelling system Hydrodynamic model

Table 4: Choice of Models for Prediction of Impacts: Land Environment *

Model	Application	Remarks
Digital Analysis Techniques	Provides land use / land cover distribution	
Ranking analysis for soil suitability criteria	Provides suitability criteria for developmental conversation activities	Various parameters viz. depth, texture, slope, erosion status, geomorphology, flooding hazards, GW potential, land use *etc*. are used.

Table 5: Choice of Methods for Prediction of Impacts: Biological Environment *

Name	Relevance	Applications	Remarks
Aquatic Flora			
Sample plot methods	Density and relative density Density and relative dominance	Average number of individuals species per unit area Relative degree to which a species predominates a community by its sheer numbers, size bulk or biomass	The quadrant sampling technique is applicable in all types of plant communities and for the study of submerged, sessile (attached at the base) or sedentary plants
	Frequency and relative frequency	Plant dispersion over an area or within a community	Commonly accepted plot size: 0.1 m^2- mosses, lichens & other

Name	Relevance	Applications	Remarks
	importance value		mat-like plants
		Average of relative density, relative dominance and relative frequency	0.1 m^2- herbaceous vegetation including grasses
			10.20 m^2 – for shrubs and saplings up to 3m tall, and
			100 m^2 – for tree communities
Transects & line intercepts methods	Cover	Ratio of total amount of line intercepted by each species and total length of the line intercept given its cover	This methods allows for rapid assessment of vegetation transition zones, and requires minimum time or equipment of establish
	Relative dominance	It is the ratio of total individuals of a species and total individuals of all species	Two or more vegetation strata can be sampled simultaneously
Terrestrial Flora			
Plot-less sampling methods	Mean point plant Mean area per plant	Mean point – plant distance Mean area per plant	Vegetation measurements are determined from points rather than being determined in an area with boundaries
	Density and relative density		Method is used in grass-land and open shrub and tree communities
	Dominance and relative dominance		It allows more rapid and extensive sampling than the plot method
	Importance value		Point quarter method is commonly used in woods and forests.
Fauna			
Species list methods	Animal species list	List of animal communities observed directly	Animal species lists present common and scientific names of the species involved so that the faunal resources of the area are catalogued
Direct Contact Methods	Animal species list	List of animals communities observed directly	This method involves collection, study and release of animals
Count indices methods (Roadside and aerial count methods)	Drive counts Temporal counts	Observation of animals by driving them past trained observers	Count indices provide estimates of animal populations and are obtained from signs, calls or trailside counts or roadside counts
	Call counts	Count of all animals passing a fixed point during some stated interval of time	These estimates, through they do not provide absolute population numbers, Provide an index of the various species in an area
			Such indices allow comparisons through the seasons or between sites or habitats
Removal methods	Population size	Number of species captured	Removal methods are used to obtain population estimates of small mammals, such as, rodents

Name	Relevance	Applications	Remarks
			through baited snap traps
Market capture methods	Population size estimate (M)	Number of species originally marked (T) Number of marked animals recaptured (t) and total number of animals captured during census (n) N = nT/t	It involves capturing a portion of the population and at some later date sampling the ratio of marked to total animals caught in the population

Table 6: Choice of Methods for Prediction of Impacts: Socio-economic Environment *

Name	Application	Remarks
Extrapolative Methods	A prediction is made that is consistent with past and present socio-economic data, e.g. a prediction based on the linear extrapolation of current trends	
Intuitive Forecasting (Delphi techniques)	Delphi technique is used to determine environmental priorities and also to make intuitive predictions through the process of achieving group consensus	Conjecture Brainstorming Heuristic programming Delphi consensus
Trend extrapolation and correlation	Predictions may be obtained by extrapolating present trends Not an accurate method of making socio-economic forecasts, because a time series cannot be interpreted or extrapolated very far into the future with out some knowledge of the underlying physical, biological, and social factors	Trend breakthrough precursor events correlation and regression
Metaphors and analogies	The experience gained else where is used to predict the socio-economic impacts	Growth historical simulation commonsense forecasts
Scenarios	Scenarios are common-sense forecasts of data. Each scenario is logically constructed on model of a potential future for which the degrees of "confidence" as to progression and outcome remain undefined	Common-sense
Dynamic modeling (Input- Out model)	Model predicts net economic gain to the society after considering all inputs required for conversion of raw materials along with cost of finished product	
Normative Methods	Desired socio-economic goals are specified and an attempt is made to project the social environment backward in time to the present to examine whether existing or planned resources and environmental programmes are adequate to meet the goals	Morphological analysis technology scanning contextual mapping - functional array - graphic method Mission networks and functional arrays decision trees & relevance trees matrix methods scenarios

*** NOTE:** Project-specific proposed prediction tools need to be identified by the project proponent and shall be incorporated in the draft ToR to be submitted to the Authority for the consideration and approval by the concerned EAC/SEAC.

ANNEXURE XVI

Basic Information to be provided by the Operator of the TSDF (Prior to the commissioning of the facility or whenever there is any change in the information provided earlier or the existing facility)

<table>
<tr><td>I.</td><td colspan="3">General Information</td></tr>
<tr><td>(1)</td><td>Name & Address of the HWTSDF</td><td>:</td><td></td></tr>
<tr><td>(2)</td><td>Contact person
Telephone
Mobile No.
Fax
E-mail</td><td>:
:
:
:
:</td><td></td></tr>
<tr><td>(3)</td><td>Month & Year of establishment</td><td>:</td><td></td></tr>
<tr><td>(4)</td><td>HWTSDF established by</td><td>:</td><td></td></tr>
<tr><td>(5)</td><td>HWTSDF presently operated by</td><td>:</td><td></td></tr>
<tr><td>(6)</td><td>Total area of the TSDF in acres</td><td>:</td><td><table><tr><th>Activity</th><th>Area in Acres</th></tr><tr><td>SLF</td><td></td></tr><tr><td>Incinerator</td><td></td></tr><tr><td>Storage for incinerable waste</td><td></td></tr><tr><td>Other storage</td><td></td></tr><tr><td>Any other</td><td></td></tr></table></td></tr>
<tr><td>(7)</td><td>Location of the TSDF
a). Delineated Area of the TSDF if any
(pl. enclose map of the delineated area)</td><td>:</td><td></td></tr>
</table>

<table>
<tr><td rowspan="6">(8)</td><td colspan="2">Industries or Industrial Estate nearby TSDF (Indicate type of industries)</td><td>:</td><td></td></tr>
<tr><td>(i)</td><td>Total number of Member Industries (pl. attach map of the industrial estates)</td><td>:</td><td></td></tr>
<tr><td>(ii)</td><td>Whether TSDF is located in industrial estate or not</td><td>:</td><td></td></tr>
<tr><td>(iii)</td><td>Total HW generation by the member industries as per authorization</td><td>:</td><td><table><tr><th>Type of wastes</th><th>Quantity in TPA</th></tr><tr><td>Landfillable</td><td></td></tr><tr><td>Incinerable</td><td></td></tr><tr><td>Recyclable</td><td></td></tr></table></td></tr>
<tr><td>(iv)</td><td>Total HW proposed to be disposed off by the member units annually</td><td>:</td><td><table><tr><th>Type of wastes</th><th>Quantity in TPA</th></tr><tr><td>Landfillable</td><td></td></tr><tr><td>Incinerable</td><td></td></tr><tr><td>Recyclable</td><td></td></tr></table></td></tr>
<tr><td colspan="3"></td><td></td></tr>
<tr><td rowspan="3">(9)</td><td colspan="2">Total Cost of the facility in Rs in lacs</td><td>:</td><td></td></tr>
<tr><td>(i)</td><td>Financing patterns</td><td>:</td><td></td></tr>
<tr><td>(ii)</td><td>Subsidy, if any (Central Govt., State Govt.) in Rs.</td><td>:</td><td></td></tr>
<tr><td>(10)</td><td colspan="2">Date of Notification of the site by the State Govt.</td><td>:</td><td></td></tr>
<tr><td rowspan="4">(11)</td><td colspan="2">Level of Groundwater in and around the disposal facility (below ground level)</td><td>:</td><td></td></tr>
<tr><td>(i)</td><td>Direction of ground water flow in the TSDF site</td><td>:</td><td></td></tr>
<tr><td>(ii)</td><td>Depth of GWT in m during Monsoon period</td><td>:</td><td></td></tr>
<tr><td>(iii)</td><td>Depth of GWT in m during Non-Monsoon Period</td><td>:</td><td></td></tr>
<tr><td>(12)</td><td colspan="2">Wind Pattern details (average) (enclose wind rose diagram)</td><td>:</td><td></td></tr>
<tr><td>(13)</td><td colspan="2">Land use around the disposal facility up to radius of 5 KM (Indicate any forest or monuments or sensitive areas)</td><td>:</td><td></td></tr>
<tr><td>(14)</td><td colspan="2">Rivers/Canals/Lakes, if any in & around the TSDF with approximate distance from TSDF</td><td>:</td><td></td></tr>
<tr><td>(15)</td><td colspan="2">Total rainfall (annual average in cms.)</td><td>:</td><td></td></tr>
<tr><td>(16)</td><td colspan="2">Geohydrological features of the TSDF Site</td><td>:</td><td></td></tr>
<tr><td>(17)</td><td colspan="2">Sources of water intake</td><td>:</td><td></td></tr>
<tr><td>(18)</td><td colspan="2">Electrical Resistivity Data around SLF</td><td>:</td><td></td></tr>
<tr><td>(19)</td><td colspan="2">Reduced level of TSDF w.r.t MSL</td><td>:</td><td></td></tr>
<tr><td>(20)</td><td colspan="2">Maximum Flood level of river, lakes, reservoir if any</td><td>:</td><td></td></tr>
</table>

(21)	Details of Consent to Establishment/ Operation issued under Water & Air Acts (please enclose copy of Consents issued by PCB)		:	
	(i)	Number and Date of issue of Consents under Water Act and its validity	:	
	(ii)	Number and Date of issue of Consents under Air Act and its validity	:	
(22)	Authorization details (please enclose copy of authorization issued by PCB)		:	
	(i)	Date of issue of Authorization	:	
	(ii)	Validity of Authorization	:	
(23)	Details of Environmental Clearance (EC) (please enclose copy)		:	
	(i)	Date of Issue of EC	:	
	(ii)	EC issued by	:	
	(iii)	EC issued for operation of TSDF , Incinerator/SLF	:	
	(iv)	EIA prepared by	:	
II. Design Details of Storage, Treatment and Disposal Facility				
(1)	Facilities available with the TSDF in respect of Transportation, Laboratory, Storage, Treatment (chemical stabilization/solidification, incineration) & SLF and any other (pl. attach layout)		:	
(2)	**Transportation :**			
	(i)	No. of vehicles (Existing/Proposed) (Own/hired)	:	
	(ii)	Type of vehicles with capacity	:	
(3)	**Laboratory**			
	(i)	No. of persons engaged in the analysis with qualification and experience	:	
	(ii)	Lab Accreditation/recognition, if any	:	
	(iii)	Instruments available in the laboratory (enclose list of equipments/instruments)	:	
	(iv)	Comprehensive capabilities of analysis of parameters including detailed analysis and fingerprint (enclose list of parameters)	:	

	(v)	Waste Acceptance criteria followed (enclose copy)	:	
	(vi)	Time (in hrs) required for fingerprint analysis parameters	:	
	(vii)	Time (in hrs) required for comprehensive analysis of relevant parameters	:	
(4)	**Storage Area**			
	(a). Temporary Storage Area for Landfillable Wastes During Monsoon			
	(i)	Temporary Storage area size in sq. meters	:	
	(ii)	Leachate collection and transportation provision made at the temporary storage area	:	
	(iii)	Safety provisions made at the temporary storage area	:	
	(iv)	Spillage collection and transportation provision made	:	
	(b) Incinerable HW (Organics) Storage Area :			
	(i)	Number of sheds	:	
	(ii)	Area of each shed in sq. meters	:	
	(iii)	Distance between sheds in meters	:	
	(iv)	Proposed quantities to be stored in each shed (in metric tons)	:	
	(V)	Arrangement of stacking of drums	:	
	(vi)	Compatibility criteria followed for storage	:	
	(vii)	Arrangement made for smoke and fire detection	:	
	(viii)	Arrangement for remedial action in case of fire	:	
	(ix)	Arrangement for spillage/run off collection	:	
	(x)	Arrangement made for control of fire accidents	:	
(5)	**Pre-treatment Facilities**			
	(i)	Facilities provided/proposed for pre-treatment	:	
	(ii)	List of Chemicals/stabilizing agents proposed to be used in the treatment processes	:	
	(iii)	Arrangements for storage of chemicals/stabilizing agents	:	
(6)	**Incineration including other thermal treatment technology :**			
	(i)	Total Installed Incineration Capacity in Tons per hour and in energy units	:	

	(ii)	Expected incineration operating hours in a month	:	
	(iii)	Make and Supplier of incinerator/ any other technology	:	
	(iv)	Pollution Control Systems attached with the incinerator (enclose details along with a flow diagram)	:	
	(v)	Arrangements made for mixing of incinerable wastes before feeding	:	
	(vi)	Safety measures adopted at the waste feed mixing area	:	
	(vii)	Criteria followed for waste feed mixing (enclose details)	:	
(7)	**Secured land filling**			
	(i)	Criteria followed for disposal of wastes in SLF (please attach details)	:	
	(ii)	Proposed Secured Landfill Capacity (in Tons)	:	
	(iii)	Proposed no. of Cells and capacity of each cell	:	
	(iv)	Construction details of the cell (provide a sketch)	:	
	(v)	Proposed liner system components and their specifications	:	
	(vi)	No. of vents proposed/provided with the capped cells	:	
	(vii)	No. of leachate collection wells proposed in each cell	:	
	(viii)	Design details of secured landfill with sketch including the proposed capping of completed Cells (provide a copy of the sketch giving information on each layer with reduced levels (RL) as approved by the PCB)	:	
	(ix)	Designed life span of the SLF in years (total as well as cell-wise details)	:	
	(x)	Expected leachate generation in KL per annum	:	
	(xi)	Operational plan of the landfill	:	
	(xii)	No. of proposed/existing monitoring wells around TSDF (attach layout with GW flow direction)	:	

(8)	**Leachate treatment details :**			
	(i)	Proposed leachate treatment (by Multiple Effect Evaporator (MEE) /Solar evaporator/steam stripping followed by Incinerator spray drier or any other means)	:	
	(ii)	Final mode of treatment and disposal of leachate other than above	:	
III.	**Procedures for waste acceptance, characterization, mode of treatment and disposal**			
(1)	Whether information proposed to be collected from the member industrial unit			**(indicate Yes/No)**
	(i)	Products manufactured	:	
	(ii)	Stepwise process chemical reactions	:	
	(iii)	Quantity of wastes generated as per the stochiometric requirements	:	
	(iv)	Characteristics of the waste (physical)	:	
	(v)	Chemical characteristics of the waste (finger print as well as detailed analysis)	:	
	(vi)	Category of the wastes (as per Schedule 1 or 2 of the HW (M, H & TM) Rules)	:	
	(vii)	Any pre-treatment given, if so, type of treatment given by the generator	:	
(2)	Whether TSDF accepting the waste from generator having the manifest		:	
(3)	Copies of the manifest sent to SPCB/PCC and the generator of the waste, after treatment and disposal		:	
(4)	Facilities provided for cleaning the transportation vehicles		:	
(5)	Treatment and disposal provision made for liquid wastes generated from cleaning of vehicles		:	
(6)	Check for any other relevant information in respect of waste acceptance procedures including packing and labeling		:	

IV.	**Monitoring Data – Base Line**		
(1)	ambient air quality (date of sampling, temperature, wind speed, wind direction and monitoring results for standard air quality parameters to be enclosed)	:	
(2)	Soil quality (up to 1m depth) (date of sampling, depth of sampling and the soil characteristics for standard soil parameters including heavy metals to be enclosed)	:	
(3)	Surface /Ground water characteristics (date of sampling, depth of ground water table and direction of flow/depth of surface water at which samples taken, characteristics for drinking water parameter to be indicated)	:	
(4)	Noise Levels in decibels (parameters to be monitored and indicated as per norms)	:	
(5)	Proposed permanent Ambient Air Quality Monitoring Stations around the TSDF (enclose location map with wind rose diagram of the area)	:	
V.	**Proposed Record keeping & maintenance with regard to the waste acceptance, treatment and disposal**		
(1)	Maintenance of records w.r.t the waste receipt manifest from the member units	:	
(2)	System of record keeping w.r.t the finger print analysis and detailed analysis of the wastes of the member units	:	
(3)	System of decision making for deciding the requirement of pre-treatment of wastes /treatment by incineration/disposal into SLF	:	
(4)	Record keeping with respect to the Wastes treated and disposed within TSDF upon receipt of wastes from the member units	:	
(5)	Arrangement made for collection and handling of spillages	:	
(6)	System of record keeping with regard to the leachate generation in KL per annum and its treatment and final mode of disposal	:	

VI.	**Miscellaneous**		
(1)	Provisions made for post –closure monitoring and maintenance (enclose copy of the escrow agreement)	:	
(2)	Emergency preparedness plan	:	
(3)	Details of Insurance policies, premiums, sum assured, including Insurances under Public Liability Insurance (PLI) Act etc	:	
(4)	Occupational Health, Facility safety systems, Risk management procedures	:	
(5)	Report on Health Status of the public living within 05 KM radius (pl. attach copy obtained from the State Health Department) and workers appointed by the facility operator (pl. attach list of workers and their health status at the time of appointment)	:	
(6)	Certificate obtained from Department of Explosives/Directorate of Industrial Safety and Health for Fire Safety and Storage	:	
(7)	Fire fighting systems descriptions	:	
(8)	Personal protective equipments (provide list of equipments)	:	

DECLARATION

This is to certify that the details furnished above are true to the best of my knowledge and as per records available with us.

Station:

Date:

Signature of Operator of a Facility

Name :
Address :

Telephone No.:

Mobile No. :

E-mail :

ANNEXURE XVII

Information on Operation of TSDF to be provided by the Operator of the TSDF on Quarterly Basis

(for the period from…….. ……. to ……)

I.	General Information		
(1)	Name & Address of the HWTSDF	:	
(2)	Contact Person Telephone/Mobile No. Fax no.: E-mail:	: : : :	
(3)	Validity of Consent under Water Act, 1974	:	
(4)	Validity of Consent under Air Act, 1981	:	
(5)	Validity of Authorization under HW (M, H & TM) Rules, 2008	:	
(6)	Total number of Member Industries sent their wastes during the period (from ..... to.....) and the quantity of wastes in tons (pl. attach list of member industries not sent their wastes during the quarter)	:	
(7)	Statement w.r.t total quantity of HW received, treated and disposed or accumulated since commissioning of the facility		

S. No	Description	Type of HW and Quantity in Tons			
		Direct Landfillable waste	Incinerable	Landfillable waste which require pre-treatment	Any other
(i)	Opening Stock of the hazardous waste				

	(ii)	Total quantity of hazardous waste received during the quarter (from ..... to.....)				
	(iii)	Total hazardous waste treated and disposed of during the quarter (From ..... to.....)				
	(iv)	Closing Stock of the hazardous waste at the end of the quarter				
	(v)	Cumulative receipt of hazardous waste since commissioning				
	(vi)	Cumulative hazardous waste disposed of since commissioning				
(8)	Is the waste in stock properly labeled and stored		:			
(9)	**Performance of SLF related activities**					
	(i)	No. of Cells filled and capped till the previous quarter	:			
	(ii)	Cell number in use	:			
	(iii)	Quantity of Leachate generated in KL during the quarter	:			
	(iv)	Characteristics of leachate (enclose parameters with max., min. and average concentration for the quarter)	:			
	(v)	Mode of treatment and disposal of leachate (enclose characteristics of discharged leachate, if any)	:			
(10)	**Performance of Incinerator/Plasma Pyrolysis**					
	(i)	Monthly average operating hours of incinerator/Plasma Pyrolysis	:			

<table>
<tr><td></td><td>(ii)</td><td>Fuel consumption in Kl/Energy Consumption during the quarter</td><td>:</td><td></td></tr>
<tr><td></td><td>(iii)</td><td>Operating parameters</td><td>:</td><td><table><tr><th>Operating parameter</th><th>Values in Range</th></tr><tr><td>Temperature in ° C</td><td></td></tr><tr><td>Residence Time in seconds</td><td></td></tr><tr><td>Pressure in ……..</td><td></td></tr></table></td></tr>
<tr><td></td><td>(iv)</td><td>Stack gaseous emission monitoring results for the previous quarter</td><td>:</td><td><table><tr><th>Para-meter</th><th>Max</th><th>Min.</th><th>Ave</th></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr></table></td></tr>
<tr><td></td><td>(v)</td><td>Date of calibration of the instruments</td><td>:</td><td></td></tr>
<tr><td></td><td>(vi)</td><td>Salt residue generation if leachate re-circulated for quenching purpose in Tons</td><td>:</td><td></td></tr>
<tr><td></td><td>(vii)</td><td>Final mode of disposal of salts generated from the incinerator/MEE</td><td>:</td><td></td></tr>
<tr><td></td><td>(viii)</td><td>Total quantum of ash generated in Tons</td><td>:</td><td></td></tr>
<tr><td></td><td>(ix)</td><td>Final mode of disposal of ash generated from the incinerator</td><td>:</td><td></td></tr>
<tr><td></td><td>(x)</td><td>Total quantum of scrubbed solution generated (in litres) and its mode of disposal</td><td>:</td><td></td></tr>
<tr><td>(11)</td><td colspan="4">Pre-treatment /Treatment Facility</td></tr>
<tr><td></td><td>(i)</td><td>List of Chemicals/stabilizing agents used in the pre-treatment processes in Tons during the quarter</td><td>:</td><td></td></tr>
<tr><td></td><td></td><td>a).Binding agents (Cement/lime /fly ash or any other agent) in Tons</td><td>:</td><td></td></tr>
<tr><td></td><td></td><td>b). Caustic in Tons</td><td>:</td><td></td></tr>
<tr><td></td><td></td><td>c). Aggregates in Tons</td><td>:</td><td></td></tr>
<tr><td></td><td></td><td>d). Any other</td><td>:</td><td></td></tr>
<tr><td></td><td>(ii)</td><td>Total quantity of wastes treated by Stabilization/ Solidification process in Tons</td><td>:</td><td></td></tr>
</table>

(12)	**Monitoring and other Miscellaneous Details** (attach details wherever applicable)			
	(i)	Ambient air quality	:	
	(ii)	Ground water quality from monitoring wells	:	
	(iii)	Gaseous emissions from vents provided to the capped SLF	:	
	(iv)	Soil characteristics	:	
	(v)	Amount deposited in Escrow Fund during the quarter (Rupees in lacs)	:	
	(vi)	Cumulative amount in Escrow (Rupees in lacs)	:	
	(vii)	Any accidents including fire/explosion/landslides occurred and measures taken (attach details separately if required)	:	
(13)	Any major changes observed in the characteristics of the wastes of the member units (provide list of such member industrial units with details)		:	
(14)	Self assessment with regard to the status on environmental consequences due to the operation of TSDF (pl. attach details)		:	
(15)	Remedial measures proposed for restoration in case of damages caused due to the improper operation of the facility (pl. attach details)		:	
(16)	Electrical Resistivity Data around SLF (to be submitted at the end of the last quarter only)		:	
(17)	Progress towards online tracking of vehicles carrying wastes from the generator		:	
(18)	Report on Health Status of the public living within 05 KM radius and workers appointed by the facility operator (pl. attach details once in a year)		:	
	(i) Workers removed from the services if any during the quarter and the reasons thereof		:	

(19)	EMP Compliance	:	
(20)	Any other operations carried out in the facility (like pre-treatment of incinerable waste for use in Kilns or recycle or re-use of other wastes)	:	

Declaration

Certify that the contents stated above are true to the best of my knowledge and based on the records as available with this facility.

Station:

Date:

Signature of Operator of the Facility

Name :
Address :

Telephone No. :
Mobile No. :

E-mail :

ANNEXURE XVIII
Monitoring Protocol for the Common TSDF Operators and HW Incinerators

1.0. Ambient Air Quality Monitoring:

(a) Number of Monitoring Stations: Air quality monitoring stations at upwind, downwind and at three stations at 120° angle around the TSDF is necessary. The locations of air quality monitoring stations depend on the stack height and location of any particular ecologically sensitive feature around the disposal facility. Location of air quality monitoring stations may be decided by the operator of the TSDF in consultation with SPCB/PCC.

(b) Additional Parameters to be monitored: Apart from the standard parameters stipulated under the National Ambient Air Quality Standards (NAAQS), additional parameters, namely, Total Volatile Organic Compounds (VOCs), Polycyclic Aromatic Hydrocarbons (PAH), to align the monitoring Programme with the potential impacts of TSDF operations, should be monitored.

(c) Frequency of Ambient Air Quality Monitoring:

(i). Parameters, namely, SPM, RPM, NOx and SOx should be continued to be monitored as per NAAQS criteria (minimum of 104 measurements in a year taken twice a week, 24 hourly).

(ii). In addition, VOCs (total), and PAH should be monitored at least twice in a year (pre-monsoon and post-monsoon).

2.0. Monitoring of Stack Gaseous Emission from Incinerator:

(a) Parameters to be monitored and the frequency:

It is recommended to carryout **quarterly** monitoring of the stack gaseous emission for the parameters as stipulated under the gaseous emission norms notified under the Environment (Protection) Fifth Amendment Rules, 2008 dated 26 June 2008. However, SO_2, NO_x, HCl and CO to be monitored continuously using on-line monitoring system.

3.0. Monitoring of the Vent Gases attached with the capped SLF:

(a). Suggested parameters and the frequency: Parameters, namely, total VOCs and H_2S should be monitored at least **once in a month** through the vents of the capped cells till designed life span of the TSDF.

4.0. Ground Water Monitoring:

It is recommended to monitor ground water characteristics at least once **in a quarter** till designed life span of the TSDF.

(a) Parameters to be analyzed: It is recommended that ground water should be analyzed for pH, Colour, EC, Turbidity (NTU), SS, TDS, TOC, COD, heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, CN, F, As and Mn, Cl, NO_3, SO_4, TKN, Total Alkalinity, Total hardness and Total Pesticides.

(b) Sampling Locations: It is recommended that the ground water samples should be collected at least up to a distance of 5 KM from the TSDF location. If no open wells or tube wells are available, action needs to be taken to provide at least **four monitoring wells (piezometric)** around the TSDF i.e. one on up gradient of the ground

water flow and other three on the down gradient side of the ground water flow at least up to first layer aquifer. Depending upon the situation, if required, the monitoring wells till second aquifer should also be extended in consultation with the SPCB/PCC. The directions of the ground water flow have to be established in consultation with the State Ground Water Board or any other authority. The ground water flow direction has to be ascertained periodically and reported at least **once in three years** so as to know any changes in the ground water flow directions due to any changes in the local conditions such as draw down of ground water.

5.0. Surface waters: Monitoring of surface waters (nullah/ river, impoundments) at upstream and downstream and in adjoining area is necessary at least **once in a quarter**. It is also necessary to collect the sample of benthal deposit of the stream upto a distance of 500 m from the TSDF. It is recommended that the surface water samples should be analyzed for pH, Colour, EC, Turbidity (NTU), SS, TDS, TOC, DO, BOD, COD, heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), Fe, CN, F, As and Mn, Cl, NO_3, SO_4, TKN, Total Alkalinity, Total hardness.

6.0. Soil samples Monitoring:

(a) Parameters to be analyzed: It is recommended that the soil samples should be analyzed for pH, EC, Colour, TDS, TOC, TSS, PAH, heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), CN, F, As and Mn.

(b) Sampling Location & Frequency of Sampling: At least one number of composite soil sample is required to be collected upto a depth of 1 m beneath the soil surface for every grid size of 250 X 250 m up to a radius of 500 m from the centre of the TSDF. It is recommended that the soil samples should be collected and analyzed for the suggested parameters at least once in a year i.e. pre-monsoon.

7.0. Biological indicator: Plantations of locally available sensitive plants to be made in all directions of the TSDF and at different distances and to observe and record periodically the health of each plant.

ANNEXURE XIX

Form through which the State Governments/Administration of the Union Territories Submit Nominations for SEIAA and SEAC for the Consideration and Notification by the Central Government

Form for Nomination of a professional/expert as Chairperson / Member / Secretary of the SEIAA / EAC / SEAC						
1	Name (in block letters)					
2	Address for communication					
3	Age & Date of Birth (Shall be less than 67 years for the members and 72 years for the Chairman)					
4	Area of Expertise (As per Appendix VI)					
5	Professional Qualifications (As per Appendix VI)	Qualification(s)		University	Year of passing	Percentage of marks
6	Work experience (High light relevant experience as per Appendix VI)	Position	Years of association			Nature of work. If required, attach separate sheets
			From	to	Period in years	
7	Present position and nature of job	Serving Central / State Government Office?			Yes/No	
		Engaged in industry or their associations?			Yes/No	
		Associated with environmental activism?			Yes/No	
		If no is the answer for above three, please specify the present position and name of the organization				
8	Whether experienced in the process of prior environmental clearance?	Yes/No. If yes, please specify the experience in a separate sheet (Please restrict to 500 words)				
9	Whether any out-standing expertise has been acquired?	Yes/ No If yes, please provide details in a separate sheet (Please restrict to 500 words).				
10	Any other relevant information?	May like to attach separate sheets (Research projects, consultancy projects, publications, memberships in associations, trainings undergone, international exposure cum experience etc.)				

The Government of……is pleased to forward the Nomination of Dr./Sh. ……..…. for the position of Chairperson / Member / Secretary of the SEIAA / SEAC / EAC to the Ministry of Environment & Forests, the Government of India for the Notification.

(Authorized Signature with Seal)

ANNEXURE XX
Composition of EAC/SEAC

Composition of the EAC/SEAC

The Members of the EAC shall be Experts with the requisite expertise and experience in the following fields /disciplines. In the event that persons fulfilling the criteria of "Experts" are not available, Professionals in the same field with sufficient experience may be considered:

- Environment Quality Experts: Experts in measurement/monitoring, analysis and interpretation of data in relation to environmental quality
- Sectoral Experts in Project Management: Experts in Project Management or Management of Process/Operations/Facilities in the relevant sectors.
- Environmental Impact Assessment Process Experts: Experts in conducting and carrying out Environmental Impact Assessments (EIAs) and preparation of Environmental Management Plans (EMPs) and other Management plans and who have wide expertise and knowledge of predictive techniques and tools used in the EIA process
- Risk Assessment Experts
- Life Science Experts in floral and faunal management
- Forestry and Wildlife Experts
- Environmental Economics Expert with experience in project appraisal

ANNEXURE XXI
Best Practices available and reference

Best Practices

The basic problem in identifying waste is that substances generally become mixed, so that conclusive identification is not possible on the basis of the material properties alone. Added to this, many substances are difficult to analyze, particularly those which can be toxic in very small quantities (e.g. dioxins, furans).

Some of these restrictions which are of particular relevance in developing countries are as follows:

- limited financial resources: particularly convertible foreign currencies
- shortage of human resources: particularly in the fields of engineering sciences, management and administration
- limits to land use: in particular because of the high population concentrations at certain points in urban areas (polarization)
- local environmental conditions: in particular because of the relative shortage of water resources and the fact that in areas of high population density in developing countries the groundwater table is usually close to the surface, so pollution can have devastating consequences for health and the environment.

Environmentally acceptable special waste management must take these factors into account. Some of these side effects may be so serious that in view of the inadequate disposal facilities there is no alternative to waste minimization.

The study of the dangers of handling hazardous waste materials varies considerably depending on the specific material properties, subdivided into the phases of collection, transport and treatment/disposal. Various types of hazard must be distinguished in terms of their effects on man and the environment. The various standards to be followed for hazardous waste management:

Standards

- ❖ Handling, storage, and transportation of all hazardous materials at each factory must comply with all permits and applicable laws and regulations.
- ❖ Material Safety Data Sheets (MSDSs) must be on file at the factory for each and every dye, chemical, and chemical product used and stored at the factory. The MSDSs must be available for review by all employees at the factory.
- ❖ Factories must have in place procedures to safely receive and handle hazardous materials that are delivered to the factory.
- ❖ Factories must provide physical, chemical, and environmental hazard information to transporters for any hazardous materials transported from the factory.

- Factories must have in place appropriate and adequate spill response equipment and procedures, in order that any hazardous material spills or releases can be safely and adequately responded to in a timely manner.
- Factories must operate above ground storage tank (AST) and underground storage tank (UST) systems in a manner that minimizes the risk for impact to the environment. Each factory must maintain a current list of all ASTs and USTs, including size, contents, location, and secondary containment method used. Each AST and UST must be inspected regularly for integrity and for evidence of leaks. Procedures must be in place for the inspection of any collected precipitation in containment areas prior to discharge. Records of any spills or leaks, including corrective action taken, must be kept on file at the factory for 5 years.
- Factories must have in place procedures for safe filling of USTs, ASTs, and other containers. The procedures must include best practices for preventing and responding to leaks and spills.
- Regular training must be provided to employees covering all of the standards in this section, and records of the training must be maintained for 5 years.
- Establish a system to properly notify third party emergency response organizations of chemicals stored on site for planning purposes
- Hazardous wastes, solids wastes, recyclable materials, and special wastes can only be shipped to permitted, authorized facilities for treatment, disposal, or other processing. Factories must have detailed information on file at the factory describing the fate of all wastes and recyclable material once the wastes and recyclable material leave the factory, all the way to final disposal or reclamation point. Factories must ensure that transporters and treatment and disposal facilities are properly authorized and permitted to accept the waste or recyclable material, and evidence of this must be kept on file at the factory for each waste or recyclable material.
- Factories must maintain good housekeeping in all solid and hazardous waste collection and storage areas, such that the risk for impact to the environment from the wastes is minimized. Hazardous waste must be stored so as to prevent or control accident releases to the air, soil, or water resources. Secondary containment must be provided for all hazardous waste storage areas. All hazardous waste containers must be properly labeled.
- Hazardous waste and solid waste storage and handling areas must be inspected regularly in order to detect potential leaks, releases, or other problems.
- Secondary containment should be provided for all ASTs and other hazardous material containers in order to minimize the chance of a spill from reaching the environment.

Best practices

- Proper sign boards shall be placed at all concerned areas.
- An emergency protocol shall be established and followed. All operating staff shall be trained, accordingly. Inter-locking systems and alarm systems shall be provided at all reasonably possible areas.
- Abnormal operations and emergency situations should immediately be brought into the notice of the local regulatory Board/Committee.
- While handling odorous wastes, care shall be taken (sealed containers, vapour balancing, nitrogen blanketing *etc*.) to avoid smell nuisance.
- Efforts must be made to provide diffused emissions collection and control/routing to combustion chambers.
- Medical camps/health check-ups of all the workmen of the incineration facility shall be conducted quarterly by registered medical practitioners.
- Adequately qualified and trained staff shall be deputed for the operations, being sensitive in nature. No ad-hoc appointments be made or no unskilled personnel shall be engaged for operation of the incinerators. All the personnel involved in handling of hazardous waste and incineration shall be on pay roll.
- The incinerator shall incorporate all safety measures to provide complete protection to the operator and the unit against all possible operational/machinery failures.
- Dedicated back-up power facility shall be provided with arrangement to automatically start functioning immediately, in case of power failures.

In countries affected by the problems, it is vital to be able to identify hazardous wastes at the place of generation and to have knowledge of the associated hazard potential, in order to control these hazards effectively within the framework of waste management planning and to put the planning into practice. Therefore a binding schedule of waste types must be compiled in preparation for the further stages of planning and implementation of waste management measures. Demarcation criteria and definition questions must be formulated for maximum harmonization with existing international regulations, so as to control transboundary movements of waste materials within the meaning of the Basel Convention as far as possible.

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