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IL&FS | Environment

TECHNICAL EIA GUIDANCE MANUAL
FOR
INTEGRATED PAINT INDUSTRY

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
B/C	Benefits Cost Ratio
BAT	Best Available Technology
BOD	Biochemical Oxygen Demand
BOQ	Bill of Quantities
BOT	Build Operate Transfer
CCA	Conventional Cost Accounting
CER	Corporate Environmental Reports
CEAA	Canadian Environmental Assessment Agency
CFE	Consent for Establishment
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CREP	Corporate Responsibility for Environmental Protection
CRZ	Coastal Regulatory Zone
DfE	Design for Environment
DMP	Disaster Management Plan
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
ES	Environmental Statements
FCA	Full Cost Assessment
HAZOP	Hazard and Operability Studies
HTL	High Tide Level
IL&FS	Infrastructure Leasing & Financial Services Limited
IVI	Importance Value Index
ISO	International Standard Organization
LCA	Life Cycle Assessment
LDAR	Leak Detection and Repair
LDO	Light Diesel Oil

LPG	Liquefied Petroleum Gas
LSHS	Low Sulphur Heavy Stock
LTL	Low Tide Level
MCA	Maximum Credible Accident
MoEF	Ministry of Environment & Forests
MT	Metric Tonne
NAQM	National Air Quality Monitoring
NGO	Non-Government Organizations
O&M	Operation and Maintenance
OECD	Organization for Economic Co-operation and Development
OEM	Original Equipment Manufacturers
PM	Particulate Matter
POTWs	Publicly Owned Treatment Works
PPA	Participatory Poverty Assessment
PRA	Participatory Rural Appraisal
QA/QC	Quality Assurance/Quality Control
QRA	Quantitative Risk Assessment
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
SPCB	State Pollution Control Board
SPM	Suspended Particulate Matter
TA	Technology Assessment
TCA	Total Cost Assessment
TEQM	Total Environmental Quality Movement
TGM	Technical EIA Guidance Manual
ToR	Terms of Reference
UT	Union Territory
UTEIAA	Union Territory Level Environment Impact Assessment Authority
UTPCC	Union Territory Pollution Control Committee
VECs	Valued Environmental Components
VOCs	Volatile Organic Compounds
WES	Workplace Exposure Standard

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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 **"Integrated Paint Industry"** sector describes types of process and pollution control technologies, operational aspects of EIA with model TOR of that Sector, technological options with cleaner production and waste minimization techniques,

monitoring of environmental quality, post clearance monitoring protocol, related regulations, and procedure of obtaining EC if linked to other clearances for e.g., CRZ, etc.

Major wastes that the paint industry must manage are empty raw material packages, dust from air pollution control equipment, off specification paint, spills, and equipment cleaning wastes. Major portion of wastewater is generated from cleaning operations and its quality depends on the chemicals/ solvents used for cleaning. The two main types of air emissions that occur in the paint manufacturing process are volatile organic compounds and pigment dusts and emphasis should be given for their reduction by adopting proper house keeping protection measures to avoid exposure to VOCs, solvent vapours, pigments and other substances including lead.

India's industrial competitiveness and environmental future depends on Industries such as Integrated Paint Industry 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 integrated paint industry, understanding on type of environmental impacts and the criteria for the significance analysis.

Chapter 3 (About Integrated Paint Industry Including Process and Pollution Control Technologies): 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) Introduction - History and evolution of paint industry in India, Present and future of paint industry in India, Market potential – influencing factors, (ii) Scientific Aspects - Raw materials, Manufacturing processes, Steps involved in formulation/production of paints, (iii) Waste Streams in Paint Manufacturing - Wastewater, Air emissions, Solid and hazardous waste, (iv) Technological Aspects - Waste minimization technologies, Better operating practices, Pollution control technologies, (v) Safety and Occupational Health Concerns - Specific hazards, Ventilation of working areas, Prevention of fires and explosions, Personal protective equipment, Lead in paint industry and (vi) Summary of

Applicable National Regulations - General description of major statutes, General standards for discharge of environmental pollutants, Industry-specific requirements.

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 integrated paint industry, 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 condensed from more detailed sources pertaining to specific topics.

The contents of the document are designed with a view to facilitate addressing of 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 an industry 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 TGMs for all the developmental activities listed in the re-engineered EIA Notification. The Infrastructure Leasing and Financial Services Ecosmart Limited (IL&FS Ecosmart), has been entrusted with the task of developing these manuals for 27 industrial and related sectors. Integrated Paint industry 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 14th September, 2006 and latest amendment as 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." Agenda 21

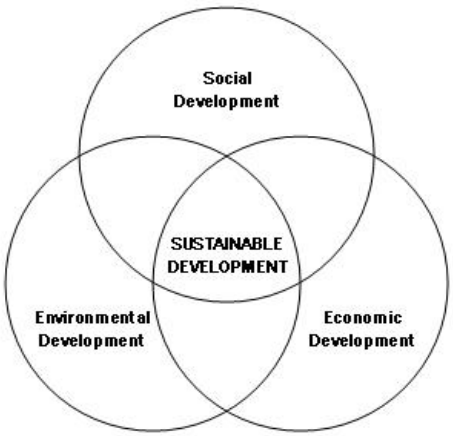

Figure 2-1: Inclusive Components of Sustainable Development

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

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*, Leak detection and repair (LDAR) 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

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 of the product at all stages of project life cycle. LCA includes product 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/firms may apply this concept to 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, hard to quantify, or occur more than three to five years after the initial investment. TCA includes all 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, 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, chemical consumption energy consumption, wastewater generation, solid/hazardous waste generation, *etc.,* per tonne of final product. Once these benchmarks are developed, the industries which are below them may be guided and enforced to reach them while those which are better than the bench mark 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 organization. These would typically address the issue of raw material consumption, energy consumption, water consumption in the organization, the quantities of wastewater generated, other solid wastes & emissions generated from the organization *etc*.

Management performance indicators are related to the management efforts to influence the environmental performance of the organizational 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 an 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 organization 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. 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 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 production. Recovery refers to engineering means such as solvent extraction, distillation, precipitation *etc*. to separate the useful constituents of wastes, so that these recovered materials can be used. Reuse 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 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 requires timely replacemnent. 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, ecosystem, 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 optimizes 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 (SEA), regional EIA, sectoral EIA and project level EIA. These are precisely discussed below:

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 will help 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 are 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 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 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 the integrated paint industry 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 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.

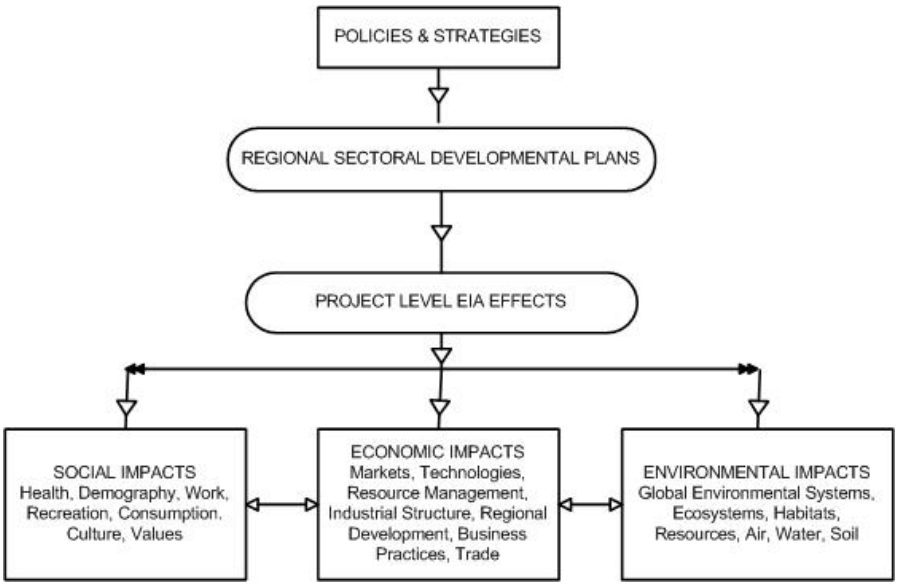

Figure 2-2: Types of Impacts

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 integrated paint industry or effluent from the Effluent Treatment Plant (ETP) into a river may lead to a decline in water quality in terms of high biochemical oxygen demand (BOD) or dissolved oxygen (DO) or rise of water toxins.

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, ambient air SO_2 rise due to stack emissions may deposit on land as SO_4 and cause acidic soils. Another example of indirect impact, is the decline in water quality due to rise in temperature of water bodies receiving cooling water discharge from the nearby industry.

This, in turn, may lead to a secondary indirect impact on aquatic flora in that water body and may further cause reduction in fish population. Reduction in fishing harvests, affecting the incomes of fishermen is a third level impact. Such 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.

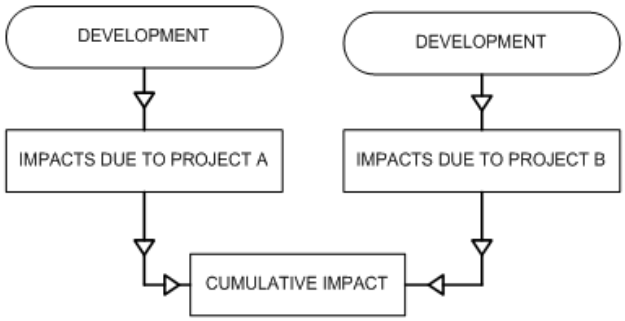

Figure 2-3: Cumulative Impact

2.8.4 Induced impacts

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.*, excess growth may be induced in the zone of influence around a project area, and in the process causing additional effects on air, water and other natural ecosystems). 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, increased recreational activities (*e.g.*, hunting, fishing), and 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 INTEGRATED PAINT INDUSTRY INCLUDING PROCESS AND POLLUTION CONTROL TECHNOLOGIES

3.1 Introduction

Paint may be defined as a liquid applied in layers to protect, decorate or finish a solid surface and which hardens to form a solid coating. The change to a solid state may result through solvent evaporation, by chemical reaction or by a combination of these processes. The products of paint manufacturing industry include architectural coatings, product coatings for original equipment manufacturers (OEM), and special purpose coatings. All these products are made with the same basic raw materials:

- vehicle or binder
- pigment to provide opacity, colour or body
- solvent to regulate viscosity
- variety of additives to impart special characteristics

In most cases, the manufacturing facilities purchase the raw materials and then formulate or blend, rather than react, to produce a finished product. Paint industry manufactures a number of products such as paint, varnish, lacquers, enamels, synthetic resins, water-based paints, *etc*.

For the purpose of this notification, an integrated paint industry is defined as an industry, which is involved in not only formulation (physical mixing of ingredients) of paints, but also in manufacturing of ingredients such as resins, lacquers, varnishes, *etc.*

3.1.1 History and evolution of paint industry in India

In 1902, M/s. Shalimar Paints, Colour & Varnish Company, a Pinchin Johnson unit, was established in Kolkata. However, a ready and expanding market for the nascent paint industry could not be created and this one lone unit went through a rather prolonged period of infancy, till the World War II. The period between the wars, thus saw the greatest ever influx of foreign paint companies into India - Goodlass Wall (1918), Elphant Oil Mills (1917) in Bombay, and British Paints, Jenson & Nicholson and Macfarlances in Calcutta. Macfarlanes was bought over by the Poddars and became a completely Indian company, while the other three: Shalimar Paints (Pinchin Johnson), British Paints and Jenson & Nicholson continued as British operated units.

During post-independence times, the Indian-owned industries emerged as key players in this sector. For many years, the Indian paint industry was manufacturing and supplying low-tech products such as cement paints, oil bound distempers, general purpose enamels and low-build-low-solids protective and industrial coatings. In contrast to those times, the paint industry in India now produces large gamut of products, including some really high-tech products, targeted towards architectural and industrial end use segments. Increased customer awareness and consumer demand has been the reason for the change

as the technological progress made by the paint industry and the raw material suppliers. Various factors including stringent quality specification introduced by foreign collaborators and consultants, newer concepts in design and construction, increased usage of newer materials such as plastics and non-ferrous metals, limited but definite improvements in the methods of application and above all, openness on the part of manufacturers and customers towards new technology were responsible for quality up-gradation in paints. Even the small-scale sector, particularly, companies set up by technocrats are now focusing attention on high value specialty products.

3.1.2 Present and future of paint industry in India

The country's per capita consumption of paints – 800-900 grams –is negligible compared to per capita consumption of 15-25 kg in the developed countries. Even the developing nations like Taiwan and Philippines have higher per capita consumption than India.

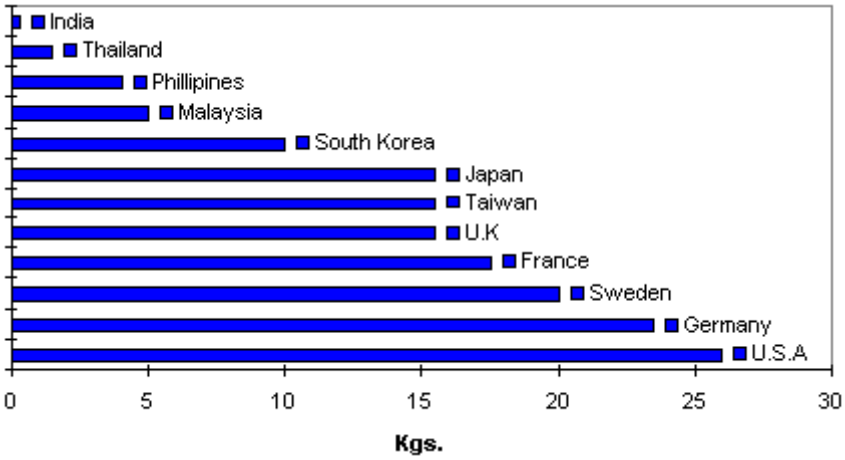

Figure 3-1: Per Capita Consumption of Paints

The classification of the paints industry can be made either product-wise or sector-wise. In the sector-wise segmentation, this industry can be classified into organized (70%) and unorganized sectors (30% market share).

Organized sector is dominated by six large players and in the unorganized sector there are about 2500 units manufacturing various categories of paints. The total volume of market is about 717,000 tonnes (T) and the industry is growing at 14% approximately. The organized sector can itself be divided into two distinct segments (product-wise) – the decorative segment, which is growing at 8% approximately and the industrial segment which is growing at 15% approximately.

A major portion of demand for decorative paints is from fresh coats on existing wall finishes and therefore the fortune of this segment is closely linked to the construction activity in the country.

3.1.2.1 Decorative segment

The decorative paints cater to housing sector.

- Premium decorative paints are acrylic emulsions used mostly in the metros.
- Medium range paints consists of enamels, popular in smaller cities and towns.

- Distempers are economy products demanded in the sub-urban and rural markets. In this segment both the organized and the unorganized sectors have a share of nearly 50 percent (%) each.

Within the decorative segment, composition of paints is shown in Figure 3-2.

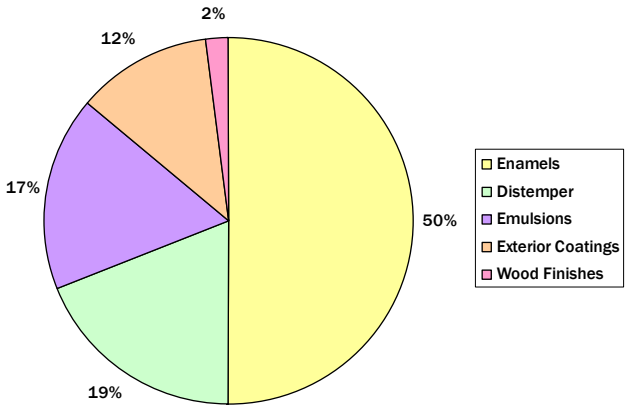

Figure 3-2: Composition of Paints in Decorative Segments

3.1.2.2 Industrial segment

As against the decorative segment, the share of unorganized sector in industrial paints is limited to 35% (roughly). This is because of overriding factor of the technology, which requires constant upgrades and servicing. Industrial paints comprise automotive paints, high performance coating, marine paints, powder coatings and coil coatings. The user industries are automobiles, engineering and consumer durables.

- Automotive paints constitute a large share of industrial paint market, which requires high-quality standards, supplier reliability and ability to offer complete coating systems. They are used for giving high quality finish to automobiles.
- High performance coatings are applied in plants for fertilizers, petrochemicals and offshore oil and atomic energy installations where anti-corrosion is very important.
- Powder coatings (water-based) are free of solvent and are used in consumer goods like washing machines, refrigerators, *etc*.
- Marine paints are used for painting ships and vessels to make them water resistant and corrosion-free.

Within the industrial segment, composition of major paints is shown in the following graph.

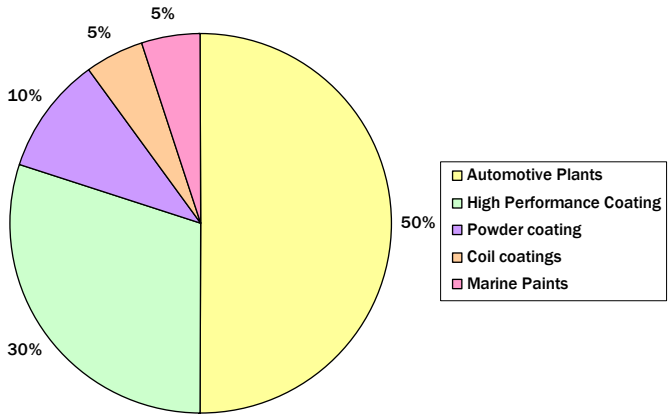

Figure 3-3: Composition of Paints in Industrial Segment

Half of the industrial paints produced in the country are automotive paints and close to one third is the high performance coating.

3.1.3 Market potential – influencing factors

Boom in Indian housing sector: Increasing urbanization, cheaper housing loans and a shift from semi-permanent to permanent housing structures have been driving factors for the growth of decorative paints segment which constitutes major part of the industry.

Strong industrial growth: There is an average growth of 10% in the automobile sector, which provides 50% of the revenue in the industrial paints segment.

Heavy infrastructure spending: New projects in roads, ports and industrial segments increases revenues from protective coatings for civil applications and road-marking paints to all parts of the building paints sector, whether interior, exterior, waterproofing or floor coatings.

Increase in manufacturing activities: Over 40% of industrial sector takes the form of OEM finishes, which is expected to grow steadily as a result of increasing demand for consumer goods in India as well as India's position now as a leading manufacturing hub for the supply of goods to the South East Asian and other world markets.

Less seasonality: About 65% of the demand for decorative paints stems from repainting. Rising aspirations, shift in the perception of paints as having a protective value rather than a mere decorative have diminished the impact of seasonality.

Rise in income: Lifestyle based spending by the Indian middle class is helping decorative segment of this industry. Contemporary wood finish formulations are replacing the more traditional lakhs while the exterior emulsions have taken over from cement paints.

3.2 Scientific Aspects

Paint is a suspension of finely separated pigment particles in a liquid that when spread over a surface in a thin layer will form a solid, cohesive, and adherent film. The products of paint manufacturing industry are categorized according to their use or type of carrier used in the manufacture and the method of curing.

Based on its use, paint products can be categorized into architectural coatings, product finishes, and special-purpose coatings. Architectural coatings are products used to coat interior and exterior surfaces. Product finishes provide first coating on newly manufactured equipment and products. Special purpose coatings are products formulated to meet specific use of requirements such as extreme temperatures or heavy wear.

Based on carrier used in paint formulation, classification refers to the volatile solvent rather than to the combined solvent and binder. The volatiles typically water or solvent, evaporate after the paint has been applied to the substrate.

Majority of the architectural coatings are water-based, whereas, product and special purpose coatings are solvent-based.

Method of curing applies to nonvolatile coating systems, which do not rely on the evaporation of solvent or water to achieve the desired finish. Coatings included in this category are powder coatings, radiation curable coatings and two part catalyzed paints.

3.2.1 Raw materials

Major raw materials used to manufacture paint are binders (resins, drying oils), solvents, pigments, extenders, petroleum thinners, additives/chemicals, *etc*. The chemical composition of paints varies depending on the desired paint properties.

Binders: Binders form a continuous phase, hold the pigment in dry film and cause it to adhere to the surface to be coated. The majority of binders in paint films are composed of resins and drying oils, which are largely responsible for the protective and general mechanical properties of the film. Resins provide characteristics such as durability and flexibility. Alkydes, acrylics and vinyls are the three commonly used resins.

Solvents: Solvents are used to keep paints in liquid form so that they can be easily applied and evaporate completely. It is used to transfer the pigment mixture to a surface in a thin, uniform film and plays no role in film formation. Materials used as solvents are aromatic and aliphatic hydrocarbons, alcohols, ketones and esters. Water is the solvent in water-based and emulsion paints.

Pigments: Pigments provide the coating with color, opacity and degree of durability to the paints. Pigments are either organic or inorganic. The major pigment used is titanium dioxide or Titan. This is white in color and has a high refractive index (bends light and adds to hiding power).

Extenders: These are mainly used to modify the gloss level of paints as, the more pigment in a paint film, the flatter the sheen will be. Extenders are used to lower the sheen or gloss. These are also used to add body to paint and to increase its filling properties. The main extenders are calcium carbonate, talc, barytes and diatomaceous earth.

Additives/chemicals: These perform a special function or impart a certain property to the coating. Some of the additives include driers, thickeners, biocides, surfactants, dispersing agents, antifoams, and catalysts, *etc*.

3.2.2 Manufacturing processes

Paint manufacturing: In general, paint manufacturing involves weighing of dry pigments, mixing and feeding through hoppers or chutes into mills where they are dispersed in an appropriate resin vehicle. The milled pigment is transferred to a mixer where thinners, drying agents, *etc.,* may be added to adjust consistency, viscosity, colour and drying time. When mixing is complete, the paint is filtered through filter cloth and packed into containers.

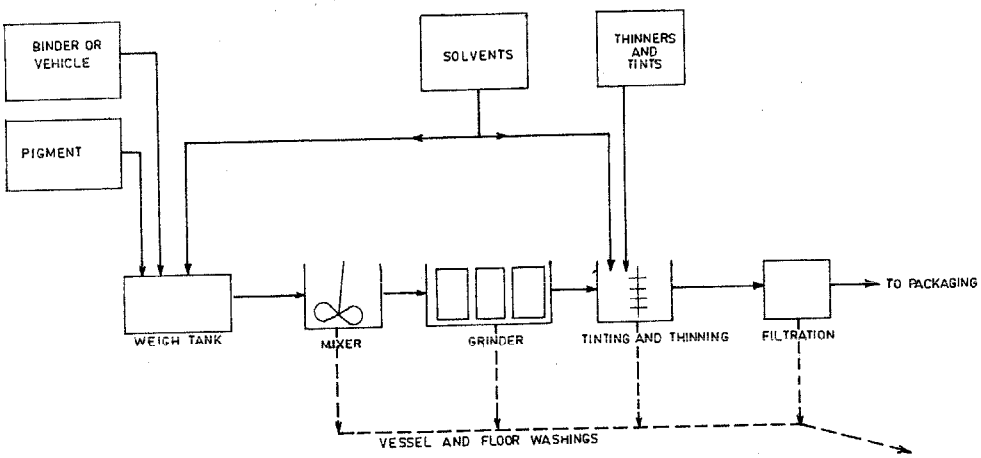

Figure 3-4: Typical Flow Chart for Paint Production

Varnish manufacturing: Varnish is an unpigmented resinous surface coating. In traditional varnish manufacture an open kettle is set over a fire in which copal or other natural gum is heated and dissolved in hot oil. Other ingredients such as driers are added and after cooling the varnish is thinned out to a workable consistency with solvent. It is then clarified by gravity settling, straining or centrifugation. Modern manufacture takes place in jacketted enclosed kettles.

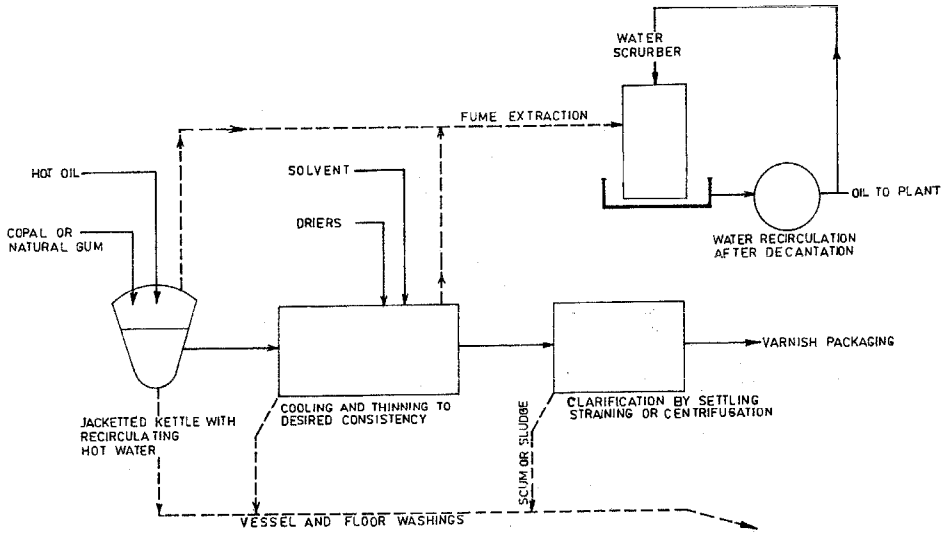

Figure 3-5: Typical Flow Chart for Varnish Manufacture

Lacquer manufacturing: Lacqures are coatings that dry only by evaporation. The pigments are first dispersed in ball mills with plasticizers and then natural or synthetic resins are added. Solvents are added to achieve required consistency. This may be done either by cold churning or by gentle warming and mixing.

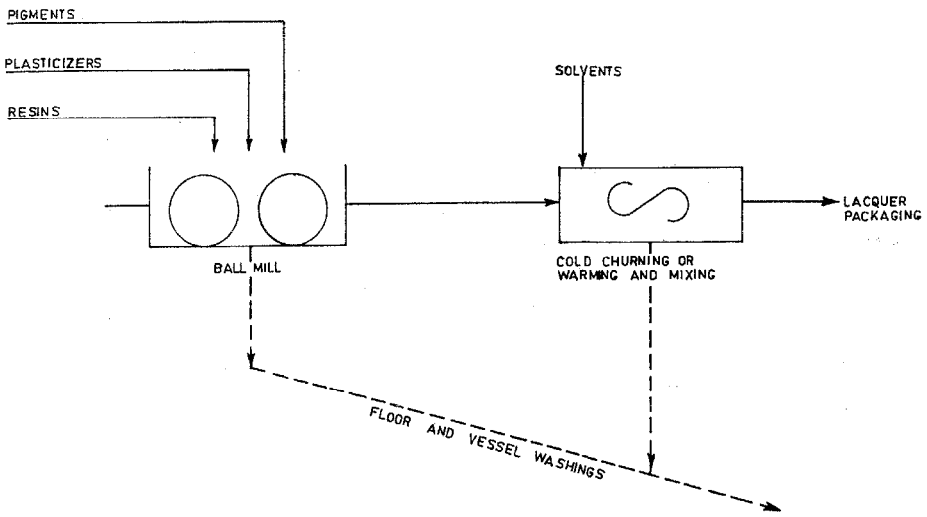

Figure 3-6: Typical Flow Chart for Lacquer Manufacture

Distemper manufacturing: Powdered raw materials together with additives go to pug mill in which soft water is used. Other raw materials are emulsified with stand oil prior to entering the pug mixer. Further grinding may be done before packing.

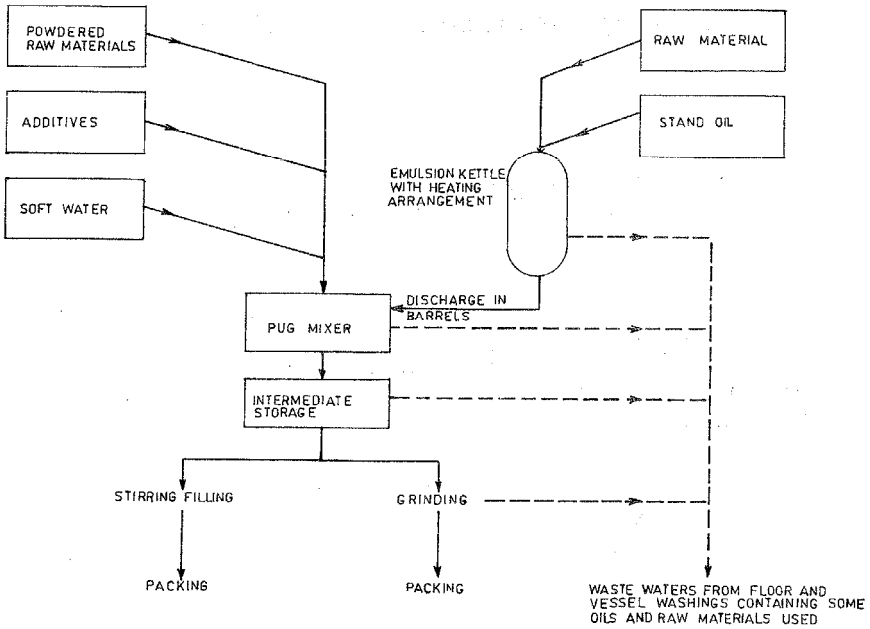

Figure 3-7: Typical Flow Chart for Manufacture of Distempers

Manufacture of resins and emulsions: Other items of interest in paint manufacture are resins and emulsions for the manufacture of which various chemicals/substances are reacted at controlled temperatures in special reactors.

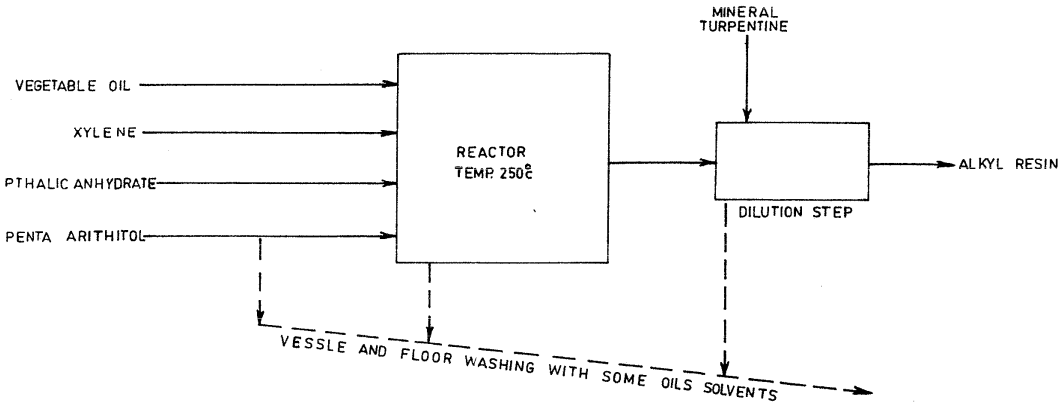

Figure 3-8: Typical Steps in Manufacture of Resins

Synthetic resins of alkyd type are manufactured by chemical reactions of polyol, oil and polyacid in presence of catalyst and certain additives in thermic fluid heated reaction vessel. The reaction is monitored by checking temperature, viscosity, acid value and percent solids. Time required for reaction varies from 18 hrs to 48 hrs. This is followed by thinning in blender with solvents to the desired percentage solids and filtration take place in a plate type pressure filter and after filtration the product is pumped into storage tanks. The above mentioned process is shown in schematic given below.

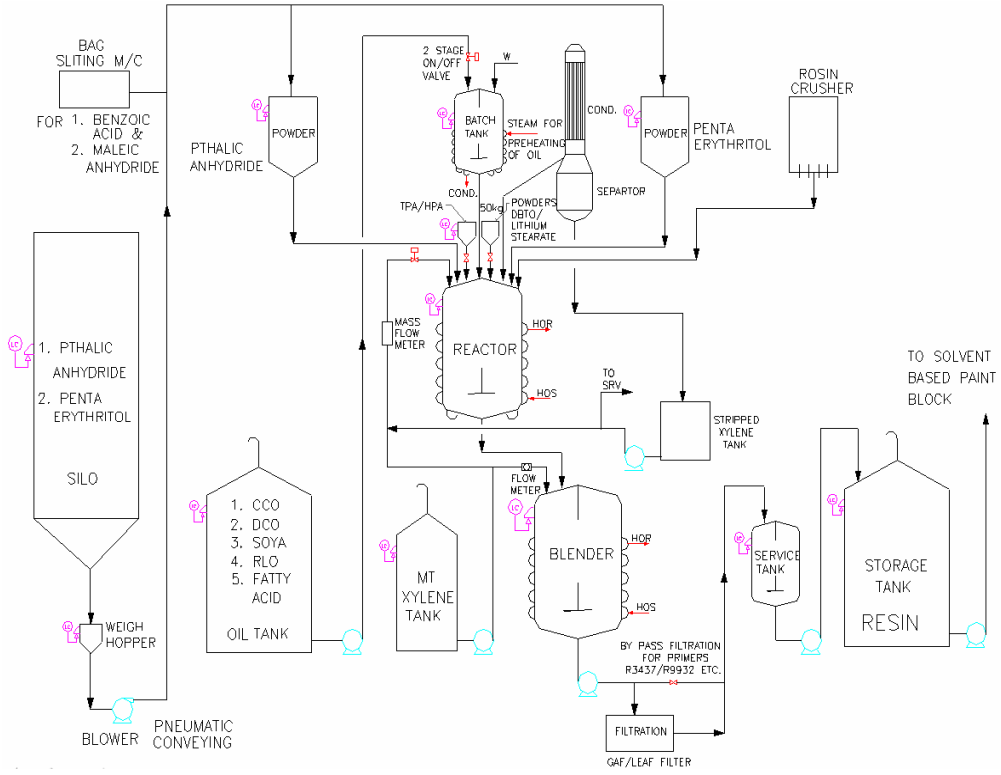

Figure 3-9: Alkyd Resin Processing - A Simplified Process Flow Diagram

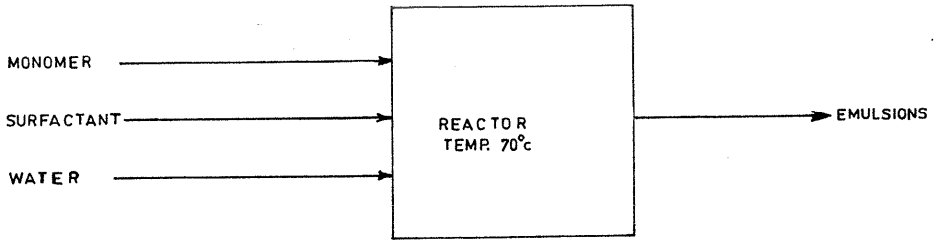

Figure 3-10: Typical Steps in Manufacture of Emulsions

Bituminous paint: Bituminous paint is manufactured in synthetic resin plants. The process followed is almost identical to that of resin manufacturing process. The bitumen (generally maxphalt grade of tar is used) is melted in a closed, jacketted kettle. Heating is done indirectly by circulating thermic fluid around the kettle, at a temperature of 150-180^{o}C. Bitumen is melted in the kettle for two hours. During heating process, fumes are given out which are passed through a water scrubber. This water is let out in to the drains from where it is finally collected and treated in the effluent treatment plant.

Melted bitumen is then thinned down to required consistency by mineral turpentine, filtered and cooled. For production of 6000 lit/month, wastewater generated is approximately 1000 lit/month. Bituminous paint is used as anticorrosive coating for water tanks, underground pipes, *etc*.

Coal tar enamel is composed of specially processed coal tar pitch combined with inert mineral filler. The enamel does not contain asphalt of either petroleum or natural base.

3.2.3 Steps involved in formulation/production of paints

The steps involved in production of various types of paints include:

I. Preassembly and premix

II. Pigment grinding/milling

III. Product finishing/blending

IV. Product filling/packaging

Some of the equipment used to accomplish these manufacturing steps include roller mills; ball and pebble mills; attritors; sand, bead, and shot mills; horizontal media mills; and high-speed disk dispersers. A generalized process flow diagram is shown in Figure 3-10.

The production of solvent-based paint begins by mixing resins, dry pigment and pigment extenders in a high speed mixer. During this operation, solvents and plasticizers are also added. Following the mixing operation, the batch is frequently transferred to a mill for additional grinding and mixing. This kind of mill is dependent on the pigment types being handled, so that no particular/single style is universal. Next, the paint base or concentrate is transferred to an agitated tank where tints, thinner (usually a volatile naphtha or blend of solvents) and balance resin are added. Up on reaching proper consistency, the paint is filtered to remove any non-dispersed pigment and transferred to a loading hopper. From the hopper, the paint is poured into cans, labeled, packed, and moved to storage.

The water-based paint process is very similar to the solvent-based process. The major difference is the substitution of water for solvent and the sequencing of material additions. Preparation of water-based paint begins by blending water, ammonia, and a dispersant together in a mixer. To this mixture, dry pigment and pigment extenders are added. After mixing, the material is ground in a mill and then transferred to an agitated mix tank. Four additions of materials occur in this tank. First, resin and plasticizers are added to the mixture; second, a preservative and an antifoaming agent are added; third, a polyvinyl acetate emulsion is added; and fourth, water is added as a thinner. Following this mixing operation, handling of paint is similar to that for solvent-based paints. At many facilities, mixing and grinding operations may be bypassed with all the dispersion operations occurring in a single high-speed mixer.

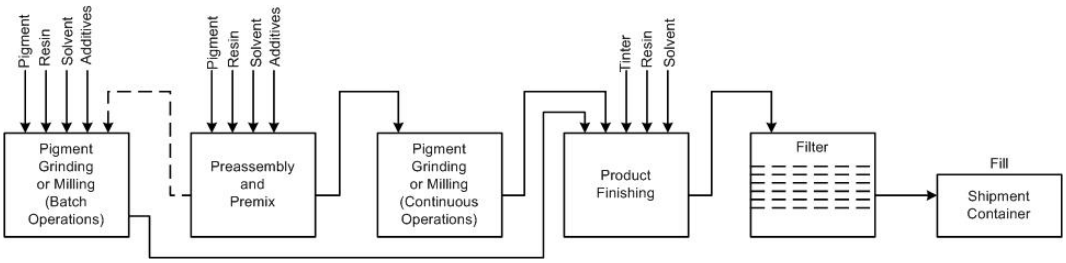

Figure 3-11: Generic Process Flow Diagram for Paint Manufacturing

3.2.3.1 Preassembly and premix

The first step in the manufacturing process is preassembly and premix. In this step, the liquid raw materials (*e.g.*, resins, solvents, oils, alcohols, and/or water) are "assembled" and mixed in containers to form a viscous material to which pigments are added. The pigment and liquid mixture forms a thicker material, which is then sent to the grinding operations. At this stage, particles in the concentrate are rather large (250 μm) and are not consistently mixed. The premix stage results in the formation of an intermediate product, which is referred to as the base or mill base. With further processing, this base with high pigment concentration may become any one of a variety of specific end products.

Resin production and cooking

Resin production is typically considered as first step in the manufacturing process. However, few paint facilities manufacture their own resins. Once the resin is manufactured, it is cooked and then converted to a usable vehicle. Over the last decade, resin production has become increasingly performed in closed reactors by chemical plants.

Chemical facilities cook resins with oils, fatty acids, or alcohols indirectly heated in closed stainless steel vessels. These reactors are normally vented through a fractional distillation column and a condenser, so that vaporized compounds are recycled back into the reactor. After the resin has been cooked and then cooled, it is thinned with solvent to produce the vehicle.

The thinning stage is often the point at which paint plants begin their manufacturing process.

Equipment selection

Premixing is necessary to keep the pigment in suspension in the resin, alcohol, solvent and oil mixture and to supply the dispersion equipment with a consistently mixed material. A wide variety of equipment may be used in the premix process. Choosing the equipment depends on batch size. Drum-sized batches made in the drum itself may be blended with a portable mixer which clamps onto the rim of the drum. These mixers normally have a three or four blade impellers and may be either hydraulic or electric. Other materials made in portable mix tanks may be blended using larger, permanent high-speed dispersers or variable-speed mixers fitted with paddle, propeller, turbine, or disc-type agitators. In some cases, paint will be moved to a dispersion mill for grinding and milling, and then transferred back to the same premix mixer for blending operations.

Other facilities use typical grinding equipment to accomplish premix operations. One paint manufacturing plant uses dispersers and mixers to achieve high-sheared mixing when working with insoluble powders (*i.e.,* pigments and additives). The same plant uses ball/pebble mills or Kady mills when mixing soluble powders. In this case, the facility may eliminate the need to transfer the material to another type of grinding equipment as the premix and milling steps are accomplished in one piece of equipment.

3.2.3.2 Pigment grinding or milling

The incorporation of pigment into paint vehicle to yield fine particle dispersion is referred to as pigment grinding or milling. This process occurs in three stages (*i.e.,* wetting, grinding, and dispersion), which may overlap in any grinding operation. To wet the pigment particles, the wetting agent, normally a surfactant must displace all contaminants (*e.g.*, air, moisture, and gases) adsorbed on the surface of the pigment particles. The wetting process actually begins in the premix step, when the pigment is charged to the liquid vehicle. Grinding is the mechanical breakup and separation of the pigment particle clusters into isolated primary particles. Dispersion is the movement of wetted particles into the body of liquid vehicle to produce a permanent particle separation.

The goal of pigment grinding is to achieve fine, uniformly-ground, and smooth, round pigment particles which are permanently separated from other pigment particles. The degree to which this is realized determines the coating effectiveness and permanency of the paint. Grinding equipment must work effectively with the vehicle to accomplish this end. Just as there is a variety of pigment vehicles, so is an array of dispersion (milling) equipment.

Equipment selection

Roller mills: Roller mills may have one-to-five rolls which grind pigments into vehicles. Most paint facilities that use roller mills operate with conventional three-roll mills. A schematic diagram of a three-roll mill is shown in Figure 3-11. The premixed pigmented paste is charged to the space between the feed and center rolls called the feed bank. End plates prevent the material in the feed bank from spilling out on the sides. The mill base is carried into feed nip region by the inward rotation of the feed and center rolls which are turning at different speeds. Some of the material remains in the feed bank while another portion transfers through the feed nip to the underside of the rolls. Here, the material splits. Some portion of the material transfers to the center roll while the remaining portion stays on the feed roll to return to feed bank. The material that was transferred to the center roll passes through the apron nip, after which a second split takes place. Some

amount remains with the center roll returning to the feed nip, while the remaining material transfers to the apron roll where it is removed from the roller mill by the takeoff apron.

As the material moves through both the feed and apron nips, it is subjected to very high shear. This shearing action serves to disperse the pigment throughout the vehicle, while the nip space determines the degree of this dispersion.

Roller mills are labor intensive requiring highly skilled operators. Their lack of speed and high operating cost make them unsuitable for large-volume production. The use of roller mills is confined to manufacture of very high-quality paints and viscous pigmented products which require fine dispersion and clean color.

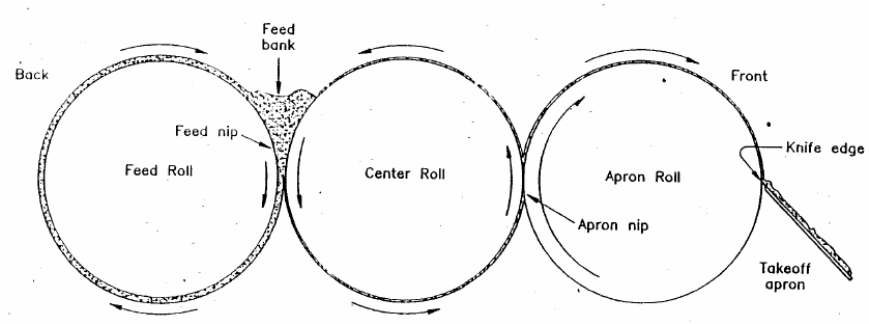

Figure 3-12: Schematic Diagram of Three-roll Mill

Ball and pebble mills: Ball and pebble mills are probably the oldest pigment dispersion equipment. They are cylindrical containers mounted horizontally and partially filled with either pebbles or ceramic, glass, or metallic balls, bails which serve as the grinding media. Paint components, either in raw material or in premix form, are charged to the mill through a top chute. The ball mill and its contents then rotate about the horizontal axis at a rate sufficient to lift the grinding media to one side and then cause them to cascade to the lower side. The tumbling action results in pigment dispersion.

Ball and pebble mills are distinguished only by their interior lining and grinding media. The paint industries conventionally define pebble mills as those mills containing a non-metallic grinding media such as ceramic, porcelain, silica balls and flint pebbles, and having an inside surface lined with a non-metallic liner such as burrstone, porcelain block, or rubber.

Ball mills, on the other hand, contain steel, alumina, iron, or nickel balls and have an interior surface of alloy steel or another metallic liner. Because of these minor differences, the terms ‘ball mill’ and ‘pebble mill’ are used rather loosely and the former is often used to describe both types of mills.

The size and type of the grinding media determine the type of paint manufactured. Small, dense grinding media tend to be more efficient at dispersing pigment than larger, more porous media. Steel-lined mills charged with steel balls can be used only for dark colors, as erosion results in the discoloration of whites and pale shades. Normally, lighter colors are made in pebble mills using ceramic media.

Ball mills offer the following advantages to paint manufacturers:

- Normally no product premixing is required. The vehicle is often charged directly to the mill followed by the pigment charge. This offers an economic advantage as many grinding processes require premixing.
- The milling process does not require skilled attention or supervision, yielding minimal labor costs. Ball mills can operate on a timer, thus completing the dispersion process outside of normal working hours (*i.e.,* at night or on weekends).
- Low maintenance costs
- Ball mills are adaptable to grinding of most paint dispersions and of all pigments. Only highly viscous products are not amenable to ball mill grinding.
- Ball mills offer product standardization and consistency
- Ball mills are capable of providing substantial physical size reduction of oversized particles, thereby upgrading pigment opacity and/or color development.

On the other hand, ball mills also have several disadvantages which include relatively longer processing times ranging from 8 to more than 36 hours and lengthy cleaning times requiring considerable amounts of solvents.

Attritors: An attritor is a stationary, vertical, cylindrical grinding tank fitted with a centralized, rotating agitator shaft to which evenly-spaced spokes are attached. The spokes extend into ball media and mill base mixture which fills the attritor during milling process. As the spokes rotate through attritor tank contents, they agitate the ball charge. The agitation provides required shear and impact to effectively disperse the pigment into the vehicle.

Attritors are available in sizes up to a total capacity of 100 gallons approximately. They may operate on a batch or on a continuous process basis and usually contain small ceramic or steel balls (*i.e.,* 1/4 inch diameter). Raw materials may be added by hand or by a manifold system. An attritor achieves pigment dispersion approximately three times faster than a ball mill, but requires constant supervision. Attritors can also handle higher viscosity materials than a ball mill.

Sand mills: Sand mills, vertical cylinders filled with grinding media, operate on the principle that the dispersion efficiency increases with the decreasing diameter of grinding media. These mills attain dispersion by rapidly stirring small spheres in the presence of pigment slurry. Paint manufacturers were using sand mills for the dispersion of pigmented mill bases since the early 1950s. Originally, manufacturers used fine-grained Ottawa sand as the grinding media. Now, however, many facilities use small beads or balls ranging from 1/32 to 1/8 of an inch. Because the size of sand mill media approaches that of bead, shot and ball mill media, the terms 'sand mill', 'ball mill' 'shot mill', and 'bead mill' are often used interchangeably. Sand, bead, and shot mills are frequently called media mills.

In vertical sand mills, the premixed slurry is pumped in at the bottom of the cylinder and rises through the sand, which is kept fluid by the quickly rotating shaft impeller. Dispersion takes place as a result of pigment shearing as it rises through the chamber. Most pigments are sufficiently dispersed when they reach the top of the chamber. The dispersed product is then allowed to filter from the mill through a mesh which retains the sand. Older sand mills operate with an exposed filtering screen which often becomes encrusted with dry mill base. Many newer mills; however, have a submerged screen that eliminates plugging problems. With an ample supply of premixed material, the sand milling process can be continuous.

Bead and shot mills: Bead mills look and operate like sand mills. The only difference between the two is the type of grinding media employed. While conventional sand mills ordinarily use Ottawa sand, bead mills use a wide variety of synthetic media including glass, ceramic, and zirconium oxide or zirconium silicate beads. The term 'beadmilling' developed in the 1960s when manufacturers started using synthetic grinding media rather than sand. Many former 'sand' mills are now 'bead' mills.

The latest bead mills are closed agitated ball mills with a stationary horizontal cylindrical grinding container enclosing a driven shaft which agitates 1 to 3 mm diameter grinding beads. The small size of grinding media necessitates that particle size in the mill base feedstock be ground and dispersed to below 250 µm. A properly set up bead mill can disperse to below 20 µm in a single pass through the mill. Bead milling systems are available in sizes ranging from 1.5 to 1,900 gallons. Most bead mill manufacturers, with few exceptions, use glass, zirconium oxide or zirconium silicate, ceramic, alumina, and in certain cases, steel ball grinding media. They may be used either for batch or continuous processing.

Shot mills are also similar to sand mills. These rugged units have a narrow, upright, cylindrical tank equipped with a rotating vertical shaft that sustains a series of evenly spaced, stainless alloy circular platforms. The platforms rotate through the media/mill base mixture. High-speed shot mills work best with small steel or ceramic grinding media. The mill operates under internal pressure and therefore is able to grind materials with high viscosities. The mill also has a variable-speed pump and submerged filter which rotates with the shaft.

High-speed stone and colloid mills: High-speed stone and colloid mills, although not as common as many of the other pigment grinding mechanisms, are other methods of achieving pigment dispersion. Modern stone (Carborundum) mills consist of two Carborundum stone components working against each other, as illustrated in Figure 3-12 (a) One stone, the stator, is held stationary while the other stone, the rotor is rotated at high speed from 3,600 to 5,400 rotations per minute (rpm). The premixed mill base is fed by gravity or under pressure into the charge area above the rotor. A viscous laminar flow, yielding pigment dispersion, results as the material moves through the grinding gap or the small space separating the two stone surfaces. Because the material spends only a fraction of a second between the stones, the dispersing action of the stone mill serves to refine rather than as a pure mixing and grinding operation. Stone mills produce the best quality product when they are fed with a well-mixed, viscous premix.

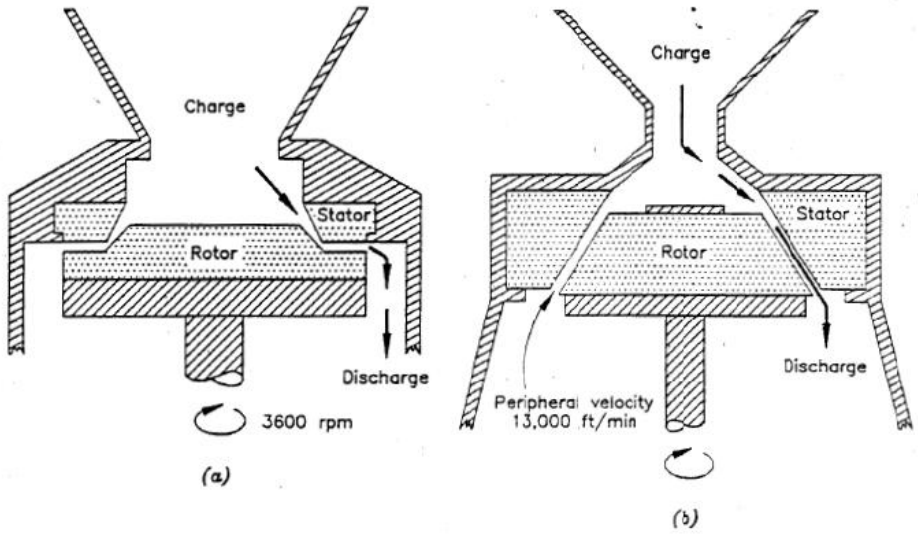

Figure 3-13: Schematic Diagram of stator/rotor assembly in a (a) high-speed stone mill (grinding region has the shape of a flat annular ring). (b) colloid mill (grinding region has the shape of a truncated cone).

Colloid mills differ from stone mills in their material of construction and their gap configuration. Figure 3-12 (b) illustrates the truncated cone arrangement distinguishing the two mills. The rotor and stator are designed with smooth, ground, and lapped faces which ensure a uniform cross section in the material in the grinding gap. Mill base consistency results in maximum shear and efficient milling. The rotor and stator in colloid mills may be constructed of Carborundum stones, high-nickel alloys, or Invar, an alloy with a low coefficient of expansion. Like stone mills, colloid mills must be provided with a well-mixed, viscous material feed. Both the stone mills and the colloid mills traditionally operate as open systems. However, both may be converted to closed systems using an accessory pump to provide the material feed.

High-speed disk dispersers: High-speed disk dispersers are the most universally used methods of dispersion in paint manufacturing industry. Their popularity continues to increase as compact, efficient, heavy-duty power sources and readily dispersible pigments become more available. Some paint blends are manufactured entirely in one piece of equipment using high-speed disk-type impellers. Essentially, the high-speed disk disperser consists of circular, steel, saw-blade-type impeller attached to the end of a steel shaft. The disk is suspended in a mixing pot which may be jacketed for water-cooling. Because there is no grinding media present in the mixing vat, the pigment disperses on itself and against the surfaces of the rotor. While high-speed disk dispersion may work well with some products such as undercoats and primers, it may not be appropriate for high-quality paints. It can, however, be used for premix operations of high-quality paints, thus reducing the number of passes in a media mill or reducing the amount of time spent in a ball mill.

High-speed dispersers provide a simple, quick, and relatively inexpensive means of distributing easy-to-disperse pigments in conventional vehicles on a batch processing basis. These dispersers are also capable of handling all phases in the preparation of some paints (*i.e.,* preassembly and premix, pigment grinding and dispersion, and product finishing) in one piece of equipment. In addition to its dispersion abilities, the high-speed disperser can be used in premix and blending (postmix) operations. Another advantage is comparatively low initial capital investment and low maintenance costs. The primary disadvantage of the high-speed disperser is its inability to disperse hard agglomerates.

Modification of high-speed disperser is a variable speed disperser. Variable speed systems allow the incorporation of dry powders into a liquid medium at low speed with minimum dusting. The speed is increased once initial wetting is complete. A second variation of the high-speed disperser is a rotor stator type machine similar to the set-up found in stone and colloid mills. Instead of disk type impellers, this disperser operates with a rotor stator unit. The stator is mounted on several shafts extending from the equipment housing, while the rotor is attached to a center disperser shaft which would typically hold a disk type impeller. The rotor stator unit may be either high-speed or variable-speed. In addition, newer models are quiet and more efficient than conventional high-speed dispersers.

Another variation of high-speed disperser/portable mix tank operation is the Kady mill. This mill consists of a high-speed disperser or agitator in combination with a fixed mix tank.

The tank is jacketed allowing for heating capability. It is also equipped with a permanent lid which can be opened during product filling operations and sealed during the mixing and dispersion process. As with disperser/portable tank operations, Kady mills contain no grinding media in the mix tank allowing the pigment to disperse on itself and against the surfaces of the rotor. Kady mills are often used in the production of high-gloss paints which require heat to develop the gloss characteristics.

High-speed impingement mills: High-speed impingement mills or kinetic dispersion mills disperse pigment agglomerates by impact. This mill consists of a slotted rotor and stator as shown in Figure 3-13. Material is sucked in at both the top and the bottom of the mill and is thrown outward by the rotating slots on the rotor against the close-fitting stator. The high velocity and forceful impact of the particles results in dispersion.

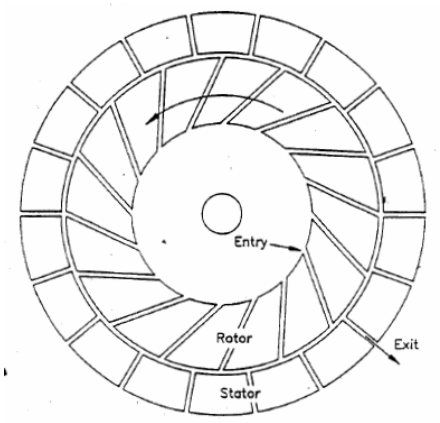

Figure 3-14: Schematic drawing of the milling head of a high-speed impingement (kinetic dispersion) mill

Impingement mills are most efficient when they are fed with a low-viscosity, easily dispersible pigment/vehicle mixture. As impingement mills are a batch process operation, no material premixing is required. The fluid vehicle (low solids content) is placed in the mill tank prior to starting the milling process. Once the rotor has started, pigment is rapidly fed into the tank. Batch grinding time averages less than 25 minutes.

Horizontal media mills: The horizontal media mill is basically a vertical mill turned 90^{o}. This configuration improves the performance of the mill by creating better material flow and by increasing the media loading capacity from 85 to 90 % of the chamber

volume. The increase in media loading from 50 % in vertical mills to 90 % in horizontal mills provides increased milling efficiency.

When provided with the proper premix feed, a standard horizontal media mill offers the most efficient one-pass operation. Properly equipped horizontal mills provide three times the productivity on an equal volume basis as the open-top sand and bead mills. Horizontal media mills are closed systems. The filtering screen is enclosed by a sheet metal cover, which controls solvent losses and expands the range of products that can be processed. Although the mill base moving through the chamber should be of low viscosity to allow the grinding media to move with maximum velocity, manufacturers using horizontal mills are no longer concerned about solvent evaporation and the mill base drying on the screen (causing the mill to overflow).

Horizontal mills range in size from 1.5 liters (0.4 gallons) to 500 liters (132 gallons). Most mills are equipped with a secondary jacket, which allows for water cooling. The mills are able to use any of the common media currently manufactured including glass beads, ceramic beads, zirconium silicate beads, and steel shot.

3.2.3.3 Product finishing

Final product specifications are achieved in the product finishing step which consists of three intermediate stages: thinning, tinting and blending.

Thinning (letdown): Material letdown, or thinning, is the process by which a completed mill base dispersion is let down or reduced with solvent and/or binder to give a coating which is designed to provide a durable, serviceable film that is easily applied to the substrate. The volume of paint may increase significantly at this point depending on the final product specifications.

Tinting: Tinting is the process of adjusting the color of completed mill base dispersions. Normally, an operator will collect a sample of paint once it exits the milling equipment. This sample will be taken to the laboratory and compared to the desired color standard. Various combinations of pigments, solvents, resins, and pastes are added to the material to meet color requirements.

Blending: Blending operations occur once the necessary additions have been made to completed mill base dispersion. Blending is the process of incorporating the additions into material in order to meet the desired product specifications. In case of batch operations, blending may simply consists of additional milling in a ball mill or added mixing and dispersing in a portable mix tank/high-speed disperser set-up. In other cases, the mill base dispersion is transferred to fixed agitated blend tanks or additional mix tank/disperser operations. In each case, material adjustments for thinning and tinting are added through top openings, agitated, and gravity fed or pumped out bottom or side spigots for filling operations.

3.2.3.4 Product filling

The final step in paint manufacturing is product filling operations. After the material has been blended, it is transferred from the blend tanks into containers for product shipment. The transfer step normally involves product filtration.

Filtering: Filtering acts to screen out impurities (*e.g.*, dust, gelled resin, and pigment aggregates) and to enhance the quality and uniformity of the product. In the case of

media mills, filters prevent the grinding media from exiting the mill and entering shipment containers. Paints may be filtered in a variety of ways. Some facilities simply attach cheese cloth or cloth socks to the exiting blend tank spigot. Other plants use filtering equipment such as strainers by sieves. A strainer consists of a vibrated screen and hopper through which product flows prior to entering shipment containers. The screens may be metal mesh, supported nylon, or another synthetic fiber. Another strainer, the Jenag strainer, has a vertical chamber holding fiber filters. The paint is fed by gravity or pump to the chamber and drawn through by vacuum.

High quality finishes, such as those used for automobiles and industrial products, may be pumped through wound polypropylene or other resin cartridge filters. Bag filters, made from felts (rayon, polypropylene, or nylon) or gauzes (polypropylene, nylon, or polyester), can be attached to the flanged end of a supply line and supported by a vibrating wire basket. These bags are usually washable and used only for small batches.

Material transfer: Once the material has been filtered, it can be transferred into pails, drums, tote tanks, tote wagons, or another container for shipment. Although most paints are sold by volume, most manufacturing facilities find it more convenient to fill the shipping containers by weight using the specific gravity of the paint. Filling may be accomplished either manually or mechanically depending on the number and size of the containers to be filled.

3.3 Waste Streams in Paint Manufacturing

Major wastes that the paint industry must manage are the empty raw material packages, dust from air pollution control equipment, off-specification paint, spills, and equipment cleaning wastes. Equipment cleaning wastes are a dominant waste stream. Primary wastes specifically associated with paint manufacturing are:

- Spills from accidental discharges
- Waste rinse water from equipment cleaning using water and/or caustic solutions
- Leftover raw materials during unloading of materials into mixing tanks
- Waste solvent from equipment cleaning using solvents
- Cotton waste from equipment cleaning
- Filter cartridges from undispersed pigments, *etc*.
- Pigment dust from air during unloading of pigment
- Emission of volatile organic compounds from open processing equipments

Wastes generated by the industry are usually managed in one of four ways: on-site reuse, on-site recycling, off-site recycling, and off-site treatment/disposal.

3.3.1 Wastewater

Water consumption during production process widely range depending up on the type of products manufactured at the time of study and the extent of water consumed in the cooling towers and floor washings. Thus, we could find no direct correlation between products manufactured and water consumed. Major portion of wastewater is generated from cleaning operations and its quality depends on the chemicals/solvents used for cleaning. Wastewater from the paint manufacturing industries generally tends to be alkaline, contain some oil and grease and Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Suspended Solids. Wastewaters may also contain small amounts of the products. The BOD and COD values give only a gross measure of

organics in the wastes. Some of the organic and inorganic compounds used in the manufacturing operations are classified as hazardous.

Raw materials used have very less chances of entering the effluent stream, as majority of them being toxic are carefully used. These toxic powders, containing chromium, copper, lead, zinc, titanium, *etc*. cannot be traced as such in the effluent because during the manufacturing process they are mixed and blended with a variety of other substances and solvents. Phthalic anhydride is a common raw material widely used in Integrated paint industry for manufacture of resins. The components in the wastewater corresponds to the respective constituents in the wastewater *ie.,* phenols incase of manufacturing phenolic resins, *etc*. These are at a high temperature and when condensed are traced in the condensate water. They are in high concentrations in the condensate water but get diluted further when mixed with other effluent streams.

- **Wastewater from caustic cleaning:** Caustic cleaning results in maximum production of wastewater in the paint industry. Caustic cleaning residuals are generated when equipment, tank, and secondary piping are washed with water, caustic, or a blend of water and caustic. Wash water liquid residuals can be recycled. Typically the wash water is filtered prior to reuse which generates sludge. The sludge typically is disposed of at off-site landfills or sent off site for fuel blending. Wash water is disposed of predominately at off-site common wastewater treatment plants. Caustic wash water sludge requires proper offsite disposal at authorized facilities.
- **Wastewater from resin house:** Water accumulates from condenser into separator. Water layer is disposed off in wastewater stream and the upper layer of solvents is reused. Water from separator is generally acidic.
- **Wastewater from water-based paints:** Distemper is the main product in water-based paints. Cleaning of hoppers, grinders and containers consume large amounts of water and contribute 400 to 700 mg/l of suspended solids, a large fraction of which is settleable.
- **Wastewater from solvent cleaning:** Solvent cleaning residuals are generated when equipment, tanks, and secondary piping are washed with a solvent or blend of solvents. Solvent cleaning wastes can be recycled back through paint production process. To extend the life of solvent wash water, many facilities send the solvent wash water through a reclamation process. The residues from reclamation process require proper disposal at authorized facilities.

3.3.2 Air emissions

The two major types of air emissions that occur in paint manufacturing process are volatile organic compounds and pigment dusts. Many paints are solvent-based and solvents are released during application, drying and (to a lesser degree) disposal. Solvents in paint add to volatile organic compounds (VOCs) in the atmosphere. Dust is generated during the assembly, pre-mix, and blending steps and is a very fine powder comprising resins and pigments that were added into the batch. Generally, dust collectors are found over the tanks used during these steps to capture the emission and collect the dust in a bag house.

Emissions during fuel burning: i) Rue gases are emitted from boilers for raising steam. Pollutants produced are minimal in case of Liquefied Petroleum Gas (LPG) and natural gases, somewhat higher for furnace oil, Low Sulphur Heavy Stock (LSHS) and light diesel oil (LDO), and maximum for coal, especially in form of particulates. Rue gases are generally discharged through 20-30 m high stacks. ii) “Thermopacs” are often used for

heating thermic fluids (*e.g.* oils) which in turn are used for heating in certain processes. Such units are operated on furnace oils, LSHS or LDO.

Emissions during process:

- **Resin production**
  - Phthalic condenser-fumes from reaction kettles are passed through phthalic condensers. These condensers contain baffles to make the fumes follow a sinuous path, forcing the phthalic particles to deposit on the walls. The efficiency of the condenser is further enhanced by providing a water jacket for cooling the fumes.
  - Special chimney-Here fine particles of phthalic are separated. Base of the chimney being conical helps the fumes to slow down to give better deposition of phthatlic particles. Weekly removal of phthalic particles is done to maintain the trap efficiency.
- **Varnish production**: Decomposition products of resin and oils are released as fumes. These fumes are scrubbed by jets of water spray.
- **Bituminous paint production**: During bitumen melting, fumes are given out and scrubbed by water.
- **Air extraction**: Air extractors and exhaust fans can be provided with suitably designed hoods at key positions to help improve ventilation in working areas. The air is dispersed through stacks. The flue gas emission from fuel sources should meet the Standards prescribed in the Emission Regulations of the CPCB.

3.3.2.1 Volatile organic compounds

VOCs are released from several types of equipment and handling operations throughout paint manufacturing process and during cleanup operations. Emissions can be categorized according to the four manufacturing processes and cleaning operations.

Preassembly and Premix: Majority of paint manufacturing facilities begin the process by thinning resins with solvents, alcohols, oils, and/or water. The equipment most often used in this premix and preassembly operation are drums and portable tanks in combination with mixers. Portable mix tanks, either alone or in combination with an agitator, are a common emissions source. Portable mix tanks are used to mix product and to keep the pigment in suspension. They are also used to transfer material from one manufacturing stage to the next. While they are being used for mixing, the tanks are often, but not always, covered with lids. If a cover is used on a mix tank during mixing, it will have a small opening through which the agitator shaft extends. In some cases, only a splash guard is used to cover the back half of the mix tank. If mix tanks are used for temporary storage, they are often covered with a solid lid. None of the lids seal with the mix tanks. Like the portable mix tanks, drums are often covered with non-sealing lids. If a cover is used on a drum during mixing, it will have a small opening for the agitator shaft.

Emissions occur during material loading when the tank or drum is uncovered or when the lid is open. VOCs may also be released through the agitator shaft opening and from around the edges of the lid during the mixing process. The quantity of material released varies with type of solvent, agitator mixing speed, material temperature, and type of cover. More organics will be released with highly volatile solvents, increased agitator speed, and warmer temperatures.

Pigment Grinding or Milling: The equipment used in grinding operations includes roller mills, ball and pebble mills, attritors, sand mills, bead and shot mills, stone and colloid mills, high-speed dispersers, impingement mills, and horizontal media mills.

Roller mills are used to manufacture high-quality paints with high solids content. The mill base vehicles used on roller mills normally contain from zero (0) to 40 % volatile content. Because the rolling cylinders on roller mills are exposed to atmosphere, the majority of volatile content in the mill base vehicle is expected to evaporate during the course of grinding process. Grinding with ball and pebble mills approaches a closed system operation. The only opening in these mills is the chute through which raw materials or premixes are added and the spigot which is used for product filling operations. VOC emissions occur during these processes.

Attritors are also approximate closed systems. Emissions may occur from the opening surrounding the agitator shaft and/or at product outfall. Older vertical media mills (*i.e.,* sand mills, bead mills, and shot mills) operate with an exposed filtering screen. As the mill base rises through the chamber and becomes exposed to the air, the solvent constituent evaporates, often leaving the screen encrusted with dry mill base. Media mill operators may apply solvent to unclog the screen or they may scrape down the filter with a coarse, dry brush. Fewer emissions occur from new vertical media mills which have submerged filtering screens.

Additional emissions of VOCs result from adding raw materials and from product filling operations. Both the stone and colloid mills traditionally operate as open systems. Emissions normally occur as the mill base feedstock is added to the charge chute on top of the rotor/stator arrangement. Similarly, emissions may occur after grinding as the material exits through the mill spillway. Enclosing the spillway and using a closed charge chute with an accessory pump will reduce overall emissions.

Majority of emissions from impingement mills also occur during the addition of raw materials and while emptying the mill of product. Impingement mills are potentially high-emission processing equipment because they require low-viscosity (low solids) vehicles. Ideally, the first vehicle addition would contain only 10% by weight solids. Subsequent additions might contain higher solids content.

Horizontal media mills are efficient, closed-system milling devices. The filtering screen is enclosed by a sheet metal cover which controls solvent losses and expands the range of products that can be processed. Although the mill base used in a horizontal mill should be of low viscosity, paint manufacturers do not have to worry about VOC emissions during the grinding process. The mill base for most horizontal mills is pumped from containers or premix equipment through an enclosed piping system. Material discharge is also through enclosed pipes or hoses.

Product Finishing: Emissions that occur during product finishing step are the result of material additions during the tinting and thinning stages. When material is finished in a fixed blend tank, releases occur during product additions through the top hatch, which normally does not seal with the blend tank.

Product Filling: Emissions occur during almost all product filling operations. The extent of these emissions is determined by the volatility of the solvent in the paint formulation, the temperature at which the product enters the shipment container, the method of material transfer, and the method of filling. Emissions increase with temperature and highly volatile solvents.

One source of emissions is scale systems, where solvent and resin raw materials are measured and transferred from storage tanks to the process tanks, between process tanks, or from process tanks to shipment containers. Emissions may occur during transfer and hose connecting and disconnecting. Another type of scale system consists of a floor scale, a drum, a drum dispenser, and a receiving container. Material is pumped out of the drum into the receiving container. Emissions occur during material transfer and free-fall into the receiving container.

In some cases, material is transferred by bucket and dip method. Here, emissions occur while the product is exposed to the air and while it is being scooped and transferred to the second container.

Another emission source is product filtering. As product flows through a filtering device, it is often exposed to the air, resulting in releases of VOCs.

Filling operations also result in VOC emissions. In one plant, portable mix tanks are mechanically lifted and tilted, allowing the finished product to gravity feed into containers for shipment. Some facilities allow product to gravity feed from processing equipment through filters into shipment containers. Emissions result from product free-fall and material splashing.

Equipment Cleaning: In addition to emissions from process operations, VOCs are also released from a variety of cleaning operations. Solvent-based materials are used to clean equipment in which solvent-based products are manufactured, while water-based supplies are used to clean after water-based production. Emissions occur during solvent addition and removal as well as during the cleaning process.

In many facilities, manufacturing equipment is cleaned manually on the production floor on an as-needed basis. In some cases, cleaning is performed after each batch, and in other cases equipment is cleaned after a series of batches. The cleaning frequency depends on the number and size of batches processed, the size of equipment to be cleaned, and the color and type of product manufactured. The standard method of cleaning grinding equipment involves emptying the mill of product and then adding solvent to the vessel to capture remaining product residue. Wash solvent is normally drained from the tank and either disposed off as hazardous waste or recycled. Mix tanks and agitator blades may be cleaned with solvents, brushes, and/or rags.

Roller mills are often cleaned by hand using rags and solvent. Larger facilities may have areas designed specifically for cleaning operations. In these facilities, equipment cleaning may be more automated (*i.e.,* automatic tank washers and spray guns), but emissions still occur during the process.

Equipment cleaning operations account for over 80% of paint industry's waste. Although solvents are not the only waste generated during cleaning processes, their contribution is high.

3.3.3 Solid and hazardous waste

Solid waste

Solid wastes generated from paint industry are as follows:

- Off-specification paint, if not reused

- Retained product samples, is not reused
- Waste generated during effluent treatment
- Waste generated as scrap (cartons, drums, containers, *etc*.)
- Paint skin
- Waste generated from spillage

Small quantities of retained product samples or quality control samples are retained for quality reference. Most off-specification paint is re-worked back into the process. Off-specification paint which cannot be used or reworked back into manufacturing process or cannot be sold as a lesser grade product is usually stored in drums or tanks and sent off-site for disposal. Disposal options include incinerators, cement kilns, fuel blender or burned as a fuel. Other non-disposal options for off-specification paint products include: Sale in a new market; rework into a primer or undercoat; sale to waste exchangers; and donation to volunteer and charity organizations.

Wastewater treatment sludge is generated from the on-site treatment of plant, equipment & tank cleaning washes, and other miscellaneous wash water streams through physical and/or chemical treatment (*e.g.*, sludge generated from the wastewater treatment of floor washings). Due to the size and nature of paint manufacturing facilities, wastewaters typically are not treated on-site. Facilities that treat their wastewaters on-site in tanks or at the on-site wastewater treatment facilities generate a sludge that usually is sent to an off-site landfill for disposal. Facilities also may send their waste off-site for incineration or to a fuel blender. The sludge generated is of two types – chemical and biological. Chemical sludge comes from oil and grease removal in the oil and grease trap, coagulation and setting in primary clarifier. Biological sludge is the organic sludge arising from biological treatment which converts non-settleable organic matter to settleable biomass. Both the types are dewatered readily on sludge drying beds.

Solid wastes generated as scrap material can be classified into metallic and non-metallic. Metallic solids such as drums, containers, tins *etc.,* are sold as scrap. Non-metallic solids such as cartons, plastic bags, cotton waste *etc.,* are also sold.

Another solid waste is in the form of 'paint skin'. Sometimes after proper thinning and mixing, the batch is emptied in mild steel containers before packing. Paint sticking on the sides of containers dries and is removed as paint skin. This cannot be put to any use and is sold along with other solid wastes.

Powders and other raw materials spilt on the floor are often collected dry and disposed off by burial. However, landfilling of dewatered sludge from effluent treatment plant (ETP) or burial of spilt powders can be done only in areas where the ground water table is low. In these areas there are remote chances of pollution of ground water by these solid wastes. In places where the ground water table is high, powders and spilt raw material may be better flushed down the drain with water and treated along with the wastewaters collected from other units. This will increase the load of suspended solids on ETP and its running cost marginally.

In areas where this waste is dumped close to drinking water sources, these wastes may enter the water body by runoff or as leachate. While disposing off solid waste by burial or by filling in low lying areas, due consideration should be given to the depth of groundwater table and nearness of fresh water sources to the site of disposal.

Hazardous waste

Waste that might be hazardous during manufacturing process of paint includes the following:

- unusable liquid paints, stains, or inks
- paint-thinner wastes of all types
- paint spray-booth filters and arrestors
- scrapings from paint booth walls and floors
- paint-stripping waste
- rags containing paint, ink, and/or solvent
- sludge from distilling paint-thinner waste
- blanket and fountain washes and other cleanup materials

3.4 Technological Aspects

3.4.1 Waste minimization technologies

Primary waste streams associated with paint manufacturing are listed in Table 3-1 along with recommended control methods. At the facility, the waste streams are equipment cleaning wastes; spills and off specification paint; leftover inorganic pigment in bags and packages; pigment dust from baghouses; filter cartridges; and obsolete products/customer returns. These waste minimization methods as listed in Table 3-1 can be classified generally as source reduction, which can be achieved through material substitution, process or equipment modification, or better operating practices; or as recycling.

Table 3-1: Waste Minimization Methods for the Paint Manufacturing Industry

Waste Stream	Waste Minimization Methods
Equipment cleaning wastes (rinse water, solvent and sludge)	▪ Use mechanical wipers on mix tanks. ▪ Use high pressure wash systems. ▪ Install Teflon liners on mix tanks. ▪ Use foam/plastic pigs to clean lines. ▪ Reuse equipment cleaning wastes. ▪ Schedule production to minimize need for cleaning. ▪ Clean equipment immediately. ▪ Use countercurrent rinse methods. ▪ Use alternative cleaning agents. ▪ Increase spent rinse settling time. ▪ Use de-emulsifiers on spent rinses.
Spills and off specification paint	▪ Increase use of automation. ▪ Use appropriate clean up methods. ▪ Recycle back into process Implement better operating practices.
Air emissions, including VOCs and pigment dust	▪ Modify bulk storage tanks. ▪ VOC emission minimization as detailed in 3.4.1.2 ▪ Use paste pigments. ▪ Install dedicated baghouse systems.
Filter cartridges	▪ Improve pigment dispersion. ▪ Use bag or metal mesh filters.
Obsolete products/customer returns	▪ Blend into new products.

3.4.1.1 Minimization of wastewater

There is considerable variation in the nature of wastewater normally generated in paint manufacturing industry. Before evolving wastewater treatment scheme, the following aspects should be looked into:

- Segregation of wastewaters based on characteristics and strength
- Reduction of volume and strength of wastewaters by adopting in-plant control measures

Treatability studies for various wastewater streams may be carried out to decide the best combination of treatment system.

Segregation of wastes is, however, recommended to reduce capital costs, improve the treatment efficiency and reduce chemical consumption. Effluents generated from paint industry can be segregated as caustic cleaning effluent, stiff paint effluent, effluent from remaining units and domestic waste

Caustic cleaning effluent is highly alkaline and needs neutralization. Effluents from other units comprise thermopac burner cleanings, resin house waste, *etc.,* which contain oil and has to be separated before mixing with the other effluents. Stiff paint effluent contains easily settleable solids which are settled in the primary clarifier and then wastewater is given further treatment.

Schemes for reducing the generation of wastewater at source (in the plant) should be practiced. This is to reduce the effluent load rather than finding methods to treat it. Unnecessary use of water not only adds to the quantity of effluent and cost of treating it, but also increases the wastage of heat, power and/or product in the effluent.

The cooling water is usually uncontaminated and thus should be collected and reused. It could be used for floor washing or discharged separately into the receiving water bodies, rather than mixing with polluted water and discharging into the treatment plant. Accidental spills and leakages should be reduced to a minimum through proper maintenance of equipment and training of personnel. In case of caustic cleaning, instead of washing away the caustic solution, it can be collected, stored and used for further cleaning. In case of stiff paints, water from first cleaning should be collected and used later as process water for a similar type of batch. Wastewater volume can also be reduced through reuse of rinse water for preparation of alkali solution. The above procedures can reduce the quantity of generation of caustic cleaning water significantly.

The dry powders and raw materials spilt on the floors during filling into the grinders and/or churners as well as while packing the finished products should be removed dry as far as possible and disposed of as dry solid wastes by burial instead of washing them with water. This will significantly reduce the pollution load of the combined wastewater, which in turn will reduce the size of the treatment plant required and its cost. Alternatively, the above material along with their containers may be sold to outside parties as scrap material.

3.4.1.2 Minimization of VOCs

Methods to minimize VOC emissions include process and equipment modifications, improved operating practices, and recycling. It is difficult, however, to determine the overall efficiency or impact of these VOC minimizing methods on individual emission

sources because many paint manufacturing facilities estimate total plant emissions rather than estimating or testing emissions by process or source (*i.e.,* filling operations, grinding operations, cleaning processes).

Equipment or Process Modifications: Two stages which are amenable to equipment and process modifications are paint manufacturing and equipment cleaning.

Tank Lids: Tank lids are the most common equipment modification used during the manufacturing process to control VOC emissions. Mix and blend tanks are a primary source of manufacturing VOC emissions because the solvent-containing materials spend a significant amount of time in this equipment. All open- top equipment may be covered during the manufacturing process to control these emissions.

The cover remains closed, except when production, sampling, maintenance, or inspection procedures require access. The cover is maintained in good condition, such that when in place, it maintains contact with the rim of the opening for at least 90 % of the circumference of the rim.

Many of the lids currently used in industry are flat and some are conical. Flat lids control emissions relatively well, but they do have some inherent flaws. The lids do not form a seal with the mix tank and the hinged door product adds chute does not always remain closed. Conical lids, a better engineering design, are considered as more efficient means of controlling emissions. However, they too have associated difficulties caused by added weight and bulky shape. The conical lids are more difficult to handle and damage more easily than the flat lids.

Lids may be constructed of plastic, wood, aluminum, or stainless steel. Plastic and wooden lids are normally one piece except for the center agitator shaft opening, while aluminum and stainless steel lids normally have hinged openings for product additions and sampling. Some facilities currently using aluminum lids question their safety. A study conducted in Germany indicates that having steel (*e.g.*, carbon steel mix tank) scraping against aluminum containing silicon (*e.g.*, mix tank cover) could be a potential source of sparks. A fire may break out if the sparks contact possible flammable vapors from solvent-containing paints.

The control efficiency of covers on mix tanks ranges from 40 to 96 % depending on the method used to determine emissions. These values represent the ratio of emission reduction to uncontrolled emissions. They do not account for any subsequent venting to control devices. The value of 96 % arose from studies conducted with mix tanks in the polymeric coating industry. In this case, the demonstrator considered only evaporative losses during the mixing process. This method of emission determination fails to include the working losses that occur during filling and emptying a vessel containing a solvent-saturated air space.

Modified Milling Equipment: In some cases paint manufacturers could reduce total VOC emissions by converting some of their older milling equipment to newer, more efficient closed-systems such as horizontal media mills. Although a wide range of products can be processed in the horizontal mills, some cannot be done. The mill base must be of a low viscosity to allow the grinding media to move with maximum velocity. The low viscosity requirement prevents some materials currently made in other types of milling equipment from being manufactured in horizontal mills. The viscosity of a product, along with other characteristics such as color, gloss, type of raw materials, and processing time, often determines the appropriate type of milling equipment.

Equipment Cleaning: Equipment cleaning generates a high percentage of waste associated with paint manufacturing. Because much of this cleaning is performed with solvents, equipment cleaning is also a major source of VOC emissions. Any methods that reduce the need or frequency of tank cleaning will also reduce emissions. Several process and equipment modifications follow.

Rubber wipers: Facilities can use rubber wipers to scrape the sides of the tank to reduce the amount of clinging paint, therefore reducing the amount of solvent needed to clean the tank. Wipers can be either manual or automatic,

High-pressure spray heads: High pressure spray heads can be used to clean process tanks. These heads can reduce cleaning material use by 80 to 90 %,

Teflon-lined tanks: Teflon lined tanks will reduce the amount of paint clinging to the side of the tank and will make cleaning easier,

Plastic pigs: Plastic or foam 'pigs' may be used to clean paint from process pipes. The 'pig' moves through the pipes and pushes ahead paint from a previous batch which has been left clinging to the pipe walls. This process reduces solvent needed to clean the pipes and increases product yield,

Automatic tub washers: Some facilities have successfully used automatic tub washers to clean process tanks. These washers form a seal with the tank, pull a vacuum, and circulate cleaning solvent on a timed schedule.

Another method to reduce emissions from solvent cleaning operations is to use larger media in milling equipment. Larger media rinses more easily than small media, and therefore requires less cleaning solvent. Glass and ceramic media and sand are also easier to clean than steel shot.

3.4.2 Better operating practices

Better operating practices are procedural or institutional policies that result in a reduction of waste. They include:

- Waste stream segregation
- Personnel practices - management initiatives, employee training, employee incentives
- Procedural measures - documentation, material handling and storage, material tracking and inventory control, scheduling
- Loss prevention practices - spill prevention, preventive maintenance, emergency preparedness
- Accounting practices - apportion waste management costs to departments that generate the waste

Better operating practices may be applied to all waste streams. In addition, specific better operating practices that apply to certain waste streams are discussed in the following sections.

(i) Equipment cleaning waste

Equipment cleaning generates most of the waste associated with paint manufacturing. Following production of either solvent or water-based paints, considerable waste or clingage remains affixed to the sides of the preparation tanks. The three methods of tank cleaning used in paint industry are (i) solvent washing for solvent-based paint, (ii) caustic washing for either, solvent or water-based paint and (iii) water washing for water-based paint. Equipment used for preparation of solvent-based paint is rinsed with solvent, which is then generally reused in the following ways:

- Collected and used in the next compatible batch of paint as part of the formulation
- Collected and redistilled either on-site or off-site
- Collected and used with or without settling for equipment cleaning, until spent. When the solvent is finally spent, it is then drummed for disposal

On-site distillation of solvent can be economical considering the disposal costs. The solvent can be recycled, recovered and the left portion can be disposed off as sludge.

Caustic rinse is used for equipment cleaning of both solvent and water-based paints, but more often with water-based paints. Water rinsing is usually insufficient in removing paint that has dried in the mix tanks. Since solvent rinsing can usually remove solvent-based paint that has dried, the need for caustic is less. There are two major types of caustic systems commonly used by the paint industry. In one type of system, caustic is maintained in a holding tank (usually heated) and is pumped into the tank to be cleaned. The caustic drains to a floor drain or sump from which it is returned to the holding tank. In the second type of system, a caustic solution is prepared in the tank to be cleaned, and the tank is soaked until it is clean. Most plants reuse the caustic solution until it loses most of its cleaning ability. At that time, the caustic is disposed off either as a solid waste or wastewater with or without neutralization.

Water wash of equipment used in the production of water-based paint is the source of considerable wastewater volume, which is usually handled as follows:

- Collected and used in the next compatible batch of paint as part of formulation
- Collected and used with or without treatment for cleaning until spent
- Disposed with or without treatment as wastewater or as a solid waste in drums

Sludge from settling tanks are drummed and disposed off as solid waste. Spent recycle rinse water is drummed and disposed off as solid waste after the soluble content prohibits further use. The percentage of solvent-base and water-base paints produced is the most important factor that affects volume of process wastewater generated and discharged at paint plants. Due to their greater use of water-wash, plants producing 90% or more water-base paint discharge more wastewater than plants producing 90% or more solvent-base paint. Additional factors influencing the amount of wastewater produced include the pressure of rinse water, spray head design, and the existence or absence of floor drains. Where no troughs or floor drains exist, equipment is often cleaned externally by hand with rags; when wastewater drains are present, there is a greater tendency to use hoses. Several plants have closed their floor drains to force the use of dry clean-up methods and discourage excessive water use.

Waste associated with equipment cleaning represents the largest source of waste in a paint facility. Methods that reduce the need or frequency of tank cleaning or allow for reuse of

the cleaning solutions are most effective. Some of the waste minimization methods include the following:

- use of mechanical devices such as rubber wipers – reduces the amount of paint left clinging to the walls of the tank
- use of high pressure spray heads and limiting wash/rinse time – reduces water use by 80 to 90 % and also removes dried-on paint so that the need for caustic is reduced.
- use of teflon lined tanks to reduce adhesion and improve drainage – applicable only to small batch tanks amenable to manual cleaning
- use of a plastic or foam "pig" to clean paint from pipes – increases yield and reduces the subsequent degree of pipe cleaning required
- alternative cleaning agent - substituting a proprietary alkaline cleaning solution for the caustic solution, cut the solution replacement frequency in half and thereby reducing the volume of cleaning solution requiring disposal
- a countercurrent rinsing sequence - this technique uses recycled dirty solution to initially clean the tank and then the recycled clean solution is used to rinse the dirty solution from the tank. Since the level of contamination builds up more slowly in the recycled "clean" solution than with a simple reuse system, solution life is greatly increased
- sludge dewatering by filtration or centrifugation – reduces sludge disposal volumes
- provision for adequate solid settling time in spent rinse solution
- use of de-emulsifiers in rinse water to promote emulsion breakdown and organic phase separation

(ii) Recovery of paint and wastewater

Most off-specification (off-spec) paint is produced by small shops that deal in specialty paints. Since these paints cost more to produce, and therefore sell at a premium price, most off-spec paint is reworked into a salable product. Since elimination of off-spec paint production has built-in economic incentives, the following techniques are widely used:

- Unless the sludge from wet cleanup can be recycled into a marketable product, the use of dry cleanup methods should be maximized wherever possible.
- By closing floor drains and discouraging employees from routinely (*i.e.* needlessly) washing down areas, some facilities have been able to achieve a large decrease in wastewater volume.
- By employing volume-limiting hose nozzles, using recycled water for cleanups, and actively involved supervision.

(iii) Bags and packages

Inorganic pigments, which may contain heavy metals and therefore be classified as hazardous, are usually shipped in separate bags. After emptying the bag, an ounce or two of pigment usually remains inside. Empty containers of liquid raw materials that constitute hazardous waste (*e.g.* solvents and resins) are typically cleaned or recycled to the original raw material manufacturer or to a local drum recycler. The following are some of the waste reduction techniques for bags and packages:

- When empty, the bags could be dissolved or mixed in with the paint. Such a method is commonly used for handling mercury compounds and other paint fungicides. This method could not be used, however, when producing high quality, smooth finish paint since the presence of this material could affect the paint's film forming property or could increase the load on the filters which would increase filter waste
- Use of rinseable/recyclable drums with plastic liners instead of paper bags
- Segregation of hazardous and non-hazardous waste
- Hazardous materials may be collected in plastic bags and stored in a special container to wait collection

(iv) Air emissions

As mentioned in the previous sections, the two major types of air emissions that occur in the paint manufacturing process are volatile organic compounds and pigment dusts. Volatile organics may be emitted from the bulk storage of resins and solvents and their use in open processing equipment such as mix tanks. Since most existing equipment is of open design, reducing or controlling organic emissions from process equipment could require substantial expenditures in retrofit costs. Following are some of the measures for bulk storage and pigment handling.

- Use of pigments in paste form instead of dry powders – pigments in waste form are supplied in drums, which can be recycled and no dust would be generated when opened
- Dedicated baghouse system for pigment loading area – all the collected pesticide dust could be recycled

VOCs

In addition to process and equipment modifications, VOC emissions may be reduced by following good operating procedures. Some of the following are good housekeeping procedures for reducing VOC emissions:

- All open-ended paint manufacturing vessels shall be securely covered during periods of operation, except when adding raw materials.
- During transfer of material to different containers, steps shall be taken to reduce and prevent splashes and spills. Any liquid or dry material spilled shall be cleaned as expeditiously as possible, but not later than the end of daily work shift.
- Waste solvent shall be collected and stored in closed containers. The closed containers may contain a device that would allow pressure relief, but would not allow liquid solvent to drain from the container prior to disposal.
- The permitted facility shall provide a permanent sign or signs for the paint manufacturing equipment which states the required work and operating practices.
- The sign or signs shall be placed in a prominent location and be kept visible and legible at all times.

Another good operating procedure which can reduce emissions is dedicating process lines and equipment. Equipment dedication eliminates cleaning between each product batch.

Scheduling compatible batches or batches from light to dark colors also reduces the need for equipment cleaning. Production scheduling and dedicating equipment may be

impossible, however, in small paint facilities that operate on a batch schedule in order to meet customer demands. In some cases, facilities operate on a same-day shipment schedule.

(v) Spills

Spills are due to accidental or inadvertent discharges usually occurring during transfer operations or equipment failures (leaks). Spilled paint and the resulting clean up wastes are usually discharged to the wastewater treatment system or are directly drummed for disposal. If the plant has floor drains, large quantities of water may be used to clean up water-based paint spills. Dry cleaning methods are employed for cleaning of solvent-containing spills or for water-based spills where floor drains are not available. Some of the better operating practices may include:

- Dry cleanup methods can be maximized wherever possible until sludge from wet cleanup is recycled.
- Employing volume-limiting hose nozzles, using recycled water for cleanups, and actively involved supervision.

(vi) Filter cartridges

These are produced during the paint loading operation. These are designed to remove undispersed pigment from the paint during loading and are saturated with paint when removed. Hence, waste minimization and economy both call for as small a cartridge as possible so as to reduce the amount of paint lost and the capital spent for the filters. If frequent filter plugging is a problem, then it should be first addressed from the standpoint of improving pigment dispersion, and not from the standpoint of increasing filter area.

Viable alternatives to cartridge filters include bag filters and metal mesh filters. Metal mesh filters are available in very fine micron sizes and they can be cleaned and reused. Since it is very important to minimize all wastes, the issue of mesh filter cleaning waste reuse or recycling would need to be addressed before switching to these filters.

(vii) Obsolete products

Obsolete products and customer returns can be blended into new batches of paint. Obsolete products result from changes in customer demand, new superior products, and expired shelf life. Marketing policies, such as discounting older paints, can reduce the amount of obsolete products requiring disposal.

(viii) Recovery of Wastes

A large number of solvents are used in paint manufacturing and a majority of them are recovered and therefore not lost in the wastewater streams. In case of oil paints, solvents are added in grinders which are closed units; therefore, loss of solvents through evaporation is considerably reduced. High temperature is maintained in resin and varnish manufacture, resulting in evaporation of solvents added. These solvent vapours, along with the water vapours generated through chemical reactions are condensed and collected in a separator. The solvent layer is removed and reused in the next batch.

3.4.3 Pollution control technologies

3.4.3.1 Wastewater treatment

Combined effluent from paint industries can be satisfactorily treated using the usual physico-chemical and/or biological treatment methods. The treatment consists of coagulant addition and adjustment of pH to an optimum level for maximum precipitation. The precipitated material is removed by gravity separation, either on batch basis or in a continuous flow tank. It is understood that if wastewater contains a high settleable solids and the wastewater quantity is low, primary treatment followed by treatment in oxidation pond may result in reasonably high BDO removal but for a higher quantity of wastewater primary treatment should be followed by secondary treatment. On the other hand, removal of COD always demands tertiary treatment. The wastewater treatment removes oil and grease, suspended solids and toxic substances.

a) Primary treatment

i) Oil and grease removal - Effluents from all units except stiff paint section and caustic cleaning waste are passed through an oil and grease removal device.

ii) Equalization-cum-neutralization - Effluent from caustic cleaning operation is highly alkaline in nature and requires neutralization prior to further treatment. An equalization-cum-neutralization tank is provided with an agitator. Effluent from stiff paint is mixed with the neutralized wastewater, dosed with a coagulant and sent to flash mixer. The effluent is then subjected to clariflocculation.

iii) Clariflocculation - The effluent is clarified in clariflocculator and subjected to biological treatment. Sludge generated in this unit is carried to the sludge drying beds for dewatering.

b) Secondary Treatment

i) Extended aeration-Domestic wastewater from the factory premises is mixed with the supernatant from clariflocculator and is biologically treated by extended aeration process.

ii) Secondary clarification-Mixed liquor from the aeration tank overflows to the - secondary clarifier. The settled sludge is recycled continuously through return sludge pumps to the aeration tank and excess sludge is discharged to sludge drying beds. Effluent from the secondary clarifier is fit for discharge to the environment.

iii) Sludge drying-Sludge from oil and grease trap, clariflocculator and secondary clarifier is dewatered on sludge drying beds. Filtrate from these beds is returned to equalization-cum-neutralization tank

The above treatment process is expected to achieve 90 to 95% efficiency in removing pollutants and thus acceptable to the recipient environment.

3.4.3.2 Recycling techniques

One common recycling technique among paint manufacturers is using spent cleaning solvent in subsequent compatible batches. After a mill or tank has been emptied of

product, solvent is added to the vessel to capture remaining product residue. The wash solvent is drained from the tank, staged, and recycled into the next compatible product batch. Mills may be cleaned by replacing the residual heel of the exiting product with an equivalent amount of solvent which is compatible with both the preceding and the ensuing batches.

Another recycling technique which reduces total solvent consumption and VOC emissions is using countercurrent rinsing sequences. This method uses recycled "dirty" solvent to initially clean the tank. Following this step, "clean" recycled or virgin solvent is used to rinse away the "dirty" solvent.

3.4.3.3 Equipment cleaning operations

Cleanup should be conducted using methods and materials that minimize emissions of VOCs (excluding low volatility compounds) and HAPs. These methods should employ high-pressure water, hot alkali or detergent cleaning. Solvent containing VOCs (excluding low volatility compounds) can be used for equipment cleaning provided that the equipment being cleaned is completely covered or enclosed except for an opening no larger than necessary to allow safe clearance for proper operation of the cleaning equipment, considering the method and material being used. In addition, any cleanup solvent containing VOCs or HAPs, both used and unused, should be collected and stored in closed containers.

Mills

1) Grinding Mills: Grinding mills must be operated in accordance with their manufacturer's specifications. All grinding mills, excluding three roll mills, must be equipped with fully enclosed screens.

2) Three Roll Mills: Three roll mills must be operated in accordance with their manufacturer's specifications.

3) Equipment Cleaning Operations: Cleanup of grinding mills and related equipment should be conducted using methods and materials that minimize emissions of VOCs, excluding low volatility compounds, and HAPs. These methods should employ high pressure water, hot alkali or detergent cleaning. VOC-containing solvents, excluding low volatility compounds, can also be utilized for equipment cleaning provided that the equipment being cleaned is completely covered or enclosed except for an opening no larger than necessary to allow safe clearance for proper operation of the cleaning equipment, considering the method and material being used. In addition, any cleanup solvent containing VOCs or HAPs, including spent solvent, should be collected and stored in closed containers.

3.5 Safety and Occupational Health Concerns

3.5.1 Specific hazards

Hazards in the paint industry may occur when exposed to solvent vapours, pigments, additives, flammable substances, isocyanates and entry into confined spaces.

Exposure to solvent vapours: The major toxic hazard is the inhalation of solvent vapours, but absorption through the skin can also occur. Solvents can remove natural protective oils from the skin, leading to dermatitis.

Exposure to pigments and additives: Finely powdered pigments can be ingested from contaminated hands on food, or inhaled into the lungs. Although the toxicities of many organic-based pigments are unknown, they are assumed to be toxic. Lead based pigments, and cadmium compounds are well known to present toxic hazards. Additives such as aryl mercury compounds and driers present particular problems of toxicity.

Flammable substances: Flammable liquids and solids—*e.g.* cobalt naphthenate—are easily ignited by an external source of ignition, as are flammable vapours given off by liquid paints and solvents.

Isocyanates: Polyurethane paints contain isocyanates as a constituent. Their vapours are powerful respiratory and skin irritants and sensitizers.

Confined spaces: Entry into vessels can expose workers to potentially lethal concentrations of contaminant if appropriate precautions are not taken.

Machinery hazards: High-speed dispersers, ball mills and three roll mills are used in the industry, together with other plant which can be hazardous if not adequately guarded.

3.5.2 Ventilation of working areas

General ventilation and specific local exhaust ventilation around process vessel must be capable of ensuring that airborne concentrations of contaminants are maintained at a level lower than the Workplace Exposure Standard (WES) for the particular contaminant (or mixture of contaminants). The type of ventilation system used for a particular workplace will depend up on the nature and source of contaminants. General dilution ventilation is the best option for low concentrations of contaminants derived from a number of sources. Where specific process vessels are the prime source of contaminants, local exhaust or extraction ventilation will provide the best method control. Effective exhaust ventilation to maintain airborne concentrations of contaminant below the workplace exposure standards must be provided wherever practicable. The removal of dust at points where bags are opened and powdered raw materials are added to processing vessels are examples of operations where local extraction systems are appropriate.

3.5.3 Prevention of fires and explosions

Many of the organic solvents used in paint manufacture are flammable. Other flammable materials used in the industry include cobalt napthenate, cellulose nitrate (used in the manufacture of nitrocellulose lacquers and some inks) and organic peroxides (a class of strong oxidizing agents which burn vigorously when ignited. The primary control measure must be the elimination of all possible sources of ignition in areas where flammable substances are handled and/or stored.

Where ventilation is provided to reduce airborne concentrations of contaminants to below the WES, this will ensure that the concentration is also below the lower flammable limit. This is because flammable limits are generally much higher than WES.

Static electricity as an ignition source can be controlled by earthing tanks and pipe work used for flammable liquids. The removal of raw materials from plastic containers must be undertaken outside areas where flammable liquids are being used.

3.5.4 Personal protective equipment

As already outlined, work processes should be designed so as to minimize the necessity for workers to wear personal protective equipment, but where "one-off" jobs are undertaken or emergency situations are encountered, *e.g.* spillages, airborne concentrations of vapours may exceed the WES and appropriate respiratory equipment must be worn.

Eye and face protection must be worn where there is a risk of injury from flying particles or chemical splashes. Protective clothing is essential for workers handling solvents in any quantity. Gloves and aprons of PVC or neoprene are resistant to most types of solvents. Solvent-resistant footwear may also be advisable, particularly where solvents are handled in bulk.

3.5.5 Lead in paint industry

In children the lead can cause damage to the brain and nervous system, Behavior and learning problems (such as hyperactivity), Slowed growth, Hearing problems, Headaches etc. Adults can suffer from: Difficulties during pregnancy, other reproductive problems (in both men and women), High blood pressure, Digestive problems, Nerve disorders, Memory and concentration problems, Muscle and joint pain *etc*.

The major sources of added lead in paint are

- Driers (as an oxidative drying agent)
- Additives and catalyst in paint intermediates and polymers / alkyds
- Pigments: lead based white and colored pigments.

Apart from these, the raw materials like solvents, pigments and extenders, resins and some of the additives may contain trace impurities of lead along with, which gets indirectly added into paint, if used.

The alternate technologies are in place for lead free paint compositions. The lead based driers are being replaced by the alternates like zirconium based driers. Also the additives and catalysts based on lead are being replaced by the alternate metals like lithium, calcium or certain proprietary raw materials. As the major source of lead in paint is from pigments, the efforts are on by all major pigment manufacturers to offer the alternates to lead based pigments. Mostly red, yellow and orange are the shades which contain some amount of lead, for which the alternate pigments are now being available / developed. The current challenges are related to get the same product performance without disturbing much the final cost, as the cost of these alternates is bit higher than the conventional lead based pigments. Since now many pigment manufacturers are coming up with the better and better alternates, it will be feasible to replace the lead to the desired level considering the hazards.

In India, specification of the Eco mark is available but this being voluntary programme, not effectively adopted. However, some of the paint specifications are revised by BIS using the ecomark specification which is: IS 164, IS 427 & 428, IS 5410, and IS 5411

(part 1 and 2) for road marking paint, distempers, interior and exterior emulsion paints and powder coatings respectively. The process is on for incorporating the same for the other solvent based and water based paints.

For lead in paint related regulations, may please refer **Annexure I**.

3.6 Summary of Applicable National Regulations

3.6.1 General description of major statutes

A compilation of legal instruments, which are applicable to the proposed integrated paint industry, is annexed as **Annexure II**.

3.6.2 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 III.**

3.6.3 Industry-specific requirements

Wastewater discharge standard for paint industry is given in the following Table.3-2

Table 3-2: Wastewater Discharge Standards for Paint Industry

Parameters	Concentration not to exceed units in mg/l, except pH
pH	6.0 to 8.5
Suspended solids	100
BOD at 27^{o}C for 3 days	50
Phenolics as C_6H_5OH	1.0
Oil and Grease	10.0
Bioassay test	90% survival in 96 hrs. in 100% effluent
Lead as Pb	0.1
Chromium as Cr Hexavalent Total	 0.1 2.0
Copper as Cu	2.0
Nickel as Ni	2.0
Zinc as Zn	5.0
Total heavy metals	7.0

Source: http://www.cpcb.nic.in/Industry-Specific-Standards/Effluent/PaintIndustry.pdf

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 fall 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 the Industry under the Purview of Notification

All new integrated paint industrial projects including expansion and modernization require prior environmental clearance. Based on pollution potential, all these projects are classified into Category B.

For the purpose of this notification, an integrated paint industry is defined as an industry which is involved in not only formulation (physical mixing of ingredients) of paints, but also involved in manufacturing of ingredients such as resins, lacquers, varnishes, *etc*.

Besides there are general conditions, when it applies, a Category B project will be treated as Category A project. These 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 proposed integrated paint industry are discussed in subsequent sections.

In case of Expansion or Modernization of the developmental Activity:

- Any developmental activity, which has an EIA clearance (existing plant), when undergoes expansion or modernization (change in process or technology) with increase in production capacity or any change in product mix beyond the list of products cleared in the issued clearance is required to submit new application for EIA clearance.
- Any developmental activity, which is listed in Schedule of the EIA Notification and due to expansion of its total capacity, if falls under the purview of either Category B or Category A, then such developmental activity requires clearance from respective Authorities.

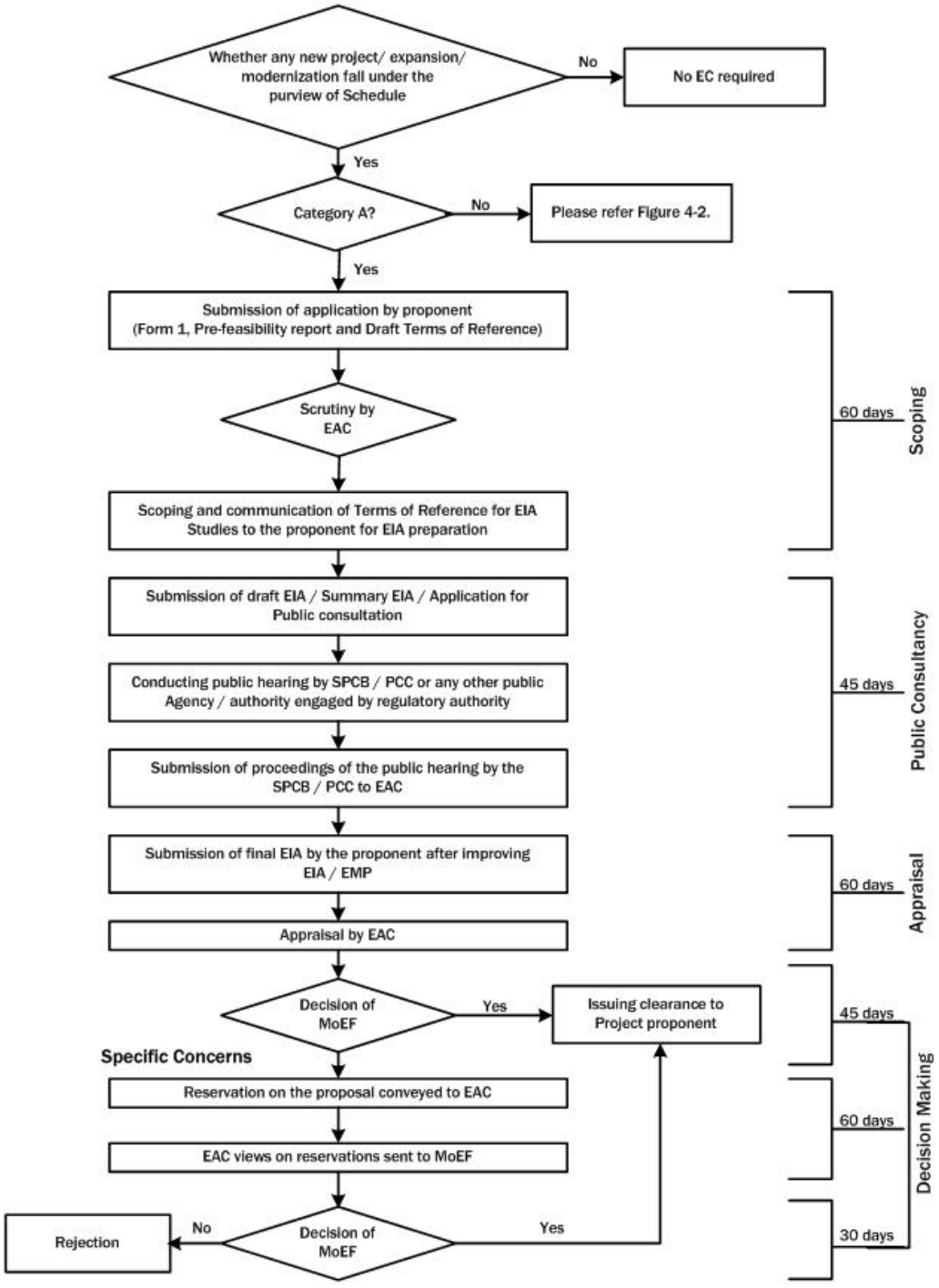

Figure 4-1: Prior Environmental Clearance Process for Activities Falling Under Category A

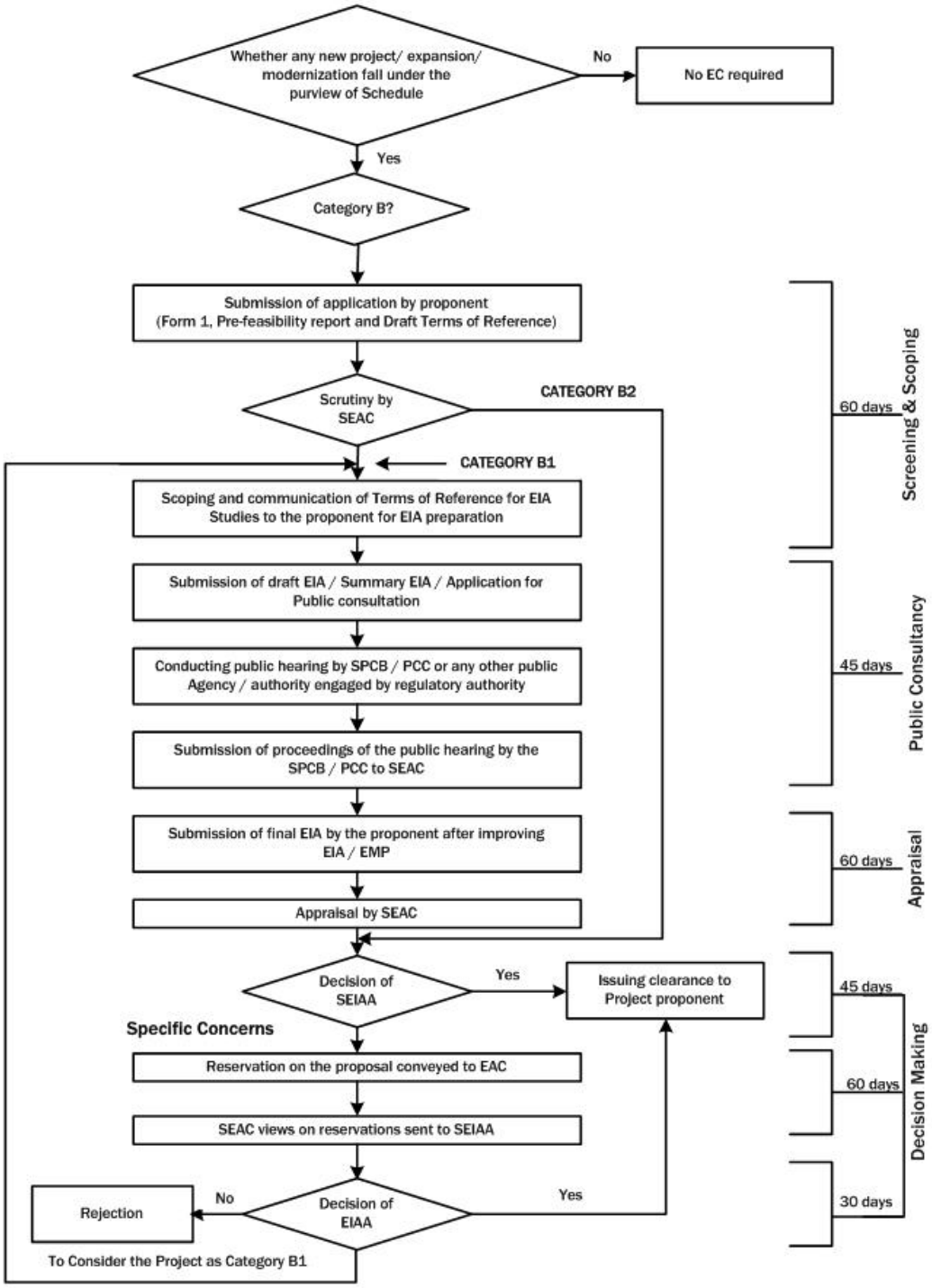

Figure 4-2: Prior Environmental Clearance Process for Activities Falling Under Category B

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 for classification of Category B1 and Category B2.

4.2.1 Applicable conditions for Category B projects

Generic condition:

- Any integrated paint project (usually falling 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 as 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 in case the activity does not fall within 10 km of the areas mentioned above.
- 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 prior 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 in Category B. SEAC shall meet at least once every month
- If any Category B integrated paint project/activity, after proposed expansion of capacity/production or fuel change, falls under the purview of Category A in terms of production capacity, 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 prior 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 prior 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.

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 III**. 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 draft 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.

Areas preferably be avoided

While siting industries, care should be taken to minimize the adverse impact of the industries on immediate neighborhood as well as distant places. Some of the natural life sustaining systems and some specific landuses are sensitive to industrial impacts because of the nature and extent of fragility. With a view to protect such sites, the industries may maintain the following distances, as far as possible, from the specific areas listed:

- Ecologically and/or otherwise sensitive areas: Preferably 5 km; depending on the geo-climatic conditions the requisite distance may be decided appropriately by the agency.
- Coastal areas: Preferably ½ km away from high tide level (HTL).
- Flood plain of the riverine system: Preferably ½ km away from flood plain or modified flood plain affected by dam in the upstream or flood control systems.
- Transport/Communication System: Preferably ½ km. away from highway and railway line.

- Major settlements (3,00,000 population): Distance from major settlements is difficult to maintain because of urban sprawl. At the time of siting of the industry, if the notified limit of any major settlement is found to be within 50 km from the project boundary, the spatial direction of growth of the settlement for at least a decade must be assessed. Subsequently, the industry may be sited at least 25 km from the projected growth boundary of the settlement.
- Critically polluted areas identified by MoEF, from time to time. Current list of critically polluted areas is given in **Annexure IV**

Note:

Ecological and/or otherwise sensitive areas include (i) Religious and Historic Places; (ii) Archaeological Monuments (e.g. identified zone around Taj Mahal); (iii) Scenic Areas; (iv) Hill Resorts; (v) Beach Resorts; (vi) Health Resorts; (vii) Coastal Areas rich in Corals, Mangroves, Breeding Grounds of Specific Species; (viii) Estuaries rich in Mangroves, Breeding grounds of Specific Species; (ix) Gulf Areas; (x) Biosphere Reserves; (xi) National Parks and Sanctuaries; (xii) Natural lakes, Swamps; (xiii) Seismic Zones; (xiv) Tribal Settlements; (xv) Areas of Scientific and Geological Interest; (xvi) Defence Installations, specially those of security importance and sensitive to pollution; (xvii) Border Areas (International) and (xviii) Air Ports.

Pre-requisite: State and Central Governments are required to identify such areas on a priority basis.

General siting factors

In any particular selected site, the following factors must also be recognized.

- No forest land shall be converted into non-forest activity for the sustenance of the industry (Ref: Forest Conversation Act, 1980)
- No prime agricultural land shall be converted into industrial site
- Land acquired shall be sufficiently large to provide space for appropriate green cover including green belt, around the battery limit of the industry
- Lay out of the industry that may come up in the area must conform to the landscape of the area without affecting the scenic features of that place
- Associated township of the industry may be created at a space having physiographic barrier between the industry and the township

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 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 preparation of an EIA Report for a particular project.

- Project proponent shall submit application to concerned Authority. The application (Form 1 as given in Annexure III) 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 summarizes the project details and also the likely environmental concerns based on secondary information, which will be availed for filling Form 1.
- From pre-feasibility report and 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 become 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 VII**) and impact prediction tools (refer **Annexure IX**) 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 project proponent before EAC/SEAC at any stage will not be a ground for rejection of the application for the prior environmental clearance.
- If a new or expansion project is proposed in a problem area as identified by the CPCB, then the Ministry may invite a 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 is not conveyed to the proponent within sixty days of the receipt of Form 1, the ToR suggested by the proponent shall be deemed as the final and will be 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/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 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, raw material (binders, solvents, pigments, extenders, additives, *etc*), technology options and its availability. 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 paint industry 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, light, heat, radiation, *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 resouces
  - 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 V**.

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. Project proponent will need information 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 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 consider 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, but 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 Table 4-1:

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 ▪ Useful in identifying secondary impacts ▪ Useful for establishing impact hypothesis and other structured science based approaches to EIA	▪ Link action to impact ▪ Useful in simplified form for checking for second order impacts ▪ Handles direct and indirect impacts	▪ Can become very complex if used beyond simplified version
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

	Description	Advantages	Disadvantages
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
Expert System	▪ Assist diagnosis, problem solving and decision making ▪ Needs inputs from user by answering systematically developed questions to identify impacts and determine their mitigability and significance ▪ Information intensive, high investment methods of analysis	▪ Excellent for impact identification and analysis ▪ Good for experimenting	▪ 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 each project-specific, Table 4-2 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 from case to case, 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						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
ENVIRONMENT	Component	Project Activities / Parameter/ factor	Detailed Topographic Survey	Land Acquirement	Site Clearing	Burning of wastes, 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 wastes	Generation of sewerage	Influx of construction workers	Deforestation	Transportation of material	Raw material handling and storage	Manufacturing process – premixing, grinding, milling, finishing, packaging, *etc.*	Process operations – cleaning of tanks, containers, equipments, *etc.*	Product handling and storage	Waste management -	Emission (VOCs) Management	
Physical	**Soil**	Erosion Risks											*								
		Contamination						*		*											
		Soil Quality						*													
	Resources	Fuels/ Electricity												*	*	*					
		Raw materials						*							*	*					
		Land especially undeveloped or agricultural land								*											
	Water	Interpretation or Alteration of River Beds					*														
		Alteration of Hydraulic Regime											*								
		Alteration of surface run-off and interflow					*	*													
		Alteration of aquifers					*	*													
		Water quality						*			*										
		Temperature																			
	Air	Air quality				*		*	*					*		*					

			PHASE I					PHASE II							PHASE III						
			Pre Construction					Construction/ Establishment							Operation and Maintenance						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
		Noise						*	*					*		*					
		Climate				*							*								
Biological	**Terrestrial Flora**	Effect on grass & flowers			*		*			*			*								
		Effect on trees & shrubs			*		*						*								
		Effect on farmland			*		*			*											
		Endangered species			*		*						*								
	Aquatic Biota	Habitat removal			*		*														
		Contamination of habitats			*		*														
		Reduction of aquatic biota			*		*														
	Terrestrial Fauna	Fragmentation of terrestrial habitats			*		*						*								
		Disturbance of habitats by noise or vibration			*		*														
		Reduction of Biodiversity			*		*						*								
Social	**Economy**	Creation of new economic activities	*									*									
		Commercial value of properties										*									
		Conflict due to negotiation and/ compensation payments																			
		Generation of temporary and permanent jobs										*									
		Effect on crops			*			*			*										
		Reduction of farmland productivity		*																	
		Income for the state and private sector																			
		Savings for consumers & private consumers																			

			PHASE I					PHASE II							PHASE III						
			Pre Construction					Construction/ Establishment							Operation and Maintenance						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
		Savings in foreign currency for the state																			
	Education	Training in new technologies	*																		
		Training in 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 Safety	Increase in Crime								*											
		Accidents caused by							*							*					
	Health					*															
	Cultural	Land use			*		*														
		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 local 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 a "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

ToR for EIA studies in respect of the integrated paint industry 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 unit size
3. Land requirement for the project including its break up for various purposes and its availability and optimization
4. Details of proposed layout clearly demarcating various facilities of the plant
5. Complete process flow diagram describing each unit, its processes and operations (mixing, grinding, milling, finishing, *etc*.), along with material balance
6. Details of proposed source-specific pollution control schemes and equipments to meet the national standards

7. Details on requirement of raw materials (binders, solvents, pigments, additives, water, *etc*.), its source and storage at the plant.
8. Details on lead balance and compliance management protocol.
9. Details on resin manufacturing process, by-products, unit processes, unit operations water pollutants, air pollutants and solid/hazardous waste.
10. Details on solvent management including loss accounting.
11. Details on specific design features such as occupational health and safety, fire and accidents, risk and emergency management protocols, *etc*.
12. Details on requirement of water along with its source and authorization from the concerned department
13. Details on water balance including quantity of effluent generated, recycled & reused. Efforts to minimize effluent discharge and to maintain quality of receiving water body
14. Details of effluent treatment plant, inlet and treated water quality with specific efficiency of each treatment unit in reduction in respect of all concerned/regulated environmental parameters
15. Details of the proposed methods of water conservation and recharging
16. Details on composition, generation and utilization of waste from the plant – left out raw materials, paint sludge, filter cartridges, off-specification paint, *etc*
17. Management plan for solid/hazardous waste generation, storage, utilization and disposal
18. Details regarding infrastructure facilities such as sanitation, fuel storage, restroom, *etc*. to the workers during construction and operation phase
19. In case of expansion of existing industries, remediation measures adopted to restore the environmental quality if the groundwater, soil, crop, air, *etc.,* are affected and a detailed compliance to the prior environmental clearance/consent conditions.
20. Any litigation pending against the project and /or any direction /order passed by any Court of Law related to the environmental pollution and impacts in the last two years, if so, details thereof.

Description of the environment

21. The study area shall be up to a distance of 3 km from the boundary of the proposed project site.
22. Location of the project site and nearest habitats with distances from the project site to be demarcated on a toposheet (1: 50000 scale).
23. Land use based on satellite imagery including location specific sensitivities such as national parks / wildlife sanctuary, villages, industries, *etc*. for the study area.
24. Demography details of all the villages/habitats.
25. Topography details of the project area.
26. The 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-economic (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

27. Geological features and geo-hydrological status of the study area
28. Details on groundwater and surface water quality of nearby water sources and other surface drains for the parameters such as pH*, Suspended solids*, BOD*, Phenolics* as C_6H_5OH, Oil and Grease*, Bioassay test*, Lead*, Chromium*, Copper*, Nickel*, Zinc *, Total heavy metals*, *etc*. (* - As applicable)
29. Existing ambient air quality for expected emissions (VOCs, pigment dust, *etc*.) from paint industry
30. The air quality contours may be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any and wind roses
31. Details on noise levels at sensitive/commercial receptors
32. Site-specific micro-meteorological data including mixing height
33. One season site-specific data excluding monsoon season
34. Proposed baseline monitoring network for the consideration and approval of the Competent Authority
35. Ecological status (terrestrial and aquatic) of the study area such as habitat type and quality, species, diversity, rarity, fragmentation, ecological linkage, age, abundance, *etc*
36. If any incompatible landuse 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*.
37. If ecologically sensitive attributes fall within the study area, proponent shall describe the sensitivity (distance, area and significance) and propose 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 area locally applicable

- Any other eco-sensitive areas

38. If the location falls in Valley, specific issues connected to the natural resources management shall be studied and presented.
39. 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.
    - Proposed site for disposal of dredged material and environmental quality at the point of disposal/impact areas.
    - Fisheries study should be done w.r.t. Benthos and Marine organic material and coastal fisheries.

Anticipated environmental impacts and mitigation measures

40. Anticipated generic environmental impacts due to this project 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).
41. 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.
42. While identifying the likely impacts, also include the following for analysis of significance and required mitigation measures:
    - impacts due to transportation of raw materials and end products on the surrounding environment
    - impacts during material handling – obsolete materials, evaporation losses, tank drainage, spills and leaks, *etc*.
    - impact during process operations – cleaning of tanks, containers, mixers, equipments, *etc*.
    - impacts on surface water, soil and groundwater
    - impacts due to air pollution (VOCs, pigment dust, *etc*.)
    - impacts due to odour pollution
    - impacts due to noise
    - impacts due to fugitive emissions
    - impact on health of workers due to proposed project activities
43. In case of likely impact from the proposed project on the surrounding reserve forests, Plan for the conservation of wild fauna in consultation with the State Forest Department.
44. 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.
45. 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

46. Comparison of alternate sites considered and the reasons for selecting the proposed site. Conformity of the site with prescribed guidelines in terms of CRZ, river, highways, railways, *etc*.
47. Details on improved technologies.
48. Details on proposed recycling, reuse and recovery options.

Environmental monitoring program

49. Monitoring programme for pollution control at source.
50. Monitoring pollutants at receiving environment for the appropriate notified parameters – air quality, groundwater, surface water, *etc*. during operational phase of the project.
51. Specific programme to monitor safety and health protection of workers.
52. Appropriate monitoring network has to be designed and proposed, to assess the possible residual impacts on VECs.
53. Details of in-house monitoring capabilities and the recognized agencies if proposed for conducting monitoring.

Additional studies

54. Details on risk assessment and damage control during different phases of the project and proposed safeguard measures.
55. Details on socio-economic development activities such as commercial property values, generation of jobs, education, social conflicts, cultural status, accidents, *etc*.
56. Proposed plan to handle the socio-economic influence on the local community. The plan should include quantitative dimension as far as possible.
57. Details on compensation package for the people affected by the project, considering the socio-economic status of the area, homestead oustees, land oustees, and landless labourers.
58. Points identified in the public hearing and commitment of the project proponent to the same. Detailed action plan addressing the issues raised, and the details of necessary allocation of funds.
59. Details on plan for corporate social responsibility including the villages, population spread, SC/ST/backward communities, generation of jobs, training and public awareness, landuse, property values, cultural status, local infrastructure, *etc*.

Environmental management plan

60. Administrative and technical organizational structure to ensure proposed post-project monitoring programme for approved mitigation measures.
61. 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).
62. Allocation of resources and responsibilities for plan implementation.
63. Details of the emergency preparedness plan and on-site and 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.

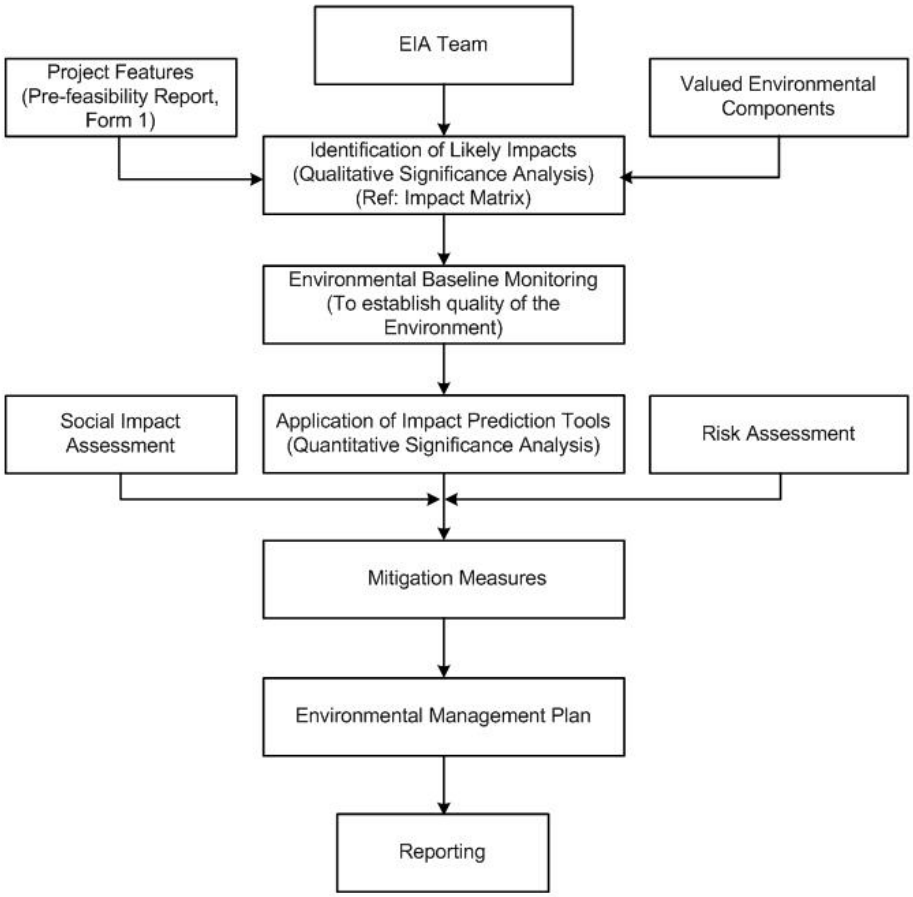

Figure 4-3: Approach for EIA Study

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
- Air and noise quality specialist

- Organic chemistry specialist
- Toxicology/Occupational health specialist
- Ecologist
- Transportation Specialist
- Safety and risk specialist
- Chemical 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, inturn 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 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 the 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 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
- improve 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.

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 depends up on the monitoring objectives specified for the selected area of interest. Types of monitoring and network design considerations are discussed in **Annexure VI**.

4.4.2.3 Baseline data generation

List of important physical environmental components and indicators of EBM are given in Table 4-3.

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 humidity ▪ 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*.)
Water	▪ 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

Environmental Component	Environmental Indicators
	▪ Wastewater discharges ▪ Thermal discharges ▪ Waste discharges, *etc.*
Air	▪ Ambient ▪ Respirable ▪ Airshed importance ▪ Odour levels, *etc.*
Noise	▪ Identifying sources of noise ▪ Noise due to traffic/transportation of vehicles ▪ Noise due to heavy equipment operations ▪ Duration and variations in noise over time, *etc.*
Coastal dynamics and morphology	▪ Wave patterns ▪ Currents ▪ Shoreline morphology – near shore, foreshore ▪ Sediment – characteristics and transport, *etc.*
Biological	▪ 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 VII**.

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 program. Statistical methods used to analyze 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: 1) frequency distribution analysis; 2) analysis of variance; 3) analysis of covariance; 4) cluster analysis; 5) multiple regression analysis; 6) time series analysis; 7) 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 VIIIA** and **Annexure VIIIB**.

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 to air, noise, water, land, biological and socio-economic environment are precisely tabulated in **Annexure IX**.

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 is also a contentious process. The interpretation of significance bears directly on the subsequent EIA process and also during prior 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
- 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 land uses, 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.

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. Explain specific effects that 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? Or 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 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; offer access to opportunities created by the project
- empower stakeholders through their participation in 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 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) need 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 integrated paint industry, 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, 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 onsite and offsite 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 basis of above evaluation against the risk acceptability criteria relevant to the situation
- Suggest risk mitigation measures based on engineering judgement, reliability and risk analysis approaches
- Delineation / up-gradation 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 4-4 shows the predictive models for risk assessment.

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	For estimating reliability of	Markov models

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

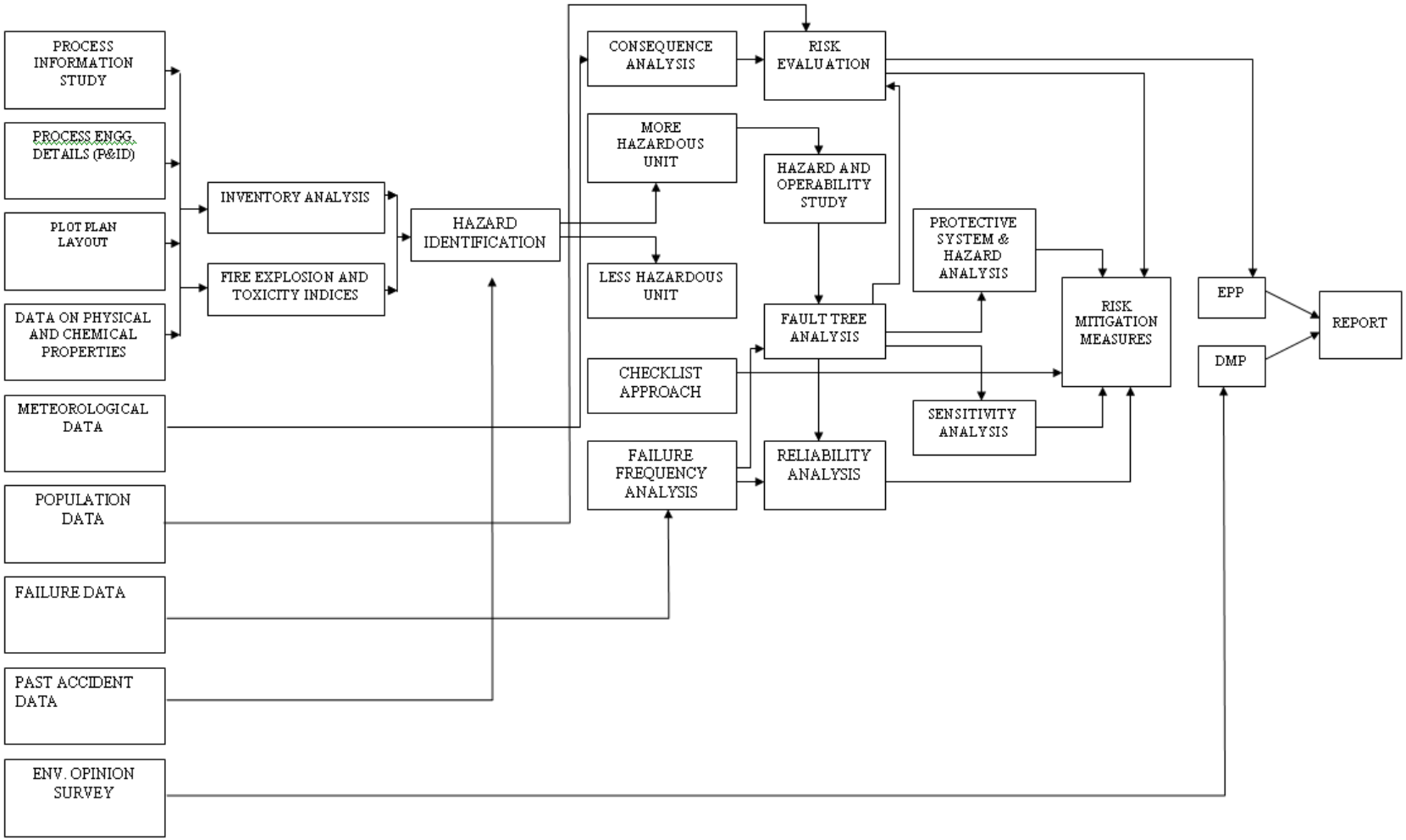

Figure 4-5: Comprehensive Risk Assessment - At a Glance

4.7 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 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

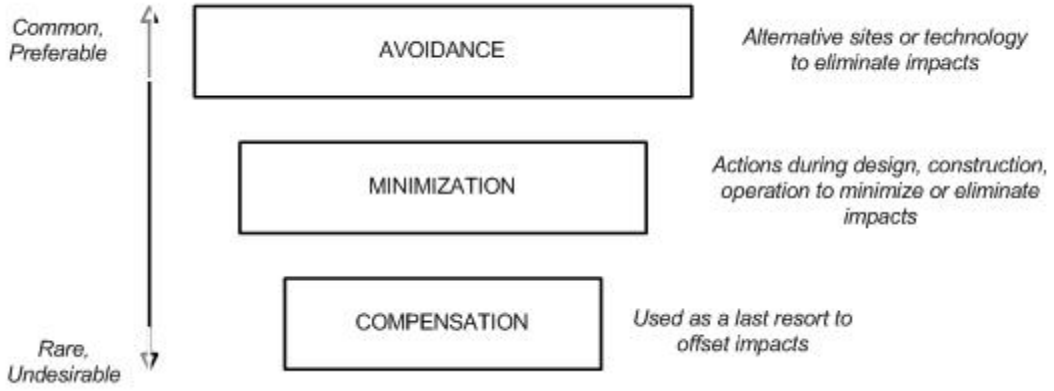

Figure 4-6: Elements of Mitigation

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
- 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
- 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 adverse impacts on surrounding environment. Detailed guidelines on siting of industries are provided in Section 4.2. However, if the developmental activity still 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 adverse impacts may be considered. These interventions, primarily aim at reducing the residual impacts on VECs 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 principal 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 this developmental activity (put sector name). This information may be used to draw appropriate 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 generic measures which are explored for mitigation of impacts are listed in Table 4-5.

Table 4-5: Typical Mitigation Measures

Impacts	Typical Mitigation Measures
Soil	▪ 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
Resources – fuel/construction material, *etc*.	▪ Availing the resources which could be replenished by natural systems, *etc*.
Deforestation	▪ Plant or create similar areas ▪ Initiate a tree planning program in other areas ▪ Donate land to conservationalist groups
Water pollution (Ground water/ Surface water)	▪ 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. ▪ Stormwater drainage system to collect surface runoff ▪ 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. ▪ 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 ▪ In case of oil waste, oil separation before treatment and discharge into the environment ▪ By 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

Impacts	Typical Mitigation Measures
	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
Air Pollution	▪ Periodic checking of vehicles and construction machinery to ensure compliance to emission standards ▪ Attenuation of pollution/protection of receptor through green belts/green cover ▪ 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
Dust pollution	▪ Adopt sprinkling of water ▪ Wetting of roadways to reduce traffic dust and reentrained particles ▪ Control vehicle speed on sight ▪ Ensure priodical wahsing of cosntruction equipment and transport vehicles to prevent accumulated dust ▪ Ensure that vehicles should be covered during transportation ▪ 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
Noise pollution	▪ Use of suitable muffler systems/enclosures/sound-proof glass panelling on heavy equipment/pumps/blowers ▪ Pumps and blowers may be mounted on rubber pads or any other noise absorbing materials ▪ Limiting certain activities ▪ Proper scheduling of high noise generating activities to minimise noise impacts ▪ Usage of well maintained construction equipment meeting the regulatory standards ▪ Placement of equipments emitting high noise in an orientation that directs the noise away from sensitive receptors ▪ Periodic maintenance of equipments/repalcing whenever necessary/lubrication of rotating parts, *etc*. ▪ By using damping, absorption, dissipation, and deflection methods ▪ By using 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

Impacts	Typical Mitigation Measures
	conservation measures ▪ Implementation of greenbelt for noise attentuation may be taken up
Biological	▪ Installation of systems to discourage nesting or perching of birds in dangerous environments ▪ Increased employee awareness to sensitive areas
Social	▪ Health and safety measures for workers ▪ Development of traffic plan that minimizes road use by workers ▪ Upgrade 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
Marine	▪ Water quality monitoring program ▪ Limit construction activities to day time to provide recuperation time at night and reduce turbidity ▪ Prevention of spillage of diesel, oil, lubes, *etc*. ▪ Usage of appropriate system to barges/workboats for collection of liquid/solid waste generated onboard ▪ Avoid discharge of construction/dredging waste (lose silt) into sea. It may be disposed at the identified disposal point. ▪ Ensure usage of suitable/proper equipment for dredging in order to minimize the turbidity and suspensions at the dredging site. ▪ Checking with the complainace conditions before discharging wastes into the sea water ▪ Have a post-dregding monitoring programme in place ▪ Take up periodic maintenance dredging including inspectionof sub-sea conditions, *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
Construction	▪ Have a Transport Management Plan in place in order to prevent/minimize the disturbance on surrounding habitats ▪ Initiate traffic density studies
Solid/Hazardous waste	▪ Proper handling of excavated soil ▪ Proper plan to collect and dispose off the solid waste generated onsite. ▪ Identify an authorized waste handler for segregation of construction and hazardous waste and its removal on a regular basis to minimise odour, pest and litter impacts ▪ Prohibit buring of refuse onsite.

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/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 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 coordination between various factors responsible for mitigation. Details should be provided w.r.t 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 residual impacts are higher than expected. It is an imperative requirement for all the 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 for integrated paint industry is given in the Table 4.6. 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 Terms of Reference)
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 ▪ 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 &	▪ 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

S.No	EIA Structure	Contents
	Mitigation Measures	▪ 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 of ensuring that ensures proper implementation of mitigative measures and their 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 web site.
- 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.
- Maintenance dredging provided the dredged material shall be disposed within port limits
- 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/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/ 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/ 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 or 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 or UTPCC. The SPCB/ 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 45 (forty five) days from date of receipt of the request letter from the Applicant. Therefore the SPCB or UTPCC concerned shall send the public hearing proceedings to the concerned regulatory authority within eight (8) 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 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 may 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/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 prior 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 prior 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 projects 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 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 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 within 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 prior 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 a 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

- MoEF or concerned SEIAA will issue a prior environmental clearance for the project.
- The project proponent should make sure that the award of prior 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 prior 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 prior environmental clearance is made available. The MoEF and SEIAA/UTEIAA, as the case may be, shall also place the prior environmental clearance in the public domain on Government Portal. Further copies of the prior 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 prior 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

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 Category 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 SEIAAs/UTEIAAs, 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 half-yearly 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 website 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.

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 organizations involved in different stages of prior environmental clearance are listed 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 advice 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

	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 advise 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 ▪ 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

Organization	Functions
	▪ 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 ▪ Finalizes 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 X**.

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 the 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

Notes:

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 (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.
- 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 IX.**
- 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 prior 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 prior 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
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,	Ministry of Environment and	All types of environmental pollutants	Protection and Improvement of the Environment	Section 2: Definitions Section 7: Not to allow emission or discharge of

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/ Pollutants	Objective of Legislation	Relevant Articles/Provisions
	amended 1991	Forests, Central Pollution Control Board and State Pollution Control Boards			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

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/ Pollutants	Objective of Legislation	Relevant Articles/Provisions
					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, Preparedness and Response) Rules, 1996	CCG, SCG, DCG, LCG and MAH Units	Hazardous Chemicals - Toxic, Explosive, Flammable, Reactive	Emergency Planning Preparedness and Response to chemical accidents	Rule 2: Definitions Rule 5: Functions of CCG Rule 7: Functions of SCG Rule 9: Functions of DCG

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/ Pollutants	Objective of Legislation	Relevant Articles/Provisions
					Rule 10: Functions of LCG
10	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 projects.	Requirements and procedure for seeking environmental clearance of projects
11	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
12	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
13	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

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/ Pollutants	Objective of Legislation	Relevant Articles/Provisions
					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

ANNEXURE II
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

S. No.	Parameter	Standards			
		Inland Surface Water	Public Sewer	Land for Irrigation	Marine Coastal Areas
1.	2.	3.			
		(a)	(b)	(c)	(d)
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 C6H5OH), 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 III
Form 1 (Application Form 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.	Name of the applicant	
11.	Registered Address	
12.	Address for correspondence:	
	Name	
	Designation (Owner/Partner/CEO)	
	Address	
	Pin Code	
	E-mail	
	Telephone No.	
	Fax No.	
13.	Details of alternative Sites examined, if any location of these sites should be shown on a toposheet.	Village-District-State 1. 2. 3.

S. No.	Item	Details
14.	Interlined Projects	
15.	Whether separate application of interlined project has been submitted	
16.	If yes, date of submission	
17.	If no, reason	
18.	Whether the proposal involves approval/clearance under: The Forest (Conservation) Act, 1980 The Wildlife (Protection) Act, 1972 The C.R.Z. Notification, 1991	
19.	Forest land involved (hectares)	
20.	Whether there is any litigation pending against the project and/or land in which the project is propose to be set up Name of the Court Case No. 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 buildings?		
1.3	Creation of new land uses?		
1.4	Pre-construction investigations e.g. bore houses, soil testing?		
1.5	Construction works?		

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
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?		
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?		

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
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		

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
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 enclosure 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. and the recommendations of the State Coastal Zone Management Authority. 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 10km 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."

ANNEXURE IV
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

S. No.	Critically Polluted Industrial Area and CEPI	Industrial Clusters/ Potential Impact Zones
		▪ 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

S. No.	Critically Polluted Industrial Area and CEPI	Industrial Clusters/ Potential Impact Zones
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

S. No.	Critically Polluted Industrial Area and CEPI	Industrial Clusters/ Potential Impact Zones
		▪ 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)	Industrial area: ▪ Patancheru ▪ Bollaram

S. No.	Critically Polluted Industrial Area and CEPI	Industrial Clusters/ Potential Impact Zones
	CEPI-70.07 (As_Ws_Ls)	

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 V
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	▪ Current demand scenario of the paint products ▪ Alternatives to meet the demand ▪ Post project scenario on residual demand
	Capacity of Integrated Paint Industry	▪ Production capacity of the industry ▪ Sustainability of raw material supply and quality ▪ Optimization of plant capacity
	Process technology	▪ Analysis of available/advanced technologies for paint manufacturing, etc. ▪ Analysis of various possible configurations for each technology or a combination of these technologies from available manufactures ▪ Broad specifications for the proposed industrial units
	Resources/raw materials	▪ Details on raw material, by products, etc. ▪ Water requirement for construction, process, domestic, utilities, *etc*. ▪ Manpower ▪ Infrastructure ▪ Electrical power ▪ Construction material like sand, brick, stone chips, borrow earth etc.
	Rejects (Pollution potential)	▪ Air emissions – VOCs, dust, *etc*. ▪ Water pollution – wastewater, washwater, rinse water, *etc*. ▪ Solid / hazardous waste ▪ Noise ▪ Odour
	Technical profile	▪ 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 plant & equipments to be used ▪ Product storage and associated transportation system ▪ Product demand & supply position data on regional basis
	Project schedule	▪ Project implementation schedule
	Future prospects	▪ Ascertain the costs and benefits of the proposed project for project life ▪ Technical and logistic constraints/ requirements of project sustainability

S. No.	Contents	Points of Coverage in Pre-feasibility Report
III.	**Selection of site based on least possible impacts**	
i.	**Choice of site selection**	
	Major techno-economic feasibility considerations	▪ Land availability & its development ▪ Product demand around the selected site ▪ Access to site for transportation of equipments/ construction machinery, material, *etc*. ▪ Raw material availability and its transportation ▪ Water availability and consumptive use ▪ Product transportation ▪ Infrastructure availability at selected site ▪ Inter-state issue, if any
	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 - Tiger reserve/elephant reserve/turtle nesting ground - Mangrove area - Wetlands - Tropical forests - Important lakes - Endangered species of flora and fauna, *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
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
	Location	▪ Geographical details - Longitude & latitude, village, taluka, district, state

S. No.	Contents	Points of Coverage in Pre-feasibility Report
		▪ 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
	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
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, *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 VI
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 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

This normally means that for designing a monitoring programme in an (study) area which might have an impact, several monitoring stations are needed for characterizing the baseline conditions of the impacted area. 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 and other power plants

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.. When considering the location of individual samplers, it is essential that the data collected are representative for the location and type of area without undue influence from the immediate surroundings.

ANNEXURE VII
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 require 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 ▪ PM10, PM2.5 ▪ SO_2 ▪ NO_2 ▪ CO ▪ H_2S* ▪ $NH*_3$ ▪ HC* ▪ Fluoride* ▪ Pb* ▪ VOC-PAH* ▪ Ozone ▪ Benzene ▪ Benzo(a)pyrene (Particulate phase only) ▪ Arsenic ▪ Nickel (parameters to be proposed by the proponent, in draft ToR, which will be reviewed and approved by	▪ 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 ▪ TOEM ▪ Beta attenuation ▪ UV photometric ▪ Chemilminescence ▪ Chemical method ▪ Gas chromatography based continuos analyzer ▪ Adsorption and desorption followed by GC analysis	▪ 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

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
EAC/SEAC)			▪ Solvent extraction folllowed by HPLC/GC analysis ▪ AAS/ICP method after sampling on EPM 2000 or equivalent filter paper	
B. Noise				
Hourly equivalent noise levels	▪ Same as for Air Pollution along with others Identified in study area	▪ At lest one day continuous in each season on a working and non-working day	▪ Instrument : Sensitive Noise level meter (preferably recording type)	▪ Min: IS: 4954- 1968 as adopted 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	▪ 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	

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
▪ 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)			aquatic flora & fauna	
For Surface Water Bodies				
▪ Total Carbon ▪ PH ▪ Dissolved Oxygen ▪ Biological Oxygen ▪ Demand ▪ Free NH_4 ▪ Boron ▪ Sodium Absorption ratio ▪ Electrical Conductivity	▪ Monitoring locations should include up-stream, on site, down stream of 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	▪ Yield & impact on water sources to be measured during critical 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	▪ 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. ▪ ▪	▪ Historical data should be collected from relevant offices such as central water commission, state and central ground water board, Irrigation dept. ▪
Parameters for wastewater characterization				
▪ Temp, colour, odour, turbidity, TSS, TDS ▪ PH , alkalinity as CaCO3, p value, M value, tatal hardness as CaCO3, chloride as cl, sulphate as S04, Nitrate as NO3, Floride as F, Phosphate as P04, Chromium as Cr (Hexavalent, total) Ammonical Nitrogen as N, TKN, % sodium, BOD at 20 C, COD,	▪ 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	All plant sources categorized as: ▪ Different Process waste streams as well as run-off conditions ▪ ETP wastewater ▪ Domestic/ sanitary wastewater

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
DO, total residual chlorine as Cl_2, oil and grease, sulphide, phenolic compound			Public Health Association.	
D. Land Environment				
▪ Soil ▪ Particle size distribution ▪ Texture ▪ pH ▪ Electrical conductivity ▪ Caution exchange capacity ▪ Alkali metals ▪ Sodium Absorption Ratio (SAR) ▪ Permeability ▪ Porosity	▪ One surface sample from each landfill and/or hazardous waste site (if applicable) and prime villages, (soil samples be collected as per BIS specifications) in the study area	▪ 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 ▪
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)	▪ 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

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
E. Solid Waste				
Quantity: ▪ Based on waste generated from per unit production ▪ Per capita contribution ▪ Collection, transport and disposal system ▪ Process Waste ▪ Quality (oily, chemical, biological)	▪ For green field unites it is based on secondary data base of earlier plants.	▪ Process wise or activity wise for respective raw material used. Domestic waste depends upon the season also	Guidelines ▪ IS 9569 : 1980 ▪ IS 10447 : 1983 ▪ IS 12625 : 1989 ▪ IS 12647 : 1989 ▪ IS 12662 (PTI) 1989	
Quality: ▪ General segregation into biological/organic/inert/hazardous ▪ Loss on heating ▪ pH ▪ Electrical Conductivity ▪ Calorific value, metals etc.	▪ Grab and Composite samples	▪ Process wise or activity wise for respective raw material used. Domestic waste depends upon the season also	Analysis ▪ IS 9334 : 1979 ▪ IS 9235 : 1979 ▪ IS 10158 : 1982	
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	▪ Considering probable impact, sampling points	▪ Season changes are very important	▪ Standards techniques (APHA et. Al. 1995, Rau	▪ Seasonal sampling for aquatic biota

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
▪ Enumeration of ▪ phytoplankton, zooplankton and benthos ▪ 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	and number of samples to be decided on established guidelines on ecological 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		and Wooten 1980) to be followed for sampling and measurement	▪ One season for terrestrial biota, in addition to vegetation studies during monsoon season ▪ 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 VIII
Sources of Secondary Data

Annexure VIIIA: 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 VIIIB: 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 IX
Impact Prediction Tools

Table 1: Choice of Models for Impact Prediction: 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; ▪ 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.
PTMAX	▪ Screening model applicable for a single point source ▪ Computes maximum concentration and distance of maximum concentration occurrence as a function of wind speed and stability class	▪ Require source characteristics ▪ No met data required ▪ Used mainly for ambient air monitoring network design
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 characteristics and receptor details
UAM (Urban Airshed Model)	▪ 3-D grid type numerical simulation model ▪ Computes O_3 concentration short term episodic conditions lasting for 1 or 2 days resulting from NOx and VOCs ▪ Appropriate for single urban area having significant O_3 problems	▪

Model	Application	Remarks
RAM (Rural Airshed Model)	▪ Steady state Gaussian plume model for computing concentration of relatively stable pollutants for 1 hr to 1 day averaging time ▪ Application for point and area sources in rural and urban setting	▪ Suitable for flat terrains ▪ Transport distance less than 50 km.
CRESTER	▪ Applicable for single point source either in rural or urban setting ▪ Computes highest and second highest concentration for 1hr, 3hr, 24hr and annual averaging times ▪ Tabulates 50 highest concentration for entire year for each averaging times	▪ Can take up to 19 Stacks simultaneously at a common site. ▪ Unsuitable for cool and high velocity emissions ▪ Do not account for tall buildings or topographic features ▪ Computes concentration at 180 receptor, circular wing at five downwind ring distance 36 radials ▪ Require sources, and met data
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
CDM(Climatol ogically Dispersion Model)	▪ It is a climatologically steady state GPM for determining long term (seasonal or annual) ▪ Arithmetic average pollutant concentration at any ground level receptor in an urban area	▪ Suitable for point and area sources in urban region, flat terrain ▪ Valid for transport distance less than 50 km ▪ Long term averages: One month to one year or longer
PLUVUE-II (Plume Visibility Model)	▪ Applicable to assess visibility impairment due to pollutants emitted from well defined point sources ▪ It is used to calculate visual range reduction	▪ Require source characteristics, met data and receptor coordinates & elevation ▪ Require atmospheric aerosols

Model	Application	Remarks
	and atmospheric discoloration caused by plumes ▪ It predicts transport, atmospheric diffusion, chemical, conversion, optical effects, and surface deposition of point source emissions.	(back ground & emitted) characteristics, like density, particle size ▪ Require background pollutant concentration of SO_4, NO_3, NOx, NO_2, O_3, SO_2 and deposition velocities of SO_2, NO_2 and aerosols
MESO-PUFF II (Meso scale Puff Model)	▪ It is a Gaussian, Variable trajectory, puff superposition model designed to account fro spatial and temporal variations in transport, diffusion, chemical transformation and removal mechanism encountered on regional scale. ▪ Plume is modeled as a series of discrete puffs and each puff is transported independently ▪ Appropriate for point and area sources in urban areas ▪ Regional scale model.	▪ Can model five pollutants simultaneously (SO2, SO4, NOx, HNO3 and NO3) ▪ Require source characteristics ▪ Can take 20 point sources or 5 area source ▪ For area source – location, effective height, initial puff size, emission is required ▪ Computes pollutant concentration at max. 180 discrete receptors and 1600 (40 x 40) grided receptors ▪ Require hourly surface data including cloud cover and twice a day upper air data (pressure, temp, height, wind speed, direction) ▪ Do not include gravitational effects or depletion mechanism such as rain/ wash out, dry deposition

Table 2: Choice of Models for Impact Modeling: 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 Models for Impact Modeling: 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 4: Choice of Models for Impact Modeling: Water Environment*

Model	Application	Remarks
QUAL-II E	Wind effect is insignificant, vertical dispersive effects insignificant applicable to streams Data required Deoxygenation coefficients, re-aeration coefficients for carbonaceous, nitrogenous and benthic substances, dissolved oxygen deficit	Steady state or dynamic model
	The model is found excellent to generate water quality parameters Photosynthetic and respiration rate of suspended and attached algae	
	Parameters measured up to 15 component can be simulated in any combination, e.g. ammonia, nitrite, nitrate, phosphorous, carbonaceous BOD, benthic oxygen demand, DO, coliforms, conservative substances and temperature	
DOSAG-3, USEPA: (1-D) RECEIV – II, USEPA	Water quality simulation model for streams & canal A general Water quality model	Steady-state
Explore –I, USEPA	A river basin water quality model	Dynamic, Simple hydrodynamics
HSPE, USEPA	Hydrologic simulation model	Dynamic, Simple hydrodynamics
RECEIVE-II, USEPA	A general dynamic planning model for water quality management	
Stanford watershed model	This model simulates stream flows once historic precipitation data are supplied The major components of the hydrologic cycle are modeled including interception, surface detention, overland inflow, groundwater, evapo-transpiration and routing of channel flows, temperature, TDS, DO, carbonaceous BOD coliforms, algae, zooplanktons, nitrite, nitrate, ammonia, phosphate and conservative substances can be simulated	
Hydrocomp model	Long-term meteorological and wastewater characterization data is used to simulate stream flows and stream water quality	Time dependant (Dynamic)
Stormwater Management model (SWMM)	Runoff is modeled from overland flow, through surface channels, and through sewer network Both combined and separate sewers can be modeled. This model also enables to simulate water quality effects to stormwater or combined sewer discharges. This model simulates runoff resulting from individual rainfall events.	Time Dependent
Battelle Reservoir model	Water body is divided into segments along the direction of the flow and each segment is divided into number of horizontal layers. The model is found to generate excellent simulation of temperature and good prediction of water quality parameters. The model simulates temperature, DO, total and	Two Dimensional multi-segment model

Model	Application	Remarks
	benthic BOD, phytoplankton, zooplankton, organic and inorganic nitrogen, phosphorous, coliform bacteria, toxic substances and hydrodynamic conditions.	
TIDEP (Turbulent diffusion temperature model reservoirs)	Horizontal temperature homogeneity Coefficient of vertical turbulent diffusion constant for charge of area with depth negligible coefficient of thermal exchange constant Data required wind speed, air temperature, air humidity, net incoming radiation, surface water temperature, heat exchange coefficients and vertical turbulent diffusion coefficients.	Steady state model
BIOLAKE	Model estimates potential fish harvest from a take	Steady state model
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 Modeling system Hydrodynamic model
RMA2	To compute flow velocities and water surface elevations	Hydrodynamic analysis model
RMA4	Solves advective-diffusion equations to model up to six non-interacting constituents	Constituent transport model
SED2D-WES	Model simulates transport of sediment	Sediment transport model
HIVEL2D	Model supports subcritical and supercritical flow analysis	A 2-dimensional hydrodynamic model
MIKE-II, DHI	Model supports, simulations of flows, water quality, and sediment transport in estuaries, rives, irrigation systems, channels & other water bodies	Professional Engineering software package

Table 5: Choice of Models for Impact Modeling: Biological Environment*

Name	Relevance	Applications	Remarks
Flora			
Sample plot methods	Density and relative density Density and relative	Average number of individuals species per unit area Relative degree to which a	The quadrant sampling technique is applicable in all types of plant communities and for the study of submerged, sessile (attached at the base) or

Name	Relevance	Applications	Remarks
	dominance	species predominates a community by its sheer numbers, size bulk or biomass	sedentary plants
	Frequency and relative frequency importance value	Plant dispersion over an area or within a community	Commonly accepted plot size: 0.1 m^2- mosses, lichens & other 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
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	These estimates, through they do not provide absolute population

Name	Relevance	Applications	Remarks
		interval of time	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 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 Models for Impact Predictions: Socio-economic Environment*

Relevance		
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	Morphological analysis technology scanning contextual mapping - functional array

Relevance		
Name	**Application**	**Remarks**
	environmental programmes are adequate to meet the goals	- graphic method Mission networks and functional arrays decision trees & relevance trees matrix methods scenarios

*** NOTE:** (i) If a project proponent prefer to use any model other than listed, can do so, with prior concurrence of concerned appraisal committee. (ii) 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 X

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 XI
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 XII

Best Practices & Latest Technologies available and reference

Technological Aspects

Waste minimization technologies

Primary waste streams associated with paint manufacturing are listed in Table 3-1 along with recommended control methods. At the facility, the waste streams are equipment cleaning wastes; spills and off specification paint; leftover inorganic pigment in bags and packages; pigment dust from baghouses; filter cartridges; and obsolete products/customer returns. These waste minimization methods as listed in Table 3-1 can be classified generally as source reduction, which can be achieved through material substitution, process or equipment modification, or better operating practices; or as recycling.

Table 3-1: Waste Minimization Methods for the Paint Manufacturing Industry

Waste Stream	Waste Minimization Methods
Equipment cleaning wastes (rinse water, solvent and sludge)	▪ Use mechanical wipers on mix tanks. ▪ Use high pressure wash systems. ▪ Install Teflon liners on mix tanks. ▪ Use foam/plastic pigs to clean lines. ▪ Reuse equipment cleaning wastes. ▪ Schedule production to minimize need for cleaning. ▪ Clean equipment immediately. ▪ Use countercurrent rinse methods. ▪ Use alternative cleaning agents. ▪ Increase spent rinse settling time. ▪ Use de-emulsifiers on spent rinses.
Spills and off specification paint	▪ Increase use of automation. ▪ Use appropriate clean up methods. ▪ Recycle back into process Implement better operating practices.
Air emissions, including VOCs and pigment dust	▪ Modify bulk storage tanks. ▪ VOC emission minimization as detailed in 3.4.1.2 ▪ Use paste pigments. ▪ Install dedicated baghouse systems.
Filter cartridges	▪ Improve pigment dispersion. ▪ Use bag or metal mesh filters.
Obsolete products/customer returns	▪ Blend into new products.

Minimization of wastewater

There is considerable variation in the nature of wastewater normally generated in paint manufacturing industry. Before evolving wastewater treatment scheme, the following aspects should be looked into:

- Segregation of wastewaters based on characteristics and strength
- Reduction of volume and strength of wastewaters by adopting in-plant control measures

Treatability studies for various wastewater streams may be carried out to decide the best combination of treatment system.

Segregation of wastes is, however, recommended to reduce capital costs, improve the treatment efficiency and reduce chemical consumption. Effluents generated from paint industry can be segregated as caustic cleaning effluent, stiff paint effluent, effluent from remaining units and domestic waste

Caustic cleaning effluent is highly alkaline and needs neutralization. Effluents from other units comprise thermopac burner cleanings, resin house waste, *etc.,* which contain oil and has to be separated before mixing with the other effluents. Stiff paint effluent contains easily settleable solids which are settled in the primary clarifier and then wastewater is given further treatment.

Schemes for reducing the generation of wastewater at source (in the plant) should be practiced. This is to reduce the effluent load rather than finding methods to treat it. Unnecessary use of water not only adds to the quantity of effluent and cost of treating it, but also increases the wastage of heat, power and/or product in the effluent.

The cooling water is usually uncontaminated and thus should be collected and reused. It could be used for floor washing or discharged separately into the receiving water bodies, rather than mixing with polluted water and discharging into the treatment plant. Accidental spills and leakages should be reduced to a minimum through proper maintenance of equipment and training of personnel. In case of caustic cleaning, instead of washing away the caustic solution, it can be collected, stored and used for further cleaning. In case of stiff paints, water from first cleaning should be collected and used later as process water for a similar type of batch. Wastewater volume can also be reduced through reuse of rinse water for preparation of alkali solution. The above procedures can reduce the quantity of generation of caustic cleaning water significantly.

The dry powders and raw materials spilt on the floors during filling into the grinders and/or churners as well as while packing the finished products should be removed dry as far as possible and disposed of as dry solid wastes by burial instead of washing them with water. This will significantly reduce the pollution load of the combined wastewater, which in turn will reduce the size of the treatment plant required and its cost. Alternatively, the above material along with their containers may be sold to outside parties as scrap material.

Minimization of VOCs

Methods to minimize VOC emissions include process and equipment modifications, improved operating practices, and recycling. It is difficult, however, to determine the overall efficiency or impact of these VOC minimizing methods on individual emission

sources because many paint manufacturing facilities estimate total plant emissions rather than estimating or testing emissions by process or source (*i.e.,* filling operations, grinding operations, cleaning processes).

Equipment or Process Modifications: Two stages which are amenable to equipment and process modifications are paint manufacturing and equipment cleaning.

Tank Lids: Tank lids are the most common equipment modification used during the manufacturing process to control VOC emissions. Mix and blend tanks are a primary source of manufacturing VOC emissions because the solvent-containing materials spend a significant amount of time in this equipment. All open- top equipment may be covered during the manufacturing process to control these emissions.

The cover remains closed, except when production, sampling, maintenance, or inspection procedures require access. The cover is maintained in good condition, such that when in place, it maintains contact with the rim of the opening for at least 90 % of the circumference of the rim.

Many of the lids currently used in industry are flat and some are conical. Flat lids control emissions relatively well, but they do have some inherent flaws. The lids do not form a seal with the mix tank and the hinged door product adds chute does not always remain closed. Conical lids, a better engineering design, are considered as more efficient means of controlling emissions. However, they too have associated difficulties caused by added weight and bulky shape. The conical lids are more difficult to handle and damage more easily than the flat lids.

Lids may be constructed of plastic, wood, aluminum, or stainless steel. Plastic and wooden lids are normally one piece except for the center agitator shaft opening, while aluminum and stainless steel lids normally have hinged openings for product additions and sampling. Some facilities currently using aluminum lids question their safety. A study conducted in Germany indicates that having steel (*e.g.*, carbon steel mix tank) scraping against aluminum containing silicon (*e.g.*, mix tank cover) could be a potential source of sparks. A fire may break out if the sparks contact possible flammable vapors from solvent-containing paints.

The control efficiency of covers on mix tanks ranges from 40 to 96 % depending on the method used to determine emissions. These values represent the ratio of emission reduction to uncontrolled emissions. They do not account for any subsequent venting to control devices. The value of 96 % arose from studies conducted with mix tanks in the polymeric coating industry. In this case, the demonstrator considered only evaporative losses during the mixing process. This method of emission determination fails to include the working losses that occur during filling and emptying a vessel containing a solvent-saturated air space.

Modified Milling Equipment: In some cases paint manufacturers could reduce total VOC emissions by converting some of their older milling equipment to newer, more efficient closed-systems such as horizontal media mills. Although a wide range of products can be processed in the horizontal mills, some cannot be done. The mill base must be of a low viscosity to allow the grinding media to move with maximum velocity. The low viscosity requirement prevents some materials currently made in other types of milling equipment from being manufactured in horizontal mills. The viscosity of a product, along with other characteristics such as color, gloss, type of raw materials, and processing time, often determines the appropriate type of milling equipment.

Equipment Cleaning: Equipment cleaning generates a high percentage of waste associated with paint manufacturing. Because much of this cleaning is performed with solvents, equipment cleaning is also a major source of VOC emissions. Any methods that reduce the need or frequency of tank cleaning will also reduce emissions. Several process and equipment modifications follow.

Rubber wipers: Facilities can use rubber wipers to scrape the sides of the tank to reduce the amount of clinging paint, therefore reducing the amount of solvent needed to clean the tank. Wipers can be either manual or automatic,

High-pressure spray heads: High pressure spray heads can be used to clean process tanks. These heads can reduce cleaning material use by 80 to 90 %,

Teflon-lined tanks: Teflon lined tanks will reduce the amount of paint clinging to the side of the tank and will make cleaning easier,

Plastic pigs: Plastic or foam 'pigs' may be used to clean paint from process pipes. The 'pig' moves through the pipes and pushes ahead paint from a previous batch which has been left clinging to the pipe walls. This process reduces solvent needed to clean the pipes and increases product yield,

Automatic tub washers: Some facilities have successfully used automatic tub washers to clean process tanks. These washers form a seal with the tank, pull a vacuum, and circulate cleaning solvent on a timed schedule.

Another method to reduce emissions from solvent cleaning operations is to use larger media in milling equipment. Larger media rinses more easily than small media, and therefore requires less cleaning solvent. Glass and ceramic media and sand are also easier to clean than steel shot.

Better operating practices

Better operating practices are procedural or institutional policies that result in a reduction of waste. They include:

- Waste stream segregation
- Personnel practices - management initiatives, employee training, employee incentives
- Procedural measures - documentation, material handling and storage, material tracking and inventory control, scheduling
- Loss prevention practices - spill prevention, preventive maintenance, emergency preparedness
- Accounting practices - apportion waste management costs to departments that generate the waste

Better operating practices may be applied to all waste streams. In addition, specific better operating practices that apply to certain waste streams are discussed in the following sections.

(i) Equipment cleaning waste

Equipment cleaning generates most of the waste associated with paint manufacturing. Following production of either solvent or water-based paints, considerable waste or clingage remains affixed to the sides of the preparation tanks. The three methods of tank cleaning used in paint industry are (i) solvent washing for solvent-based paint, (ii) caustic washing for either, solvent or water-based paint and (iii) water washing for water-based paint. Equipment used for preparation of solvent-based paint is rinsed with solvent, which is then generally reused in the following ways:

- Collected and used in the next compatible batch of paint as part of the formulation
- Collected and redistilled either on-site or off-site
- Collected and used with or without settling for equipment cleaning, until spent. When the solvent is finally spent, it is then drummed for disposal

On-site distillation of solvent can be economical considering the disposal costs. The solvent can be recycled, recovered and the left portion can be disposed off as sludge.

Caustic rinse is used for equipment cleaning of both solvent and water-based paints, but more often with water-based paints. Water rinsing is usually insufficient in removing paint that has dried in the mix tanks. Since solvent rinsing can usually remove solvent-based paint that has dried, the need for caustic is less. There are two major types of caustic systems commonly used by the paint industry. In one type of system, caustic is maintained in a holding tank (usually heated) and is pumped into the tank to be cleaned. The caustic drains to a floor drain or sump from which it is returned to the holding tank. In the second type of system, a caustic solution is prepared in the tank to be cleaned, and the tank is soaked until it is clean. Most plants reuse the caustic solution until it loses most of its cleaning ability. At that time, the caustic is disposed off either as a solid waste or wastewater with or without neutralization.

Water wash of equipment used in the production of water-based paint is the source of considerable wastewater volume, which is usually handled as follows:

- Collected and used in the next compatible batch of paint as part of formulation
- Collected and used with or without treatment for cleaning until spent
- Disposed with or without treatment as wastewater or as a solid waste in drums

Sludge from settling tanks are drummed and disposed off as solid waste. Spent recycle rinse water is drummed and disposed off as solid waste after the soluble content prohibits further use. The percentage of solvent-base and water-base paints produced is the most important factor that affects volume of process wastewater generated and discharged at paint plants. Due to their greater use of water-wash, plants producing 90% or more water-base paint discharge more wastewater than plants producing 90% or more solvent-base paint. Additional factors influencing the amount of wastewater produced include the pressure of rinse water, spray head design, and the existence or absence of floor drains. Where no troughs or floor drains exist, equipment is often cleaned externally by hand with rags; when wastewater drains are present, there is a greater tendency to use hoses. Several plants have closed their floor drains to force the use of dry clean-up methods and discourage excessive water use.

Waste associated with equipment cleaning represents the largest source of waste in a paint facility. Methods that reduce the need or frequency of tank cleaning or allow for reuse of

the cleaning solutions are most effective. Some of the waste minimization methods include the following:

- use of mechanical devices such as rubber wipers – reduces the amount of paint left clinging to the walls of the tank
- use of high pressure spray heads and limiting wash/rinse time – reduces water use by 80 to 90 % and also removes dried-on paint so that the need for caustic is reduced.
- use of teflon lined tanks to reduce adhesion and improve drainage – applicable only to small batch tanks amenable to manual cleaning
- use of a plastic or foam "pig" to clean paint from pipes – increases yield and reduces the subsequent degree of pipe cleaning required
- alternative cleaning agent - substituting a proprietary alkaline cleaning solution for the caustic solution, cut the solution replacement frequency in half and thereby reducing the volume of cleaning solution requiring disposal
- a countercurrent rinsing sequence - this technique uses recycled dirty solution to initially clean the tank and then the recycled clean solution is used to rinse the dirty solution from the tank. Since the level of contamination builds up more slowly in the recycled "clean" solution than with a simple reuse system, solution life is greatly increased
- sludge dewatering by filtration or centrifugation – reduces sludge disposal volumes
- provision for adequate solid settling time in spent rinse solution
- use of de-emulsifiers in rinse water to promote emulsion breakdown and organic phase separation

(ii) Recovery of paint and wastewater

Most off-specification (off-spec) paint is produced by small shops that deal in specialty paints. Since these paints cost more to produce, and therefore sell at a premium price, most off-spec paint is reworked into a salable product. Since elimination of off-spec paint production has built-in economic incentives, the following techniques are widely used:

- Unless the sludge from wet cleanup can be recycled into a marketable product, the use of dry cleanup methods should be maximized wherever possible.
- By closing floor drains and discouraging employees from routinely (*i.e.* needlessly) washing down areas, some facilities have been able to achieve a large decrease in wastewater volume.
- By employing volume-limiting hose nozzles, using recycled water for cleanups, and actively involved supervision.

(iii) Bags and packages

Inorganic pigments, which may contain heavy metals and therefore be classified as hazardous, are usually shipped in separate bags. After emptying the bag, an ounce or two of pigment usually remains inside. Empty containers of liquid raw materials that constitute hazardous waste (*e.g.* solvents and resins) are typically cleaned or recycled to the original raw material manufacturer or to a local drum recycler. The following are some of the waste reduction techniques for bags and packages:

- When empty, the bags could be dissolved or mixed in with the paint. Such a method is commonly used for handling mercury compounds and other paint fungicides. This method could not be used, however, when producing high quality, smooth finish paint since the presence of this material could affect the paint's film forming property or could increase the load on the filters which would increase filter waste
- Use of rinseable/recyclable drums with plastic liners instead of paper bags
- Segregation of hazardous and non-hazardous waste
- Hazardous materials may be collected in plastic bags and stored in a special container to wait collection

(iv) Air emissions

As mentioned in the previous sections, the two major types of air emissions that occur in the paint manufacturing process are volatile organic compounds and pigment dusts. Volatile organics may be emitted from the bulk storage of resins and solvents and their use in open processing equipment such as mix tanks. Since most existing equipment is of open design, reducing or controlling organic emissions from process equipment could require substantial expenditures in retrofit costs. Following are some of the measures for bulk storage and pigment handling.

- Use of pigments in paste form instead of dry powders – pigments in waste form are supplied in drums, which can be recycled and no dust would be generated when opened
- Dedicated baghouse system for pigment loading area – all the collected pesticide dust could be recycled

VOCs

In addition to process and equipment modifications, VOC emissions may be reduced by following good operating procedures. Some of the following are good housekeeping procedures for reducing VOC emissions:

- All open-ended paint manufacturing vessels shall be securely covered during periods of operation, except when adding raw materials.
- During transfer of material to different containers, steps shall be taken to reduce and prevent splashes and spills. Any liquid or dry material spilled shall be cleaned as expeditiously as possible, but not later than the end of daily work shift.
- Waste solvent shall be collected and stored in closed containers. The closed containers may contain a device that would allow pressure relief, but would not allow liquid solvent to drain from the container prior to disposal.
- The permitted facility shall provide a permanent sign or signs for the paint manufacturing equipment which states the required work and operating practices.
- The sign or signs shall be placed in a prominent location and be kept visible and legible at all times.

Another good operating procedure which can reduce emissions is dedicating process lines and equipment. Equipment dedication eliminates cleaning between each product batch.

Scheduling compatible batches or batches from light to dark colors also reduces the need for equipment cleaning. Production scheduling and dedicating equipment may be

impossible, however, in small paint facilities that operate on a batch schedule in order to meet customer demands. In some cases, facilities operate on a same-day shipment schedule.

(v) Spills

Spills are due to accidental or inadvertent discharges usually occurring during transfer operations or equipment failures (leaks). Spilled paint and the resulting clean up wastes are usually discharged to the wastewater treatment system or are directly drummed for disposal. If the plant has floor drains, large quantities of water may be used to clean up water-based paint spills. Dry cleaning methods are employed for cleaning of solvent-containing spills or for water-based spills where floor drains are not available. Some of the better operating practices may include:

- Dry cleanup methods can be maximized wherever possible until sludge from wet cleanup is recycled.
- Employing volume-limiting hose nozzles, using recycled water for cleanups, and actively involved supervision.

(vi) Filter cartridges

These are produced during the paint loading operation. These are designed to remove undispersed pigment from the paint during loading and are saturated with paint when removed. Hence, waste minimization and economy both call for as small a cartridge as possible so as to reduce the amount of paint lost and the capital spent for the filters. If frequent filter plugging is a problem, then it should be first addressed from the standpoint of improving pigment dispersion, and not from the standpoint of increasing filter area.

Viable alternatives to cartridge filters include bag filters and metal mesh filters. Metal mesh filters are available in very fine micron sizes and they can be cleaned and reused. Since it is very important to minimize all wastes, the issue of mesh filter cleaning waste reuse or recycling would need to be addressed before switching to these filters.

(vii) Obsolete products

Obsolete products and customer returns can be blended into new batches of paint. Obsolete products result from changes in customer demand, new superior products, and expired shelf life. Marketing policies, such as discounting older paints, can reduce the amount of obsolete products requiring disposal.

(viii) Recovery of Wastes

A large number of solvents are used in paint manufacturing and a majority of them are recovered and therefore not lost in the wastewater streams. In case of oil paints, solvents are added in grinders which are closed units; therefore, loss of solvents through evaporation is considerably reduced. High temperature is maintained in resin and varnish manufacture, resulting in evaporation of solvents added. These solvent vapours, along with the water vapours generated through chemical reactions are condensed and collected in a separator. The solvent layer is removed and reused in the next batch.

Pollution control technologies

Wastewater treatment

Combined effluent from paint industries can be satisfactorily treated using the usual physico-chemical and/or biological treatment methods. The treatment consists of coagulant addition and adjustment of pH to an optimum level for maximum precipitation. The precipitated material is removed by gravity separation, either on batch basis or in a continuous flow tank. It is understood that if wastewater contains a high settleable solids and the wastewater quantity is low, primary treatment followed by treatment in oxidation pond may result in reasonably high BDO removal but for a higher quantity of wastewater primary treatment should be followed by secondary treatment. On the other hand, removal of COD always demands tertiary treatment. The wastewater treatment removes oil and grease, suspended solids and toxic substances.

a) Primary treatment

i) Oil and grease removal - Effluents from all units except stiff paint section and caustic cleaning waste are passed through an oil and grease removal device.

ii) Equalization-cum-neutralization - Effluent from caustic cleaning operation is highly alkaline in nature and requires neutralization prior to further treatment. An equalization-cum-neutralization tank is provided with an agitator. Effluent from stiff paint is mixed with the neutralized wastewater, dosed with a coagulant and sent to flash mixer. The effluent is then subjected to clariflocculation.

iii) Clariflocculation - The effluent is clarified in clariflocculator and subjected to biological treatment. Sludge generated in this unit is carried to the sludge drying beds for dewatering.

b) Secondary Treatment

i) Extended aeration-Domestic wastewater from the factory premises is mixed with the supernatant from clariflocculator and is biologically treated by extended aeration process.

ii) Secondary clarification-Mixed liquor from the aeration tank overflows to the - secondary clarifier. The settled sludge is recycled continuously through return sludge pumps to the aeration tank and excess sludge is discharged to sludge drying beds. Effluent from the secondary clarifier is fit for discharge to the environment.

iii) Sludge drying-Sludge from oil and grease trap, clariflocculator and secondary clarifier is dewatered on sludge drying beds. Filtrate from these beds is returned to equalization-cum-neutralization tank

The above treatment process is expected to achieve 90 to 95% efficiency in removing pollutants and thus acceptable to the recipient environment.

Recycling techniques

One common recycling technique among paint manufacturers is using spent cleaning solvent in subsequent compatible batches. After a mill or tank has been emptied of

product, solvent is added to the vessel to capture remaining product residue. The wash solvent is drained from the tank, staged, and recycled into the next compatible product batch. Mills may be cleaned by replacing the residual heel of the exiting product with an equivalent amount of solvent which is compatible with both the preceding and the ensuing batches.

Another recycling technique which reduces total solvent consumption and VOC emissions is using countercurrent rinsing sequences. This method uses recycled "dirty" solvent to initially clean the tank. Following this step, "clean" recycled or virgin solvent is used to rinse away the "dirty" solvent.

Equipment cleaning operations

Cleanup should be conducted using methods and materials that minimize emissions of VOCs (excluding low volatility compounds) and HAPs. These methods should employ high-pressure water, hot alkali or detergent cleaning. Solvent containing VOCs (excluding low volatility compounds) can be used for equipment cleaning provided that the equipment being cleaned is completely covered or enclosed except for an opening no larger than necessary to allow safe clearance for proper operation of the cleaning equipment, considering the method and material being used. In addition, any cleanup solvent containing VOCs or HAPs, both used and unused, should be collected and stored in closed containers.

Mills

1) Grinding Mills: Grinding mills must be operated in accordance with their manufacturer's specifications. All grinding mills, excluding three roll mills, must be equipped with fully enclosed screens.

2) Three Roll Mills: Three roll mills must be operated in accordance with their manufacturer's specifications.

3) Equipment Cleaning Operations: Cleanup of grinding mills and related equipment should be conducted using methods and materials that minimize emissions of VOCs, excluding low volatility compounds, and HAPs. These methods should employ high pressure water, hot alkali or detergent cleaning. VOC-containing solvents, excluding low volatility compounds, can also be utilized for equipment cleaning provided that the equipment being cleaned is completely covered or enclosed except for an opening no larger than necessary to allow safe clearance for proper operation of the cleaning equipment, considering the method and material being used. In addition, any cleanup solvent containing VOCs or HAPs, including spent solvent, should be collected and stored in closed containers.

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