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IL&FS | Environment

TECHNICAL EIA GUIDANCE MANUAL FOR CHEMICAL FERTILIZERS

Prepared for

The Ministry of Environment and Forests
Government of India

by

IL&FS Ecosmart Limited
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ACRONYMS

AAQ	Ambient Air Quality
AMDEA	Activated Methyl Diethanolamines
ANP	Ammonium Nitro Phosphate
APHA	American Public Health Association
AS	Ammonium Sulphate
BOD	Biochemical oxygen demand
BOQ	Bill of Quantities
BOT	Built-Operate-Transfer
BLEVE	(Boiling Liquid Expanding Vapour Cloud) or Vapour Cloud Explosion
CAN	Calcium ammonium nitrate
CCA	Conventional Cost Accounting
CEAA	Canadian Environmental Assessment Agency
CER	Corporate environmental reports
CETP	Common Effluent Treatment Plant
CFE	Consent for Establishment
COD	Chemical Oxygen Demand
CP	Cleaner Production
CPCB	Central Pollution Control Board
CRZ	Coastal Regulatory Zone
DAP	Diammonium phosphate
DO	Dissolved Oxygen
EAC	Expert Appraisal Committee
EBM	Environmental Baseline Monitoring
EcE	Economic-cum-Environmental
ECI	Environmental Condition Indicators
EHS	Environment Health and Safety
EIA	Environmental Impact Assessment
EIS	Environmental Information system
EPI	Environmental Performance Indicators
EMS	Environmental Management System
EMP	Environmental Management Plan
ETP	Effluent Treatment Plant
FACT	Fertilizer & Chemicals Travancore of India Ltd
FCA	Full Cost Assessment
FCI	Fertilizers Corporation of India
FE&TI	Fire-Explosion and Toxicity Index

GHG	Green House Gas
HTL	High Tide Line
IL&FS	Infrastructure Leasing and Financial Services
ISO	International Standard Organization
km	Kilometre
LDAR	Leak Detection and Repair
LCA	Life Cycle Assessment
LTS	Low Temperature Shift
MAP	Monoammonium phosphate
MCA	Maximum Credible Accident
MEA	Mono Ethanolamine
MoEF	Ministry of Environment & Forests
MOP	Muriate of Potash
NAQM	National Air Quality Monitoring
NGO	Non-Government Organizations
OCD	Offshore and Coastal Dispersion Model
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbons
PCC	Pollution Control Committee
PGR	Purge Gas Recovery
ppm	Parts per Million
R&D	Research and Development
R&R	Resettlement and Rehabilitation
RPM	Respirable Particulate Matter
RSPM	Respirable Suspended Particulate Matter
QA/QC	Quality Assurance/Quality Control
QRA	Quantitative Risk Assessment
SEAC	State Level Expert Appraisal Committee
SEIAA	State Level Environment Impact Assessment Authority
SEZ	Special Economic Zone
SPCB	State Pollution Control Board
SPM	Suspended Particulate Matter
SS	Suspended Solids
SSP	Single Super Phosphate
TA	Technology Assessment
TCA	Total Cost Assessment
TDS	Total Dissolved Solids
TEQM	Total Environmental Quality Movement
TGM	Technical EIA Guidance Manual

TSDF	Treatment Storage Disposal Facility
TSS	Total Suspended Solids
UAP	Urea Ammonium Phosphates
UT	Union Territory
UTEIAA	Union Territory Level Environment Impact Assessment Authority
UTPCC	Union Territory Pollution Control Committee
VOC	Volatile Organic Compound
VEC	Valued Environmental Components
WBCSD	World Business Council on Sustainable Development

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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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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 **"Chemical Fertilizers"** 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.

A large research initiating has focused on developing environmental friendly, efficient and economical production of chemical fertilizers. Emphasis should be given to control gaseous emissions such as urea dust, H_2S, SO_2, NO_X and Fluoride under permissible limits. Proper reuse/disposal of solid hazardous waste such as carbon waste, spent catalyst, ETP sludge, etc has to be ensured. A number of new technologies are also being developed which are at different stages of research. With the development of these technologies, it is expected that the specific energy consumption can be reduced upto 6.0 Gcal per ton of Ammonia.

India's industrial competitiveness and environmental future depends on Industries such as Chemical Fertilizers 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

(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 effectively integrating 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 Environmental 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 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 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 the Terms of Reference (ToR) for 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 (TGMs) 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 chemical fertilizer industry, understanding on type of environmental impacts and the criteria for the significance analysis.

Chapter 3 (Chemical Fertilizers): 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 - Growth of fertilizer industry, Captive plants, (ii) Scientific Aspects - Intermediates required for the production of fertilizers, Nitrogen fertilizers, Phosphatic plants, (iii) Environmental Aspects of Concern - Effluent and emissions generated from fertilizer plants, Processes adopted for treating effluent and emissions generated during the production of intermediates and fertilizers, (iv) Technical aspects, (v) Environmental Management Aspects, and (vi) Summary of Applicable National Regulations - General description of major statutes, General standards for discharge environmenal pollutants, Industry-specific requirements, Charter on corporate responsibility for environment protection (CREP) in fertilizer industry, Proposed regulatory 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 chemical fertilizer 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 on the process of 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 the chemical fertilizer sector and would be able to draw a benchmark to establish 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 new or expansion projects, use to 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. 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. The Chemical Fertilizer 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 purposes of this project, the key elements considered under TGMs are: conceptual aspects of EIA; developmental activity-specific information; operational aspects; and roles and responsibilities of involved stakeholders.

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

2. CONCEPTUAL FACETS OF EIA

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

2.1 Environment in EIA Context

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

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

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

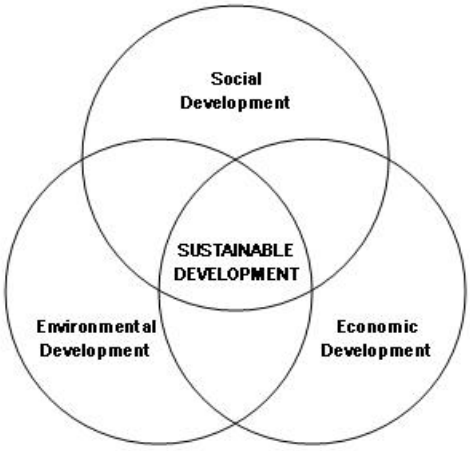


Figure 2-1: Inclusive Components of Sustainable Development

2.2 Pollution Control Strategies

Pollution control strategies can be broadly categorized in to preventive and reactive. The reactive strategy refers to the steps that may be applied once the wastes are generated or contamination of 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 itself. 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. A few of them given below:

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

2.3 Tools for Preventive Environmental Management

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

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

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

2.3.1 Tools for assessment and analysis

2.3.1.1 Risk assessment

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

2.3.1.2 Life cycle assessment

A broader approach followed to deal with environmental impacts in manufacturing is called LCA. This approach recognizes that environmental concerns are associated with every step of the processing w.r.t. manufacturing of products and also examines environmental impacts of the product at all stages of project life cycle. LCA includes the product design, development, manufacturing, packaging, distribution, usage and disposal. LCA is concerned with reducing environmental impacts at all 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 (*e.g.*, 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
- Bench marking 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 include compliance verification, problem identification, environmental impact measurement, environmental performance measurement, conforming effectiveness of EMS providing a database for corrective actions and future actions, developing compan's environmental strategy, communication and formulating environmental policy.

The MoEF, Government of India (GoI) 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 Boards (SPCBs). ES is a proactive tool for self-examination of the industry 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 significant aspects and give enough evidence of good environmental house keeping. Besides the existing prescribed standards, an insight to identify the performance indicators and prescribing schedule for systematic improvement in performance of these indicators will yield better results.

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

2.3.1.6 Environmental indicators

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

The operational performance indicators are related to the process and other operational activities of the 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 management efforts to influence environmental performance of 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 are 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 an organization's commitment towards a formulated environmental policy, it is essential that top management 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 should 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 are 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 reduce the pollutants further. 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 is brought in to avoid accumulation of dangerous products in the environment.

- **Tradable Permits:** It is aimed at cost-minimizing the allocation of the control burden. 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, in the national interest, subsidies are important to sustain the expansion of production. 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 these global funding mechanisms, 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 in order to internalize the externalities, *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% in first run, thus encouraging for 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 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 products

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

2.3.2.6 Eco-labeling

Eco-labelling is the practice of supplying information on 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 by-product to the extent possible *i.e.* Re-cycle, Recover, Re-use, Recharge. Recycling refers to using 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 useful constituents of wastes, so that this recovered material can be used. Re-use refers to the utilization of waste from one process as a raw material to other. Recharging is an option in which the natural systems are used for renovation of waste for further use.

2.3.2.9 Eco-efficiency

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

- Mass: There is an opportunity to significantly reduce mass burdens (raw materials, fuels, utilities consumed during the life cycle)
- Reduce Energy Use: The opportunity is to redesign the product or its use to provide significant energy savings
- Reduce Environmental Toxins: This is a 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 recyclability 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 increases 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 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 require timely replacement. Also these may be used as supplementary/ complimentary in implementation of the regulation. The agreements may include:

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

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

2.3.3 Tools for communication

2.3.3.1 State of environment

The Government of India has brought out the state of environment report for entire country and similar reports are 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 give 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, regional EIA, sectoral EIA and project level EIA. These are precisely discussed below:

Strategic environmental assessment

Strategic Environmental Assessment (SEA) refers to systematic analysis of the environmental effects of development policies, plans, programmes and other proposed strategic actions. SEA represents a proactive approach to integrating 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 helps in addressing specific environmental problems that may be encountered in planning and implementing sectoral development projects.

Project level EIA

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

From the above discussion, it is clear that EIA shall be integrated at all the levels *i.e*. strategic, regional, sectoral and the project level. Whereas, the strategic EIA is a structural change in the way the things are evaluated for decision-making, the regional EIA refers to substantial information processing and drawing complex inferences. The project-level EIA is relatively simple and reaches to meaningful conclusions. Therefore in India, project-level EIA studies take place on an 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 considered while 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 learnt 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.
- Interdisciplinary- should ensure that appropriate techniques and experts in 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 Chemical Fertilizer 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 the technical and economic factors throughout the project planning, assessment and implementation phases. Environmnetal 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 Plans (EMPs). 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 states 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 taking process about the developmental activity.

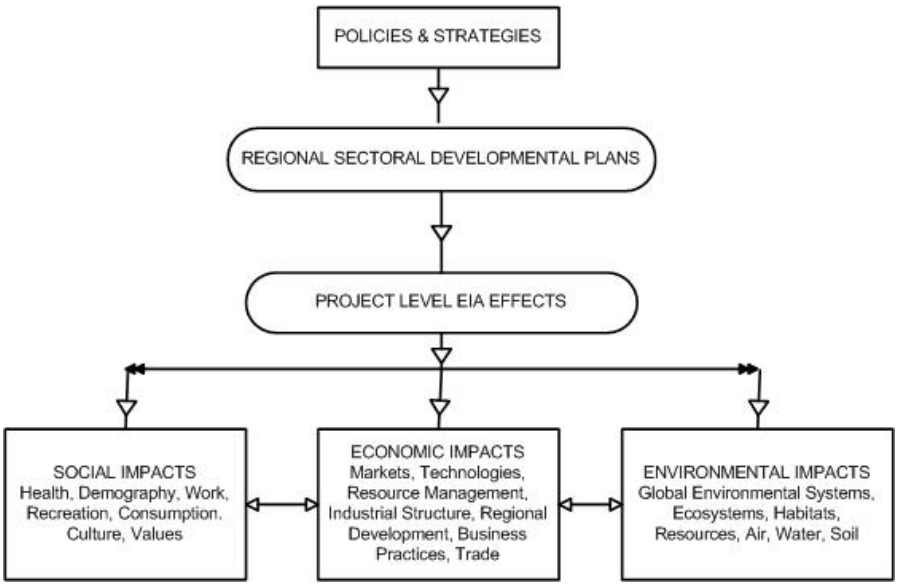


Figure 2-2: Type of Impacts

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 nor can be 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 chemical fertilizer 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).

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 third 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 and may also lead to biomagnification. 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. Many indirect impacts may also be positive such as greening of the area; improved recreational, health and educational facilities; employment generation and enhanced economic activity of a region.

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.

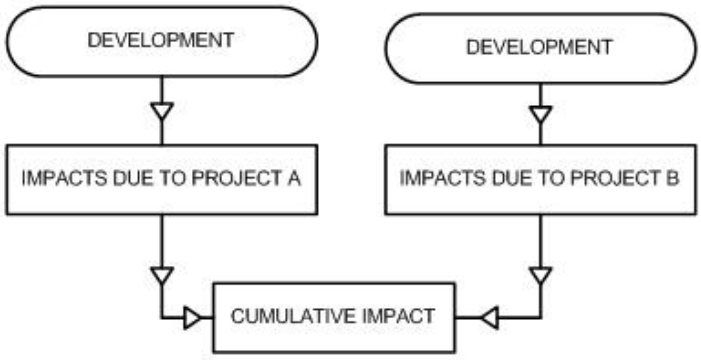


Figure 2-3: Cumulative Impact

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 fertilizer industry, and in the process causing additional effects on air, water and other natural ecosystems). Induced actions may not be officially announced or be a 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 by specifying it very early at ToR stage.

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 (one approach reported by Duval and Vonk 1994) include the following:

- Exceeding of threshold limit: Significance may increase if a threshold is exceeded. e.g., Emissions of PM10 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. *e.g*. 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 CHEMICAL FERTILIZER INDUSTRY INCLUDING PROCESS AND POLLUTION CONTROL TECHNOLOGIES

3.1 Introduction

Any material – organic, inorganic, natural or synthetic – which supplies one or more chemical elements required for the plant growth is considered as a fertilizer. These chemical elements are called nutrients since they are essential for plant growth. Nutrients are categorized as primary, secondary and micronutrients. The primary nutrients are nitrogen (N), phosphorus (P) and potassium (K). The primary nutrients are required in macro quantities and are normally supplied through chemical fertilizers. Based on the nutrient(s) present in fertilizer they are categorized as straight fertilizers (single nutrient) or complex fertilizer (more than one nutrient). The Indian fertilizer industry produces both straight fertilizers (barring potassium) and NP/NPK complex fertilizers.

- Straight nitrogenous fertilizers
  - Urea
  - Ammonium salts [Ammonium Chloride, Ammonium Sulphate & Calcium ammonium nitrate (CAN)]
- Straight phosphatic fertilizers
  - Single super phosphate (SSP)
- Complex NP/NPK fertilizers
  - NP/NPK fertilizers based on mixed acid route: Example Diammonium phosphate (DAP)
  - NP/NPK fertilizers based on nitro-phosphate route: Example Ammonium nitro phosphate (ANP)

Ammonia is the basic chemical required for making all the listed nitrogenous fertilizers. Natural gas, naphtha and fuel oil are the feedstock for nitrogenous fertilizer manufacture. At present, natural gas contributes 72.5 percent (%) to nitrogenous fertilizer capacity. The share of naphtha and fuel oil is about 17.5% and 10% respectively. In case of phosphatic fertilizer manufacture, the raw materials required are rock phosphate and sulphur. The availability of indigenous rock phosphate is limited and that too not of high quality. So, major quantity of rock phosphate is imported (about 5.24 million tonnes of rock phosphate imported during 2007-08). Petroleum refineries are a source of sulphur supply. However, this cannot meet fertilizer industry's entire sulphur requirement and hence, sulphur is imported (about 1.75 million tonnes of sulphur imported during 2007-08). The Indian fertilizer industry also imports ammonia (1.67 million tonnes imported during 2007-08) and phosphoric acid (2.21 million tonnes imported during 2007-08) as intermediate products.

The other primary nutrient - Potassium is imported as muriate of potash (MOP) since India does not have any potassium resource. India imported about 4.42 million tonnes of MOP (60% K_2O) during 2007-08.

There has been a gap in the production and consumption of nitrogenous and phosphatic fertilizers by about 24.4% and 32.7% during 2007-08, respectively. To meet the demand, significant quantities of urea and DAP fertilizers have been imported, in addition to the domestic production of fertilizer.

3.1.1 Growth of fertilizer industry

The Indian fertilizer industry had a very humble beginning in 1906, when the first manufacturing unit of SSP was set up in Ranipet near Chennai. The Fertilizer & Chemicals Travancore of India Ltd. (FACT) at Cochin, Kerala and the Fertilizers Corporation of India (FCI) at Sindri, Bihar were the first large-sized fertilizer plants set up in the forties and fifties respectively with a view to establish an industrial base to achieve self-sufficiency in foodgrain. Subsequently, the green revolution in the mid sixties gave an impetus to the growth of fertilizer industry in India. The eighties and nineties witnessed a significant addition to the fertilizer production capacity.

The installed capacity of nitrogenous plants as on 31.03.2008 has reached a level of 12.3 million tonnes of nitrogen (inclusive of an installed capacity of 21.0 million tonnes of urea after reassessment of capacity) and 5.7 million tonnes of P_2O_5, making India the 3rd largest fertilizer producer in the world. The rapid buildup of fertilizer production capacity in the country has been achieved as a result of a favourable policy environment facilitating large investments in the public, co-operative and private sectors. Presently, there are 51 large sized fertilizer plants in the country manufacturing a wide range of nitrogenous and complex fertilizers. Out of these, 32 units produce urea, 19 units produce NP/NPK complex fertilizers. There are nine ammonium sulphate (AS) plants (by-product of steel / caprolactum plants) and one CAN plant. Besides these, there are about 79 medium and small-scale SSP units in operation.

3.1.2 Captive plants

In addition to feedstock, raw materials and intermediates required for fertilizer production, de-mineralized water, power and steam are also needed and usually produced in captive plants located in the same premises of the fertilizer plants. It is evident that a fertilizer production plant is generally a complex of many facilities/features based on the type and capacity of main production plant.

3.2 Scientific Aspects

3.2.1 Intermediates required for the production of fertilizers

The intermediates required for the production of nitrogenous and phosphatic fertilizers are:

- Ammonia
- Sulphuric acid (H_2SO_4)
- Phosphoric acid(H_3PO_4)
- Nitric acid (HNO_3)

3.2.1.1 Ammonia

(A)Steam reforming

Presently, the steam reforming concept based on natural gas is considered to be the most dominating and best available technique for production of ammonia.

Overall conversion

The theoretical process conversions, based on methane feedstock, are given in the following approximate formulae:

$$0.88CH_4 + 1.26\ Air + 1.24\ H_2O \longrightarrow 0.88CO_2 + N_2 + 3H_2$$

$$N_2 + 3H_2 \longrightarrow 2NH_3$$

The synthesis gas production and purification normally takes place at 25 to 35 kilograms per square centimeter (kg/cm^2) pressure. The ammonia synthesis pressure is in the range of 100-250 kg/cm^2. The block diagram of the steam reforming is given in Figure 3-1.

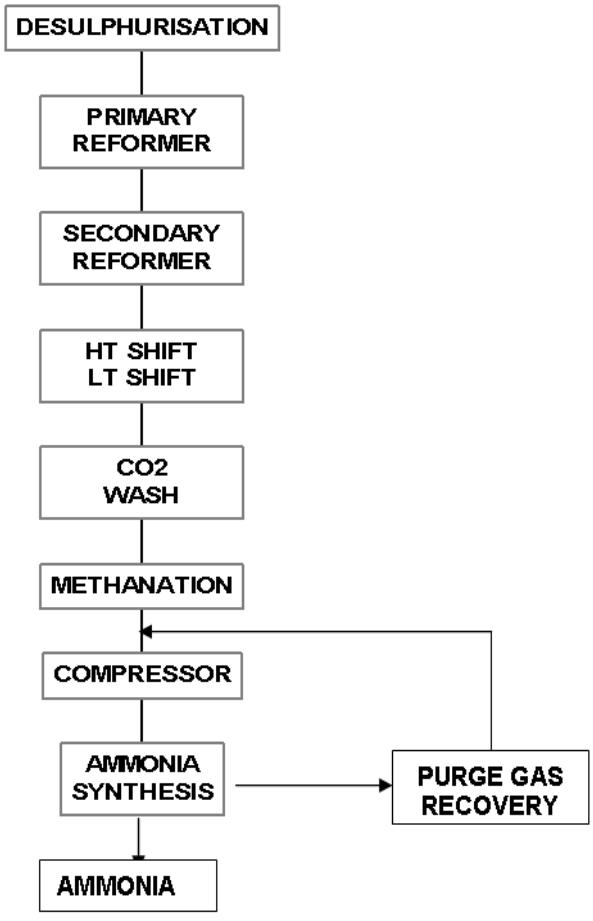


Figure 3-1: Block Diagram of Steam Reforming Process

Step 1: Feedstock desulphurization: This part of the process removes sulphur from the feedstock over a zinc oxide catalyst-bed, as sulphur is poison to the catalysts used in subsequent processes. The sulphur level is reduced to less than 0.1 parts per million (ppm) in this part of the process.

Step 2: Primary reforming: The gas from the desulphurizer is mixed with process steam, usually coming from an extraction turbine, and steam gas mixture is then heated further to 500-600° C in the convection section before entering the primary reformer. In some new or revamped plants the preheated steam/gas mixture is passed through an adiabatic pre-reformer and reheated in the convection section before entering the primary reformer.

The process steam is added to adjust steam to carbon-molar ratio (S/C- ratio), which should be around 3.0 for the reforming processes. The optimum ratio depends on several factors, such as feedstock quality, purge gas recovery, primary reformer capacity, shift operation and the plant steam balance. In new plants, S/C ratio may be less than 3.0.

The primary reformer consists of a large number of high nickel chromium alloy tubes filled with nickel-containing reforming catalyst in a big chamber (radiant box) with burners to provide heat. The overall reaction is highly endothermic and additional heat is provided to raise the temperature to 780-830°C at the reformer outlet.

The composition of gas leaving the reformer is given by close approach to the following chemical equilibrium:

$$CH_4 + H_2O \longleftrightarrow CO + 3H_2$$

$$CO + H_2O \longleftrightarrow CO_2 + H_2$$

The heat for the primary reforming is supplied by burning natural gas or other fuels, in the burners of a radiant box containing catalyst filled tubes.

The flue gas leaving the radiant box has temperature in excess of 900°C, after supplying the high level heat to the reforming process. About 50-60% of fuel's heat value is directly used in the process itself. The heat content (waste heat) of the flue-gas is recovered in the reformer convection section, for various process and steam duties.

The flue-gas leaving the convection section at 100-200°C is one of the main sources of emissions from the plant. These emissions are mainly CO_2, NO_x, with small amounts of SO_2 and CO.

Step 3: Secondary reforming: Only 30-40% of the hydrocarbon feed is reformed in the primary reformer because of the chemical equilibrium at the actual operating conditions. The temperature must be raised to increase the conversion. This is done in the secondary reformer by internal combustion of part of the gas with process air, which also provides the nitrogen for the final synthesis gas. In the conventional reforming process the degree of primary reforming is adjusted so that the air supplied to the secondary reformer meets both the heat and the stoichiometric synthesis gas requirement.

The process air is compressed to the reforming pressure and heated further in the primary reformer convection section to about 600°C. The process gas is mixed with air in a burner and then passed over a nickel-containing secondary reformer catalyst. The reformer outlet temperature is around 1000°C, and up to 99% of the hydrocarbon feed (to primary reformer) is converted, giving a residual methane content of 0.2-0.3% (dry gas basis) in the process gas leaving the secondary reformer.

The process gas is cooled to 350-400°C in a waste heat boiler/super heater downstream from the secondary reformer.

Step 4: Shift conversion: The process gas from secondary reformer contains 12-15% CO (dry gas basis) and most of the CO is converted in the shift section according to the reaction:

$$CO + H_2O \longleftrightarrow CO_2 + H_2$$

In the high temperature shift conversion (HTS), the gas is passed through a bed of iron oxide/chromium oxide catalyst at around 400°C, where the CO content is reduced to about 3% (dry gas basis). The gas from the HTS is cooled and passed through the low temperature shift (LTS) converter.

The LTS is filled with a copper oxide/zinc oxide-based catalyst and operates at about 200-220°C. The CO content is reduced to around 0.2%.

Step 5: Carbon dioxide (CO_2) Removal: The process gas from the low temperature shift converter contains mainly Hydrogen, (H_2) N_2, CO_2, and excess process steam. The gas is cooled and most of the excess steam is condensed before it enters the CO_2 removal section. This condensate usually contains 1500-2000 ppm of ammonia, 800-1200 ppm of methanol and minor concentration of other chemicals. All these are stripped and the condensate is recycled. The heat released during cooling/condensation is used for:

- Regeneration of CO_2 scrubbing solution
- Driving the absorption refrigeration units
- Boiler water preheating

The amount of heat released depends on the process steam to carbon ratio.

The CO_2 is removed in a chemical or physical absorption process. The solvents used in chemical absorption process are mainly aqueous amine solutions such as mono ethanolamine (MEA), activated methyl diethanolamines (aMDEA) or hot potassium carbonate solutions. Physical solvents are glycol, dimethylethers (Selexol), propylene carbonates and others.

Residual CO_2 content is usually in the range 100-1000 ppmv, depending on the process used. Contents of CO_2 down to 50 ppmv are achievable.

Step 6: Methanation: The small residual amount of CO and CO_2 in the synthesis gas, are poisonous for the ammonia synthesis catalyst and must be removed by conversion to methane (CH_4) in the methanator.

$$CO + 3H_2 \longrightarrow CH_4 + H_2O$$

$$CO_2 + 4H_2 \longrightarrow CH_4 + H_2O$$

The reaction takes place at around 300°C in a reactor filled with nickel containing catalyst. CH_4 is an inert gas but water must be removed before it enters the converter.

Step 7: Synthesis gas compression and ammonia synthesis: Modern ammonia plants use centrifugal compressors for synthesis gas compression, usually driven by steam turbines, with steam being produced within the ammonia plant from exothermic heat of reactions. The refrigeration compressor, needed for condensation of product ammonia, is also driven by a steam turbine.

The synthesis of ammonia takes place over an iron catalyst at pressure usually in the range of 100-250 kg/cm^2 and temperatures in the range of 350-550°C:

$$N2 + 3H_2 \longleftrightarrow 2NH_3$$

Only 20-30% of synthesis gas is converted to ammonia per pass in multi-bed catalyst filled converter. Ammonia that is formed is separated from the product gas mixture by cooling/condensation, and the unreacted gas is recycled with the addition of fresh make up synthesis gas, thus maintaining loop pressure. In addition, extensive heat exchange is required due to exothermic reaction and large temperature range in the loop.

Synthesis loop arrangements differ with respect to (w.r.t.) the points in the loop at which the make-up gas is delivered while ammonia and purge gas are taken out.

Conventional reforming with methanation as the final purification step, produces synthesis gas containing inert (CH_4 and argon) in quantities that don't dissolve in the condensed ammonia. Major part of these is removed by taking out a purge stream from the loop. Size of this purge stream controls the level of inert in the loop to about 10-15%. The purge gas is scrubbed with water to remove ammonia before being used as fuel or before being sent to hydrogen recovery unit.

Vaporizing ammonia is used as a refrigerant in most ammonia plants, to achieve sufficiently low ammonia concentration in the recycled gas. Ammonia vapours are liquefied by compression in the refrigeration compressor.

Steam reforming with some modifications will continue to be used for new plants for years to come. Developments are expected to go in the following directions.

- Lowering steam carbon ratio
- Shifting duty from primary to secondary reformer
- Improved final purification
- Improved synthesis loop efficiency
- Improved power energy system
- Low NOx burners
- Non-iron based ammonia synthesis catalyst

In India almost all NG (Natural gas) based plants and naphtha based plants use conventional steam reforming process. Some newer plants have introduced adiabatic pre-reforming, low steam carbon ratio operation, purge gas recovery to control inert, low NOx burners and improved steam and power system resulting in better performance.

(B) Partial oxidation of heavy oils

The partial oxidation process is used for the gasification of heavy feedstock such as residual oils and coal. Extremely viscous hydrocarbons may also be used as fraction of the feed.

An air separation unit is required for the production of oxygen in partial oxidation step while liquid nitrogen wash is required to remove impurities from the synthesis gas.

The partial oxidation is a non-catalytic process, taking place at high pressure (>50 kg/cm^2) and temperature around 1400°C. Some steam is added for temperature moderation. The simplified reaction pattern is:

$$-CH_n- + 0.5O_2 \longrightarrow CO + n/2H_2$$

CO_2, CH_4 and soot are formed. Sulphur compounds in the feed are converted to hydrogen sulfide (H_2S). The process gas is freed from solids by water scrubbing after waste heat recovery and the soot is recycled to feed. The H_2S in the process is separated in a selective absorption step and reprocessed to elemental sulphur in a Claus unit.

The shift conversion usually has two temperature shift catalyst beds with intermediate cooling. Steam for shift conversion is supplied partially by a cooler-saturator system and partially by steam injection.

CO_2 is removed by using an absorption agent. Residual traces of absorption agent and CO_2 are then removed from the process gas, before final purification by a liquid nitrogen wash. In this unit practically all the impurities are removed and N_2 is added to give the stoichiometric H_2 to N_2 ratio.

Ammonia synthesis is quite similar to steam reformation plants, but more efficient due to high purity of synthesis gas from liquid N_2 wash unit and the loop does not require a purge. The process block diagram is given in Figure 3-2.

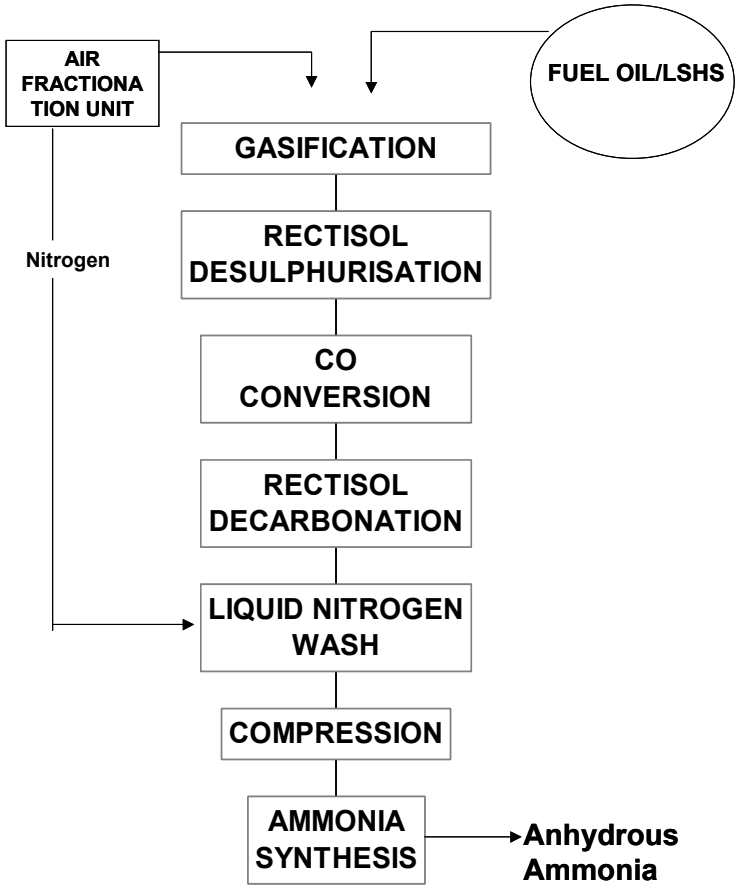


Figure 3-2: Block Diagram of the Partial Oxidation Process

(C)Storage of ammonia

Liquefied ammonia from production plants is used either directly in downstream plants or transferred to storage tanks. The storage tanks are of three types namely:

- Fully-refrigerated atmospheric tanks with a capacity up to 50000 tonnes. The tanks can be single containment, single-wall tanks with bunding; double containment tanks with two vertical walls; or full containment closed storage tanks with two walls.
- Pressurized storage spheres or cylinders at ambient temperature with a capacity up to about 1700 tonnes.
- Semi-refrigerated tanks.

3.2.1.2 Nitric acid

Nitric acid is produced by ammonia oxidation process. The liquid ammonia is evaporated, superheated and sent with compressed air to a converter, containing platinum-rhodium catalyst gauzes where ammonia oxidation takes place at a temperature of 850-950°C. In the converter, ammonia is converted to nitric oxide, which is then converted to nitrogen dioxide in oxidation vessel with the help of secondary air. The process water absorbs nitrogen dioxide in absorption column.

$4NH_3$	+	**$5O_2$**	→	**4NO**	+	**$6H_2O$**
Ammonia		**Oxygen**		**Nitric oxide**		**Water**
2NO	+	**O_2**	→	**$2NO_2$**		
$3NO_2$	+	**H_2O**	→	**NO**	+	**$2HNO_3$**
Nitrogen dioxide		**Water**		**Nitric oxide**		**Nitric acid**

A flow sheet for the manufacture of nitric acid by dual pressure system is shown in Figure 3-3.

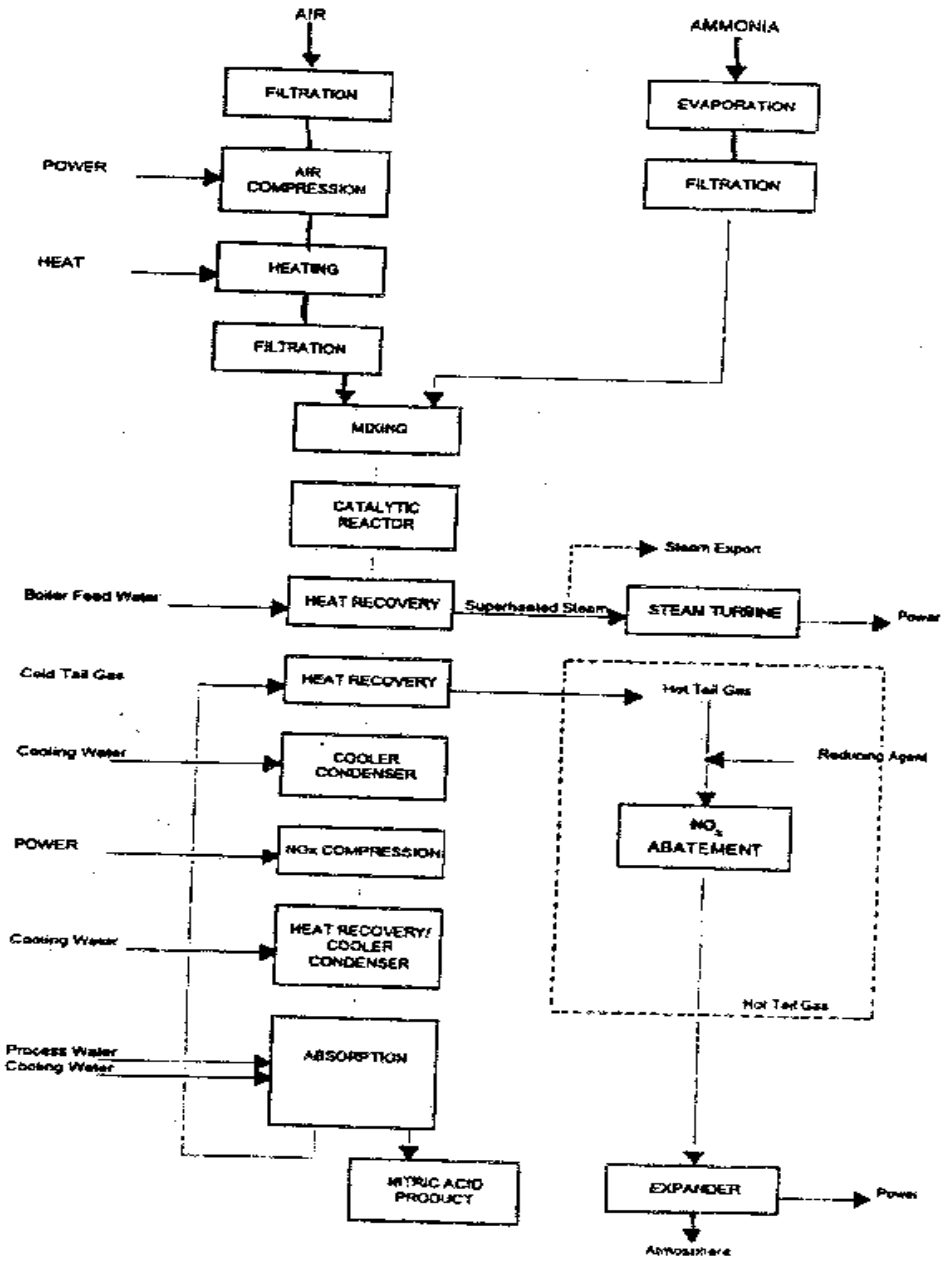


Figure 3-3: Flow Diagram for Dual Pressure Nitric acid

Although the principal steps have remained at the heart of nitric acid technology, there have been revolutionary developments over the years which have progressively optimized the process for better use of raw materials, catalyst, capital equipment and energy. Commercially relevant processes exist where oxidation and absorption are both carried out at medium pressure, or they are both carried out at high pressure or oxidation is affected at medium pressure and absorption at high pressure (dual process). In view of the beneficial effect of pressure on absorption, this is either carried out at the same pressure as the oxidation step or a higher one. The pressures used are going up as new developments in materials and fabrication methods are being made. Various processes have also been developed which are aimed primarily at reducing the absolute level of emissions to meet stack standards of 200ppm or even, in some cases, less than 100 ppm. These range from chemical and physical absorption or absorption to reduce emissions.

Depending upon the cooling water temperature and the process adopted, nitric acid or concentration ranging from 50 to 65% can be produced for use in fertilizer industry.

3.2.1.3 Sulphuric acid

Sulphur dioxide is first obtained either by burning the molten sulphur in the presence of air or by roasting the pyrites:

$$S + O_2 \rightarrow SO_2$$

$$4FeS_2 + 11O_2 \rightarrow 8SO_2 + 2Fe_2O_3$$

$$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$$

The sulphur dioxide after catalytic conversion to sulphur trioxide is absorbed in water to form sulphuric acid.

$$2SO_2 + O_2 \rightarrow 2SO_3$$

$$SO_3 + H_2O \rightarrow H_2SO_4$$

The following methods are used for the manufacture of sulphuric acid:

(i) Chamber/tower process:

The chamber process is called so because the reactions which produce sulphur trioxide and sulphuric acid take place within a lead chamber.It is the oldest process and is now obsolete.

(ii) Contact process:

Sulphuric acid (H_2SO_4) is mostly manufactured by the contact process. Elemental sulphur of 99.5 % purity and containing less than 0.25 % carbon is burnt in an excess of dry air at a temperature 950°-1100°C to form sulphur dioxide. The gases containing SO_2 are cooled to 450°- 500°C and then passed over vanadium pentoxide catalyst charged in a converter. The catalytic oxidation of SO_2 to SO_3 is carried out in three or more catalyst beds. The gases are cooled further in heat exchanger and sent to an absorption tower containing recirculating acid to produce stronger acid. Water is added to the strong acid to restore the original strength and the temperature is maintained in the range of 70°-90°C by cooling the recirculating acid. The product acid of 97-98 % is withdrawn. Unabsorbed gases are vented to the atmosphere.

To increase the conversion of SO_2 to SO_3 the double catalyst / double absorption (DCDA) system is introduced. In this system, the process flow is modified so that the gas after passing through three catalyst beds is withdrawn and passed through the first absorber to remove SO_3. The remaining gases are reheated to about 420°C and then sent through the fourth catalyst bed for further conversion and then sent to second absorption tower. In the DCDA system, conversion of SO_2 to SO_3 to the tune of 99.7% can be obtained and the SO_2 loss is reduced to less than 2 kg of SO_2 per tonne of H_2SO_4. High efficiency mist eliminators are used to maintain the acid mist at less than 50mg / NH_3. A flow sheet for the process is shown in Figure 3-4.

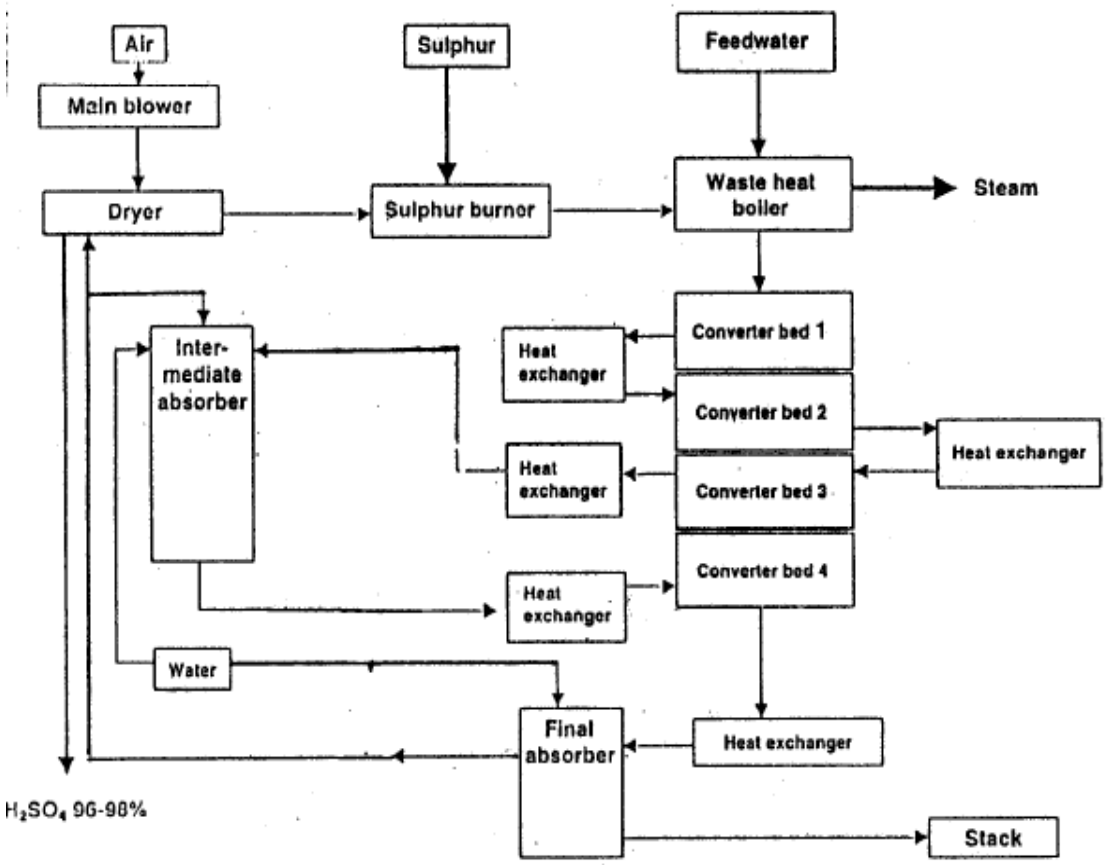


Figure 3-4: Process of Manufacture of Sulphuric Acid

3.2.1.4 Phosphoric acid

There are two basic methods in commercial use for the production of phosphoric acid – the wet process and the furnace process.Production of phosphoric acid by Wet process is as follows:

Acidulation of finely ground rock phosphate with sulphuric acid to form phosphoric acid and gypsum

$$Ca10(PO_4)6F_2 + 10H_2SO_4 + 10nH_2O \rightarrow 6H_3PO_4 + 10\ (CaSO4.nH2O) + 2HF$$

Rock Phosphate	Sulphuric acid	Water	Phosphoric acid		Hydrogen Fluoride

Where n = 0, ½ or 2

- Separation of gypsum from the acid by filtration.
- Washing of gypsum to remove adhering phosphoric acid.
- Concentration of acid by evaporation to desired concentration.

Counter current washing of gypsum is employed to recover as much phosphoric acid as possible without excessive dilution of acid. Dilute acid is recycled to the extraction step.

The acid from the filter is concentrated through indirect heating by steam in a vacuum evaporator.

Commercial wet processes may be classified according to the hydrate form in which the calcium sulfate crystallizes:

- Anhydrite – $CaSO_4$
- Hemihydrate – $CaSO_4$. ½ H2O
- Dihydrate – $CaSO_4$.$2H_2O$

The hydrate form is controlled mainly by temperature and acid concentration. At present there is no commercial use of the anhydrite process, mainly because the required reaction temperature is high enough to cause severe corrosion difficulties.

Table 3-1: List of Commercial Processes Followed

Crystal Form(s)	No. of separating stage	Usual conc. Of Product Acid % P2O5	Usual Temp. °C	
			Reactor	Recrystalizer
Dihydrate	1	26 – 32	70 – 85	-
Hemihydrate	1	40 – 50	85 – 100	-
Hemihydrate-Dihydrate	1	26 – 30	90 – 100	50 – 60
Hemihydrate-Dihydrate	2	40 – 50	90 – 100	50 – 65
Dihydrate – Hemihydrate	2	35 – 38	65 – 70	90 – 100

A typical flow sheet for phosphoric acid production is given in Figure 3-5.

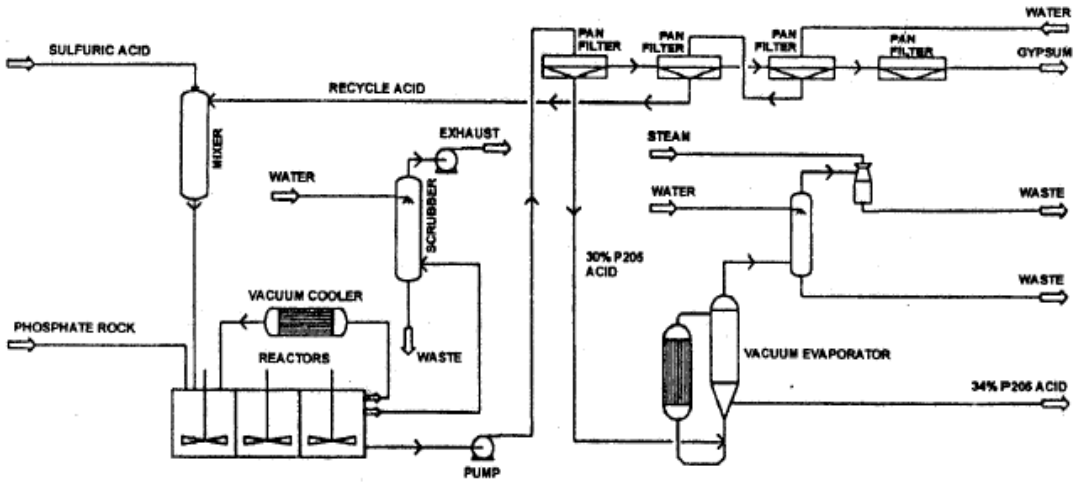


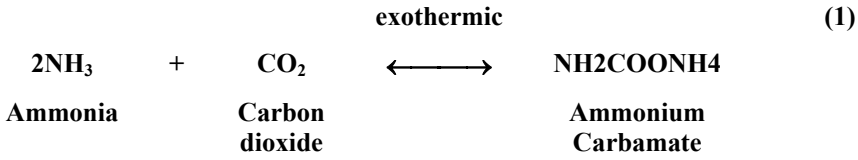
Figure 3-5: Manufacturing Process of Phosphoric Acid

3.2.2 Nitrogen fertilizers

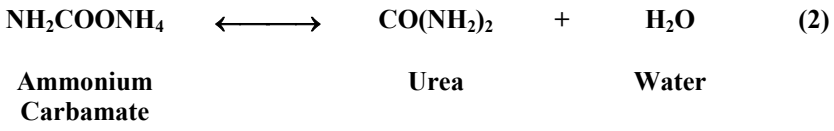
3.2.2.1 Urea

The commercial synthesis of urea involves compression of ammonia and CO_2 at 160-220 atm and 170 -190°C in an autoclave to form ammonium carbamate, which is subsequently dehydrated by application of heat to produce urea and water.

Step 1:



Step 2:



First reaction (1) is fast and exothermic and essentially goes to completion under the reaction conditions. Subsequent reaction (2) is slower and endothermic and does not go to completion. The conversion (on a CO_2 basis) is usually in the order of 50-80%. The conversion increases with increasing temperature and NH_3/CO_2 ratio and decreases with increasing H_2O/ CO_2 ratio.

The design of a commercial process involves the concept of total recycle and is based on three major considerations:

- To separate urea from other constituents
- To recover excess NH_3 and
- Decompose carbamate for recycling

The simplest way to decompose carbamate to CO_2 and NH_3 requires the reactor effluent to be depressurized and heated. This involved cooling of gases and re-combining them to form carbamate liquor, which was pumped back to urea reactor. A series of loops were used involving carbamate decomposers at progressively lower pressure and carbamate condensers. A basic result of recycling gases was that the NH_3/ CO_2 molar ratio in the reactor increased thereby increasing the urea yield.

Significant improvements were subsequently achieved by decomposing carbamate in the reactor effluent without reducing the system pressure. This stripping process dominated synthesis technology and offered capital/energy savings. Two commercial stripping systems were developed, one using CO_2, and other using NH_3 as the stripping gases.

The urea solution arising from synthesis and subsequent purification stages of the process is concentrated for prilling directly or diverted to granulation for production of urea prills or granules. In India all the urea plants are based on prilling and produce urea prills.

Improvements in process technology have concentrated on reducing production costs and minimizing environmental impacts. These include boosting CO_2 conversion efficiency,

increasing heat recovery, reducing utilities consumption and recovering residual NH_3 and urea from plant effluents. Some or all of these improvements have been used in updating existing plants while some plants have added computerized systems for process control. New urea installations vary in size from 800 to 3850 tonnes per day.

Block diagram for CO_2 and NH_3 stripping total recycle processes are as shown in figure 3.6 and 3.7 respectively.

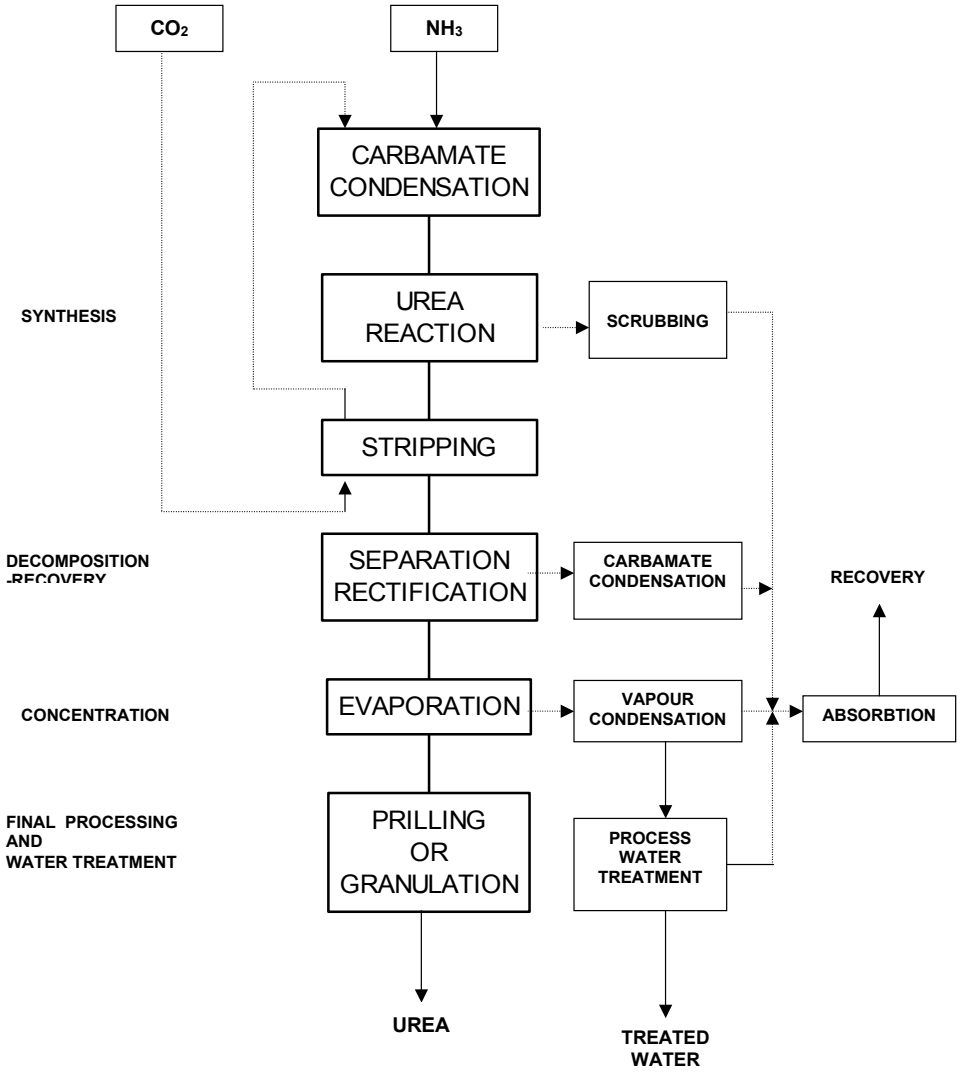


Figure 3-6: Block Diagram of a Total Recycle CO_2 Stripping Urea Process

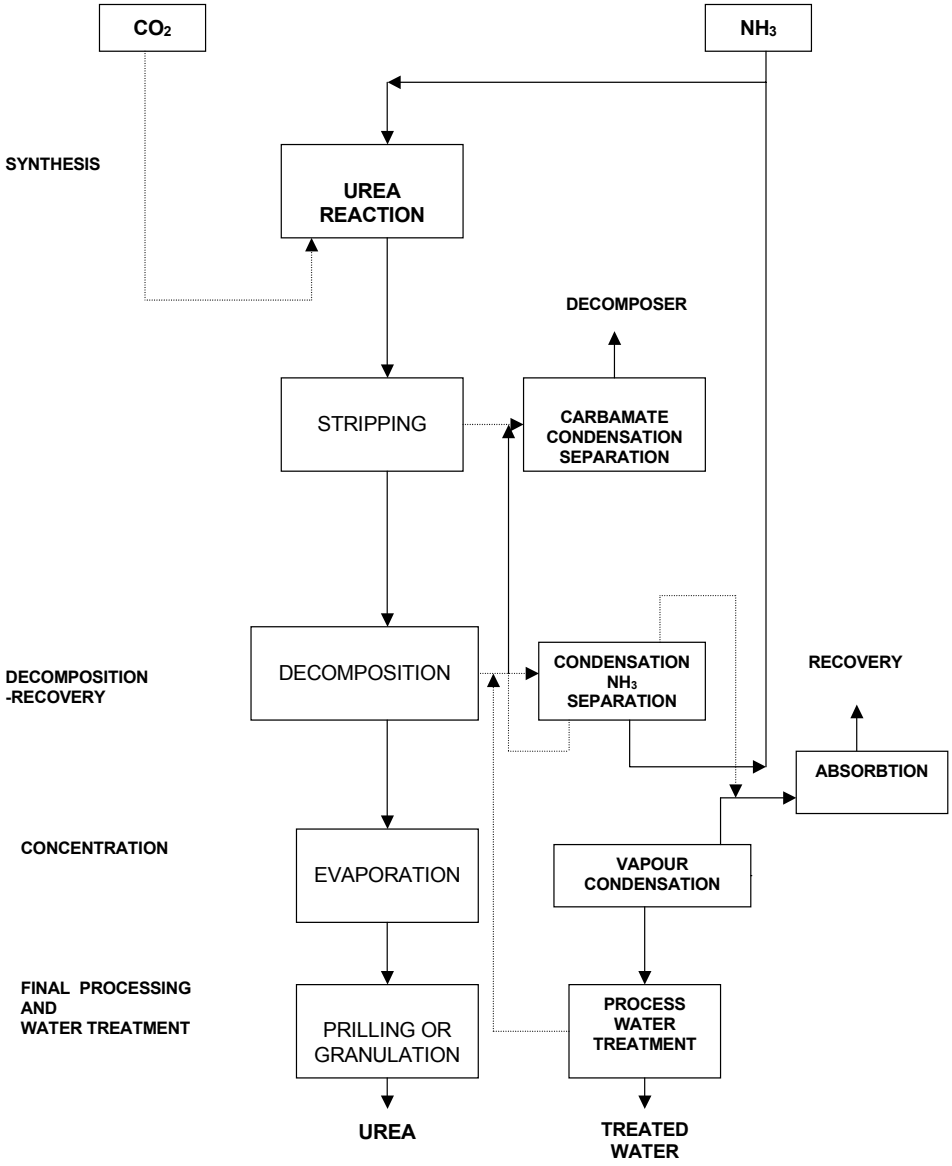


Figure 3-7: Block Diagram of a Total Recycle NH3 Stripping Process

3.2.2.2 Ammonium sulphate

Ammonium sulphate contains about 21% nitrogen and 24% sulphur and has traditionally been popular in various parts of the country. A number of methods are used for producing ammonium sulphate:

- Recovery from coke ovens: Coke oven gas (obtained when coal is heated to make coke) contains about 1% ammonia by volume. This gas is cooled and passed into saturators containing weak sulphuric acid. Ammonium sulphate crystals formed in the saturator are recovered, centrifuged, washed and dried. This process is used in 6 steel plants where large coke oven batteries are in operation.
- Direct neutralization: Gaseous ammonia is directly neutralized with sulphuric acid in saturator evaporator under vacuum or at atmospheric pressure to produce ammonium sulphate.

$2NH_3$	+	H_2SO_4	→	$(NH_4)SO_4$
Ammonia		**Sulphuric Acid**		**Ammonium Sulphate**

The neutralizer, reactor and the crystallizer are interconnected so that the heat released during neutralization is used to evaporate water in the slurry. Crystallizer is designed to produce uniform sized crystals. Ammonium sulphate is separated by centrifugation and the mother liquor is recycled back. The ammonium sulphate liquor is corrosive and hence corrosion inhibitors such as phos-acid or arsenic compound are added in some cases. Arsenic compound being highly toxic should not exceed the limit of 0.01% in the product.

Amorphous ammonium sulphate is prepared by reacting gaseous ammonia and sulphuric acid in spray towers. The heat of reaction removes all water present and the dry, fine product is continuously removed from the base of the tower. This product is suitable for making dry-mixed and granular fertilizers.

Gypsum process/ merseburg process: In this process CO_2 is absorbed in ammonium solution to form ammonium carbonate. Ammonium carbonate is then reacted with gypsum (calcium sulphate) to produce ammonium sulphate and calcium carbonate.

$$NH_3 + H_2O \rightarrow NH_4OH$$

$$2NH_4OH + CO_2 \rightarrow (NH_4)2CO_3 + H_2O$$

$$CaSO_42H_2O + (NH_4)2CO_3 \rightarrow (NH_4)2SO_4 + CaCO_3 + H_2O$$

Gaseous ammonia is absorbed in water and then converted to ammonium carbonate by absorbing CO_2. Ammonium carbonate is reacted with gypsum (calcium sulphate) to produce ammonium sulphate and calcium carbonate.

Calcium carbonate is removed by filtration. Ammonium sulphate solution is evaporated, crystallized, centrifuged and dried.

Naturally occurring gypsum or by-product gypsum from phosphoric acid plants can be used for this process.

During plant operation, it is important to control the pH within close range of 3 to 3.5 since lower pH results in thin crystals and excessive acidity also promotes over growth of crystals especially in pipelines. Insufficient acidity on the other hand, not only produces inferior crystals which are difficult to wash and store, but may also cause ammonia loss . The nutrient content of ammonium sulphate is also stochiometrically fixed and is not subjected to any variation. The acidity can be maintained as per the specification by proper washing of ammonium sulphate crystals and the moisture can be maintained by proper drying. Ammonium sulphate liquor is quite corrosive. Corrosion inhibitors such as arsenic compounds are added in some cases. Arsenic compound being highly toxic should not exceed the limit of 0.01ppm. To improve crystal size and shape, small quantity of trivalent metallic salts are added.

By-product ammonium sulphate from caprolactum: Ammonium sulphate solution is formed during the manufacture of caprolactum (the starting material for Nylon-6). The waste liquor containing 35% solution of ammonium sulphate is concentrated, and ammonium sulphate is recovered by crystallization, centrifuging and drying.

3.2.2.3 Calcium ammonium nitrate

Ammonium nitrate solution is first prepared by reacting preheated ammonia with nitric acid in a neutralizer. Ammonia is preheated to 85°C by vapours from the neutralizers which also preheat nitric acid to about 65°C. Ammonium nitrate liquor of 82-83% concentration, which is produced in the neutralizer, is concentrated to 92-94% in a vacuum concentrator heated with steam.

Concentrated ammonium nitrate is then pumped and sprayed over powered limestone and recycled material from the screen, in a rotary drum granulator. The hot granules are dried in a rotary drier by hot air.

Dried hot granules are screened. Fines and oversize granules after crushing are recycled back to granulator. Granules of proper size are cooled in a rotary cooler by air and coated with soapstone dust in a coating drum. The final product is sent to storage.

3.2.3 Phosphatic plants

3.2.3.1 Complex (NP/NPK) fertilizer plants

Compound or complex fertilizer means a fertilizer containing two or more nutrients during the production of which chemical reaction takes place. Details of various complex fertilizers manufactured in the country are given below:

(i) Ammonium phosphate sulphate

This is composed mainly of ammonium sulphate and ammonium phosphate with a nitrogen content of 16% and P_2O_5 content of 20% in the 16-20-0 grade. In the 20-20-0 grade, some urea is added to increase nitrogen to 20%. Raw materials required to produce ammonium phosphate sulphate are ammonia, phosphoric acid and sulphuric acid. To make ammonium phosphate sulphate (16:20:0), a mixture of 25-30% P_2O_5,, phosphoric acid and sulphuric acid is directly neutralized with the ammonia. The resulting slurry is granulated in a blunger. This produces a mixture of mono-ammonium phosphate and ammonium sulphate which are present in proportions of about 42% and 58% respectively. Ammonium phosphate sulphate has the same good physical property as the other ammonium phosphates, in addition to being a carrier of plant nutrient sulphur. In yet another process, ammonium sulphate solution is added to phosphoric acid and then the mixture is ammoniated. Urea can be added in the blunger for the 20-20-0 grade.

$$2NH_3 + H_3PO_4 \rightarrow (NH_2)2HPO_4$$

$$2NH_3 + H_2SO_4 \rightarrow (NH_4)2SO_4$$

(ii) Ammonium phosphates

Ammonium phosphates are highly concentrated sources of water soluble plant food. They can be easily mixed with most the other fertilizer materials and have favourable physical characteristics which make handling and application to the soil far easy. The ammonium phosphates are most readily soluble of all the phosphatic fertilizers and thus the phosphate content becomes immediately available to growing plants. The two most important ammonium phosphates are mono-ammonium phosphate (MAP) and

diammonium phosphate (DAP). Out of these two, the latter is about four times more soluble in water than the former.

- MAP is a rich fertilizer/intermediate with a high P_2O_5 content of 50-55% and nitrogen content of 10-12%. It is produced in powdered or micro pill form, as it is primarily meant as an intermediate to produce NP and NPK grade mixtures and granulated fertilizers. It is, however, not manufactured in India.
- DAP, 18-46-0, is a high analysis fertilizer containing 18% by weight of ammoniacal nitrogen and 46% by weight of P_2O_5. The P_2O_5 present in DAP is mostly water soluble. It is used all over India. Imported DAP is also used to meet the consumption demand in the country. DAP is extensively used and accounted for about 60% of total P_2O_5 produced in the country. Phosphoric acid of 40-54%, P_2O_5 concentration and ammonia are the raw materials. DAP is manufactured by reacting two moles of ammonia with one mole of phosphoric acid. Wet process phosphoric acid of about 40-42% P_2O_5 is partially neutralized (to about 89%) by anhydrous ammonia.

$2NH_3$	+	H_3PO_4	→	$(NH_4)2HPO_4$
Ammonia		**Phosphoric Acid**		**DAP**

The preliminary neutralization is done in a pre-neutraliser and the mole ratio of NH_3:H_3PO_4 is maintained around 1:4. The resultant slurry containing a mixture of DAP and MAP is metered into the ammoniator granulator. Fines from recycle system are also added into the ammoniator granulator. Ammonia is further added into the bed of granules through special spargers to increase the mole ratio of NH_3:H_3PO_4 to around two. The heat of reaction aids in removal of water vapour from the slurry. Over half of the water introduced in the process is evaporated in pre-neutralisation and more water is driven off in the ammoniator granulator. Any unreacted ammonia gas is then scrubbed with water and weak phosphoric acid, and returned to the pre-neutraliser. The granulator discharge is then dried, screened after thorough drying, cooled and conditioned by coating agent if necessary and then bagged. Oversize granules are ground and recycled back to granulator along with fines.

(iii) Nitro phosphate

The term nitro phosphate covers the range of fertilizers containing the nutrients N and P (along with potassium as required) produced with nitric acid treatment of rock phosphate. Ammonium nitrate is one of the principal components in the product. The nitro phosphate process is sulphur independent, more energy-efficient, has no by product disposal problem, raw material flexibility (variety of grades of rock phosphate can be used), *etc*.

The important raw materials required to produce nitro phosphate containing N-P are nitric acid, phosphoric acid, rock phosphate and ammonia. Depending on the process adopted, other materials like DAP, sulphuric acid and ammonium sulphate are also added. Potassium salt is added as necessary for NPK grades.

The basic principle of nitro phosphate manufacture is the acidulation of ground rock phosphate with nitric acid (53-60% concentration) in a series of reactors. The reaction mass contains calcium nitrate and phosphoric acid. The mixture can be converted into a solid granulated/prilled fertilizer by three or four important methods, and depending on the method adopted, the water soluble P_2O_5 content and the N-P ratio in the final product can be varied significantly.

$Ca10(PO_4)_6$	+	$20HNO_3$	→	$6H_3PO_4$	+	$10Ca_2(NO_3)$	+	$2HF$
Rock Phosphate		**Nitric Acid**		**Phos Acid**		**Calcium Nitrate**		**Hydrogen Fluoride**

(iv) Urea ammonium phosphates (UAP)

Fertilizers manufactured by using urea, ammonia and phosphoric acid are called the UAPs. Solid urea helps to augment the nitrogen content supplied by ammonia. Phosphoric acid, ammonia and urea are the raw materials.

Ammonia and phosphoric acid in the required proportions are reacted in the pre-neutraliser. The resulting ammonium phosphate slurry is pumped to the granulator. Here, the nitrogen content is further increased by adding more ammonia and solid urea. Filler (sand or dolomite) may be added as desired, depending upon the grade. The granulator discharge is then dried, screened, cooled and coated with a coating agent, to prevent caking.

(v) NPK complex fertilizers

There are 11 NPK grades based on nitrate, urea and ammonium phosphate. The NPK grades produced and marketed in the country are 15-15-15, 17-17-17, 10-26-26, 12-32-16, 22-22-11, 14-35-14, 17-17-17 (with urea N), 14:28:14, 15:15:15 (with urea N), 19-19-19, and 20:10:10. NPK complex Fertilizers are solid Fertilizers in the form of uniform granules commonly referred to by a sequence of three numbers, the first of which represents the per cent nitrogen expressed as N; the second the per cent phosphorus expressed as available P_2O_5; the third-, the per cent potassium expressed as soluble K_2O. These fertilizers are very convenient to use, because they contain all the three primary plant nutrients in the desired proportions.

Required raw materials are phosphoric acid, ammonia, potash and urea to increase the nitrogen content where necessary. Fillers (sand, dolomite, *etc*.) and coating agents (clay, soapstone, *etc*.) are also required for certain grades. Ammonia and phosphoric acid (48-54% P_2O_5) in the required proportions are metered to the pre-neutraliser and the resultant ammonium phosphate slurry is pumped and distributed in a granulator over a bed of recycled material. The granulator can be a blunger or a rotating drum. Ammoniation is continued in the granulator to get required N:P ratio. Solid materials like urea, filler (sand or dolomite) and potash are also added to make up the required product formulation. The granulator discharge is then dried, screened, cooled and coated with a coating agent (clay or powdered soapstone) to improve the storage properties. A flow sheet for the process is shown in Figure 3-8.

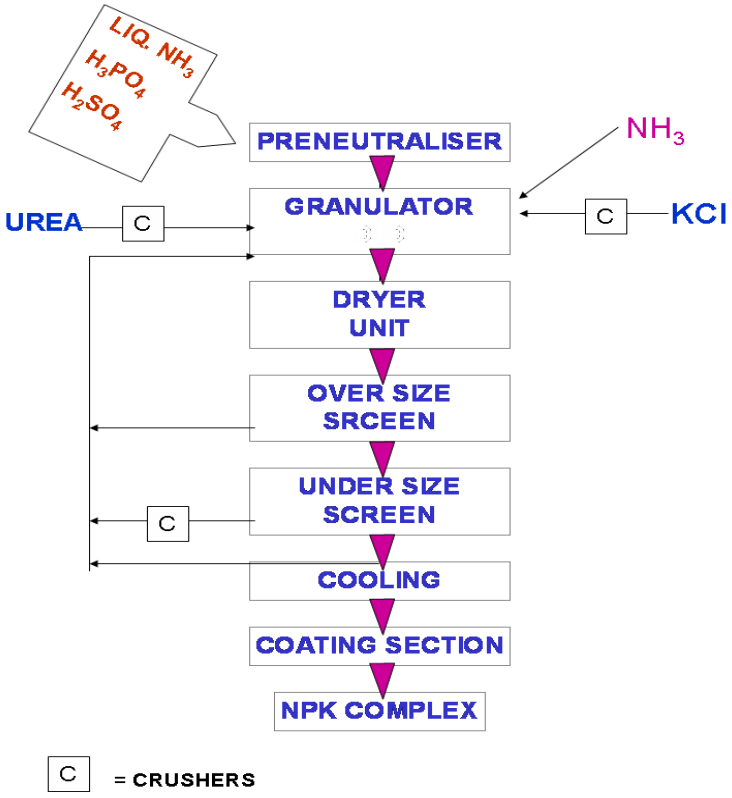


Figure 3-8: Block Diagram for NP/NPK Production Process

3.2.3.2 Developments in the technology of complex fertilizer production

(i) Pipe reactors

In conventional slurry granulation, phosphoric acid is neutralized in a discrete reaction vessel, the preneutraliser, wherein the mole ratio of NH_3:H_3PO_4 is controlled at about 1:4 for high solubility. The reaction heat evolved is considerable, and the reactor has to be cooled to prevent uncontrollable boiling and maintain the operating temperature at around 110-120°C. There is little potential for reusing this low grade heat elsewhere. To improve the conventional process of DAP making, the pre-neutralizer is replaced with the pipe reactor.

Ammonia and phosphoric acid react violently together in a short length of pipe which discharges through one or more spray nozzles directly into the granulator. A slight pressure builds up in the pipe and raises the operation temperature to the region of 150°C for ammonium phosphate systems. Residence time is extremely short. The combination of heat and pressure let-down evaporates the maximum amount of water from the reaction slurry. Pipe reactor technology provides a means of utilizing the reaction heat to flash off much of the water from the reaction solution inside the granulator, reducing dramatically the heat requirement for subsequent drying.

Presently, there are several pipe reactor granulation systems in commercial use. These processes differ in details. All of them can be used for the production of granulated MAP and DAP. In DAP production, all pipe reactor systems are prone to ammonia slippage, sometimes as high as 10-15% but this can be recovered by high efficiency scrubbers, using the phosphoric acid process feed. Because of the greatly reduced energy need for

drying and also the vastly increased throughputs for granulators, these systems have resulted in very significant reductions in operating costs.

(ii) Granulation process

Processes developed for production of granular complex NPKs mostly involve chemical reactions, immediately before granulation either in pre-neutraliser or in pipe reactor. However, in many cases reaction is also carried out in granulator to optimize the characteristic of each product formulation. There are essentially three broad types of systems: phosphate-based, nitrate or urea-based, or nitro phosphate-based. Phosphate-based systems for NPK production are similar to those for ammonium phosphates, with the addition of other ingredients, such as urea, ammonium nitrate, and potassium chloride to achieve the desired product analysis. In such processes, care must be taken with certain combinations of ingredients, such as urea and TSP,; but, in general higher capacities can be achieved compared to DAP, because of the reduced evaporation load. For high-nitrogen requiring NPK formulations, granulation circuits were developed based on ammonium nitrate solution, with the addition of phosphate and potash components as required. These systems were also based on agglomeration with liquid phase and subsequent drying. By using concentrated solutions of ammonium nitrate and also urea, melt granulation processes were developed for NPK production, where solidification is based on cooling rather than drying.

There are basically four processes of manufacturing granulated fertilizers which are listed below:

- Bulk blending: Bulk blending technology refers to physical mixing of fertilizer material usually finished products like urea, DAP, MAP, *etc*.
- Compaction granulation: Compaction techniques have been developed in which dry, finely divided powders are bound together into large particles by the application of mechanical force, using pressure roller compaction machine or similar devices. The dry materials are first weighted in right proportion to achieve the requisite nutrient grade and thoroughly mixed. Compaction has proved to be useful method for granulating dry materials.
- Steam granulation: In steam granulation, the finely divided solid raw materials are proportioned and thoroughly mixed to achieve the designed nutrient ratio and granulated. The granulation is usually a rotary drum type or pugmill-type granulator. Steam, and/or water is introduced to provide sufficient liquid phase and plasticity to cause the dry raw materials to agglomerate and compact into particle size granules. The moist granules are dried in a rotary drum type dryer, cooled and screened. The off size material is recycled back to the granulator.
- Chemical granulation: Most of the commercial processes available for granulation of urea can also be used for NP/NPK complex fertilizer.

3.2.3.3 Single super phosphate (SSP)

SSP is the most important single nutrient phosphate fertilizer produced in India. It contains about 16% P_2O_5 in water soluble form and 12% sulphur. SSP has traditionally been very popular in various parts of the country. At present, SSP is produced in 73 plants in India.

Raw materials required to produce SSP are rock phosphate and sulphuric acid. Imported as well as indigenous rock phosphate is used for SSP manufacture.

Ground rock phosphate (90% passing through 100 mesh) of 30-35% P_2O_5 content is mixed with sulphuric acid (65-70% strength) in a specially designed mixer. The reaction proceeds in two steps. First, the sulphuric acid reacts with part of the rock forming phosphoric acid. Then the phosphoric acid formed reacts with more rock forming monocalcium phosphate. The two reactions take place concurrently but the first stage is completed rapidly while the second stage continues for several days or weeks. The fluid material from the mixer goes to a den where it solidifies. The solidification results from continued reaction and crystallization of monocalcium phosphate. The superphosphate is excavated from the den after 30 minutes to four hours. At this time, the superphosphate is still somewhat plastic and the temperature is around 100°C. This product is removed from the den and conveyed to storage for final curing which requires 2-6 weeks depending on the nature and proportion of raw material and condition of manufacture. The cured product is reclaimed, milled, screened and either bagged for marketing or sent for granulation.

$Ca_3(PO_4)_2$	+	$2H_2SO_4$	+	H_2O	→	$Ca(H_2PO_4)_2$	+	$2CaSO_4$
Rock Phosphate		**Sulphuric acid**		**Water**		**Monocalcium Phosphate**		**Calcium Sulphate**

In most of the SSP plants, fluorine compounds generated in the mixer/dryer is recovered by scrubbing with water or dilutes alkali as hydrofluorosilicic acid and is recycled back to the mixer which reduces the sulphuric acid consumption.

3.3 Environmental Aspects of Concern

3.3.1 Effluent and emissions generated from fertilizer plants

Effluent and emissions generated from fertilizer plants including utilities are given in the Table below:

Table 3-2: Effluents from Fertilizer Industry

Plants	Liquids	Gases
Ammonia	▪ Process condensate bearing Ammonia & methanol from steam reformation of NG/Naphtha ▪ Oil bearing effluent from pumps and compressor section, leakages and washings of equipments, *etc* ▪ Effluent bearing absorbent chemicals like K_2CO_3, methanol, DEA MEA, glycerin, *etc*., from carbon dioxide removal section owing to leakage spillage from the system ▪ Carry over from gasification process using fuel oil, containing suspended carbon, sulphide, vanadium, *etc*	▪ Flue gas containing mainly CO_2, SO_2, NO_x and particulate from primary reformer stack ▪ CO_2 ▪ Purge gas from synthesis gas section ▪ H_2S from rectisol wash unit
Urea	▪ Process condensate containing urea, ammonia and CO_2 from vacuum concentration section ▪ Effluents containing mainly oil from carbon dioxide compression section, leakages from pumps and washings of	▪ Dust from prilling tower and product handling ▪ Ammonia fumes from the prilling tower and scrubbers

Plants	Liquids	Gases
	equipments	
Sulphuric acid	▪ Waste heat boiler blow down and acidic wastewater due to spillage, leakage and washing of the plant and equipments	▪ Off gases containing acid mist and SO_2 from the absorption tower stack
Phosphoric acid	▪ Effluent bearing phosphate and fluoride and suspended solid purged from recycle scrubber ▪ Hydrofluorosilicic acid containing condensate generated from the vacuum concentration section ▪ The gypsum pond overflow containing fluoride, phosphate and suspended solids	▪ Dust from rock handling and grinding section ▪ Fluoride compounds emitted from fume scrubbers
Nitric acid	▪ Small quantity of boiler blow down and acidic wastewater from spillage, leakage and washing of the plant and equipment	▪ NO_x bearing gas emitted from absorption tower stack
SSP	▪ Effluent bearing phosphate, fluoride and SS from the scrubber	▪ Emission of fluoride compounds from acidulation of rock phosphate ▪ Dust emission from rock grinding and handling section ▪ During curing of the product, dust and fluoride compounds are released
	▪ Effluent containing ammonia, nitrate, fluoride, phosphate and SS from scrubber used for controlling emissions ▪ Effluent containing ammonia, nitrate phosphate and SS due to spillage leakage, washing, *etc*	▪ Rock Phosphate dust from grinding mill ▪ NO_x, F and dust from reaction vessel ▪ NH_3 from calcium nitrate tetra-hydrate section, acid neutralization and ammonium nitrate evaporation section, prilling tower / granulator ▪ Dust from prilling tower, granulator, product cooling section, drying section, *etc*
DAP/APS/UAP	▪ Wastewater from draining and washing of equipment; leakages from pump glands	▪ NH_3 and small quantity of fluoride compounds from neutralization and granulation operation ▪ Dust emission from drying, screening and cooling section
NPK	▪ Wastewater from draining and washing of equipment; leakages from pump glands	▪ Dust from drying, screening and cooling section ▪ Fluoride compounds & ammonia fumes from neutralization and granulation operation
De-mineralization of Water	▪ Acidic and alkaline effluents arising from regeneration of ion exchangers in DM plant	▪ Nil
Steam and Power Generation	▪ Boiler blow down containing high total dissolved solids (TDS) and conditioning chemicals like hydrazine/sodium sulphite, sodium phosphate, *etc*	▪ Flue gas discharged through the boiler house stack; may contain particulate matter, NO_x, SO_2, *etc*., depending up on the fuel used like coal, NG, F.O/naphtha, *etc*
Cooling Water Treatment System	▪ Blow down bearing phosphates, biocides, *etc*	▪ Nil

3.3.2 Processes adopted for treating effluent and emissions generated during the production of intermediates and fertilizers

3.3.2.1 Liquid effluents

A. Ammoniacal effluent

A significant quantity of ammoniacal effluent is discharged from the nitrogenous fertilizer plant which requires treatment (for reducing the ammoniacal nitrogen content) before disposing into receiving bodies to avoid pollution and also recover ammonia. The technology available for the removal of ammoniacal nitrogen is:

- Stripping (air and steam)
- Ion-exchange
- Reverse osmosis
- Chlorination
- Biological nitrification and de-nitrification

Of these, only steam stripping is most widely and successfully used for stripping ammonia from the ammoniacal effluent discharged from the nitrogenous fertilizer plants. Ammonia in the nitrogenous fertilizer plant effluent is contributed mainly by the process condensate which is formed while cooling of the synthesis gas. The concentration of ammonia in the process condensate depends up on the age and temperature of the shift catalyst and the process conditions. The process condensate is first steam-stripped, stripped overhead may be either incinerated or condensed to recover aqueous ammonia or injected into the primary reformer stack. In the fertilizer plant, the stripped overhead containing ammonia is scrubbed with dilute phosphoric acid. The scrubbed liquid is used for complex fertilizer production and portion is sent to the sulphuric acid plant for neutralizing the effluent. The scrubbed gas is vented to the atmosphere. The stripped process condensate is used as a cooling tower make up and as boiler feed water, after passing it through an activated carbon filter and caution polisher.

B. Urea plant effluent

The largest source of liquid pollution in Urea plant is process condensate formed in the concentration section while Urea is evaporated under vacuum. The evaporated process water is condensed in surface condensers and the resultant process condensate contains about 5-6% ammonia and 1% urea. This condensate is treated in MP/deep hydrolyser-stripper where free CO_2 and ammonia are stripped out along with the CO_2 and the ammonia formed by the hydrolysis of urea in the hydrolyser. While the overhead condensate is partly refluxed and partly recycled to the LP condenser for reuse, the stripped process condensate containing about 2 ppm urea and 5 ppm ammonia is reused as Boiler Feed Water after polishing. The Deep Hydrolyser Stripper combination yields maximum recovery of CO_2 and Ammonia from the process condensate and very pure condensate. Almost all urea plants in India have installed urea hydrolyser-stripper to their facilities. In two of the fuel oil based plants, the process condensate is first stripped off ammonia and then subjected to conventional biological nitrification and de-nitrification process for urea hydrolysis.

Of the above treatment options use of hydrolyser stripper is preferred since urea recovered as ammonia and CO_2 whereas in the biological treatment system urea is lost to the atmosphere as nitrogen.

C. Oil-bearing effluent

The main sources of oil in the fertilizer factory effluent are the oil unloading, storage and pumping sections. The other source is the pumps and compressors bay. In general, the proportion of emulsified oil is low w.r.t. the total quantity of the oil present in the effluent. Therefore, under normal conditions, emulsion breaking by treatment is not necessary. Further, these oil and greases are almost insoluble in water. Being lighter than water, oil and grease float on the surface of the water. In certain cases, to take care of oil emulsion, coagulant and coagulant aids are used.

For the removal of oil and grease, usually mechanical gravity type oil separators are used. These gravity separators are provided with suitable type of oil skimmers and the skimmed oil is recovered, reconditioned and reused.

D. Effluent-bearing absorbent chemicals from CO_2 removal sections

Depending on the type of the CO_2 absorption process adopted, arsenic, MEA, methanol or vanadium arise in the effluent. Most of the new plants have gone in for glycine and secondary amine based vetrocoke process or benfield CO_2 removal process. Plants with arsenic-based CO_2 removal process have switched over to other processes in order to totally eliminate the use of arsenic.

Normally, the quantity of MEA or methanol which finds its way out in the effluent is quite low and does not pose any problem of pollution. Under normal operating conditions of the plants usually no specific treatment is necessary for MEA and methanol.

The quantity of vanadium discharged from the CO_2 absorption system is quite low and as such no specific treatment is usually required.

E. Fluoride and phosphate

Almost all effluents in NPK and DAP plants are recycled back into the process. A small quantity of effluent released from leaks, washings, *etc*., is collected in a tank and sent to phosphate and fluoride removal plant.

The main sources of effluent from the phosphoric acid plant are the scrubber liquors generated through scrubbing of gases, gypsum pond water and floor washings. The effluent is collected and treated with lime slurry to raise the pH from 4 to 5, when most of the fluoride gets precipitated as calcium fluoride. The contents of the tanks are fed to a clariflocculator. The solids settled at the bottom are separated and filtered. The filtrates and the overflow from the clariflocculator is treated with more lime to raise the pH to 9-10. At this pH, most of the phosphates and fluorides are precipitated as calcium salt and are separated in clariflocculator. The overflow from the clariflocculator is sent to the effluent balancing pond for pH correction and then reused.

F. Nitro-phosphate effluent

The effluent from nitro phosphate plant contains ammoniacal nitrogen, phosphates, fluorides, nitrate nitrogen, SS *etc*., and requires a series of treatments for removal of pollutants. The liquid effluent from nitro phosphate is first sent to equalizing tanks to avoid shock loading and then subjected to air stripping to remove ammoniacal nitrogen. Further, the phosphate and fluorides are removed in two stages with lime. Finally the nitrate is removed from the effluent by biological de-nitrification. A source of organic

carbon is provided in the reactor and especially cultured bacteria breaks nitrate and nitrite to nitrogen and oxygen which escapes to atmosphere.

Biological treatment was the only available option for removal of nitrate from the effluent. Consequently all the three nitro phosphate plants have adopted biological treatment system.

3.3.2.2 Gaseous emissions

A. Prilling tower dust

One of the major sources of dust emission is the urea prilling tower. The prilling tower is either of induced draft, forced draft or natural draft type. The natural draft prilling tower is designed for an effective free fall height of 75 feet to minimize particulate dust emission (maximum dust content of 40 mg/nm^3) as against forced draft prilling tower. By and large plants commissioned prior to 1982 are forced draft prilling towers, while the newer plants have natural draft prilling tower. In addition, in new plants de-dusting system could be provided at the top of prilling tower to bring down the emission level further to 15 mg/Nm^3. The de-dusting system consists of two stages scrubbing system and has provision for circulation of lean urea solution for dust scrubbing and demister flushing. The circulating urea solution of about 10% concentration is recirculated to urea process. The treated effluent is used as makeup for this system. In old generation plants with induced draft and forced draft prilling tower, the prilling towers have been equipped with the dust collector of porous resin construction with a mist eliminator and water washing of urea dust to minimize dust emission. Installation of acoustic granulator and use of improved prilling tower buckets have also helped in reducing dust levels considerably.

Lot of urea dust is emitted during product handling like falling from one conveyor to another, screening, de-lumping, bagging, *etc*. To recover the dust, wet de-dusting systems are installed. In the dust recovery system urea particles suspended in the air system are dissolved into water. The system is designed for inlet dust concentration of 8 gm/m^3 of air and outlet dust concentration less than 50 mg/m^3 of air. Urea solution of 2-3% concentration from the de-dusting system is recirculated in the plant.

B. Hydrogen sulphide

The ammonia plant based on gasification of fuel oil produces a large quantity of hydrogen sulphide when the fuel oil contains high sulphur (2.5 to 4.2%). The hydrogen sulphide formed is recovered by washing gases with methanol. Upon regeneration of methanol, H_2S is liberated which is converted to elemental sulphur through claus process.

C. Sulphur dioxide

The major source of sulphur dioxide emission is the sulphuric acid plant. The sulphur dioxide level in the stack in simple conversion single absorption process normally is over 2000 ppm due to the low conversion efficiency of SO_2 to SO_3 in the converter. The adoptions of the double conversion double absorption (DCDA) process increase the conversion efficiency to 99.5% and hence the production, while the SO_2 level in the effluent gas is reduced to 500-600 ppm. Higher conversion efficiency can be achieved by using 5th bed or using caesium catalyst in 4th bed.

D. Acid mist

Acid mist is produced in the sulphuric acid plant by the reaction of SO_3 present in a small portion with moisture present in the plant. Mist is very stable and forms visible and persistent plume in the stack gas. Acid mist may be removed by electrostatic precipitator but being expensive and not always very easy to maintain in perfect operating condition, is not preferred. The acid mist eliminator is ideally suited and commonly used. Elimination of mist (by mist eliminator) is effected after the intermediate absorption and also after final absorption. The DCDA system with a mist eliminator can bring down the emission level of SO_2 to 500 ppm and the mist to 30 ppm.

E. Oxides of nitrogen (NOx)

The tail gases from the nitric acid plant containing unabsorbed NOx are the main sources of emission. Extended absorption and chilling process and selective catalytic reduction have been adopted to reduce NOx concentration in the tail gas and increase acid production. Catalytic reduction is the most widely accepted NOx abatement process. In the weak nitric acid plant, dinitrogen oxide (N_2O) is produced as an undesirable by-product. It is a greenhouse gas (GHG) and has global warming potential of 310. For reducing the N_2O emission from nitric acid plant, secondary N_2O abatement catalyst is used.

F. Particulate matter

The steam raising plant using coal or coal yard or coal handling system throws off coal dust. This is tackled by providing the dust extracting system. The coal dust recovered is reused.

Particulate matter is emitted due to various plant operations like grinding and handling of rock phosphate, drying, cooling and storing of fertilizer and also from urea plant. Wet grinding, wet and dry collectors are the control equipment used for collecting particulate matter. The dry type equipment includes a settling chamber, a centrifugal and inertial separator, a fabric collector and an electrostatic precipitator. The wet type equipments are gravity spray separator, dynamic precipitator, venture scrubber and wet centrifugal scrubber.

G. Fluoride emission

The rock phosphate containing 4% fluoride liberates fluoride compound during the acidification of rock phosphate. The process of concentration of phosphoric acid releases fluoride compound and the nitro phosphate plant emits NOx and fluoride compound. In the super phosphate plant and the phosphoric acid plant, the fluoride is released as HF and silicon tetra fluoride (SiF_4). SiF_4 further reacts with either hydrofluoric acid to form hydrofluorosilicic acid or with water to form hydrofluorosilicic acid and silicon dioxide.

The gaseous effluent from the phosphoric acid plant is scrubbed in a specially designed scrubber. In SSP plant and phosphoric acid plant multi-stage scrubbers are used to absorb more than 99% of the fluoride. The hydrofluorosilicic acid formed is converted to sodium-silico fluoride, aluminum fluoride or cryolite, *etc*., or recycled to the acidulation section for conversion of rock phosphate to single super phosphate/phos acid.

Thus, it may seem that most of the liquid effluents have been adequately treated to recover useful material and the treated wastewater has been put to reuse. In case of

gaseous emission measures have been adapted to reduce pollution at source and in some cases waste materials emitted have been recovered and reused.

3.3.2.3 Solid waste

Waste minimization/utilization/disposal and elimination of the use of toxic substances play a crucial role in environment management practices. The fertilizer industry is seized with the problem of utilization/disposal of waste generated in fertilizer production. The wastes generated and the sources of waste in the fertilizer manufacturing process are given in Table 3-3 below.

Table 3-3: Solid Waste generated from the Fertilizer Industry & their Sources

Sl. No.	Solid Waste	Sources
1	Spent Catalyst	The process of manufacture of ammonia involves several steps. In almost all the steps catalysts are used. Catalyst is also used in synthesis of sulphuric acid. These catalysts have different life
2	Carbon Slurry	The carbon waste is basically generated in ammonia plants based on either fuel oil or coal. In ammonia plants based on partial oxidation of fuel oil, during gasification of oil, about 2% carbon is left unburnt and thus large quantity of carbon is produced everyday
3	Waste Oil	Waste oil is collected from spillages, leakages and washings from oil unloading, storage, pumping section, pumps and compressor bays
4	Acid/Alkaline Waste	By and large the acid and alkaline waste is generated in demineralization plants and acid plants
5	Fly Ash	Some of the fertilizer plants have captive power plants based on coal. Such plants generate fly ash and it is recovered through electrostatic precipitators.
6	ETP Sludge	ETP Sludge is produced from ETP
7	Sulphur Sludge	In the sulphuric acid plant, sulphur sludge is the major waste product
8	Hydrofluorosilicic Acid (H_2SiF_6)	In the manufacture of phosphoric acid and SSP, fluorine present in the rock phosphate is released on acidification. The released fluorine is scrubbed with water to generate Hydrofluorosilicic acid, which is a strong acid
9	Phosphogypsum	Phosphogypsum is the by-product in the manufacture of phosphoric acid. For every tonne of phosphoric acid manufactured, approximately 4.5-5 tonnes of gypsum are generated
10	Chalk	Chalk is produced as a by-product from nitro phosphate plants
11	Other Wastes like Silica, Scrap, Lime sludge	Solid waste like silica generated in the fluorine scrubbing system during the formation of hydrofluorosilicic acid

Almost all fertilizer plants generate wastes either hazardous or non-hazardous in some form or other. Efforts have to be continuously made to minimize/recycle/utilize the waste

produced and also eliminating the use of toxic substances to make fertilizer production eco-friendly.

The manners in which they are handled and disposed off currently are dealt with, in the following paragraphs.

a) Spent Catalyst

The catalysts used in ammonia plant have different life ranging from 5 to 10 years. The life span of new generation catalysts is longer. By using these new generation catalysts, changing catalysts has become less frequent nevertheless catalyst wastes are generated. Waste generated is sold to authorized waste processes for metal recovery and reuse. Catalysts having no buyers may be sent to TSDF.

Table 3-4: Typical Life of Different Catalyst in Ammonia Plants

Sl. NO.	Section	Catalytic System	Catalyst supplier Guarantee (Years)	Typical Catalyst Life Achieved in Operation
1	Hydro-desulphurization	CoO-MoO-Al_2O_3 CoO-NiO- Al_2O_3	5	5
2	Desulphurization	ZnO	2	2
3	Primary gas reforming	NiO- Al_2O_3	3	5
4.	Primary naphtha reforming	NiO support	3	5
5.	Secondary Reforming	NiO- Al_2O_3	3	10
6.	High Temp. shift	Fe2O3-Cr_2O_3 Fe_2O_3- Cr_2O_3-CuO	3	8
	Low Temp. Shift	CuO-ZnO- Al_2O_3	2	4-5
8.	Methanation	NiO-Al_2O_3	3	10
9.	Ammonia Synthesis	Fe_3O_4-K_2O-Al_2O_3-CaO	5	10

In the phosphatic plant category only sulphuric acid plants generate vanadium pentoxide (V_2O_5) catalyst waste. V_2O_5 has an expected life of 5-9 years. There are no buyers for V_2O_5 catalyst waste so it is sent to TSDF or stored in plant premises.

b) Carbon Waste

Fuel oil-based plants basedon shell power generate carbon waste since they are based on 80% carbon recycle whereas plants based on Texaco process recycle 100% carbon. The carbon waste generated is usually by mixing it with oil and burning it in the boiler or stored in lined lagoons and sold for use in downstream industries like rubber, dyes, *etc*. The carbon waste generation will be totally eliminated when these plants switch over to gas feedstock (by end of 2010). New greenfield plant based on fuel oil is unlikely to come up in future.

c) Waste Oil

The waste oil generated is processed and reused in the plant or sold to authorized agencies.

d) Fly ash

The quantum of fly ash varies depending upon the coal quality (ash content). Of late, there has been a growing demand for fly ash which is utilized in the manufacture of cement, bricks, reclamation of USAR farm land and also for landfilling.

e) Effluent treatment plant (ETP) sludge

Sludge from ETP is used as manure or stored in lagoons.

f) Sulphur sludge

The sulphur sludge generated depends on the quality of sulphur and is mostly used as filler in the complex fertilizer plants and SSP plants since sulphur is secondary nutrient.

g) Hydrofluorosilicic acid

Hydrofluorosilicic acid produced in phosphoric acid and SSP plant is reused for acidulation of rock phosphate. As a result sulphuric acid is saved, besides utilization of hydrofluorosilicic acid. In some of the plants hydrofluorosilicic acid is converted to AlF_3, cryolite/fluoride chemicals.

h) Phosphogypsum

The production of phospho gypsum per tonne of phosphoric acid depends on the quality and the source of the rock. Phosphogypsum is mostly sold to cement manufactures, used in agricultural as soil conditioner and for making gypsum board/panel, *etc*., and a considerable quantity is stored in the plant premises.

i) Chalk

Quantum of chalk generated also depends up on quality of the phosphate rock. Chalk generated is either used for making CAN or sold as such.

j) Silica & lime sludge

Silica or lime sludge is used as filler.

3.4 Technical Aspects

The Indian fertilizer industry kept pace with the fast developments in fertilizer technology taking place elsewhere in the world. Cleaner technologies, improved design features and innovative measures were adopted to conserve resource and minimize pollution. The adoption of more efficient technological processes geared towards greater energy efficiency and production efficiency also helped in preventing pollution at source. Thus all technological advancements have led to cleaner production. Retrofitting and revamping of the existing plants adopting innovative measures and process modifications,

recovery of valuable products, substitution of toxic and hazardous materials with non-toxic materials, *etc*., have helped in achieving cleaner production.

Clean technologies which are available for adoption by new plants and already incorporated by some of the existing plants are given below.

- Installation of S-50 converter with new horizontal boiler and steam drum to save energy
- Installation of low NOx burner
- CO_2 recovery plant to tap CO_2 from flue gases to increase urea production and reduce CO_2 emission
- Installation of energy efficient two stage CO_2 removal system
- Non-arsenic based CO_2 removal plant
- Installation of liquid ammonia wash tower to purify makeup gas
- Installation of purge gas recovery (PGR) unit
- Improve steam generation efficiency by efficient burners, control of excess air and micro processor based instrumentation
- Installation of hydrolyser stripper for recovery of urea, NH_3 and CO_2 and conserve water through recycle of treated water
- Installation of DCS system and optimizer to maximize production and minimize energy consumption and also to operate plant under most stable and optimum condition
- Use of Non-chromate based cooling water treatment
- Installation of pre-decomposer and pre-concentrator unit in urea plant for energy saving
- Installation of additional trays in urea reactor for energy savings
- Installation of dry dedusting system at transfer points
- Installation of N_2O abatement system in nitric acid plants
- Adoption of dual pressure process (high pressure absorption and medium pressure oxidation) for nitric acid production to improve production efficiency
- Adoption of catalytic reduction for reducing NOx in the tail gas
- Use of pipe reactor technology for NP/NPK complex Fertilizer production for capacity enhancement
- Use of DCDA process of sulphuric acid production with 5^{th} bed or 4^{th} bed with better catalyst
- Use of caesium promoted catalysts for improving SO_2 to SO_3 conversion efficiency
- Multi-stage scrubbing system for reduction of ammonia/particulate matter/fluoride, *etc.*
- Installation of high efficiency cyclones for reduction in dust emission

3.5 Environmental Management Aspects

In addition to adoption of cleaner technologies, certain measures that may be adopted for minimizing environmental impacts are:

A. Nitrogenous fertilizer plants

- New ammonia plants should preferably be based on natural gas, subject to availability of gas
- Industry should select low GHG emission technologyies
- Adequate capacity holding tanks with recovery/reuse facility shall be provided for storing the reactor and loop draining during plant setup conditions. The capacity of holding tanks shall be sufficient to hold two consecutive drainings
- Stormwater drain and effluent channels should be independent and two effluents should not be mixed
- Flow meters should be installed for measuring the input water and wastewater discharge from the battery limit
- In addition to monitoring of the groundwater quality around the plant, periodic monitoring of groundwater should be carried out around the place where the wastewater from the battery limit is discharged
- Non-chromate cooling water treatment should be adopted
- Arsenic should not be used as inhibiter or anti-corrosive agent in CO_2 removal section

B. NP/NPK complex fertilizer plants including acid plants

- Sulphuric acid plants should be DCDA plants and should have 5^{th} or 4^{th} bed with better catalyst
- The nitric acid plant should preferably have dual pressure process in view of higher conversion efficiency of ammonia into acid. Also should install N_2O abatement system to reduce GHG emission
- Scrubber should be installed to control the excessive SO_2 emission during startup and shutdown conditions of plant
- Continuous SO_2 monitoring in sulphuric acid plants with 200 tonnes per day (TPD) capacity and above
- In the phosphoric acid plant, emission of fluoride compounds from the reactor is recovered as hydrofluorosilicic acid. The use of recovered hydrofluorosilicic acid for making fluoride chemicals should be explored and encouraged
- Complex fertilizer plants having captive phosphoric acid plant should monitor the stormwater quality for pH and fluoride
- Spent catalyst (V_2O_5) should be sent to authorized recyclers or TSDF
- Plants should have proper plan for utilization of phosphogypsum. Gypsum stored in the pond should be properly managed *i.e.*, pond wall bunding, impervious lining of pond and recycle sump, catch drain, secondary catch drain, ground water monitoring, *etc*., should be implemented
- Sulphur sludge generated in sulphuric acid plant should be used as filler in NP/NPK complex fertilizer since sulphur is secondary nutrient to alleviate the sulphur deficiency prevalent in Indian soils

- New nitro phosphate plant installing biological treatment technology for removal of nitrate nitrogen should ensure complete de-nitrification
- Lime sludge and biological sludge should be analyzed for hazardous constituents and then disposed off as per the Hazardous Waste (Management and Handling) Rules, 1989 as amended
- Plants generating chalk waste should draw plan for 100% utilization of chalk
- Stack height should be provided on the basis of normal plant operations for sulphuric acid plants
- Adequate control systems should be provided to achieve norms on total fluoride (gaseous and particulate)

C. SSP plant

- SSP plants should be designed for zero discharge and minimal particulate emission in the grinding unit
-
- Adequate control systems should be provided to achieve norms on total fluoride (gaseous and particulate)
- Stack height should be provided on the basis of normal plant operations for sulphuric acid plants
- Spent catalyst (V_2O_5) should be sold to authorized recyclers or sent to TSDF
- The sulphur sludge generated in sulphuric acid plant should be used as filler in SSP fertilizer since sulphur is secondary nutrient to alleviate the sulphur deficiency prevalent in Indian soils

D. General

- Captive power plant based on coal should maximize utilization of fly ash in cement manufacturing, brick manufacturing and agricultural application
- Good housekeeping practices should be in place
- Ammonia, urea, and NP/NPK plant effluent contains plant nutrient nitrogen and P_2O_5; hence preferably be used for irrigation purpose
- Regular monitoring for ambient air for prescribed parameters as applicable should be carried out besides groundwater monitoring for applicable parameters
- Plant should go in for voluntary initiatives like ISO 14001, OSHAS 18001, GHG reduction projects, CDM, *etc*.

3.6 Summary of Applicable National Regulations

3.6.1 General description of major statutes

A comprehensive list of all the laws, rules, regulations, decrees and other legal instruments which are notified under Environment (Protection) Rules in 1986 and relevant to chemical fertilizer industry is annexed as **Annexure I**.

3.6.2 General standards for discharge of environmental pollutants

General standards for discharge of environmental pollutants as per CPCB is given in **Annexure II**.

3.6.3 Industry-specific requirements

A. Environmental standards

- In order to regulate the discharge of effluent and emission from fertilizer industries, the effluent and emission standards were notified under Environment (Protection) Rules in the year 1986. These standards are given as **Annexure III (A-E), IV** and **V (A & B).**
- Fertilizer industries generate solid wastes and some of these wastes are hazardous in nature. The provisions of hazardous Waste (Management and Handling) Rules, 1989 and amendments made therein are applicable to hazardous wastes generated from fertilizer industries.

3.6.4 Charter on corporate responsibility for environment protection (CREP) in fertilizer industry

During 2003, the CPCB and the fertilizer industry worked out a mutually acceptable charter on CREP. The industry agreed to implement the action points of the charter within the time limit mutually agreed upon. The action points of the charter are annexed in **Annexure V(C).**

3.6.5 The proposed regulatory requirements

The government is in the process of revising the existing environmental protection standards and also incorporating new standards for some of the pollutants.

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 other technical guidance for conducting objective oriented EIA report, its review and decision making. Besides, the Notification also classifies projects into Category A, which require prior environmental clearance from MoEF and Category B from SEIAA/UTEIAA.

Consistency with other requirements

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

4.1 Coverage of Chemical Fertilizers under the Purview of Notification

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

- Category A: all projects except single super phosphate.
- Category B: all projects having single super phosphate.

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. Each stage in the process of prior environmental clearance for the chemical fertilizers is discussed in subsequent sections. 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.

In case of Expansion or Modernization of the developmental Activity:

- Any developmental activity, which has an EIA clearance (existing project), 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.

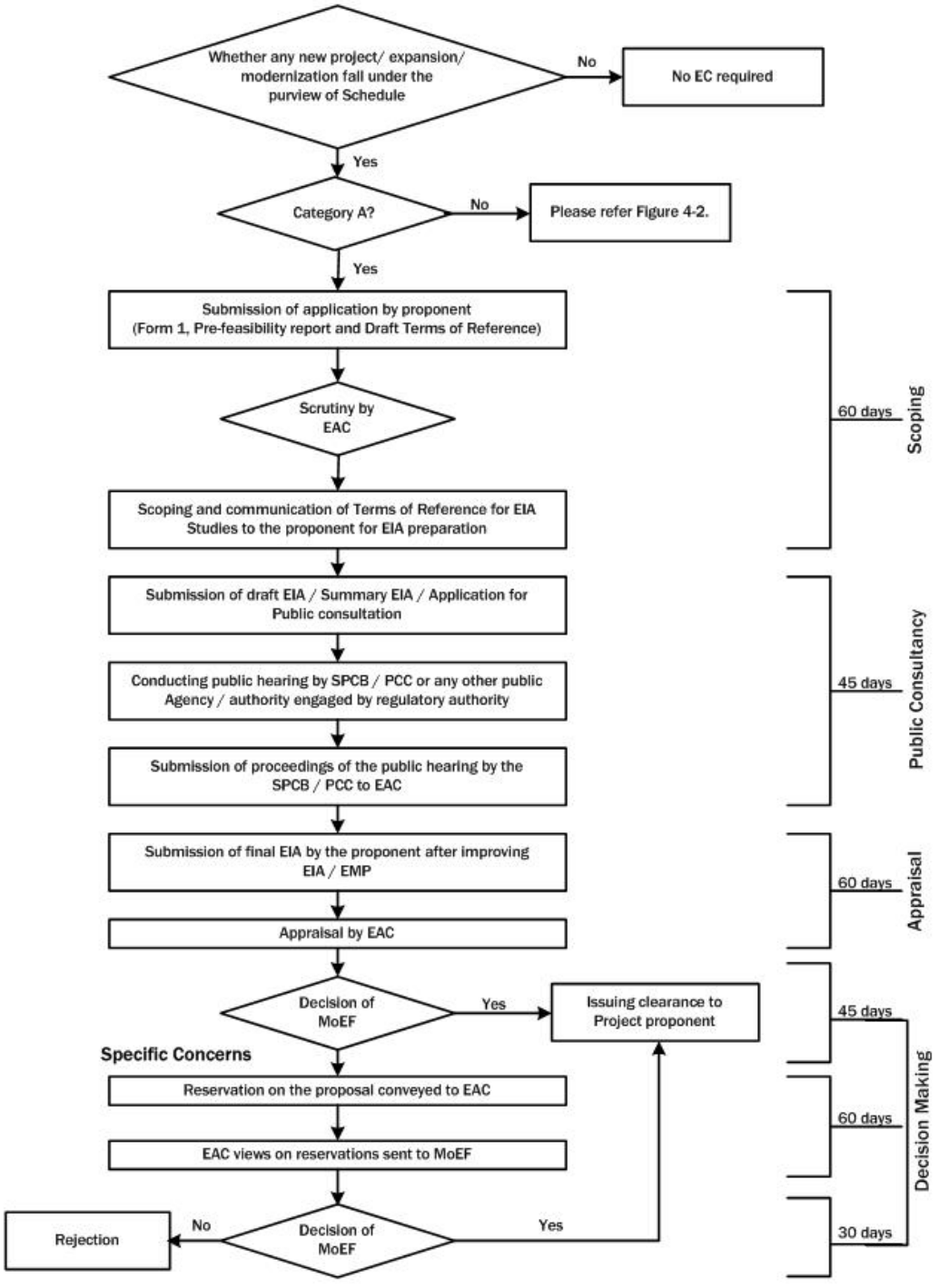


Figure 4-1: Prior Environmental Clearance Process for Activities Falling Under Category A

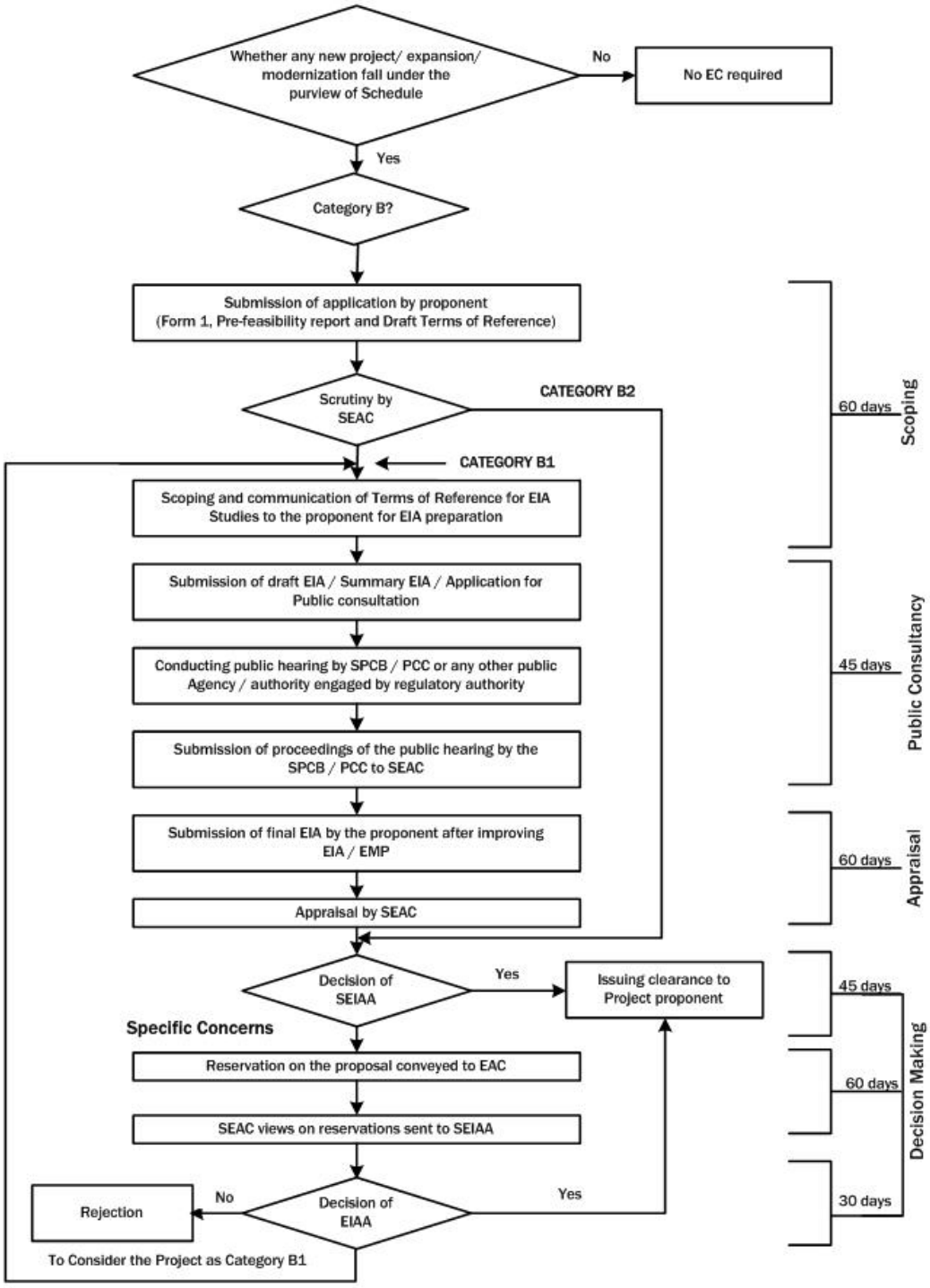


Figure 4-2: Prior Environmental Clearance Process for Activities Falling Under Category B

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 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

General condition:

- Any chemical fertilizer plant having single super phosphate (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 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 chemical fertilizer industry/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 screening for 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 in Form 1 given in **Annexure VI**. The proponent has to submit the filled in Form 1 along with pre-feasibility report and draft ToR for EIA studies to the concerned Authority *i.e.*, the MoEF for Category A projects. Please refer subsequent sections for the information on how to fill Form 1, contents of pre-feasibility report and draft ToR for chemical fertilizer industry.
- 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 line (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 by 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 major settlements notified limit of any major settlement is found to be as 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 VII**)

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.
- Enough space should be provided for storage of recyclable solid wastes so that these could be available for possible reuse.
- Layout 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 concerns and issues which are important to project decisions. Besides, scoping defines the requirements and boundaries of an EIA study.

Scoping refers to the process by which 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, determines 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 VI**) 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 provides a summary of 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 (receiving environment/social components, which are likely to get effected due to the project operations/ activities).
  - Once the project details from pre-feasibility report & Form 1; and VECs are identified, a matrix establishing interactions which can lead to 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 need to be studied further (quantitative analysis) in subsequent EIA studies. All such points find a mention in the draft ToR to be proposed by the project proponent. The draft ToR shall include applicable baseline parameters (refer annexure X) and impact prediction tools (refer annexure XII) 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 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 formulate a sub-committee for a site visit, if considered necessary. The sub-committee will act up on receiving a written approval from the Chairperson of EAC/SEAC concerned. Project proponent will 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 their 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 the 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 representative SEIAA to the EAC to present their views, if any at the stage of scoping.
- The final set of ToRs 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 final and will be approved for EIA studies.

- Final ToR for EIA studies shall be displayed on websites of the MoEF/SEIAA.
- Applications for prior environmental clearance may be rejected by the concerned Authority based on the recommendation by the 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 w.r.t 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 materials, technology options, efficiency, 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 chemical fertilizer plant is located/proposed. However, the environmental information to be furnished in the pre-feasibility report may include:

- Project description, including in particular:
  - a description of the physical characteristics of the whole project and the landuse requirements during the construction and operational phases
  - a description of the main characteristics of production processes, for instance, nature and quantity of the 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 operation of the proposed project
- 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.
- A description of environment as aspects 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 project
  - use of natural resources – specific consumptions
  - emission of pollutants, creation of nuisances and elimination of waste, and description by the developer of the forecasting methods used to assess the effects on environment
- A description of key measures envisaged to prevent, reduce and where possible offset any significant adverse effects on environment
- A non-technical summary of information provided under the above headings

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

Besides, depending on the scope defined in pre-feasibility report, some pre-feasibility reports are based on various studies and data collection and addresses in detail the concern as technical & economical analysis and detailed feasibility level design of equipment, process optimization, economic, financial, social and environmental investigations, cost estimates with detailed bill of quantities (BOQ). The components identified here focuses on the requirements of scoping for EIA study. Additional points which may be covered in the pre-feasibility report besides the points discussed above are listed in **Annexure VIII**.

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. Form 1 requires information within 15 km around the project, whereas actual study area for EIA 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 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	▪ Map the impacts spatially and displays them pictorially	▪ Easy to understand ▪ Good to display	▪ Addresses only direct impacts ▪ Does not address

	Description	Advantages	Disadvantages
	▪ Useful for comparing site and planning alternatives for routing linear developments ▪ Can address cumulative effects ▪ Information incentive	method ▪ Good siting tool	impact duration or probability
GIS	▪ Maps the impacts spatially and displays 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
ENVIRONMENT	COMPONENT	Project Activities / Parameter/ factor	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	Fluoride Pollution Issues, imbalance of nutrients in soils and Eutrophication	Fluoridation of Chemicals	Phosphogypsum Stacks	Wastewater Issues	Fluoride & Radon Air Emissions from Waste Ponds	Radiation Hazards	Phosphate Mining Operations
Physical	**Soil**	Erosion Risks															*			
		Contamination												*	*		*			
		Soil Quality												*	*		*			
	Resources	Fuels/ Electricity						*					*							
		Construction material- stone, aggregates																		
		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												*	*		*	*		

			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
		Temperature																		
	Air	Air quality											*	*		*		*		*
		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												*			*		*	
		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												*						

			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
		Income for the state and private sector																		*
		Savings for consumers & private consumers																		
		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	Temporary			*												*			
		Chronic														*		*		
		Acute												*					*	
	Cultural	Land use							*			*						*		*
		Recreation												*						
		Aesthetics and human interest		*	*	*			*	*			*	*	*	*	*	*		*
		Cultural status																		

Note:

1. Above table represents a model for likely impacts, which will have to be arrived at on a 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.

1. Will there be a large change in environmental conditions?
2. Will new features be out-of-scale with the existing environment?
3. Will the effect be unusual in the area or particularly complex?
4. Will the effect extend over a large area?
5. Will there be any potential for trans-frontier impact?
6. Will many people be affected?
7. Will many receptors of other types (fauna and flora, businesses, facilities) be affected?
8. Will valuable or scarce features or resources be affected?
9. Is there a risk that environmental standards will be breached?
10. Is there a risk that protected sites, areas, features will be affected?
11. Is there a high probability of the effect occurring?
12. Will the effect continue for a long time?
13. Will the effect be permanent rather than temporary?
14. Will the impact be continuous rather than intermittent?
15. If it is intermittent will it be frequent rather than rare?
16. Will the impact be irreversible?
17. 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 checklist. The questions are designed so that an 'Yes' answer in column 3, will generally point towards the need for analyzing for the significance and requirement for conducting an impact assessment for the effect.

4.3.6 Terms of Reference for EIA studies

ToR for EIA studies in respect of chemical fertilizer 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, its availability and optimization.
4. Details of proposed layout clearly demarcating various units within the plant.
5. Complete process flow diagram describing each unit, its processes and operations, along with material and energy inputs and outputs (material and energy balance).
6. Details on requirement of raw materials, its source and storage at the plant.
7. Details on requirement of energy and water along with its source and authorization from the concerned department.
8. In case the water source for the plant is groundwater then management of high TDS reject from DM plant.
9. Details on water balance including quantity of effluent generated, recycled & reused. Efforts to minimize effluent discharge and to maintain quality of receiving water body.
10. 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.
11. Details of the proposed methods of water conservation and recharging.
12. Details of proposed source-specific pollution control schemes and equipments to meet the national standards.
13. Details of fluorine recovery system in case of phosphoric acid plants to recover fluorine as hydrofluorosilicic acid (H_2SiF_6) and its uses.
14. Sources of secondary emissions, its control and monitoring as per the CPCB guidelines.
15. Management plan for solid/hazardous waste generation, storage, utilization and disposal. Ex. Disposal of by products viz., chalk, spent catalyst, hydrofluorosilicic acid and phosphogypsum, sulphur muck, *etc*.
16. Adoption of measures taken to achieve zero discharge during dry season in case of complex fertilizer plant (DAP/NPK excluding acid plants) and also SSP. Adoption of cleaner and energy-efficient technologies. (Higher emphasis on energy efficiency in case of nitrogenous plants and resource conservation in case of complex fertilizer plants).
17. In case of existing plants going for expansion, details of the programmes undertaken for the protection of occupational health of the workers.
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 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 10 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. Landuse 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 fallign within the study area.
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. Surface water quality of nearby water sources such as dam/river, *etc*. and other nearby surface drains.
29. Details on ground water quality.
30. Details on existing ambient air quality and expected, stack and fugitive emissions for PM10, PM 2.5, Urea dust*, NH_3*, SPM*, SO_2*, NOx*, HF*, F*, *etc*., and evaluation of the adequacy of the proposed pollution control devices to meet standards for point sources and to meet AAQ standards. (* - As applicable)
31. 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.
32. AQM studies for the proposed fertilizer plant.
33. Details on noise levels at sensitive/commercial receptors.
34. Details on existing water quality paramters such as pH, Ammoniacal Nitrogen, Total Kjeldhal Nitrogen, Free Ammoniacal Nitrogen, Nitrate Nitrogen, Cyanide as CN, Vanadium as V, Arsenic as As, Suspended Solids, Oil and Grease,* Cr as Cr+6,* Total Chromium as Cr, *etc*.
35. Site-specific micro-meteorological data including mixing height.
36. One season site-specific data excluding monsoon season.
37. Proposed baseline monitoring network for the consideration and approval of the Competent Authority.
38. Ecological status (terrestrial and aquatic) of the study area such as habitat type and quality, species, diversity, rarity, fragmentation, ecological linkage, age, abundance, *etc*.
39. If any incompatible land use attributes fall within the study area, proponent shall describe the sensitivity (distance, area and significance) and propose the additional points based on significance for review and acceptance by the EAC/SEAC. Incompatible land use attributes include:

    - Public water supply areas from rivers/surface water bodies, from 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.

40. If ecologically sensitive attributes fall within 10 km from the project boundary, proponent shall describe the sensitivity (distance, area and significance) and propose the additional points based on significance for review and acceptance by the EAC. Ecological sensitive attributes include:

- National parks
- Wild life sanctuaries Game reserve
- Tiger reserve/elephant reserve/turtle nesting ground
- Mangrove area;
- Wetlands
- Reserved and protected forests, *etc*.
- Any other closed/protected area under the Wild Life (Protection) Act, 1972, any other area locally applicable

41. If the location falls in valley, specific issues connected to the management of natural resources management shall be studied and presented.

Anticipated environmental impacts and mitigation measures

42. 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).
43. 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.
44. 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 on surface water, soil and groundwater
- impacts due to air pollution on orchards, prime agricultural land, *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

45. Proposed odour control measures.
46. Hazard identification taking resources to hazardous indices, inventory analysis, natural hazardous probability, *etc*., Consequent analysis of failure and accidents resulting in release of hazardous substances.
47. Details on surface as well as roof top rainwater harvesting and groundwater recharge.
48. Action plan for the greenbelt development – species, width of plantations, planning schedule *etc*., in accordance to CPCB published guidelines.
49. 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.
50. For identifying the mitigation measures, please refer Chapter III for source control and treatment. Besides typical mitigation measures which may also be considered are discussed in Table 4-5.

Analysis of alternative resources and technologies

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

Environmental monitoring program

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

Additional studies

59. Details on risk assessment and damage control during different phases of the project and proposed safeguard measures.
60. Details on socio-economic development activities such as commercial property values, generation of jobs, education, social conflicts, cultural status, accidents, *etc*.
61. Proposed plan to handle the socio-economic influence on the local community. The plan should include quantitative dimension as far as possible.
62. 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.

63. 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.

Environmental management plan

64. Administrative and technical organizational structure to ensure proposed post-project monitoring programme for approved mitigation measures.
65. 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).
66. Allocation of resources and responsibilities for plan implementation.
67. 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 4-7).

4.4 Environmental impact assessment

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

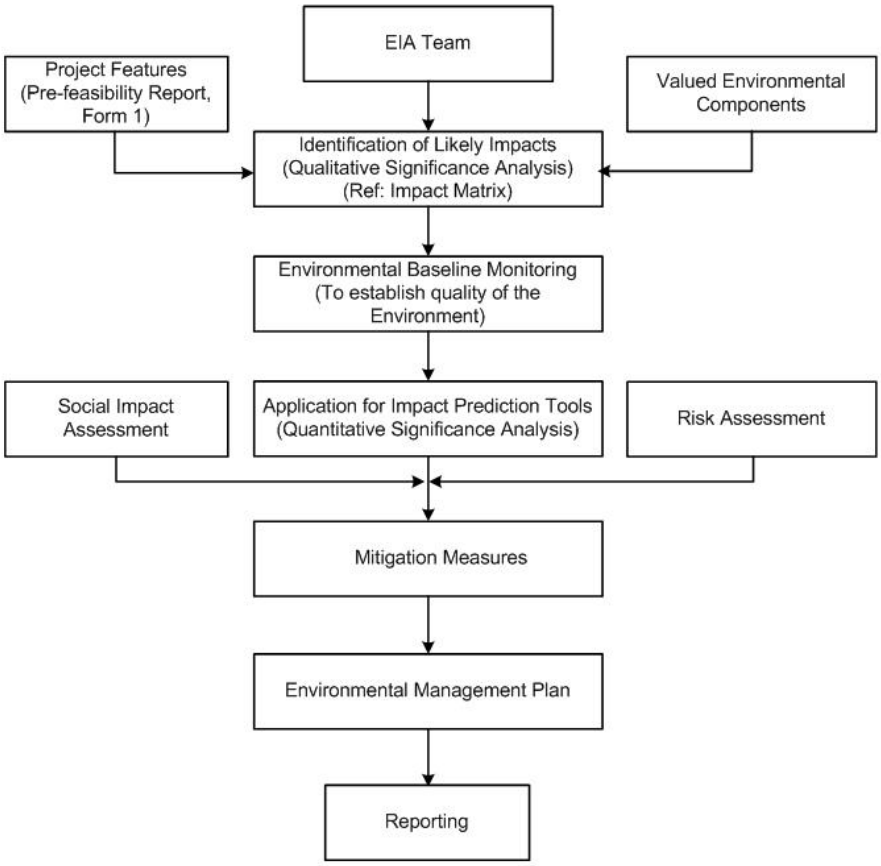


Figure 4-3: Approach for EIA Study

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/environmental regulator
- Air and Noise quality expert
- Occupational health
- Geology/geo-hydrology
- Ecologist
- Transportation specialist
- Safety and health specialist
- Social scientist
- Agronomy
- Chemical Engineer
- Civil Engineer, *etc.*

4.4.2 Baseline quality of the environment

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

Description of the existing environment should include the natural, cultural, socio-economic systems and their inter-relationships. 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 chemical fertilizer project activity.

4.4.2.1 Objective 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; and
- 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 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 on the monitoring objectives specified for the selected area of interest. Types of monitoring and network design considerations are discussed in **Annexure IX**.

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 ▪ Stability conditions and mixing height, etc.
Geology	▪ Underlying rock type ▪ Surgical material ▪ Geologic structures (faults, shear zones, *etc*.) ▪ Geologic resources (minerals, *etc*.)
Topography	▪ Slope form ▪ Landform and terrain analysis ▪ Specific landform types, etc.
Coastal dynamics and morphology	▪ Wave patterns ▪ Currents ▪ Shoreline morphology – near shore, foreshore ▪ Sediment – characteristics and transport, etc.
Soil	▪ Type and characteristics ▪ Porosity and permeability ▪ Sub-soil permeability ▪ Run-off rate ▪ Effective depth (inches/centimeters)

Environmental Component	Environmental Indicators
	▪ Inherent fertility ▪ Suitability for method of sewage disposal, etc.
Drainage	▪ Surface hydrology ▪ Drainage network ▪ Rainfall runoff relationships ▪ Hydrogeology ▪ Groundwater characteristics – springs, *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 ▪ 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*.
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 X**.

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 and 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 environmental monitoring program. Statistical methods used to analyze 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 certain 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 sources of secondary data are provided in **Annexure XI A** and **Annexure XI B**.

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, designing & developing EMPs, and monitoring programs. The more accurate the predictions, the more confident the EIA practitioner will be in prescribing specific measures to eliminate or minimize the adverse impacts of development project.

Choice of models/methods for impact predictions in respect of air, noise, water, land, biological and socio-economic environment are precisely tabulated in **Annexure XII**.

4.4.4 Significance of impacts

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

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

One common approach is based on determination of the significance of predicted changes in the baseline environmental characteristics and compares these w.r.t regulatory standards, objective criteria and similar ‘thresholds’ as eco-sensitivity, cultural /religious values. Often, these are outlined in guidance. A better test proposed by the CEAA (1995) is to determine if ‘residual’ environmental effects are adverse, significant, and likely (given under). But at this stage, the practice of formally evaluating significance of

residual impacts, *i.e.*, after predicting the nature and magnitude of impacts based on before-versus-after-project comparisons, and identifying measures to mitigate these effects is not being followed in a systematic way.

i. Step 1: Are the environmental effects adverse?

Criteria for determining if effects are 'adverse' include:

- Effects on biota health
- Effects on rare or endangered species
- Reductions in species diversity
- Habitat loss
- Transformation of natural landscapes
- Effects on human health
- Effects on current use of lands and resources for traditional purposes by aboriginal persons; and
- Foreclosure of future resource use or production

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

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

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

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

Criteria for determining 'likelihood' include:

- Probability of occurrence, and
- Scientific uncertainty

4.5 Social Impact Assessment

Social impact assessment is the 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 minimizing or 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 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 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. Social analysis 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 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 inclusion of 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 socio-economic 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 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 People 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. Where possible, participatory monitoring mechanisms shall be incorporated. The framework should:

- 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 operation of the project. Indicators should be of such a nature that results and impacts can be disaggregated by gender and other relevant social groups
- define transparent evaluation procedures. Depending on context, these may include a combination of methods, such as participant observation, key informant interviews, focus group discussions, census and socio-economic surveys, gender analysis, participatory rural appraisal (PRA), participatory poverty assessment (PPA) methodologies, and other tools. Such procedures should be tailored to the special conditions of the project and to the different groups living in the project area; Estimate resource and budget requirements for monitoring and evaluation activities, and a description of other inputs (such as institutional strengthening and capacity building) needs to be carried out.

4.6 Risk Assessment

Industrial accidents result in great personal and financial loss. Managing these accidental risks in today's environment is the concern of every industry including chemical fertilizers, 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 decisions 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 /update 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
- Disaster Management Plans

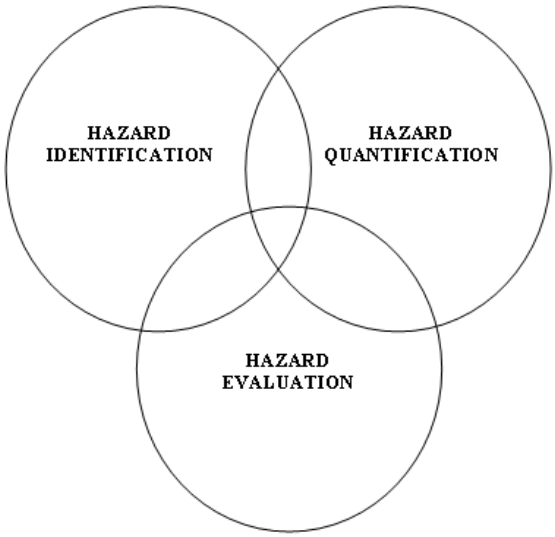


Figure 4-4: Risk Assessment – Conceptual Framework

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 predicted models for risk assessment.

Table 4-4: Guidance for Accidental Risk Assessment

Name	Application	Remarks
EFFECT WHAZAN	Consequence Analysis for Visualization of accidental chemical release scenarios & its consequence Consequence Analysis for Visualization of accidental chemical release scenarios & its consequence	Heat load, press wave & toxic release exposure neutral gas dispersion
EGADIS	Consequence Analysis for Visualization of accidental chemical release scenarios & its consequence	Dense gas dispersion
HAZOP and Fault Tree Assessment	For estimating top event probability	Failure frequency data is required
Pathways reliability and protective system hazard analysis	For estimating reliability of equipments and protective systems	Markov models
Vulnerability Exposure models	Estimation of population exposure	Uses probit equation for population exposure
F-X and F-N curves	Individual / Societal risks	Graphical Representation

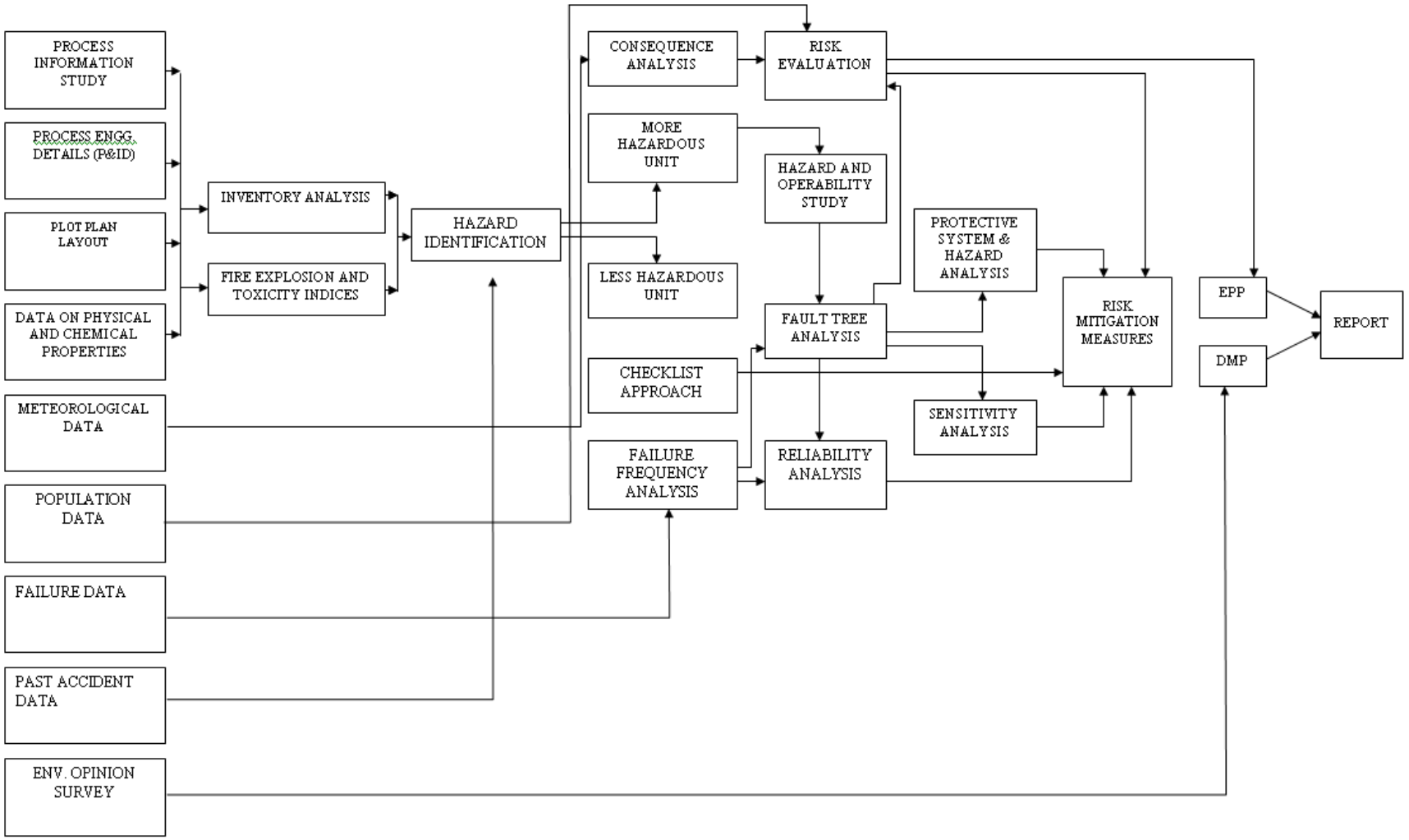


Figure 4-5: Comprehensive Risk Assessment at a Glance

4.6.1 Disaster management plan

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

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

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

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

- Effective rescue and medical treatment of casualties
- Safeguard other people
- Minimize damage to property and the environment
- Initially contain and ultimately bring the incident under control
- Identify any dead
- Provide for the needs of relatives
- Provide authoritative information to the news media
- Secure the safe rehabilitation of affected area
- Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the emergency

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

DMP should include Emergency Preparedness Plan, Emergency Response Team, Emergency Communication, Emergency Responsibilities, Emergency Facilities, and Emergency Actions

Emergency preparedness plan

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

- Assignment of duties and responsibilities among the authorities, participating agencies, response team, their coordinators and/or those responsible for the pollution incident
- Relationship with other emergency plans
- A reporting system that ensures rapid notification in the event of a pollution incident
- The establishment of a focal point for coordination and directions connected to the implementation of the plan
- Response operations should always cover these four phases:

  - Discovery and alarm
  - Evaluation, notification and plan invocation
  - Containment and countermeasures
  - Cleanup and disposal
- Identification of expertise and response resources available for assistance for the implementation of plan
- Directions on necessary emergency provisions applicable to the handling, treatment or disposal of certain pollutants
- Link to the local community for assistance, if necessary
- Support measures, such as procedures for providing public information, carrying out surveillance, issuing post-incident reports, review and updating of the plan, and periodic exercising of the plan.

Emergency response

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

- The exposure of workers should be limited as much as possible during the operation
- Contaminated areas should be cleaned and if necessary disinfected
- Limited impact on the environment at the extent possible

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

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

Response team

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

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

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

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

Response to injuries

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

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

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

Emergency communication

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

Emergency responsibilities

The responsibilities of the key personnel should be defined for the following:

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

Emergency facilities

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

Emergency actions

- Emergency warning
- Evacuation of Personnel
- All Clear Signal
- Public information and warning
- Coordination with local authorities
- Mutual aid
- Mock drills

4.7 Mitigation Measures

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

4.7.1 Important considerations for mitigation methods

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

- The predicted adverse environmental as well as social impacts for which mitigation measures are required, should be identified and briefly summarized along with cross referencing them to the significance, prediction components of the EIA report or other documentation.

- Each mitigation measure should be briefly described w.r.t the impact of significances to which it relates and the conditions under which it is required (for example, continuously or in the event of contingencies). These should also be cross-referenced to the project design and operating procedures which elaborate on the technical aspects of implementing the various measures.
- Cost and responsibilities for mitigation and monitoring should be clearly defined, including arrangements for coordination between 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-effectivity, 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, such as substituting a hazardous chemical with a non-hazardous one, or the re-cycling or re-use of waste materials, *etc*.

Other generic measures

- Extend education facility and vocational training to the children of the neighbouring villages
- Extend hospital facilities for adjacent villages and provide community with water supply
- Develop community projects to improve rural economy, health and sanitation standards, animal husbandry, *etc*
- Conduct mass awareness programmes for villagers, township residents and employees about the chemicals / raw materials being used in the plant, emergency preparedness of the industry, *etc*
- Develop green belt / greenery in and around the plant
- Develop infrastructure like roads, power supply, transport, *etc*
- Adopt rainwater harvesting to recharge the ground water
- Adopt accredited Environment Management Systems: ISO 14001, OHSAS – 18001

4.7.2 Hierarchy of elements of mitigation plan

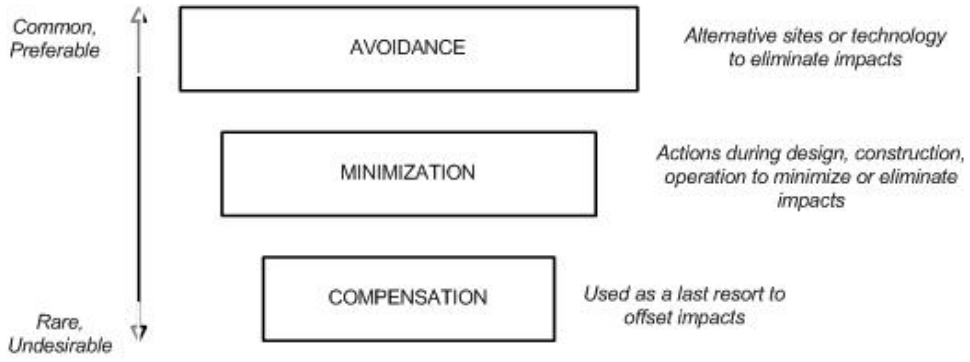


Figure 4-6: Hierarchy of elements of mitigation plan

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

Important compensation elements

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

In kind compensation

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

4.7.3 Typical mitigation measures

Choice of location for the developmental activity plays an important role in preventing the adverse impacts on the surrounding environment. Detailed guidelines on siting of industries are provided in Section 4.2. However, if the developmental activity still produces any 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 the 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 the 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. This information may be used to draw appropriate control measures applicable at source.

The choice of interventions for mitigation of impacts may also be numerous and depend on various factors. Mitigation measures based on location-specific suitability and some other factors are discussed in sub-sections 4.7.1 and 4.7.2. A few typical measures which may also be explored for mitigation of impacts are listed in Table 4-5 and Table 4-6

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 sludge 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 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 malodors 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 re-entrained particles ▪ Control vehicle speed on sight ▪ Ensure periodical washing of construction 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 paneling 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/replacing 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 conservation measures ▪ Implementation of greenbelt for noise attenuation 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 sufficient counseling 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 compliance conditions before discharging wastes into the sea water ▪ Have a post-dregding monitoring programme in place ▪ Take up periodic maintenance dredging including inspection of sub-sea conditions, etc.
Occupational health and safety	▪ Provision of worker camps with proper sanitation 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 communicable diseases. ▪ Arrangement to dispose off the wastes at approved disposal sites. ▪ Provide preventive measures for potential 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 minimize odour, pest and litter impacts ▪ Prohibit burning of refuse onsite.

Management of cooling effluents from Scrubbing Tower

Washwater from the scrubbing towers may contain toxic substances like arsenic, monoethanolamine, potassium carbonate *etc*., in a nitrogenous fertilizer plant, while that in a phosphatic fertilizer plant may contain a mixture of carbonic acid, hydrofluoric acid and hydroflousilicic acid. Both alkaline and acidic wastes are also expected from the boiler feed water treatment, the wastes being generated during the regeneration of anion and cation exchanger units. Scrubbing towers result in high rates of water consumption, as well as the potential release of high temperature water. Recommended water management strategies include:

- Adoption of water conservation opportunities for facility cooling systems
- Use of heat recovery methods (also energy efficiency improvements) or other cooling methods to reduce the temperature of heated water prior to discharge to ensure the discharge water temperature does not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which

takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity among other considerations

- Minimizing use of anti-fouling and corrosion inhibiting chemicals by ensuring appropriate depth of water intake and use of screens. Least hazardous alternatives should be used with regards to toxicity, biodegradability, bioavailability, and bioaccumulation potential. Dose applied should accord with local SPCB requirements and manufacturer recommendations

Testing for residual biocides and other pollutants of concern should be conducted to determine the need for dose adjustments or treatment of cooling.

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 will signal the need for corrective actions.

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

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

Responsibilities for mitigation and monitoring should be clearly defined, including arrangements for coordination between various actors 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 Chemical Fertilizer is given in the Table 4.7. Each task prescribed in ToR shall be incorporated appropriately in the contents in addition to the contents described in the following 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 ToR for EIA)
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

S.NO	EIA STRUCTURE	CONTENTS
		project to meet environmental standards, environmental operating conditions, or other EIA requirements (as required by the scope) ▪ Assessment of New & untested technology for the risk of technological failure
3.	Description of the Environment	▪ Study area, period, components & methodology ▪ Establishment of baseline for VECs, as identified in the scope ▪ Base maps of all environmental components
4.	Anticipated Environmental Impacts & Mitigation Measures	▪ Details of Investigated Environmental impacts due to project location, possible accidents, project design, project construction, regular operations, final decommissioning or rehabilitation of a completed project ▪ Measures for minimizing and / or offsetting adverse impacts identified ▪ Irreversible and Irretrievable commitments of environmental components ▪ Assessment of significance of impacts (Criteria for determining significance, Assigning significance) ▪ Mitigation measures
5.	Analysis of Alternatives (Technology & Site)	▪ Incase, the scoping exercise results in need for alternatives: ▪ Description of each alternative ▪ Summary of adverse impacts of each alternative ▪ Mitigation measures proposed for each alternative and selection of alternative
6.	Environmental Monitoring Program	▪ Technical aspects of monitoring the effectiveness of mitigation measures (incl. Measurement methodologies, frequency, location, data analysis, reporting schedules, emergency procedures, detailed budget & procurement schedules)
7.	Additional Studies	▪ Public consultation ▪ Risk assessment ▪ Social impact assessment, R&R action plans
8.	Project Benefits	▪ Improvements in the physical infrastructure ▪ Improvements in the social infrastructure ▪ Employment potential –skilled; semi-skilled and unskilled ▪ Other tangible benefits
9.	Environmental cost benefit analysis	▪ If recommended at the scoping stage
10.	EMP	▪ Description of the administrative aspects of ensuring that mitigative measures are implemented 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	▪ The names of the Consultants engaged with their brief resume and nature of Consultancy rendered

4.10 Public Consultation

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

- Public consultation is not a decision taking process, but is a process to collect views of the people having plausible stake. If the SPCB/Public agency conducting public hearing is not convinced with the plausible stake, then such expressed views need not be considered.
- Public consultation involves two components, one is public hearing, and other one is inviting written responses/objections through Internet/by post, *etc*., by placing the summary of EIA report on the website.
- All Category A and Category B1 projects require public hearing except the following:
  - Once prior environmental clearance is granted to an industrial estate/SEZ/EPZ *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 or UTPCC to arrange public hearing.
- Project proponent shall enclose with the letter of request, at least 10 hard copies and 10 soft copies of the draft EIA report including the summary EIA report in English and in the 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 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 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 or UTPCC shall arrange to video film the entire proceedings. A copy of the videotape or a CD shall be enclosed with the public hearing proceedings while forwarding it to the Regulatory Authority concerned.
- The attendance of all those who are present at the venue shall be noted and annexed with the final proceedings.
- There shall be *no quorum* required for attendance for starting the proceedings
- Persons present at the venue shall be granted the opportunity to seek information or clarifications on the project from the proponent. The summary of the public hearing proceedings accurately reflecting all the views and concerns expressed shall be recorded by the representative of the SPCB / UTPCC and read over to the audience at the end of the proceedings explaining the contents in the local/ vernacular language and the agreed minutes shall be signed by the District Magistrate/District Collector/Deputy Commissioner or his or her representative on the same day and forwarded to the SPCB/UTPCC concerned.

- A statement of the issues raised by the public and the comments of the proponent shall also be prepared in the local language or the official State language, as the case may be and in English and annexed to the proceedings.
- The proceedings of the public hearing shall be conspicuously displayed at the office of the Panchayats within whose jurisdiction the project is located, office of the concerned Zilla Parishad, District Magistrate/District Collector/Deputy Commissioner and the SPCB /UTPCC. The SPCB / 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 project proponent. Therefore the SPCB or UTPCC concerned shall send public hearing proceedings to the concerned regulatory authority within eight (8) days of the completion of 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.
- Up on 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 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 appropriate fee to the public agency for conducting public hearing.
- A public agency means a non-profit making institution/ body such as technical/academic institutions, government bodies not subordinate to the concerned Authority.
- If SPCB/Public Agency authorized for conducting public hearing informs the Authority, stating that it is not possible to conduct the public hearing in a manner, which will enable the views of the concerned local persons to be freely expressed, then Authority may consider such report to take a decision that in such particular case, public consultation may not have the component of public hearing.
- Often restricting the public hearing to the specific district may not serve the entire purpose, therefore, NGOs who are local and registered under the Societies Act in the adjacent districts may also be allowed to participate in public hearing, if they so desire.
- Confidential information including non-disclosable or legally privileged information involving intellectual property right, source specified in the application shall not be placed on the website.
- The Authority shall make available, on a written request from any concerned person, the draft EIA report for inspection at a notified place during normal office hours till the date of the public hearing.

- While mandatory requirements will have to be adhered to, utmost attention shall be given to the issues raised in the public hearing for determining the modifications needed in the project proposal and the EMP to address such issues.
- Final EIA report after making needed amendments, as aforesaid, shall be submitted by the applicant to the concerned Authority for prior environmental clearance. Alternatively, a supplementary report to draft EIA and EMP addressing all concerns expressed during the public consultation may be submitted.

4.11 Appraisal

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

- The appraisal shall be made by EAC to the Central Government or SEAC to SEIAA.
- Project proponent either personally or through consultant can make a presentation to EAC/SEAC for the purpose of appraising the features of the project proposal and also to clarify the issues raised by the members of the EAC/SEAC.
- On completion of these proceedings, concerned EAC/SEAC shall make categorical recommendations to the respective Authority, either for grant of prior environmental clearance on stipulated terms & conditions, if any, or rejection of the application with reasons.
- In case EAC/SEAC needs to visit the site or obtain further information before being able to make categorical recommendations, EAC/SEAC may inform the project proponent accordingly. In such an event, it should be ensured that the process of prior environmental clearance is not unduly delayed to go beyond the prescribed timeframe.
- Up on 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 receipt of the updated EIA and EMP reports, after completing public consultation.

The EIA report will be typically examined for following:

1) 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.
2) 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.

3) Description of the project site – how well the interfaces between the project related activities and the environment have been identified for the entire project cycle *i.e.*, construction, operation and decommissioning at the end of the project life.
4) How complete and authentic are the baseline data pertaining to flora and fauna and socio economic aspects?
5) 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.
6) How consistent are the various values of environmental parameters w.r.t. each other?
7) Is a reasonable assessment of the environmental and social impact made for the identified environmental issues including project affected people?
8) 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.
9) How well the concerns expressed/highlighted during the public hearing have been addressed and incorporated in the environmental management plan giving item wise financial provisions and commitments (in quantified terms)?
10) How far the proposed environmental monitoring plan will effectively evaluate the performance EMP's? Are details for environmental monitoring plan provided in the same manner as the EMP?
11) Identification of hazard and quantification of risk assessment and whether appropriate mitigation plan has been included in the EMP?
12) Does the proposal include a well formulated time bound green belt development plan for mitigating environmental problems such as fugitive emissions of dust, gaseous pollutants, noise, odour, *etc*.?
13) 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?
14) 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?
15) Is the information presented in 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 the 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 the 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 the concerned SEIAA will issue the environmental clearance for the project.
- The project proponent should make sure that the award of environment clearance is properly publicized in at least two local newspapers of the district or state where the proposed project is located. For instance, the executive summary of the environmental clearance may be published in the newspaper along with the information about the location (website/office where it is displayed for public) where the detailed environmental clearance is made available. The MoEF and SEIAA/UTEIAA, as the case may be, shall also place the prior environmental clearance in the public domain on Government Portal. Further copies of the environmental clearance shall be endorsed to the Heads of local bodies, Panchayats and Municipal bodies in addition to the relevant offices of the Government.
- The prior environmental clearance will be valid from the start date to actual commencement of the production of the developmental activity.

4.13 Post-clearance Monitoring Protocol

The MoEF, Government of India will monitor and take appropriate action under the Environment (Protection) 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 proponent's 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 the 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, 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 summary of EIA report		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	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 the	Participates in public hearings and offers comments and observations . Comments can be sent directly to SEIAA through

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

Table 5-2: Organization-specific Functions

Organization	Functions
Central Government	▪ Constitutes the EAC ▪ Considering recommendations of the State Government, constitutes the SEIAA & SEAC ▪ Receives application from the project proponent in case of Category A projects or Category B projects attracting general condition ▪ Communicates the ToR finalized by the EAC to the project proponent. ▪ Receives EIA report from the project proponent and soft copy of summary of the report for placing in the website ▪ Summary of EIA report will be placed in website. Forwards the received responses to the project proponent ▪ Engages other public agency for conducting public hearings in cases where the SPCB does not respond within time ▪ Receives updated EIA report from project proponent incorporating the considerations from the proceedings of public hearing and responses received through other media ▪ Forwards updated EIA report to the EAC for appraisal

Organization	Functions
	▪ 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 XIII**.

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 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, provided that, in case a decision is taken by majority, the details of views, for and against it, shall be clearly recorded in the minutes and a copy thereof 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
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

S. No.	Attribute	Requirement		
		Members	Member–Secretary	Chairperson
				permitted
7	Eminent environmental expertise with understanding on environmental aspects and impacts	Desirable	Desirable	Compulsory
8	Expertise in the environmental clearance process	Desirable	Desirable	Compulsory

Note:

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

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

5.2 EAC and SEAC

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

A. Constitution

- EAC and SEAC shall be constituted by the Central Government comprising a maximum of 15 members including a Chairperson and Secretary. In case of SEAC, the State Government or UT Administration is required to nominate the professionals/experts for consideration and Notification by the Central Government.
- The Central Government will notify as and when the nominations (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 XIV**.

- 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 endeavor to reach a consensus in each case, and if consensus cannot be reached, the view of the majority shall prevail.

D. Operational Issues

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

i. Tenure of EAC/SEIAA/SEAC

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

ii. Qualifying Criteria for Nomination of a Member to EAC/SEIAA/SEAC

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

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

These are elaborated subsequently.

a) Professional Qualification

The person should have at least (i) 5 years of formal University training in the concerned discipline leading to a MA/MSc Degree, or (ii) in case of Engineering/Technology/ Architecture disciplines, 4 years formal training in a professional training course together

with prescribed practical training in the field leading to a B.Tech/B.E./B.Arch. Degree, or (iii) Other professional degree (e.g. Law) involving a total of 5 years of formal University training and prescribed practical training, or (iv) Prescribed apprenticeship/articleship and pass examinations conducted by the concerned professional association (e.g. MBA/IAS/IFS). In selecting the individual professionals, experience gained by them in their respective fields will be taken note of

b) Relevant Experience

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

c) Absence of Conflict of Interest

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

iii. Age

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

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

Note:

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

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

ANNEXURE I
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,	Ministry of Environment and Forests, Central	All types of environmental	Protection and Improvement of the	Section 2: Definitions

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/Pollutants	Objective of Legislation	Relevant Articles/Provisions
	1986, amended 1991	Pollution Control Board and State Pollution Control Boards	pollutants	Environment	Section 7: Not to allow emission or discharge of environmental pollutants in excess of prescribed standards Section 8: Handing of Hazardous Substances Section 10: Power of Entry and Inspection Section 11: Power to take samples Section 15-19: Penalties and Procedures
6	Environmental (Protection) Rules, 1986 (Amendments in 1999, 2001, 2002, 2002, 2002, 2003, 2004)	Ministry of Environment and Forests, Central Pollution Control Board and State Pollution Control Boards	All types of Environmental Pollutants	Protection and Improvement of the Environment	Rule 2: Definitions Rule 3: Standards for emission or discharge of environmental pollutants Rule 5: Prohibition and restriction on the location of industries and the carrying on process and operations in different areas Rule 13: Prohibition and restriction on the handling of hazardous substances in different areas Rule 14: Submission of environmental statement
7	Hazardous Waste (Management and Handling) Rules, 1989 amended 2000 and 2003	MoEF, CPCB, SPCB, DGFT, Port Authority and Customs Authority	Hazardous Wastes generated from industries using hazardous chemicals	Management & Handling of hazardous wastes in line with the Basel convention	Rule 2: Application Rule 3: Definitions Rule 4: Responsibility of the occupier and operator of a facility for handling of wastes Rule 4A: Duties of the occupier and operator of a facility Rule 4B: Duties of the authority Rule 5: Grant of authorization for handling hazardous wastes Rule 6: Power to suspend or cancel authorization Rule 7: Packaging, labeling and transport of hazardous wastes Rule 8: Disposal sites Rule 9: Record and returns Rule 10: Accident reporting and follow up

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	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 Rule 10: Functions of LCG

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/Pollutants	Objective of Legislation	Relevant Articles/Provisions
	Response) Rules, 1996				
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	Batteries (Management and Handling) Rules, 2001.	SPCB, CPCB and MoEF	Lead Acid Batteries	To control the hazardous waste generation (lead waste) from used lead acid batteries	Rule 2: Application Rule 3: Definitions Rule 4: Responsibilities of manufacturer, importer, assembler and re-conditioner Rule 5: Registration of Importers Rule 7: Responsibilities of dealer Rule 8: Responsibilities of recycler Rule 9: Procedure for registration / renewal of registration of recyclers Rule 10: Responsibilities of consumer or bulk consumer Rule 11: Responsibilities of auctioneer Rule 14: Computerization of Records and Returns
12	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
13	Public Liability Insurance Rules, 1991 amended	Ministry of Environment & Forests, District Collector	Hazardous Substances	To provide immediate relief to persons affected by accident involving	Rule 2: Definitions Rule 6: Establishment of administration of fund Rule 10: Extent of liability

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/Pollutants	Objective of Legislation	Relevant Articles/Provisions
	1993			hazardous substances and also for Establishing an Environmental Relief fund	Rule 11: Contribution of the owner to environmental relief fund
14	Factories Act, 1948	Ministry of Labour, DGFASLI and Directorate of Industrial Safety and Health/Factories Inspectorate	Chemicals as specified in the Table	Control of workplace environment, and providing for good health and safety of workers	Section 2: Interpretation Section 6: Approval, licensing and registration of factories Section 7A: General duties of the occupier Section 7B: General duties of manufacturers *etc*., as regards articles and substances for use in factories Section 12: Disposal of wastes and effluents Section 14: Dust and fume Section 36: Precautions against dangerous fumes, gases, *etc*. Section 37: Explosion or inflammable dust, gas, *etc*. Chapter IVA: Provisions relating to Hazardous processes Section 87: Dangerous operations Section 87A: Power to prohibit employment on account of serious hazard Section 88: Notice of certain accident Section 88A: Notice of certain dangerous occurrences Chapter X: Penalties and procedures
15	The Petroleum Act, 1934	Ministry of Petroleum and Natural Gas	Petroleum (Class A, B and C - as defined in the rules)	Regulate the import, transport, storage, production, refining and blending of petroleum	Section 2: Definitions Section 3: Import, transport and storage of petroleum Section 5: Production, refining and blending of petroleum Section 6: Receptacles of dangerous petroleum to show a warning Section 23-28 Penalties and Procedure
16	The Petroleum Rules, 2002	Ministry of Petroleum and Natural Gas, Ministry of Shipping (for Notification of authorized ports for import),	Petroleum (Class A, B and C - as defined in the rules)	Regulate the import, transport, storage, production, refining and blending of petroleum	Rule 2: Definition Chapter I part II: General Provision Chapter II: Importation of Petroleum Chapter III: Transport of Petroleum

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/Pollutants	Objective of Legislation	Relevant Articles/Provisions
		Ministry of Environment & Forests or SPCB (for clearance of establishment of loading/unloading facilities at ports) Chief Controller of Explosives, district authority, Commissioner of Customs, Port Conservator, State Maritime Board (Import)			Chapter VII: Licenses
17	The Explosives Act, 1884	Ministry of Commerce and Industry (Department of Explosives)	Explosive substances as defined under the Act	To regulate the manufacture, possession, use, sale, transport, export and import of explosives with a view to prevent accidents	Section 4: Definition Section 6: Power for Central government to prohibit the manufacture, possession or importation of especially dangerous explosives Section 6B: Grant of Licenses
18	The Explosive Rules, 1983	Ministry of Commerce and Industry and Chief Controller of Explosives, port conservator, customs collector, railway administration	Explosive substances as defined under the Act	To regulate the manufacture, possession, use, sale, transport, export and import of explosives with a view to prevent accidents	Rule 2: Definition Chapter II: General Provisions Chapter III: Import and Export Chapter IV: Transport Chapter V: Manufacture of explosives Chapter VI: Possession sale and use Chapter VII: Licenses
19	The Gas Cylinder Rules, 2004	Ministry of Commerce and Industry and Chief Controller of Explosives, port conservator, customs collector, DGCA, DC,	Gases (Toxic, non toxic and non flammable, non toxic and flammable, Dissolved Acetylene	Regulate the import, storage, handling and transportation of gas cylinders with a view to	Rule 2: Definition Chapter II: General Provisions Chapter III: Importation of Cylinder Chapter IV: Transport of Cylinder

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/Pollutants	Objective of Legislation	Relevant Articles/Provisions
		DM, Police (sub inspector to commissioner)	Gas, Non toxic and flammable liquefiable gas other than LPG, LPG	prevent accidents	Chapter VII: Filling and Possession
20	The Static and Mobile Pressure Vessels (Unfired) Rules, 1981	Ministry of Commerce and Industry and Chief Controller of Explosives, port conservator, customs collector, DGCA, DC, DM, Police (sub inspector to commissioner)	Gases (Toxic, non toxic and non flammable, non toxic and flammable, Dissolved Acetylene Gas, Non toxic and flammable liquefiable gas other than LPG, LPG	Regulate the import, manufacture, design, installation, transportation, handling, use and testing of mobile and static pressure vessels (unfired) with a view to prevent accidents	Rule 2: Definition Chapter III: Storage Chapter IV: Transport Chapter V: Licenses
21	The Motor Vehicle Act, 1988	Ministry of Shipping, Road Transport and Highways	Hazardous and Dangerous Goods	To consolidate and amend the law relating to motor vehicles	Section 2: Definition Chapter II: Licensing of drivers of motor vehicle Chapter VII: Construction equipment and maintenance of motor vehicles
22	The Central Motor Vehicle Rules, 1989	Ministry of Shipping, Road Transport and Highways	Hazardous and Dangerous Goods	To consolidate and amend the law relating to motor vehicles including to regulate the transportation of dangerous goods with a view to prevent loss of life or damage to the environment	Rule 2: Definition Rule 9: Educational qualification for driver's of goods carriages carrying dangerous or hazardous goods Rule 129: Transportation of goods of dangerous or hazardous nature to human life Rule 129A: Spark arrestors Rule 130: Manner of display of class labels Rule 131: Responsibility of the consignor for safe transport of dangerous or hazardous goods Rule 132: Responsibility of the transporter or owner of goods carriage Rule 133: Responsibility of the driver Rule 134: Emergency Information Panel

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/Pollutants	Objective of Legislation	Relevant Articles/Provisions
					Rule 135: Driver to be instructed Rule 136: Driver to report to the police station about accident Rule 137: Class labels
23	The Custom Act, 1962	CBEC, Ministry of Finance	Hazardous Goods	To prevent entry of illegal hazardous goods or banned goods including hazardous or banned chemicals	Section 2: definitions Section 11: Power to Prohibit Importation or Exportation of Goods
24	The Merchant Shipping Act, 1958 amended in 2002 and 2003	Ministry of Shipping, Road Transport and Highways	All packaged cargo including Dangerous and hazardous goods as defined in the rules	For safe handling and transportation of cargo including dangerous goods to prevent accident	Section 3: Definitions Section 331: Carriage of Dangerous Goods
25	Merchant Shipping (carriage of Cargo) Rules 1995	Ministry of Shipping, Road Transport and Highways	All packaged cargo including Dangerous and hazardous goods as defined in the rules	For safe handling and transportation of cargo including dangerous goods to prevent accident	
26	The Indian Port Act, 1908	Ministry of Shipping, Road Transport and Highways	All Chemicals - handling and storage	For control of activities on ports including safety of shipping and conservation of ports	Section 2: Definitions Chapter IV: Rules for the safety of shipping and the conservation of ports Chapter VII: Provisions w.r.t. penalties
27	The Dock Workers, (Safety, Health and Welfare) Act, 1986	Ministry of Labour, DGFASLI and Directorate of Dock Safety	All Chemicals termed as dangerous goods	Safety of Dock workers including handling of dangerous goods	
28	The Dock Workers, (Safety, Health and Welfare) Rules, 1990	Ministry of Labour, DGFASLI and Directorate of Dock Safety	All Chemicals termed as dangerous goods	Safety of Dock workers including handling of dangerous goods	

ANNEXURE II
General Standards for Discharge of Environmental Pollutants

Table: Water Quality Standards

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

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

Note :-

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

Table: Noise Standards

Ambient air quality standards in respect of noise

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

Note :

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Order Dated: 21st June, 2002

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

Amendments/modifications

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

"(1) that the generator sets above 5KVA shall not be operated in residentoal 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 x OKVA

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
Effluent Discharge Standards for Straight Nitrogenous Fertilizers

ANNEXURE III – A

Effluent discharge standards for straight nitrogenous fertilizer (excluding calcium ammonium nitrate and ammonium nitrate) industries, prescribed under Environment (Protection) Rules, 1986.

S. No.	Parameters	Plants commissioned after January 01, 1982	Plants commissioned before January 01, 1982
1.	pH	6.5 - 8.0	6.5 - 8.0
2.	Ammoniacal Nitrogen	50	75
3.	Total Kjeldhal Nitrogen	100	150
4.	Free Ammoniacal Nitrogen	4	4
5.	Nitrate Nitrogen	10	10
6.	Cyanide as CN	0.2	0.2
7.	Vanadium as V	0.2	0.2
8.	Arsenic as As	0.2	0.2
9.	Suspended Solids	100	100
10.	Oil and Grease	10	10
11.	* Cr as Cr+6	0.1	0.1
12.	* Total Chromium as Cr	2.0	2.0

Concentrations in mg/l except for pH

* To be complied with at the outlet of Chromate removal unit.

ANNEXURE III - B

Effluent discharge standards for straight nitrogenous fertilizer (including calcium ammonium nitrate and ammonium nitrate) industries, prescribed under Environment Protection Rules, 1986.

S. No.	Parameters	Plants commissioned after January 01, 1982	Plants commissioned before January 01, 1982
1.	pH	6.5-8.0	6.5-8.0
2.	Ammoniacal Nitrogen	50	75
3.	Total Kjeldhal Nitrogen	-	150
4.	Free Ammoniacal Nitrogen	4	4
5.	Nitrate Nitrogen	20	20
6.	Cyanide as CN	0.2	0.2
7.	Vanadium as V	0.2	0.2
8.	Arsenic as As	0.2	0.2
9.	Suspended Solids	100	100
10.	Oil and Grease	10	10
11.	* Cr as Cr+6	0.1	0.1
12.	* Total Chromium as Cr	2.0	2.0

Concentrations in mg/l except for pH.

* To be complied with at the outlet of Chromate removal unit.

ANNEXURE III - C

Effluent discharge standards for complex fertilizer (excluding calcium ammonium nitrate, ammonium nitrate and nitro phosphate) industries, prescribed under Environment Protection Act (1986), rule.

S. No.	Parameters	Plants commissioned after January 01, 1982	Plants commissioned before January 01, 1982
1.	pH	6.5-8.0	6.5-8.0
2.	Ammonical Nitrogen	50	75
3.	Total Kjeldhal Nitrogen	100	150
4.	Free Ammonical Nitrogen	4	4
5.	Nitrate Nitrogen	10	10
6.	Cyanide as CN	0.2	0.2
7.	Vanadium as V	0.2	0.2
8.	Arsenic as As	0.2	0.2
9.	Suspended Solids	100	100
10.	Oil and Grease	10	10
11.	** Cr as Cr+6	0.1	0.1
12.	** Total Chromium as Cr	2.0	2.0
13.	Phosphate as P	5	5
14.	* Fluoride as F-	10	10

Concentrations in mg/l except for pH.

*To be complied with at the outlet of fluoride removal unit. If the recipient system so demands, fluoride as F shall be limited to 1.5 mg/l.

** To be complied with at the outlet of Chromate removal unit.

ANNEXURE III - D

Effluent discharge standards for complex fertilizer (including calcium ammonium nitrate, ammonium nitrate and nitro phosphate) industries, prescribed under Environment (Protection) Rule, 1986

S. No.	Parameters	Plants commissioned after January 01, 1982	Plants Commissioned before January 01, 1982
1.	pH	6.5-8.0	6.5-8.0
2.	Ammonical Nitrogen	50	75
3.	Total Kjeldhal Nitrogen	-	-
4.	Free Ammonical Nitrogen	100	150
5.	Nitrate Nitrogen	20	20
6.	Cyanide as CN	0.2	0.2
7.	Vanadium as V	0.2	0.2
8.	Arsenic as As	0.2	0.2
9.	Suspended Solids	100	100
10.	Oil and Grease	10	10
11.	** Cr as Cr+6	0.1	0.1
12.	** Total Chromium as Cr	2.0	2.0
13.	Phosphate as P	5	5
14.	* Fluoride as F	10	10

Concentrations in mg/l except for pH

* To be complied with at the outlet of fluoride removal unit. If the recipient system so demands, fluoride as F shall be limited to 1.5 mg/l.

** To be complied with at the outlet of Chromate removal unit.

ANNEXURE III - E

Effluent discharge standards for straight phosphatic fertilizer industries, prescribed under environment (Protection) Rule, 1986

S. No.	Parameters	Concentration limit (mg/l except for pH)
1.	pH	7.0-9.0
2.	Suspended solids	100
3.	Oil and Grease	10
4.	** Cr as Cr+6	0.1
5.	** Total Chromium as Cr	2.0
6.	Phosphate as P	5
7.	* Fluoride as F	10

Concentrations in mg/l except for pH

** To be complied with at the outlet of fluoride removal unit. If the recipient system so demands, fluoride as F shall be limited to 1.5 mg/l.*

*** To be complied with at the outlet of Chromate removal unit.*

ANNEXURE IV
Emission Standards for Chemical Fertilizers

ANNEXURE IV

Emission standards for fertilizer industries of different categories prescribed under Environment (Protection) Rule, 1986

Phosphatic fertilizer plants (Phosphoric acid manufacturing unit, granulation, mixing and grinding of rock phosphate)		**Urea plants (particulate matter emissions from prilling tower)**	
Fluorides	PM	Commissioned before January 01, 1982	Commissioned after January 01, 1982
25 mg/NM3	150 mg/NM3	150 mg/NM3 and 2.0 kg/tonne of product	50 mg/NM3 and 0.5 kg/tonne of product

Emission standards from captive acid plants

S. No.	**Industry**	**Parameter**	**Standard**
1.	Nitric acid	Oxides of nitrogen	3 kg/tonne of weak acid (before concentration) produced.
2.	Sulphuric acid	Sulphur dioxide	4 kg/tonne of concentrated (100%) acid produced.

ANNEXURE V
Wastewater Consumption Standards for Chemical Fertilizers

ANNEXURE V - A

Wastewater consumption standards for fertilizer industries of different categories prescribed under water (Prevention and control of pollution) Cess Rule, 1978

Straight nitrogenous fertilizer	**Straight Phosphatic fertilizer (SSP and TSP)**	**Complex fertilizer(Depends on the primary product)**	
15 m3/tonne of urea or equivalent produced	2 m3/tonne of SSP/TSP	Nitrogenous fertilizer	Phosphatic fertilizer
		15 m^3/tonne	**2m^3/tonne**

ANNEXURE V - B

Wastewater generation standards for fertilizer industries of different categories prescribed under Environment (Protection) Rule, 1986.

Straight nitrogenous fertilizer	**Straight Phosphatic fertilizer (SSP and TSP)**	**Complex fertilizer**
5 m3/tonne of urea or equivalent produced	0.5 m^3/tonne of SSP/TSP	Standards of nitrogenous and phosphatic fertilizer are applicable depending on the primary product.

ANNEXURE V - C

Charter on Corporate Responsibility for Environmental Protection in Fertilizer Industry

Action Points

Though most of the industries have provided facilities for achieving liquid effluent and air emission standards, the following action points are recommended for conservation of water & raw material, better management of wastes and measures needed for protecting the environment.

1. Conservation of Water

Every attempt should be made by the fertilizer industry to reduce consumption of water by taking following measures:

As cooling tower consumes, substantial amount of water, concentration factor (CF) of circulating water in the cooling towers should be increased for its efficient functioning, the dependable good conditioning chemicals and biocides should be applied.

The industry should attempt dry floor cleaning so as to minimize use of water for washing of floors. No process water should be used for cleaning of the floor.

For development of green belt, treated wastewater may be used instead of fresh water.

The leakages, overflow and spillages taking place in distribution system should be checked and controlled to avoid wastage of water.

The consumption from the raw water supply point and to use by different plants/facilities should have appropriate system to know where and what quantity of water is used.

2. Conservation of Material

The feed stocks used for manufacture of ammonia (an intermediate chemical for producing urea) are natural gas, naphtha and fuel oil, out of which natural gas is transported by pipeline while the naphtha and fuel oil are stored in the plant premises. The industries are required to adopt appropriate measures for storage of naphtha and fuel oil, such as parapet around the tank and collection tank for leakages of naphtha/oil.

All the plants should recover ammonia as well as bottom water from condensate arising from ammonia plant, by installing stream-stripping system.

All the operating urea plants should install deep thermal hydrolyser stripper as a facility for treatment of condensate arising from urea plant and to recycle ammonia and to use bottom water.

Purge gas recovery unit (PGRU) should be installed by all the ammonia plants for recovery of gases.

The phosphatic fertilizer plants manufacturing phosphoric acid should make effort to recover hydrofluorosilicic acid, which may be either sold as by-product or converted into aluminum fluoride for use by other industries.

In manufacturing of nitro phosphate, chalk is produced as by-product, which should be properly collected and used for production of cement.

Spillage urea around prilling tower should be recovered by dissolving in urea dissolving tank followed by recycle in the process. At the bagging plant also, spilled urea and the dedusting scrubber liquor are to be collected and recycled in the process plant through urea dissolving unit.

3. Elimination of Toxic Substances

Some of the old industries in ammonia plant are still using arsenic-based solution as an absorbent for CO_2 recovery (Vetrocoke process). They should change over to the non-arsenic system. Phasing out of the arsenic-based system should be done within a period of two years.

At present, few industries are using chromate based conditioning chemicals in cooling towers, which generate effluent containing chromate. The chromium based conditioning chemicals are to be phased out within two years and non-chromate based conditioning chemicals should be used only, as most of the plants have satisfactory used such non-chromate based chemicals.

4. Wastewater Treatment

As far as possible, the treatment unit should be provided at the end of the processing plant for specific pollutant such as oil removal system at the place of oil handling, phosphate and fluoride removal system for the phosphate and fluoride bearing effluent, ammonia removal system for ammonia bearing effluent, chromium removal system for cooling water blow down where chromate-based chemicals are used.

Residual pollutants can be removed in a centralized biological treatment plant, where necessary by providing nitrification and denitrification system. It must be ensured that performance of denitrification process is complete.

Biohydrolysis of urea is carried out by some of industries. This causes serious pollution due to ammonia near the treatment unit. Therefore, installation and operation of such system desired to be avoided.

The industries should install holding ponds for storing occasional, accidental and unforeseen effluent, which can disturb the performance of effluent treatment system. Such holding ponds should have an arrangement to pump the effluent to ETP at a regulated rate.

5. Management of Stormwater

No wastewater arising from the process plants and associate facilities should be carried or discharged into stormwater drains. In order to prevent any wastewater or the pollutant getting discharged into water bodies through stormwater drains, continuous monitoring for pH, Fluoride and ammonia shall be provided with a recording and alarm system. Also, the provision for holding ponds should be made to store water in case any parameter exceeds the stipulated limit.

6. Emission Control

All the new prilling towers should be based on natural draft system and designed to comply with the urea particulate emission standards as per the stipulation given at the time of environmental clearance.

The existing old urea plant should install an appropriate system (scrubber, acoustic system *etc*.) so as to comply with existing standard stipulated under E(P) Act.

To control SOx emission from sulphuric acid plant, scrubber should be installed and operated during start-up and shut down. Tail gas after scrubbing should be discharge at same height through the stack and the scrubbing liquid should be preferably prepared with ammonia instead of caustic soda. In case of large sulphuric acid plant (500 MTPA) and above, modified DCDA system of higher stage conversion and absorption should be provided for better conversion and less emission of Sulphur, thereby further reducing emission of SOX.

Adequate measures should be adopted for controlling emission during storage and grinding of rock phosphate.

7. Management of Hazardous Chemical

Hazardous chemicals should be adequately stored and marked.

Many industries have leakage, overflow and spillage *etc*., taking place in the distribution system. This should be checked and controlled.

Modern ammonia plants store NH_3 in atmospheric pressure ammonia tank whereas older plants use Horton Sphere. If situation arises, Horton Sphere should be changed over to atmospheric pressure ammonia storage tank.

8. Solid Waste Management

Carbon slurry generated in the Partial Oxidation process should be transported to impervious carbon ponds for further use.

Sulphur muck generated during production of sulphuric acid need to be collected and stored in an organized manner.

Chalk produced during Nitrophosphate production should be stored properly before use in the cement plant.

Huge quantity of gypsum is generated during the manufacture of phosphoric acid. As gypsum is contaminated with fluoride and phosphate, the gypsum should be stored in impervious pond. The pond should be well designed and provided with paved road for facilitating approach from all sides.

Catalysts are changed or made-up based on loss of activity after use for some time. The waste catalysts are to be disposed. Disposal should be done with appropriate organized manner e.g. Secured land filling, returning to the supplier with a special contract during purchasing, selling for metal recovery *etc*.

The plants, which use arsenic or chromium, generate arsenic & chromium sludge, which should be disposed using a well-designed disposal method.

The management of solid wastes is a grey area. Industries should take proper attention and adopt well-designed management system.

9. Monitoring of Effluent, Emission and Ambient Air Quality

Continuous monitoring for SO_2 in sulphuric acid plants (200 TPD and above) and fluoride emission in phosphoric acid plants should be provided by all the units.

Ambient air monitoring should be done at appropriate locations and reported data should include location of monitoring stations in a layout plan and wind rose pattern complete information data should be provided.

Ground water monitoring around the storage facilities and also beyond the factory premises should be carried out at a regular interval particularly for the parameters like Nitrate, Fluoride and pH and the record of the sampling depth and location of station should be indicated in a map showing the contour of the area.

10. Creation of Environment Management Cell

Every industry should have Environmental management cell headed by an experienced technologist and provided with the facilities of laboratory for monitoring and a library. The cell should also conduct training for appraisal on environmental issues to the operating officials. They should update/maintain the records, flow sheets, maps *etc*., relating to the environment.

ANNEXURE VI
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 VII
Critically Polluted Industrial Areas and Clusters/Potential Impact Zone

Table 1: Details of Critically Polluted Industrial Areas and Clusters / Potential Impact Zone (Ref: Office Memorandum No. J-11013/5/2010-IA.II(I) Dated 13.1.2010)

S. No.	Critically Polluted Industrial Area and CEPI	Industrial Clusters/ Potential Impact Zones
1.	Ankeshwar (Gujarat) CEPI-88.50(Ac_Wc_Lc)	▪ GIDC Ankeshwar and GIDC, Panoli
2	Vapi (Gujarat) CEPI-88.09(Ac_Wc_Lc)	▪ GIDC Vapi
3	Ghaziabad (Uttar Pradesh) CEPI-87.37(Ac_Wc_Lc)	Sub-cluster A ▪ Mohan nagar industrial area ▪ Rajinder nagar industrial area ▪ Sahibabad industrial area Sub-cluster B ▪ Pandav nagar industrial area ▪ Kavi nagar industrial area ▪ Bulandshahar road industrial area ▪ Amrit nagar ▪ Aryanagar industrial area Sub-cluster C ▪ Merrut road industrial are Sub-cluster D ▪ Loni industrial area ▪ Loni Road industrial area ▪ Roop nagar industrial area Sub-cluster E ▪ Hapur Road industrial area ▪ Dasna ▪ Philkura Sub-cluster F (Other scattered industrial areas) ▪ South side of GT road ▪ Kavi Nagar ▪ Tronica city ▪ Anand Nagar ▪ Jindal Nagar ▪ Prakash Nagar ▪ Rural industrial estate
4	Chandrapur (Maharashtra) CEPI-83.88 (Ac_Wc_Lc)	▪ Chandrapur (MIDC Chandrapur, Tadali, Ghuggus, Ballapur)
5	Kobra (Chhatisgarh) CEPI-83.00 (Ac_Ws_Lc)	▪ Industrial areas and their townships of NTPC, BALCO, CSEB (East) & CSEB (West) ▪ Korba town
6	Bhiwadi (Rajasthan) CEPI-82.91 (Ac_Wc_Ls)	▪ RIICO industrial areas Phase I to IV ▪ Bhiwadi town ▪ Other surrounding industrial areas: Chopanki, Rampura Mundana, Khuskhera Phase I to III
7	Angul Talcer(Orissa) CEPI-82.09 (Ac_Wc_Lc)	▪ MCL Coal mining area, Augul – Talcer region ▪ Industrial area (60 km x 45 km) Following blocks of Augul district: ▪ Kohina block ▪ Talcher block

		▪ Angul block ▪ Chhendipada block ▪ Banarpal block ▪ Odapada block of Dhenkamal district
8	Vellore (North Arcot) (Tamil Nadu) CEPI-81.79 (Ac_Wc_Lc)	▪ Ranipet, SIPCOT industrial complex
9	Singrauli (Uttar Pradesh) CEPI-81.73 (Ac_Wc_Ls)	Sonebhadra (UP) ▪ Dala-Tola ▪ Obra ▪ Renukoot ▪ Anpara ▪ Renusagar ▪ Kakri ▪ Dudhichuwa ▪ Bina ▪ Khadia ▪ Shakti nagar ▪ Rihand nagar ▪ Bijpur Sigrauli (Madhya Pradesh) Vindhyachal nagar and Jaynat, Nigahi, Dudhichua, Amlohri & Jhingurdah townships
10	Ludhiana (Punjab) CEPI-81.66 (Ac_Wc_Ls)	Ludhiana municipal limits covering industrial clusters: ▪ Focal point along with NH-I- Total eight phase ▪ Industrial area-B- from sherpur chowk to Gill road & Gill road to Miller Kotla road (left side of road) ▪ Mixed industrial area – right side of Gill road ▪ Industrial area –C (near Juglana village) ▪ Industrial area A & extension: area between old GT road and Ludhiana bypass road ▪ Industrial estate: near Dholwal chowk ▪ Mixes industrial area (MIA) Miller gunj ▪ MIA – bypass road ▪ Bahdur industrial area ▪ Tejpur industrial complex
11	Nazafgarh drain basin, Delhi CEPI-79.54 (As_Wc_Lc)	▪ Industrial areas: Anand Parvat, Naraina, Okhla and Wazirpur
12	Noida (Uttar Pradesh) CEPI-78.90 (Ac_Wc_Lc)	Territorial Jurisdiction of: ▪ Noida Phase-1 ▪ Noida Phase-2 ▪ Noida Phase-3 ▪ Surajpur industrial area ▪ Greater Noida industrial area ▪ Village- Chhaparaula
13	Dhanbad (Jharkhand) CEPI-78.63 (Ac_Ws_Lc)	Four blocks of Dhanbad district: ▪ Sadar (Dhanbad Municipality) ▪ Jharia (Jharia Municipality, Sindri industrial area) ▪ Govindpur (Govindpur industrial estate) ▪ Nirsa
14	Dombivalli (Maharashtra) CEPI-78.41 (Ac_Wc_Ls)	▪ MIDC Phase- I, Phase- II

15	Kanpur (Uttar Pradesh) CEPI-78.09 (Ac_Wc_Ls)	Industrial areas: ▪ Dada nagar ▪ Panki ▪ Fazalganj ▪ Vijay nagar ▪ Jajmau
16	Cuddalore (Tamil Nadu) CEPI-77.45 (As_Wc_Lc)	▪ SIPCOT industrial complex, Phase I & II
17	Aurangabad (Maharashtra) CEPI-77.44 (Ac_Wc_Ls)	▪ MIDC Chikhalthana, MIDC Waluj, MIDC Shendra, and Paithan road industrial area
18	Faridabad (Haryana) CEPI-77.07 (Ac_Ws_Lc)	▪ Sector 27-A, B, C, D ▪ DLF phase- 1, sector 31,32 ▪ DLF phase- 2, sector 35 ▪ Sector 4, 6, 24, 27, 31, 59 ▪ Industrial area Hatin ▪ Industrial model township
19	Agra (Uttar Pradesh) CEPI-76.48 (As_Wc_Ls)	▪ Nunihai industrial estate, Rambag nagar, UPSIDC industrial area, and Runukata industrial area
20	Manali (Tamil Nadu) CEPI-76.32 (Ac_Ws_Ls)	▪ Manali industrial area
21	Haldia (West Bengal) CEPI-75.43 (As_Wc_Ls)	▪ 5 km wide strip (17.4 x 5.0 km) of industrial area on the southern side of the confluence point of Rivers Hugli and Rupnarayan, covering ▪ Haldia municipal area & Sutahata block – I and II
22	Ahmedabad (Gujarat) CEPI-75.28 (Ac_Ws_Ls)	▪ GIDC Odhav ▪ GIDC Naroda
23	Jodhpur (Rajasthan) CEPI-75.19 (As_Wc_Ls)	▪ Industrial areas including Basni areas (phase-I & II), industrial estate, light & heavy industrial areas, industrial areas behind new power house, Mandore, Bornada, Sangariya and village Tanwada & Salawas. ▪ Jodhpur city
24	Greater Cochin (Kerala) CEPI-75.08 (As_Wc_Ls)	▪ Eloor-Edayar industrial belt, ▪ Ambala Mogal industrial areas
25	Mandi Gobind Garh (Punjab) CEPI-75.08 (Ac_Ws_Lc)	▪ Mandi Govindgarh municipal limit and khanna area
26	Howrah (West Bengal) CEPI-74.84 (As_Ws_Lc)	▪ Liluah-Bamangachhi region, Howrah ▪ Jalan industrial complex-1, Howrah
27	Vatva (Gujarat) CEPI-74.77 (Ac_Wc_Ls)	▪ GIDC Vatva, Narol industrial area (Villages Piplaj, Shahwadi, Narol)
28	Ib Valley (Orissa) CEPI-74.00 (Ac_Ws_Ls)	▪ Ib Valley of Jharsuguda (Industrial and mining area)
29	Varansi-Mirzapur (Uttar Pradesh) CEPI-73.79 (As_Wc_Ls)	▪ Industrial estate, Mirzapur ▪ Chunar ▪ Industrial estate, Chandpur, Varansi ▪ UPSIC, industrial estate, Phoolpur ▪ Industrial area, Ramnagar, Chandauli
30	Navi Mumbai (Maharashtra) CEPI-73.77 (Ac_Ws_Ls)	▪ TTC industrial area, MIDC, Navi Mumbai (including Bocks-D, C, EL, A, R, General, Kalva)

31	Pali (Rajasthan) CEPI-73.73 (As_Wc_Ls)	▪ Existing industrial areas: Mandia road, Puniyata road, Sumerpur ▪ Pali town
32	Mangalore (Karnataka) CEPI-73.68 (Ac_Ws_Ls)	▪ Baikampady industrial area
33	Jharsuguda (Orissa) CEPI-73.34 (Ac_Ws_Ls)	▪ Ib valley of Jharsuguda (Industrial and mining area)
34	Coimbatore (Tamil Nadu) CEPI-72.38 (Ac_Ws_Ln)	▪ SIDCO, Kurichi industrial Clusters
35	Bhadravati (Karnataka) CEPI-72.33 (Ac_Ws_Ln)	▪ KSSIDC Industrial area, Mysore paper mill & VISL township complex
36	Tarapur (Maharashtra) CEPI-72.01 (Ac_Ws_Ls)	▪ MIDC Tarapur
37	Panipat (Haryana) CEPI-71.91 (As_Ws_Ls)	▪ Panipat municipal limit and its industrial clusters
38	Indore (Madhya Pradesh) CEPI-71.26 (As_Ws_Ls)	Following 09 industrial area: ▪ Sanwer road ▪ Shivaji nagar ▪ Pologround ▪ Laxmibai nagar ▪ Scheme no.71 ▪ Navlakha ▪ Pipliya ▪ Palda ▪ Rau Indore city Other surrounding industrial areas: Manglia, Rajoda, Asrawad, Tejpur Gadwadi
39	Bhavnagar (Gujarat) CEPI-70.99 (As_Ws_Ls)	▪ GIDI Chitra, Bhavnagar
40	Vishakhapatnam (Andhra Pradesh) CEPI-70.82 (As_Ws_Ls)	▪ Bowl area (the area between Yarada hill range in the south to Simhachalam hill range in the north and sea on the east and the present NH-5 in the west direction)
41	Junagarh (Gujarat) CEPI-70.82 (As_Ws_Ls)	Industrial areas: ▪ Sabalpur ▪ Jay Bhavani ▪ Jay Bhuvneshwari ▪ GIDC Junagarh (I&II)
42	Asansole (West Bengal) CEPI-70.20 (As_Ws_Ls)	▪ Bumpur area surrounding IISCO
43	Patancheru - Bollaram (Andhra Pradesh) CEPI-70.07 (As_Ws_Ls)	Industrial area: ▪ Patancheru ▪ Bollaram

Note:

Names of identified industrial clusters/potential impact zones are approximate location based on rapid survey and assessment and may alter partially subject to the detailed field study and monitoring. Detailed mapping will be made available showing spatial boundaries of the identified industrial clusters including zone of influence/ buffer zone, after in depth field study.

ANNEXURE VIII
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**	▪ Details on prima facie idea of the project.
II.	**Project Details**	
	Need/Justification of the Project	▪ Current demand scenario of the product ▪ Alternatives to meet the demand ▪ Post project scenario on residual demand
	Industry(s) Capacity	▪ Sustainability of raw material, fuel supply and quality ▪ Optimization of fertilizer plant capacity
	Process technology	▪ Analysis of all available/advanced technologies, etc. ▪ Analysis of various possible configurations for each technology or a combination of these technologies from available manufactures ▪ Broad specifications for the proposed industry (s) including but not limited to: - Plant outputs and process flow diagrams for each alternative - Electrical equipment, I&C equipment, DCS equipment with redundancy - Balance of plant equipment - General plant layout
	Resources/raw materials	▪ Details on raw material, by products/byproducts ▪ Water - Water requirement for process, utilities, domestic, gardening etc. - Source of construction water and potable water - Source of circulating/consumptive water - Quality of raw water, treated water - Water budget calculations and effluent generation - Approved water allocation quota (drinking, irrigation and industrial use) and surplus availability - Feasible ways of bringing water to site indicating constraints if any. - Lean season water availability and allocation source in case main source not perennial. ▪ Manpower ▪ Infrastructure ▪ Electrical power ▪ Construction material like sand, brick, stone chips, borrow earth etc.
	Rejects (Pollution potential)	▪ Air emissions ▪ Water pollution ▪ 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	▪ Outline project implementation and procurement arrangement including contract packaging ▪ Project implementation schedule showing various activities
	Future prospects	▪ Ascertain the costs and benefits of the proposed project for project life ▪ Technical and logistic constraints/ requirements of project sustainability
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 (Fuel, etc.) 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 land-use attributes fall within the study area, the following details has to be provided: - Public water supply areas from rivers/surface water bodies, from groundwater - Scenic areas/tourism areas/hill resorts - Religious places, pilgrim centers that attract over 10 lakh pilgrims a year - Protected tribal settlements (notified tribal areas where industrial activity is not permitted); CRZ - Monuments of national significance, World Heritage Sites - Cyclone, Tsunami prone areas (based on last 25 years); - Airport areas - Any other feature as specified by the State or local government and other features as locally applicable, including prime agricultural lands, pastures, migratory corridors, etc. ▪ If ecologically sensitive attributes fall within the study area, please give details. Ecologically sensitive attributes include - National parks - Wild life sanctuaries Game reserve - Tiger reserve/elephant reserve/turtle nesting ground - Breeding grounds - Core zone of biosphere reserve - Habitat for migratory birds - Mangrove area - Tropical forests - Important lakes - Endangered species of flora and fauna, *etc*.
	Social aspects	▪ Corporate 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 ▪ 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, *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 IX
Types of Monitoring and Network Design Considerations

TYPES OF MONITORING AND NETWORK DESIGN CONSIDERATIONS

A. Types of Monitoring

Monitoring refers to the collection of data using a series of repetitive measurements of environmental parameters (or, more generally, to a process of systematic observation). The environmental quality monitoring programme design will be dependent upon the monitoring objectives specified for the selected area of interest. The main types of EIA monitoring activities are:

- Baseline monitoring is the measurement of environmental parameters during the pre-project period for the purpose of determining the range of variation of the system and establishing reference points against which changes can be measured. This leads to the assessment of the possible (additional available) assimilative capacity of the environmental components in pre-project period w.r.t. the standard or target level.
- Effects monitoring is the measurement of environmental parameters during project construction and implementation to detect changes which are attributable to the project to provide the necessary information to:
  - verify the accuracy of EIA predictions; and
  - determine the effectiveness of measures to mitigate adverse effects of projects on the environment.
  - Feedback from environmental effect monitoring programs may be used to improve the predictive capability of EIAs and also determine whether more or less stringent mitigation measures are needed
- Compliance monitoring is the periodic sampling or continuous measurement of environmental parameters to ensure that regulatory requirements and standards are being met.

Compliance and effects monitoring occurs during the project construction, operation, and abandonment stages. The resources and institutional set-up should be available for the monitoring at these stages. All large-scale construction projects will require some construction stage monitoring. To control the environmental hazards of construction as specified in the EIA, a monitoring program should be established to ensure that each mitigation measure is effectively implemented. There are numerous potential areas for monitoring during operations.

The scope of monitoring topics discussed in this chapter is limited to Baseline and Effects monitoring. In addition, this chapter will also discuss the Compliance monitoring during the construction phase. Post-project monitoring requirements are discussed in the EMP.

Before any field monitoring tasks are undertaken there are many institutional, scientific, and fiscal issues that must be addressed in the implementation of an environmental monitoring program. Careful consideration of these issues in the design and planning stages will help avoid many of the pitfalls associated with environmental monitoring programs. Although these issues are important but the discussions here are confined to the monitoring network design component.

B. Network Design

Analysis of Significant Environmental Issues

At the outset of planning for an environmental monitoring network, the EIA manager may not know exactly what should be monitored, when monitoring should begin, where it should monitor, which techniques should be employed, and who should take responsibility for its conduct. Because there are usually a number of objective decisions associated with network design to be made, it is important to start with an analysis of environmental issues. The scoping phase of an EIA is designed to identify and focus on the major issues. Scoping should provide a valuable source of information on the concerns that need to be addressed by the monitoring network design. These are project specific as well as specific to the environmental setting of the location where the project is proposed to be located

Hence, the network designs are associated with questions like:

- What are the expected outputs of the monitoring activity?
- Which problems do we need to address to? *etc*.

Defining the output will influence the design of the network and optimize the resources used for monitoring. It will also ensure that the network is specially designed to optimize the information on the problems at hand

What to Monitor?

The question of what to monitor is associated with the identification of VECs.

VECs are generally defined as environmental attributes or components of the environment that are valued by society as identified during the scoping stage of the project. They are determined on the basis of perceived public concerns. For example, changes to water quality and quantity could have implications on fish by affecting habitat, food supply, oxygen, and contaminant uptake. Similarly, employment and business, and economies are both VECs that serve as pathways.

The choice of VECs is also related to the perceived significant impact of the project implementation on important environmental components. In general, the significance or importance of environmental components is judged based on:

- legal protection provided (for example, rare and endangered species)
- political or public concerns (for example, resource use conflicts and sustainable development)
- scientific judgment (for example, ecological importance); or
- commercial or economic importance

However, in addition to their economic, social, political or ecological significance, the chosen VEC should also have unambiguous operational ease, be accessible to prediction and measurement; and be susceptible to hazard. Once the VECs are defined, the VECs may be directly measured (for example, extent of habitat for an endangered species). In cases where it is impossible or impractical to directly measure the VECs, the chosen measurement endpoints or environmental indicators must correspond to, or be predictive of assessment endpoints.

The chosen environmental indicators must be: 1) measurable; 2) appropriate to the scale of disturbance/ contamination; 3) appropriate to the impact mechanism; 4) appropriate

and proportional to temporal dynamics; 5) diagnostic; and 6) standardized; as well as have: 1) a low natural variability; 2) a broad applicability; and 3) an existing data series.

Where, How and How Many Times to Monitor?

These are the other components of Monitoring Network Design. These questions are best answered based on local field conditions, capacity and resources available, prevailing legal and regulatory priorities, *etc*. For this, screening or reconnaissance surveys of the study area are also necessary. This may also include some simple inexpensive measurements and assimilative/dispersion modeling. The data will give some information on the prevailing special and temporal variations, and the general background air pollution in the area. The number of monitoring stations and the indicators to be measured at each station in the final permanent network may then be decided upon based on the results of the screening study as well as on the knowledge of the sources of the proposed development and prevailing local environmental/meteorological conditions. The best possible definition of the air pollution problem, together with the analysis of the resources: personnel, budget and equipment available, represent the basis for the decision on the following questions:

- What spatial density (number) of sampling stations is required? How many samples are needed and during what period (sampling (averaging) time and frequency)?
- Where should the stations be located?
- What kind of equipment should be used?
- What additional background information is needed?
  - meteorology
  - topography
  - population density
  - emission sources and emission rates
  - effects and impacts
- How will the data be made available/communicated?

C. Site Selection

When considering the location of individual samplers, it is essential that the data collected are representative for the location and type of area without the undue influence from the immediate surroundings. In any measurement point in the study area the total ambient concentration is the representative of:

- natural background concentration
- regional background
- impact of existing large regional sources such as Industrial emissions

To obtain the information about the importance of these different contributions it is therefore necessary to locate monitoring stations so that they are representative for different impacts. In addition to the ambient pollution data, one would often need other data governing the variations such as meteorological data for air pollution, to identify and quantify the sources contributing to the measurements.

ANNEXURE X
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 ▪ RPM ▪ SO_2 ▪ NO_2 ▪ CO ▪ H_2S* ▪ $NH*_3$ ▪ HC* ▪ Fluoride* ▪ Pb* ▪ VOC-PAH* ▪ Mercury* (parameters to be proposed by the proponent, in draft ToR, which will be reviewed and approved by EAC/SEAC)	10 to 15 locations in the project impact area	24 hrly twice a week 8 hrly twice a week 24 hrly twice a week	▪ Gravimetric (High – Volume) ▪ Gravimetric (High – Volume with Cyclone) ▪ EPA Modified West & Gaeke method ▪ Arsenite Modified Jacob & Hochheiser ▪ NDIR technique ▪ Methylene-blue ▪ Nessler's Method ▪ Infra Red analyzer ▪ Specific Ion meter	**Monitoring Network** ▪ Minimum 2 locations in upwind side, more sites in downwind side / impact zone ▪ All the sensitive receptors need to be covered **Measurement Methods** As per CPCB standards for NAQM, 1994

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
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 ▪ Fish & other aquatic flora & fauna (parameters are given in ToR for EIA studies based on nature of project, raw material & process	Set of grab samples during pre and post- monsoon for ground and surface water for the whole study zone. For lab. Analysis the samples should be preserved for transport safe	Diurnal and season-wise	Samples for water quality should be collected and analyzed as per: IS: 2488 (Part 1-5) methods for sampling and testing of industrial effluents Standard methods for examination of water and waste water analysis published by American Public Health Association. International standard practices for benthos and aquatic flora & fauna	

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
technology, location-nature/activities within of air basin)				
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, DO, total residual chlorine as Cl2, oil and grease, sulphide, phenolic compound	Implant Source depending upon the different waste streams the parameters can be optimized Grab and composite sampling representing avg of different process operations as well as worst emission scenario should be represented	Different operational cycles as well as raw material variations should be reflected in the analysis	Samples for water quality should be collected and analyzed as per: IS: 2488 (Part 1-5) methods for sampling and testing of industrial effluents Standard methods for examination of water and wastewater analysis published by American Public Health Association.	All plant sources categorized as: ▪ Different Process waste streams as well as run-off conditions ▪ ETP wastewater Domestic/ sanitary wastewater

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
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) ▪ Satellite Imageries ▪ (1:25,000)	Drainage within the plant area and surrounding is very important for storm water impacts. From land use maps sensitive receptors (forests, parks, mangroves etc.) can be identified
E. 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	

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
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 ▪ Enumeration of ▪ phytoplankton, zooplankton and benthos ▪ Fisheries ▪ Diversity indices	Considering probable impact, sampling points 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	Season changes are very important	Standards techniques (APHA et. Al. 1995, Rau and Wooten 1980) to be followed for sampling and measurement	Seasonal sampling for aquatic biota One season for terrestrial biota, in addition to vegetation studies during monsoon season Preliminary assessment

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
▪ 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	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			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 XI
Sources of Secondary Data

Annexure XIA: 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 XIB: 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 XII
Impact Prediction Tools

Table 1: Choice of Models for Prediction of Impacts: Air Environment *

Model	Application	Remarks
ISCST 3	▪ Appropriate for point, area and line sources ▪ Application for flat or rolling terrain ▪ Transport distance up to 50 km valid ▪ Computes for 1 hr to annual averaging periods	▪ Can take up to 99 sources ▪ Computes concentration on 600 receptors in Cartesian on polar coordinate system ▪ Can take receptor elevation ▪ Requires source data, meteorological and receptor data as input
AERMOD with AERMET	▪ Settling and dry deposition of particles ▪ Building wake effects (excluding cavity region impacts) ▪ Point, area, line, and volume sources ▪ Plume rise as a function of downwind distance ▪ Multiple point, area, line, or volume sources ▪ Limited terrain adjustment ▪ Long-term and short-term averaging modes ▪ Rural or urban modes ▪ Variable receptor grid density and ▪ Actual hourly meteorology data	▪ Can take up to 99 sources ▪ Computes concentration on 600 receptors in Cartesian on polar coordinate system ▪ Can take receptor elevation ▪ Requires source data, meteorological and receptor data as input
PTDIS	▪ Screening model applicable for a single point source ▪ Computes maximum pollutant concentration and its occurrences for the prevailing meteorological conditions	▪ Require source characteristics ▪ Average met data (wind speed, temperature, stability class *etc*.) required ▪ Used mainly to see likely impact of a single source
MPTER	▪ Appropriate for point, area and line sources applicable for flat or rolling terrain ▪ Transport distance up to 50 km valid ▪ Computes for 1 hr to annual averaging periods ▪ Terrain adjustment is possible	▪ Can take 250 sources ▪ Computes concentration at 180 receptors up to 10 km ▪ Requires source data, meteorological data and receptor coordinates
CTDM PLUS (Complex Terrain Dispersion Model)	▪ Point source steady state model, can estimate hrly average concentration in isolated hills/ array of hills	▪ Can take maximum 40 Stacks and computes concentration at maximum 400 receptors ▪ Does not simulate calm met conditions ▪ Hill slopes are assumed not to exceed 15 degrees ▪ Requires sources, met and terrain

Model	Application	Remarks
		characteristics and receptor details
OCD (Offshore and coastal Dispersion Model)	▪ It determines the impact of offshore emissions from point sources on the air quality of coastal regions ▪ It incorporates overwater plume transport and dispersion as well as changes that occur as the plume crosses the shore line ▪ Most suitable for overwater sources shore onshore receptors are below the lowest shore height	▪ Requires source emission data ▪ Require hrly met data at offshore and onshore locations like water surface temperature; overwater air temperature; relative humidity *etc*.
FDM (Fugitive Dust Model)	▪ Suitable for emissions from fugitive dust sources ▪ Source may be point, area or line (up to 121 source) ▪ Require particle size classification max. up to 20 sizes ▪ Computes concentrations for 1 hr, 3hr, 8hr, 24hr or annual average periods	▪ Require dust source particle sizes ▪ Source coordinates for area sources, source height and geographic details ▪ Can compute concentration at max. 1200 receptors ▪ Require met data (wind direction, speed, Temperature, mixing height and stability class) ▪ Model do not include buoyant point sources, hence no plume rise algorithm
RTDM (Rough Terrain Diffusion Model)	▪ Estimates GLC is complex/rough (or flat) terrain in the vicinity of one or more co-located point sources ▪ Transport distance max. up to 15 km to up to 50 km ▪ Computes for 1 to 24 hr. or annual ave5rage concentrations	▪ Can take up to 35 co-located point sources ▪ Require source data and hourly met data ▪ Computes concentration at maximum 400 receptors ▪ Suitable only for non reactive gases ▪ Do not include gravitational effects or depletion mechanism such as rain/ wash out, dry deposition

Table 2: Choice of Models for Prediction of Impacts: Noise Environment *

Model	Application
FHWA (Federal Highway Administration)	Noise Impact due to vehicular movement on highways
Dhwani	For predictions of impact due to group of noise sources in the industrial complex (multiple sound sources)
Hemispherical sound wave propagation Air Port	Fore predictive impact due to single noise source For predictive impact of traffic on airport and rail road

Table 3: Choice of Methods for Prediction of Impacts: Water Environment *

Model	Application	Remarks
Estuary models/ estuarial Dynamic model	It is simulates tides, currents, and discharge in shallow, vertically mixed estuaries excited by ocean tides, hydrologic influx, and wind action Tides, currents in estuary are simulated	Dynamic model
Dynamic Water Quality Model	▪ It simulates the mass transport of either conservative or non-conservative quality constituents utilizing information derived from the hydrodynamic model Bay-Delta model is the programme generally used. ▪ Up to 10 independent quality parameters of either conservative or non-conservative type plus the BOD-DO coupled relationship can be handled	Dynamic model
HEC -2	To compute water surface profiles for stead7y, gradually: varying flow in both prismatic & non- prismatic channels	
SMS	Lake circulation, salt water intrusion, surface water profile simulation model	Surface water Modelling system Hydrodynamic model

Table 4: Choice of Models for Prediction of Impacts: Land Environment *

Model	Application	Remarks
Digital Analysis Techniques	Provides land use / land cover distribution	
Ranking analysis for soil suitability criteria	Provides suitability criteria for developmental conversation activities	Various parameters viz. depth, texture, slope, erosion status, geomorphology, flooding hazards, GW potential, land use *etc*. are used.

Table 5: Choice of Methods for Prediction of Impacts: Biological Environment *

Name	Relevance	Applications	Remarks
Aquatic Flora			
Sample plot methods	Density and relative density Density and relative dominance	Average number of individuals species per unit area Relative degree to which a species predominates a community by its sheer numbers, size bulk or biomass	The quadrant sampling technique is applicable in all types of plant communities and for the study of submerged, sessile (attached at the base) or sedentary plants
	Frequency and relative frequency	Plant dispersion over an area or within a community	Commonly accepted plot size: 0.1 m^2- mosses, lichens & other

Name	Relevance	Applications	Remarks
	importance value		mat-like plants
		Average of relative density, relative dominance and relative frequency	0.1 m^2- herbaceous vegetation including grasses
			10.20 m^2 – for shrubs and saplings up to 3m tall, and
			100 m^2 – for tree communities
Transects & line intercepts methods	Cover	Ratio of total amount of line intercepted by each species and total length of the line intercept given its cover	This methods allows for rapid assessment of vegetation transition zones, and requires minimum time or equipment of establish
	Relative dominance	It is the ratio of total individuals of a species and total individuals of all species	Two or more vegetation strata can be sampled simultaneously
Terrestrial Flora			
Plot-less sampling methods	Mean point plant Mean area per plant	Mean point – plant distance Mean area per plant	Vegetation measurements are determined from points rather than being determined in an area with boundaries
	Density and relative density		Method is used in grass-land and open shrub and tree communities
	Dominance and relative dominance		It allows more rapid and extensive sampling than the plot method
	Importance value		Point quarter method is commonly used in woods and forests.
Fauna			
Species list methods	Animal species list	List of animal communities observed directly	Animal species lists present common and scientific names of the species involved so that the faunal resources of the area are catalogued
Direct Contact Methods	Animal species list	List of animals communities observed directly	This method involves collection, study and release of animals
Count indices methods (Roadside and aerial count methods)	Drive counts Temporal counts	Observation of animals by driving them past trained observers	Count indices provide estimates of animal populations and are obtained from signs, calls or trailside counts or roadside counts
	Call counts	Count of all animals passing a fixed point during some stated interval of time	These estimates, through they do not provide absolute population numbers, Provide an index of the various species in an area
			Such indices allow comparisons through the seasons or between sites or habitats
Removal methods	Population size	Number of species captured	Removal methods are used to obtain population estimates of small mammals, such as, rodents

Name	Relevance	Applications	Remarks
			through baited snap traps
Market capture methods	Population size estimate (M)	Number of species originally marked (T) Number of marked animals recaptured (t) and total number of animals captured during census (n) N = nT/t	It involves capturing a portion of the population and at some later date sampling the ratio of marked to total animals caught in the population

Table 6: Choice of Methods for Prediction of Impacts: Socio-economic Aspect *

Name	Application	Remarks
Extrapolative Methods	A prediction is made that is consistent with past and present socio-economic data, e.g. a prediction based on the linear extrapolation of current trends	
Intuitive Forecasting (Delphi techniques)	Delphi technique is used to determine environmental priorities and also to make intuitive predictions through the process of achieving group consensus	Conjecture Brainstorming Heuristic programming Delphi consensus
Trend extrapolation and correlation	Predictions may be obtained by extrapolating present trends Not an accurate method of making socio-economic forecasts, because a time series cannot be interpreted or extrapolated very far into the future with out some knowledge of the underlying physical, biological, and social factors	Trend breakthrough precursor events correlation and regression
Metaphors and analogies	The experience gained else where is used to predict the socio-economic impacts	Growth historical simulation commonsense forecasts
Scenarios	Scenarios are common-sense forecasts of data. Each scenario is logically constructed on model of a potential future for which the degrees of "confidence" as to progression and outcome remain undefined	Common-sense
Dynamic modeling (Input- Out model)	Model predicts net economic gain to the society after considering all inputs required for conversion of raw materials along with cost of finished product	
Normative Methods	Desired socio-economic goals are specified and an attempt is made to project the social environment backward in time to the present to examine whether existing or planned resources and environmental programmes are adequate to meet the goals	Morphological analysis technology scanning contextual mapping - functional array - graphic method Mission networks and functional arrays decision trees & relevance trees matrix methods scenarios

* **NOTE**: (i) If project proponent prefers 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 XIII

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 XIV
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 XV

Best Practices & Latest Technologies available and reference

Best Practices & Latest Technologies available and reference

Best available techniques

Common issues

BAT is to carry out regular energy audits for the whole production site, to monitor key performance parameters and to establish and to maintain mass balances for nitrogen, P_2S_5, steam, water and CO_2. Minimisation of energy losses is carried out by generally avoiding steam pressure reduction without using the energy or by adjusting the whole steam system in order to minimize the generation of excess steam. Excess thermal energy should be used on-site or off-site and, if local factors prevent that, as a last option, steam might be used for generating only electrical power.

BAT is to improve the environmental performance of the production site by a combination of recycling or re-routing mass streams, efficiently sharing equipment, increasing heat integration, preheating of combustion air, maintaining heat exchanger efficiency, reducing waste water volumes and loads by recycling condensates, process and scrubbing waters, applying advanced process control systems and by maintenance.

Production of ammonia

BAT for new installations is to apply conventional reforming or reduced primary reforming or heat exchange autothermal reforming. In order to achieve the NO_x concentration emission levels given in Table I, techniques such as SNCR at the primary reformer (if the furnace allows the required temperature/retention time windows), low NO_x burners, ammonia removal from purge and flash gases or low temperature desulphurisation for autothermal heat exchange reforming, should be applied

BAT is to carry out routine energy audits. Techniques to achieve the energy consumption levels given in Table II, are extended preheating of the hydrocarbon feed, preheating of combustion air, installation of a second generation gas turbine, modifications of the furnace burners (to assure an adequate distribution of gas turbine exhaust over the burners), rearrangement of the convection coils and addition of additional surface, pre-reforming in combination with a suitable steam saving project. Other options are improved CO_2 removal, low temperature desulphurisation, isothermal shift conversion (mainly for new installations), use of smaller catalyst particles in ammonia converters, low pressure ammonia synthesis catalyst, use of sulphur resistant catalyst for shift reaction of syngas from partial oxidation, liquid nitrogen wash for final purification of the synthesis gas, indirect cooling of the ammonia synthesis reactor, hydrogen recovery from the purge gas of the ammonia synthesis or the implementation of an advanced process control system. In partial oxidation, sulphur is recovered from flue-gases, e.g. by applying a combination of a Claus unit with tail gas treatment to achieve BAT associated emission levels and efficiencies given in the BREF on Oil and Gas Refineries. BAT is to remove NH_3 from process condensates, e.g. by stripping. NH_3 is recovered from purge and flash gases in a closed loop. The full text provides guidance on how to handle startup/shutdown and other abnormal operating conditions.

Production of nitric acid

BAT is to use recoverable energy: co-generated steam and/or electrical power. BAT is to reduce emissions of N_2O and to achieve the emission factors or emission concentration levels given in Table III by applying a combination of the following techniques:

- optimising the filtration of raw materials
- optimising the mixing of raw materials
- optimising the gas distribution over the catalyst
- monitoring catalyst performance and adjusting the campaign length •

optimisation of the NH_3/air ratio

- optimising the pressure and temperature of the oxidation step
- N_2O decomposition by extension of the reactor chamber in new plants •

catalytic N_2O decomposition in the reactor chamber

- combined NO_x and N_2O abatement in tail gases.

Split view: Industry and one Member State do not agree with the N_2O emission levels associated with the application of BAT *for existing plants* due to the limited experience with the De-N_2O techniques presented in Sections 3.4.6 and 3.4.7, the variance in the results obtained from pre-selected test installations, and the many technical and operational constraints for applying these techniques in the nitric acid plants in operation in Europe today. In their opinion, the applied catalysts are still under development, although already placed on the market. Industry also claims that the levels should relate to averages achieved in the lifetime of the De-N_2O catalyst, although this lifetime is not known yet. Industry and one Member State claim that the BAT range should include 2.5 kg N_2O/tonne 100 % HNO_3 for existing plants.

BAT is to reduce emissions during startup and shutdown conditions. BAT is to reduce emissions of NO_x and to achieve the emission levels given in Table IV by applying one or a combination of the following techniques:

- optimisation of the absorption stage
- combined NO_x and N_2O abatement in tail gases
- SCR
- addition of H_2O_2 to the last absorption stage.

Production of sulphuric acid

BAT is to use recoverable energy: co-generated steam, electrical power, hot water. The options to achieve the conversion rates and emission levels given in Table V are the application of double contact/double absorption, single contact/single absorption, the addition of a 5th catalyst

bed, using a cesium promoted catalyst in bed 4 or 5, the change over from single to double absorption, wet or combined wet/dry processes, regular screening and replacement of the catalyst (especially in catalyst bed 1), the replacement of brick-arch converters by stainless steel converters, improving raw gas cleaning (metallurgical plants), improving air filtration, e.g. by two stage filtration (sulphur burning), improving sulphur filtration, e.g. by applying polishing filters (sulphur burning), maintaining heat exchanger efficiency or tail gas scrubbing (provided that by-products can be recycled on-site).

BAT is to continuously monitor the SO_2 levels required to determine the SO_2 conversion rate and the SO_2 emission level. The options to achieve SO_3/H_2SO_4 mist emission levels (see Table VI) are the use of sulphur with a low impurity content (in case of sulphur burning), adequate drying of inlet gas and combustion air (only for dry contact processes), the use of a larger condensation area (only for the wet catalysis process), adequate acid distribution and circulation rate, applying high performance candle filters after absorption, controlling concentration and temperature of the absorber acid or applying recovery/abatement techniques in wet processes, such as ESP, WESP or wet scrubbing. BAT is to minimise or abate NO_x emissions. BAT is to recycle exhaust gases from product H_2SO_4 stripping to the contact process.

Phosphate rock grinding and prevention of rock dust dispersion

BAT is to reduce dust emissions from rock grinding, e.g. by application of fabric filters or ceramic filters and to achieve dust emission levels of 2.5 - 10 mg/Nm^3. BAT is to prevent dispersion of phosphate rock dust by using covered conveyor belts, indoor storage, and frequently cleaning/sweeping the plant grounds and the quay.

Production of phosphoric acid

BAT for existing installations using a wet process is to achieve P_2O_5 efficiencies of 94.0 - 98.5 %, e.g. by applying one or a combination of the following techniques:

- dihydrate process or improved dihydrate process
- increasing the residence time
- recrystallisation process
- repulping
- double-stage filtration
- recycling the water from the phosphogypsum pile •

selection of phosphate rock.

BAT for new installations is to achieve P_2O_5 efficiencies of 98.0 % or higher, e.g. by applying a hemi-dihydrate recrystallisation process with double-stage filtration. BAT for the wet process is to minimise the emissions of P_2O_5 by applying techniques like entrainment separators (where vacuum flash coolers and/or vacuum evaporators are used), liquid ring pumps (with recycling of the ring liquid to the process) or scrubbing with recycling of the scrubbing liquid.

BAT is to reduce fluoride emissions by the application of scrubbers with suitable scrubbing liquids and to achieve fluoride emission levels of 1 - 5 mg/Nm^3 expressed as HF. BAT for wet processes is to market the generated phosphogypsum and fluosilicic acid, and, if there is no market, to dispose of it. Piling of phosphogypsum requires precautionary measures and recycling of water from these piles. BAT for wet processes is to prevent fluoride emissions to water, e.g. by the application of an indirect condensation system or by a scrubbing with recycling or marketing the scrubbing liquid. BAT is to treat waste water by applying a combination of the following techniques:

- neutralisation with lime
- filtration and optionally sedimentation
- recycling of solids to the phosphogypsum pile.

Plant concept	NO_x emission as NO_2
	mg/Nm^3
Advanced conventional reforming processes and processes with reduced primary reforming	90- 230 [x]
Heat exchange autothermal reforming	a) 80 b) 20
a) Process air heater b) Auxiliary boiler [x] Low end of the range: best existing performers and new installations	
No direct correlation between concentration levels and emission factors could be established. However, emission factors of 0.29 - 0.32 kg/tonne NH_3 are seen as a benchmark for conventional reforming processes and processes with reduced primary reforming. For heat exchange autothermal reforming, an emission factor of 0.175 kg/tonne NH_3 is seen as a benchmark.	

Table I: NO_x emission levels associated with BAT for the production of ammonia

Plant concept	Net energy consumption [x]
	GJ(LHV)/tonne NH_3
Conventional reforming processes, processes with reduced primary reforming or heat exchange autothermal reforming	27.6 - 31.8
[x] For interpretation of the given energy consumption levels, please refer to the full text. As a consequence, the levels might vary up to ± 1.5 GJ. Generally, the levels relate to steady state operation as it would be typically experienced during a performance test directly following a revamp or an overhaul at intended capacity.	

Table II: Energy consumption levels associated with BAT for the production of ammonia

		N_2O emission level [x]	
		kg/tonne 100 % HNO_3	ppmv
M/M, M/H and H/H	New plants	0.12 - 0.6	20 - 100
	Existing plants	0.12 - 1.85	20 - 300
L/M plants		No conclusion drawn	
[x] The levels relate to the average emission levels achieved in a campaign of the oxidation catalyst			

Table III: N_2O emission levels associated with the application of BAT for the production of HNO_3 Note: there is a split view on the emission levels for existing plants (see text above)

	NO_x emission level as NO_2	
	kg/tonne 100 % HNO_3	ppmv
New plants	--	5 - 75
Existing plants	--	5 - 90 [x]
NH_3 slip from SCR	--	<5
[x] Up to 150 ppmv, where safety aspects due to deposits of AN restrict the effect of SCR or with addition of H_2O_2 instead of applying SCR		

Table IV: NO_x emission levels associated with the application of BAT for the production of HNO_3

Conversion process type		Daily averages	
		Conversion rate [x]	SO_2 in mg/Nm^3 [xx]
Sulphur burning, double contact/double absorption	Existing installations	99.8 - 99.92 %	30 - 680
	New installations	99.9 - 99.92 %	30 - 340
Other double contact/double absorption plants		99.7 - 99.92 %	200 - 680
Single contact/single absorption			100 - 450
Other			15 - 170

[x] These conversion rates relate to the conversion including the absorption tower, they do not include the effect of tail gas scrubbing

[xx] These levels might include the effect of tail gas scrubbing

Table V: Conversion rates and SO_2 emission levels associated with BAT for production of H_2SO_4

	Emission level as H_2SO_4
All processes	10 - 35 mg/Nm^3
Yearly averages	

Table VI: SO_3/H_2SO_4 emission levels associated with BAT for production of H_2SO_4

	GJ/tonne HF	Remark
Fuel for kiln heating	4- 6.8	Existing installations
	4- 5	New installations, production of anhydrous HF
	4.5 - 6	New installations, production of anhydrous HF and HF solutions

Table VII: Achievable consumption levels associated with BAT for the production of HF

	kg/tonne HF	mg/Nm^3	Remark
SO_2	0.001 - 0.01		Yearly averages
Fluorides as HF		0.6 - 5	

Table VIII: Achievable emission levels associated with BAT for the production of HF

	Parameter	Level mg/Nm^3	Removal efficiency in %
Phosphate rock digestion, sand washing, CNTH filtration	NO_x as NO_2	100 - 425	
	Fluoride as HF	0.3 - 5	
Neutralisation, granulation, drying, coating, cooling	NH_3	5- 30 [x]	
	Fluoride as HF	1 - 5 [xx]	
	Dust	10 - 25	>80
	HCl	4 - 23	

[x] The lower part of the range is achieved with nitric acid as scrubbing medium, the upper part of the range is achieved with other acids as scrubbing medium. Depending on the actual NPK grade produced (e.g. DAP), even by applying multistage scrubbing, higher emission levels might be expected

[xx] in the case of DAP production with multistage scrubbing with H_3PO_4, levels of up to 10 mg/Nm^3 might be expected

Table IX: Emission levels to air associated with the application of BAT for the production of NPK

Hydrofluoric acid

The options to achieve fuel consumption levels within the ranges given in Table VII are preheating the feed H_2SO_4, optimised kiln design and optimised temperature profile control for the rotary kiln, using a pre-reactor system, energy recovery from kiln heating or spar calcination.

BAT for the treatment of tail gases from the fluorspar process is to apply, e.g. water scrubbing and/or alkaline scrubbing and to achieve the emission levels given in Table VIII. BAT is to reduce dust emissions from fluorspar drying, transfer and storage and to achieve dust emission levels of 3 - 19 mg/Nm^3.

Split view: Part of industry claims that the dust emission levels are not achievable, because changing the bags in the applied fabric filters more than one time per year would not be economically viable.

Waste water from wet scrubbing is treated, e.g. by neutralisation with lime, addition of coagulation agents, filtration and optionally sedimentation. BAT for the fluorspar process is to market the generated anhydrite and fluosilicic acid, and if there is no market, to dispose of it, e.g. by landfilling.

Production of NPK fertilisers

BAT is to improve the environmental performance of the finishing section, e.g. by applying plate bank product cooling, recycling of warm air, selecting proper size of screens and mills, e.g. roller or chain mills, applying surge hoppers for granulation recycle control or applying online product size distribution measurement for granulation recycle control. BAT is to minimise the NO_x load in exhaust gases from phosphate rock digestion, for example, by accurate temperature control, a proper rock/acid ratio, phosphate rock selection or by controlling other relevant process parameters.

BAT is to reduce emissions to air from phosphate rock digestion, sand washing and CNTH filtration by applying, e.g. multistage scrubbing, and to achieve emission levels given in Table IX. BAT is to reduce emission levels to air from neutralisation, granulation, drying, coating, cooling by applying the following techniques and to achieve the emission levels or removal efficiencies given in Table IX:

- dust removal, such as cyclones and/or fabric filters •

wet scrubbing, e.g. combined scrubbing.

BAT is to minimise waste water volumes by recycling washing and rinsing waters and scrubbing liquors into the process, e.g. and by using residual heat for waste water evaporation. BAT is to treat the remaining waste water volumes.

Production of urea and UAN

BAT is to improve the environmental performance of the finishing section, for example, by applying plate bank product cooling, redirecting urea fines to the concentrated urea solution, selecting proper size of screens and mills, e.g. roller or chain mills, applying surge hoppers for granulation recycle control or applying product size distribution measurement and control. BAT is to optimise the total energy consumption for urea production by applying one or a combination of the following techniques:

- for existing stripping installations, continue applying stripping technology •

for new installations, applying total recycling stripping processes

- for existing conventional total recycling installations, only in case of a substantial urea plant capacity increase, upgrading to stripping technology
- increasing heat integration of stripping plants
- applying combined condensation and reaction technology.

BAT is to treat all exhaust gases from the wet sections by scrubbing, taking into account the lower explosion limit and to recycle the resulting ammonia solutions to the process.

BAT is to reduce ammonia and dust emissions from prilling or granulation and to achieve ammonia emission levels of 3 - 35 mg/Nm^3, e.g. by scrubbing or optimising the operation conditions of prilling towers, and to re-use scrubber liquids on-site. If the scrubbing liquid can be re-used, then preferably by acidic scrubbing, if not, by water scrubbing. In optimising the emission levels to the values mentioned above, it is assumed that dust emission levels of 15 - 55 mg/Nm^3 are achieved, even with water scrubbing.

Where process water with or without treatment is not re-used, BAT is to treat process water, e.g. by desorption and hydrolysation and to achieve the levels given in Table X. If, in existing plants, the levels cannot be achieved, it is BAT to apply subsequent biological waste water treatment. It is also BAT to monitor the key performance parameters as described in the full text.

		NH_3	Urea	
After process water treatment	New plants	1	1	ppm w/w
	Existing plants	<10	<5	

Table X: BAT levels for the treatment of process water from urea production

Production of AN/CAN

BAT is to optimise the neutralisation/evaporation stage by a combination of the following techniques:

- using heat of reaction to preheat the HNO_3 and/or to vapourise NH_3
- operating the neutralisation at an elevated pressure and exporting steam
- using the generated steam for evaporation of the ANS
- recovering residual heat for chilling process water
- using the generated steam for the treatment of process condensates
- using the heat of reaction for additional water evaporation.

BAT is to effectively and reliably control pH, flow and temperature. The options to improve the environmental performance of the finishing section are applying plate bank product cooling, recycling of warm air, selecting proper size of screens and mills, e.g. roller or chain mills, applying surge hoppers for granulation recycle control or applying product size distribution measurement and control.

BAT is to reduce dust emissions from dolomite grinding to levels <10 mg/Nm^3 by applying, e.g. fabric filters. Because of an insufficient data basis, no conclusions could be drawn for emissions to air from neutralisation, evaporation, granulation, prilling, drying, cooling and conditioning.

BAT is to recycle process water on site or off site and to treat the remaining waste water in a biological treatment plant or using any other technique achieving an equivalent removal efficiency.

Production of SSP/TSP

BAT for waste water treatment is to apply BAT given in the BREF on Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector. BAT is to improve environmental performance of the finishing section by one or a combination of the following techniques:

- applying plate bank product cooling
- recycling of warm air
- selecting proper size of screens and mills, e.g. roller or chain mills •

applying surge hoppers for granulation recycle control

- applying online product size distribution measurement for granulation recycle control.

BAT is to reduce fluoride emissions by the application of scrubbers with suitable scrubbing liquids and to achieve fluoride emission levels of 0.5 - 5 mg/Nm^3 expressed as HF. BAT is to reduce waste water volumes by the recycling of scrubbing liquids, where, besides the manufacture of SSP or TSP, acidulated phosphate rock (PAPR) is also produced. BAT for the production of SSP/TSP and multi purpose production is to reduce emissions to air from neutralisation, granulation, drying, coating, cooling by applying the following techniques and to achieve the emission levels or removal efficiencies given in Table XI:

- cyclones and/or fabric filters
- wet scrubbing, e.g. combined scrubbing.

	Parameter	Level mg/Nm^3	Removal efficiency in %
Neutralisation, granulation, drying, coating, cooling	NH_3	5- 30 [x]	
	Fluoride as HF	1 - 5 [xx]	
	Dust	10 - 25	> 80
	HCl	4 - 23	

[x] The lower part of the range is achieved with nitric acid as scrubbing medium, the upper part of the range is achieved with other acids as scrubbing medium. Depending on the actual NPK grade produced (e.g. DAP), even by applying multistage scrubbing, higher emission levels might be expected

[xx] In the case of DAP production with multistage scrubbing with H_3PO_4, levels of up to 10 mg/Nm^3 might be expected

Table XI: Emission levels to air associated with the application of BAT for production of SSP/TSP

REFERENCES

Reference Documents

- ***Ministry of Environment and Forest, GoI*** – "Environment Impact Assessment Notification" S.O.1533 dated 14th September 2006.
- ***Ministry of Environment and Forest, GoI –*** "Environment Impact Assessment Notification 2006 – Amendment" S.O. 195 (E) dated 1st December, 2009.
- ***Ministry of Environment and Forest, GoI –*** Charter on Corporate Responsibility for Environment Protection Action Points for 17 Categories of Industries, CPCB, March 2003.
- ***International Association for Impact Assessment*** in Cooperation with Institute of Environmental Assessment, UK – "Principles of Environmental Impact Assessment Best Practice, 1996
- ***Larry W. Canter,*** "Environmental Impact Assessment", Second Edition, McGraw Hill, University of Oklahoma, 1996.
- ***European Commission*** – "Integrated Pollution Prevention and Control Reference Document on Best Available Techniques for the Manufacture of Large Volume Organic Chemicals – Ammonia, Acids and Fertilizers", August, 2007.
- ***IFC*** - "Environmental, Health and Safety Guidelines for Nitrogenous Fertilizer Production", April 30, 2007.
- ***IFC*** - "Environmental, Health and Safety Guidelines for Phosphate Fertilizer Plants", April 30, 2007.
- ***USEPA*** - "Sector Note Book on Agricultural Chemical Industry", September, 2000.
- ***Egyptian Environmental Affairs Agency (EEAA),*** - "Inspection Manual: Fertilizer Industry, Egyptian Pollution Abatement Project (EPAP)", July 2002.
- ***Central Board for the Prevention and Control of Water Pollution*** - "Minimal National Standards Complex Fertilizers Industries", Comprehensive Industry Document Series: COINDS/25/1984-85, 1985.
- ***Central Board for the Prevention and Control of Water Pollution*** - "Minimal National Standards Straight Nitrogenous Fertilizer Industry", Comprehensive Industry Document Series: COINDS/24/1984-85.
- ***Central Pollution Control Board*** - "Environmental Auditing in Fertilizer Industry".
- ***Central Pollution Control Board*** - "Standard Methodology for Environmental Auditing in Fertilizer Industry", Programme Objective Series: PROBES/114/2007, April 2007.
- ***Ministry of Chemicals and Fertilizers, GoI*** - "Annual Report 2007-08", Department of Fertilizers.

- ***Ecosmart India Ltd.,*** **-** Report on Secondary Data Collection for Environmental Information Centre, submitted to Ministry of Environment and Forests, 28th March 2003

Referred Websites

- http://envfor.nic.in/divisions/iass/eia.htm
- http://www.cpcb.nic.in/
- http://www.epa.gov/
- http://www.iaia.org

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