FEDERAL GOVERNMENT OF NIGERIA

GUIDELINES FOR ENVIRONMENTAL IMPACT ASSESSMENT

(DECREE 86, 1992)

SECTORAL GUIDELINES

FOR

MANUFACTURING INDUSTRIES

FEDERAL MINISTRY OF ENVIRONMENT

Sectoral Guidelines for MANUFACTURING INDUSTRIES

Federal Ministry of Environment

TABLE OF CONTENTS

Contents

FORWARD

In furtherance of the mandate of the Federal Ministry of Environment as the apex organization for the overall protection of the Environment and Conservation of Natural Resources as contained in Decree 58 of 1988 and 59 of 1992, the present set of guidelines on various sectors of the Nigerian Economy have been developed. This is to ensure the environmental sustainability of these sectors through compliance with E.I.A Decree 86 of 1992 which makes Environmental Impact Assessment (EIA) mandatory for all new major projects.

In order to achieve sustainable development, the significance of EIA projects, processes or activities cannot be over-emphasized. These guidelines have been developed to assist project proponents with emphasis on the significant associated and potential impacts as well as future monitoring programs are also contained therein for guidance.

These guidelines, if properly followed will assist the project proponent in conforming with the requirements of the EIA Decree No.86 of 1992, and to obtain certification from the Federal Government of Nigeria through the Federal Ministry of Environment.

The Sectoral Guidelines for the Manufacturing Industries are presented in six sub-sectors namely: Chemical Industries, Pulp, Paper and Timber Processing Industries, Industrial Food Processing, Iron and Steel Manufacturing, Non-Ferrous Metal industries, and Fertilizer Industries.

The Existence of these Guidelines does not in any way preclude the project proponent from complying with other applicable regulations and laws.

The Ministry however reserves the right to modify or replace these Guidelines in the whole or part as deemed fit in the circumstances.

PERM.SEC, FED. MIN. OF ENVRIOMENT

PREFACE

These Sectoral Guidelines provide advice and guidance to assist in the preparation of the EIA Reports for industrial projects. Each of the following sections contains issues that must be addressed in the EIA Report on the projects in the Manufacturing Industries Sector. Each Guideline also provides a Sector checklist to aid EIA Preparers.

The purpose of these Sectoral Guidelines is to assist the EIA Practitioner in identification of the grouping or types of industrial projects; project components or activities potentially causing significant environmental impacts; the identification of these potential impacts, characterization of mitigation measures to ameliorate the impacts.

Particularly, the overall aim is to describe general typical industry environment interactions without delving deeply into specific problems of different industrial sectors. It is recommended that these Guidelines be used in conjunction with other manuals and textbooks on environmental protection and control of impacts from industrial development.

1.0 INTRODUCTION

Industrial development can beneficially aid a country's socio-economic development through the production of goods for export and foreign exchange earnings, and/or tools and machinery for other sectors of the national economy. Industrial developments could also provide employment and promote the development of infrastructure.

However, industrial development can be the primary causes of depreciation of environmental resources through their detrimental impacts on the human environment. The impacts seem unavoidable as industries are inherently planned to utilize and develop limited natural resources to generate products for the human use and consumption.

Industrial development apart from using raw materials and limited natural resources in conversion processes and therefore alter the natural ecology but also always produces residues in the form of energy or matter which are often discharged as wastes since the conversion processes can never be completely total. If the residues are not utilized, then these wastes on discharge become biosphere pollutants which may adversely affect the quality of environment. The degree to which the pollutants affect the physical environment depends upon their quantitative and qualitative characteristics as well as the receiving media. Some pollutants are readily biodegradable, whilst others persist for a long time and may not even decompose. Also, some pollutants have low toxicity, whereas others are highly toxic or carcinogenic in trace quantities. As measurements, monitoring, analytical and bioassay techniques improve, the ecotoxicological effects of pollutants also become better known.

In addition to effects on the physical environment, industry and industrialization also have societal impacts. Their impacts are generally much more difficult to assess and often cannot be perceived at the initial stages because of complex interacting, synergistic and symbiotic factors which do not follow any set rules. As these societal impacts can be very significant, they need to be considered at the national level of strategy formulation and policy making hence, while the economic gains of industrial development may be vast, the damage from improperly conceived or operated industrial projects could also be huge on the physical environment and society.

The level of impact usually relates to the siting, scale and sector of the manufacturing industry. Some notable types include:

- Large scale industrial complexes (e.g thermal power stations, nuclear power stations, large scale iron and steel plants, asbestos processing plants, all chemical installations)

Small and medium sized industrial projects category (e.g metal processing, agrochemicals, food, textiles, wood and leather processing, rubber etc)

Impacts due to siting depend on the general environmental sensitivity of the plant location. Some remarkable effects due to siting of the industrial project include:

- Concentration of a sizeable number of small plants in the same locality creating a significant demand or stress on the local renewable resources and/or services, or on the waste assimilation capabilities of terrestrial and aquatic ecosystems.
- Transformation of rural primary products into consumable projects from rural industrial project e.g agricultural industries for milling, sugar refining or livestock industries for pulp, charcoal, lumber etc or earth-resource industries e.g cement, brick-making, sand quarries, salt etc.

The identification and institutionalization of appropriate mitigation plans of harmful side effects of industrialization through Environmental Impact Assessment (EIA) is now universally recognized as an important component of the establishment an execution of industrial development activities either for the project preparation or monitoring.

It is now widely recognized that proper control of industrial development and processing is feasible and does not unduly increase the cost of production. The EIA process is now well established as a key to successful control of impacts of industrial development on the environment, especially with respect to the controlled use of limited natural resources and mitigated discharge of pollutants. The process ensures the incorporation at the project planning stages of desirable and appropriate steps to discourage huge environmental impacts from the project.

2.0 PROJECT JUSTIFICATION

In preparing an EIA for an industrial project, the Report shall include a justification for the new Project. In this regard, the project proponent or initiator shall provide background information to the EIA Preparers on the justification for the project. This shall include a summary of the Project's feasibility studies report, the need, value and sustainability of the economics of the Projects. Such justification shall delineate the advantages of the Project to its intended end-users and indicate the over-riding advantages or positive impact of the Project over its anticipated environmental impacts. Such advantages may include the benefits of any industrial project in the context of Nigeria's industrializing scenario. The justification may also include the rationale for selecting the Project amongst various available options or alternatives and any socio-economic factor's justifying the Project.

3.0 PROJECT AND/OR PROCESS DECRIPTION

3.1 General

The causes of the impacts of an industrial project often originate from within the industrial plant itself or may result from associated activities either in the construction or operation of the plants. The project description in an Industrial Project EIA Report should provide a detailed explanation and description of the proposed action and present brief information on possible associated environment environmental impacts together with the potential sources and associated in-built or to-be-built impact control measures on the Project.

The process description should provide information on alternative production processes considered, raw materials, production capacity, location, facilities supply water, energy etc; transportation of industries in-put and output goods, and other factors that may directly or indirectly cause changes in environmental parameters from the Project.

The pattern of availability of raw materials is an important factor in site selection in industrial development. However, the availability and use would invariably lead to depletion of ecological resources. Hence a detailed description of the raw materials resource in terms of the sustainability of supply, depletion rate of the resource, impacts of raw material exploitation on resource base and the creation of new industry as a result of its use, must be included in the EIA (e.g for a soda ash plant, rock salt to be used must be provided by a new and possibly different mining industry). Material balance mechanisms must be invoked where possible.

The manufacturing process flow charts should be included in this section of the EIA Report. This would show approximate material balance of raw materials, products and wastes, sources of pollution, process alternatives or options, and the industrial project components or phases such as new infrastructure required, employment and migration changes and effects etc, together with environmental implication at each phase.

In addition, a description of land use with aerial photos or maps showing the nexus of the site and the surrounding affected areas should be included. Attention should be given here to site selection options, alternative processes and technology options selection. Some of these issues are further discussed shortly.

3.2 TYPES OF MANUFACTURING INDUSTRY PROJECTS WITH POTENTIAL FOR SIGNIFICANT ENVIRONMENTAL IMPACTS

In these guidelines the types broadly include:

- Chemical Industries including Dyes; Ink; Pharmaceuticals; Textiles; Leather & Tannery; Paints and allied products; Cement and non-metallics; Pesticides; Glass Manufacturing; Plastics and Synthetics; and Natural Rubber Industry.
- Pulp, Paper Timber/Wood Processing
- Iron and Steel Manufacturing
- Non-Ferrous Metals
- Fertilizers Manufacturing and Production
- Food and beverages processing

4.0 DESCRIPTION OF THE ENVIRONMENT/BASELINE INFORMATION

4.1 Project Site Selection, Site Preparation and Construction

Site Selection is an important factor in assessing the potential impacts of industrial development on the environment. Hence the need for a description of the environment of the industrial project must be carried out. The selection of the site of the project is usually based on a number of parameters such as availability of land, labour, water and energy; transport facilities and costs, utilities, infrastructure, accessibility to raw material source etc. The potential of pollution from wastes and their rate of recharge and depletion at the site should be considered. It is to be noted that the capacity of the site to absorb waste discharges without short or long term damage will vary from different wastes and different environment settings. Hence, heavy waste producing industrial developments should not be sited in environmentally sensitive areas or in areas of high concentration of impacting plants. Factors to be examined and described should include:

(i) **Land**

Soil types should be identified in terms of depth, rock,type, permeability and erodability, compaction, general soil mechanics etc. The identification or characterization should include any areas for waste disposal purposes such as sanitary landfills, effluent irrigation farm etc. These should be complemented by (ii) below.

(ii) **Site Topography and Geology**

The site's landscape and topography including the major drainage_basins, developments, transportation systems etc, should be identified. The capacity of receiving waters to assimilate effluent as determined by aquatic phsio-chemical parameters e.g temperature, current patterns, flow rates, dissolved oxygen, biochemical and chemical oxygen demand, dissolved or suspended solids, electrical conductivities.

The geology, hydrogeology and hydrology (surface waters) of the proposed site should be described as to the extent that the potential of contaminant intrusion on underground waters; the foundation conditions for structures to be installed;

hazard from the landslides subsidence or other earth movements must be highlighted. The climate and/or meteorological conditions must be described.

(iii) **Ecological Characteristics**

In addition to (i) and (ii) , the flora and fauna of the site to be used must be described highlighting environmentally sensitive resources to be impacted. The description should include major ecological systems in the proposed project area, habitats of wildlife and fish life, endangered species as in CITES, natural resources beneficial to man for foods, recreation, etc. aesthetics of the environment, aquaculture and other economic values that may be impacted. The atmosphere and meteorological interactions of the proposed site should be described indicating effects of incremental or non-incremental contribution of the industrial emissions.

(iv) **Potential land-use**

The location of human communities at risk (if any), the current protected areas, areas of historical or cultural significance, monuments, historical buildings etc, must be indicated. Also commercial, residential, agricultural, silvicutural, industrial or recreational uses of land in the site selected are to be described. All local and governmental land use laws and regulations that may affect the project are to be described. Where land use plans already exist for the area being affected by the Project, the EIA Report should carefully describe how the proposed site selected conforms or does not conform to the plan.

Land-use maps showing details of current or potential land-use should be provided. A description of changes in land-use patterns which will result from land conversions or displacements by the Project should be given.

(v) **Social Issues**

Certain human environments need special attention in the process of industrial development because of their socio-economic sensitivity to the proposed industrial project. Hence, within the EIA, a description of existing populated sites in the vicinity of the industry project including the demography, cultural characteristics, anthropology, archeology, health and welfare should be examined. The sensitivities of the socio-economy of the local population to the proposed industrial project should be identified by a characterization of the population's income level, distribution and the possible restructuring of the local economy to be caused by the Project.

(vi) **<u>Infrastructural Services of the Site</u>**

The identification of the support services in the Proposed site is usually a key factor in the site selection as presence of adequate environment-friendly infrastructure that pre-date the project considerably reduce negative impacts of the Project. Availability of energy and power, water supply etc, for example obviate the need for creation of these necessities with their attendant undue impacts. Hence, within the Project's EIA, the water, power supply systems must be described in terms of

(a) their nature and if environment-friendly type

(b) their adequacy for meeting all the plant's needs, and

(c) cost of supply

As most industrial projects require substantial volumes of water, the effect of heavy water demand by the Project on the amount available to other users and its relationship to the pattern of seasonal water supply fluctuations which may constrain industrial development need to be assessed and described in the EIA.

The EIA should also consider the transportation system in terms of possible impacts from increased network usage, stress on community transport services etc in the EIA.

Also the pattern of availability of skilled or unskilled labour to operate and manage different stages of the industrial processes needs to be described together with the numbers of unskilled labour force available in the vicinity of the Project site.

It is also necessary to examine the availability of processing facilities, such as saw mills, machine tools, refrigeration, central waste treatment facilities etc, and telecommunications systems in the area together with educational, public health and medical services for the proposed staff of the industry. These factors determine the complementarily of the Project with its proposed environment. The description of the general public health conditions would aid the identification of academic diseases and potential health problems which may be caused or accelerated by the proposed project.

In the Description of the Environment of the proposed Project, discussions on the advantages or otherwise of possible alternative sites or locations must be included. It should be emphasized in this regard, that Facility Siting is one of the areas in which an EIA can be most effective in ensuring that the assimilative capacity of the environment is not exceeded, but only if the assessment process begins before siting options are foreclosed. Furthermore, complex industrial developments and facilities with a high potential for significant environmental impact cannot be handled simply. Full identification of the potential impacts associated with each site would be necessary. General discussion from site preparation, construction, to the operational phases of the project is presented below.

5.0 ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACTS

As highlighted in section (1) above, while the installation of manufacturing industry project is invariably beneficial to the socio-economic environment if however could lead to impacts on the structure, composition and functioning of some of elements of the ecosystem. The impact may be both positive and/or negative. The installation and the accompanying processes may lead to incremental environmental changes or depletion of environmental resources. Similarly, the impacts may have cumulative effects just as the observed impacts may have long or short-term effects. It is also possible that these effects or impacts may be reversible or in a worst case scenario, it may be irreversible and adverse. Projects may also sometimes have direct or indirect impacts on the ecosystem.

The EIA should assess all impacts of the project (positive or negative) from thr construction phase to the phase of operations of the facilities and its processes. Outlined below are general reviews of the issues to be examined in the EIA Report.

5.1 Impacts from Construction Phase

The impacts on the environment from the construction of industrial facilities commence from the processes of the site preparation. These impacts include those on soil chemistry, flora and fauna, hydrology, air, aquatic ecosystem and human health.

The site preparation and the construction of the industrial plant include a number of operations and activities with potentially significant environmental impacts. These activities include for example:

- land clearing, grading, leveling, surface excavation, terracing, etc
- sand filling (if swamp), surfacing and paving
- construction of plant buildings
- construction of transmission lines powerlines
- road construction
- blasting and drilling
- land reclamation
- ditching drainage
- dredging
- quarrying, mining (raw materials generation)
- housing and services for labour force
- settlements relocation, migration etc

The main potential environmental impacts caused by site preparation and construction which should always be considered include:

- impacts on hydrological balance and drainage patterns
- erosion
- impacts on surface water and ground water quality(siltation, spills of soils and other chemicals)
- air pollution (dusts, fumes and exhaust emissions)
- noise and vibration
- disturbance to local traffic
- solid wastes
- ecological impacts (fisheries, terrestrial wildlife, sensitive habitaits)

- visual impacts (aesthetics)
- changes in land use and income distribution
- changes in settlement patterns, population structure and population dynamics
- social conflicts between migrant workers and local residents
- occupational and public health problems (accidents, exposure to hazardous materials, a transmission of diseases)
- impacts on archaeological and historical resources and cultural and recreational sites

5.2 Impacts from the Process/Operation Phase

The operational stage of an industrial development project often involves various components and associated activities causing different types of impacts on the ecological and social environment. These activities include e.g raw material handling (quarrying, mining, off-loading, conveying, storing, etc) energy production operations, actual process operations, transportation and waste disposal. In addition to "normal" operations the hazardous impacts of possible accidents and process failures should be assessed. The positive socio-economic impacts of Manufacturing Industry Projects include:

- increased opportunities for income generation and wealth
- increased wealth
- increased goods and services
- increased access, particularly to previously inaccessible areas
- introduction of secondary development peripheral to, or
- related to, the industrial activity by new access roads, utilities and townsites established to serve industrial facilities.

The main activities of the operational stage which have environmental impacts are identified below; and general descriptions of the main potential impacts follow later

5.2.1 Raw Material Handling Operations as Source of Impact

Raw material handling operations directly associated with the proposed development may be a source of impact apart from other characteristics of the project. The description should include details on material extraction, off-loading, conveying, pre-treatment, storage and similar operations performed on or adjacent to the proposed development. The assessment of potential impacts of all these operations based on the identification of impact sources and information on quantities of pollutants likely to be produced should be undertaken. The use of all raw materials for example the use of forest resources for forestry industry must be based on plans which ensure sustainable resource use in the long term

5.2.2 The Manufacturing Processes as Source of Impact

Manufacturing processes almost always produce certain qualities of waste in the form of gaseous, liquid or solid residues and excess heat and noise. Several techniques exist for determining the behavior of atmospheric and aqueous pollutants and for assessing noise.

The identification of pollution impacts while conducting the EIA of the new industrial Project should be possible by examining the flow charts and material diagrams. A material survey, which should include the material balances of raw materials, additives, products and wastes indicate sources of pollution as well as ways to eliminate wastes and to conserve resources. Quantifying the amounts of these materials should enable the EIA preparers to specify atmospheric, liquid and solid waste characteristics produced by each production process. Impact sources causing noise, odour, vibration, etc may have to be identified by other methods, for instance, from studies of previously constructed similar installations.

The EIA Report should assist to overcome the problems of maintaining required environmental monitoring and controls and further assist in choosing the overall technology to be used in the Projects.

5.2.3 Industrial Waste Disposal Programme as Impacts

The waste disposal programme in Projects could serve as source of impacts. Hence the adequacy or otherwise of the disposal programme designed in the Project must be assessed

Emphasis should be placed on reuse of waste materials or sale and/or utilization of by-products whenever possible. Discharge to the environment should be considered as a last resort. If the wastes have to be discharged, adequate waste treatment must be provided.

The disposal of hazardous and toxic wastes requires special consideration. Appropriate waste management methods should be always be sought. If the wastes are incinerated or land-filled, the impacts should be assessed, and a long term monitoring programme is needed to ensure that hazardous air pollution is not caused and that wastes are not escaping from the landfill and pollute the soil and water.

In most cases, the industrial wastes are produced as by-products of the processes. In addition, the potential for the actual end product(s) to become waste causing aesthetic impacts, reduced hygiene or other problems if not collected, recycled or disposed properly, must be considered when assessing impacts of industrial projects. On the other hand, positive impacts gained, for example, when a new type of product replaces old and environmentally more problematic ones should be recorded as well

5.2.4 Energy-producing Operations and Cooling Water Systems as Impact Source

If the proposed project includes energy-producing operations, the pollutants and other impacts associated with energy production should be identified and quantified. When for instance fuelwood is used as an energy source, the impacts of wood extraction must be assessed.

The used water in the cooling water systems may contain a large quantity of pollutants. These pollutants combined with the high temperature of the water may drastically impair stream ecology and water quality. Where recirculatory cooling systems are used, various types of chemical compounds are added to the circulating water for purposes of slime and corrosion control and usually these contain toxins, for example, chromium, chlorine or organic tin compounds, which are very toxic to people, terrestrial and aquatic life.

5.2.5 Impacts from Transportation Systems

The EIA preparers must consider impacts induced by the transportation requirements of the proposed development. These may include marine terminals, deepwater ports, new highways and roads(clearing and construction), pipelines, etc. When the project does not construct its own ports or roads, the impact may manifest itself only as increased traffic.

Accidents and Hazards

In addition to assessing the impacts of any well-running processes, also the possible accidents and emergencies as well as other process failures (including those in solid waste management, gas purification and waste water treatment) and their consequences should be considered. The assessment of risks and hazards include:

- identification of potentially hazardous materials, their location and quantities stored and used
- identification of possible ways in which failure of plants or processes could present a hazard to the surrounding environment
- identification of routes or events which could lead to hazardous failures
- quantification of the probability of hazardous failures and their consequences
- risk management planning (safety procedures, contingency plans, etc)

5.3 Main Types of Environmental Impacts of Industrial Manufacturing

Resource depletion

Raw material exploitation may cause depletion of the resource. This is especially relevant to non-renewable natural resources, such as minerals and fossil fuels. Depletion may also be a risk to renewable natural resources, such as water and forest resources, if they are not used on a sustained basis.

Also the impacts on soils of the area may include:

Deposition on land sites of contaminated solid wastes which can have a deleterious effect on the quality of adjacent soils and restrict future land use both in the short term and long term, particularly for agricultural purposes.

Leachates from solid wastes dumping with direct toxicity or effect on the soil pH can prevent vegetation from growing.

All of the impacts on the elements of the ecosystem must be examined.

Hydrological Impacts

The hydrological impacts of the intake of water for industrial processes are of the dame types as in domestic water supply e.g potential resource depletion, saline intrusion, ground subsidence, problems to downstream water supply, contaminant or pollutant intrusion etc.

Water pollution impacts

Water quality and related beneficial uses are often most affected by industrial development. The significance of the impacts depend for instance on the flow and concentrations of pollutants, such as solids, heavy metals and other toxins, and turbidity, alkalinity , acidity, temperature and other parameters of the effluent as well as the volume and quality of receiving waters and their uses.

Major Sources of Industrial Water Pollution Include;

- the mining or manufacturing of goods for commerce either as an intermediate or final produce
- the production of power, stream or water involving either the combustion of fossil fuels or use of radioactive materials
- settlements accompanying industrial development
- cleaning and maintenance of machines, building and other facilities
- transportation by water
- leaching of contaminants from industrial refuse
- spills of oils and other chemicals
- Condensation and/or absorption of gaseous wastes by water.

Other impacts on water resources to be assessed and included in the EIA Report should include the following as appropriate:

- Deoxygenation by biodegradable substances, leading to asphyxiation of fish or increased toxicity of pollutants.
- Increase of nutrients in the ecosystem
    - Eutrophication through fertilization by phosphates, ammonia and nitrates
    - Proliferation of algae, macrophytes ad aquatic weeds
    - Oxygen depletion at night
    - Reduction in species diversity

- Increase in pH values, thus increasing the toxicity of ammonia

- Discharge of wastewater at a detrimentally high temperature, encouraging biodegradation and reducing oxygen solubility
- Changes in turbidity and colour by suspended and dissolved solids blocking sunlights and reducing photosynthesis, or interfering with feeding and breathing of aquatic fauna
- Contamination of surface water, poisoning aquatic flora and fauna
  - Untreated industrial wastes, containing heavy metals, mineral acids, pesticides, ammonia or other directly toxic substances
  - Formation of foam
  - Siltation
- Change in pH levels
- Contamination of groundwater, eg from slurry ponds or solid waste refuse sites, rendering it unfit as drinking water source
  - High concentrations of nitrates and fluorides
  - Toxic materials such as herbicides and pesticides
- Damage to sewage systems
  - Deposition of calcium carbonate and choking of sewers
  - Corrosion through oxidization of hydrogen sulphide to sulphuric acid on sewer walls
  - Toxicity of discharges to micro-organism employed in the biological treatment of sewerage
- Change of hydrological regime
  - Change of stream flow by returning industrial liquid wastes at location distant from the abstraction point in stream flow
  - Reduction of stream flows and groundwater levels through over tapping especially in the dry seasons
  - Flow increase causing scouring erosive tendencies and other hydrologic changes
  - Reduced availability of water supplies to other industrial agriculture and domestic users

- Reduction of dilative capacity of stream, particularly where it is already receiving polluting loads

- Hazardous materials accidents and spillage
- High damage from contaminated industrial liquid and solid wastes to aquatic and terrestrial flora and fauna in wetlands environments, particularly in nutrient-poor wetlands with low flushing capabilities.

Air Pollution

Emissions of gaseous pollutants can have adverse health or productivity effects on human beings, animals and vegetation and can degrade man-made structures. The assessment requires baseline information on existing environment, eg meteorological conditions, etc. which the EIA process should have established as in section 4 earlier.

Industrial contaminants may originate from a number of sources, the principal ones of which include:

- Mining or manufacturing of products for commercial purposes
- Production of power, steam or water involving the combustion of fossil fuels or radioactive materials
- Burning of industrial refuse
- Construction or demolition of buildings
- Transportation
- Accidental release of hazardous gases
- Treatment of liquid wastes resulting in the release of gaseous by-products.

Notable Impacts on Air Quality to be examined in the EIA include:

- Climatic impacts (stratospheric ozone depletion, greenhouse effects,global warming): nitrogen oxides, carbon dioxide, methane, chlorofluoro-carbons (CFCs)
- Acidification of the environment: SO2/NOX
    - Long-range transportation
    - Damage to forested areas, buildings, infrastructure, agricultural productivity aquatic ecosystems (especially shallow static water bodies such as lagoons, or shallow lakes)

- Human health impacts
- Odours from
    - Storage of raw materials
    - Disposal of wastes on land-sites
    - Industrial processes
- Dusts/Particulates could be
    - Corrosive (e.g lime)
    - Irritant (e.g zinc oxide, fluorides, ammonia)

Land Pollution and Changes in Land Use

With introduction of industry, land use patterns in the surrounding area often experience substantial changes. In addition to the changes in the use of the project site area, other project-induced changes may occur, for example, new settlements and urbanization. The land could become a hazard or nuisance to the adjacent population under conditions uncontrolled use.

Land may become polluted through the addition of contaminants or alteration and become unsuitable for any productive use. Industrial sources of land pollution include:

- Disposal of industrial solid or liquid wastes by landfill operations
- Burning of industrial wastes
- Mining of minerals
- Demolition of man-made or land-based structures yielding residual debris
- Storage of materials which causes nuisances
- Spills of oils and other chemicals
- Damming or draining of lands to impound or to remove excess water

The most common contaminants contributing to land pollution from Industrial Projects are

- Packing materials (eg. Paper, cartons, boxes, plastics)
- Tins, cans, ash
- Slag from smelting operations
- Tailing from mineral ore concentration operations

- Organic residues from cannery operations
- Organic sludges e.g from pulp and paper mills, textile plants and waste water treatment plants
- Junked vehicles, parts, oil drums, etc
- Waste oils and other chemicals

Other impacts from the discharge or deposition of waste materials on land areas that may result include general unsightliness, or unpleasant aesthetic effects, increased erosion, ecological impacts, fires and explosions, increased transmission of diseases and surface water pollution etc

Ecological Impacts

Industrial development causes ecological impacts either through air, water and land pollution, or alteration of habitats or other disturbance (eg traffic noise). For example important fish and terrestrial wildlife resources may be affected and productivity of different important ecosystems may be severely reduced.

Occupational and Public Health Impacts

Industrial development projects may have deleterious impacts on human health, especially in relation to changes of air and water quality and noise levels. Hazards to employees and residents adjacent to the project facility may originate from accidents, hazardous materials and communicable diseases. Transportation, storage and use of hazardous chemicals should be of special concern. Increased traffic may also affect health through noise, dust, exhausts and accidents.

Social Impacts

Industrial development can have substantial beneficial impacts, for example job creation. However, severe conflicts and problems may also occur. For instance, projects employing large labour force during construction and operation may require to import labour from elsewhere. Local residents may feel that their culture and potential incomes are threatened by outsiders; and conflicts could arise

While industrialization may increase employment, it may also decrease it by the mechanization and automation of previously more labour-intensive work. Possible pollution impacts may also reduce the income opportunities of people working in other fields. In some cases industrial development may affect especially the livelihood of women.

Another notable impact which may arise is a reduction of land values near the industrial plant.

The negative socio-economic impacts of an Industrial Project that should be assessed for the EIA Report include:

- Resettlement problems
- Damage to cultural sites
- Increased demands on local services and facilities from workforce on local communities
- Social and cultural conflicts within local population, and between local population and industry workforce
- Community institutional instability
- Removal of farm labour thereby reducing food security
- Human health impacts
- Respiratory problems through high concentrations of sulphur dioxide particularly when associated with emissions of particulates, or through irritant dusts
- Health impacts of photochemical smog and ozone in the lower atmosphere whose creation is facilitated by nitrogen oxides emissions
- Sulphur dioxide and photochemical smog affect agricultural productivity and plants in general
- Severe burning and blindness through mineral acids such as hydrochloric, nitric, sulphuric, and phosphoric
- Accident risks (fire and explosion accidents/hazardous materials)

It is also very important to consider the workers' and their families' needs of food, water, shelter, sanitation, medical services, transportation, education and other social services that may be affected by Proposed Projects. Fulfilling these basic needs may become a heavy burden, and if not properly arranged may cause severe social problems.

6.0 MITIGATION MEASURES/ALTERNATIVES

In order to protect the environment from the adverse effects of manufacturing industry programmes and projects, the EIA Preparers must design and/or recommend a number of mitigation and management options that should be implemented. For all the identified probable or possible impacts from the new Project, the overbearing Mitigation Measures options of choice include:

- Utilization of the best available technology
- Payment of optimal liability compensation to local communities and
- Institutionalization of adequate abatement measures

The manufacturing processes should be designed to maximize recycling potential and minimize the generation of residues. For example, new low and non-waste technologies and being developed which can reduce environmental impacts, enhance resource conservation and improve working conditions. These technologies and required operational skills have unfortunately not been always available for many developing countries. Therefore efforts must also continue with conventional processes to install cost-effective pollution control technologies.

A basic problem usually is that the pollution control system for Industrial Projects in developing countries like Nigeria in may cases require the proper functioning of high-technology equipment, usually imported from industrialized countries. This may cause dependence on foreign experts and imported spare parts. Training of operating maintaining personnel is essential as well as efficient monitoring. In many cases experience has shown that systems in developing countries have not been properly operated or maintained once project consultants have left. This has happened for example because of ineffective monitoring and enforcement of environmental regulations and because of ineffective monitoring and enforcement of environmental regulations and

because the personnel trained in operating and maintaining such high-technology equipment have left for higher-paying positions.

Hence, pollution control options or mitigation measures designed must be simple, effective and workable in the Nigerian environment. Some examples of key options given below may be undertaken individually or combined into an action plan. To achieve the best results, mitigation measures options should be determined through the close participation of those for whom the project is intended, and likely to be adversely affected the project proponents and the EIA Preparers. It is ideal that the EIA report should consider and handle the development of mitigation measures and other issues under this section with the general recommendations as delineated below.

6.1 MITIGATION/MEASURES

For Project Siting

The following are possible options to be considered and recommended by the EIA preparers for this stage of the assessment. These measures are optimally applied at project planning stage.

- Where possible, locate project in established industrial zones with
    - Provision of adequate water supply
    - Sewerage and waste water treatment facilities
- Locate plants with liquid discharges on watercourse with adequate waste-absorbing capacity
- Prepare transport sector studies and select safe transport routes to reduce likely impact from spillage
- Draft contingency measure for spillage
- Where possible avoid siting that would open up sensitive or valued environments
- Choose site fulfilling following condition
    - Plot size sufficient to landfill or dispose on-site
    - Close to suitable disposal site
    - Convenient for public/private contractors to collect and haul solid waste disposal

- Suitable on a water course having maximum water dilution and absorbing capacity
- Suitable in an area where water waste can be reused with minimal treatment for agricultural or industrial purposes
- Situation within a municipality that is able to accept plant wastes in their sewage treatment system.

- Limit earth movement and soil exposure the dry season
- Balance cutting with filling
- Resurface and revegetate exposed surface
- Protect vulnerable surface with mulch
- Provide sedimentation basins
- Line receiving surface with stone or concrete

6.2 CONSTRUCTION PHASE MITIGATION MEASURES

- Limit earth movement and soil exposures the dry season
- Balance cutting with filling
- Resurface and re vegetate exposed surface
- Protect vulnerable surface with mulch
- Provide sedimentation basins
- Line receiving surfaces with stone or concrete

6.3 Operational Phase Mitigation Measures

(i) Measures for Mitigation of socio-economic and Health Impacts are most important to be developed first. Also it is necessary to increase health and safety in the industrial work-place through the close monitoring of health and safety procedures skills and safety training, and responsible site/plant management

(ii) Mitigation of Impacts on Water Bodies

Typical recommendation should include:

- Use water and energy efficiently to reduce the impact of over extraction for other users

- Recycle water, raw materials, process chemical and energy concentration of effluent discharge to the environment
- Introduce and enforce high procedural, maintenance and safety standard and good housekeeping, eg. Ensuring that pipe faults and leakages are detected and rectified rapidly
- Introduce best available liquid and solid waste treatment technology. Applicable to the industrial project. such technologies include systems for:
    - Reduction of suspended solids (e.g. filtration systems, settlement lagoons and clarifiers)
    - Removal of oil and grease (e.g. by skimming, filtrations, ultra filtration and flotation)
    - Modification of acidity or alkalinity (eg .joint neutralizing of acid and alkaline waste)
    - Reduction of toxic chemicals such as chromium,copper,nickel,and zinc(eg. by chemical precipitation and filtration)
    - Reduction of chemical oxygen demand by appropriate methods of chemical physical and/or biological treatment

- Use secure storage facilities and on-site/off-site waste disposal site. Such facilities should be able to
    - Prevent accidental release of waste
    - Protect the waste against rainfall that may result in contaminate runoff and leaching
    - Secure lined disposal facilities and establish monitoring systems for leakages
    - Be located away from towns to minimize health hazard and odour nuisance
    - Control waste incineration

- Invest in on-site mitigation equipment for spillages and other accident to combat the risk of industrial hazard either
    - Within the plant during operations and/or storage or

- In the transport of raw materials and wastes

(iii) **<u>Mitigation Measures for Impacts on Air Quality</u>**

In this Section, the EIA Report should

- Classify emission sources according to their geographical location ensure dispersal or pollutants over the airshed
- Recommend the use of best available control technology (BACT) to control emission of gases that cause acid rain and greenhouse effects
- Recommend the reduction of discharges of fumes via appropriate BACT
- Recommend the use of dust and particulate prevention systems via appropriate BACT
- Minimize dust generation

7.0 ENVIRONMENTAL MONITORING PLAN

The purpose of a monitoring programme for environmental protection during a project operation is to:

- Provide assurance that the predicted impacts from a project are within the engineering and environmental acceptable limits.
- Provide early warning of unacceptable environmental conditions, particularly where significant impacts are predicted (for example, the discharge of toxic residues directly to local surface and ground water drinking water supplies).

Hence, the EIA Preparers must consider, design and recommend an Environmental Monitoring Plan for the New Industrial Project. The plan should include long and short term Mitigation/Abatement Measures for all significant environmental impacts. Such long and short term Monitoring Action Plans should form a key chapter in the EIA Report. In this manner, the monitoring of significant impacts and the institution of the appropriate recommended Mitigation Measures shall be ensured. Furthermore, continuous auditing procedures/system/plan of the Project’s discharges and operation shall be embedded within the Action Plan. These are all towards ensuring compliance monitoring and the establishment of clean and safe production processes within the New

Industrial Project. Each project has to be treated individually for accurate assessment towards the setting up of the appropriate Environmental Action Plan.

For example, an extensive monitoring plan for small-scale rural industrial projects is probably not practicable due to costs involved in acquiring the required baseline data but this must be assessed by the EIA Preparers. The Monitoring Plan for large-scale industrial project is mandatory as baseline data of the construction and operation phases would have been available from the EIA. Therefore in this regard, examples of the issues of consideration are:

- **For gaseous discharges**: a continuous air monitoring of the primary pollutants at source and at previously define air quality receptor locations (eg. residential or agricultural areas) must be carried out
- **For liquid and solid waste discharges**: the surface water monitoring of expected pollutants and water quality parameters that are important for human health must be implemented
- Also the seasonal water quality monitoring together with groundwater monitoring and the monitoring of upstream and downstream sections from the point of discharge in any receiving water body used by the public or considered environmentally significant must be carried out.

Similarly biological monitoring of natural resources near to the Project that are predicted to be affected must be included for implementation in the recommended Action Plan.

For example, the effect of the discharge of cooling water to an estuary on the aquatic resources must be considered. The monitoring may also include scientific assays such as

- Soil surveys
- Meteorological measurements
- Flora and fauna assessments
- Biochemical/toxicological measurements
- Aquatic/hydrological/hydrogeological assessment or social/economic surveys of affected or nearby settlements

In this section, the EIA Preparers must indicate all the monitoring schedules, the parameters to be monitored and the scope of the Monitoring.

8.0 REMEDIATION PLAN AFTER DECOMMISSIONING PLANT CLOSURE

The project shall provide the necessary environmental remediation plans that will be implemented to restore the natural environment in the future event of the industrial closure or when the project is decommissioned either temporarily or permanently. The plan shall take into consideration both the positive and negative impacts that such Projects may have had on the environment before its closure. The ways and means of restoring the project area back to its original status shall be fully exploited and firm implementation measures must be established in this section.

A GENERAL CHECKLIST FOR CONDUCTING EIA FOR INDUSTRIAL DEVELOPMENT PROJECTS

9.0 A GENERAL CHECKLIST FOR INDUSTRIAL PROJECTS

1. INTRODUCTION

- Background to Proposed Project
- Legal and administrative framework and objectives of the EIA

2. PROJECT JUSTIFICATION

- Need for the Project
- Value of the Project
- Envisaged sustainability of Project

3. PROJECT DESCRIPTION

- Planning, location
- Raw material/product input and output
- Technological layout
- Production Process
- Project Operation/Maintenance
- Project Schedule

4 DESCRIPTION OF THE ENVIRONMENT

- Baseline data on Project
- Environmental Site Selection Considerations

In this regards examine

- whether there are possible alternative sites or locations which could be considered in project siting
- whether in the alternative project sites or nearby there are:
    - areas of unique or exceptional quality
    - human settlements
    - important ground or surface water resources
    - tourism attractions/areas
    - recreational areas

- nature conservation areas
- schools or hospitals
- unique ecosystems or important wildlife habitats or endangered species
- important fishing areas
- important agricultural or forestry areas
- important cultural or historical or scientific resources areas
- area important for vulnerable human populations (eg. indigenous cultivating, fishing or pastoralist people and their livestock)

- whether the project siting might cause conflicts with the above mentioned land or resources, interests, values or social groups
- whether there is a history of outbreak of serious communicable diseases in the area
- whether the area can provide sufficient:
    - local work force
    - Raw materials
    - Transportation facilities
    - Energy supply
    - Water supply
    - Capacity of receiving waters to assimilate effluents
    - Sewer services and waste water treatment facilities
    - Waste disposal facilities
    - Community services (medical, schools, transportation, food, sanitation, etc)

- Whether there are applicable local or natural regulations regarding
    - EIA
    - Water pollution control
    - Air pollution control
    - Noise pollution control
    - Soil conservation

- Solid waste disposal
- Hazardous waste disposal
- Spill prevention and control
- Workers health and safety
- Storage and handling of hazardous materials

- Whether the project area is covered within any appropriate land use Planning document (eg area master plan)

5. **<u>ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACTS</u>:**

Impacts on the ecosystem that may result from the Project in all its Phases must be considered. Such include

(a) Impacts from Site Preparation and Construction

<u>Identify and Predict</u>- impacts of relevant site preparation and construction activities and components, such as:

- Land clearing, grading, leveling, surface excavation, cut and fill, terracing, etc
- Surfacing and paving
- Construction of plant buildings
- Construction of transmission lines and pipelines
- Road construction
- Barriers, including fencing
- Blasting and Drilling
- Land reclamation
- Ditching, drainage
- Dredging, port facilities construction
- Quarrying, mining
- Transportation

- Material storage
- Housing and services to the labour force
- Migration
- Resettlement of people

On the following components of the ecosystem

- Hydrology and drainage patterns
- Surface and ground water quality
- Air quality
- Noise and vibration levels
- Land/soil quality
- Wildlife
- Aesthetics
- Fisheries
- Land use, such as agriculture, forestry, tourism, recreation
- Local traffic
- Working opportunities
- Income opportunities
- Settlement plans
- Population structure and dynamics
- Social structures
- Local life style and values
- Occupational and public health
- Archaeological, historical, cultural or scientific values
- Land values
- Social services

(b) Impacts from Project Operation

<u>Identify and Predict</u>- the impacts of following activities/components (relevant to each alternative):

- Raw material exploitation, handling, transportation and storage
- Water supply
- Energy production
- Gaseous emissions (from processes, energy production and traffic)
- Liquid effluents (including excess heat)
- Solid wastes
- Process and traffic noise
- Possible accidents, hazards and process malfunctions
- Handling of hazardous materials
- Maintenance and repair

On for examples:

- Local traffic
- Raw material resources
- Air quality
- Noise levels
- Land/soil quality
- Other land uses, interests and values (as mentioned in section 1 and 2 above)
- Ecology
- Occupational health
- Public health
- Migration patterns
- Settlement patterns
- Population structure and dynamics
- Working opportunities
- Local life style and values
- The role of women

- Social services
- Land values

6. MITIGATION MEASURES

Identify, Plan and recommend adequate mitigation measures of harmful impacts. For example identify alternative design, manufacturing processes, raw material fuels, etc which could be considered, or by considering the possibilities to provide/practice:

- Use of low-waste and low-pollution technology
- Air pollution
- Waste water treatment
- Water recycling and conservation
- Energy conservation
- Noise control measures
- Solid waste management (especially recycling)
- Training and education of (local) workers and general public
- Workers safety measures
- Contingency plans and equipment
- Medical and other social services development
- Safe storage facilities for hazardous materials
- Resettlement plans
- Compensatory measures
- Landscaping

7. ENVIRONMENTAL MONITORING PLAN

Establish an adequate environmental protection and environmental monitoring plan during project's operational phase either pre-commissioning or during plant operations. Include in your plan

- The monitoring schedule
- The parameters to be monitored

- The methods for the monitoring
- The scope of the monitoring

8. **REMIDIATION PLANS AFTER DECOMMISSIONING OR CLOSURE OF INDUSTRIAL PLANT**

Establish an adequate plan for restoration of the natural environment in the future event of plant's closures or de-commissioning of industry either temporarily or permanently.

SUB-SECTOR EIA GUIDELINES

GUIDELINES FOR
CHEMICAL INDUSTRY SUB-SECTOR

9.1 CHEMICAL INDUSTRIES SUB-SECTOR

1.0 INTRODUCTION

This section includes the required guidelines on the EIA for establishment of

- Chlor-Alkali Pharmaceutical
- Cement
- Glass manufacturing
- Tannery
- Pesticides
- Natural rubber Production
- Plastics
- Textiles
- Paints and allied products industries
- Dyes
- Ink

The chemical industry incorporates a diverse range of activities, including production of inorganic chemicals, organic chemicals, pharmaceutical, synthetic dyes and explosives. The negative environmental impacts of production of chemicals can be severe, for example, a number of processes are hazardous and many chemicals are either toxic, flammable or explosive in nature. Many toxic materials have immediate negative impacts; others have long-term effects, even at concentrations. Efforts to minimize or reduce negative environmental impacts should therefore take the specific nature of these compounds into account. Potential wastes and emissions are also specific to the materials used as well as the types of compounds manufactured. As it is not possible to discuss in this Guideline the entire range of chemicals produced, an overview, only of the main impacts will be given below. Guidelines on Petrochemicals are dealt with in another Handbook on sectoral Guidelines.

Large quantities of water are used in the chemical industry for processing, cooling and washing. Water bodies may easily become contaminated with chemicals or by-products. Components of aquatic discharges which may present environmental and public hazards if released into water courses and underground reservoirs include toxic/carcinogenic pollutants, suspended solids and substances with high BOD/COD. Water bodies may be affected, adversely by tank farms, product discharge and processing areas, cooling water blowdown, flushing and cleaning water and accidental release of raw materials and finished products. Runoff control measures, such as storm water detention basis with treatment prior to discharge, are usually required to avoid such adverse impacts.

Solid wastes arising from the chemical industry may include residues from raw materials, waster polymers, sludges from boiler feed, tank cleaning or pollution control equipment, and ash from coal boiler operations. Disposal of such waste, together with catalysts, can generate an environmental problem.

Atmospheric pollutants, although better controlled today, still represent a major source of environmental pollution. Substances include particulate matter and a wide range of gaseous compounds, including sulphur, carbon oxides (CO and CO2), and Nitrogen oxides NOx) from boiler fuels and process furnaces.

Although indirectly part of the petrochemical process,, the production of pharmaceutical is usually viewed as a separate industry consumes a vast amount of raw materials in terms of product output. For example, large quantities of solvents are required in this industry. At the end stages, large volumes of waste water, sludge and solid wastes are produced. Process wastes require treatment in order to reduce BOD and COD as well as toxicity to aquatic organisms. Solid wastes may be incinerated together with waste solvents which cannot be recycled.

2.0 PROJECT JUSTIFICATION

The project proponent and the EIA prepares for a new chemical industry shall provide a justification for the new industrial project to be established. This would include the need for the project, the value of the project and the envisaged sustainability of the project. Overall, the advantages of establishing the project vis-à-vis the anticipated impacts on the environment must be evaluated.

3.0 PROJECT/PROCESS DESCRIPTION

The new project proponent and the EIA preparers shall provide full details of the type of the Industrial Project or process. This should include the project location, the nature, extent and size of the project, the input and output of the raw materials and products, the technological layout or manufacturing design/flowchart; the production process, the project operation and maintenance procedures, the project schedules etc

4.0 DESCRIPTION OF THE ENVIRONMENT

The EIA preparers shall undertake adequate scientific studies and/or socio-economic surveys of the environment and area of the new Project's location and provide a vivid and detailed description of the entire area and the location of the proposed industrial project/process. The description shall include but not be limited to geographical location, climatic conditions and full ecological characteristics of the area/location. The preparers shall supply along with the description, the results of the studies/survey carried out on the soil, ambient noise levels, aquatic, vegetation, fauna, ground water resources and the socio-economic characteristics of the area.

The EIA preparers shall acquire and supply the above base-line data in addition to a description of the land-use, landscape and infrastructural services of the area including any archaeological, historical or cultural values of the area as well as ecologically-sensitive areas

5.0 ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACT

Most of the materials used in the manufacture of chemicals and allied products are flammable and explosive. Although many chemicals and allied products are toxic, some are also carcinogenic. Potential explosion hazards are sometimes very severe because of highly reactive compounds and the high pressures that may be involved in the manufacturing and handling of chemicals and allied materials.

Highly toxic materials that cause immediate injury, such as phosgene or chlorine would be classified as a safety hazard. Others have long-term effects sometimes in very low concentrations. In studies on the production of chemicals and their environmental impact, toxicity, hazards; and operability considerations were found to play an important role. The potential wastes and emissions are a function of the types of compounds manufactured and the great diversity of processes and chemicals used in manufacturing them.

The negative environmental impacts of production of chemicals can be severe. (For information on chemical hazards, consult the guidebook of the National Institute for Occupational Safety and Health (NIOSH), of the U.S Department of Health and Human Resources (HHS) hazards. The attached Table at the end of this section gives a summary of the negative environmental impacts from chemical production.

Large quantities of water are used in the chemical industry for processing, cooling and washing. During chemical manufacturing, water often becomes contaminated with chemicals or by-products. The Federal Ministry of Environment has published a list of compounds from water effluent guidelines for various categories of Industries. Pollutants which may present a hazard when released into waterways and underground aquifers include toxic priority pollutants, carcinogenic compounds, suspended solids, and substances with high biochemical oxygen demand (BOD) and chemical oxygen demand (COD).

Groundwater and surface water resources can be negatively impacted by rainwater from tank farms, product discharge and processing areas, pipe tracks, cooling water blowdown, flushing and cleaning water and accidental release of raw materials and finished products. Runoff control measures, such as storm water detention basis with treatment prior to discharge, are usually required to avoid such adverse impacts.

Depending on the process used, air pollutants include particulate matter and a great number of gaseous compounds including sulphur oxides, carbon oxides, nitrogen oxides from boiler furls and process furnaces, ammonia, nitrogen compounds and chlorinated compounds. These emissions result from several sources including process equipment, storage facilities, pumps, valves vents and leaking seals.

Air emissions are controlled by use of incineration (stack flares), absorption, gas scrubbing, and other absorption gas scrubbing, and other absorption processes. Air quality standards to regulate emissions from chemical manufacturing facilities have been established by the Federal Ministry of Environment.

Soild wastes from the chemical process industry may include residues from raw materials, waste polymers, sludges from boiler feed, tank cleaning or pollution control equipment, ash from coal boiler operations. Waste materials may be contaminated with chemical substances from the processes. The disposal of chemical industry waste can generate an environmental problem. However, efficient waste management techniques are now well known to handle these problems.

6.0 MITIGATION MEASURES/ALTERNATIVES

In this section, the EIA preparers must consider and recommend adequate mitigation measures or alternative to ameliorate or abate all significant environmental impacts identified earlier.

These measures must be considered and either implemented or project re-designed before proponents finally embark on the particular project. There could be possibility of having a 'No-Project Option" Cost-benefit analysis must be employed in selecting alternatives.

7.0 ENVIRONMENTAL MONITORING PLAN

The project proponent and the EIA preparers shall establish and provide information on an Action Plan to ensure compliance with the recommended mitigation measures for significant environmental impacts at every phase of the Project together with the operations auditing plan. Such plan which is to ensure environmental protections shall include the monitoring schedule, the parameters to be monitored in each case. These shall be based on the types and complexity of the mitigation measures

8.0 REMIDIATION PLANS AFTER PLANT DECOMMISSIONING OF CLOSURE

The Project Proponent or the EIA Preparers shall establish and provide information on a post-project area back to its original status in the future event of the Industrial Plant's closure and decommissioning. The overall positive and negative changes which the project may inflict on the ambient environment before its closure shall be taken into consideration in establishing the Plan.

IMPACTS FROM VARIOUS TYPES OF KEY CHEMICAL INDUSTRIES

Some notable examples of well-known impacts of various types of key chemical industries include the following:

(a) **Chlor-alkali industry**

The processes to produce chlorine and caustic alkali give rise to discharges of chlorine to the atmosphere. Two different chloroalkali cell processes can be used -diaphragm-cells or mercury cells. In the latter case, mercury is the main pollutant from the plant. In the former case, some total suspended solids, chromium, copper, lead, nickel and zinc may be present in the waste water, which, in addition, may be alkaline.

Various complex methods for atmospheric mercury removal have been developed. These usually produce other waste contaminated with mercury(sludges), which need proper treatment.

(b) **Pharmaceutical Production**

The typical material flow for a synthetic organic medicinal chemical process yields only 10 percent of finished products based on the input of raw materials. Large quantities of solvents are required. These waste solvents that cannot be recycled may cause problems. It is important that Non-biodegradable solvents should not be allowed to enter in liquid waste stream but they could be disposed only by a careful incineration. In addition, the process wastes may require treatment by a biological means in order to reduce BOD and COD. There will be a considerable biological sludge to dispose from this waste water treatment process. A large quantity of solid wastes may also result from the process, which is usually incinerated with the waste solvents. One problem peculiar to environmental protection in the pharmaceutical industry is that certain products of certain organisms can restrict the biological organisms present in the waste water treatment plant (eg. penicillin, streptomycin and aureomycin wastes lack biological organism pollutants)

(c) **Glass Manufacturing**

Glass melting furnaces may give rise to nitrogen oxides, particulates, sulphur oxides, and small amount of hydrocarbons. In the case of water pollutants most significant are total suspended solids (TSS), oil and chemical oxygen demand (COD).

(d) **Cement Industry**

The major pollutant from cement factories is particulates. It may be dust produced in the rotary kiln, crushing and grinding, blending, moving material to silos and packaging.
The particulates may also include oxides of sulphur and nitrogen, hydrocarbons and other chemicals. Cement manufacturing plants have been “notorious” for damaging agricultural productivity in wide areas around the plant due to release of cement dusts to the atmosphere. These dusts can impair all types of nearby operations, including commercial, recreational, residential, tourism as well as forest and wildlife values, ranging from nuisances to significant damage levels.
Wastewaters are produced during the blending processes and when wet scrubbers are used for removing dust from the kiln exit gases. The water pollutant then is dust which in water becomes a problem of total suspended solid.
Air pollution can be reduced by certain process modifications and by means of fabric filters, venture scrubbers or electrostatic precipitiators.

(e) **Pesticides Manufacturing**

Toxic chemicals used as pesticides include a wide range of compounds, and thus a wide variety of processes are used. Various gaseous pollutants which are normally released in a pesticides plant are sulphur dioxide, chlorine, hydrochloric acid and mercaptans. The pollutants contained in wastewaters can be different toxic by-products, oils , suspended solids and catalysts.

(f) **Natural Rubber Production**

Liquid effluent constitute the most important sources of pollution from natural rubber production. The most important parameters are BOD, COD, TSS, total solids and ammonia-based nitrogen. In some cases alkalinity may need to be changed by decreasing pH.

A CHECKLIST FOR CHEMICAL INDUSTRY PROJECTS

1. INTRODUCTION

- Background to Proposed Project
- Legal and administrative framework and objectives of the EIA

2. PROJECT JUSTIFICATION

- Need for the Project
- Value of the Project
- Envisaged sustainability of Project

3. PROJECT DESCRIPTION

- Planning, location
- Raw material/product input and output
- Technological layout
- Production Process
- Project Operation/Maintenance
- Project Schedule

4 DESCRIPTION OF THE ENVIRONMENT

- Baseline data on Project
- Environmental Site Selection Considerations

In this regards examine

- whether there are possible alternative sites or locations which could be considered in project siting
- whether in the alternative project sites or nearby there are:
  - areas of unique or exceptional quality
  - human settlements
  - important ground or surface water resources

- tourism attractions/areas
- recreational areas
- nature conservation areas
- schools or hospitals
- unique ecosystems or important wildlife habitats or endangered species
- important fishing areas
- important agricultural or forestry areas
- important cultural or historical or scientific resources areas
- area important for vulnerable human populations (eg. indigenous cultivating, fishing or pastoralist people and their livestock)

- whether there are already significant environmental problems (eg air pollution, water pollution, noise, erosion, deforestation or social conflicts, etc) in the project zone
- whether there is a history of outbreak of serious communicable diseases in the area
- whether the area can provide sufficient:
  - local work force
  - Raw materials
  - Transportation facilities
  - Energy supply
  - Water supply
  - Capacity of receiving waters to assimilate effluents
  - Sewer services and waste water treatment facilities
  - Waste disposal facilities
  - Community services (medical, schools, transportation, food, sanitation, etc)

- Whether there are applicable local or natural regulations regarding
  - EIA
  - Water pollution control

- Air pollution control
- Noise pollution control
- Soil conservation
- Solid waste disposal
- Hazardous waste disposal
- Spill prevention and control
- Workers health and safety
- Storage and handling of hazardous materials

- Whether the project area is covered within any appropriate land use Planning document (eg area master plan)

5. <u>ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACTS</u>:

Impacts on the ecosystem that may result from the Project in all its Phases must be considered. Such include

(a) Impacts from Site Preparation and Construction

<u>Identify and Predict</u>- impacts of relevant site preparation and construction activities and components, such as:

- Land clearing, grading, leveling, surface excavation, cut and fill, terracing, etc
- Surfacing and paving
- Construction of plant buildings
- Construction of transmission lines and pipelines
- Road construction
- Barriers, including fencing
- Blasting and Drilling
- Land reclamation
- Ditching, drainage

- Dredging, port facilities construction
- Quarrying, mining
- Transportation
- Material storage
- Housing and services to the labour force
- Migration
- Resettlement of people

On the following components of the ecosystem

- Hydrology and drainage patterns
- Surface and ground water quality
- Air quality
- Noise and vibration levels
- Land/soil quality
- Wildlife
- Aesthetics
- Fisheries
- Land use, such as agriculture, forestry, tourism, recreation
- Local traffic
- Working opportunities
- Income opportunities
- Settlement plans
- Population structure and dynamics
- Social structures
- Local life style and values
- Occupational and public health
- Archaeological, historical, cultural or scientific values
- Land values
- Social services

(b) Impacts from Project Operation

Identify and Predict- the impacts of following activities/components (relevant to each alternative):

- Raw material exploitation, handling, transportation and storage
- Water supply
- Energy production
- Gaseous emissions (from processes, energy production and traffic)
- Liquid effluents (including excess heat)
- Solid wastes
- Process and traffic noise
- Possible accidents, hazards and process malfunctions
- Handling of hazardous materials
- Maintenance and repair

On for examples:

- Local traffic
- Raw material resources
- Air quality
- Noise levels
- Land/soil quality
- Other land uses, interests and values (as mentioned in section 1 and 2 above)
- Ecology
- Occupational health
- Public health
- Migration patterns
- Settlement patterns
- Population structure and dynamics
- Working opportunities
- Local life style and values

- The role of women
- Social services
- Land values

6. MITIGATION MEASURES

Identify, Plan and recommend adequate mitigation measures of harmful impacts. For example identify alternative design, manufacturing processes, raw material fuels, etc which could be considered, or by considering the possibilities to provide/practice:

- Use of low-waste and low-pollution technology
- Air pollution
- Waste water treatment
- Water recycling and conservation
- Energy conservation
- Noise control measures
- Solid waste management (especially recycling)
- Training and education of (local) workers and general public
- Workers safety measures
- Contingency plans and equipment
- Medical and other social services development
- Safe storage facilities for hazardous materials
- Resettlement plans
- Compensatory measures
- Landscaping

7. ENVIRONMENTAL MONITORING PLAN

Establish an adequate environmental protection and environmental monitoring plan during project's operational phase either pre-commissioning or during plant operations. Include in your plan

- The monitoring schedule
- The parameters to be monitored

- The methods for the monitoring
- The scope of the monitoring

8. **REMIDIATION PLANS AFTER DECOMMISSIONING OR CLOSURE OF INDUSTRIAL PLANT**

Establish an adequate plan for restoration of the natural environment in the future event of plant's closures or de-commissioning of industry either temporarily or permanent

TABLE 1. CHEMICAL INDUSTRY PROJECTS

Potential Negative Imapacts	**Mitigation Measures**
Direct Site Selection	
1. Siting of plant on/near sensitive habitats such as mangroves, esturaries, wetland, coral reefs	1 - Locate plants industrially zoned area, if possible to minimize or concentrate stress on local environmental services and to facilitate the monitoring of discharges - Involve natural resource agencies in site selection process to review alternative
2. Siting along water courses causing their eventual degradation	2 - Site selection process should examine alternatives that minimize environmental effects and do not preclude beneficial use of the water body - Plants with liquid discharges should be located only on a watercourse having adequate capacity to assimilate wastes in treated effluent
3. Siting can cause serious air pollution problems for local area	3 - Locate plants in an area not subject to air inversions or trapping of pollutants, and where prevailing winds are towards relatively unpopulated areas
4. Siting can aggravate solid waste problems in area	4 - Site selection should evaluate the location according to the following guidelines - Plot size sufficient for landfill or disposal on-site - Proximity to suitable disposal site

	- Convenient for public/private contractors to collect and haul solid wastes for final disposal
5 - Water pollution from discharge of liquid effluents and process cooling water or runoff from waste piles - Depending on the process, runs at too high TOS,BOD,COD and pH	5 - Laboratory analysis of liquid effluent should include applicable chemicals (depending on the process), TOS,BOS,COD, pH and in-situ temperature <u>All Plants</u> - No cooling water discharge. If recycling not feasible, discharge cooling water provided receiving water temperature does not rise 3^{o}C - Maintain pH level of effluent discharge between 6.0 and 9.0 - Control effluent to specified limitations in FMEnv's guidelines for the specific process and/or industry <u>Processing, Storage and Dispatch Area</u> - Minimize rainfall allowed to percolate through piles and runoff in uncontrolled fashion - Line open storage areas to collect all stormwater

6 Particulate emissions to the atmosphere from all plant operations	6 Control particulates by scrubbers, fabric filter collectors or electrostatic
7 Gaseous emission of SOx, NOx, and CO and other applicable chemicals to the atmosphere from chemical processes	7 Control by scrubbing with water of alkaline solutions, incineration, or absorption by other catalytic processes
8 Accidental release of potentially hazardous solvents, acidic and alkaline materials	8 - Maintain storage and disposal areas to prevent accidents - Provide spill mitigation equipment - Provide area diking or double wall tanks
9 Accidental radiation/biological hazard release (pharmaceutical)	9 - Maintain certified storage and disposal facilities to minimize potential for release
10 Noise	10 - Reduce noise impact by enclosing and insulation noise emitting processes or equipment in buildings or by use of other noise abatement procedures
11 Surface runoff of chemicals, raw materials, intermediates, end products and solid wastes frequently stored in piles on the facility site can pollute surface waters or percolate to groundwaters	11 - Rainwater percolation and runoff from solid materials, fuels and waste piles can be controlled by covering and/or containment to prevent percolation and runoff to ground and surface waters
12 Occupation health effects on workers due to fugitive dust,	12 Facility implement a Safety and Health Program designed

materials handling, noise, or other process operations Accidents occur at higher than normal frequency because of level of skill or labour	to: - Identify, evaluate, monitor and control health hazards - Provides safety training
13 Regional solid waste problem exacerbated by inadequate on-site storage or skill or labour	13 - Plan for adequate on-site disposal areas assuming screening for hazardous characteristics of the leachate is known - Provide in design phase, for adequate ultimate disposal facilities
14 Transit patterns disrupted, noise and congestion crated, and pedestrian hazards aggravated by heavy trucks transporting raw materials to/from facility	14 - Site selection can mitigate some of these problems - Special transportation sector studies should be prepared during project feasibility to set best routes to reduce impacts - Transporter regulation and development of emergency contingency plans to minimize risk of accidents

GUIDELINES FOR
PULP, PAPER AND TIMBER PROCESSING SUB-SECTOR

9.3 PULP, PAPER AND TIMBER PROCESSING SUB-SECTOR

1.0 INTRODUCTION

This category comprises all manufacturing projects involving the production of paper, such as newspaper or kraft paper, soft tissue paper, and paperboard.

The pulp and paper manufacturing can be divided into a two step process (a) pulping of a great variety of fibrous materials from wood or other plant fibers or from recycled paper, and (b) the production of paper products.

The production of paper can be combined with the pulping (integrated papermills) or be separate, in which case the pulp is bought from the pulplmills in the country or imported. In industrial countries, pulp mills usually have a capacity of more than 500 tons of pulp per day. This output is less for pulp mills in developing countries.

The pulping processes can be mechanical, thermo-mechanical and chemi-thermo-mechanical, or chemical with either sulphite, kraft or kraft/sulphite processes. The kraft process is the dominant pulping process because of its versatility and flexibility. Some older plants use the sulfite process which was dominat until 1935, because at that time sulfite pulp was considerably cheaper and easier to produce than kraft pulp.

In an integrated papermill, the pulp slurry is directly piped to the paper machines. A non integrated mill obtains the pulp mostly in dry form. The dry pulp is mixed with water before being fed to the paper mill.

The primary raw material for pulping is wood, but other plant fibers are used also: straw, bagasse, bamboo, papyrus, sisal, flax, jute etc. Waste paper is an increasingly important raw material, especially for the production of news print paper and certain tissues, writing paper, magazines and boxboard. De-inking is the only chemical treatment as most of the recycled paper is mechanically pulped.

The pulp mills in Nigeria are often close to their forest resource base Good forest management is usually important in the reserves to ensure a steady and sustained supply of wood and also because the logging of trees is one of the most difficult and hazardous operations in the paper industry.

2.0 PROJECT JUSTIFICATION

The project proponent and the EIA preparers for a new Pulp, Paper or Timber Processing Industry shall provide a justification for the new Industrial Project to be established. This would include the need for the project, the value of the project and the envisaged sustainability of the project. Overall, the advantages of establishing the project vis-à-vis the anticipated impacts on the environment must be evaluated.

3.0 PROJECT/PROCESS DESCRIPTION

The new project proponent and the EIA preparers shall provide full details of the type of the Industrial Project or process. This should include the project location, the nature, extent and size of the project, the input and output of the raw materials and products, the technological layout or manufacturing design/flowchart; the production process, the project operation and maintenance procedures, the project schedules etc

4.0 DESCRIPTION OF THE ENVIRONMENT

The EIA preparers shall undertake adequate scientific studies and/or socio-economic surveys of the environment and area of the new Project's location and provide a vivid and detailed description of the entire area and the location of the proposed industrial project/process. The description shall include but not be limited to geographical location, climatic conditions and full ecological characteristics of the area/location. The preparers shall supply along with the description, the results of the studies/survey carried out on the soil, ambient noise levels, aquatic, vegetation, fauna, ground water resources and the socio-economic characteristics of the area.

The EIA preparers shall acquire and supply the above base-line data in addition to a description of the land-use, landscape and infrastructural services of the area including any archaeological, historical or cultural values of the area as well as ecologically-sensitive areas

5.0 ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACT

Increased cost of construction, raw materials and energy, and a greatly increased environmental awareness have radically affected the design and operating philosophies of the pulp and paper industry unlike mills built prior to the seventies.

Adverse impacts on the environment (eg natural and tropical forests degradation) by the development of wood resources to feed the manufacturing mills has led to serious problems is land erosion; water shed management, and loss of degradation of forest habitat. Crop pests can expand unchecked when forests are converted to monoculture. This procedure requires use of pesticides and /or herbicides, which have toxicological effects on beneficial organisms.

Wood harvesting can have severe environmental and health impacts, as well. One of the most hazardous occupations is logging out, if not properly supervised, it can affect soil fertility and promote soil erosion that causes increased turbidity in streams, lakes, and estuaries .Also, chemical changes in the waterways can occur if large quantities of waste wood, bark, and litter are allowed to decompose in them.

Pulp and paper mills used great quantities of water in the preparation of wood by wet debarking. Although wet debarking is physical the most effluent way to remove bark with less wood loss and less dirt, the higher cost for effluent control of waste water and the lower heating valve of wet bark are one of the primary reason today to convert from wet to dry debarking. The most important parameters for controlling polluting in wet debarking are TSS, BODs, Ph,and toxicity.

The use of non-wood fibres like straw, bamboo, bagasse eliminates debarking but requires pretreatment through washing to remove direct grit and pith in bagasse. All of the various pulping processes generate substantial effluent streams that have to be treated and, as far as possible, recycled; most processes caused air pollution.

Impacts from Kraft and soda pulping

Liquid effluent from the Kraft and soda pulping consist of spent liquor and contaminated condensates. The condensate is often processed into turpentine; as a valuable steam stripping is more expensive**,** it is often preferred above air stripping because of much smaller gas volumes to be handled. odour control can be great problem. Major components in the condensate are toxic, reduced sulfur compound, and methanol. An additional operation, bleaching, can increase the toxicity of the condensate when chlorine is used. Oxidative bleaching, on the other hand, will reduce the toxicity and colour of the effluent water.

The “black liquor” that is produced from pulp washing has to be concentrate by evaporation and burned afterwards. For the process, a multiple effect evaporator with steam should be used. Because of considerable hydrogen sulfide emissions, the older method of direct evaporation with flue gasses should be discouraged .sulfur is recovered as sodium disulfide; it is converted separately in caustic soda for recycling mainly as sodium bicarbonate.

Gaseous emissions from the Kraft and soda process consist of sulfur compound, organic compound, sulfur dioxide, and nitrogen oxides. The sulfur compounds especially, can cause severe odour problems. The gases have to be collected and scrubbed carefully. The recovery boiler furnace where spent liquor is incinerated can be a major source of particulate emission as is the smelt dissolving tank and the line kiln.

Impact from Sulphite pulping

Sulphite pulping produces effluent and emissions different in composition from those of the kraft process. The spent liquor is evaporated and burned in a recovery furnace and the sulphur dioxide that is formed is absorbed in a chemical recovery system. Depending on the basic sulphite solution used, sodium and magnesium can be recovered and recycles; however, calcium and ammonia pose problems. Ammonia is oxidized in the furnace into nitrogen oxides.

The toxicity of effluent water should be controlled carefully. Air pollution in the sulfite process is rather different from that in the Kraft process. Sulphur dioxide is a major pollutant and requires carefully designing of the acid preparation system and the digester gas relief systems prevent air pollution.

Impact from mechanical and Thermo-mechanical pulping

Mechanical and thermo- mechanical pulping processes primarily use softwood. These processes are the simplest method for producing wood pulp, and the total amount of waste materials is substantial smaller than from the chemical processes. mechanical pulping converts 90 to 95 percent of the wood into pulp, compare to about 50 percent from the Kraft process. Air pollution is minimal and water pollution depends mainly on the type of wood used and consists of carbohydrates, lignin extractive, acetic acid, formic solid, such as certain carbohydrates, extractive, and inorganic solution from cell contents and rotting processes.

Paper making requires large quantities of water, most of which can be recycled after treatment. The characteristic of the effluent vary from mill to mill depending on the degree of water recycling, grade of paper produced, size of mill, and raw material used. Pollutant will consist of suspended solid and dissolved substances from the wood fibers and from the additive used in the paper production.

OTHER ENVIRONMENTAL IMPACT ISSUES

Air pollution

The main air pollution problems in the pulping plant are malodorous sulfur compounds with extremely low detection threshold levels (1 and 10 parts per billion [ppb]). These gases are produced primarily in Kraft pulping plants, from digester blow and relief valves, vacuum washer hood and seal tank vents, multiple effect evaporation hotweel vents, recovery furnace flues, smelt dissolving tanks, slaker sulfur gases requires a design that collects all of gases, including the incidental releases, and an adequate incineration system with scrubbing of the exhaust gases.

Incidental chlorine emission through tank, vents, wash filters, and sewer in pulp bleaching operation are another point of concern in plant design

Effluent system

The main problems here are the high BOD and COD levels in water discharge from the plant and the black liquor effluent. All pulping plants (chemical and mechanical) require roper-and-wash-water is discharge into receiving waters. Any sulfides or sulfites in the effluent have to be oxidized to sulfate salt and the colour has to be reduced t an acceptable level. Total suspended solid can be reduced in advance by coagulation, flocculation, sedimentation and necessary, filtration.

Pulp and paper production uses large quantities of water for washing and for pollution abatement equipment. To minimize the demand for outside water, a pulp papermill should treat its wastewater and, if quality permits, recycle it in the process. To facilitate recycling, heavily contaminated streams in the process should be kept separate from lightly contaminated ones.

Solid waste

Preparing the wood for use in a puling plant generates a great amount of solid waste; logging, including the felling of trees, clearing the trees of branches, and removal of bark, dirt, sand, or stone, proper disposal of this waste should be include in the design of project; other source of solid waste are rejects from the screen, recausticizing rejects, waste water sludges and off-spec paper and trash. In addition, boiler ash may contribute as much as a fourth of the total solid waste product. Where possible, solid waste should be burned and the waste heat recovered. The burning of solid waste often has to be preceded by de- watering.

In practice, a pulpmill is often combined with a saw mill. The additional wood waste from a saw mill can be used in wood burning boilers or, in the case of saw dust and wood chips, as bases material for the production of clipboard and wallboard.

Approximately 75 percent of the solid waste is organic and, if not burned, must be disposed of properly to avoid stress on the environment. Because toxic and hazardous solid waste discharge into a landfill can degrade groundwater resources, proper disposal should be planned from the beginning. Lined storage with continuous leachate monitoring may be necessary.

In developing countries, interest in the use of non-wood fibers in the pulp and paper industry is increasing. Small mills are being established using primarily rice and wheat straw, kenaf, bagasse, bamboo and jute cutting, among other materials. From an environmental perspective, the most important different between non-wood and wood raw materials is the high ash content of non-wood materials that create greater problems for solid waste disposal.

Solid waste disposal should be kept to minimum. Solid waste may be used as fuel in the plant for production of stream, though this may require cyclones and gas scrubbing equipment.

6.0 MITIGATION MEASURE/ALTERNATIVE

In this section, the EIA preparers must consider and recommend adequate mitigation measure or alternative to ameliorate or abate all significant environmental impacts identified earlier.

These measures must be considerate and either implemented or project re-designed before proponent finally having embarks on the particular project. There could be a possibility of having a "No Project Option" cost-benefit analysis must be employed in selecting alternatives.

7.0 ENVIRONMENTAL MONITORING PLAN

The project proponent and the EIA preparers shall establish and provide information on an Action plan to ensure compliance with the recommended mitigation for significant environment impact at every phase of project together with the operations plan. Such plan which is to ensure environmental protections shall include the monitoring in each case. Theses shall be based on the type and complexity of the mitigation measure.

8.0 REMEDIATION PLANS AFTER PLANT DECOMMISSIONING CLOSURE

The project proponent or the EIA preparers shall establish and provide information on a post-project Remediation plan which shall ensure a complete restoration of the project area back to its original status in the future event of the industrial plants closure and decommissioning. The overall positive and negative changes which the project may inflict on the ambient environment before its closure shall be taken into consideration in establishing the plan.

A CHECKLIST FOR PULP, PAPER AND TIMBER PROCESSING PROJECTS

1. INTRODUCTION

- Background to Proposed Project
- Legal and administrative framework and objectives of the EIA

2. PROJECT JUSTIFICATION

- Need for the Project
- Value of the Project
- Envisaged sustainability of Project

3. PROJECT DESCRIPTION

- Planning, location
- Raw material/product input and output
- Technological layout
- Production Process
- Project Operation/Maintenance
- Project Schedule

4 DESCRIPTION OF THE ENVIRONMENT

- Baseline data on Project
- Environmental Site Selection Considerations

In this regards examine

- whether there are possible alternative sites or locations which could be considered in project siting
- whether in the alternative project sites or nearby there are:
    - areas of unique or exceptional quality
    - human settlements
    - important ground or surface water resources
    - tourism attractions/areas
    - recreational areas
    - nature conservation areas
    - schools or hospitals
    - unique ecosystems or important wildlife habitats or endangered species
    - important fishing areas
    - important agricultural or forestry areas
    - important cultural or historical or scientific resources areas
    - area important for vulnerable human populations (eg. indigenous cultivating, fishing or pastoralist people and their livestock)

- whether there are already significant environmental problems (eg air pollution, water pollution, noise, erosion, deforestation or social conflicts, etc) in the project zone
- whether there is a history of outbreak of serious communicable diseases in the area
- whether the area can provide sufficient:
    - local work force
    - Raw materials
    - Transportation facilities
    - Energy supply
    - Water supply
    - Capacity of receiving waters to assimilate effluents
    - Sewer services and waste water treatment facilities

- Waste disposal facilities
- Community services (medical, schools, transportation, food, sanitation, etc)

- Whether there are applicable local or natural regulations regarding
    - EIA
    - Water pollution control
    - Air pollution control
    - Noise pollution control
    - Soil conservation
    - Solid waste disposal
    - Hazardous waste disposal
    - Spill prevention and control
    - Workers health and safety
    - Storage and handling of hazardous materials

- Whether the project area is covered within any appropriate land use Planning document (eg area master plan)

5. ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACTS:

Impacts on the ecosystem that may result from the Project in all its Phases must be considered. Such include

(a) Impacts from Site Preparation and Construction

<u>Identify and Predict</u>- impacts of relevant site preparation and construction activities and components, such as:

- Land clearing, grading, leveling, surface excavation, cut and fill, terracing, etc
- Surfacing and paving
- Construction of plant buildings

- Construction of transmission lines and pipelines
- Road construction
- Barriers, including fencing
- Blasting and Drilling
- Land reclamation
- Ditching, drainage
- Dredging, port facilities construction
- Quarrying, mining
- Transportation
- Material storage
- Housing and services to the labour force
- Migration
- Resettlement of people

On the following components of the ecosystem

- Hydrology and drainage patterns
- Surface and ground water quality
- Air quality
- Noise and vibration levels
- Land/soil quality
- Wildlife
- Aesthetics
- Fisheries
- Land use, such as agriculture, forestry, tourism, recreation
- Local traffic
- Working opportunities
- Income opportunities
- Settlement plans
- Population structure and dynamics
- Social structures

- Local life style and values
- Occupational and public health
- Archaeological, historical, cultural or scientific values
- Land values
- Social services

(b) Impacts from Project Operation

Identify and Predict- the impacts of following activities/components (relevant to each alternative):

- Raw material exploitation, handling, transportation and storage
- Water supply
- Energy production
- Gaseous emissions (from processes, energy production and traffic)
- Liquid effluents (including excess heat)
- Solid wastes
- Process and traffic noise
- Possible accidents, hazards and process malfunctions
- Handling of hazardous materials
- Maintenance and repair

On for examples:

- Local traffic
- Raw material resources
- Air quality
- Noise levels
- Land/soil quality
- Other land uses, interests and values (as mentioned in section 1 and 2 above)
- Ecology
- Occupational health

- Public health
- Migration patterns
- Settlement patterns
- Population structure and dynamics
- Working opportunities
- Local life style and values
- The role of women
- Social services
- Land values

6. MITIGATION MEASURES

Identify, Plan and recommend adequate mitigation measures of harmful impacts. For example identify alternative design, manufacturing processes, raw material fuels, etc which could be considered, or by considering the possibilities to provide/practice:

- Use of low-waste and low-pollution technology
- Air pollution
- Waste water treatment
- Water recycling and conservation
- Energy conservation
- Noise control measures
- Solid waste management (especially recycling)
- Training and education of (local) workers and general public
- Workers safety measures
- Contingency plans and equipment
- Medical and other social services development
- Safe storage facilities for hazardous materials
- Resettlement plans
- Compensatory measures
- Landscaping

7. **ENVIRONMENTAL MONITORING PLAN**

Establish an adequate environmental protection and environmental monitoring plan during project's operational phase either pre-commissioning or during plant operations. Include in your plan

- The monitoring schedule
- The parameters to be monitored
- The methods for the monitoring
- The scope of the monitoring

8. **REMIDIATION PLANS AFTER DECOMMISSIONING OR CLOSURE OF INDUSTRIAL PLANT**

Establish an adequate plan for restoration of the natural environment in the future event of plant's closures or de-commissioning of industry either temporarily or permanently

Potential Negative Impacts	Mitigating Measures
Direct: Site Selection 1. Siting of plant on/near sensitive habitats such as mangroves, estuaries, wetlands, coral reefs	1 i. Locate plant in industrially zoned area, if possible, to minimize or concentrate the stress on local environmental services and to facilitate the monitoring of discharges ii. Integrate site selection process with natural resource agencies to review alternatives
2. Siting along water courses curing their eventual degradation	2 i. Site selection process should examine alternatives that minimize environmental effects and not preclude beneficial use of the water body ii. Plants with liquid discharges should only be located on a watercourse having adequate waste-absorbing capacity

3. Siting can cause serious air pollution problems for local area	3. i. Locate in an area not subject to air inversions or trapping of pollution, and where prevailing winds are towards relatively unpopulated areas
Direct: Plant Operation 4 • Inadequate or non-existent forest management resulting in soil erosion, diminishing biotopes • Unchecked pesticide application causing toxicological effects on beneficial organisms and undesirable changes in forest ecosystems	4. i. In project design phase, develop a forest management plan based on an environmental impact study ii. Do not select wood supply from primary forest reserves
Direct: Plant Operation (continued) 5 i. Release of gaseous wastes ii. sulphur dioxide iii. total reduced sulphur compounds (TRS) iv. particulates v. toxic organic compounds (e.g. chlorine, hydrogen sulphide)	5. Sulphur Dioxide i. Control by proper operations such as liquor recovery furnace ii. select appropriate auxiliary fuels iii. fuel desulfurization, flue gas scrubbing, and process modification TRS i. Collection by headers, scrubbed with alkali solution, then burned

	<u>Particulate</u> i. Removal by evaporators
6 i. Release of liquid wastes to water bodies ii. Conventional pollutants causing the following impacts - Change in pH and toxicity - dissolved and suspended solids - eutrophication - foam and scum - slime growth - thermal effects - changes in taste, colour and odour - fish-flesh tainting iii. Toxins such as trichlorophenol, pentachlorophenol and zinc.	6. i. In-plant operating and housekeeping measures - Pulp washing, chemical and fibre recovery, treatment and reuse of selected waste streams, collection of spills, and prevention of collection tanks for accidental discharges. - Monitoring of sewers, drainage channels and discharges to warm of spills - Load levelling of treatment facilities by use of storage basins and other measures - Recycling of barking water ii. External effluent treatment - Primary-sedimentation basins, gravity clarifiers and dissolved air floatation - Secondary-oxidation ponds, trickling filter aerated lagoon, activated sludge, irrigation, sedimentation basin (to remove biological solids) and secondary clarifier - Toxins control by substitution o0f less/non-

	toxic chemicals -
Direct: Plant Operation (continued) 7 Disposal of solid wastes on the land i. Subsurface leaching with subsequent contamination of ground and surface water ii. Ground and surface water iii. Destruction of ecologically sensitive areas such as marshes and other wetlands iv. proliferation of rodents, scavengers and insects harmful to human and unslightly conditions v. Fires, health hazards, and unsightly conditions	7. Source reduction, source segregation, by-product utilization, appropriate planning and management or disposal sites such as lining of disposal sites with collection system for fun-off water and leachate
8 Sludge incineration	8. i. Dewatering by vacuum filtration and chemical conditioning to prepare sludges for burning ii. Incinerators - Waste only - burning in the bark boiler - burning in power boiler

9 i. Occupational health effects on workers due to: - Special pulp mill operations such as preparing logs (chipping and grinding) - Handling and storing of pulpwood and paper chips, and raw materials other than pulpwood - Chemical processes used in making pulp, bleaching and stock preparation - Handling of spent liquors and machine room operations involves dust, fumes and gases as well as shredders, clippers, cutters, heavy mobile equipment etc.	9. Facility should implement a safety and health programme designed to: i. identify evaluate, monitor and control hazards to employees ii. design safe operating procedures iii. provide training in safety practices and the handling emergencies
10. Transit patterns disrupted, noise and congestion created and pedestrian hazards aggravated by heavy trucks transporting raw materials, fuel and final products to/from the facility	10. Site selection can mitigate some of these problems i. Special transportation sector studies should be prepared during project feasilbility stage to select best routes to reduce impacts ii. Follow transportation regulations and develop emergency contingency plans to minimize risk of accidents.

GUIDELINES FOR

INDUSTRIAL FOOD PROCESSING SUB- SECTOR

9.4 INDUSTRIAL FOOD PROCESSING SUB-SECTOR

1.0 INTRODUCTION

Food processing projects involve the processing and packaging of meat and meat products, fish and shellfish, dairy products, fruits and vegetables, grains and beverages production. Food processing may include refinement, preservation, product improvement, storage and handling, packaging and canning.

The basic raw materials of the industry are either naturally produced or grown. The processing may involve receiving and storing raw or partially processed plant or animal or other food materials, processing the materials into finished products, and packaging and storing the finished products. The general objective of food processing is to extend the shelf life of the raw commodities through the use of the various preservation methods.

2.0 PROJECT JUSTIFICATION

The project proponent and the EIA preparers for a new Food Processing Industry shall provide a justification for the new industrial project to be established. This would include the need for the project, the value of the project and the envisaged sustainability of the project. Overall, the advantages of establishing the project vis-à-vis the anticipated impacts on the environment must be evaluated.

3.0 PROJECT/PROCESS DESCRIPTION

The new project proponent and the EIA prepares shall provide full details of the type of the industrial Project or process. This should include the project location, the nature, extent and size of the project; the input and output of the raw materials and products, the technological layout or manufacturing design/flow-chart, the production process; the project operation and maintenance; the project schedules etc.

4.0 DESCRIPTION OF THE ENVIRONMENT

The EIA preparers shall undertake adequate scientific studies and/or socio-economic surveys of the environment and area of the new industrial location and provide a vivid and detailed description of the entire project area and the location of the proposed industrial project/process. The description shall include but not limited to geographical location, climatic conditions and full ecological characteristics of the area/location. The preparers shall supply along with the description, the results of the studies/survey carried out on the soil, ambient or noise levels, aquatic vegetation, fauna, ground water resources and the socio-economic characteristics of the area.

The EIA preparers shall acquire and supply the above base-line data in addition to a description of the land-use, landscape and infrastructural services of the area including any archaeological, historical or cultural values of the area as well as ecologically-sensitive areas.

5.0 ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACT

The food processing industry provides food product for immediate or future human consumption and by-products for use in the livestock industry. The industry generated large volumes of wastewater and solid wastes and may also be a source of air pollutants. Wastewaters arise mainly from leaks, spills, and equipment washouts. Large volumes are also generated in the washing operations to remove soil, pesticides and skin from fruits and vegetables.

Screening is extensively employed in the industry to remove solids. The recovered solids have market value and are normally processed for animal fed. Although air emission is not a problem, odour problems can be significant.

Impacts from Diary Products

The diary processing industry manufactures 20 types of milk products including pasteurized milk, ice cream, butter, cheese, condensed milk, dry milk, whey and cultured products. Although diary plants may perform a combination of operations to produce several products, some plants may produce only one or two. Typical manufacturing c processes for the diary product industry involve:

i. Receiving and storing raw materials, comprising receiving areas, transfer equipment, and large refrigerated tanks for storage.
ii. Clarification to remove suspended solids, and separation to remove cream – processes usually accomplished by large centrifuges of special design.
iii. Churning, homogenising, culturing, condensing, and drying to produce butter, ice cream, cheese, buttermilk, etc and
iv. Packaging and storing for subsequent shipment.

The major sources of wastes and wastewater from the diary processing industry are wash and rinse water from wash-ups, unrecovered by-products, spoiled or damaged products, and entrainment from evaporators.

Under normal operations and with good housekeeping, receiving and storing raw materials are not major sources of waste. Solid waters are minor and maybe disposed of at a sanitary landfill.

A significant characteristics of the waste stream of all diary plants is the marked variation flow, BOD temperature and Ph. In a fluid milk plant, approximately 94 percent of the BOD is contributed by milk, milk products and other edible products. Of all the wastes, whey presents the most difficult disposal problem. The most common disposal methods are those used in livestock feed and spray irrigation, discharge to municipal system, concentration, and drying.

The main safety hazards in the dairy industry result from bursting bottles, flying glass, and falls on slippery floors. Common health hazards include animal diseases as brucellosis, bovine tuberculosis, anthrax, etc. workers may also contract cheese-workers' itch.

Impacts for Fruits and Vegetable Processing

Canning and preserving extends the shelf life of raw commodities. Preservation methods involve canning, freezing, dehydrating, and brining. Fruits and vegetable preserving generally includes cleaning, sorting, peeling, sizing, stabilizing and processing.

Prior to processing, the fruits and vegetables are washed and rinsed using great quantities of water and occasionally detergents. The washed products are sorted and graded by mechanical, optical, manual or hydraulic means. Mature products are separated using a brine solution of controlled density. Following sorting, the products are mechanically stemmed, snipped, and trimmed.

Many fruits and vegetables are peeled to remove residual soil, pesticide and coarse, fuzzy or tough peels. The process is accomplished either mechanically, thermally or chemically. Pitting, coring, slicing and dicing are carried out mechanically without the use of water. Some fruits are pureed and squeezed to produce juices. Vegetables, on the other hand are blanched and canned. Finally, depending on the type of operation, some products are dried.

Fruits and vegetables processing are major water user and waste generators. The washing and rinsing operation, sorting, in-plant transport, peeling, blanching, canning, mixing, cooking and clean-up are major generators of wastewater and solid wastes. Gaseous emissions are minor though odour may be significant in some cases.

The wastewater parameter of significance are BOD, TSS and pH. Fecal coliform may be of concern but can be prevented by practicing god housekeeping and maintaining sanitary conditions at all times. Because of the wide variation in flow and strength (BOD) of the wastewaters, treatment facilities must be designed to handle large, intermittent volumes. Citrus wastes contain pectin substances that interfere with settling of suspended solids.

In fruit and vegetable canneries, the major accidents are due to lifting, burns from steam, acids and alkalis, and cuts from broken glasses and sharp tins. The main health problem is dermatitis and skin infection caused by chemicals, and the handling of fruits and vegetables. In some plants, excessive noise, temperature stress, and high humidity may also create health problems.

Impacts from Meat Processing

Meat processing plants purchase animal carcasses, meat parts and other materials. They also manufacture sausages, cooked meats, smoked meats, canned meats, frozen and fresh meat cuts, natural sausage casings, and other specialties. The processing operation may be carried out separately or in conjunction with slaughterhouses.

The meat processor receives frozen carcasses that are wet or dry, thawed, or chipped. Unlike dry thawing wet thawing, wet thawing generates large volumes of wastewater. Chipping involves reduction equipment designed to handle frozen meat. A typical plant may involve one or more of the following operations;

i. meat cutting to prepare standardized products for hotels, restaurants, institutions, fast food outlets, etc.
ii. ham processing for curing in pickling solutions followed by cooking, smoking, cooling, slicing, and packaging.
iii. sausages and luncheon meats manufacturing require substantial size reduction, intensive mixing and moulding, or forming of finished products and
iv. canned products for hams, sandwich spread, and pet foods.

Meat processing is a year-round operation with daily operation on an intermittent basis. Plants usually shut down daily for extensive clean-ups. The industry produces large volumes of wastewater with varying amounts of suspended solids. Solid wastes, resulting mainly from screening and housekeeping, are normally recovered and sent to a rendering plant. Although gaseous emissions are not significant, odours are problem. They originate from cooking of animal materials, animal residues and decomposition of organic matter.

The most important parameters of concern in the mat processing industry are BOD, TSS, oils and grease, PH and fecal coliforms. Depending on the type of operation, phosphorous and ammonia may also be a problem. Of the processes described previously, meat canning and ham processing are the largest contributors to wastewater flows, BOD, TSS, and oil grease. Meat cutting operations are the lowest.

The waterload discharged from the meat industry can be reduced to desired levels through effective water management, in-plant waste controls, process modifications, and wastewater treatment systems.

Safety hazards in the meat processing industry result mainly from slippery floors, burns and cuts and abrasions from sharp tins, broken glasses and cutting machinery. Main health problems are dermatitis caused by chemical and skin infections. Diseases associated with animals such as anthrax, actinomycosis, erysipeloid, and tuberculosis, are also a potential source of health hazard. Other health problems may include noise, high temperature and humidity.

Impacts from Fish and Shellfish Processing

The canned and preserved fish and seafood industry has progressed from drying and curing technique to preserving, freezing, canning, and rendering of fish products. The length of the fish processing season varies greatly depending upon the harvesting season and the amount of material processed in the industry.

The process used in this industry includes harvesting of the fish, storing, receiving, eviscerating, pre-cooking, pick-up or cleaning, preserving and packaging. Following harvesting, fish is unloaded from the vessel, weighed and transported to the processing area for either immediate processing or cold storage. In some operations, pre-processing to behead shrimps, eviscerate fish or shell fish is carried out at sea. The wastes are dry captured or screened from wastewater and processed as by-products.

Depending on the final product destination, fresh fish and seafood may be packaged for immediate consumption or cooked for picking and cleaning operation to remove skin, bone, shell, gill etc. The picking may be followed by freezing, canning, pasteurization and refrigeration.

There is considerable variation from process plant, in the amount of water used and the waste generated. In general, wastes from this industry contains BOD, COD, TSS, oil and grease, and maybe of high or low pH. Normally, these wastewater contain no hazardous or toxic materials. Occasionally, wastewater containing high concentrations of sodium chloride may be discharged.

Under normal operations, gaseous emissions are not a problem. Solid waste if not recovered, could present a treatment and disposal problem. Fortunately, newer plants recover most solid wastes by screening or dry collection. These wastes are further processed as fish meal, concentrated protein soluble, oils, liquid fertilizers, fish food pellets, animal fed, shall novelties etc.

In the fish canning industry, major accidents results from lifting, handling, and falling materials. Secondary causes include falls on slippery floors and burns and cuts from machinery and sharp objects. The main health problems arise from warts due to virus and fish slime, and skin infections and dermatitis caused by chemicals.

OTHER ENVIRONMENTAL IMPACT ISSUES

<u>Water</u>

Significant quantities of water are used in the food processing industry. The main uses of the water are for washing, rinsing and in-plant transport of products and clean-ups.

In the fruit and vegetable industry, for example, it has been common t use water to transport the raw materials within a plant and to consider such use as both economical and of sanitary significance. However, the leaching of solubles from the products (eg. Sugars and acids from cut fruits and sugars and starch from cut vegetables) has led to alternative means of fluid transport, such as osmotically equivalent fluid systems. Nonetheless, effective washing after harvesting is required due to use of pesticides and other contaminants and mechanical harvesting techniques that result in residues of soil and dirt in the fruits and vegetables.

6.0 MITIGATION MEASURES/ALTERNATIVES

In this section, the EIA preparers must consider and recommend adequate mitigation measures or alternatives to ameliorate or abate all significant environmental impacts identified earlier.

These measures must be considered and either implemented or project re-designed before proponent finally embarks on the particular project. There could be a possibility of having a "No-Project Options". Cost benefit analysis must be employed in selecting alternatives.

7.0 ENVIRONMENTAL MONITORING PLAN

The project proponent and the EIA preparers shall establish and provide information on an Action Plan to ensure compliance with the recommended mitigation measures for significant environmental impacts at every phase of project together with the operations auditing plan. Such plan which is to ensure environmental protection shall include the monitoring schedule, the parameters to be monitored in each case. These shall be based on the types and complexity of the mitigation measures.

8.0 REMEDIATION PLANS AFTER PLANT DECOMMISSIONING OR CLOSURE

The Project Proponent or the EIA preparers shall establish and provide information on a post-project. Remediation plan which shall ensure a complete restoration of the Project area back to its original status in the future event of the Industrial Plants closure and decommissioning. The overall positive and negative changes which the project may inflict on the ambient environment before its closure shall be taken into consideration in establishing the Plan.

A CHECKLIST FOR INDUSTIAL FOOD PROCESSING PROJECTS

1. INTRODUCTION

- Background to proposed project
- Legal and administrative framework and objectives of the EIA

2. PROJECT JUSTIFICATION

- Need for the project
- Value of the project
- Envisaged sustainability of the project

3. PROJECT DESCRIPTION

- Planning, location
- Raw materials/product input and output
- Technological layout
- Production Process
- Project Operation/Maintenance
- Project Schedule

4. DESCRIPTION OF THE ENVIRONMENT

- Baseline data on Project
- Environmental site selection considerations

In this regard examine

- Whether there are possible alternative sites or locations which could be considered in project siting
- Whether in the alternative project sites or nearby there are:
    - Areas of unique or exceptional quality

- Human settlements
- Important ground or surface water resources
- Tourism attractions/areas
- Recreational areas
- Nature conservation areas
- Schools or hospitals
- Unique ecosystems or important wildlife habitats or endangered species.
- Important fishing areas
- Important agricultural or forestry area
- Important cultural or historical scientific resources areas
- Area important for vulnerable human populations (eg. Indigenous cultivating, fishing or pastoralist people and their livestock).

- whether there are already significant environmental problems (eg air pollution, water pollution, noise, erosion, deforestation or social conflicts, etc) in the project zone
- whether there is a history of outbreak of serious communicable diseases in the area
- whether the area can provide sufficient:
  - local work force
  - Raw materials
  - Transportation facilities
  - Energy supply
  - Water supply
  - Capacity of receiving waters to assimilate effluents
  - Sewer services and waste water treatment facilities
  - Waste disposal facilities
  - Community services (medical, schools, transportation, food, sanitation, etc)

- Whether there are applicable local or natural regulations regarding
  - EIA

- Water pollution control
- Air pollution control
- Noise pollution control
- Soil conservation
- Solid waste disposal
- Hazardous waste disposal
- Spill prevention and control
- Workers health and safety
- Storage and handling of hazardous materials

- Whether the project area is covered within any appropriate land use Planning document (eg area master plan)

5. ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACTS:

Impacts on the ecosystem that may result from the Project in all its Phases must be considered. Such include

(a) Impacts from Site Preparation and Construction

Identify and Predict- impacts of relevant site preparation and construction activities and components, such as:

- Land clearing, grading, leveling, surface excavation, cut and fill, terracing, etc
- Surfacing and paving
- Construction of plant buildings
- Construction of transmission lines and pipelines
- Road construction
- Barriers, including fencing
- Blasting and Drilling
- Land reclamation

- Ditching, drainage
- Dredging, port facilities construction
- Quarrying, mining
- Transportation
- Material storage
- Housing and services to the labour force
- Migration
- Resettlement of people

On the following components of the ecosystem

- Hydrology and drainage patterns
- Surface and ground water quality
- Air quality
- Noise and vibration levels
- Land/soil quality
- Wildlife
- Aesthetics
- Fisheries
- Land use, such as agriculture, forestry, tourism, recreation
- Local traffic
- Working opportunities
- Income opportunities
- Settlement plans
- Population structure and dynamics
- Social structures
- Local life style and values
- Occupational and public health
- Archaeological, historical, cultural or scientific values
- Land values
- Social services

(b) Impacts from Project Operation

<u>Identify and Predict</u>- the impacts of following activities/components (relevant to each alternative):

- Raw material exploitation, handling, transportation and storage
- Water supply
- Energy production
- Gaseous emissions (from processes, energy production and traffic)
- Liquid effluents (including excess heat)
- Solid wastes
- Process and traffic noise
- Possible accidents, hazards and process malfunctions
- Handling of hazardous materials
- Maintenance and repair

On for examples:

- Local traffic
- Raw material resources
- Air quality
- Noise levels
- Land/soil quality
- Other land uses, interests and values (as mentioned in section 1 and 2 above)
- Ecology
- Occupational health
- Public health
- Migration patterns
- Settlement patterns
- Population structure and dynamics
- Working opportunities

- Local life style and values
- The role of women
- Social services
- Land values

6. <u>MITIGATION MEASURES</u>

Identify, Plan and recommend adequate mitigation measures of harmful impacts. For example identify alternative design, manufacturing processes, raw material fuels, etc which could be considered, or by considering the possibilities to provide/practice:

- Use of low-waste and low-pollution technology
- Air pollution
- Waste water treatment
- Water recycling and conservation
- Energy conservation
- Noise control measures
- Solid waste management (especially recycling)
- Training and education of (local) workers and general public
- Workers safety measures
- Contingency plans and equipment
- Medical and other social services development
- Safe storage facilities for hazardous materials
- Resettlement plans
- Compensatory measures
- Landscaping

7. <u>ENVIRONMENTAL MONITORING PLAN</u>

Establish an adequate environmental protection and environmental monitoring plan during project's operational phase either pre-commissioning or during plant operations. Include in your plan

- The monitoring schedule
- The parameters to be monitored
- The methods for the monitoring
- The scope of the monitoring

8. REMIDIATION PLANS AFTER DECOMMISSIONING OR CLOSURE OF INDUSTRIAL PLANT

Establish an adequate plan for restoration of the natural environment in the future event of plant's closures or de-commissioning of industry either temporarily or permanent

TABLE 3: FOOD PROCESSING

Potential Negative Impacts	Mitigating Measures
Direct: Site Selection 1. Siting of plant on/near sensitive habitats such as mangroves, estuaries, wetlands, coral reefs or use of prime agricultural lands.	i. Locate plant to minimize or concentrate the stress on local environmental services and to facilitate the monitoring of discharges. ii. Integrate site selection process with natural resource agencies to review alternatives.
2. Siting along water courses causing their eventual degradation.	2 Site selection process should examine alternatives that minimize environmental effects and not preclude beneficial use of the water body using the following guidelines: i. On a watercourse having maximum water dilution and absorbing capacity ii. In an area where wastewater can be reused with minimal treatment for agricultural or industrial purposes iii. Within a municipality that is able to accept the plant waste in their sewage treatment system
3. Siting can cause serious odour pollution problem for	3 Locate plants in an area not subject to air inversions or

local area.	to trapping pollution, and where prevailing winds are towards relatively unpopulated areas.
4 Siting can aggravate solid problems in an area.	4. For facilities producing large volume of waste, site selection should evaluate the location according to the following guidelines: i. plot size sufficient to landfill or on-site disposal ii. proximity to a suitable disposal site iii. convenient for public/private contractors to collect and haul solid wastes for final disposal.
5 Water pollution from discharge of liquid effluents and process cooling water or runoff from waste piles. Plants: Oil and Grease, TDS, TSS, BOD, COD	5. Laboratory analysis of liquids effluent should include oil and grease, TDS, TSS, BOD, COD and in-situ temperature monitoring. <u>All Plants</u> i. No cooling water discharge. If recycling not feasible, discharge cooling water provided receiving water temperature does not rise >3ºc. ii. Maintain pH level of effluent discharge between 6.0 and 9.0. iii. Control effluent to Federal Ministry of

	Environment specified limitations for specific process or industry. iv. Land application of waste effluents where appropriate.
6 Particulate emissions to the atmosphere from all plant operations.	6. Control particulates by fabric filter collectors or electrostatic precipitators.
7 Gaseous and odorous emissions to the atmosphere from processing operation.	7. i. Control by natural scrubbing action of alkaline materials. ii. Analysis of raw materials during feasibility state of project can determine levels of sulfur to properly design control equipment.
8 Accidental release of potentially hazardous solvents, acidic alkaline materials.	8. i. Maintain storage and disposal areas to prevent accidental release. ii. Provide spill control equipment.
Indirect: 9 Occupational health effects on workers due to material handling, noise or other process operations. - Accidents occur higher than normal frequency because of level of knowledge and skill.	9. Facility should implement a safety and Health Programme designed to identify, evaluate, monitor, and control safety and health hazards at a specific level of detail, and to address the hazards to workers health and safety and procedures for employee

	protection, including any or all of the following: i. site characterization and analysis ii. site control iii. training iv. medical surveillance v. engineering controls, work practices and personal protective equipment vi. monitoring vii. informational programs viii. handling raw and process materials ix. decontamination procedures x. emergency response xi. illumination xii. sanitation at permanent and temporary facilities xiii. regular safety meetings.
10. Regional solid waste problem exacerbated by inadequate on-site storage.	10 Plan for adequate on-site disposal areas assuming that the characteristics of the leachate is known.
11. Transmit patterns disrupted, noise and congestion created and pedestrian hazard aggravated by heavy trucks transporting raw materials to/from facility.	11 Site selection can mitigate some of these problems, such as pedestrian hazards. i. Special transportation sector studies should be

	prepared during project feasibility to select best routes to reduce impacts. ii. Transport regulation and development of emergency contingency plans to minimize risk of accidents.
12. Potential for disease transmission from inadequate waste disposal.	12 Develop specifications for; i. Food preparation and or processing ii. Waste disposal processes iii. Monitor fecal coliform or other bacteria

GUIDELINES FOR

IRON AND STEEL MANUFACTURING SUB-SECTOR.

9.5 **IRON AND STEEL MANUFACTURING SUBSECTOR**

1.0 INTRODUCTION

The steel industry is one of the most basic industries required in developing countries as this industry often provides the cornerstone for the whole industrial sector. Its economic impact is of great importance as an employer and, as a supplier of basic products, to a multitude of other industries: building and construction, machinery and equipment, and the manufacturing of transport vehicles, and railways.

Apart from the environmental impacts related to mining activities, there are environmental consequences which result from the processing of the mine products. Processing sometimes occurs near to the mine; in other situations, it is located at a considerable distance. The metallurgical industry involves a complex series of processes whereby an iron ore or metallic element is transferred into a product, usually through the addition of coke, limestone and other materials. Ferrous ore processing includes the economically crucial activity of iron and steel making.

The production of coke generates significant quantities of wastewater which contains ammonia and other components released in the cooling process. This water contains potentially toxic concentrations of phenols, cyanide, thiocyanate, ammonia, sulphide, and chloride. Atmospheric emissions include visible smoke, coke dust, ammonia, hydrogen sulphide, nitrogen oxides and carbon monoxide. A range of pollution abatement measures are available which, if employed, would remove particulates and gaseous pollutants from excess gases. Many of these gases can be recovered and sold as chemical products.

Preparation of iron-bearing ores results in large quantities of tailings and in emission of dust and SO_2. During the preparation phases, the conversion of iron ores to molten iron produces significant amounts of particulate emissions and carbon monoxide. Dust control, handling of hot off gases and waste water treatment are important considerations.

Both iron and steel works produce large amounts of solid waste such as blast furnace slag. Some of this can be used to produce cement. Basic slag can also be used as fertilizer. Solvents and acids used in cleaning steel are potentially hazardous substances. Adequate measures should be taken to collect, store and dispatch these and other by-products. Waste water treatment systems are required for all iron and steel making processes. Recycling of used and treated water should be considered.

The final stages of steep production involve casing and rolling, during which large quantities of lubricants and hydraulic oils are employed to protect the metals against corrosion and to improve their properties. The most common discharges resulting from this process are acid wastes, heavy metals, oils, grease and cyanide. Wastes maybe treated according to specific chemical methods and the remaining solids dumped or incinerated.

2.0 PROJECT JUSTIFICATION

The project proponent and the EIA preparers shall provide a justification for the new industrial project to be established. This would include the need for the project, the value of the project and the envisaged sustainability of the project. Overall, the advantages of establishing the project vis-à-vis the anticipated impacts on the environment must be evaluated.

3.0 PROJECT/PROCESS DESCRIPTION

The project proponent and the EIA preparers for an Iron and Steel Manufacturing project shall provide full details of the type of the Industrial Project or process. This should include the project location, the nature, extent and size of the project; the input and output of the raw materials and products, the technological layout or manufacturing design/flow-chart, the production process; the project operation and maintenance; the project schedules etc.

4.0 DESRIPTION OF THE ENVIRONMENT

The EIA preparers shall undertake adequate scientific studies and/or socio-economic surveys of the environment of the Plant Location and provide a vivid and detailed description of the entire project area and the location of the proposed industrial project/process. The description shall include but not limited to geographical location, climatic conditions and full ecological characteristics of the area/location. The preparers shall supply along with the description, the results of the studies/survey carried out on the soil, ambient or noise levels, aquatic vegetation, fauna, ground water resources and the socio-economic characteristics of the area.

The EIA preparers shall acquire and supply the above base-line data in addition to a description of the land-use, landscape and infrastructural services of the area including any archaeological, historical or cultural values of the area as well as ecologically-sensitive areas.

5.0 ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACT

Considerable quantities of wastewater and air emissions are generated in the course of making iron and steel. If not adequately managed, significant degradation of land, water, and air can result resulting environmental impacts. A brief description of the typical waste generated during iron and steel making processes is given in the following sections.

Impacts from Coke Production and By-Product Recovery

Coke is produced by heating bituminous coal to drive off volatile components. Coke is sued in iron producing blast furnaces as a reducing agent to convert iron ore to iron, and from this process a certain amount of carbon from the coke is dissolved in the liquid iron. During the coking process, great amounts of gas containing carbon monoxide are evolved, thereby furthering a whole series of chemicals: coal tar, crude light oils (containing benzene, toluene, xylene), ammonia, naphthalene, and significant amounts of water vapor. Most of these substances can be recovered and refined as chemical products; the remaining coke oven gas is used internally in different processes and furnaces for heating purposes, while surplus gas could be used either for power generation or as raw materials for the production of chemicals.

Coke production generates significant quantities of wastewater which contains ammonia and other components released in the cooking process. This water contains potentially toxic concentrations of phenols, cyanide, thiocyanate, ammonia, sulphide, and chloride.

Air emissions from coke production include visible smoke, coke dust, and most of the volatile substances mentioned above.

Ore preparation

Iron bearing ores (hermatite, limonite, magnetite) are crushed, sized, and agglomerated through sintering, pelletizing, noduling, and briquetting to produce a preconditioned concentrated ore feeding the blast furnace process. Ore preparation can generate large quantities of tailings and results in emission of dust and sulfur dioxide.

Iron Production

Iron Production occurs in a blast furnace and involves the conversion of iron ores into molten iron by reduction with coke and separating undesirable components such as phosphorus, and manganese through the addition of limestone. Blast furnace gases are significant sources of particulate emissions and contain carbon monoxide. Blast furnace slag is formed by the reaction of limestone with other components and silicates present in the ores. The slag is quenched in water that may result in emissions of carbon monoxide and hydrogen sulphide. Liquid waste from iron production originates from the scrubbing of flue gases and slag quenching. This wastewater is commonly high in suspended solids and may contain a wide range of organic compounds (phenols and cresols), ammonia, arsenic compounds and sulphides.

Steel Production

The iron produced in the blast furnaces is refined in the steel process where most of the carbon dissolved in the molten iron is removed. In old plants, the steel making process still uses the pen hearth furnace, but in new plants the most favoured method is the basic oxygen furnace in which carbon is dissolved in the liquid iron and burned off with oxygen. In both processes, considerable amounts of hot off-gases contain carbon monoxide and dust. These gases can be recycled after deducting.

Casting, Rolling, and Finishing

The final steps in the steep production involve the shaping of steel ingots or billets into desired end-products. Ingots or billets are rolled into slabs, wire, sheets, plates, bars, pipes, and rods. During rolling, large quantities of lubricating and hydraulic oils are used. In addition, pickling (cleaning to remove oxides) and cleaning of the final product to remove oil and grease may generate significant quantities of acidic, alkaline, and solvent liquid wastes. In modern plants, the step of ingot casting is often omitted and the molten steel is sued directly in continuous casting and milling.

Direct Reduction: Steel Mini-mills

The integrated mini-mill consists of a direct reduction furnace and an electric arc furnace with continuous billet casting it is here that reduction of the iron ore is achieved by the use of natural gas (or oil products) which is converted in a gas reforming furnace into a hydrogen containing gas. The sponge iron produced in the reduction process is fed to an electric arc furnace for conversion to steel. In this furnace, in addition to the sponge iron, considerable quantities of scrap iron are often used. The omission of the coking process and the use of high grade iron ores makes this process alternative less polluting than the conventional blast furnace process, but there can still be a significant emission of dust and carbon monoxide.

6.0 MITIGATION MEASURES/ALTERNATIVES

In this section, the EIA preparers must consider and recommend adequate mitigation measures or alternatives to ameliorate or abate all significant environmental impacts identified earlier.

These measures must be considered and either implemented or project re-designed before proponent finally embarks on the particular Project. There could be a possibility of having a “No-Project Option”. Cost benefit analysis must be employed in selecting alternatives.

7.0 ENVIRONMENTAL MONITORING PLAN

The project proponent and the EIA preparers shall establish and provide information on an Action Plan to ensure compliance with the recommended mitigation measures for significant environmental impacts at every phase of project together with the operations auditing plan. Such plan which is to ensure environmental protection shall include the monitoring schedule, the parameters to be monitored in each case. These shall be based on the types and complexity of the mitigation measures.

8.0 REMEDIATION PLANS AFTER PLANT DECOMMISSIONING OR CLOSURE

The Project Proponent or the EIA Preparers shall establish and provide information on a post-project Remediation plan which shall ensure a complete restoration of the Project area back to its original status in the future event of the Industrial Plants closure and decommissioning. The overall positive and negative changes which the project may inflict on the ambient environment before its closure shall be taken into consideration in establishing the Plan.

A CHECKLIST FOR INDUSTIAL IRON AND STEEL PROCESSING PROJECTS

1 INTRODUCTION

- Background to proposed project
- Legal and administrative framework and objectives of the EIA

2 PROJECT JUSTIFICATION

- Need for the project
- Value of the project
- Envisaged sustainability of the project

3 PROJECT DESCRIPTION

- Planning, location
- Raw materials/product input and output
- Technological layout
- Production Process
- Project Operation/Maintenance
- Project Schedule

4 DESCRIPTION OF THE ENVIRONMENT

- Baseline data on Project
- Environmental site selection considerations

In this regard examine

- Whether there are possible alternative sites or locations which could be considered in project siting
- Whether in the alternative project sites or nearby there are:
    - Areas of unique or exceptional quality
    - Human settlements
    - Important ground or surface water resources
    - Tourism attractions/areas
    - Recreational areas
    - Nature conservation areas
    - Schools or hospitals
    - Unique ecosystems or important wildlife habitats or endangered species.
    - Important fishing areas
    - Important agricultural or forestry area
    - Important cultural or historical scientific resources areas
    - Area important for vulnerable human populations (eg. Indigenous cultivating, fishing or pastoralist people and their livestock).

- whether there are already significant environmental problems (eg air pollution, water pollution, noise, erosion, deforestation or social conflicts, etc) in the project zone
- whether there is a history of outbreak of serious communicable diseases in the area
- whether the area can provide sufficient:
    - local work force
    - Raw materials
    - Transportation facilities
    - Energy supply
    - Water supply
    - Capacity of receiving waters to assimilate effluents
    - Sewer services and waste water treatment facilities
    - Waste disposal facilities
    - Community services (medical, schools, transportation, food, sanitation, etc)

- Whether there are applicable local or natural regulations regarding
    - EIA
    - Water pollution control
    - Air pollution control
    - Noise pollution control
    - Soil conservation
    - Solid waste disposal
    - Hazardous waste disposal
    - Spill prevention and control
    - Workers health and safety
    - Storage and handling of hazardous materials

- Whether the project area is covered within any appropriate land use Planning document (eg area master plan)

5. ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACTS:

Impacts on the ecosystem that may result from the Project in all its Phases must be considered. Such include

(a) Impacts from Site Preparation and Construction

Identify and Predict- impacts of relevant site preparation and construction activities and components, such as:

- Land clearing, grading, leveling, surface excavation, cut and fill, terracing, etc
- Surfacing and paving
- Construction of plant buildings
- Construction of transmission lines and pipelines
- Road construction
- Barriers, including fencing
- Blasting and Drilling
- Land reclamation
- Ditching, drainage
- Dredging, port facilities construction
- Quarrying, mining
- Transportation
- Material storage
- Housing and services to the labour force
- Migration
- Resettlement of people

On the following components of the ecosystem

- Hydrology and drainage patterns
- Surface and ground water quality

- Air quality
- Noise and vibration levels
- Land/soil quality
- Wildlife
- Aesthetics
- Fisheries
- Land use, such as agriculture, forestry, tourism, recreation
- Local traffic
- Working opportunities
- Income opportunities
- Settlement plans
- Population structure and dynamics
- Social structures
- Local life style and values
- Occupational and public health
- Archaeological, historical, cultural or scientific values
- Land values
- Social services

(b) Impacts from Project Operation

Identify and Predict- the impacts of following activities/components (relevant to each alternative):

- Raw material exploitation, handling, transportation and storage
- Water supply
- Energy production
- Gaseous emissions (from processes, energy production and traffic)
- Liquid effluents (including excess heat)
- Solid wastes
- Process and traffic noise

- Possible accidents, hazards and process malfunctions
- Handling of hazardous materials
- Maintenance and repair

On for examples:

- Local traffic
- Raw material resources
- Air quality
- Noise levels
- Land/soil quality
- Other land uses, interests and values (as mentioned in section 1 and 2 above)
- Ecology
- Occupational health
- Public health
- Migration patterns
- Settlement patterns
- Population structure and dynamics
- Working opportunities
- Local life style and values
- The role of women
- Social services
- Land values

6. MITIGATION MEASURES

Identify, Plan and recommend adequate mitigation measures of harmful impacts. For example identify alternative design, manufacturing processes, raw material fuels, etc which could be considered, or by considering the possibilities to provide/practice:

- Use of low-waste and low-pollution technology
- Air pollution

- Waste water treatment
- Water recycling and conservation
- Energy conservation
- Noise control measures
- Solid waste management (especially recycling)
- Training and education of (local) workers and general public
- Workers safety measures
- Contingency plans and equipment
- Medical and other social services development
- Safe storage facilities for hazardous materials
- Resettlement plans
- Compensatory measures
- Landscaping

7. ENVIRONMENTAL MONITORING PLAN

Establish an adequate environmental protection and environmental monitoring plan during project's operational phase either pre-commissioning or during plant operations. Include in your plan

- The monitoring schedule
- The parameters to be monitored
- The methods for the monitoring
- The scope of the monitoring

8. REMIDIATION PLANS AFTER DECOMMISSIONING OR CLOSURE OF INDUSTRIAL PLANT

Establish an adequate plan for restoration of the natural environment in the future event of plant's closures or de-commissioning of industry either temporarily or permanently

TABLE 4: IRON AND STEEL MANUFACTURING

Potential Negative Impacts	Mitigating Measures
Direct: Site Selection 1. Siting of plant on/near sensitive habitats such as mangroves estuaries, wetlands, coral reefs.	**1.** i. Locate plant in industrially zoned area, if possible, to minimize or concentrate the stress on local environmental services and to facilitate the monitoring discharges. ii. Involvement of natural resources agencies in site selection process to review alternatives.
2. Siting along water courses causing their eventual degradation.	2. i. Site selection process should examine alternatives that minimize environmental effects and do not preclude beneficial use of water bodies. ii. Plants with liquid discharges should only be located on a water-course having adequate capacity to assimilate waste in treated effluent.
3. Siting can cause serious air pollution problems for local area.	3. i. Locate plant at elevation above local topography, in an area not subject to air inversions, and where prevailing winds are towards relatively unpopulated areas.
4. Siting can aggravate solid waste problems in an area	4.Site selection should evaluate the location according to the following guidelines:

	i. proximity to suitable disposal site ii. plot size sufficient for landfill or disposal on-site iii. convenient for public/private contractors to collect and haul solid wastes for final disposal iv. reuse or recycle materials to reduce waste volumes.
5. Water pollution from discharge of liquid effluents and process cooling water or runoff from waste piles. i. Plants: Total Suspended Solids (TSS), oil and grease, ammonia nitrogen, cyanide, phenols, benzene, naphthalene, benzo-a-pyrene, pH, lead, zinc. ii. Material storage piles runoff: TSS, pH, Metals.	5. Laboratory analysis of liquids effluent should include: TSS, oil and grease, ammonia nitrogen, cyanide, phenols, benzene, naphthalene, benzo-a-pyrene, pH, lead, zinc, and in-situ temperature monitoring. All Plants i. No cooling water discharge. If recycling not feasible, discharge cooling water provided receiving water temperature does not rise >3°c. ii. Maintain pH level of effluent discharge between 6.0 and 9.0. iii. Control effluent to Federal Ministry of Environment specified limitations for specific process or industry. Material Storage Piles/Solid Waste Disposal Areas i. Minimize stormwater allowed to percolate through materials and runoff in uncontrolled fashion.

	ii. Line open storage areas.
6. Particulate emissions to the atmosphere from all plant operations.	6. Control particulates by fabric filter collectors or electrostatic precipitators.
7. Gaseous emissions of SO_x and CO to the atmosphere from Coke production and fuel burning.	7. i. Control by scrubbing action of alkaline resolutions. ii. Analysis of raw materials during feasibility state of project planning can determine existing levels of sulfur to properly design emission control equipment. iii. Strip, recycle and reuse carbon monoxide.
8. Accidental release of potentially hazardous solvents, acidic alkaline materials.	8. i. Maintain storage and disposal areas to prevent accidental release. ii. Provide spill mitigation equipment, double wall tanks and/or diking of storage tanks.
9. Surface runoff of constituents, raw materials, coal, coal breeze and other substances frequently stored in piles on the facility grounds can pollute surface waters or percolate to ground waters.	1. Rainwater percolation and runoff from solid materials, fuel and waste piles can be controlled by covering and/or containment to prevent percolation and runoff ground and surface waters Diked areas should be off sufficient size to contain an average 24 hour rainfall.

Indirect: 2. Occupational health effects on workers due to fugitive dust, material handling, noise or other process operations. Accidents occur higher than normal frequency because of level of skill or labour.	10. Facility should implement a safety and Health Programme designed to : i. identify, evaluate, monitor, and control safety and health hazards ii. provide safety trainings
11. Regional solid waste problem exacerbated by inadequate on-site storage or lack of ultimate disposal facilities.	i. Plan for adequate on-site disposal areas assuming screening for hazardous characteristics of the leachate is known.
ii. Transmit patterns disrupted, noise and congestion created and pedestrian hazard aggravated by heavy trucks transporting raw materials and fuel to/from facility.	12. i. Site selection can mitigate some of these problems, such as pedestrian hazards. ii. Special transportation sector studies should be prepared during project feasibility to select best routes to reduce impacts. iii. Transport regulation and development of emergency contingency plans to minimize risk of accidents.

GUIDELINES FOR

NON-FERROUS METALS SUB-SECTOR

9.6 **NON-FERROUS METALS MANUFACTURING PROJECTS**

1.0 INTRODUCTION

The metals that will be discussed in these Guidelines are aluminium, ferroalloys, copper, lead, zinc and nickel. The scale of production or the production processes of other many more non-ferrous metals involve either production in small quantities or in highly specialized processes, or as by-products of other operations, and hence cause no-significant impacts.

Aluminium

Aluminium is produced from the ore bauxite, a hydrated aluminium oxide. The bauxite ore first has to be purified from other elements by dissolving the alumina with a strong caustic soda solution. The residue is filtered off (red mud) and reworded for alumina. The final residue is discarded. Pure alumina is separated after crystallization, thickening, filtering, and calcining.

The alumina is then electrolytically reduced, alloyed, and cat into ingots.

Secondary aluminium production has aluminium scrap and returned metal as feed. The scrap and recycled aluminium are smelted in a furnace, adding fluxing agents: they are then alloyed, damaged (magnesium removal), and degassed with chlorine and skimmed before casted into ingots.

Ferroalloys

The principal step in ferroalloy production is the reduction and smelting of mixed oxides in an electric furnace. The carbon in coke, which is usually added to the feed, removes the oxygen as carbon monoxide gas. The non-reducible oxides report in the slag and the reducible metals form an alloy .The molten slag and alloy are periodically tapped from the bottom of the furnace. The type of alloy-ferrochrome, ferromanganese, ferronickel, ferrosilicon, ferrovandadium, ferronobium etc depends on the composition of the ore feed to the furnace. The slag and alloy are cooled and separated. The alloy is broken, crushed, and screened to size for market.

The main environmental concerns in ferroalloy production are the carbon monoxide gas and the large quantity of ultra-fine dusts created in the electric furnace. In the past, furnaces were open; however, modern plants now use closed furnaces which improve the efficiency and greatly assists in controlling the gases and fumes produced by high-temperature operations. The gases are cleaned by cyclones, bag houses and scrubbers. The fine dusts are agglomerated and returned to the furnace. The carbon monoxide is used as fuel to preheat the feed or to fire boilers.

Molten slag and, less frequently, the alloy are sometimes granulated in a heat of water. This yield liquid effluent and fine solid slag which must be impounded, as such have some potential for environmental degradation. The furnaces are cooled with water, which produces another effluent stream.

Copper and Nickel Sulphide Smelting

The major portions of the worlds copper and nickel are produced by the pyrometallurgical process of sulphide smelting. The principal step in this process is the melting and gravity separation of the low-density molten oxide slag from the higher density molten matte, which is a mixture of metal sulphides.

A roasting step which is used to adjust the sulphur and iron content of the furnace matte is usually found upstream of this smelting or melting step. In roasting, the feed n heated and reacted with air. The unwanted sulphur departs as sulphur oxide and the iron (which is usually present as a sulphide) as iron oxide which, in smelting will go into the slag. An environmental concern in roasting is the presence, in many ores, of such impurities as arsenic, antimony, and cadmium. Their oxides tend to vaporize and later condense as dust in the off-gas.

Converting of the matte follows smelting. Air, sometimes enriched in oxygen, is blown into the molten matter to remove sulphur and iron. The product is blister copper (an impure metallic copper) or iron-free sulphides, both of which require further processing. Converting is a high-temperature, high gas-volume operation, which tends to eliminate impurities from the matte (eg. oxides of lead, arsenic, and cadmium).

The equipment used in each of the steps described above has lately gone through many changes, motivated either by economics or environmental protection. Their net effects have been to decrease fuel consumption and yield a lower volume of gas with higher sulphur dioxide content. The latter improvement facilitates dust removal and recovery of sulphur as sulphuric or liquid sulphur dioxide.

Lead

Smelting of lead ores and concentrates has typically involved sintering to remove the sulphur, oxidize the lead and agglomerate the fine material, followed by reduction melting in a blast furnace. In recent years, some countries have adopted a direct smelting process in which lead sulphide concentrate is fed to one end of a molten bath, where injected oxygen removes the sulphur, while coal or gaseous reductants are injected at the other end to reduce the lead oxides out of the slag that is formed. Slag is removed at one end and crude metal from the other. The crude lead is then be-electrorefined.

Zinc

Sulphide minerals are the primary sources of zinc. The routes are in use to extract the metal: one is a combination of pyrometallurgy, hydrometallurgy and electrometallurgy; and the other is a straight pyrometallurgical process. Both start by converting the sulphide to an oxide. In the pyrometallurgical process, zinc oxide sinter cake is fed to a blast furnace. The zinc metal vaporizes and is condensed as molten zinc from the off-gases. In the hydrometallurgical step, the zinc oxide is dissolved with sulphuric acid, the solution is purified, and the zinc is recovered by electro winning (a plating process). Jarosite, an iron sulphate, is a solid waste product from the purification step; and the electrowinning operation has a tendency to produce a fine acid mist.

2.0 PROJECT JUSTIFICATION

The project proponent and the EIA preparers for a new non-ferrous metal industry shall provide a justification for the new Industrial project to be established. This would include the need for the project, the value of the project and the envisaged sustainability of the project. Overall, the advantages of establishing the project vis-à-vis the anticipated impacts on the environment must be evaluated.

3.0 PROJECT/PROCESS DESCRIPTION

The project proponent and the EIA preparers shall provide full details of the type of the Industrial Project or process. This should include the project location, the nature, extent and size of the project; the input and output of the raw materials and products, the technological layout or manufacturing design/flow-chart, the production process; the project operation and maintenance; the project schedules etc.

4.0 DESCRIPTION OF THE ENVIRONMENT

The EIA preparers shall undertake adequate scientific studies and/or socio-economic survey of the environment and area of the new Project location and provide a vivid and detailed description of the entire project area and the location of the proposed industrial project/process. The description shall include but not limited to geographical location, climatic conditions and full ecological characteristics of the area/location. The preparers shall supply along with the description, the results of the studies/survey carried out on the soil, ambient or noise levels, aquatic vegetation, fauna, ground water resources and the socio-economic characteristics of the area.

The EIA preparers shall acquire and supply the above base-line data in addition to a description of the land-use, landscape and infrastructural services of the area including any archaeological, historical or cultural values of the area as well as ecologically-sensitive areas.

5.0 ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACT

The principal environmental impacts from the production of aluminium, starting with the processing of the mined ore, are the problems of the disposal of red mud (a mixture of clays and highly corrosive caustic soda), emissions from fuel burning, emissions from the aluminium electrolysis process, and waste liquid and slurry streams. The red mud can degrade receiving waters and ground waters.

Emissions from the electrolysis plant consist of hydroluoride, an extremely corrosive and hazardous gas, and carbon monoxide. Magnesium and gases from the damaging and degassing processes, respectively contain chlorine and must be scrubbed. The scrub liquor must then be neutralized

Ferroalloy production generates large amounts of fine dust and fine coke (coke breeze). The electrofurnaces produce large volumes of toxic gases, including carbon monoxide and some arsenic compounds. If not useable for other purposes the slag has to be disposed of. Off-gases can be cleaned of dust through cyclones and baghouses, or further purified by scrubbing. The recovered dust can be recycled through a pelletizing plant. Scrubbing delivers an effluent which cannot be discharged without treatment.

Nickel Production is Different

The environmental impacts from the production of nickel depends on the process. The direct electrometallurgical production of ferronickel will produce large quantities of particulates and carbon monoxide gas, and small emissions of sulphur containing gases. The pyrometallurgical processes with matte production usually emits gases that are rich in particulates and toxic gases originating from the roasters, smelters and converters as well as from power generation, which is often part of the production facilities. Gases from the plant can contain sulphur dioxide, nitrogen oxides, carbon monoxide, and hydrogen sulphides. Liquid effluents are generated by gas scrubbing and water cooling of converter matte and slag, furnace matte, reduction kilns, etc. Solid waste consist of slag, settled solids from cooling pits, and sludges from waste treatment. If the carbonyl process is applied, nickel-carbonyl, a highly poisonous gas, is formed as an intermediate.

Copper smelting and refining gases contain sulphur dioxide and particulates. The sulphur dioxide should be recovered and processed into sulphuric acid. Liquid effluent originates from acid plant blowdown, contact cooling, and slag granulation. Refining plant effluents contain waste electrolyte and cathode wash, fine slag, and anode mud.

Secondary copper production generate effluent from slag milling, smelter air pollution control, contact cooling, electrolyte and slag granulation. Solid waste is mainly from air scrubbers, cyclones and precipitators, furnace slag, and from secondary copper production as scrap or pre-treatment waste.

Air pollutants from lead processing include particulate matter, sulphur dioxide, arsenic, antimony, and cadmium in the sintering plant. The highly concentrated sulfur dioxide stream from the blast furnace plant should be removed in a sulfuric acid plant. Particulates are high in lead and should be removed in baghouses or scrubbers. Liquid effluents, which may contain toxic metals, originate from the sintering plant scrubbers, acid plant blowdown, and other scrubbers in the plant. Slag granulation is another source of effluents. The effluents contain lead, zinc, copper, and cadmium. Solid wastes originate from cyclones bagfilters etc. and for most part can be reused in the plant.

Secondary lead plants produce effluents containing battery acid from cracked battery washers and from scrubbing equipment for air pollution control. The battery acid is contaminated with lead, antimony, cadmium, arsenic, and zinc, and should be kept separate from other wastes and not discharged.

Zinc Production Processes Too Cause Significant Environment Impact If Uncontrolled

Emissions in the pyrometallurgical zinc process contain sulfur dioxide, arsenic, lead, and cadmium. The sulfur dioxide is recovered for sulfuric acid production. Carbon monoxide is an important component from the reduction furnace off-gases. Uncondensed zinc fumes are scrubbed and returned to the refining process. The electrometallurgical zinc process has the same type of air emissions, with the occasional addition of mercury (removed in a scrubber). Effluents from scrubbers, acid plant blowdown and from leaching units may contain the same elements as the air emissions.

OTHER ENVIRONMENTAL IMPACT ISSUES

Air Emissions

The production of aluminium from alumina by electrolysis causes air emissions of fluorine which contain gases that can be very harmful for the environment and for human health. These emissions require careful monitoring. These gases are normally dry scrubbed with alumina powder which eliminates most of the fluorine. The remainder has to be removed by wet alkaline scrubbing.

Substantial particulate emissions can occur in the production of ferrochrome and ferromanganese. These can be minimised in the design phase by choice of furnace (open, semi-open, or closed) and the inclusion of pelletizing unit to return fines to the process.

In the plants, sulfur dioxide gas from roasting of sulphide ores is recovered, cleaned and used as feedstock for producing sulfuric acid. The gas cleaning produces effluents with arsenic, selenium, and other toxic metal salts which cannot be discharged into natural water streams, but have to be treated to remove these elements.

Effluents

In general, water effluents need not be a special issue if properly managed and monitored. All particulates should be settled and removed as far as possible, water should be recirculated in the process, if necessary after treatment. No discharge of water containing metal ions (metal salts) from the copper, chromium, manganese, nickel, zinc and lead processes should be allowed in concentrations over those indicated in the FMEnv National Guidelines.

Solid Wastes

Solid wastes contain significant quantities of other metals and are normally sold to other processors. Cadmium however, is an exception, its recovery is nearly always practiced at the zinc production site. For more information on the environmental impacts from nonferrous metal production, see attached Table at the end of this section.

6.0 MITIGATION MEASURES/ALTERNATIVES

In this section, the EIA preparers must consider and recommend adequate mitigation measures or alternatives to ameliorate or abate all significant environmental impacts identified earlier.

These measures must be considered and either implemented or project re-designed before proponent finally embarks on the particular Project. There could be a possibility of having a "No-Project Options". Cost benefit analysis must be employed in selecting alternatives.

7.0 ENVIRONMENTAL MONITORING PLAN

The project proponent and the EIA preparers shall establish and provide information on an Action Plan to ensure compliance with the recommended mitigation measures for significant environmental impacts at every phase of project together with the operations auditing plan. Such plan which is to ensure environmental protection shall include the monitoring schedule, the parameters to be monitored in each case. These shall be based on the types and complexity of the mitigation measures.

8.0 REMEDIATION PLANS AFTER PLANT DECOMMISSIONING OR CLOSURE

The Project Proponent or the EIA Preparers shall establish and provide information on a post-project Remediation plan which shall ensure a complete restoration of the Project area back to its original status in the future event of the Industrial Plants closure and decommissioning. The overall positive and negative changes which the project may inflict on the ambient environment before its closure shall be taken into consideration in establishing the Plan.

A CHECKLIST FOR NON-FERROUS METAL MANUFACTURING PROJECTS.

1. **INTRODUCTION**

- Background to proposed project
- Legal and administrative framework and objectives of the EIA

5. **PROJECT JUSTIFICATION**

- Need for the project
- Value of the project
- Envisaged sustainability of the project

6. **PROJECT DESCRIPTION**

- Planning, location
- Raw materials/product input and output
- Technological layout
- Production Process
- Project Operation/Maintenance
- Project Schedule

7. **DESCRIPTION OF THE ENVIRONMENT**

- Baseline data on Project
- Environmental site selection considerations

In this regard examine

- Whether there are possible alternative sites or locations which could be considered in project siting

- Whether in the alternative project sites or nearby there are:

- Areas of unique or exceptional quality
- Human settlements
- Important ground or surface water resources
- Tourism attractions/areas
- Recreational areas
- Nature conservation areas
- Schools or hospitals
- Unique ecosystems or important wildlife habitats or endangered species.
- Important fishing areas
- Important agricultural or forestry area
- Important cultural or historical scientific resources areas
- Area important for vulnerable human populations (eg. Indigenous cultivating, fishing or pastoralist people and their livestock).

- whether there are already significant environmental problems (eg air pollution, water pollution, noise, erosion, deforestation or social conflicts, etc) in the project zone
- whether there is a history of outbreak of serious communicable diseases in the area
- whether the area can provide sufficient:
    - local work force
    - Raw materials
    - Transportation facilities
    - Energy supply
    - Water supply
    - Capacity of receiving waters to assimilate effluents
    - Sewer services and waste water treatment facilities
    - Waste disposal facilities
    - Community services (medical, schools, transportation, food, sanitation, etc)

- Whether there are applicable local or natural regulations regarding

- EIA
- Water pollution control
- Air pollution control
- Noise pollution control
- Soil conservation
- Solid waste disposal
- Hazardous waste disposal
- Spill prevention and control
- Workers health and safety
- Storage and handling of hazardous materials

- Whether the project area is covered within any appropriate land use Planning document (eg area master plan)

5. ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACTS:

Impacts on the ecosystem that may result from the Project in all its Phases must be considered. Such include

(a) Impacts from Site Preparation and Construction

Identify and Predict- impacts of relevant site preparation and construction activities and components, such as:

- Land clearing, grading, leveling, surface excavation, cut and fill, terracing, etc
- Surfacing and paving
- Construction of plant buildings
- Construction of transmission lines and pipelines
- Road construction
- Barriers, including fencing

- Blasting and Drilling
- Land reclamation
- Ditching, drainage
- Dredging, port facilities construction
- Quarrying, mining
- Transportation
- Material storage
- Housing and services to the labour force
- Migration
- Resettlement of people

On the following components of the ecosystem

- Hydrology and drainage patterns
- Surface and ground water quality
- Air quality
- Noise and vibration levels
- Land/soil quality
- Wildlife
- Aesthetics
- Fisheries
- Land use, such as agriculture, forestry, tourism, recreation
- Local traffic
- Working opportunities
- Income opportunities
- Settlement plans
- Population structure and dynamics
- Social structures
- Local life style and values
- Occupational and public health
- Archaeological, historical, cultural or scientific values

- Land values
- Social services

(b) Impacts from Project Operation

Identify and Predict- the impacts of following activities/components (relevant to each alternative):

- Raw material exploitation, handling, transportation and storage
- Water supply
- Energy production
- Gaseous emissions (from processes, energy production and traffic)
- Liquid effluents (including excess heat)
- Solid wastes
- Process and traffic noise
- Possible accidents, hazards and process malfunctions
- Handling of hazardous materials
- Maintenance and repair

On for examples:

- Local traffic
- Raw material resources
- Air quality
- Noise levels
- Land/soil quality
- Other land uses, interests and values (as mentioned in section 1 and 2 above)
- Ecology
- Occupational health
- Public health
- Migration patterns
- Settlement patterns

- Population structure and dynamics
- Working opportunities
- Local life style and values
- The role of women
- Social services
- Land values

6. MITIGATION MEASURES

Identify, Plan and recommend adequate mitigation measures of harmful impacts. For example identify alternative design, manufacturing processes, raw material fuels, etc which could be considered, or by considering the possibilities to provide/practice:

- Use of low-waste and low-pollution technology
- Air pollution
- Waste water treatment
- Water recycling and conservation
- Energy conservation
- Noise control measures
- Solid waste management (especially recycling)
- Training and education of (local) workers and general public
- Workers safety measures
- Contingency plans and equipment
- Medical and other social services development
- Safe storage facilities for hazardous materials
- Resettlement plans
- Compensatory measures
- Landscaping

7. **ENVIRONMENTAL MONITORING PLAN**

Establish an adequate environmental protection and environmental monitoring plan during project's operational phase either pre-commissioning or during plant operations. Include in your plan

- The monitoring schedule
- The parameters to be monitored
- The methods for the monitoring
- The scope of the monitoring

8. **REMIDIATION PLANS AFTER DECOMMISSIONING OR CLOSURE OF INDUSTRIAL PLANT**

Establish an adequate plan for restoration of the natural environment in the future event of plant's closures or de-commissioning of industry either temporarily or permanently.

Table 5: NONFERROUS METALS PROCESSING SUBSECTOR

Potential Negative Impacts	Mitigating Measures
Direct: Site Selection 1. Siting of plant on/near sensitive habitats such as mangroves estuaries, wetlands, coral reefs.	**1.** i. Locate plant in industrially zoned area, if possible, to minimize or concentrate the stress on local environmental services and to facilitate the monitoring discharges. ii. Involve natural resources agencies in site selection process to review alternatives.
2. Siting along water courses causing their eventual degradation.	2. i. Site selection process should examine alternatives that minimize environmental effects and do not preclude beneficial use of water bodies. ii. Plants with liquid discharges should only be located on a water-course having adequate capacity to assimilate waste in treated effluent.
3. Siting can cause serious air pollution problems for local area.	3 Locate plant at elevation above local topography, in an area not subject to air inversions, and where prevailing winds are

	towards relatively unpopulated areas.
4 Siting can aggravate solid waste problems in an area	4. Site selection should evaluate the location according to the following guidelines: i. proximity to suitable disposal site ii. plot size sufficient for landfill or disposal on-site iii. convenient for public/private contractors to collect and haul solid wastes for final disposal iv. reuse or recycle materials to reduce waste volumes.
5 Water pollution from discharge of liquid effluents and process cooling water or runoff from waste piles. • Plants: metals, oil and grease, ammonia, nitrogen • Material storage piles runoff: TSS, pH, metals.	5. Laboratory analysis of liquids effluent should include: TSS, oil and grease, ammonia, nitrogen, pH, and in-situ temperature monitoring. <u>All Plants</u> i. No cooling water discharge. If recycling not feasible, discharge cooling water provided receiving water temperature does not rise >3^{o}c. ii. Maintain pH level of effluent discharge between 6.0 and 9.0. iii. Control effluent to Federal Ministry of Environment guidelines for specific process or industry.
6 Particulate emissions to the atmosphere from all plant	6. Control particulates by fabric filter collectors or electrostatic

operations.	precipitators.
7 Gaseous emissions to the atmosphere from metal processing and fuel burning.	7 i. Control by scrubbing with alkaline solutions. ii. Analysis of raw materials during feasibility stage of project planning can determine existing levels of sulfur to properly design emission control equipment.
8 Accidental release of potentially hazardous solvents, acidic and alkaline materials.	8. i. Maintain storage and disposal areas to prevent accidental release. ii. Provide spill mitigation equipment, double wall tanks and/or diking of storage tanks.
9 Surface runoff of constituents, raw materials, and other substances frequently stored in piles on the facility grounds can pollute surface waters or percolate to ground waters.	1. i. Rainwater percolation and runoff from solid materials, fuel and waste piles can be controlled by covering and/or containment to prevent percolation and runoff to ground and surface waters. ii. Diked areas should be of sufficient size to contain an average 24 hour rainfall.
10 Occupational health effects on workers due to fugitive dust,	2. Facility should implement a safety and Health Programme

material handling, noise or other process operations. • Accidents occur higher than normal frequency because of level of skill or labour.	designed to: i. identify, evaluate, monitor, and control safety and health hazards ii. provide safety trainings
11 Regional solid waste problem exacerbated by inadequate on-site storage or lack of ultimate disposal facilities.	3. Plan for adequate on-site disposal areas assuming screening for hazardous characteristics of the leachate is known.
12 Transmit patterns disrupted, noise congestions created and pedestrian hazards aggravated by heavy trucks transporting raw materials and fuel to/from facility.	4. i. Site selection can mitigate some of these problems, such as pedestrian hazards. ii. Special transportation sector studies should be prepared during project feasibility to select best routes to reduce impacts. iii. Transport regulation and development of emergency contingency plans to minimize risk of accidents.
13 Mining of ore and coal locally for metals manufacturing can create conflicts with other industries (coal for utilities), and aggravate erosion/sedimentation of water courses by uncontrolled or unrestricted operations.	13 i. Plan for coal resource usage to fit availability and impose restrictions on manner of mining. ii. Coordination with responsible agency-in-charge to examine site reclamation options once facility is decommissioned.

14 Metals processing may require significant amounts of electricity which may result in conflicts with other industrial users. • Accidents occur at higher than normal frequency because of level of skill or labour.	14 i. Operate metal processing operations at hours when other power consuming industries are not operating. ii. Increase electrical power generation capabilities.

GUIDELINES

FOR

FERTILIZER INDUSTRY SUB-SECTOR

9.7 FERTILIZER INDUSTRY SUB-SECTOR

1.0 INTRODUCTION

Most fertilizer manufacturing projects involve the production of chemical compounds that are used to supply crops and plants with nitrogen, phosphorus and potassium in different combinations according to specific needs. The raw materials used, as well as the volume and types of waste produced, depends on the required concentration of the final compound. Production of waste water is a major problem for all three processes. This may be acidic or alkaline, depending on the type of manufacturing process, and may contain a range of substances toxic to aquatic organisms in higher concentrations. Total suspended solids, nitrate and organic nitrogen. Phosphorus and potassium frequently occur in effluents, resulting in elevated BOD. Runoff from storage heaps during storms can also contribute to BOD. Excessive or improper use of the fulfilled granulated materials on farmland can also contribute to eutrophication of surface waters and nitrogen contamination of ground water resources.

2.0 PROJECT JUSTIFICATION

The new fertilizer industry project proponent and the EIA preparers shall provide a justification for the new industrial project to be established. This would include the need for the project, the value of the project and the establishing the project vis-à-vis the anticipated impacts on the environment must be evaluated.

3.0 PROJECT/PROCESS DESCRIPTION

The project proponent and the EIA preparers shall provide full details of the type of the industrial project or process. This should include the project location, the nature, extent and size of the project; the input and output of the raw material and products, the technological layout or manufacturing design/flow-chart; he production process; the project operation and maintenance procedures; the project schedules etc.

4.0 DESCRIPTION OF THE ENVIRONMENT

The EIA preparers shall undertake adequate scientific studies and/or socio-economic surveys of the environment of the fertilizer plant Location and provide a vivid and detailed description of the entire area and the location of the proposed industrial project/process. The description shall include but not limited to geographical location, climatic conditions and full ecological characteristics of the area/location. The preparers shall supply along with the description, the results of the studies/survey carried out on the soil, ambient or noise levels, aquatic, vegetation, fauna, ground water resources and the socio-economic characteristics of the area.

The EIA preparers shall acquire and supply the above base-line data in addition to a description of the land-use, landscape and infrastructural services of the area including any archaeological, historical or cultural values of the area as well as ecologically-sensitive areas.

5.0 ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACT

This fertilizer industry's positive socio-economic impacts in Nigeria's economy are obvious: fertilizer is critical to achieving the level of agricultural production needed to feed the nation's rapidly growing population. There are also indirect positive impacts of proper fertilizer use on the natural environment; for example, chemical fertilizer enables production to be intensified on existing cropland, while reducing the need for expansion onto lands that may have other natural or social resource values.

However, negative environmental impacts from fertilizer production can be severe. Wastewaters are the major problem. They may be highly acidic or alkaline and, depending on the type of plant, may contain a number of substances toxic to aquatic organisms in higher concentrations: ammonia or ammonium compounds. Urea from nitrogen plants, cadmium arsenic, and fluorine from phosphate rock. Total suspended solids, nitrate and organic nitrogen, phosphorus, [potassium and (as a consequence), elevated biochemical oxygen demand (BOD) are also common in effluents; and, with the exception of BOD, in storm water runoff from raw material and waste storage areas.

Phosphate plants can be designed to have no wastewater discharge except for evaporation pond overflow during conditions of high rainfall, but this is not always practical.

Finished fertilizer products are also potential water pollutants; excessive or improper we may contribute to eutrophication of surface waters and nitrogen contamination of ground water. Phosphate mining can cause negative impacts on water quality as well. These should be considered in predicting the potential impacts of projects that will lead to new or expanded mining operations, whether or not the plant is sited near the mine (see the Guidelines on "Mining and Mineral Processing").

Air pollutants include particulate matter from boiler flues and phosphate rock grinding, fluorine (the principal air pollutant from phosphate plants), acid mist, ammonia, and oxides of sulphur and nitrogen. Solid wastes are principally from phosphate plants and consist primarily of ash (if coal is used to produce steam for the processes), and Gypsum (which may be considered hazardous because of the presence of cadmium, uranium, radon gas emissions or other toxic elements in the phosphate rock).

Sulfuric acid and nitric acid manufacturing and handling constitute significant occupational safety and health hazards. Accidents resulting in ammonia releases can endanger not only plant workers, but also people who reside or work nearby. Other possible accidents are explosions and injuries to the eyes, nose, throat and lungs.

A number of these impacts can be avoided altogether or mitigated more successfully and at less cost by prudent plants site selection. Hence careful consideration must be given to the selection of the Plant Location apart from other mitigation measures that must be recommended by the EIA preparers.

OTHER ENVIRONMENTAL IMPACT ISSUES

Solid Wastes

Solid wastes produced during fertilizer manufacturing are complex and cannot be indiscriminately disposed of on land. Potentially hazardous materials include vanadium catalysts from sulphuric acid plants, and arsenic sludges from any sulphuric use acid plants that us e pyrites, and require special handling and disposal. Gypsum may be difficult to dispose of especially if contaminated with toxic metals. Ash from ammonia plants based on coal gasification may also be as disposal problem. Sufficient land area should be available to allow proper placement of solid wastes exist and should be evaluated for each project. Ultimate solid waste disposal measures should be identified in the project plan and thoroughly evaluated during project feasibility studies.

Ammonia

The production, use, and storage of ammonia will require sound design, good maintenance and monitoring to minimize the risk of accidental releases and explosions. A contingency plan to protect plant staff and neighbouring communities is imperative.

Waste Minimization

Significant quantities of water are used in the fertilizer industry for processes, cooling, and for operation of pollution abatement equipment. Liquid wastes originate in the processes, cooling tower and boiler blowdown, resulting in spills, leaks, and runoff. However, there are opportunities to reuse water within plants, thereby diminishing the quantities that have to be impounded or traded and reducing the plant's demand on local water sources. For example, wastewater from phosphoric acid production can be reused as process water in the same plant. Other wastewater can be used in condensers, gas scrubber, and cooling systems.

Gypsum from phosphate fertilizer plants can be reused in cement manufacturing and production of building block and gypsum board. Gypsum has also been used as cover material in sanitary landfills. If the gypsum get contaminated with toxic metals or radioactive materials, it will require special handling.

Hydrofluosilicic acid can be used by National Water Corporation/Boards for the fluoridation and generation of portable water as it is a waste product of phosphate fertilizer production, and it is substantially less costly than sodium fluoride. Export of the acid is generally not economically attractive, nevertheless, there may be circumstances in which it could be reused in a developing country, especially after converting it to sodium salt. The acid can also be used for the production of aluminium fluoride.

Project Alternatives Issues to be considered

Site Selection

The nature of fertilizer production is such that impacts on water quality and impacts of raw material extraction, and transportation of bulk materials to and from the plant warrant special attention in evaluating alternative sites. Receiving waters with substandard quality or insufficient flow to accept even well-treated effluents are inappropriate. If the demand for raw materials for a phosphate plant will necessitate opening additional quarry sites, they should identified (if known) and their environmental impacts considered as part of the project's EIA. All possible sites should be reviewed and considered for the optional location with minimum environmental impact.

Manufacturing Process

Although a variety of alternatives exist in project planning and execution, the type of fertilizer manufacturing process is generally constrained by the raw materials available and the demand for particular finished products. In the selection of the phosphoric acid process, the quality of the gypsum by-product should be a parameter: a hemihydrate process could produce a gypsum that is directly usable as an additive in cement manufacture.

Iron and steel coking plant are an alternative but limited source of ammonium sulphate fertilizer (produced from ammonia and sulphuric acid); ammonium sulphate is a by-product of coke production and also of caprolactum (nylon) production. Natural gas, oil, naphtha and coal are alternative raw materials for ammonia production.

Natural gas, oil and coal are alternative fuels for generating steam at fertilizer plant.

6.0 MITIGATION MEASURABLE/ALTERNATIVES

In this section, the EIA preparers must consider and recommend adequate mitigation measures or alternatives to ameliorate or abate all significant environmental impacts identified earlier.

These measures must be considered and either implemented or project re-designed before proponent finally embarks on the particular Project. There are could be a possibility of having "No-Project Option" Cost-benefit analysis must be employed in selecting alternatives.

7.0 ENVIRONMENTAL MONITORING PLAN

The project proponent and the EIA Prepares shall establish and provide information on an Action plan to ensure compliance with the recommended mitigation measures for significant environmental impacts at every phase of project together with the operations auditing plan. Such plan which is to ensure environmental protections shall include the monitoring schedule, the parameters to be monitored in each case. These shall be based on the types and complexity of the mitigation measures.

8.0 REMEDIATION PLANS AFTER PLANT DECOMMISSIONING OR CLOSURE

The Project Proponent or the EIA Preparers shall establish and provide information on a postponed Remediation Plan which shall ensure a complete restoration of the project area back to its original status in the future event of the industrial plant's closure and decommissioning. The overall positive and negative changes which the project may inflict on the ambient environment before its closure shall be taken into consideration in establishing the plan.

A CHECKLIST FOR FERTILIZER INDUSTRY PROJECTS

1 INTRODUCTION

- Background to proposed project
- Legal and administrative framework and objectives of the EIA

2 PROJECT JUSTIFICATION

- Need for the project
- Value of the project
- Envisaged sustainability of the project

3 PROJECT DESCRIPTION

- Planning, location
- Raw materials/product input and output
- Technological layout
- Production Process
- Project Operation/Maintenance
- Project Schedule

4 DESCRIPTION OF THE ENVIRONMENT

- Baseline data on Project
- Environmental site selection considerations

In this regard examine

- Whether there are possible alternative sites or locations which could be considered in project siting

- Whether in the alternative project sites or nearby there are:

    - Areas of unique or exceptional quality
    - Human settlements
    - Important ground or surface water resources
    - Tourism attractions/areas
    - Recreational areas
    - Nature conservation areas
    - Schools or hospitals
    - Unique ecosystems or important wildlife habitats or endangered species.
    - Important fishing areas
    - Important agricultural or forestry area
    - Important cultural or historical scientific resources areas
    - Area important for vulnerable human populations (eg. Indigenous cultivating, fishing or pastoralist people and their livestock).

- whether there are already significant environmental problems (eg air pollution, water pollution, noise, erosion, deforestation or social conflicts, etc) in the project zone
- whether there is a history of outbreak of serious communicable diseases in the area
- whether the area can provide sufficient:
    - local work force
    - Raw materials
    - Transportation facilities
    - Energy supply
    - Water supply
    - Capacity of receiving waters to assimilate effluents
    - Sewer services and waste water treatment facilities
    - Waste disposal facilities
    - Community services (medical, schools, transportation, food, sanitation, etc)

- Whether there are applicable local or natural regulations regarding
    - EIA
    - Water pollution control
    - Air pollution control
    - Noise pollution control
    - Soil conservation
    - Solid waste disposal
    - Hazardous waste disposal
    - Spill prevention and control
    - Workers health and safety
    - Storage and handling of hazardous materials

- Whether the project area is covered within any appropriate land use Planning document (eg area master plan)

5. ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACTS:

Impacts on the ecosystem that may result from the Project in all its Phases must be considered. Such include

(a) Impacts from Site Preparation and Construction

Identify and Predict- impacts of relevant site preparation and construction activities and components, such as:

- Land clearing, grading, leveling, surface excavation, cut and fill, terracing, etc
- Surfacing and paving
- Construction of plant buildings
- Construction of transmission lines and pipelines
- Road construction
- Barriers, including fencing
- Blasting and Drilling
- Land reclamation
- Ditching, drainage
- Dredging, port facilities construction
- Quarrying, mining
- Transportation
- Material storage
- Housing and services to the labour force
- Migration
- Resettlement of people

On the following components of the ecosystem

- Hydrology and drainage patterns
- Surface and ground water quality

- Air quality
- Noise and vibration levels
- Land/soil quality
- Wildlife
- Aesthetics
- Fisheries
- Land use, such as agriculture, forestry, tourism, recreation
- Local traffic
- Working opportunities
- Income opportunities
- Settlement plans
- Population structure and dynamics
- Social structures
- Local life style and values
- Occupational and public health
- Archaeological, historical, cultural or scientific values
- Land values
- Social services

(b) Impacts from Project Operation

Identify and Predict- the impacts of following activities/components (relevant to each alternative):

- Raw material exploitation, handling, transportation and storage
- Water supply
- Energy production
- Gaseous emissions (from processes, energy production and traffic)
- Liquid effluents (including excess heat)
- Solid wastes
- Process and traffic noise

- Possible accidents, hazards and process malfunctions
- Handling of hazardous materials
- Maintenance and repair

On for examples:

- Local traffic
- Raw material resources
- Air quality
- Noise levels
- Land/soil quality
- Other land uses, interests and values (as mentioned in section 1 and 2 above)
- Ecology
- Occupational health
- Public health
- Migration patterns
- Settlement patterns
- Population structure and dynamics
- Working opportunities
- Local life style and values
- The role of women
- Social services
- Land values

6. MITIGATION MEASURES

Identify, Plan and recommend adequate mitigation measures of harmful impacts. For example identify alternative design, manufacturing processes, raw material fuels, etc which could be considered, or by considering the possibilities to provide/practice:

- Use of low-waste and low-pollution technology
- Air pollution

- Waste water treatment
- Water recycling and conservation
- Energy conservation
- Noise control measures
- Solid waste management (especially recycling)
- Training and education of (local) workers and general public
- Workers safety measures
- Contingency plans and equipment
- Medical and other social services development
- Safe storage facilities for hazardous materials
- Resettlement plans
- Compensatory measures
- Landscaping

7. **ENVIRONMENTAL MONITORING PLAN**

Establish an adequate environmental protection and environmental monitoring plan during project's operational phase either pre-commissioning or during plant operations. Include in your plan

- The monitoring schedule
- The parameters to be monitored
- The methods for the monitoring
- The scope of the monitoring

8. **REMIDIATION PLANS AFTER DECOMMISSIONING OR CLOSURE OF INDUSTRIAL PLANT**

Establish an adequate plan for restoration of the natural environment in the future event of plant's closures or de-commissioning of industry either temporarily or permanently.

TABLE 6: FERTILIZER MANUFACTURING SUBSECTOR

Potential Negative Impacts	Mitigating Measures
Direct:Site Selection 1. Siting of plant on/near sensitive habitats such as mangroves, estuaries, wetlands, coral reefs or use of prime agricultural lands.	1. Locate plant to minimize or concentrate the stress on local environmental services and facilitate the monitoring or discharges. ii. Integrate site selection process with natural resource agencies to review alternatives.
2. Siting along water courses causing their eventual degradation.	2. Site selection process should examine alternatives that minimize environmental effects and not preclude beneficial use of the water body. ii. Plants with liquid discharges should only be located on a water course having adequate waste-absorbing capacity. iii. Within a municipality that is able to accept the plant wastes in their sewage treatment system.
3. Siting can cause serious odour pollution problems for local area.	3. Locate at high elevation in an area not subject to air inventions, and where prevailing winds are towards relatively unpopulated areas.

4. Siting can aggravate solid waste problems in an area.	4. Site-selection should evaluate the location according to the following guidelines: i. Plot size sufficient to landfill or on-site disposal ii. Proximity to a suitable disposal site iii. Convenient for public/private contractors to collect and haul solid wastes for final disposal. iv. Availability of options for gypsum disposal or reuse.

5. Water pollution from discharge of liquid effluents, and process cooling water or runoff from waste piles. ii. Phosphate plants: phosphate, fluoride, BOD, Total Dissolved Solids (TDS), pH. iii. Nitrogen plants: ammonia, urea, ammonium nitrate COD, pH. iv. Materials storage runoff: TSS, pH metals.	5. Laboratory analysis of liquid effluent should include fluoride, BOD TSS and in-situ pH temperature monitoring. **All Plants** i. No cooling water discharge if recycling not feasible. Discharge cooling water provided receiving water temperature does not rise >3°C.

	ii. Maintain pH level of effluent discharge between 6.0 and 9.0. iii. Control effluent of limitations for specific process and/or industry. **<u>Material Storage Piles/Solid Waste Disposal Areas</u>** i. Minimize rainfall allowed to percolate through piles and runoff in uncontrolled fashion. ii. Line storage areas.
6. Particulate emissions to the temperature to the atmosphere from all plant operations.	6. Control particulates by fabric filter collectors or electrostatic precipitators
7. Gaseous emissions of SOx and NOx ammonia, acid mist and fluorine compounds to the atmosphere.	7. i. Control by scrubbing ii. Analysis of raw materials during feasiblilty state of project. iii. Analyze raw materials during feasibility stage of project. iv. Proper design of sulfuric acid Plants and nitric aciod plants with NOx abatement equipment.
8. Accidental release of potential hazardous solvents, acidic/alkaline materials.	8. i. Maintain storage and disposal areas to porevent accidental release.

9. Surface runoff of constituents, raw materials and solid waste frequently stored in plies on the facility grounds can pollute surface waters or percolate to ground water.	9. i. Plant proper storage in design phase ii. Cover and/or line storage areas (especially gysum piles) to prevent percolation and runoff to ground and surface water. iii. Diked areas should be of sufficient size to contain an average 24 hour rainfall.
10. Occupational health effects on workers due to fugitive dust, materials handling or other process operations, and accidents occur at higher than normal frequency because of level of skill or labour.	10. Facility should implement a safety and health program designed to: i. identify, evaluate, monitor and control safety and health hazards at a specific level of detail. ii. address the hazards to worker health and safety iii. propose procedures for employee protection iv. provide safety training.
11. Regional solid waste problem exacerbated by inadequate on-site storage or lack of ultimate disposal facilities.	11. Plan for adequate on-site disposal, assuming screening for hazardous characteristics of the leachate is known
	ii. Provide spill mitigation equipment iii. Provide dikes around storage tanks.

12. Transit patterns disrupted, noise and congestion created and pedestrian hazards aggravated by heavy trucks transporting raw materials to/from facility.	12. i. Site selection can mitigate some of these problems. ii. Special transportation sector studies should be prepared during project feasibility to select best routes to reduce impacts. iii. Transporter regulation and development of emergency contingency plans to minimize risk of accidents.
13. Increasing nitrate pollution of ground water from use of nitrogen fertilizers	13. Direction for use should be provided to minimize nitrate pollution potential.
14. Eutrophication of natural water system.	14. Direction for use should be provided to minimize nitrate and phosphate pollution potential.

9.8 GENERAL EIA REPORT WRITING FORMAT

Below is a guide on the presentation of the contents of Report of EIA

1. Table of contents
2. Lists of maps
3. List of tables etc
4. List of acronyms
5. Acknowledgment
6. Introduction
   - Background information
   - Legal Framework for the EIA process
   - Terms of Reference/Objectives of EIA

7. Project justification
   - Need for the project
   - Value of the project
   - Envisage sustainability

8. Project and/ or process description
   - Type (eg. Food processing)
   - Input and output of raw materials and products
   - Location
   - Technological layout
   - Production Process
   - Project operation and maintenance
   - Project schedule

9. Description of the environment (including baseline data acquisition) study approach
   - Baseline data acquisition methods
   - Geographical location
   - Field data

- Climatic conditions
- Air quality assessment
- Noise level assessment
- Vegetation cover characteristics
- Potential land use and landscape patterns
- Ecological sensitive wildlife
- Terrestrial fauna and wildlife
- Soil studies
- Aquatic studies
- Groundwater resources
- Socio-economic studies
- Infrastructural services

10. Associated and potential environmental impacts
    - Impact prediction methodology
    - Significant negative impacts
    - Significant positive impacts
    - Site preparation and construction impacts
    - Transportation impacts
    - Raw-materials impacts
    - Process impacts
    - Project specific incremental environmental changes (if any)
    - Project specific cumulative effects
    - Project specific long/short term effects
    - Project specific reversible/irreversible effects
    - Project direct/indirect effects
    - Project specific adverse/beneficial effect
    - Project specific risk and hazard assessment (if any)

11. Mitigation measures/alternatives
    - Best available control technology
    - Liability compensation
    - Site alternatives, location/routes
    - No project option
    - (Insert a table listing impacts with corresponding mitigation measures)

12. Environmental monitoring plan
    - Monitoring schedule
    - Parameters to be monitored
    - Scope of monitoring

13. Remediation plans after de-commissioning/closure
14. Conclusions and recommendations
15. EIA Preparers
16. Bibliography
17. Appendices.

ACKNOWLEDGEMENT

The Federal Ministry of Environment wishes to give a special thanks to the National Technical Committee for the implementation of Environmental Impact Assessment (EIA) in Nigeria for its commitment to sustainable development through the preparation for EIA in Nigeria.

Although consideration of the peculiar Nigeria Environment guided the preparation of the guidelines, the general approach is based on an amalgamation of the world Bank, Commonwealth, African Development Bank, and finnish Development Agency.

Contributions of the staff of the EIA Secretariat of Federal Ministry of Environment, local and international consultants, particularly, Mr Thumbail R,G. H. (UNEP Consultant) are greatly acknowledged.

The National EIA Workshop held in 1995 at the Lagos Sheraton Hotel and Towers, Ikeja, Lagos, culminated in the preparation of the EIA Procedural and Sectoral Guidelines. The Federal Ministry of Environmental expresses gratitude to Government and Environmental Agencies, the Organized Private Sector, Non Government Organizations (NGO'S) and individuals for their contributions at this workshop.