Pakistan Environment Protection Agency
October 1997

Sectoral guidelines for environmental reports— Major chemical and manufacturing plants

Contents

SECTORAL GUIDELINES FOR ENVIRONMENTAL REPORTS
MAJOR CHEMICAL AND MANUFACTURING PLANTS

1. INTRODUCTION

1.1 Scope of Guidelines

This guideline deals with major chemical and manufacturing plants. These plants may involve the production or storage of chemical substances (including reactive, toxic of flammable liquids, vapors, gases and solids) and may include the following operations:

a) facilities with major distillation, filtration and dewatering processes
b) drying, crushing, formulation, blending and packaging facilities
c) storage facilities for raw materials, products and by-products, bulk storage facilities, stockpiles and dumps
d) recycling facilities, and
e) other manufacturing plants.

Some of the industries to which these guidelines apply include:

- ***Petrochemicals Industry:*** These chemicals are based on petroleum, natural gas, or coal as raw material. The raw materials include; ethylene, methanol, ethanol, acetic acid, acetone, adipic acid, aniline, benzene, caprolactam, compounds from chlorine and fluorine with aliphatic or aromatic chemicals, dinitro- and trinitro-toluene, formaldehyde, and alcohols. Solid products include; synthetic resins, plastics and elastomers , rubber, melamine, nylon, polyester, polyolefins and polyvinylchlorides. Other products like cellulose and sugar based chemicals can also be accommodated in this group.

- ***Inorganic chemicals Industry:*** This may include the manufacture of chlorine/alkali, calcium carbide, inorganic acids, salts, phosphor compounds, hydrogen peroxide, inorganic pigments such as titanium dioxide, and metal salts. Inorganic chemicals such as ammonia, nitric acid, urea, phosphoric acid, etc., are discussed in the section on fertilizer manufacturing.

- ***Pharmaceuticals and Fine Chemicals Industry:*** These chemicals are manufactured from petrochemicals, natural products, or inorganic chemicals. The products include; pharmaceuticals, synthetic fragrance and flavor compounds.

- ***General Manufacturing Industry:*** This may include sugar mills, refineries, smelters, materials processing plants, and others.

The guidelines will assist proponents to identify the key environmental issues that need do be assessed as well as mitigation measures and alternatives that should be considered. Readers are advised not to apply a mechanistic approach based on these guidelines. No technique can replace the thoughtful consideration of the

proposal, its siting and the physical and cultural environment in which it is proposed.

The environmental issues discussed in these guidelines are not exhaustive and the degree of relevance of each will vary from proposal to proposal. The specific chemical or manufacturing sector environmental report should only deal with issues relevant to the particular proposal. The focus of the environmental report should be on key environmental issues.

1.2 Context of Guidelines

This guideline is part of a package of regulations and guidelines which include:

- The Pakistan Environmental Ordinance 1997
- Policy and procedures for filing, review and approval of environmental assessments
- Guidelines for the preparation and review of Environmental Reports
- Guidelines for public participation
- Guidelines for sensitive and critical areas
- Pakistan environmental legislation and the National Environmental Quality Standards (NEQS)
- Sectoral guidelines for environmental reports: ***Major Chemical and Manufacturing Plants***

This guideline should not be read on its own, but in the context of the overall package.

1.3 Reference Materials

The development of these guidelines rely heavily on the following sources:

- Government of Pakistan EIA Guidelines 1986
- ADB Guidelines 1993
- World Bank EIA Guidelines 1994
- The UNEP EIA Training Resource Manual June 1996
- New South Wales EIS Guidelines 1997

2.0 SECTOR OVERVIEW

2.1 Operations

The environmental report should provide appropriate information about the project development stage. The chemical facility's operations should be described for the following key areas:

1. Production process
2. Cleaner production considerations
3. Hazard management considerations
4. Other operational factors.

The specific environmental issues that need to be addressed for each of the above

operations are discussed below.

2.1.1 Production Process

The environmental mass balance for the production process should be outlined in the environmental report; with diagrammatic illustrations of each stage and product line. The diagrams should quantify inflows and outflows of materials, points of discharge to the environment and their respective destinations (sewer, stormwater, atmosphere, recycling, landfill, storage).

Information on major chemical substances and all dangerous goods used, stored or produced on-site must be provided. The information should indicate:

- the dangerous goods class and their storage, phase, pressure and temperature
- maximum quantities stored on site
- any fuels received in bulk or piped to the site
- any significant adverse effects from chemicals on site.

2.1.2 Clean Production Considerations

The report should give consideration to product life-cycle strategies such as measures to manage empty packaging, waste from users, or products past their shelf life.

Clean Production Considerations should include:

- management systems for environmental impacts from transfer and production facilities, including provisions to deal with spills or accidental releases
- waste minimisation measures; typically through source reduction approaches involving product or process alternatives
- recycle or reuse of wastes and by-products
- storage procedures for temporary or permanent solid or liquid waste including:

  a) provisions to manage leachate
  b) transportation arrangements
  c) waste facility approval (by Responsible Authority for receiving the types of materials)

- air management systems to measure, collect, treat, and recycle gaseous emissions
- water management systems to provide water quality standards for any wastewater discharged from the site to sewer, stormwater or natural drainage system
- identify potential soil contaminants and mitigation measures.

3. POTENTIAL IMPACTS ON THE ENVIRONMENT

The impacts on the environment due to the wastes and emissions produced from

chemical and manufacturing plants are a function of the types of products manufactured and the diverse range of processes and chemicals used.

The potential negative environmental impacts of production of chemicals can be disastrous. Some references for developing contingency procedures and mitigating potential impacts are listed below:

1. The National Institute of Occupational Safety & Health a branch of the US Department of Health & Human Resources has published a book for information on chemical and health hazards.

2. The Dow Fire and Explosion Index published by the American Institute of Chemical Engineers (AICE) is used for information on fire and explosion hazards.

3. Appendix III contains a summary of potential negative impacts from chemical and petrochemical production and specific mitigation measures.

3.1 Hazards

Most of the materials used in the manufacture of chemical and petrochemicals are flammable and explosive. Many chemicals and petrochemicals are toxic and some are also carcinogenic. Because of the highly reactive compounds and the high pressures involved in manufacturing and handling, potential explosion hazards are much more severe compared to other industries.

Some materials (e.g., chlorine and phosgene) are highly toxic and cause injury on contact; they are classified as a safety hazard. Other materials have long-term effects sometimes in very low concentrations.

The environmental assessment should consider potential hazards related to:

(a) operational activities, and
(b) natural disasters.

Operational hazards include accidental release of toxic substances, explosions or fires. Natural disaster contingency planning should concern bushfires, earthquakes, lightning strike, flooding or cyclone. For each category potential hazards should be identified, and the significance of their consequences assessed in order to develop associated contingency scenarios.

For chemical facilities with a risk of fire, explosion, or release of chemical substances a preliminary hazard analysis (PHA) should be considered. The important elements of a PHA include:

1. identifying hazard scenarios associated with use or storage of chemical substances and calculating the probability of potentially hazardous incident occurring

2. conducting a quantitative risk assessment of the most relevant hazards; this assessment should be based on public safety considerations as well

as impact on the environment if an operational hazard or natural hazard takes place.

3. identifying risk mitigation measures; this should include an assessment of the adequacy of operational and emergency procedures involving dangerous and hazardous goods and their effectiveness in reducing risk and environmental impacts.

4. assessing cumulative risk levels expected from the proposed development (i.e. the safety implication for surrounding land uses).

The adequacy of the proposed safeguards should be evaluated against the risk levels.

When assessing hazards involved with storage and transportation of chemicals, the following issues need to addressed:

1. toxic combustion from potential fires; (include toxic particle fallout, decomposed and undecomposed active ingredients)
2. leakage and contamination issues or toxic releases from volatile spills
3. operation of automatic safety systems in event of a fire
4. heat radiation from potential fire and their impact for fire fighting services (i.e. setback distances that may restrict fire fighting)
5. reactivity of chemicals with each other
6. the reactivity of different chemicals with water and their impact on storage and fire fighting measures
7. the management of temporary goods stacking
8. detection and fire fighting equipment
9. site management plan, encompassing on-site materials management, day-to-day operations, drainage control and emergency plans
10. the containment of contaminated firewater and other run-off entering the environment.

3.2 Water Discharges

Large quantities of water are used in the chemical and manufacturing industry for process, cooling and washing and associated water contamination occurs. Pollutants which may present a hazard if released into waterways and underground aquifers include toxic priority pollutants, carcinogenic compounds, suspended solids, and BOD & COD substances.

A new document entitled *"Sectoral Guidelines for Environmental Reports - Regulatory Requirements and NEQS"* contains National Environmental Quality Standards for Industrial Effluents. The reader of this draft will find this material as an Appendix to Major Thermal Power Stations at present.

When dealing with water issues, the primary objective should be to minimize the impact or demand on existing waterbodies and systems. Groundwater and surface water resources can be negatively impacted by product discharge and processing areas, pipe tracks, cooling water blowdown, flushing and cleaning water, and accidental release of raw materials and finished products. Run-off control measures,

such as stormwater detention basins with treatment prior to discharge are normally necessary to avoid such adverse water impact.

3.3 Air Emissions

Air pollutants include particulate matter and depending on the process used a great number of gaseous compounds including sulfur oxides, carbon oxides from boiler flues 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), adsorption, gas scrubbing, and other absorption processes. National Environmental Quality Standards for industrial gaseous emissions are listed in Appendix IV, Table 7.

3.4 Solid Waste

Solid wastes from chemical and manufacturing plants may include residuals from raw materials, waste polymer, sludges from boiler feed, tank cleaning or pollution control equipment, and ash from coal boiler operations. Waste material may be contaminated with chemical substances from the processes. Spent catalysts can generate an environmental problem in petrochemical industries.

Dewatered ash and chemically stabilized sludges can be disposed of in:

a) land fills sited in areas of low permeability with deep ground water tables; and
b) where ground water seepage is a potential concern lined disposal cells.

4.0 MITIGATION MEASURES

4.1 Site Alternatives

The nature of chemical/manufacturing industry is such that the environmental impacts of production, storage, and transportation warrant special attention in evaluating alternative sites. Apart from emission and effluent issues, another critical aspect that needs attention is the transportation of raw materials and end products. Often toxic or highly inflammable materials are involved, especially in the petrochemical industry which can pose special transportation problems. Transportation through densely populated areas should be avoided during site the selection process.

Many impacts can be avoided altogether or mitigated more successfully and at less cost by thoughtful site selection. Section 2.6 on site selection in the *"Guidelines for the preparation and review of environmental reports"* should be read in conjunction with this section.

4.2 Hazardous Materials Management

Bio-industrial and pharmaceutical waste can contain hazardous waste materials. When dealing with disposal of such solid waste the following practices should be adopted:

- For hazardous or radioactive materials there should be adequate treatment, storage, and disposal facilities.
- Procedures to ensure wastes are only disposed of at facilities which are operated in accordance with EPA standards.

Special problems are posed by the production of explosive materials or of highly reactive chemicals. Here design considerations like ruptured discs, explosion, and fire walls have to be incorporated to minimize environmental and health risks at the work site and outside.

Special environmental problems are often generated by formulation plants where chemicals are mixed to special formulations to serve the market. Examples are pesticide formulation plants, solvent formulation facilities, and explosives facilities. Environmental, health, and hazard procedures for these type of plants should be the same as for the manufacturing plants that produce the components that are blended.

4.3 Water Management

4.3.1 Water Supply

Consider a wide range of water supply sources such as stormwater reuse, groundwater sources, water recycling, and other reuse sources. An assessment should be made of the adequacy of water supply sources and the potential impact on any community water supply or groundwater resource, or on the water balance in any natural water system.

4.3.2 Wastewater Minimization

The volume of wastewater effluent can be reduced significantly by:

1. ensuring separate systems for stormwater and process water management
2. recycling water from one process to another; e.g., use blowdown from high pressure boiler as feedwater for low pressure boiler
3. use treated effluent as make-up water wherever possible
4. design systems that recycle water repeatedly for the same purpose e.g., cooling towers, or steam condensates as boiler feedwater
5. plan and design for efficient water usage in the plant operation.

Wastewater flows can be further reduced by applying good housekeeping practices:

- minimizing wastes during sampling
- using dry cleaning methods for spills
- applying sound inspection and maintenance systems to minimize leakage

- segregating waste streams with special disposal characteristics (e.g., spent cleaning solution).

Wastewater effluent control equipment is now available for practically every waste stream. Wastewater effluent can be controlled through neutralization, evaporation, aeration, stripping, flotation, filtration, oil separation, carbon absorption, ion exchange, reverse osmosis, biological treatment, and land application of process wastewater.

4.3.3 Surface Water

Where there is risk of contamination to a waterbody, the mitigation strategy should consider the following issues:

a) existing water quality and its use
b) drainage and flow characteristics
c) potential pollution and effect on water quality from designed and accidental sources
d) assessment of the adequacy of water management systems to prevent impact on water quality.

4.3.4 Groundwater Contamination; Mitigation Measures

If groundwater is vulnerable because of its depth, overlying geological characteristics or presence of recharge areas in the vicinity of the site, or if local groundwater is used as drinking water, or is reversibly connected to surface waters and thereby aquatic ecosystems, issues to mitigate these impacts include:

a) baseline information on groundwater aquifers including a description of the groundwater system, groundwater quality, and groundwater users
b) potential pollution sources; including contamination from holding-tank seepage, fuel or chemical storage facilities or from contaminated surface water or wastewater disposal practices
c) potential impacts on groundwater and any users
d) assessment of proposed measures to prevent groundwater contamination; the assessment should consider bunding of fuel chemical storage and the production area or sealing of the site
e) management and monitoring practices to manage adverse impacts, including:

    - monitoring the integrity of all sealed surfaces
    - bunding systems, and
    - maintenance of in-ground collection and storage tanks.
    - Installing groundwater monitoring devices up and down hydraulic gradients of the site
    - proposals for remedial action if pollution occurs.

4.3.5 Flood Mitigation

For chemical/manufacturing plant sites located in flood prone areas the following issues should be considered in the mitigation approach:

a) flooding status, flood frequency, flood depth, flood direction
b) vulnerability of plant facilities
c) potential impacts from inundation of facility
d) management of contaminated water
e) flood mitigation measures such as levees (use Local Council approved specifications).

4.4 Air Emissions: Mitigation Measures

Site selection is of primary importance in considering minimisation of the impact of air emissions. Site selection should be based on an assessment of pollution entrapment characteristics of the location, and prevailing winds being towards relatively unpopulated areas.

The primary damage from air emissions include adverse effects on human health and comfort, on vegetation, and on aesthetics. Air emissions may be controlled by use of incineration (stack flares), adsorption, gas scrubbing, membrane separation, cyclones, electrostatic precipitators, baghouse filters, catalytic reduction or oxidation, incineration and absorption systems.

To prevent dust from polluting the environment, materials which are stored and prone to wind disturbance should be contained in buildings, or covered, or other measures taken.

Mitigation strategy to reduce the impact of air emissions should give consideration to:

a) the baseline review of air quality
b) the cumulative air quality issues within a defined air-shed
c) nearby land use sensitive to changes in air quality
d) potential gas or particulate emissions, and their characteristics including toxicity, flammability, odor, corrosive nature, and deposition rate
e) design of the air quality management system with plans to enclose potential gas or dust generating activities and use fabric filters or electrostatic precipitators to attain performance criteria as outlined by NEQS (Appendix III)
f) mechanisms to minimize the impacts of gas or dust emissions in the event of system failure
g) potential impacts on air quality in relation to sensitive areas where there is acute risk to human health and natural ecology, this assessment may involve modeling of dispersion contours with regard to the influence of local topography and weather.

4.5 Noise; Mitigation Measures

In order to protect the public from nuisance stemming from plant operation including noise and pollutant emission, a buffer strip should be maintained around the periphery of those sections of the plant which are potential nuisance sources. The buffer area which may vary from 10 meters to 30 meters or more depending on circumstances, will be improved by screen planting.

Other mitigation measures include:

a) use of low sound rated equipment
b) control timing of noise and vibration to least disruptive periods
c) install noise barriers
d) particularly noisy operations should be enclosed
e) design noise monitoring program identifying location of monitoring sites.

4.6 Transport and Traffic Issues

Due to the nature of materials being transported traffic and transportation issues associated with chemical and manufacturing facilities can pose significant hazards.

A road traffic impacts study should be carefully considered for proposals involving significant increases in traffic. The study should assess:

- changes in the nature of road traffic
- transport requirements for project
- traffic movement
- alternative modes of transport to handle additional traffic
- alternatives routes
- suitability of network to deal with chemical facility traffic for transport of material (consider noise, vibration and impact on sensitive locations such as schools, hospitals, and areas of high traffic risk).
- upgrade proposals to handle traffic and improve safety through additional traffic management devices (e.g., round-abouts, signs, lights, road marks, speed breakers, and road upgrades).

For projects where there is transportation of material by pipeline, the construction impacts on the community and biophysical environment should be considered. Incidents such as pipeline leakage or fire must have suitable contingency plans including periodical safety drills.

4.7 Aesthetics

Industrial structures should be designed to minimize adverse impacts on the environmental aesthetics. Architectural design should blend the structures into the landscape and use trees for screening.

The proposed mitigation and management measures to reduce visual impacts should include:

a) layout, design, color scheme, fencing, screening, or visual treatment
b) landscaping

4.8 Flora and Fauna; Impact Mitigation

When terrestrial or aquatic vegetation is likely to be impacted due to change in water quality or quantity or habitat destruction, the mitigation plan should consider the following:

a) identify local plant and animal habitats or ecological communities that will be affected
b) indicate local or regional scarcity or importance of these habitats, ecological communities, populations and species
c) if relevant indicate;
    - threatened species
    - rare plant species
    - protected vegetation, or
    - fish species
d) potential impacts on species, populations or ecological communities or their habitats
    - directly through habitat destruction, or species reduction, or
    - indirectly through changes in surface or groundwater quantity/quality or change in air quality
e) species or community sensitivity to the disturbance; the potential impact of disturbance to biodiversity
f) significance of flora and fauna for other biota
g) landscaping and rehabilitation proposals and their role in mitigating impacts such as rehabilitation with indigenous species; the provision of new appropriate habitats; opportunities for colonization
h) identify potential weed and introduced species and describe measures to control and prevent infestations at the site and control spread into other localities

5.0 EMISSION REQUIREMENTS

The list of environmental legislation and regulatory requirements in Pakistan, and the NEQS will be provided in a new document entitled *"Sectoral Guidelines for Environmental Reports - Regulatory Requirements and NEQS".* The reader of this draft will find this material as an Appendix to Major Thermal Power Stations at present.

Some of the NEQS levels are currently undergoing revision and as updates are made available these guidelines will be amended.

The requirements represent the basic minimum standards that should apply to all projects. More stringent emission requirements will be appropriate if the environmental assessment indicates that the benefits of additional pollution controls as reflected by ambient exposure levels and by other indicators of environmental damage outweigh the additional costs involved. In particular:

If the environmental assessment establishes, for one or more of the pollutants covered in this document, that:

a) the baseline exposure of significant populations within the airshed exceeds the trigger value for ambient exposure, and

b) the proposed project will result in significant worsening in this exposure level,

then the Responsible Authority may require the project comply with stricter emission requirements, or it may require alternatives to reduce emissions from other sources to mitigate ambient exposures within the airshed.

The environmental assessment should also address other project-specific environmental concerns, such as emissions of cadmium, mercury, and other heavy metals resulting from burning certain types of coal or heavy fuel oil. In such cases, the Responsible Authority will require specific measures to mitigate the impact of such emissions and set associated emission requirements.

6.0 MONITORING AND REPORTING

The monitoring program should provide information about actual impacts and early warning information of unacceptable environmental conditions.

6.1 Baseline Conditions

Monitoring should begin before design and construction to determine *baseline conditions*. Baseline conditions are described by conducting a detailed analysis of each significant impact by collecting data and other information that will help to describe the baseline situation at the expected time of implementation.

Baseline conditions during the feasibility study may be different to baseline conditions at the time the plant is operational. For instance for projects where the construction phase is several years and/or there are lengthy delays, it is likely that the current baseline conditions will no longer apply at the time the project is operational. In such cases predictions will need to be made about future baseline conditions.

Baseline data collection methodology is covered in *Section 3.4 of the "Guidelines for the Preparation and Review of Environmental Reports".*

The length of monitoring during construction and operation phases will depend on the environmental resource that is being affected and the expected duration of the impact. Specific monitoring programs will be required depending on the type plant and the type of resources predicted to be affected.

6.2 Monitoring

Monitoring should be restricted to what is essential to protect the environment. The list of environmental parameters to be monitored should be accompanied by an explanation of each of the parameters is needed.

The design and management of a monitoring plan for a major project is discussed in *Section 5.2 of the "Guidelines for the Preparation and Review of Environmental Reports".*

For air emissions primary pollutants emitted from the plant should be monitored on a ongoing basis. Monitoring sites should be established to measure emission concentrations and ground level concentrations at predefined air quality receptor locations (e.g., residential areas, agricultural areas, etc.).

Automatic air quality monitoring systems measuring ambient levels major pollutants outside the plant boundary should be installed desirably in at three locations where there is:

1. least influence of the plant (background)
2. maximum pollution concentration, and there are
3. sensitive receptors such as protected areas and population centers.

The number of such air quality monitors should be greater if the area in which the plant is located is prone to temperature inversions or other meteorological conditions which lead to high levels of air pollutants affecting nearby populations or sensitive ecosystems.

For surface water the type and nature of the discharge wastewater will determine if surface water monitoring will be required. Expected pollutants should be measured as well as water quality parameters that are important for human health and public welfare. If not more frequent, seasonal water quality monitoring should be conducted.

Groundwater monitoring may be required if contamination of groundwater is predicted. Monitoring should be conducted upstream of the point of discharge, and downstream from the point of discharge in any receiving water body used by the public or considered environmentally significant (i.e., rivers, drinking and irrigation wells).

Continuos environmental monitoring of the most significant environmental parameters should be maintained, and periodic reviews and corrective actions taken. Although any monitoring program will be process and site-specific, Table 1 below is a summary of procedures that should be established.

Table 1: Summary of monitoring procedures for chemical and manufacturing plants

Monitoring Program	Monitoring Frequency

Air	
• combustion gases in boilers and furnaces; for carbon monoxide	continuous
• workspace air quality monitoring for compounds used in the process	continuos
• gaseous and particulate emissions for chemicals that are used or generated in the process to protect operating personnel from toxic gases	periodic or continuous if critical
• ambient air quality in vicinity of plant; especially toxic and hazardous chemicals, through remote sensors and alarms	continuous
• ambient air quality for particulate matter	continuous
Water	
• wastewater streams including cooling water	periodic if critical continuous
• stormwater discharge from plant and storage areas; pH and total suspended solids	periodic
• receiving water quality downstream for dissolved oxygen and applicable pollutants	continuos
• testing receiving water for pH, and total suspended solids	continuos
• groundwater quality to detect contamination from the process or storage area	periodic
Solid Waste	
• monitoring effects of solid waste management practices on ground and surface water resources	periodic
Noise	
• monitoring all areas of the plant for ambient noise levels	periodic
Control	
• measurement of selected process parameters to check operation of pollution control equipment (such as flue gas temp to check operation of scrubbers)	periodic
• adherence to safety and pollution control procedures, and updating of safety and emergency plans	regular audit

6.3 Analysis and Review

Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Records of monitoring results should be maintained in an acceptable format and reported to the responsible authorities and relevant parties, in the form of a process control chart as required. Where the results of monitoring show that the standards are consistently met, the monitoring frequency can be reduced

7.0 MANAGEMENT AND TRAINING

The environmental impacts of chemical and manufacturing plants can be significant and on-going, and thus require careful development of management systems for

materials handling, clean production and waste minimisation, recycling, and pollution control technologies.

Institutional support is necessary through trained personnel in air, water, and soil pollution control technologies. These personnel in conjunction with equipment manufacturers should develop standard operating procedures for the plant which should include:

- pollution control equipment operation
- air and water quality monitoring requirements
- prevention malodorous emissions
- noise reduction practices
- directives for notification of proper authorities in the event of accidental release of pollutants.

The standard operating procedures must be enforced by management. Special training must be provided for toxic and hazardous materials handling and their management should be further improved by detectors, and alarms.

Emergency procedures must be developed by trained plant safety specialist for effective action in the event of a major spill, leakage, fire, or explosion. The planning and development of emergency procedures should include local government agencies, local community services (e.g., medical, and fire fighting), and members from the surrounding community who play key roles in emergencies.

Management must develop and implement periodic drills as one of the components of its response plan. Ongoing training in safework practice and good environmental housekeeping practices must be given high priority throughout all plant operating levels.

Checklist of environmental parameters Major chemical/manufacturing plants

APPENDIX I

Reproduced from the ADB Environmental Guidelines (1993)

Illustrative examples of potential negative impacts Vs specific mitigation measures

APPENDIX II

TABLE 4: Potential Negative Impacts Vs Mitigation Measures
Site Selection

Potential Negative Impacts Site Selection	**Specific Mitigation Measures** Site Selection
1. Plant site near sensitive habitats, eg: • estuaries • mangroves.	⇒ Locate facility elsewhere, eg. within industrial estate which are equipped to deal with stress on local environmental services. It should also facilitate the monitoring of emissions This will concentrate and from sensitive air quality receptors.
2. Water course degradation	⇒ Examine alternate site location that will not affect beneficial use of water course. ⇒ Check water course capacity to assimilate treated effluent. ⇒ Dilute effluent at point of discharge
3. Air pollution problems for locals	⇒ Locate plant site based an assessment of pollution trapping and prevailing winds are towards relatively unpopulated areas.
4. Solid waste problems	⇒ Select site with landfill disposal on-site, or ⇒ proximity to suitable disposal site with easy system for solid waste collection for final disposal.

TABLE 5 Potential Negative Impacts Vs Mitigation Measures
Plant Operation

Potential Negative Impacts Plant Operation	**Specific Mitigation Measures** Plant Operation
1. Water contamination with high temperature, BOD, COD, TDS, and pH due to • process cooling water • effluents, or • runoff from stockpiles/waste piles.	⇒ Recycle cooling water. If this is not feasible ensure receiving body water temperature does not rise > 3°C. ⇒ Maintain pH between 6-9. ⇒ Control effluent to specified NEQS. ⇒ Minimize rain exposure to stockpiles and minimize uncontrolled runoff ⇒ Line open storage areas to collect all stormwater.
2. Particulate emissions	⇒ Use Fabric (Baghouse) Filter or Electrostatic Precipitators.
3. Gaseous emissions, eg: • SO_x, NO_x, CO and others.	⇒ Scrub with water or alkaline solutions ⇒ Incinerate, or ⇒ absorption by other catalytic process.
4. Accidental release of hazardous solvent	⇒ Assess use of double wall tanks ⇒ Housekeeping and maintenance to prevent accident ⇒ Provide and maintain spill kits.
5. Noise	⇒ Use low rated equipment ⇒ Control timing of noise and vibration to least disruptive periods ⇒ Install noise barriers
6. Groundwater contamination	⇒ Cover and contain open storage areas to prevent runoff to surface and ground waters ⇒ Use lines disposal cells to prevent ground water seepage ⇒ Monitor stormwater quality before discharge

TABLE 6 Potential Negative Impacts Vs Mitigation Measures
Indirect

Potential Negative Impacts Indirect	**Specific Mitigation Measures** Indirect
1. Occupational health effects due to dust, noise, or other process operations	⇒ Provide dust collector equipment and dust masks ⇒ Maintain noise levels below 85 dBA, or provide ear protection ⇒ Implement Occupational Health & Safety Program to: • identify, assess, monitor, and control health hazards • provide safety training
2. Regional solid waste problem	⇒ Plan and design adequate on-site storage and ultimate disposal facilities
3. Heavy traffic carrying hazardous materials threat to motorists and pedestrians	⇒ Appropriate site selection ⇒ Conduct traffic studies to select best route to reduce impacts ⇒ Regulations for transporters and develop emergency contingency plans to minimize risk of accidents

Major environmental legislation and regulations for Pakistan — APPENDIX III

TABLE 5: Major environmental legislation and regulations for Pakistan

Type	Authority	Responsible Agency	Requirements
Comprehensive Environmental Protection	• Ordinance No. XXVII of 1983	Environment & Urban Affairs Div. Ministry of Housing & Works	Proforma document
Protection of Antiquities	• Act No. VI 1977	Ministry of Culture, Archeology, Sports & Tourism, Dept. of Archeology	Provides protection and preservation of sites which are historical and archeologically important
Water Resources	1. Indus River Water Apportionment Accord-91 2. West Pakistan Act of 1958	Indus River System Water & Power Development Authority (WAPDA)	Distribution and apportionment of Indus River Water Management of water and power resources
Water Pollution & Liquid Effluents	1. Pakistan Penal code, 1960 2. Factories Act, 1934 3. Statutory Notification S.R.O. 742(1/93)	Provincial Governments Ministry of Industry Environment & Urban Affairs Div. Ministry of Housing & Works	Fouling a public spring or reservoir Disposing untreated industrial waste in water bodies Adherence to set effluent standards
Air Pollution	Pakistan Penal Code, 1960	Provincial Governments	Vitiating the atmosphere in any way so as to make it noxious to human health
Standards for Gaseous Emissions	1. Statutory Notification S.R.O. 742(1/93) Statutory Notification S.R.O. 1023(1/95)	Environment & Urban Affairs Div. Ministry of Housing & Works Environment & Urban Affairs Div. Ministry of Housing & Works	Adherence to set effluent standards Adherence to set effluent standards with respect to SO_2 and NO_X for coal & oil power plants

Toxic or Hazardous Waste	Pakistan Penal Code, 1960	Provincial Governments	Negligent conduct with respect to poisonous substances
Forest Conservation	Forest Act, 1927	Ministry of Food & Agriculture, Forest Div.	Clearing forest, removing forest produce, quarrying, felling and chopping of trees, branches, etc., in reserved or protected areas, defacing trees and timber, and altering forest boundaries
Fisheries	West Pakistan Fisheries Ordinance, 1961	Provincial Fisheries Department	Destruction of fish; capture of certain size; harvesting of certain species in specified periods
Wildlife Conservation Protection	1. West Pakistan Ordinance of 1959 2. Sindh Wildlife Protection Act	Zoological Survey, National Council for conservation of Wildlife; Ministry of Food, Agriculture and Cooperatives Sindh Wildlife Management Board	Promote conservation and establish limits on hunting Promote conservation and establish limits on hunting

TABLE 6: National Environmental Quality Standards for municipal and liquid industrial effluents (mg/l, unless otherwise defined)

Serial No.	Parameter	Existing Standards	Revised Standards		
			Into Inland Waters	Into Sewage Treatment	Into Sea
1	Temperature / Temperature increase*	40 C	≤3C	≤ 3C	≤ 3C
2	pH value	6-10	6-9	6-9	6-9
3	5-days Biochemical Oxygen Demand (BOD) at 20C. (1)	80	80	400	200
4	Chemical Oxygen Demand (COD) (1)	150	150	600	600
5	Total suspended solids	150	200	400	200
6	Total dissolved solids	3500	3500	3500	3500
7	Grease and oil	10	10	10	10
8	Phenolic compounds (as phenol)	0.1	0.1	0.3	0.3
9	Chloride (as Cl)	1000	1000	1000	SC
10	Fluoride (as F)	20	10	10	10
11	Cyanide (as CN) total.	2	1	1	1
12	An-ionic detergents (as MBAS) (2)	20	20	20	20
13	Sulphate (SO4)	600	600	1000	SC
14	Sulphide (S)	1.0	1	1	1
15	Ammonia (NH3)	40	40	40	40
16	Pesticides, herbicides, fungicides and insecticides (3)	0.15	0.15	0.15	0.15
17	Cadmium (4)	0.1	0.1	0.1	0.1
18	Chromium (trivalent & hexavalent) (4)	1.0	1	1	1
19	Copper (4)	1.0	1	1	1
20	Lead (4)	0.5	0.5	0.5	0.5
21	Mercury (4)	0.01	0.01	0.01	0.01
22	Selenium (4)	0.5	0.5	0.5	0.5
23	Nickel (4)	1.0	1	1	1
24	Silver (4)	1.0	1	1	1
25	Total toxic metals	2.0	2	2	2
26	Zinc	5.0	5	5	5
27	Arsenic (4)	1.0	1	1	1
28	Barium (4)	1.5	1.5	1.5	1.5

29	Iron	2.0	1.5	8	8
30	Manganese	1.5	1.5	1.5	1.5
31	Boron (4)	6.0	6	6	6
32	Chlorine	1.0	1	1	1

1. Summing minimum dilution 1:10 on discharge, lower ratio would attract progressively stringent standards to be determined by the Federal Environmental Protection Agency. By 1:10 dilution means for example, that for each one cubic meter of treated effluent the recipient water body should have 10 cubic meter of water for dilution of this effluent.
2. Modified Benzene Alkyl Sulphate; assuming surfactant as bio-degradable.
3. Pesticides. herbicides, fungicides, and insecticides.
4. Subject to total toxic metals discharge.
5. Applicable only when and where sewage treatment is operational and BOD5=80 mg/l is achieved by the sewer treatment system.
6. Provided discharge is not at shore and not within 10 miles of mangrove or other important estuaries.

SC Discharge concentration at or below Sea concentration.

∗ The effluent should not result in temperature increase of more than 3C at the edge of the zone where initial mixing and dilution take place. In case zone is not defined, use 100 meters from the point of discharge.

Note: Dilution of gaseous emissions and liquid effluents to bring them to the NEQS limiting value is not permissible through excess air mixing/blowing in to the gaseous emissions or through fresh water mixing with the effluent before discharge into environment.

TABLE 7: National Environmental Quality Standards for industrial gaseous emission (mg/ Nm3 unless otherwise defined)

Serial No.	Parameter	Source of Emission	Existing Standards.	Revised Standards
1	Smoke (1)	Smoke opacity not to exceed	40% or 2 (Ringlemann scale)	40 %
2	Particulate matter (2)	Boilers and furnaces:		
		(i) Oil fired.	300	300
		(ii) Coal fired.	500	500
		(iii) Cement Kilns.	200	300
		Grinding, crushing, clinker coolers and related processes, metallurgical processes, converter, blast furnaces and cupolas	500	500
3	Hydrogen Chloride (3)	Any.	400	400
4	Chlorine (3)	Any.	150	150
5	Hydrogen fluoride (3)	Any.	150	150
6	Hydrogen sulphide (3)	Any.	10	10
7	Sulphur Oxides	Sulfuric acid plant	400	5000
		Urban Areas.	400	1000
		Rural Areas.		1500
8	Carbon monoxide (3)	Any.	800	800
9	Lead (3)	Any.	50	50
10	Mercury (3)	Any.	10	10
11	Cadmium (3)	Any.	20	20
12	Arsenic (3)	Any.	20	20
13	Copper (3)	Any.	50	50
14	Antimony (3)	Any.	20	20
15	Zinc (3)	Any.	200	200
16	Oxides of Nitrogens	Nitric acid manufacturing unit.	400	3000
		Gas fired.	400	400
		Oil fired		600
		Coal fired		1200

1. or 2 on the Ringlemann scale
2. Based on the assumption that the size of the particulates is 10 micron or more.
3. Any source
4. In respect of emissions of sulphur dioxide and nitrogen oxides, the power plants operating on oil or coal as fuel shall, in addition to national Environmental Quality Standards (NEQS) specified above, comply with the following standard.

TABLE 8: Sulphur dioxide and nitrogen oxide ambient air requirements

A. SULPHUR DIOXIDE

Sulphur Dioxide Background Levels (ug/m3)

			Standards	
			Criterion I	**Criterion II**
Background Air Quality (SO_2 Basis)	Annual Average (ug/m3)	Max. In 24 Hour Interval (ug/m3)	Max. SO_2 Emission (tons/day/plant)	Max. Allowable Ground Level Increment To Ambient (ug/m^3 one year average)
Unpolluted	<50	<200	500	50
Moderately Polluted*				
Low	50	200	500	50
High	100	400	100	10
Very Polluted**	>100	>400	100	10

* For intermediate values between 50 and 100 ug/m3 linear interpolations should be used.

** No project with sulphur dioxide emissions will be recommended.

B. NITROGEN OXIDES

Ambient air concentrations of nitrogen oxides, expressed as NO2, should not exceed the following:-

Annual Arithmetic Mean	100 ug/m3 (0.05 ppm)

Emission levels for stationary sources discharges, before mixing with the atmosphere, should be maintained as follows:

For fuel fired stream generators, as nanogram (10E-9 gram) per joule of heat input:-

Liquid fossil fuel	130
Solid fossil fuel	300
Lignite fossil fuel	260