# IPDC Finance Limited
## Board Paper
## Approval for Environmental & Social Risk Management Policy

### Background

The Sustainable Finance Department of Bangladesh Bank has issued guidelines on Environmental & Social Risk Management (ESRM) for Banks and Financial Institutions on June 16, 2022 which has replaced the previous guidelines circulated on February 08, 2017. The main purpose of this documents is to implement the guideline throughout the organization through approval of ESRM policies & procedures for IPDC Finance Limited.

### Current Issue

The Environmental & Social Risk Management Policy, version 1 was approved on 171st Board Meeting dated 22 April 2018. The Draft Policy has been updated based on revised guideline issued by Bangladesh Bank on Environmental & Social Risk Management (ESRM) for Banks and Financial Institutions on June 16, 2022.

Based on the above requirement, the major changes include the followings:

- Guidelines of ESRM has been made more comprehensive with the provision Environmental and Social Due Diligence (ESDD) for infrastructure projects.
- ESDD Checklist is updated with Guidance notes for ten (10) environmentally sensitive sectors for investment are introduced.
- Applicability of ESDD in relation with Financing Limit for different segment of customers (cottage/micro/small/medium/large, retail and agricultural) has been updated as follows:

| Transaction Type | Financing limit in New Policy | Financing Limit in Previous Policy |
|---|---|---|
| Financing in all agriculture activities related to farming if there is any environmentally or socially adverse agricultural practices involved | More than Tk. 2.5 million | Any |
| Financing in Small Enterprises (manufacturing and services) and the loan/investment | More than Tk. 3.0 million | More than 1 million |
| Financing in all Medium Enterprises (manufacturing and services) | More than Tk. 5.0 million | Any |

- Exclusion list has been updated in line with the revised policy.
- The escalation matrix is updated.
- The responsibility of different roles under the credit chain is updated based on the existing organizational structure of IPDC.

Board Audit Committee reviewed the policy and recommended to the Board of Directors for approval.

## Submission:

The Board is requested to kindly consider approval of Draft Environmental & Social Risk Management Policy.

| *Prepared by:* | *Reviewed by:* |
|---|---|
| Md. Ashique Hossain | Mominul Islam |
| Head of Credit Risk Management | Managing Director & CEO |

*Enclosed: Draft Environmental & Social Risk Management Policy, Version 2*

# Environmental & Social Risk Management Policy

**Version: 2.0**

IPDC FINANCE

## Control sheet

### Document Control

| Policy Name: | Environmental & Social Risk Management Policy |
|---|---|
| Version: | 2.0 |
| Date Approved: | |
| Next Review: | After 36 months |
| Policy Owner: | Head of Credit Risk Management |
| Approval Authority: | IPDC Board of Directors |

### Version Control

| Version | Date | Change summary | Responsible Person |
|---|---|---|---|
| 1.0 | | New policy development based on the Guidelines on Environmental & Social Risk Management (ESRM) issued by Sustainable Finance Department of Bangladesh Bank for Banks and Financial Institutions in February, 2017 | Md. Ashique Hossain, HoCRM |
| 2.0 | | Updated based on revised guideline issued by Bangladesh Bank on Environmental & Social Risk Management (ESRM) for Banks and Financial Institutions on June 16, 2022 which has replaced the previous guidelines circulated on February 08, 2017. | Sushil Kumar Mondal, AGM, CRM |

# LIST OF ABBREVIATIONS

| | |
|---|---|
| BDT | Bangladeshi Taka |
| CAMELS | Capital Adequacy Assets Management Capability Earnings Liquidity Sensitivity |
| CITES | Convention on International Trade in Engendered Species |
| CRMC | Credit Risk Management Committee |
| DoE | Department of Environment |
| E&S | Environmental & Social |
| EC | Executive Committee |
| ECR | Environment Conservation Rules |
| ERM | Environmental Risk Management |
| ESAP | Environmental & Social Action Plan |
| ESDD | Environmental & Social Due Diligence |
| ESIA | Environmental & Social Impact Assessment |
| ESMS | Environmental & Social Management System |
| ESRM | Environmental & Social Risk Management |
| ESRR | Environmental & Social Risk Rating |
| ETP | Effluent Treatment Plant |
| FI | Financial Institution |
| GDP | Gross Domestic Product |
| GHGs | Greenhouse Gases |
| HoC | Head of Credit |
| IFC | International Finance Corporation |
| IMF | International Monetary Fund |
| IP | Indigenous People |
| MD | Managing Director |
| NGO | Non-Governmental Organization |
| ODS | Ozone Depleting Substances |
| PAH | Polycyclic Aromatic Hydrocarbons |
| PCB | Polychlorinated Biphenyl |
| PM | Particulate Matter |
| RMC | Risk Management Committee |
| RMG | Ready Made Garment |
| RO | Relationship Official |
| SBN | Sustainable Banking Network |
| SFU | Sustainable Finance Unit |
| SME | Small & Medium Enterprise |
| UN | United Nations |
| UNESCO | United Nations Educational, Science & Cultural Organization |
| VOC | Volatile Organic Compound |

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## 1.0 Background

The Sustainable Finance Department of Bangladesh Bank has issued guidelines on Environmental & Social Risk Management (ESRM) for Banks and Financial Institutions on June 16, 2022 which has replaced the previous guidelines circulated on February 08, 2017. The main purpose of this documents is to implement the guideline throughout the organization through approval of ESRM policies & procedures for IPDC Finance Limited. With that aim in perspective, this document mainly covers the followings:

- Overview of the ESRM guidelines issued by Bangladesh Bank
- Applicability of the guidelines
- Development of Environmental & Social Management System (ESMS) of IPDC
- Development of ESRM policy of IPDC

## 2.0 Overview of the Environment & Social Risk Management Policy:

The core objective of the Environment & Social Risk Management (ESRM) Policy is to make the company realize to integrate Environment & Social (E&S) risks and incorporate appropriate risk mitigation measures in overall credit management to be able for expanding the credit/investment portfolio rather than avoid investing in high E&S risks. Consequently, compared to the erstwhile ERM polices, the ESRM polices introduce the following features to be more streamlined, interactive and user friendly in nature:

- The ESRM policy provides a robust, auto generated, quantitative risk rating system to reduce the subjectivity of a qualitative risk assessment method that was present in the ERM Guidelines.
- The ESRM policy has a bigger focus on social and climatic risks which are becoming relevant and crucial for Bangladesh.
- The ESRM policy, in addition to investment threshold, define applicability based upon sector specific E&S impacts and the categories are expanded to include agriculture, cottage, micro, retail and trading enterprises, small enterprises, medium enterprises, large enterprises and infrastructure projects. .
- The organisational roles and responsibility defined in the ESRM policy are built upon the principles of integration of E&S risks into the company's overall credit policy. It clearly delineates the responsibility of different functions of the company in terms of E&S risk assessment and the decision-making process based upon E&S risk rating.
- This policy is supplemented with guidance notes for ten (10) environmentally sensitive sectors for investment. These guidance notes will be the guiding principle for E&S risk management for those sectors and can be used as the template for developing guidance notes for other environmentally sensitive sectors.
- This policy includes an E&S Due Diligence (ESDD) checklist (Annex-2) which is divided into three sections: (i) General risks, (ii) Environmental health and safety risks, (iii) Social risks. The checklist is integrated with the generic and the 10 environmentally sensitive sectors for investment. Thus, it is broad in scope but at the same time the process is much more streamlined for ease of use by the practitioners in the financial sector.
- In this policy, the term loan will synonymously be used as investment' if the company operates Shariah based financing.

## 3.0 Typical E&S Risks

Potential E&S risks may not seem significant or relevant at the time of approval of a financial transaction, but may become so during execution, for instance as a result of higher regulatory standards and increased levels of enforcement. Please refer to E&S risks in detail (Annex-4) for explanation on some of the common E&S risks.

## 4.0 Applicability of the Policy

The loan categories for which the ESRM Policy is applicable are cottage, micro small, medium enterprises (CMSME) finance; financing in retail and trading enterprises; consumer financing; financing in all large manufacturing and service enterprises (other than CMSME, retail and trading enterprises) and infrastructure finance. All loan proposals (New/Renewal/Rescheduling/ Restructuring) for the above applicable sectors will have to be first screened against the exclusion list (Annex-1).

- **Agriculture:** In the agriculture sector, if an agriculture loan application (New/Renewal/ Rescheduling/Restructuring) involves activities related to farming (e.g. crop production, animal farming, poultry and dairy firms, fisheries and hatchery, shrimp culture, nursery, apiculture, horticulture) and there is any environmentally or socially adverse agricultural practices involved such as use of pesticides, agro-chemicals leading to top soil depletion, ground water contamination; use of nitrogenous fertilizers instead of organic fertilizers leading to nitrous oxide emissions and the loan/investment proposal amounting to more than BDT 2.5 million (25.00 Lakh), in addition to exclusion list, it is to be complied with ESDD checklist (Annex-2). The loan application amounting less than BDT 2.5 million (25.00 Lakh) for above mentioned farming activities as well as agriculture financing related to farming with full organic and environment friendly practices of any amount will not require complying ESDD checklist. Agribusiness involving sorting, packaging, distribution and sales will also not require completing ESDD checklist.

- **Cottage, Micro, Retail and Trading Enterprises:** For financing in cottage, micro, retail and trading enterprises, only the exclusion list has to be complied. ESDD checklist shall be complied for the loan proposal of any amount for E&S sensitive retail & trading enterprises which include:
  - chemical or chemical ingredients,
  - highly fire absorbent products,
  - electronic appliances,
  - combustible oil,
  - paper and dry materials,
  - plastic items

- **Small Enterprises:** ESDD checklist shall be complied in addition to exclusion list in Small Enterprises (manufacturing and services) financing/investment (New/ Renewal/ Rescheduling/ Restructuring) of any amount which include
  - washing, dyeing and finishing units of RMG sector (water, chemical pollution),
  - small steel rerolling mills (operational health and safety, thermal, air pollution),
  - brick kilns (air pollution, child labour, burning of fossil fuel),
  - units for tanning, dressing and dyeing of leather and fur (water, chemical, air pollution),
  - pesticides, agrochemical and nitrogen manufacturing units (land contamination, water, air pollution),
  - chemicals and chemical products manufacturing units (safety, pollution),
  - rubber and plastic products manufacturing units (pollution),
  - batteries and accumulators manufacturing units (chemical pollution),
  - any other industry or business segment falls under the red category of ECR 1997 (Environmental Conservation Rule 1997)

  Apart from environmental issues mentioned above, for financing in small enterprises amounting to more than BDT 3.00 million (30.00 Lakh) has to be complied with the ESDD checklist. If the financing proposal is not more than BDT 3.00 million (30.00 Lakh), only the exclusion list has to be complied.

- **Medium Enterprises:** All loan/investment proposals (New/Renewal/Rescheduling/ Restructuring) from medium enterprises (manufacturing and services) amounting to more than BDT 5.00 million (50.00 Lakh) enterprises have to be complied with the ESDD checklist in addition to Exclusion List compliance. If the financing proposal is not more than BDT 5.00 million (50.00 Lakh), only the exclusion list has to be complied.
- **Large Enterprises (Manufacturing and Services):** Financing in all large manufacturing and service enterprises (other than CMSME, retail and trading enterprises) have to be complied with the ESDD checklist in addition to Exclusion List compliance.
- **Infrastructure Projects:** All loan applications (New/Renewal/Rescheduling/ Restructuring) for Infrastructure Projects have to be complied with third party Environmental and Social Impact Assessment (ESIA) [Guidance Note on ESIA in Annex-9] in addition to the compliance of ESDD checklist and Exclusion List. Infrastructure projects include those basic facilities and services which contribute to different economic activities and thereby help in the large-scale socio-economic development of the country. Infrastructure projects will cover the following categories:
  - Power (Electricity, Oil or Gas) Generation, supply, pipelines etc
  - Transport; Road, bridge, tunnels, airports, ports, railways, terminal & depots, inland waterways
  - Economic Zones, EPZ, PEPZ
  - Communication/Telecommunication
  - Fixed lines, transition lines & towers, satellites etc
  - Land development, Real State, Commercial Building
  - Tourism Industries

  Loan applications for infrastructure projects of E&S sensitive industry sectors mentioned in Annex-10 may require ESIA compliance as part of other regulatory requirements. IPDC will ensure that the ESIA has been complied before the loan transaction.

**Table 1: Applicability of the guideline by the transaction type**

| S. No. | Transaction Type | Exclusion List | ESDD checklist | Third party ESIA |
|---|---|---|---|---|
| 1 | Financing in all agriculture activities related to farming with full organic and environment friendly practices. | ✓ | | |
| 2 | Financing in all agriculture activities related to farming if there is any environmentally or socially adverse agricultural practices involved such as use of pesticides, agro-chemicals leading to top soil depletion, ground water contamination; use of nitrogenous fertilizers instead of organic fertilizers leading to nitrous oxide emissions and the loan/investment proposal *amounting to not more than BDT 2.5 million (25.00 Lakh)* | ✓ | | |
| 3 | Financing in All agriculture activities related to farming if there is any environmentally or socially adverse agricultural practices involved such as use of pesticides, agro-chemicals leading to top soil depletion, ground water contamination; use of nitrogenous fertilizers instead of organic fertilizers leading to nitrous oxide emissions and the loan/investment proposal *amounting to more than BDT 2.5 million (25.00 Lakh)* | ✓ | ✓ | |
| 4 | Financing in all types of Cottage Enterprises, all types of Micro, Retail & Trading Enterprises and Consumer Financing | ✓ | | |

| | | | | |
|---|---|---|---|---|
| 5 | Financing in E&S sensitive retail & trading enterprises of any amount which include chemical or chemical ingredients, highly fire absorbent products, electronic appliances, combustible oil, paper and dry materials, plastic items | ✓ | ✓ | |
| 6 | Financing in Small Enterprises (manufacturing and services) and the loan/investment proposal *amounting to not more than BDT 3.00 million (30.00 Lakh)* | ✓ | | |
| 7 | Financing in Small Enterprises (manufacturing and services) and the loan/investment proposal *amounting to more than BDT 3.00 million (30.00 Lakh)* | ✓ | ✓ | |
| 8 | Financing in all Medium Enterprises (manufacturing and services) *amounting to not more than BDT 5.00 million (50.00 Lakh)* | ✓ | | |
| 9 | Financing in all Medium Enterprises (manufacturing and services) *amounting to more than BDT 5.00 million (50.00 Lakh)* | ✓ | ✓ | |
| 10 | Financing in Small/Medium Enterprises (manufacturing and services) and the loan/investment proposal *of any amount* of following categories:<br>a) Washing, dyeing and finishing units of RMG sector (water, chemical pollution)<br>b) Small steel re-rolling mills (operational health and safety, thermal, air pollution)<br>c) Brick kilns (air pollution, child labour, burning of fossil fuel)<br>d) Units for tanning, dressing, and dyeing of leather and fur (water, chemical, air pollution)<br>e) Pesticides, agrochemical, and nitrogen manufacturing units (land contamination, water, air pollution)<br>f) Chemicals and chemical products manufacturing units (safety, pollution)<br>g) Rubber and plastic products manufacturing units (pollution)<br>h) Batteries and accumulators manufacturing units (chemical pollution)<br>i) Any other industry or business segment falls under the red category of ECR 1997 (Environmental Conservation Rule 1997) | ✓ | ✓ | |
| 11 | Financing in all large manufacturing and service enterprises (other than CMSME, retail and trading enterprises) | ✓ | ✓ | |
| 12 | Financing in Infrastructure Projects | ✓ | ✓ | ✓ |

## 5.0 Applicable Standards

All national regulations pertaining to E&S governance will be applicable while carrying out E&S due diligence of a particular transaction. This means all relevant E&S permits, consents, licenses, and monitoring of E&S parameters as per the national regulations are to be considered as mandatory compliance requirements for evaluation of a loan application. A list of applicable national regulations and international treaties where Bangladesh is a signatory is provided as Annex-8 for reference.

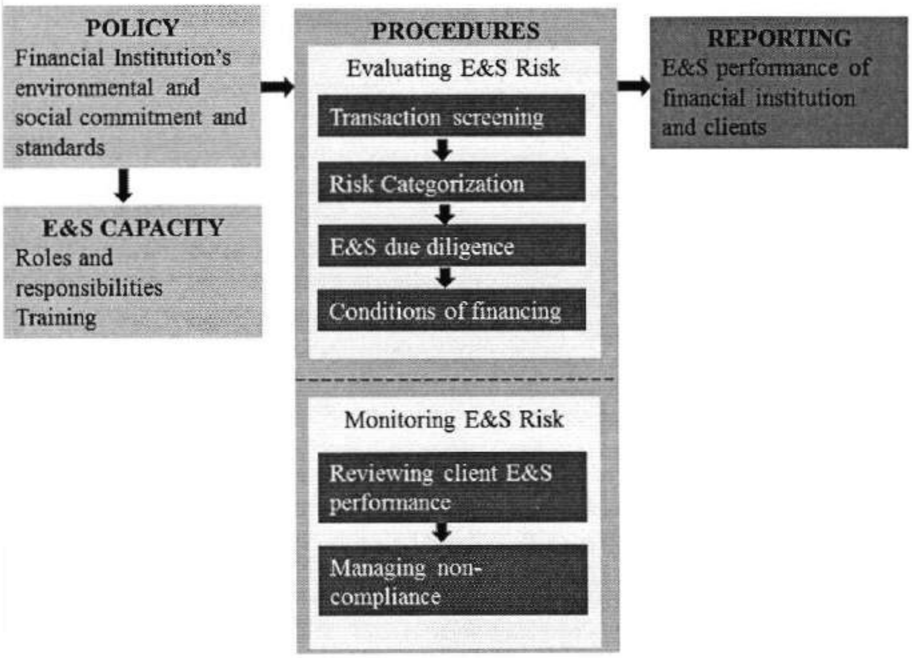
If clients have management systems in place as per international frameworks such as ISO 14001for environmental management, OHSAS 18001 for occupational health and safety, SA8000 for socially acceptable practices in the workplace then it will be considered as good practices. Adherence to IFC Performance Standards will be considered in case of large project financing as a good practice and optional requirement.

## 6.0 Environmental & Social Risk Management System (ESMS) of IPDC

The ESMS of IPDC is a set of policies, procedures, tools and internal capacity to identify, monitor and manage its exposure to the E&S risks of its clients. The ESMS also states IPDC's commitment to E&S management, explains its procedures for identifying, assessing and managing E&S risk of financial transactions, defines the decision-making process, describes the roles, responsibilities and capacity needs of staff in doing so and states the documentation and recordkeeping requirements. It also provides guidance on how to screen transactions, categorize transactions based on their E&S risk, conduct E&S due diligence and monitor the client's E&S performance. It will be implemented through a set of procedures for:

- Screening transactions,
- Conducting environmental and social due diligence,
- Categorizing transactions based on their environmental and social risk,
- Decision-making process,
- Monitoring the client's/investee's environmental and social performance, and
- Managing a client's/investee's non-compliance with the environmental and social standards of IPDC

**Components of an ESMS**




The procedures outlined in the ESMS shall be applied to each transaction as part of overall risk management framework of IPDC. For each transaction, this also requires the company to formally document its E&S review as part of its record-keeping process, consider E&S findings during the decision-making process, and incorporate E&S requirements such as a corrective action plan as clauses in legal agreements with clients/investee.

Key components of the ESMS are described below.

### A. Environmental & Social Policy of IPDC

IPDC continually endeavors to ensure effective Environmental & Social management practices in all its activities, products and services with a special focus on the following:

- Ensuring that all activities undertaken by the Company are consistent with the *Applicable Requirements* outlined later in this document

- Ensuring that all projects are reviewed against the *Applicable Requirements*
- Financing projects only when they are expected to be designed, built operated and maintained in a manner consistent with the Applicable Requirements
- Making best efforts to ensure that all projects are operated in compliance with the *Applicable requirements* on an ongoing basis, during the currency of the Company's financing
- Ensuring transparency in its activities
- Ensuring that the management and the shareholders of the client companies understand the policy commitments made by the Company in this area.
- This Policy will be communicated to all staff and operational employees of the Company.

***Applicable Requirements***

The Company will ensure that all projects are reviewed and evaluated against the following Environmental & Social requirements:

- The Exclusion List for all projects
- The applicable national laws on environment, health, safety and social issues and any standards established therein
- The IFC Performance Standards

**B. Organization structure**

For the ESMS to function properly, it is essential that roles and responsibilities for carrying out the necessary procedures and making decisions are clearly defined. The following staff of IPDC will be involved with implementing different aspects of the ESMS:

- **Relationship Managers** (Officials in Corporate/ Retail/ MME/ SCF and other Division): RMs are responsible for identifying E&S risks in a client's operation by talking to the client/ relevant officials, site visits, collecting documents, permits relevant for the proposed transaction. RMs are responsible for filling out the ESDD checklist in consultation with the client at approval stage, collect additional information and respond to credit queries if necessary also follow up with client if there are any pre disbursement actions to be completed. RMs also negotiates with the client in finalizing action plans and timelines where necessary.
- **Official in CRM Division:** Official in Credit Risk Management (CRM) Division in Head Office/Branch will review the ESDD checklist completed by the RMs. Based upon the risk rating the official escalates the transaction to Head of CRM. The in-charge of Risk Control Unit (RCU) will also work as ESRM unit Head until new recruitment for the position.
- **Head of Business:** Head of Business is responsible to ensure that the RM under his/her jurisdiction properly comply with the requirements of these guidelines during the initial processing of loan/investment proposals and after disbursement of loan/investment.
- **Head of CRM:** Head of CRM is responsible for ensuring that in each transaction no critical E&S issues were overlooked, there is adequate documentary evidence to support client's E&S performance and to ensure enough measures have been taken to manage identified risk.
- **Senior Management / Board of Directors:** The Senior Management (MD/AMD/DMD) and the Board should be responsible for the IPDC's overall commitment to E&S objectives.

- **Credit Administration Department(CAD):** The CAD ensures that IPDC's E&S requirements are incorporated in legal agreements for each transaction. The CAD may advise if a client's non-compliance with E&S clauses constitutes a breach of contract and is considered an Event of Default under the terms of the legal agreement that requires follow up by Senior Management.
- **Sustainable Finance Unit (SFU):** SFU of IPDC is responsible for coordination with different departments, branches of IPDC for ensuring the compliance of ESRM and proper implementation of ESMS. This unit is responsible for updating the Board through Sustainable Finance Committee on the current status of IPDC's portfolio regarding ESRM, facilitating the Board's decision-making process where there are unresolved E&S issues or non-compliance. The unit is also responsible for periodic reporting to Bangladesh Bank and as/when required. Head of the SFU may be called upon by the Board to opine on critical E&S issues of a transaction. The SFU is also responsible for tracking latest E&S issues in the media and support transaction teams in identifying and managing E&S risks in lending

### C. Screening Transaction

At the initial stage of evaluating a potential financial transaction, RM should screen the activities of the potential client to determine if it is under exclusion list (Annex -1). If the activity falls under the exclusion list, the financial transaction should not be considered. During the initial screening the RM should consider the Department of Environment (DoE) categorization as it gives a sense whether the transaction is in a high risk sector.

### D. Categorizing Transaction

To determine the extent of E&S due diligence which will be required for a particular transaction, an E&S risk category should be assigned to each transaction. The level of E&S risk will vary greatly for different types of financial transactions and by industry sectors. To help IPDC to determine the extent of E&S due diligence that will be required for a particular transaction, the concerned staff should assign an E&S risk category to each transaction. This provides an initial assessment of the E&S risk associated with the transaction. Together with the findings of the E&S due diligence, this E&S risk category can be incorporated into the overall risk assessment of a transaction and factored into the decision-making process. This initial categorization can be done by considering DoE categories of Green, Orange A, Orange B and Red. A list of business categories is available in the Environment Conservation Rules (ECR), 1997.

### E. Conducting ESDD

Conducting ESDD on transactions is a critical component of ESMS and its outcome should be factored in to the decision-making process for proceeding with a transaction. The purpose of the E&S due diligence is to review any potential E&S risks associated with the business activities of a potential client ensure that the transaction does not carry E&S risks, which could present a potential liability/risk to the IPDC. The purpose of the E&S appraisal is to:

- Identify and assess potential E&S impacts and issues, both adverse and beneficial, associated with a proposed investment project;
- Conduct a gap analysis to define areas of project noncompliance with the requirements of the national laws
- Assess the commitment and capacity of the client to manage identified impacts and define remedial measures as needed;

- Assess the quality and adequacy of the client's E&S management systems and practices to avoid, minimize, or mitigate adverse impacts, and define remedial measures as needed;
- Identify measures to avoid, minimize, mitigate, or offset/compensate for adverse impacts on workers, affected communities, and the environment;
- Design an Environmental and Social Action Plan (ESAP or Action Plan) addressing all deficiencies and non-compliances discerned during the appraisal containing specific tasks designed to close all significant gaps;
- Ensure that the investment contracts (e.g., loan documentation) include appropriate definitions, covenants, clauses and associated elements to obligate the client to comply with all E&S laws and regulations, the ESAP, and applicable sections of general and sector-specific checklists; and stipulate progress and performance reporting obligations;

IPDC shall refer to the ESDD checklist only for carrying out the ESDD. The ESDD checklists will auto generate the E&S risk ratings – high, medium and low based on the responses provided to the questions in the checklist. The process of E&S due diligence, filling in the ESDD checklists will involve a simple desktop review or may require a site visit with the use of technical experts, if necessary, to understand potential E&S risks associated with business activities and review a client's compliance with the IPDC's E&S requirements. Relevant documents shall be collected to support E&S findings. Below are typical steps for conducting ESDD.

- **Step1:** Exclusion List: Screening of the project against a list of activities under exclusion list (Annex-1); the loan to be rejected if the project involves in the exclusion list.
- **Step 2:** DoE Categorization: Review of industry sector and environmental and social issues that are typically associated with this type of operation; The loan/investment applications do not fall into any category (Red/Orange A/Orange B/Green) defined by DoE, will be categorised as 'others' under this guidelines;
- **Step 3:** ESDD:
  - ➢ Review the project's compliance with applicable national environmental and social regulations;
  - ➢ Review the project sponsors' track record on environmental and social issues, in terms of potential non-compliance with national regulations or negative publicity;
  - ➢ Review the project's compliance against international standards or industry best practice regarding environmental and social issues; and
  - ➢ Documenting all required information. Every loan file should have a fully completed E&S checklist, copies of all permits, clearances (DoE clearance certificate, fire license, buyer's audit report), ESAP, E&S Covenants in loan agreement and after disbursement subsequent supervision reports.
- **Step 4:** Generate Risk Rating: Upon completion of the relevant checklist a risk rating (High, Medium, or Low) will be generated automatically.
- **Step 5:** ESAP: For High and Medium Risk transaction, a time bound action plan and relevant covenants will have to be included in the loan documentation.
- **Step 6:** Escalation: Depending upon the risk rating, the transaction will have to be escalated to the relevant authority according to escalation matrix (Annex-3).

- **Step 7:** Monitoring: Review of the proposed actions (if any) to mitigate potential environmental and social issues associated with the project throughout all phases of the project life cycle.
- **Step 8: Reporting:** The IPDCs will have to report both internally to senior management and also externally to Bangladesh Bank, shareholders on their sustainability performance.

**F. Decision making process**

Once the ESDD is completed the checklist will auto generate a risk rating- High, Medium or Low.

- **High Risk:** Transactions typically involve clients with business activities with significant adverse E&S impacts that are sensitive, diverse, or unprecedented. A potential impact is considered sensitive if it may be irreversible (such as loss of a major natural habitat), affect vulnerable groups or ethnic minorities, involve involuntary displacement and resettlement, or affect significant cultural heritage sites.
- **Medium Risk:** Transactions typically involve clients with business activities with specific E&S impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures and international best practice. Potential adverse environmental impacts on human populations or environmentally important areas are less adverse than those of High Risk transactions.
- **Low Risk:** Transactions typically involve clients with business activities with minimal or no adverse E&S impacts.

All the low risk transactions will be approved by the Credit Officer. All the medium risk transaction will be escalated to the Management Credit Committee (MCC) . All the high risk transactions will be escalated to the Board, after review by the MCC, for approval. In absence of the Board, the high risk transactions can be approved by the Executive Committee.

**G. Corrective Action Plan and Covenants:**

For Medium and High Risk projects there will be identified risks which will have to be mitigated. A corrective action plan can be developed identifying the risk, mitigation measure, timeline for implementation and who should be responsible for implementation. Transaction specific corrective action plan and covenants can be part of the legal loan documents. Various types of covenants are outlined in Annex-5 & a template of the corrective action plan is provided in Annex-6

**H. Monitoring:**

The purpose of monitoring a client's E&S performance is to assess existing and emerging E&S risks associated with a client's operations during the transaction. After approval a transaction, IPDC needs to monitor the client's ongoing compliance with the E&S clauses stipulated in the legal agreement. E&S risks or compliance status may change from the time of transaction approval.

From the time of transaction approval, E&S regulations may become more stringent, the client may modify its operations or production processes in a way that exacerbates previously identified risks or present new E&S risks. Managing emerging E&S risks at the transaction level ensures effective E&S risk management at the portfolio level.

The monitoring process generally involves a review of periodic E&S performance reports submitted by the client and regular site visits of the client's operations. Special attention should be paid to:

- Assessing implementation of any mitigation measures specified in the corrective action plan

- Monitoring for valid E&S permits or licenses
- Any fines and penalties for non-compliance with E&S regulations
- Recent reports from the relevant regulator or inspection authority confirming compliance with specified laws, including any emissions measurements proving that emissions are below the permitted limits
- E&S occurrences including major accidents or incidents associated with a client's operations such as worker injuries and spills
- Media attention to E&S issues related to the client
- Any complaints submitted by stakeholders about a client

If IPDC respective staff identifies E&S issues, such as a client's non-compliance with E&S clause stipulated in the legal agreement, they should follow up with the client to resolve these in a reasonable time frame. Depending upon the complexity of the E&S issues associated with a client's operation, IPDC respective staff should require a new corrective action plan and/or periodic on E&S performance throughout the duration of the transaction. The reporting frequency should be tailored to each individual transaction and should be based on self-monitoring by the client or monitoring by independent third parties and/or regulatory authorities. IPDC needs to refer to the monitoring checklist (Annex-7) for documenting their finding during the monitoring process.

**I. Managing Eventualities in Investment Projects:**

Non-routine events do occur in conjunction with business development, with consideration of new clients and investments, during appraisal, and in the post-commitment supervision cycle. Some common eventualities may include:

- Direct complaints made to IPDC for investing in environmentally or socially harmful projects.
- Negative media report/ Non-Governmental Organization (NGO) campaign about a particular transaction which IPDC has financed
- Serious accidents, incidents including fatalities
- Worker unrest, riots, demonstration on the roads

As soon as the RM knows about any such occurrence, the RM will immediately inform Head of Corporate/SME/Retail/SCF and other department , collect factual information about the event, conduct a site visit and develop an action plan to mitigate the occurrence of such event in the future and communicate to the client what implication there might be due to the event. There might also be requirement of re visiting the risk rating in light of the recent event.

**J. Internal/External Communication:**

IPDC's ESMS shall include periodic reporting on the E&S performance of transactions and measures taken to reduce its overall exposure to E&S risk. It should compile all E&S findings from monitoring clients and aggregate findings at the portfolio level. By analyzing this information, we can have a better understanding of its overall exposure to E&S risk through its portfolio. E&S performance reports typically include information on:

- Portfolio breakdown by business line, industry sector and E&S risk category
- Overall exposure to E&S risk and performance
- High-risk transactions and E&S due diligence process prior to transaction approval

- Major E&S risks of individual transactions, including cases of non-compliance
- Significant E&S accidents or incidents related to a transaction
- Implementation and changes in the company's ESMS

## 7.0 Implementing ESMS

E&S risk management procedures to be fully integrated into the IPDC's existing risk management framework. The Sustainable Finance Unit (SFU) of the company in consultation with relevant business teams and credit related departments will take a lead on implementation of ESMS.

## 8.0 Provision of Incentives and Disincentives

On the basis of the performance of the borrower(s) in relation with change in ESRR, incentives and disincentives need to be considered for the following

### 8.1 High ESRR at transaction/application/proposal level

The management of IPDC is authorized to consider the provision of incentives and disincentives for projects that have high pre-disbursal ESRR. During post-disbursal monitoring of the performance of the project, if change in ESRR is observed, the following options may be considered, provided any change to the interest rate and repayment term has to be incorporated as part of the loan agreement linked with changes in ESRR.

**Table 2: Options for incentives and disincentives**

| Sl. | Particulars | Probable option(s) |
|---|---|---|
| 1 | Incentive(s) if change in ESRR is positive | • Issuance of appreciation letter and upload the name of project on IPDC's website<br>• Reduction in interest rate<br>• Higher debt-equity ratio for borrowers<br>• Flexibility in loan conditions<br>• Favorable loan to value ratio for borrowers |
| 2 | Disincentive(s) if change in ESRR is negative | • Increase in interest rate<br>• Lower debt-equity ratio for borrowers<br>• Tougher loan covenants/conditions<br>• Tougher loan to value ratio for borrowers |

## Annex-1: Exclusion List

| Sl. No. | Sector / Activities |
|---|---|
| 1 | Production or trade in any product or activity deemed illegal under host country laws or regulations or international conventions and agreements, or subject to international bans, such as pharmaceuticals, pesticides/herbicides, ozone depleting substances, PCB's, wildlife or products regulated under the Convention on International Trade in Endangered Species (CITES).<br>Links: United Nations (UN) list of banned chemicals and products: http://www.un.org/esa/coordination/Consolidated.list-13FinalFinal.pdf<br>https://cites.org/sites/default/files/eng/app/2017/E-Appendices-2017-10-04.pdf |
| 2 | Ship breaking/ trading activities which include:<br>1. Ships with prevalent asbestos use (for e.g. passenger cruise);<br>2. Ships not certified —gas free for hot work |
| 3 | Drift net fishing, deep sea bottom trawling, or fishing with the use of explosives or cyanide |
| 4 | Hydraulic horn and >75 decibel horns, polypropylene and polythene bags, two stroke engines. |
| 5 | Operations impacting UNESCO World Heritage Site and/or Ramsar site |
| 6 | Illegal logging, and logging operations or conversion of land for plantation use in primary tropical moist forests |
| 7 | Production or activities involving forced labour/ child labour |
| 8 | Production or trade in:<br>1. Weapons and munitions<br>2. Tobacco in any form<br>3. Gambling, casinos<br>4. Pornography (goods/stores/web-based)<br>5. Brick production through Fixed Chimney Kiln (FCK) |
| 9 | Production or activities that impinge on the lands owned, or claimed under adjudication, by Indigenous Peoples, without full documented consent of such peoples |

## Annex-2: ESDD Checklist

| **Basic Information** | |
|---|---|
| Bank/FI Name | |
| Branch Name | |
| Date | |
| Name of Client/Account | |
| Transaction ID | |
| Location | |
| Division | |
| District | |
| Upazilla/Thana | |
| Sector | |
| | |
| CIB Sector code | |
| Product Manufactured/Traded | |
| Core Market | |
| Name of Relationship Official | |
| DOE Categorisation | |
| Transaction Type as Table 1 of Guidelines | |

| **Risk Rating of the Project** | |
|---|---|
| General Risks | |
| Environmental health and safety risks | |
| Social risks | |
| **Final Score** | |

Summary of the Rating

| | Questions | Answer |
|---|---|---|
| **1.0 General Risks** | | |
| 1.01 | Land clearance permit | O Valid O Applied O Not Taken O Not Applicable |
| 1.02 | Water discharge permit | O Valid O Applied O Not Taken O Not Applicable |
| 1.03 | Clearance from DOE | O Valid O Applied O Not Taken O Not Applicable |
| 1.04 | Fire license | O Valid O Applied O Not Taken O Not Applicable |
| 1.05 | Boiler license | O Valid O Applied O Not Taken O Not Applicable |
| 1.06 | Factory inspection certificate | O Valid O Applied O Not Taken O Not Applicable |

| | | |
|---|---|---|
| 1.07 | Permission from Department of Explosives | O Valid O Applied O Not Taken O Not Applicable |
| 1.08 | Notices were received or fines/penalties were charged for exceeding the limits of air, water, noise and waste levels in past three years. | O Yes O No/Not Applicable |
| 1.09 | The local community is adversely affected by pollution or there was loss of livelihood because of the project. | O Yes O No/Not Applicable |
| 1.10 | Worker unrest in the project caused riots/road blocks within the last three years. | O Yes O No/Not Applicable |
| 1.11 | The project involves activities like converting rice fields into industrial land, filling out water bodies (river, ponds) for business purpose. | O Yes O No/Not Applicable |
| 1.12 | The client has taken adequate measures to mitigate the impact of the operation on the eco-sensitive areas as per regulations. | O Yes/Not Applicable O No |
| 1.13 | The client has a defined policy on environmental health and safety. | O Yes/Not Applicable O No |
| 1.14 | The client has a defined policy on social issues management. | O Yes/Not Applicable O No |
| 1.15 | The client has a defined policy on grievance mechanism. | O Yes/Not Applicable O No |
| | | |
| **2.0 Environmental risks** | | |
| 2.01 | Plant machineries, walkways, office areas etc. are free from dust emission. | O Yes/Not Applicable O No |
| 2.02 | There is sufficient ventilation i.e. provisions for cross ventilation (e.g., windows at regular intervals, exhaust fans, dust controller etc.) | O Yes/Not Applicable O No |
| 2.03 | There are regular monitoring mechanism and records of ambient air quality and noise level. | O Yes/Not Applicable O No |
| 2.04 | There are mitigation measures to minimize air pollution. | O Yes/Not Applicable O No |
| 2.05 | There are mitigation measures to minimize high noise level. | O Yes/Not Applicable O No |
| 2.06 | There are proper measures to control emission of $CO_2$, $SO_2$, NOX. | O Yes/Not Applicable O No |

| | | |
|---|---|---|
| 2.07 | Wastewater/effluent is discharged to a location which is not according to the license and permits. | O Yes O No/Not Applicable |
| 2.08 | There is an installed Effluent Treatment Plant (ETP) or Sewage Treatment Plant (STP). | O Yes/Not Applicable O No |
| 2.09 | There are monitoring records of treatment of water (such as quantity of water treated, quality of wastewater before and after treatment, running hours of ETP etc.) | O Yes/Not Applicable O No |
| 2.10 | There is a strong odor of chemicals, dumped waste, blocked sewerage etc. caused by untreated effluent. | O Yes O No/Not Applicable |
| 2.11 | The project keeps wastewater discharge (quality and quantity) within the prescribed limit. | O Yes/Not Applicable O No |
| 2.12 | There is evidence of land contamination because of activities such as leakages, spills, improper storage of waste, toxic effluent discharge. | O Yes O No/Not Applicable |
| 2.13 | There are well maintained records on quantity and quality of solid waste generated (including when it was generated) and how it is being treated. | O Yes/Not Applicable O No |
| 2.14 | There are boxes, cartons, plastic packets, rags, unused or left over raw materials dumped indiscriminately. | O Yes O No/Not Applicable |
| 2.15 | There is a disaster management system in place to deal with natural calamities | O Yes/Not Applicable O No |
| | | |
| **3.0 Social risks** | | |
| 3.01 | There are sufficient notice boards in domestic language with information on Personal Protective Equipment (PPE)s, workplace safety, occupational hazards. | O Yes/Not Applicable O No |
| 3.02 | There are regular trainings of employees on occupational health and safety. | O Yes/Not Applicable O No |
| 3.03 | There is an onsite occupational health and safety treatment center. | O Yes/Not Applicable O No |
| 3.04 | Sufficient firefighting equipments are available, accessible, and identifiable from a distance. | O Yes/Not Applicable O No |

| | | |
|---|---|---|
| 3.05 | Firefighting equipments are properly maintained and kept unlocked, and have valid license. | O Yes/Not Applicable O No |
| 3.06 | Appropriate numbers of independent emergency exits are available per working area. | O Yes/Not Applicable O No |
| 3.07 | All emergency exits and access routes are free from obstruction. | O Yes/Not Applicable O No |
| 3.08 | There are regular health & safety audits. [Check if there are audits carried out by Accord, Alliance, buyers (for RMG sector only) any other third party] | O Yes/Not Applicable O No |
| 3.09 | Non-compliances identified in the audit reports are addressed. | O Yes/Not Applicable O No |
| 3.10 | There is an independent and functioning evacuation alarm present with continuous sound to notify all workers about an emergency situation and to ensure a fast and safe evacuation. | O Yes/Not Applicable O No |
| 3.11 | A fire safety plan or onsite emergency plan or disaster management plan is in place. | O Yes/Not Applicable O No |
| 3.12 | There is a daycare center for the children of the employees. | O Yes/Not Applicable O No |
| 3.13 | Facilities such as washroom and drinking water are sufficient for the employees. | O Yes/Not Applicable O No |
| 3.14 | Employees have a separate place for eating. | O Yes/Not Applicable O No |
| 3.15 | The project ensures payment of minimum wage. | O Yes O No/Not Applicable |
| 3.16 | There is evidence of employees working more than 60 hours in a week. | O Yes O No/Not Applicable |
| 3.17 | Verbal, physical abuse or fines are used as disciplinary actions. | O Yes O No/Not Applicable |
| 3.18 | There is evidence of discrimination based on gender or religion. | O Yes O No/Not Applicable |
| 3.19 | There are adequate safeguards in place to avoid child labour and forced labour. | O Yes/Not Applicable O No |
| 3.20 | The project maintains records for age of workforce, wages, payment and attendance. | O Yes/Not Applicable O No |
| 3.21 | There are provision for labor unions, representation, collective bargaining and grievance mechanism. | O Yes/Not Applicable O No |

| | | |
|---|---|---|
| 3.22 | There is presence of a plan for community health and safety. | O Yes/Not Applicable O No |
| 3.23 | There is evidence of issues that may create nuisance/accidents/injuries to local community in future. | O Yes O No/Not Applicable |
| 3.24 | There is physical evidence of foul smell, noise, air pollution etc. due to project operations that may impact the local community. | O Yes O No/Not Applicable |
| 3.25 | There are measures to mitigate adverse impacts of the hazardous waste on the local community. | O Yes/Not Applicable O No |
| 3.26 | There are safeguards in place to minimize or avoid community exposure to potential harmful impacts from hazardous material. | O Yes/Not Applicable O No |
| 3.27 | The client has taken mitigation measures to stop spreading waterborne diseases or improper disposal of solid waste on land. | O Yes/Not Applicable O No |
| 3.28 | The project caused displacement of local community. | O Yes O No/Not Applicable |
| 3.29 | The displaced community were resettled and properly compensated. | O Yes/Not Applicable O No |
| 3.30 | The project has a grievance redressal system (such as regular meeting) which gives the affected community and other stakeholders a platform to express their concerns. | O Yes/Not Applicable O No |

## Annex-3: Escalation Matrix

| Risk Rating | Proposing Stage | Approval Stage | Disbursement Stage |
|---|---|---|---|
| Low | ESDD Checklist is to be completed by RM, approved by official(s) of CRM in head office/branch and processed as per normal credit process for both existing and new clients | | |
| **Medium** | RM & official of Risk Control Unit (RCU) Head of to sign off jointly for new or existing clients | Escalation Process: if CRM official feels the transaction needs to be escalated:<br>1. CRM official will be the first point of review.<br>2. If identified risk(s) is unresolved, proceed for review by RCU and approval by Head of CRM.<br>3. Credit approval can only be granted subsequent to resolution via above steps.<br>4. If require, Time-bound action plan to mitigate risks may form part of approval conditions. | If there are any conditions to be fulfilled as part of approval, RCU will check for the same before disbursing. |
| **High** | RM & Head of Risk Control Unit (RCU) to sign off jointly for new or existing clients with proposals to: REJECT (with reasons documented for record); or PROCEED with providing proper justification | Escalation Process:<br>1. CRM official will be the first point of review<br>2. If identified risk(s) is unsolved, proceed for review by Head of CRM and Head of Sustainable Finance Unit/Department<br>3. All high risk projects are to be escalated to Board (to EC if Board meeting has not been held within the given time) with a recommendation from MCC.<br>4. Credit approval can only be granted subsequent to resolution via above steps<br>5. Time-bound action plan to mitigate risks may form part of approval conditions | If there are any conditions to be fulfilled as part of approval, Management Credit Committee (MCC) will check for the same before disbursing. |

## Annex-4: E&S Risks in Detail

**Air emissions and Air Quality -** Emissions of air pollutants can occur from a wide variety of activities during construction, operation and decommissioning of a client's operations. Air emissions are typically associated with processes such as combustion, storage of materials or other industry-sector specific processes and can be:

- **Point sources:** These are discrete, stationary, identifiable sources of emissions (such as a specific stack, vent or other discrete point of emission) that release pollutants to the atmosphere. They are typically located in manufacturing or production plants. Point sources are characterized by the release of air pollutants typically associated with the combustion of fossil fuels, such as nitrogen oxides (NOx), sulfur dioxide (SO2), carbon monoxide (CO), and particulate matter (PM), as well as other air pollutants including certain volatile organic compounds (VOCs) and metals that may also be associated with a wide range of industrial activities.

- **Fugitive sources:** These are emissions that are distributed spatially over a wide area and originate in operations where exhausts are not captured and released through a stack. Fugitive emissions have the potential for much greater ground-level impacts than stationary source emissions, since they are discharged and dispersed close to the ground. The two main types of fugitive emissions are Volatile Organic Compounds (VOCs) and Particulate Matter (PM). Other contaminants (NOx, SO2 and CO) are mainly associated with combustion processes designed to deliver electrical or mechanical power, steam and heat.

- **Mobile sources:** These are emissions associated with vehicle use and include CO, NOx, SO2, PM and VOCs. Emissions can be reduced by implementing a regular vehicle maintenance and repair program, instructing drivers on better driving practices that reduce both the risk of accidents and fuel consumption, replacing older vehicles with newer, more fuel efficient alternatives, converting to cleaner fuels and installing emissions control devices such as catalytic converters.

  A client should estimate and monitor air emissions associated with operations through qualitative or quantitative assessments and atmospheric dispersion models to assess potential ground level concentrations and environmental impacts. At a facility level, air emissions should not result in pollutant concentrations that exceed the ambient air quality standards set by national authorities, which would result in fines and/or penalties if concentrations are in violation of national legislation. Pollutant concentrations can also be compared to international best practice and standards to identify any deviations, which would indicate poor performance of an operation. Air emissions of concern typically include:

- **VOCs:** Emissions of VOCs are associated with industrial activities that produce, store and use VOC-containing liquids or gases in particular where the material is under pressure. Typical sources include equipment leaks (from valves, fittings and elbows), open vats and mixing tanks, storage tanks, unit operations in wastewater treatment systems and accidental releases. Emissions can be reduced by modifying equipment, regularly monitoring equipment to detect and repair leaks, using less volatile substances such as aqueous solvents and collecting vapours through air extractors.

- **PM:** Dust or PM is released during certain operations such as the combustion of fossil fuels, open storage of solid materials, and from exposed soil surfaces, including unpaved roads. Emissions can be reduced through dust control methods such as covers, water suppression, or increased moisture content for open materials storage piles, or controls (such as a baghouse or cyclone).

- **Ozone Depleting Substances (ODS):** Ozone depleting substances (ODSs) include chemicals, which have been scheduled for phase-out under the Montreal Protocol on Substances that Deplete the Ozone Layer. Systems or processes using chlorofluorocarbons (CFCs), halons, 1,1,1-trichloroethane (methyl chloroform), carbon tetrachloride, hydrochlorofluorocarbons (HCFCs), hydrobromofluorocarbons (HBFCs), and methyl bromide should be gradually phased out or not used at all as determined by national regulations. These chemicals are typically used in a variety of applications including refrigeration, air conditioning, manufacturing foam products, solvent cleaning, aerosol propellants, fire protection systems and as crop fumigants.

- **Greenhouse Gases (GHGs):** GHGs, as defined under the Kyoto Protocol to the United Nations Framework Convention on Climate Change, include carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride ($SF_6$). GHGs can be generated by a facility's production processes as well as from the production of power (on-site or off-site) for use by the facility. Emissions can be reduced through mechanisms such as carbon financing, energy efficiency, sustainable forms of agriculture and forestry, use of renewable forms of energy, carbon capture and storage technologies, recovery and use of methane in waste management and energy distribution.

- **Sulfur dioxide ($SO_2$):** Sulfur dioxide ($SO_2$) is mainly produced by the combustion of fuels such as oil and coal and as a by-product from some chemical production or wastewater treatment processes. Emissions can be reduced through the use of alternate fuels such as low sulfur coal, light diesel or natural gas, emissions control technologies.

- **Toxics (mercury):** Mercury exists as elemental mercury, inorganic mercury compounds (primarily mercuric chloride), and organic mercury compounds (primarily methyl mercury). All forms of mercury are toxic and each form exhibits different health effects. A major source of exposure to elemental mercury is through inhalation in the work place. Sources of inorganic mercury compounds are generally low as their use has mostly been banned but limited exposure can occur through the use of old cans of latex paint. Sources of methyl mercury include fungicide-treated grains and meat from animals fed with treated grain.

  Where possible, a client's operations should avoid, minimize and control adverse impacts to human health, safety and the environment from emissions to air. The generation and release of air emissions can be managed through a combination of energy use efficiency, process modification, selection of fuels or other materials and application of emissions control techniques. IPDC can help a client to identify areas for reductions in air emissions and to identify environmental business opportunities.

**Water use and conservation -** A client's operations use water in various production processes, which vary by industry sector. Typically, water use at the facility level is associated with processes such as described here.

- **Process water:** Processes that typically use large quantities of water include washing machines, rinsing, water jets or sprays to keep conveyors clean or to cool product, and the use of tanks, which are refilled to control losses. Opportunities for reducing water use exist through water reuse, improved equipment maintenance and better process design.

- **Building facility operations:** Consumption of building and sanitary water is typically less than that of industrial processes. Areas for reducing water use include repairing leakages and installing water-saving devices.

- **Cooling systems:** Once-through cooling systems with cooling towers use large quantities of water and can be replaced by closed circuit cooling systems. Fresh water use can also be reduced by replacing it with treated water.

- **Heating systems:** Closed heating systems based on the circulation of low or medium pressure hot water may consume large quantities of water if they leak and are poorly maintained. In some cases, large quantities of water may be used by steam systems but water use can be reduced through steam recovery systems and improved systems operations.

Where possible, a client's operations should reduce overall water use at the facility level by managing the water consumption associated with specific production processes to avoid excess costs. IPDC can help a client to identify areas for reductions in water use and new environmental business opportunities.

**Wastewater and water quality** - A client's operations generate wastewater, which is treated on site and/or discharged either to the municipal sewage system for treatment or directly to the environment (surface water) without prior treatment. Wastewater includes process wastewater, wastewater from utility operations, storm water and sanitary wastewater. Wastewater will vary in quality and quantity by industry sector and typically includes:

- **Process wastewater:** Pollutants may include acids, bases, and many others. These include soluble organic chemicals, suspended solids, nutrients (phosphorus and nitrogen), heavy metals (such as cadmium, chromium, copper, lead, mercury, nickel and zinc), cyanide, toxic organic chemicals, oily materials and volatile materials. The costs of treating process wastewater can be significant.

- **Wastewater from utilities operations:** Utility operations such as cooling towers and demineralization systems may result in high rates of water consumption, as well as the potential release of high temperature water containing high dissolved solids, residues of biocides and residues of other cooling system anti-fouling agents.

- **Storm water:** Storm water includes any surface runoff and flows from process and materials staging areas resulting from precipitation or drainage. Typically storm water runoff contains suspended sediments, metals, petroleum hydrocarbons, Polycyclic Aromatic Hydrocarbons (PAHs) and coliform. Rapid runoff, even of uncontaminated storm water, also degrades the quality of the receiving water by eroding stream beds and river banks.

- **Sanitary wastewater:** This may include effluents from domestic sewage, food service and laundry facilities serving site employees and can also include other sources such as from laboratories, medical infirmaries, equipment maintenance shops and water softening.

A client should monitor the quality, quantity, sources and discharge points of liquid effluents by type (process, utilities operations, storm water and sanitary). At a facility level, discharges of wastewater should not result in contaminant concentrations in excess of the effluent discharge quality standards of national regulations to avoid liability for fines and/or penalties. Discharge

quality can also be compared to international best practice and standards to identify any deviations, which would indicate poor performance of an operation. The generation and discharge of wastewater should be managed to reduce the volume of water requiring specialized treatment by improving water use efficiency, modifying production processes (including the use of hazardous materials that contaminate water), and treating wastewater on-site prior to discharge in order to reduce the load of contaminants.

Where possible, a client's operations should avoid, minimize and control adverse impacts to human health, safety and the environment from wastewater generation through wastewater management, water conservation and reuse. IPDC can help a client to identify opportunities for preventing or reducing wastewater generation through water conservation and recycling/reusing within operations and to identify environmental business opportunities.

**Wastes** - A client's operations may generate, store, or handle any quantity of hazardous or non-hazardous waste across a range of industry sectors.

Waste can be solid, liquid, or contain gaseous material that is discarded by disposal, recycling, burning or incineration. It can be a by-product of a manufacturing process or an obsolete commercial product that can no longer be used for its intended purpose and requires disposal. Inappropriate waste disposal practices can lead to contamination of ground water or potential fines and/or penalties as stipulated in national regulations.

Solid (non-hazardous) waste generally includes domestic trash, inert construction/demolition materials, metal scrap and empty containers (except those previously used to contain hazardous materials, which should be managed as a hazardous waste), and residual waste from industrial operations.

Hazardous waste shares the properties of a hazardous material (such as ignitability, corrosiveness, reactivity, or toxicity), or other physical, chemical, or biological characteristics that may pose a potential risk to human health or the environment if improperly managed. When a hazardous material is no longer usable for its original purpose and is intended for disposal, but still has hazardous properties, it is considered a hazardous waste. Typically, hazardous wastes include solvents, fuels, and asbestos in building materials, PCB oils in electrical equipment, most pesticides, and ozone depleting substances in refrigeration systems. Wastes may also be defined as "hazardous" by local regulations or international conventions, based on the origin of the waste and its inclusion on hazardous waste lists or based on its characteristics. Hazardous wastes should always be segregated from non-hazardous wastes. Facilities that generate and store wastes need to consider issues linked to waste minimization, generation, transport, and disposal. Typically, approaches to waste management include:

- **Waste management planning:** Facilities that generate waste should characterize their waste according to composition, source, types of wastes produced, generation rates, or according to local regulatory requirements. This information can be used to identify opportunities for pollution prevention, such as source reduction, reuse, and recycling.

- **Waste prevention:** Processes can be designed and operated to prevent, or minimize, the quantities of wastes generated and hazards associated with the wastes generated. This can be accomplished by substituting raw materials or inputs with less hazardous or toxic materials, or with those where processing generates lower waste volumes, and improving manufacturing processes to convert materials more efficiently.

- **Recycling and reuse:** The total amount of waste can be significantly reduced through the implementation of recycling and reuse plans. This entails identifying and recycling products that can be reintroduced into the manufacturing process or industry activity at a site or in industrial processing operations located at other facilities. It also includes identifying materials that can be reused, saving both costs and disposal needs.

- **Treatment and disposal:** If waste materials are still generated after the implementation of feasible waste prevention, reduction, reuse, recovery and recycling measures, waste materials should be treated and disposed of while considering all measures to avoid potential impacts to human health and the environment. Typical treatment and disposal methods include on-site or off-site biological, chemical, or physical treatment of the waste material to render it non-hazardous prior to final disposal; and treatment or disposal at permitted facilities specially designed to receive the waste.

- **Hazardous waste storage:** Hazardous waste should be stored so as to prevent or control accidental releases to air, soil, and water resources. This requires the need for storage in closed containers away from direct sunlight, wind and rain; secondary containments; and the provision of adequate ventilation where volatile wastes are stored.

- **Hazardous waste transportation:** On-site and off-site transportation of waste should be conducted using appropriate protocols to prevent or minimize spills, releases, and exposures to employees and the public. All waste containers designated for off-site shipment should be secured and labelled with the contents and associated hazards, and be properly loaded on the transport vehicles before leaving the site.

- **Hazardous treatment and disposal:** In the absence of qualified commercial or government-owned waste vendors, facilities generating waste should have the technical capability to manage the hazardous waste or install on-site waste treatment or recycling processes in a manner that reduces immediate and future impacts to the environment. This may also require the need for applicable permits, certifications, and approvals.

- **Small quantities of hazardous waste:** Hazardous waste materials are frequently generated in small quantities by many projects through a variety of activities such as equipment and building maintenance activities. Waste storage collection and storage areas should be visually inspected on a regular basis for evidence of accidental releases and to verify that wastes are properly labelled and stored. These types of wastes include spent solvents and oily rags, empty paint cans, chemical containers; used lubricating oil; used batteries (such as nickel-cadmium or lead acid); and lighting equipment, such as lamps or lamp ballasts.

- Where possible, a client's operations should implement sound waste management practices at the facility. IPDC can help a client to identify environmental business opportunities.

**Land contamination** - Land can become contaminated due to releases of hazardous materials, wastes, or oil, including naturally occurring substances.
Releases of these materials may be the result of historic or current site activities, including accidents during their handling and storage, or due to poor management or disposal. Land is considered contaminated when it contains hazardous materials concentrations, including oil, above baseline and/or naturally occurring levels.

Contaminated lands may involve topsoil or subsurface soil that, through leaching and transport, may affect groundwater, surface water, and adjacent sites. Where subsurface contaminant sources
include volatile substances, soil vapour may also create potential for contamination through infiltration of indoor air spaces of buildings.

Land contamination is a concern when hazardous materials, waste, or oil are present in any environment at potentially hazardous concentrations and the potential for contact with humans, wildlife, plants, and other living organisms exists. This may occur when a contaminant migrates from its point of release (e.g., leaching into potable groundwater) and humans or other living organisms are exposed to it (e.g., through ingestion or skin absorption). This has potential risks to human health(e.g., risk of cancer) and ecology and represents a liability to the polluter/business owners (e.g., cost of remediation, damage of business reputation and/or business-community relations) or affected parties (e.g., workers at the site and nearby property owners).

Land contamination should be avoided by preventing or controlling the release of hazardous materials, hazardous wastes, or oil to the environment. When contamination of land is suspected or confirmed during any project phase, the cause of the uncontrolled release should be identified and corrected to avoid further releases and associated adverse impacts. Contaminated lands should be managed to avoid the risk to human health and ecological receptors. This requires clean up reducing the level of contamination at the site while preventing human exposure.

In cases of land contamination representing an immediate risk to human health and the environment, appropriate risk reduction should be implemented as soon as practicable to remove the imminent hazard. Risk mitigation strategies should be developed based on site-specific conditions and target contaminant source reduction, taking into consideration technical and financial feasibility. To protect human health, access to a contaminated site should be limited or prevented, for example through signage, fencing, or site security. This may also require capping contaminated soil with clean soil to prevent human contact, introducing certain plants into contaminated soils or paving them over as an temporary measure to prevent direct contact.
A client's operations should implement the necessary measures to prevent releases of hazardous materials, waste, or oil to the ground. IPDC can help a client to identify environmental business opportunities.

**Labour and Working Conditions** - The pursuit of economic growth through employment creation and income generation should be balanced with protection for basic rights of workers. For any business, the workforce is a valuable asset, and a sound worker-management relationship is a key ingredient to the long-term sustainability of the enterprise. Failure to establish and foster a sound worker-management relationship can undermine worker commitment and retention, result in labour strikes, and can jeopardize a client's operations. Conversely, through a constructive worker-management relationship, and by treating the workers fairly and providing them with safe and healthy working conditions, clients may create tangible benefits, such as enhancement of the efficiency and productivity of their operations.
A client's commitment to establishing a sound worker-management relationship encompasses the following aspects:

- **Human resources policy:** A client should adopt a policy appropriate to its size and workforce, which sets out its approach to managing employees. The policy provides information regarding their rights under national labour and employment law, including their rights related to wages and benefits.

- **Working conditions and terms of employment:** A client should document and communicate to all employees and workers (including contract workers) their working conditions and terms of employment. These include their entitlement to wages and benefits, hours of work, overtime arrangements and overtime compensation, and leave for illness, maternity, vacation or holiday, that at a minimum comply with national law. This includes respecting a collective bargaining agreement with a workers' organization if there is such an agreement.

- **Workers' organizations:** Where permitted by law, employees should be granted the right to associate freely and to bargain collectively, by forming and joining workers' organizations or through alternative means. A client should not discourage workers from forming or joining workers' organizations and should not discriminate or retaliate against workers who participate in such organizations and bargain collectively.

- **Non-discrimination and equal opportunity:** A client should not make employment decisions on the basis of personal characteristics unrelated to inherent job requirements but rather on the principle of equal opportunity and fair treatment.

- **Retrenchment:** If a client anticipates the elimination of a significant number of jobs or a layoff of a significant number of employees, it should develop a plan for managing the adverse impacts on employees.

- **Grievance mechanism:** A client should provide all employees with a mechanism to raise reasonable workplace concerns, confidentially or anonymously if needed, so that concerns can be addressed promptly at the management-level without any retribution.

- **Child labour and forced labour:** A client cannot employ children in a manner that is economically exploitative, or is likely to be harmful to the child or to interfere with the child's education. A client cannot employ forced labour, which consists of any work or service not voluntarily performed by an individual but executed under threat of force or penalty.

- **Supply chain:** A client should pay attention to unfair labour practices of its suppliers, especially in instances where low labour cost is a factor in the competitiveness of supplies, and ensure that this is not due to harmful labour practices.
  Respecting international standards with regard to labour and working conditions benefits a client's operations by encouraging positive worker-management relationships that lead to more productive and stable operations, including a reduced likelihood of strikes, and provides a reputational advantage that comes from enhanced public recognition that good international standards are being followed.

**Community Health, Safety and Security** - A client's operations can increase the potential for community exposure to risks and impacts arising from accidents, structural failures, and releases of hazardous materials. A client's operations often bring benefits to communities including employment, services, and opportunities for economic development. However, these operations can also increase the potential for community exposure to risks and impacts arising from accidents, structural failures, and releases of hazardous materials. Communities may also be affected by impacts on their natural resources, exposure to diseases, and the use of security personnel.

While acknowledging the public authorities' role in promoting the health, safety and security of the public, it is also the client's responsibility to avoid or minimize these risks and impacts that may arise from operations. This includes implementing the following actions:

- **Consultation and grievance channels:** Where appropriate, the client should conduct consultations and establish a line of communication with the impacted community in order to understand and monitor potential impacts. An appropriate consultation and grievance mechanism can help manage and minimize potential risks, avoid reputational issues and reduce the risk of conflicts with the community.

- **Infrastructure and equipment safety:** The client needs to ensure that operations are conducted to prevent potential injury to the surrounding community, especially if aspects of the operations are accessible to the community. If the client's operations involve operation of moving equipment on public roads, the client needs to ensure that the necessary safety measures are in place to prevent the occurrence of any incidents and accidents.

- **Hazardous materials safety:** The client needs to prevent or minimize the potential for community exposure to hazardous materials that may be released during operations. If there is a potential for life-threatening hazards, the client needs to modify operations or substitute or eliminate substances causing the hazard. The client also needs to control the safety of deliveries of raw materials and of transportation and disposal of wastes.

- **Environmental and natural resource issues:** The client needs to avoid or minimize the exacerbation of impacts caused by natural hazards, such as landslides or floods that could arise from land use changes due to operations. This also includes avoiding or minimizing adverse impacts due to operations on soil, water, and other natural resources used by the affected communities.

- **Community exposure to disease:** The client needs to prevent or minimize the potential for community exposure to water-borne or vector-borne disease, and other communicable diseases that could result from operations. This also includes preventing or minimizing the transmission of communicable diseases that may be associated with the influx of temporary or permanent labour associated with the client's operations.

- **Increase in traffic:** Traffic, especially movement of heavy vehicles increases especially during construction phase. This can lead to possible accidents/incidents which need to be minimized. There is a need for traffic management plan and training of staff to manage and minimize accidents/incidents.

- **Emergency preparedness and response:** The client needs to inform surrounding communities of potential hazards associated with operations and collaborate with the community and local government agencies in preparing to respond effectively to emergency situations.

- **Use of security personnel:** A client may retain security personnel to safeguard its operations, which may pose risks to the surrounding community if not managed properly. This includes ensuring that security personnel have not been implicated in past abuses, have been adequately trained in the use of force (including firearms, if necessary) as well as in the conduct toward workers and the local community. The client will also provide a mechanism to allow the surrounding community to express concerns about security personnel and will investigate any allegations of unlawful or abusive acts of security personnel to take the necessary action to prevent recurrence.

If the impacts of a client's operations on the surrounding community are not appropriately managed, this can create conflict and objections to the client's presence in the community. This represents a reputational risk to the client at the local level, and if not addressed, may escalate to reputational risk at the regional and even international level.

**Land Acquisition and Resettlement** - Involuntary resettlement refers both to physical displacement and to economic displacement due to land acquisition associated with a client's operations. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (access to resources for income generation or means of livelihood) due to land acquisition (including rights-of-way) associated with a client's operations. Resettlement is considered involuntary when affected individuals or communities do not have the right to refuse displacement. This occurs in cases of: i) lawful expropriation or restrictions on land use based on eminent domain; and ii) negotiated settlements in which the buyer can resort to expropriation or impose legal restrictions on land use if negotiations with the seller fail. Displaced persons may be classified as persons who:

- have formal legal rights to the land they occupy;
- do not have formal legal rights to land, but have a claim to land that is recognized or recognizable under the national laws; or
- have no recognizable legal right or claim to the land they occupy.

Unless properly managed, involuntary resettlement may result in long-term hardship and impoverishment for affected persons and communities, as well as environmental damage and social stress in areas to which they have been displaced. For these reasons, involuntary resettlement should be avoided or at least minimized. However, where it is unavoidable, appropriate measures to mitigate adverse impacts on displaced persons and host communities should be carefully planned and implemented with appropriate disclosure of information, consultation, and the informed participation of affected persons. This includes implementing the following actions:

- **Compensation and benefits for displaced persons:** When displacement cannot be avoided, the client will offer displaced persons and communities compensation for loss of assets at full replacement cost and other assistance to help them improve or at least restore their standards of living or livelihoods.

- **Grievance mechanism:** The client needs to ensure that a grievance mechanism is in place to receive and address specific concerns about compensation and relocation that are raised by displaced persons or members of host communities.

- **Social impact assessment, resettlement planning and implementation:** Where involuntary resettlement is unavoidable, the client will conduct a census to identify the persons who will be displaced by the project, understand the likely impacts on the affected persons and community, develop entitlement framework and determine who will be eligible for compensation.
- **Physical displacement:** If people living on the site of a client's operations must move to another location, the client will: i) offer displaced persons choices among feasible resettlement options, including adequate replacement housing or cash compensation; and ii) provide relocation assistance suited to the needs of each group of displaced persons, with particular attention paid to the needs of the poor and the vulnerable. New resettlement sites built for displaced persons will offer improved living conditions.

- **Economic displacement:** If land acquisition for the client's operations causes loss of income or livelihood, the client will promptly compensate these persons, for example by compensating affected business owners for the cost of re-establishing commercial activities elsewhere, for lost net income during the period of transition, and for the costs of the transfer and reinstallation of their business operations.

- **Government-managed resettlement:** Where land acquisition and resettlement are the responsibility of the government, the client needs to collaborate with the responsible government agency to the extent permitted by the agency to achieve outcomes that are consistent with best international practice.

If a client's operations involve land acquisition and resettlement, this should be carefully managed to prevent the likelihood of hardship and impoverishment for affected persons and communities. Given that a displaced community will not be entirely satisfied with its new situation unless there is noticeable improvement in standards of living or livelihoods, this will remain a reputational risk for the client.

**Indigenous Peoples -** Indigenous Peoples (IPs) are recognized as social groups with identities that are distinct from dominant groups in national societies and are often among vulnerable segments of the population. Indigenous Peoples may be referred to in different countries by such terms as "Indigenous ethnic minorities", "aboriginals", "hill tribes", "minority nationalities", "scheduled tribes", "first nations", or "tribal groups".

IPs typically self-identify as members of a distinct indigenous cultural group and are recognized as such by others; have a collective attachment to geographically distinct habitats or ancestral territories, making use of natural resources in these habitats and territories; have customary cultural, economic, social, or political institutions that are separate from those of the dominant society or culture; and communicate in an indigenous language, often different from the official language of the country or region.

Indigenous Peoples are often closely tied to their traditional or customary lands and the natural resources on these lands. While these lands may not be under their legal ownership as defined under national law, the use of these lands by communities of IPs for their livelihoods or for cultural purposes is often recognized under customary law. However, the economic, social and legal status of Indigenous Peoples often limits their capacity to defend their interests and rights to lands and natural and cultural resources. Indigenous Peoples are particularly vulnerable if their lands and resources are transformed, encroached upon by outsiders, or significantly degraded. Their languages, cultures, religions, spiritual beliefs, and institutions may also be under threat. These characteristics expose Indigenous Peoples to different types of risks and severity of impacts, including loss of identity, culture, and natural resource-based livelihoods, as well as exposure to impoverishment and disease.

A client should ensure that during the course of operations, the identity, culture and natural resource-based livelihoods of Indigenous Peoples are respected and exposure to impoverishment and disease is prevented. This includes implementing the following actions:

- Avoid or minimize adverse impacts. When a client cannot completely avoid impacts on Indigenous Peoples, the client needs to mitigate or compensate for these impacts in a culturally appropriate manner and with the informed participation of affected Indigenous Peoples.

- **Consultation:** The client needs to establish an ongoing relationship with the affected communities of Indigenous Peoples, which should be culturally appropriate. If there are adverse impacts, the consultation process needs to ensure the free, prior, and informed consultation of the Indigenous Peoples and facilitate their informed participation with respect to proposed mitigation measures and sharing development benefits.

- **Sharing development benefits:** The client needs to identify opportunities for development benefits for affected Indigenous Peoples. This should aim at improving their standard of living and livelihoods in a culturally appropriate manner, including the long-term sustainability of the natural resource on which they depend.

- **Impacts on traditional or customary lands.** If a client's operations are located within traditional or customary lands or involve the commercial use of natural resources located on these lands, this will generate adverse impacts on the livelihoods or cultural identity of the community of Indigenous Peoples. The client needs to inform affected communities of their rights under national laws, including the recognition of customary rights; make efforts to avoid or at least minimize the size of the impacted land; and offer land-based compensation as well as culturally appropriate development opportunities to affected communities.

- **Relocation of Indigenous Peoples:** The client should avoid the relocation of Indigenous Peoples from their traditional lands. If relocation is unavoidable, the client needs to enter into a good faith negotiation with the affected communities and ensure that any relocation complies with best international standards.

If a client's operations are initiated and conducted without the involvement of Indigenous Peoples, this can lead to misunderstanding and conflict. Given worldwide concern for the well-being of Indigenous Peoples, there are significant reputational risks for a client if Indigenous Peoples issues are not managed appropriately.

**Cultural Heritage -** Cultural heritage encompasses properties and sites of archaeological, historical, cultural, artistic and religious significance as well as unique environmental features and cultural knowledge, and practices of communities protected for future generations. Cultural heritage encompasses properties and sites of archaeological, historical, cultural, artistic and religious significance as well as unique environmental features and cultural knowledge, innovations and practices of communities embodying traditional lifestyles, which are protected for current and future generations. Consistent with the requirements of the Convention Concerning the Protection of the World Cultural and Natural Heritage, a client is required to avoid significant damage to cultural heritage due to their business activities.
Impacts on cultural heritage typical involve the following:

- **Chance finds:** During the construction of a client's facility(s), there may be physical impacts on previously unknown or undocumented resources that were fully or partially buried prior to the start of construction.

- **Community input:** Where a project may affect cultural heritage, the client will consult with affected communities who use, or have used, the cultural heritage for longstanding cultural purposes to identify cultural heritage of importance. A client should incorporate the views of the affected communities on cultural heritage into the decision-making process.

- **Removal of cultural heritage:** Most cultural heritage is best protected by preserving it in its place, since removal is likely to result in irreparable damage or destruction of the cultural heritage. Cultural heritage should only be removed if the client can demonstrate that the overall benefits of operations at a particular site outweigh the anticipated loss of cultural heritage.

- **Legally protected cultural heritage areas:** When a client's proposed operations are located within a legally protected area or a legally defined buffer zone, the client is required to take additional measures to promote and enhance the conservation of the area.

**Use of cultural heritage.** If a client makes commercial use of a community's cultural heritage, such as embodiment of traditional lifestyles, the client is required to enter into a good faith negotiation with the affected local communities and to provide fair and equitable sharing of benefits from the commercialization of their cultural heritage.

If a client's operations are initiated and conducted without consideration for cultural heritage, there are significant legal and reputational risks. A systematic approach concerned for cultural heritage issues throughout a client's operations, including additional investments in the enhancement of cultural heritage, can bring significant reputational advantage to a client at both the local and international level.

## Annex-5: Covenants

E&S clauses can be incorporated into legal agreements with clients. This helps reduce IPDCs exposure to potential E&S risks associated with a client's operations.

**Positive Covenants:** Measures or actions to be taken by the client. These may include the requirement for compliance with national E&S regulations and international standards, and periodic reporting on E&S performance. In the event of significant accidents and incidents, with potentially adverse E&S effects such as spills or workplace accidents resulting in death, serious or multiple injuries or major pollution, the client is required to notify IPDC in a timely manner, such as within 3 days.

**Negative Covenants:** Actions that the client should refrain from undertaking.

**Conditions Precedent:** Conditions and requirements that the client has to fulfil prior to disbursement of funds by IPDC. These may include proof of valid permits and licenses, preparation of government-requested reports and delivery of completion of mitigation actions stipulated in the corrective action plan.

**Event of Default:** An event that entitles IPDC to cancel a transaction and declare all amounts owed by the client to become immediately due and payable. For transactions that involve complex E&S issues, this may include specifying a time period such as 30 days during which the client can resolve the issue after notification by IPDC.

**Corrective Action Plan:** The Plan is typically included as an annex to the legal agreement, outlining the specific mitigation actions to be taken by the client according to an agreed timeframe for implementation.

To assess compliance with the E&S clauses stipulated in the legal agreement, IPDC staff should periodically monitor clients and, as necessary, require the preparation of a periodic E&S performance report for review. IPDC should consider material non-compliances with the E&S clauses as a breach of contract, which constitutes an Event of Default under the terms of the legal agreement.

In case of such an event, IPDC staff needs to work with clients to resolve non-compliance issues in order to ensure that any potential exposure to the client's E&S risks is mitigated. Where resolving the non-compliance issue is not possible, It may be required to take legal action against the client to reduce its exposure to the E&S risks associated with the transaction.

## Annex-6: Corrective Action Plan

IPDC may develop a corrective action plan with a timeframe for the client to implement appropriate mitigation measures to comply with the E&S requirements. Depending on the nature of E&S risks associated with a client's operations, IPDC staff will develop a corrective action plan with a timeframe for the client to implement appropriate mitigation measures to comply with its E&S requirements. The purpose of a corrective action plan is to mitigate potential E&S risks in the context of a transaction to an acceptable level for the company.

IPDC staff should tailor the scope of a corrective action plan to each client according to the specific risks identified during the E&S due diligence process or during subsequent transaction monitoring. Corrective action plans range from simple mitigation measures to detailed management plans with actions that can be measured quantitatively or qualitatively. The corrective action plan should include a description of the specific mitigation actions to be taken by the client, a timeframe for implementation and a reporting requirement to inform IPDC on the status of completion.

IPDC will need to discuss the corrective action plan with the client and agree on its scope and timeframe for completion. If the corrective action plan is developed as part of the transaction appraisal process, it should be included in the legal agreement. The timeframe for implementation of specific mitigation measures will vary according to the E&S risk and may range from being a condition of transaction approval to a reasonable timeframe from disbursement or when E&S issues were identified during transaction monitoring.

The following template can be used for documenting the corrective action plan agreed with the client. The template also contains few examples for guidance.

**Table: Corrective Action Plan template with examples**

| Area of E&S concern as identified through ESDD | Corrective Actions required | Time frame | Action completion indicator | Respon -sibility | Cost involved |
|---|---|---|---|---|---|
| Evidence of land pollution due to discharge of untreated effluent | Action plan may include:<br>• Removal and treatment of contaminated ground soil<br>• Construction of sewage system for industrial wastewater<br>• Construction of wastewater treatment facility and discharge system for treated water | 6 months | • Installation of Effluent Treatment Plant (ETP). The ETP should be operational and the qualitative parameters of treated effluent should be within limits<br>• The discharge of treated effluent should be through the constructed discharge system and no other modes of discharge and leakages<br>• Qualitative parameters of treated contaminated ground soil should be within limits | Board | |
| Absence of grievance redressal mechanism | Establish a grievance redressal mechanism | 3 months | Well established grievance redressal mechanism which is appropriately communicated to the external stakeholders | Board | |
| Displacement of | Restoration of community | 3 months | | Senior | |

| Area of E&S concern as identified through ESDD | Corrective Actions required | Time frame | Action completion indicator | Respon -sibility | Cost involved |
|---|---|---|---|---|---|
| community structure | structure for common benefits | | | Manage ment | |
| Loss of trees, crops, perennials | Compensating for standing crops and trees | 1 year | Plantation of trees | Senior Manage ment | |

## Annex-7: Monitoring Checklist

| Sl. No. | Question /Issues to check | Response |
|---|---|---|
| *Project Summary Information* | | |
| 1 | Reporting period covered by this supervision report | |
| 2 | Specification of project stage (design, construction, operation or closure stage) | |
| 3 | Key developments and any major changes in project location and design, if any from the time of loan disbursement or from the last supervision period. | |
| *General Information* | | |
| 4 | Status of implementation of covenants/corrective action plan. Is it in line with the agreed timeframe? (i.e. if all covenants are implemented or partially implemented or not implemented or delayed implementation).<br>If partially implemented or not implemented or delayed implementation, RM to please mention the reason in the response column along with a timeline for completion of implementation as committed by the client during supervision. | |
| *EHS Management* | | |
| 5 | If there was any incidence of accidents, spills, leakages, explosion etc. during the reporting period.<br>If yes, what was the scale of damage (e.g. if there was any fatality, monetary loss etc.)? What was the action taken in response to the incident? | |
| 6 | If there were any recent fines or penalties issued by the regulatory body<br>If yes, RM to please mention the nature of violation, amount of fine/penalty paid, action taken by the client to address the issue to avoid any such fine/penalty in future. | |
| 7 | If there was any health & safety incident.<br>If yes, what was the extent of injury – minor, major or fatal?<br>What was the action taken in response to the incident? | |
| 8 | If there are any new E&S risks or adverse impacts observed due to client's operation. RM to please mention the types of new E&S risks, the reason for such new E&S risks, mitigation measures undertaken by the client to address the E&S risks. | |
| *Permits and Compliance Certificates* | | |
| 9 | All the required permits, licenses and clearances in place.<br>RM to please mention the issuance dates and duration of validity of all such permits, licenses and clearances. | |
| 10 | Other international management systems (for e.g. ISO 14000, OHSAS 18001, SA8000) followed by the client and if they have valid certifications for those management systems? | |
| *Grievance Redressal* | | |
| 11 | If there have been any recent complaints, grievance or protest received from local communities.<br>If yes, RM to please specify the nature of grievances; actions taken by the client to resolve grievances and if there any outstanding issues and measures proposed by the client to resolve them. | |
| 12 | If there were concerns raised during the stakeholder consultations carried out by the client during the reporting period.<br>If yes, what was the approach undertaken by the client to address those concerns? | |
| *Other Information* | | |
| 13 | Any other information pertaining to environmental matters, management approach, community, media or NGO coverage that need to be mentioned.<br>If there are any environment friendly initiatives, energy saving equipment etc. that might be relevant for IPDC. | |

## Annex-8: List of Relevant National Regulations and International Treaties

| Key E&S Areas | Relevant local regulation | Relevant international treaties and conventions for which Bangladesh is a signatory |
|---|---|---|
| Assessment and management of E&S risks and impacts | • National Environmental Policy, 2018<br>• Environment Pollution Control Ordinance, 1977<br>• Environmental Quality Standards for Bangladesh, 1991<br>• National Environment Management Action Plan (NEMAP), 1995<br>• Environment Conservation Act, 1995 and amended in 2010<br>• Environment Conservation Rules, 1997 and amended in 2003<br>• EIA Guidelines For Industry, 2021 | |
| Management of labour related issues such as recruitment, wages, occupational health and safety and others | • Labour Policy 2012<br>• Bangladesh Labour Act, 2006<br>• Labour Welfare Foundation law 2006<br>• Bangladesh Labour (Amended)Law, 2013<br>• Labour Relations under Labour Laws, 1996<br>• National Child Labour Elimination Policy, 2010<br>• The Fire Prevention and Extinction Act, 2003<br>• Fire Prevention and Extinction Rules, 2014<br>• Bangladesh Factory Act, 1965<br>• Bangladesh Factory Rules, 1979<br>• OSH Policy, 2011<br>• The Employees State Insurance Act, 1948<br>• The Employer's Liability Act, 1938<br>• Maternity Benefit Act, 1950<br>• Workmen's Compensation Act, 1923<br>• The Employment of Children Act, 1938 Bangladesh Industrial Act 1974 | • Occupational Hazards Due to Air Pollution, Noise and Vibration (Geneva), 1977<br>• Prevention and Control of Occupational Hazards (Geneva), 1974<br>• Occupational Safety and Health in Working Environment (Geneva), 1981<br>• Occupational Health Services (Geneva), 1985 |
| Resource efficiency and pollution prevention | • The Environment Pollution Control Ordinance, 1977<br>• National 3-R Strategy, 2010 (3R: Reduce, Reuse and Recycle)<br>• Hazardous Waste and Ship Breaking Waste Management Rules, 2011<br>• Biomedical Waste Management Rules, 2008<br>• Draft National Solid Waste Management Rules, 2010<br>• Draft National River Conservation Act, 2011 | • International Convention on Climate Change (Kyoto<br>• Protocol), 1997<br>• UN Framework Convention on Climate Change (New York), 1992<br>• International Convention on Civil Liability for Oil Pollution Damage (Brussels), 1969<br>• Convention on Oil Pollution (London), 1990 |

| Key E&S Areas | Relevant local regulation | Relevant international treaties and conventions for which Bangladesh is a signatory |
|---|---|---|
| | | • UN Convention on the Law of the Sea (Montague Bay), 1982 |
| Community health, safety and security | • Disaster Management Act, 2012<br>• Public Health Emergency Provisions Ordinance, 1994<br>• Biomedical Waste Management Rules, 2008<br>• Climate Change Act, 2010<br>• Draft National Solid Waste Management Rules, 2010<br>• National Plan for Disaster Management 2010-2015<br>• Sound Pollution Law, 2006<br>• Ship Breaking and Hazardous Waste Management Rules, 2010<br>• Water Supply and Sewerage Authority Ordinance, 1963<br>• Noise Control Rules<br>• National Health Policy, 2011 | • International Convention on Climate Change (Kyoto Protocol), 1997<br>• UN Framework Convention on Climate Change (New York), 1992<br>• International Convention on Civil Liability for Oil Pollution Damage (Brussels), 1969<br>• Civil Liability on Transport of Dangerous Goods (Geneva), 1989 |
| Land acquisition and Involuntary resettlement | • National Land Use Policy<br>• The Land Acquisition Act, 1894<br>• The Acquisition and Requisition of Immovable Property Ordinance, 1982<br>• The Acquisition and Requisition of Immovable Property Act, 2017 | |

| Key E&S Areas | Relevant local regulation | Relevant international treaties and conventions for which Bangladesh is a signatory |
|---|---|---|
| Biodiversity conservation and sustainable management of living natural resources | • National Biodiversity Strategy and Action plan (2004)<br>• Bangladesh Wildlife Conservation and Security Act, 2012<br>• Bangladesh Wild Life (Preservation) Act, 1974<br>• Bio Safety Rules, 2012<br>• Forest (Amendment) Act, 2012<br>• Forest Policy, 1994<br>• Social Forestry Rules, 2004<br>• National Forest Policy and Forest Sector Review (1994,2005)<br>• Draft Tree Conservation Act, 2012<br>• The Private Forests Ordinance Act, 1959<br>• Forest Transit Rule, 2011<br>• Climate Change Act, 2010 □ Deer Rearing Policy, 2009<br>• The Protection and Conservation of Fish Act 1950<br>• Draft Wetland Policy, 1998<br>• The Protection and Conservation of Fish Rules (1985)<br>• The Protection and Conservation of Fish Act, 1950<br>• National Conservation Strategy, 1992<br>• Private Fisheries Protection Act 1889<br>• Marine Fisheries ordinance 1983<br>• Revised National Conservation Act, 2010 | • Protocol on Biological Safety (Cartagena Protocol), 2000<br>• UN Framework Convention on Climate Change (New York), 1992<br>• International Plant Protection Convention (Rome), 1951<br>• International Convention on Climate Change (Kyoto Protocol), 1997<br>• Convention Relative to the Preservation of Fauna and Flora in Their Natural State (London), 1933<br>• International Convention for the Protection of Birds (Paris), 1950<br>• Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar), 1971<br>• Convention on The Conservation of Migratory Species of Wild Animals (Bonn), 1979<br>• Convention on Biological Diversity (Rio de Janeiro), 1992<br>• Convention on International Trade in Endangered Species of Wild Fauna and Flora<br>• UN Convention on The Law of The Sea (Montague Bay), 1982 |
| Indigenous peoples | • Social Forestry Rules, 2004<br>• The Acquisition and Requisition of Immovable Property Act, 2017<br>• The Land Acquisition Act, 1894 | |
| Cultural heritage | • The Antiquities Act, 1968 | • World Cultural and Natural Heritage (Paris), 1972 |

| | |
|---|---|
| IFC<br>Standards for different sectors | • IFC's Environmental, Health, and Safety (EHS) Guidelines: Textile Manufacturing<br>• IFC EHS Guidelines for Cement Manufacturing<br>• IFC EHS Guidelines for Construction Materials Extraction<br>• IFC EHS Guidelines for Tanning and Leather Finishing<br>• IFC EHS Guidelines for Ceramic Tile and Sanitary Ware Manufacturing<br>• IFC EHS Guidelines for Thermal Power Plants<br>• IFC EHS Guidelines for Nitrogenous Fertilizer Manufacturing,<br>• IFC EHS Guidelines for Phosphate Fertilizer Manufacturing,<br>• IFC EHS Guidelines for Pulp and Paper |

## Annex-9: Guidance Note on Environmental and Social Impact Assessment (ESIA) under Environmental and Social Risk Management

1. **Introduction:** To have a detailed understanding of the impacts of any project or industrial/manufacturing unit on different aspects of environment and society, Environmental and Social Impact Assessment (ESIA) is inevitable. ESIA is a process for predicting and assessing the potential environmental and social impacts of a proposed project; considering inter-linked socioeconomic and environmental impacts, both beneficial and adverse; evaluating alternatives and designing appropriate mitigation, management and monitoring measures. ESIA explores ways and means to mitigate adverse impacts of project activities, shape projects to adapt the local environment and social set up, present the predictions and alternatives to decision-makers. It also enables in carrying out environmental and social cost-benefit analysis of projects at the primary stage.
2. **Process of conducting ESIA:**
   - 2.1. **Screening**: Screening is a quick, high-level analysis to determine whether a full ESIA is necessary.
   - 2.2. **Scoping**: If a full ESIA is required, scoping determines which impacts are likely to be significant and should become the main focus of the ESIA. Scoping also identifies data availability and gaps.
   - 2.3. **Baseline studies**: Baseline studies provide a reference point against which any future changes associated with a project can be assessed and offer information for subsequent monitoring of environmental and social performance.
   - 2.4. **Impact prediction and evaluation**: Impact prediction and evaluation is the heart of the ESIA and involves analyzing the impacts identified in the scoping and baseline work to determine their nature, temporal and spatial scale, reversibility, magnitude, likelihood, extent and effect.
   - 2.5. **Mitigation**: Mitigation aims to eliminate or reduce negative environmental and social impacts.
   - 2.6. **Consideration of alternatives**: When all mitigation measures have been identified, a comparison of alternatives will allow identification of the least damaging option.
   - 2.7. **Environmental and Social Management Plan (ESMP):** This plan defines resources, roles and responsibilities required to manage environmental and social impacts as well as implement mitigation measures. The ESMP forms a link between the ESIA and the Environmental and Social and Management System.
   - 2.8. **Environmental and Social Impact Assessment Report**: The Environmental and Social Impact Assessment Report is the physical report on the ESIA process and findings. This report should provide a clear, jargon-free review of potential impacts and how they have been and will be mitigated.
3. **Standard Contents of Environmental and Social Impact Assessment Report:** The contents and structure of Environmental and Social Impact Assessment Report will definitely vary from project to project. Minimum contents for a standard ESIA report are given below:

<u>Section-1: Introduction</u>
Background
Objectives
1.2.1 Objectives of the Farm (Industry)
1.2.2 Objectives of ESIA
Scope of Work
Consistency with DOE Guidelines
Consistency with Bangladesh Bank Guidelines
Methodology
The ESIA Team (name, educational and work experience, Signature of all members) Limitations

Acknowledgement

Section-5: Prediction, evaluation and mitigation measures of impacts

5.1. General Consideration
5.2. Impacts on Physio-Chemical Environment
5.2.1 Impact due to Liquid Discharge
5.2.2 Impact on Air Quality
5.2.3 Pollution from Solid Waste
5.3. Impact on Socio-Economic Environment
5.3.1 Impact on Employment and Family Finance
5.3.2 Impact on Health and Safety
5.4. Impact on Indigenous people
5.5. Impact due to land acquisition
5.6. Hydrological Impact
5.7. Soil Erosion Investigation
5.8. Geotechnical Investigation

Section-6: Environmental and social management plan

6.1. General Consideration
6.2. Mitigation/Benefit Enhancement Measures
6.3. Monitoring Requirement
6.4. Monitoring Indicators
6.5. Environmental and Social Management Plan (ESMP)

Section-7: Disaster Management Plan

7.1 General Consideration
7.2 Type of Hazards/Disaster
7.3 Disaster Management Plan (DMP)

Section-8: Conclusion and recommendations

8.1. Conclusions
8.2. Recommendations
8.3. List of Reference

Annex: List of Applicable policies and legislations

- Industrial Policy 1991, 2005
- National Environmental Policy 1992
- National Conservation Strategy
- National Environmental Management Action Plan (NEMAP)
- Conventions, Treaties and Protocols
- Bangladesh Environmental Conservation Act (ECA), 1995 (Amended in 2002)
- Environment Conservation Rules (ECR) 1997 (Amended in 2003)
- Environment Court Act, 2000
- National Land-use Policy, 2001
- Bangladesh Labor Act, 2006 (Amended in 2013)
- Bangladesh National Building Code
- National Agricultural Policy 1999 (Amended in 2013)
- National Water Policy 1999
- National Water Management Plan: Development Strategy (2011)
- Bangladesh Water Act 2013
- Guideline on Environmental and Social Risk Management (ESRM) for Banks and Financial Institutions in Bangladesh, 2017

- National Fisheries Policy 1998

**4. Eligibility criteria to be Third Party for conducting ESIA:**

ESIA will generally be arranged by the borrowers at its own cost and submitted along with the loan application. IPDC will ensure that ESIA is done through qualified third party. Qualification criteria include:

i. Capacity and ability to prepare ESIA following specific structure and to a high standard.
ii. Service provider's legal status, formation documents and availability of required licenses or approvals for doing the service
iii. Adequate experience and competence to prepare ESIA
iv. ESIA preparing team consists of at least 5 members.

***Qualifications for members are as follows:***

a) One member having Post graduate degree in Environmental Engineering/Earth and Environmental sciences (Geography, Geology, Soil Science, Forestry)/Disaster science and Management/ related subject with at least Five-year experience in relevant field.

b) One social safeguard specialist having post graduate degree in social science / Sociology/ related subject with at least Two-year experience in relevant field.

c) One certified energy auditor registered under Association of Energy Engineers (AEE) or any other nationally or internationally recognized organization with at least Two-year experience in relevant field.

d) 2 other members graduated in agricultural/Civil/Water Recourse Engineering or Environmental Science or related subject with at least Two-year experience in relevant field.

## Annex-10: Sector Specific Guidance Note on ESRM

IPDC Finance will use the industry specific ESDD if the project activities fall within the following industries:

A. Textile and Apparel Sector
B. Tanning and Leather Finishing Sector
C. Cement Manufacturing Sector
D. Ceramic Tile and Sanitary Ware Manufacturing Sector
E. Fertilizer Manufacturing Sector
F. Pharmaceutical Sector
G. Ship Breaking Sector
H. Power Sector
I. Pulp & Paper Sector
J. Steel Re-rolling Sector

### Objectives of the Sector Specific Guidance Note

The objective of this Guidance Note on ESRM is to provide a high-level indicative summary of potential environmental and social (E&S) risks and performance levels for transactions in environmentally and socially sensitive sectors in Bangladesh. The scope of application will be fully aligned with the Guidelines on ESRM for IPDC complying applicable national regulations. The standards of this guidance will be complied as the minimum requirements whereas IPDC may prefer to the application of more stringent standards for the respective clients. A full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

## A. ESRM Guidance Note for Textile and Apparel Sector

### 1. Introduction

The objective of this Guidance Note on ESRM for the Textile & Apparel Sector is to provide a high level indicative summary of potential environmental and social (E&S) risks and performance levels for transactions in the Textile & Apparel sector in Bangladesh. The scope of application will be fully aligned with the Section 4 of this policy. At all times, applicable national regulations are to be followed. Where national regulations differ from the levels and measures presented in this Guidance Note, loan proposals are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in this Guidance Note are appropriate, in view of specific loan proposal, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment. For the purposes of this Guidance Note, Textile sector activities include, but are not limited to: Yarn Production; Fabric Production; Washing, Dyeing and Finishing (WDF); Ready Made Garment (RMG) Production; Polymer Synthesis and Natural Raw Material Production.

### 2. Industry Specific Impacts and Management

#### *2.1. Environmental Issues:*

The major environmental concerns related to the Textile & Apparel sector in Bangladesh include the following:

- **<u>Hazardous materials management</u>**

Textile manufacturing activities may include the use of hazardous chemicals mainly during pretreatment and dyeing processes in WDF to provide the final product with desired visual and functional properties. These chemicals include surfactants (e.g. detergents, lubricants etc.), complexing agents (e.g. EDTA or polyphosphate), antifoaming agents (based on mineral oils or hydrocarbons) and textile preservation agents (e.g. brominated and chlorinated compounds, dieldrin, arsenic, and mercury).

The chemicals are potentially hazardous, toxic and persistent in nature that can have a very damaging impact on the human health and the environment if not handled with proper care. The key measure that can be taken to avoid or minimize the use of these hazardous materials is to replace these agents with biodegradable or at least bio-eliminable compounds that do not contain Nitrogen or Phosphate in their molecule. Some examples are:

- For detergents / surfactants- APEO should be replaced with alcohol ethoxylates
- For anti-foaming agents – mineral oil based antifoaming agents should be replaced with agents based on silicones, phosphoric acid esters, high molecular alcohols, fluorine derivatives
- For complexing agents – EDTA should be replaced with polycarboxylic acids (e.g. polyacrylates and polyacrylate-maleic acid copolymerisates), hydroxy carboxylic acids (e.g. gluconates, citrates) and sugar-acrylic acid copolymers
- For lubricants – mineral oil based lubricants should be replaced with water-soluble lubricants
- For flame retardants and cross linking agents – Agents with high formaldehyde levels should be avoided

In addition, recovery of auxiliary dyeing agents such as caustic soda (sodium hydroxide) by evaporation techniques should be practiced. In all cases, chemicals prohibited by Section 6.2.1 of the Oeko-Tex Association Standard 1000 (Oeko-Tex Association, 2006c) should be avoided in textile manufacturing.

- **Wastewater**

Wastewater is the most prominent environmental issue of the textile manufacturing process. WDF is the major source of wastewater with high toxic load that, if not treated properly, may significantly contaminate surface and ground water, adversely impacting the environment and human health. These units treat fabrics with chemicals (e.g. dyes) and liquor baths and often require several washing, rinsing, and drying steps, generating significant wastewater effluents. The scouring process during Yarn Production to remove dirt, soil, grease from fibres also generate large volume of alkaline wastewater. During the finishing process, water-polluting substances can originate from the dyes themselves (e.g. aquatic toxicity, metals, colour), auxiliaries contained in the dye formulation (e.g. dispersing agents, anti-foaming agents, etc.), basic chemicals and auxiliaries used in dyeing processes (e.g. alkali, salts, reducing and oxidising agents, etc.) and residual contaminants present on the fibre from yarn and fibre production (e.g. residues of pesticides in cotton, grease, spin finishes on synthetic fibres). Because of presence of these constituents, effluent streams from dyeing processes are typically alkaline with high BOD (from 700 to 2,000 mg/l) and COD loads, hot and coloured and may contain significant concentrations of heavy metals (e.g. chromium, copper, zinc, lead, or nickel). The generation of wastewater can be limited by the installation of Effluent Treatment Plants (ETP). In Bangladesh, in majority of WDF units ETP is either not installed or if installed, is non-operational. Below is a list of common and effective pollution prevention and control techniques that may be adopted in different stages of WDF process depending on the requirement.

- Recovery of heat from the final effluent should be practiced
- Use of bio-degradable or bio-eliminable chemicals during pre-treatment, dyeing and finishing processes should be adopted as discussed above
- Optimization of mechanical removal of water prior to the drying process
- Implementation of mechanical liquor extraction to reduce dye liquor carryover and improve washing efficiency
- Installation of ETP adhering to national standards
- Adoption of Bio-filtration process in ETP (combined aerobic, anaerobic process)
- Residual liquor during wet operations should be minimized through reduced application, reduced tank volumes and padding liquor recycling

- If possible, use of continuous and semi-continuous dyeing processes to reduce water consumption with respect to more traditional batch dyeing processes
- Replacement of chrome dyes with reactive dyes, liquid sulfur dyes with sulphide free or low sulphide dyes, adoption of low-salt, pH controlled dyeing process as applicable

- **Water Consumption**

The wet processing operations involved in WDF are water intensive. Water consumption in textile manufacturing has a significant environmental footprint in terms of wastewater/sludge production, ground and surface water contamination (impacting community health as well), and energy used in water pumping and heating. Keeping these in mind, it is important to have water meters installed at key processes and locations to track the quantity of water being consumed in various operations. Some of the leading textile manufacturers in Bangladesh have gone for installation of water meters on dyeing and rinsing machines, leading to significant water and energy savings and this can be replicated in other units in the country. Some of the effective techniques to optimize water consumption are as follows:

- Installation of water meters on dyeing and rinsing machines
- Use of water flow control devices
- Elimination of water leaks and reduced hose pipe use
- Reuse of cooling water from dyeing machine
- Reuse of dye baths, preparation and finishing water
- Counter current rinsing or reusing waste water from one process for another with less exacting water requirements. For example, using bleaching rinse water for textile washing or washing the floor.

- **Air Emissions**

Textile manufacturing operations that may generate significant sources of air pollutants include Raw Material Production, Yarn Production and WDF. The possible sources of air emissions and the mitigation measures are listed below. In addition there are exhaust gases from combustion of fossil fuels for heat/steam generation.

**Table- Sources of Air Emissions and Mitigation Measures:**

| Sector Activities | Air Emissions | Mitigation Measures |
|---|---|---|
| Raw Material Production, Yarn Production | • Dust generated from cotton handling and storage , synthetic staple processing<br>• Volatile Organic Compound (VOC) emissions from solvent wash for removal of water insoluble oils from fibres | • Enclosure of dust producing equipment, and use of local exhaust ventilation;<br>• Use of dust extraction and recycling systems to remove dust from work areas;<br>• Installation of fabric filters to prevent outdoor emissions. |

| | | |
|---|---|---|
| WDF<br>- | • VOC emissions from organic solvents, formaldehydes, ammonia, methanols etc. used during fabric cleaning, printing, heating processes; stenter frames used in dyeing processes<br>• Odour from dyeing and other finishing processes due to use of oils, solvent vapours, formaldehyde, sulfur compounds, and ammonia | • Installing and modifying equipment to reduce solvent use; □ Adopting water-based methods for removing oil and grease from fabric instead of using volatile solvents; □ Substituting cleaning solvents with less toxic solvents, particularly chlorinated solvents;<br>• Recovery of VOCs through vapor recovery units, and use of a fully closed-loop system, especially if cleaning with halogenated organic solvents cannot be avoided (e.g. for fabrics that are heavily loaded with silicone oils) using appropriate control technologies (e.g. diversion of stack emissions through boilers; installation of scrubbers with activated carbon slurries; installation of activated carbon absorbers; or incineration of extracted vapours in a combustion system).<br>• Substituting odour-intensive substances with less impacting compounds (e.g. sulfur containing dyestuffs with sulphide-free dyestuffs)<br>• Capturing and recovering the offgases from the processes (e.g. installation of heat recovery systems);<br>• Routing of stack emissions through boilers to reduce odour emissions. |

- **Energy consumption**

Textile manufacturing may involve significant use of energy resources. Heat consumption is particularly significant in drying and curing operations and in activities involving wet treatments. A list of basic low to moderate cost energy saving techniques are provided below some of which have been implemented by a few textile manufacturing units in Bangladesh leading to significant energy savings.

- Insulation of steam pipes
- Retrofitting boilers
- Recovery of waste heat from flu gas, steam
- Insulation of pipes, valves, and flanges
- Use of energy efficient motors
- Replacement of old spinning and weaving machines
- Use of servo motor based sewing machines
- Use of air nozzles to save compressed air

- **Solid and liquid waste**

Wastes specific to the textile industry include trials, selvedge, trimmings, cuttings of fabrics, and yarns; spent dyes, pigments, and printing pastes; and sludge from process wastewater treatment containing mainly fibers and grease. Solid and liquid wastes generated in textile industries should be effectively recycled or reused within the process or external activities (e.g. waste fibers, cuttings, and trimmings can be recycled as a feedstock for other operations, including low-grade products non-woven, insulation etc.). Management and disposal of hazardous and non-hazardous wastes should be in line with Environmental Conservation Act, 1995 (ECA) and Environmental Conservation Rules, 1997 (ECR) that have provisions for environmentally sound use, storage, transportation, import and export of hazardous and non-hazardous wastes or its components.

### *2.2. Health and Safety Issues:*

**Table- Common Structural, Fire & Electrical Safety Issues**

| Area | Issues commonly observed |
|---|---|
| Structural | Highly stressed columns, undocumented vertical extensions, localised areas of high loads in buildings, discrepancy between structural drawing & built structure, minor to major cracks in structural elements. |
| Fire | Inadequate, untested fire alarms, inadequate exit capacity compared to the occupancy load, inadequate exit signs. |
| Electrical | Unsealed entry and exit points of cable, excessive dust deposit on cables, cables laid on floor without guard, oil spill in generator room, inadequate earthing. |

**Table- Common Occupational Health Issues**

| Hazard | Description | Mitigation Measures |
|---|---|---|
| Chemical | • Workers' exposure to fine particles such as cotton dust leading to respiratory diseases during fibre (cotton) preparation.<br>• During finishing operations, VOC emitted during printing or fabric cleaning process leading to respiratory, heart diseases.<br>• Residues of pesticides and chemicals are left behind on the fabric leading to dermatitis.<br>• Chromium is a major cause of allergic contact dermatitis among workers who perform dyeing operations and handle dyestuffs containing chromium.<br>• Organic dusts, including cotton dust, are combustible and present a potential explosion hazard. | • Installation of dust and VOC extraction, recycling (e.g. scrubbers)<br>• Use of well-ventilated rooms<br>• Use of vacuum cleaning of surfaces instead of compressed air sweeping techniques;<br>• Implementation of regular housekeeping procedures<br>• Use of shift and task rotation strategies for workers to minimize VOC exposure<br>• Use of enclosed equipment<br>• Use of personal protective equipment (PPE) |

| | | |
|---|---|---|
| Physical | • Physical contact of workers with hot surfaces or moving equipment such as spinning, carding machines.<br>• High noise in the spinning and weaving mills during yarn and fabric production.<br>• Exposure to extreme heat and humidity in the sweatshops during wet processing and dry finishing operations in WDF units from the use of steam and hot fluids.<br>• Exposure to X-rays in the area of monitoring foam thickness during foam dyeing. | • Implementation of machine guarding and lock-out-tag-out systems and procedures<br>• Use of personal hearing protection<br>• Management of noise as per ECA 1995 and ECR 1997 (Rule 12, Schedule-4) |

### *2.3. Community Health & Safety:*

As discussed earlier, one of the major concerns for community health is the wastewater from the WDF units that can potentially contaminate the surface and ground water. Odours from dyeing and other finishing processes by oils, solvent vapours, formaldehyde, sulfur compounds, and ammonia can also impact community well-being. Measures to reduce toxicity in the wastewater, control odorous emissions are discussed in earlier sections.

An additional community health and safety issue concerns the use of chemicals and their potential risk to the health of consumers who purchase garments produced by the textile industry. Specific consideration should be given to ensuring that these products are safe for human use. The manufacturer should avoid using allergenic dyestuffs and dyestuffs that form carcinogenic compounds. Adequate testing for pH, pesticides, heavy metals, formaldehyde, chlorinated phenols, chloro-organic carriers, and biologically active finishes should be conducted to assess textile characteristics according to the typical conditions of their use prior to entry into the markets.

### 2.4. *Social Issues*

| Area | Issues commonly observed in Bangladesh |
|---|---|
| Gender Discrimination | Gender discrimination is an issue regarding recruitment, deciding on wages, promotion and providing incentives to the women workforce. Trainings to female workers on labour rights is another important aspect. |
| Working Conditions | In addition to structural, fire & electrical safety issues, availability of in-house health clinic and skilled nurses to attend the workers as well as sufficient toilet facilities, supply of potable water at the workplace are inevitable for healthy working condition. |
| Working Hours | Long working hour (e.g. beyond 12 hours/day, 7 days/week) is an issue due to inadequacy of training to workers' on labour rights, record keeping by the mill/factory owners on workers' daily working hours, payment of wages and overtime. |
| Maternity Leave | Issues like not granting maternity leave for 6 months or granting maternity leave without pay by the factory owners are still prevalent in the RMG sector. |
| Minimum Wages | Bangladesh aims to increase the minimum wage of the textile sector as it is still lower than that of most of the other peer countries where textile industry is prominent. |

| | |
|---|---|
| Forced and Child Labour | Existence of bonded child labour, forced labour due to insufficient policy, internal audit, record keeping on age proof by the mill/factory management. |
| Workers' Rights, Collective Bargaining | Restrictions on freedom of association, collective bargaining by the mill management are apparent from the lack of documentation of trade unions' activities. |
| Workers' Skills | Employment of unskilled workers to meet the ever growing demand for garment products often leads to repeat work, reducing productivity. Hence there is a need for competency based, industrial training with proactive participation from the mill/factory owners. |

Projects in this sector should follow national regulations, and in their absence, good international industry practices (GIIP), with respect to the following common social / worker issues:

- **Working conditions and the management of worker relationships**. For example, the project should have established policies and procedures for human resources management; working conditions and terms of employment; worker organizations and collective bargaining; non-discrimination and equal opportunity; and managing retrenchment, and worker grievance mechanisms.
- **Protecting the workforce**: For example, the project should have established policies and procedures to protect against child and forced labour.
- **Occupational Health and Safety:** For example, the project should provide for a safe and healthy work environment, with consideration of inherent risks in the sector and specific classes of hazards in the client's work areas, including physical, chemical, biological, and radiological hazards.
- **Workers engaged by third parties and supply chains.** For example, the project should ensure that contracted workers and workers of companies within their supply chain are managed according to national regulations, or in their absence, GIIP.

**3. Performance Indicators and Monitoring**

**3.1. Wastewater discharge quality standards**

| Pollutants | Unit | Guideline Values | |
|---|---|---|---|
| | | ***Good International Industry Practice (GIIP)*** | ***National Standards**** |
| pH | -- | 6 - 9 | 6 - 9 |
| BOD | mg/L | 30 | 50 - 100 |
| COD | mg/L | 160 | 200 - 400 |
| TSS | mg/L | 50 | 150 - 200 |
| Oil and Grease | mg/L | 10 | 10 |
| Cadmium | mg/L | 0.02 | 0.05 – 0.5 |
| Chromium (total) | mg/L | 0.5 | 0.5 - 1 |
| Chromium (hexavalent) | mg/L | 0.1 | 0.1 - 1 |
| Copper | mg/L | 0.5 | 0.5 - 3 |
| Nickel | mg/L | 0.5 | 1 |
| Zinc | mg/L | 2 | 5 |
| Phenol | mg/L | 0.5 | 1 |
| Sulfide | mg/L | 1 | 1 - 2 |

| Ammonia | mg/L | 10 | 5<br>*For irrigated land 15* |
|---|---|---|---|

** The National Standards are not specific to textile sector and is applicable for all the industrial units. The national standards are defined as per the location of disposal – inland surface water; public sewer; irrigated land. For ease of comparison, here the national standards are given as range and not as per the location of disposal.*

### 3.2. Ambient air quality standards

| Pollutants | Unit | Guideline Values | | |
|---|---|---|---|---|
| | | ***IIP*** | | ***National Standards*** |
| | | *Averaging period* | *Value* | |
| Suspended Particulate Maters | µg/m3 | 1 year ($PM_{10}$) | 20 | 100 – 500 |
| | | 24 hour ($PM_{10}$) | 50 | |
| | | 1 year ($PM_{2.5}$) | 10 | |
| | | 24 hour ($PM_{2.5}$) | 25 | |
| Sulphur dioxide | µg/m3 | 24 hour | 20 | 30 - 120 |
| | | 10 minute | 500 | |
| Oxides of Nitrogen | µg/m3 | 1 year | 40 | 30 - 100 |
| | | 1 hour | 200 | |

** The National Standards are not specific to textile sector and is applicable for all the industrial units. The national standards are defined as per the categories of areal – industrial and mixed; commercial and mixed; residential and rural; sensitive. For ease of comparison, here the national standards are given as range and not as per the location of disposal.*

### 3.3. Resource and energy consumption standards

| Process | Guideline Values | | | |
|---|---|---|---|---|
| | ***GIIP*** | | | ***National Standards*** |
| | Electrical Energy (kWh/kg) | Thermal Energy (MJ/kg) | Water Consumption (l / kg) | |
| Wool Scouring | 0.3 | 3.5 | 2-6 | No national standards |
| Yarn finishing | - | - | 70-120 | |
| Yarn dyeing | 0.8-1.1 | 13-16 | 15-30 (dyeing)<br>30-50 (rinsing) | |
| Loose fiber dyeing | 0.1-0.4 | 4-14 | 4-15 (dyeing)<br>4-20 (rinsing) | |
| Knitted fabric finishing | 1-6 | 10-60 | 70-120 | |
| Woven fabric finishing | 0.5-1.5 | 30-70 | 50-100 | |
| Dyed woven fabric finishing | - | - | <200 | |

### 3.4. Waste generation standards

| Outputs per unit of product | Unit | Guideline Values |
|---|---|---|

| | | *GIIP* | *National Standards* |
|---|---|---|---|
| Wastewater Wool Scouring | l/kg | 2–6 | No national standards |
| Wastewater Yarn Finishing Wool | l/kg | 35–45 | |
| Wastewater Yarn Finishing Cotton | l/kg | 100–120 | |
| Wastewater Yarn Finishing Synthetic Fiber | l/kg | 65–85 | |
| Wastewater Knitted Fabric Finishing Wool | l/kg | 60–70 | |
| Wastewater Knitted Fabric Finishing Cotton | l/kg | 60–135 | |
| Wastewater Knitted Fabric Finishing Synthetic Fiber | l/kg | 35–80 | |
| Wastewater Woven Fabric Finishing Wool | l/kg | 70–140 | |
| Wastewater Woven Fabric Finishing Cotton | l/kg | 50–70 | |
| Wastewater Woven Fabric Finishing + Print Cotton | l/kg | 150—80 | |
| Wastewater Woven Fabrics Finishing Synthetic Fiber | l/kg | 100-180 | |
| Sludge from Wastewater Treatment | $kg/m^3$ treated wastewater | 1–5 | |

**3.5. Social standards**

| Areas | Unit | Values | |
|---|---|---|---|
| | | *National Standards* | *GIIP* |
| Maternity leave | Month | 6 months + benefits | 6 months + benefits |
| Minimum age | Years | Below 14 | Below 14 , for countries whose economy and educational facilities are insufficiently developed, otherwise below 15 |
| Minimum wages | USD/ month | 68 | Vietnam-128, China-266, Cambodia- 100, Indonesia-199, India-176, Thailand-237, Srilanka-69, Pakistan-95 |
| Working Hour | Hours/ week | 48 | Vietnam-48, China-40, Cambodia- 48, Indonesia-40, India-40, Thailand-48, Srilanka-45.5, Pakistan-48 |
| Overtime limit | Hours/ year | 416 | Vietnam-200, China-432, Cambodia- 540, Indonesia-728, India-No limit, Thailand1872, Srilanka-624, Pakistan-No limit |
| Annual leave | Days | 17 | Vietnam-12, China-5, Cambodia- 18, Indonesia-12, India-16, Thailand-6, Srilanka-14, Pakistan-14 |

| | | | |
|---|---|---|---|
| Trade Union/Collective bargaining | - | The provisions related to registration of trade unions are simplified under the amended labour act in 2013 but the revised act has still no provisions on Freedom of Association and Collective Bargaining | The way in which collective bargaining are given legal force varies considerably across different industrial relations systems. Globally, the best practice is to give collective bargaining a status similar to that of administrative law. The global buyers through their code of conduct include aspect on freedom of association and collective bargaining as one of the core issues. |

## 4. General Description of Industry Activities

| Sector Activity | Sub-sector Activities |
|---|---|
| Yarn Production | Mostly cotton is used as the raw material/fibre in Bangladesh for yarn production. However, the country does not have its own production of cotton. It imports 70% of the cotton from central Asia. EHS issues around cotton production are beyond the scope of this guideline unless these are captured under buyer requirements such as Better Cotton Initiative and other Supply chain certification requirements. Before the fibre can be spun into yarn, a series of preparation phases, including ginning, opening, blending, scouring, carding, combing, and drafting are undertaken. Once the fibre is ready, it is spun in the spinning mills to produce yarn through a series of grouping, twisting and spinning operations. |
| Fabric Production | The most important methods for fabric manufacture are weaving and knitting. |
| | Weaving is done using looms. There are many kinds of looms including shuttle, projectile, rapier, and fluid jet. Knitting is a method of converting yarn into fabric by intermeshing loops, which are formed with the help of needles. In Bangladesh there are both weaving and knitting mills. |
| WDF | Washing involves cleaning textiles or apparel with water and chemicals; dyeing involves colouring or printing substrates; finishing involves the superficial treatment of textiles or apparel at the wet or dry stage. WDF is more popularly known in Bangladesh as dyeing, printing, and finishing. These are the final steps in the textile industry. Here textile materials undergo both mechanical and chemical treatment. Perfection in WDF operation determines the appearance and use of the fabric and thus its marketability. |
| RMG | This involves cutting and sewing of garments ready for export. |

| | |
|---|---|
| Polymer and Synthesis Raw Natural Material Production | In the polymer production process, reactants are purified and then polymerised. Once the polymer is ready after polymerization, it is separated from the reaction mass through a series of separation and drying steps. Finally, the polymer is extruded and pelletized for packaging and shipment. The major natural raw material for textile sector is cotton. The cotton is used for yarn production and further details are discussed under the —Yarn Production‖ sector activity. |

## B. ESRM Guidance Note for Tanning and Leather Finishing Sector

### 1. Introduction

The objective of this Guidance Note on ESRM for the Tanning and Leather finishing Sector is to provide a high level indicative summary of potential environmental and social (E&S) risks and performance levels for transactions in the Tanning and Leather finishing sector in Bangladesh. The scope of application will be fully aligned with the Section 4 of this policy. At all times, applicable national regulations are to be followed. Where national regulations differ from the levels and measures presented in this Guidance Note, loan proposals are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in this Guidance Note are appropriate, in view of specific loan proposal, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment. For the purpose of this Guidance Note, the leather& tannery industry consists of two main sub-sectors namely: 1) Tanning; 2) Leather finishing operations. The primary activities considered in the above sub-sectors of Tanning and leather finishing sector activities include but are not limited to:

- Hide and Skin Pre-storage/Storage, and Beam house Operations: Sorting and Trimming, Curing and Storing, Soaking, Dehairing and Liming of Bovine Hides, Painting and Liming of Sheepskins, Fleshing
- Tanyard operations: Deliming, Bating, Degreasing, Pickling, Wet-White Pretanning, Tanning, Draining, Samming, and Setting, Splitting, Shaving
- Post-Tanning Operations: Neutralization, Bleaching, Retanning, Dyeing, Fatliquoring, Drying
- Finishing Operations: Mechanical Finishing Processes, Surface Coat Application

### 2. Industry Specific Impacts and Management *2.1.*

***Environmental Issues:***

The major environmental concerns related to the Tanning and Leather Finishing sector in Bangladesh include the following:

- **<u>Wastewater</u>**

Industrial effluent generated during tanning operations is a major pollutant. The wastewater effluent typically contains both solid and liquid matter. The solid wastes are mainly generated in the initial and final stages of tannery operations whereas the liquid waste is mainly produced during the tanning and dying of leather. The effluent may contain dissolved lime, Hydrogen Sulfide, Ammonium or Calcium salts, acids, Chromium dyes, oils, organic matter and dissolved solids.

**Table- Process wastewater and mitigation measures as sub-sectoral activities**

| Sector Activities | Industrial process wastewater | Mitigation Measures |
|---|---|---|
| Pretanning (e.g., | • Wastewater from pre-tanning and beam house processes may contain dirt, dung and | Screen wastewater to remove large solids<br>Use an enzymatic dehairing process and recover hair for resale, reducing Chemical Oxygen |

| | | |
|---|---|---|
| sorting, trimming, curing) and beam house operations (e.g., soaking, dehairing, liming, and fleshing) | • blood washed from the hides and skins and discharged in the soak liquor, resulting in high levels of suspended and dissolved solids and organic matter<br>• Process-specific substances, such as salt, biocides and pesticides can be found in the combined wastewater<br>• effluents from these activities; Salted and brined hides can produce a leachate contaminated with dirt, bacteria, blood, salt, etc.<br>• Effluent (e.g., soak liquor) contains proteins including albumin and proteolytic and other bacteria.<br>• Inorganic sulfides (NaHS or Na2S) and lime treatment are used in the dehairing process, which may result in sulfidecontaining liquors in the wastewater effluent. Although a total substitution of sulfides used in this process is not practical, especially for bovine hides | • Demand (COD) by up to 40–50 perce<br>• For conventional lime dehairing processes, use sulfide and lime in a 20–50 percent overall solution<br>• Maintain sulfide-containing wastewater at an alkaline pH (>10) level. The conventional treatment is lime and sulphide wastewater oxidation (catalytic oxidation tanks, or aeration tanks). Care should be taken to avoid an accidental pH value–dependent (pH<7) release of hydrogen sulfide (H2S), arising from, for<br>• example, inappropriate mixing of alkaline<br>• Avoid the use of banned chlorinated / halogenated phenols, as well as banned, and less biodegradable, biocides containing arsenic,<br>• mercury, and chlorinated substances<br>• Monitor use of biocide by keeping an inventory of biocide inputs and outputs.<br>• If conventional lime dehairing process is used, filter wastewater to recover hair before dissolution. This may reduce COD by 15–20 percent and total nitrogen by 25–30 percent in mixed tannery effluent;<br>• Recycle liming float which may reduce COD by 30–40 percent; nitrogen by up to 35 percent, sulfide use by up to 40 percent, and lime use by up to 50 percent<br>• Use easily degraded ethoxylated fatty alcohols, instead of ethoxylated alkylphenols, as surfactants in degreasing<br>• Use carbon dioxide (CO2) deliming (e.g. for light bovine hides of less than 3 mm thickness). For thicker hides, the process requires an increase in the float temperature (up to 35°C), and / or process duration, and / or the addition of small amounts of deliming auxiliaries.<br>• Use of natural drying of small skins at facilities in suitable warm, dry climates<br>• Use of chilling for short-term preservation of freshly processed hides or skins, and / or use of<br>• antiseptics to increase storage time<br>• Undertake trimming and, where possible, pre-fleshing before curing or other pretanning operations<br>• Use of mechanical or manual removal of salt from hides and skins before soaking<br>• Installation of salt-free pickling systems, and use of non-swelling polymeric sulphonic acids (this may affect leather characteristics); |

| Sector Activities | Industrial process wastewater | Mitigation Measures |
|---|---|---|
| Tanyard operations (deliming, bating, degreasing, pickling, tanning) | • Significant nitrogen loads and resulting discharge of ammonia nitrogen are typically associated with tanning processes. The use of ammonium salts in the process is a main source of ammonia nitrogen in tannery effluents (up to 40 percent)<br>• Degreasing process may result in discharge of residual fat that retains a considerable amount of the chlorinated solvent Wastewater from deliming and bating processes may contain<br>• Sulfides, chlorides, ammonium salts (TKN, Ammonia Nitrogen) and calcium salts.<br>• Trivalent chromium salts (Cr III) are among the most commonly used tanning agents, accounting for the majority (approximately 75 percent) of the chromium in the wastewater stream | • Installation of salt-free pickling systems, and use of non-swelling polymeric sulphonic acids<br>• Use of short (e.g. low-water content) floats in the tanning cycle (e.g. floats using from 20 - 40% water w.r.t. normal floats), which allow for water savings of up to 70 percent and facilitate chrome fixation<br>• Consider using alternative tanning agents in place of, or in addition to, chromium, considering the toxicity and persistence of the alternative agents as well as the use and desired characteristics of the leather product.<br>• Avoid the use of chromium (VI), by limiting the type of chromium employed to chromium (III)<br>• Recycle chrome tanning floats. This may reduce chromium use up to 20 percent in a conventional tannery process and up to 50 percent in wool-on sheepskins. Liquor containing excess chromium may be precipitated, acidified and then recycled. Reduce chromium concentration in the waste float by using high-exhaustion chromium salts and alkaline products and or increasing the float temperature;<br>• Avoid the use of Chromium because it can adsorb onto the surface of organic particles of varying sizes and may not precipitate out of solution. Care must be taken that these<br>• Recycle supernatant from chrome recovery to enhance chrome savings |
| PostTanning Operations | The main wastewater contaminants depend on the tanning techniques used. Posttanning operations involve use of several classes of chemicals including fat liquoring agents, chlorinated organic | Avoid the use of halogenated compounds (e.g. in fatliquors)<br>Recover impregnating agents from effluents<br>Avoid the use of sequestering and wetting agents with low biodegradability compounds (e.g. ethylen-diamintetraacetate)<br>Avoid the use of Di-carboxylic acids for the |
| | compounds, impregnating agents, sequestering agents, masking agents and dyes. | precipitation of chromium during pre-treatment of effluent; |

| Sector Activities | Industrial process wastewater | Mitigation Measures |
|---|---|---|
| Finishing Operations | Finishing wastewaters may contain lacquer polymers, solvents, color pigments and coagulants. | Substitute organic solvent based dyes with nonhalogenated and solvent / water-based and water-soluble dyes for dyeing and finishing operations |

- **Air Emissions**

Tanning and leather finishing activities generate air emissions, including releases of organic solvents (VOCs), sulfides from the beam house and wastewater treatment, ammonia from the beam house, tanning, and post-tanning operations, dust/total particulate matter from various process operation and odours. The control techniques used for the several of emissions sources are as discussed below:

**Organic solvents are used in degreasing and finishing processes. Controls methods include -** water-based formulations (containing low quantities of solvent) for spray dyeing; Implement organic solvent-saving finishing techniques such as roller coating or curtain coating machines where applicable (e.g, application of heavy finish layers), and otherwise use spraying units with economizers and high volume / low-pressure spray guns; Prohibit the use of internationally banned solvents; Control VOC emissions through the application of secondary control techniques.

**Sulfides are used in the dehairing process.** Hydrogen sulphide ($H_2S$) may be released when sulfide-containing liquors are acidified and during normal operational activities. $H_2S$ is an irritant and asphyxiant.

**Prevention and control measures** for sulfide emissions include:

- Maintain a basic pH over 10 in facility equalizing tanks and sulfide oxidation tanks
- Prevent anaerobic conditions in sulfate-containing liquors and sludge
- Add manganese sulfate to treated effluent, as needed, to facilitate the oxidation of sulfides
- Where H2S formation may occur, use adequate ventilation to capture the emissions, followed by treatment with wet scrubbers or bio-filters (particularly for wastewater treatment units).

**Ammonia emissions may be generated from some of the wet processing steps** (e.g. deliming and dehairing, or during drying if it is used to aid dye penetration in the coloring process). Prevention and control of ammonia emissions may be achieved through use of adequate ventilation, followed by wet scrubbing with an acidic solution.

**Dust/total particulate may be generated from various operations** (e.g. storage and handling of powdery chemicals, dry shaving, buffing, dust removal machines, milling drums, and staking). Dust emissions should be controlled through use of a centralized system, employing cyclones, scrubbers, and/or bag filters, as needed.

**Odours may result** from raw hides and skins, putrefaction, and from substances including sulfides, mercaptans, and organic solvents. Prevention and control measures for odour emissions include the following:

- Promptly cure raw hides
- Reduce the time that sludge remains in the thickener, dewater thickened sludge by centrifugation or filter press and dry the resulting filter cake. Sludge containing less than 30 percent solids may generate especially strong odours
- Ventilate tannery areas and control exhaust from odorous areas (e.g. where wastewater sludge is thickened and dewatered), through use of a bio-filter and / or a wet scrubber with acid, alkali, or oxidant.

- **Solid waste**

Solid waste includes salt from raw skin / hide dusting; raw skin / hide trimmings; organic matter such as hair from the liming/dehairing process, which may contain lime and sulphides, and fleshing from raw skins/hides; wet-blue shavings, which contains chromium oxide; wet-blue trimming, which is generated from finishing processes and contains chromium oxide, syntans, and dye; and buffing dust, which also contains chromium oxide, syntans, and dye & tannery sludge. Organic matter is oxidised by bacteria and this can deplete oxygen levels in the water killing fish and other biodiversity.

Some good practices in managing risks emanating from solid wastes in a tannery include:

- Develop and implement a waste management plan covering all aspects of waste treatment on site. Wherever possible, priority should be given to reduction of wastes generated, and recovery and re-use of raw materials.
- Proper segregation of different waste/residue fractions to facilitate recovery and re-use (e.g., to manufacture pet toys, pet food, leather fibreboard)
- Reduce inputs of process agents (particularly precipitation agents in wastewater treatment) to the extent practical
- Proper segregation of different waste/residue fractions to facilitate recovery and re-use (e.g., to manufacture pet toys, pet food, leather fibreboard)
- Treat waste on site for example by dewatering (thickening) of sludges, compacting, rendering (drying and grinding to make bone meal), anaerobic digestion, composting, thermal treatment and proper disposal of chrome containing sludge to a treatment facility.

- **Hazardous materials**

The level of knowledge about proper storage and handling of particularly hazardous chemicals is very low within tannery workers. Measuring and mixing of chemicals is done manually in the small-scale tanneries. Process control is generally absent. Direct contact with chemicals such as chromium, residual chemicals can lead to dermatitis and other diseases, chrome ulceration may occur in chrome tanning, especially on the hands. Tanneries may use a range of flammable materials. There may be large quantities of solvent vapours within the production areas, which can explode if ignited. Explosions or fires can result in widespread contamination and destruction, impacting not only the immediate site but surrounding land, rivers and communities. Good practices in managing risks emanating from handling and storage of hazardous materials include the following:

- Consider feasibility of substitution of hazardous chemicals with less hazardous alternatives.  Proper storage of chemicals in a dedicated, enclosed and secure facility with a roof and a paved/concrete floor
- Chemical tanks should be completely contained within secondary containment such as bunds
- Chemicals with different hazard symbols should not be stored together - clear guidance on the compatibility of different chemicals can be obtained from the Materials Safety Data Sheet (MSDS) which should be readily available from the manufacturer and on site.
- Inspect tanks routinely to prevent overfilling or filling with incompatible materials.
- Avoid potential sources of ignition including banning smoking in and around facilities.
- Provide the local fire department with a list/ volume of products stored on the premises.  Emergency storage lagoons may be needed to prevent contaminated firewater reaching watercourses
- Introduce accident, fire and explosion precautions and emergency response plans and involve the emergency services and neighbouring community in the creation and practice of these plans to respond to major incidents at the installation.

- **Energy consumption**

Tanneries consume energy during mechanical operations and during the day to day running of the buildings. Typical energy consumption is for mechanical operations of dehairing, rotating drums, spray machines, drying and refrigeration etc. There is need to improve thermal efficiency of heating equipment to minimise heat loss.

**Table- Consumption of thermal and electrical energy**

| Energy input | Use | % overall consumption |
|---|---|---|
| Thermal energy |  Drying<br> Hot water<br> Space heating | 32 – 34<br>32 – 34<br>17 – 20 |

| | | |
|---|---|---|
| Electrical energy | □ Machinery and process vessels<br>□ Compressed air<br>□ Light | 9 – 12<br>1.5 – 3<br>1.5 – 3 |

Good practices in managing risks emanating from thermal energy consumption include:

- Low temperature drying (LTD) machines are available with reduced energy consumption, although in some cases they can lengthen the drying process (e.g. LTD drying tunnels may require all night to dry leathers, compared with 4 hours in conventional hang drying tunnels, but may have three times the capacity).
- Considerable reductions in energy consumption can be achieved by optimising the mechanical dewatering processes prior to drying.
- Keeping drying temperature low and drying time and amount of exhaust air at the necessary minimum will keep heat losses to a minimum.
- Implement heat recovery processes such as energy savings can be achieved by heat pumps incorporating recovery systems. Waste heat can be used from and for other processes. By means of heat exchangers, energy can be recovered from the waste process water, from condensate from vacuum dryers, from evaporated water from high frequency drying, or from exhaust air from drying.

Good practices in managing risks emanating from electrical energy consumption include:

- Mechanical finishing operations create noise, and consume energy. Dust extraction systems contribute to both of these parameters. Recycling of the cleaned air might save energy for workplace heating.
- Monitor and target energy usage and implement behavioural change programmes.

### 2.2. *Health and Safety Issues:*

**Table - Common Structural, Fire & Electrical Safety Issues in Bangladesh**

| Area | Issues commonly observed | Prevention and Mitigation Measures |
|---|---|---|
| Structural | Highly stressed columns; undocumented vertical extensions; localised areas of high loads in buildings; discrepancy between structural drawing and built structure; minor to major cracks in structural elements. | • Compliance to regulatory requirements including the Bangladesh National Building Code (BNBC) (2015) or international codes, such as those compiled by the International Code Council (ICC), (2006).<br>• Undertake periodic structural safety audits by accredited agencies. |

| | | |
|---|---|---|
| Fire | Inadequate, untested fire alarms; inadequate exit capacity compared to the occupancy load; lack of exit signage. | • Compliance with the by-laws of the Fire<br>• Regulation (2014), part of the Bangladesh Labor (Amendment) Act (2013), which includes requirements regarding the formation of a safety committees, and other measures such as emergency exits, access to stairs, and provision of personal protective equipment (PPE).<br>• Provisions for fire hydrants as per the requirements of BNBC (2015) and by Fire Regulation 2014, including water supply specifications according to the building size/hazard.  Undertake regular fire audits by accredited agencies, with mock drills to be conducted on a periodic basis as per the fire hazard assessment of the facility. |
| Electrical | Unsealed entry and exit points for electrical cable; excessive dust deposit on cables; cables laid on floor without guarding / protection; oil leaks in generator room; inadequate cable grounding. | Undertake electrical safety assessment on a periodic basis, and ensure workers are trained and provided with appropriate PPE based on the risk assessment. |

**Table - Common Occupational Health Issues**

| Hazard | Description | Mitigation Measures |
|---|---|---|
| Exposure to chemicals | Tannery workers may be exposed to chemical hazards during loading, unloading, handling, and mixing of chemicals; during the washing, and disposing of chemical containers; and during the management and disposal of chemical waste and effluent. | • Consider feasibility of substitution of hazardous chemicals with less hazardous alternatives.<br>• Chemicals that will react should be segregated. Specifically, acids should be stored away from sodium sulfide, and alkalis away from ammonium salts, to prevent accidental mixing and release of dangerous gases (e.g. H2S, NH3) |

| | | |
|---|---|---|
| | | • Small containers (e.g. dyes and fatliquors samples) should be safely stored on racks and shelves. Heavier chemical containers (particularly those containing liquid chemicals, such as acids) should be stored on wooden or plastic pallets at the floor level<br>• Use of personal protection equipment (e.g. gloves, glasses, boots, aprons, masks, hoods, respirators), particularly in the wet activity areas of the tannery. Respirators / masks with particulate filters and glasses should be used when handling powder and liquid chemicals. Inspect tanks routinely to prevent overfilling or filling with incompatible materials.<br>• Use equipment and techniques (e.g. roller coating) to minimize indoor air pollution (e.g. during spraying and general application of finishing treatments);<br>• Use air extraction systems and ventilation in areas / machines for dry shaving, buffing, dedusting, spraying, and weighing. |
| Exposure to biological agents | Workers may be exposed to disease-agents such as bacteria, fungi, mites and parasites which may be present in the hides or may form during the manufacturing process. | • Provide personal protective equipment to reduce contact with materials potentially containing pathogens<br>• Ensure hides move between processes quickly in order to prevent the growth of bacteria. For example, delimed skins are no longer protected from bacterial growth by an alkaline environment and should be moved to degreasing and pickling stages as rapidly as possible. |
| Other physical injuries | Injuries from slips, trips and fall. These are primarily caused by uneven surfaces, inappropriate footwear, poor lighting, weather conditions, trailing cables and pipe work, especially during unblocking, maintenance and cleaning activities. | • To ensure that walkways are constructed of non-slip materials and route cables and pipework under walkways.<br>• Control the effect of fires and |

| | | |
|---|---|---|
| | Tanneries may use a range of flammable materials. There may be large quantities of solvent vapours within the production areas, which can explode if ignited. Explosions or fires can result in widespread contamination and destruction. | • explosions by segregating process, storage, utility and safe areas. |

### *2.3. Community Health & Safety:*

**Table - Community health & safety impacts and mitigation measures**

| | |
|---|---|
| Risk of road accidents during transportation of materials | Traffic safety:<br>• Road safety measures like emphasizing safety aspects among drivers, improving driving skills and requiring licensing of drivers, adopting limits for trip duration and arranging driver rosters to avoid overtiredness, use of speed control devices (governors) on trucks and remote monitoring of driver actions<br>• Transportation of hazardous materials:<br>• To ensure compliance with local laws and international requirements applicable to the transport of hazardous materials (Hazmats)<br>• Standard operating procedures for transportation of Hazmats - proper labelling of containers, shipping manifest, ensuring adequate transport vehicle specifications, , use of labelling and placarding (external signs on transport vehicles)<br>• Training of employees in shipping procedures and emergency procedures |
| Respiratory problems arising out of exposure to dust and other gaseous emissions | • Inclusion of buffer strips or other methods of physical separation around project sites to protect the public from major hazards associated with hazardous materials incidents or process failure<br>• Modifying process or storage conditions to reduce the potential consequences of an accidental off-site release. Provisions to alert the public, provide for evacuation of surrounding areas, establish safety zones around a site, and ensure the provision of emergency medical services to the public<br>• Improving shut-down and secondary containment to reduce the amount of material escaping from containment and to reduce the release duration<br>• Reducing the probability that releases will occur through improved site operations and control and through improvements in maintenance and inspection |

| | |
|---|---|
| Risk of fire and structural damage | • Fire prevention measures such as fuel load & control of combustibles, ignition sources, interior finish flame spread characteristics, interior finish smoke production characteristics, human acts, and housekeeping and maintenance<br>• Fire suppression system – fire hydrants<br>• Emergency response plan to assist staff and emergency response teams during real life emergency and training exercises |
| Noise pollution | • Noise monitoring may be carried out for the purposes of establishing the existing ambient noise<br>• Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas<br>• Improving the acoustic performance of constructed<br>• Installing vibration isolation for mechanical equipment<br>• Re-locating noise sources to less sensitive areas to take advantage of<br>• distance and shielding buildings, apply sound insulation |

### *2.4. Social Issues*

This section will be same as described in the corresponding section of _Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector.

## 3. Performance Indicators and Monitoring

### *3.1. Wastewater discharge quality standards*

| Pollutants | Unit | Guideline Values | |
|---|---|---|---|
| | | GIIP | National Standards* |
| pH | S.U. | 6 – 9 | 6 – 9<br>(across all discharge locations i.e. inland surface water, public sewer and irrigated land) |
| $BOD_5$ | mg/L | 50 | 50 - 100 |
| COD | mg/L | 250 | 200 - 400 |
| Total Suspended Solids | mg/L | 50 | 150 (inland surface water), 200 (irrigated land) 500 (public sewer |
| Sulfide | mg/L | 1.0 | 1-2 |
| Chromium (hexavalent) | mg/L | 0.1 | 0.5 - 1 |
| Chromium (total) | mg/L | 0.5 | 0.1 – 1 |
| Chloride | mg/L | 1000 | 600 |
| Sulfate | mg/L | 300 | 400 |
| Ammonia | mg/L | 10 | 5 |
| Oil & grease | mg/L | 10 | 10 |
| Total nitrogen | mg/L | 10 | 50-75 |
| Total phosphorus | mg/L | 2 | 8-15 |
| Phenols | mg/L | 0.5 | 1 |
| Total coliform bacteria | MPN/100 ml | 400 | No national standard |
| Temperature increase | °C | <3 | No national standard |

** The National Standards are not specific to Leather and tannery sector and is applicable for all the industrial units. The national standards are defined as per the location of disposal – inland surface water; public sewer;*

*irrigated land. For ease of comparison, here the national standards are given as range and not as per the location of disposal. In addition to the above mentioned pollutants, there are other pollutants as well for which standards are specified.*

### 3.2. Air emission levels for leather finishing

| Category | Unit | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *National Standards* |
| Upholstery Leather (= 4 gram add-on/square feet) | kg of HAP loss per 100 sq. meters of leather processed | 1.3/0.2 | No national standard |
| Upholstery Leather (<4 gram add-on/square feet) | | 3.3/1.2 | |
| Water-resistant/Specialty Leather | | 2.7/2.4 | |
| Non-water-resistant Leather | | 1.8/1.1 | |

### 3.3. Effluent load from tannery processes based on GIIP

| Values per tonne of rawhide | Water ($m^3/t$) | COD (kg/t) | $BOD_5$ (kg/t) | SS (kg/t) | Cr(III) (kg/t) | Sulfides (kg/t) | TKN (kg/t) | Chlorides (kg/t) | SO4 (kg/t) | Oil/Grease (kg/t) | TDS (kg/t) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Bovine Salted Raw Hide Process | 12–37 | 145–230 | 48–86 | 85–155 | 3–7 | 2–9 | 10–17 | 145–220 | 45–110 | 9–18 | 300–520 |
| Pig Skins | 32–69 | 140–320 | 52–115 | 70–135 | 3–6 | 3–7 | 12–20 | 80–240 | 40–100 | 34–71 | 180–500 |
| Sheepskins (wet-salted) | 110–295 | 330–1005 | 135–397 | 175–352 | 9–15 | 6–20 | 21–44 | 210–640 | 45–110 | 40–150 | - |
| Wool-on Sheepskins | 275-410 | 780-1500 | 220-1300 | 195 | 20 | - | 21 | 910 | - | 40-150 | 1520 |

### 3.4. Dry Sludge Generation from Tannery Wastewater Treatment based on GIIP

| Parameter | Sludge Production (kg DS/tonne rawhide) |
|---|---|
| Sludge (total) | 400-500 |
| Primary Treatment | |
| Mixing + Sedimentation | 80 |
| Mixing + Chemical treatment + Sedimentation | 150-200 |
| Mixing + Chemical treatment + Flotation | 150-200 |
| Biological treatment | |
| Primary or chemical + Extended aeration | 70–150 |

| | |
|---|---|
| Primary or chemical + Extended aeration with nitrification and denitrification | 130–150 |
| Primary or chemical + Aerated facultative lagoons | 100–140 |
| Anaerobic treatment (lagoon or UASB) | 60–100 |
| Membrane biological reactor (MBR) | d |

### 3.5. Resource and energy consumption standards

| Inputs per unit of product | Unit | Guideline Values | |
|---|---|---|---|
| | | GIIP | National Standards |
| Energy/ Fuel: Energy consumption per unit of production bovine salted hides, conventional chrometanning) | GJ/tonn e | 9.3–42 | No national standard |
| Materials: Chemical consumption (bovine salted hides, conventional chrome-tanning) | kg/tonn e | Approx . 500 | No national standards |

### 3.6. Waste generation standards

| Outputs per unit of product | Unit | Guideline Values | |
|---|---|---|---|
| | | GIIP | National Standards |
| Solid Waste: (Hazardous / Non-Hazardous)(bovine salted hides, conventionalchrome-tanning) | Kg/t | 450-730 | No national standards |
| Air Emission: (organic solvents)(bovine salted hides, conventionalchrome-tanning) | Kg/t | Approx. 40 | |

### 3.7. Social standards

This section will be same as described in the corresponding section of _Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector‘.

## 4. General Description of Industry Activities

| Sector Activity | Sub-sector Activities |
|---|---|

| | |
|---|---|
| Leather tannery | 1) **Beam house operations:** Raw hides and skins are typically procured from the hide and skin markets or directly from the abattoirs (slaughter houses) and delivered to the tanneries or fellmongeries (a fellmongery is a tannery that processes sheep skins). The various activities in beamhouse operations includes:<br>• Curing: Long-term preservation method (up to six months) includes salting, brining, drying, or dry salting. Short-term preservation (typically two to five days) involves cooling, using crushed ice or refrigerated storage, and biocides. Hides and skins are generally stored on pallets in ventilated or air conditioned areas.<br>• Soaking: This allows hides and skins to reabsorb any lost water, clean them, and remove interfibrillary material. Soaking can range from several hours to a few days. Additives to soaking water include surfactants, enzyme preparations, bactericides, and alkali products.<br>• Unhairing and liming: Mechanical and chemical treatments remove hair, epidermis, some interfibrillary components, and open up the fibre structure. Elimination of keratinous material (e.g. hair, hair roots, epidermis) and fats from the pelts involves the use of sulphides and lime treatments. To remove the wool from sheepskins, _paint' (containing lime and sodium suphide) is applied to the skin and left to dissolve the cells around the hair root, allowing hair or wool to be |

removed by mechanical or manual pulling.

- Fleshing: This is a mechanical process to scrape off the excess organic material from the hide (e.g. connective tissue and fat).
- Deliming: This removes residual lime (or other alkali) from the pelts by gradually lowering pH through washing and addition of deliming chemicals (e.g. ammonium sulphate, among others), increasing temperature, and removing residual chemicals and degraded skin components.
- Bating: Enzymes are used to remove undesirable hair roots and pigments from the leather. This can improve the grain of the hide and the subsequent run and stretch of the leather.
- Degreasing: This is the elimination of excess grease from fatty skins. Three different methods commonly used for degreasing are degreasing in aqueous medium with non-ionic surfactant, degreasing in aqueous medium with organic solvents and non-ionic surfactants, and degreasing in an organic solvent medium.

2) **Tanyard:** Leather is called _pickled' leather up until the end of the tanyard processes, where it becomes _wet blue' leather.
   - Pickling: This is conducted to lower the pH of the pelt before tanning. Depending on the type of tanning, the pickling floats will have a different composition; this normally includes sulphuric acid and common salt.
   - Tanning: This leads to the stabilization of the collagen fibre through cross-linking by tanning agents; after this, hides are no longer subject to putrefaction. Tanning agents can be categorized in three main groups namely mineral (chrome); vegetable; and alternatives (e.g. syntans, aldehydes, and oil tannage). Different tanning agents are used depending on the properties required in the finished leather.
   - Draining, horsing, samming, and setting: After tanning, leathers are drained, rinsed, and either horsed up (hung on a _horse') to _age' or unloaded into boxes and subsequently sammed (squeezed between rollers) to reduce the moisture content. Setting-out operations stretch the leather.
   - Splitting and Shaving: Splitting cuts leather to a set thickness. Shaving is carried out when splitting is not possible or when minor adjustments to the thickness are required.
3) **Post-tanning:** These processes are mostly undertaken in a single processing vessel. Specialized operations may also be performed to add certain properties to the leather product (e.g. water resistance or flame retardation). A wide variety of processes and chemicals may be used in this phase. For example, the re-tannage of leather, vegetable tanning extracts, syntans, aldehydes, resins, and mineral tanning agents might be used. Weak alkalis (e.g. sodium or ammonium bicarbonate, formiate, or acetate) are used in the neutralization process. Before leather is tradable

| | |
|---|---|
| | and storable as an intermediate product (referred to as _crust') it undergoes a drying process. Drying techniques include samming, setting, centrifuging, hang drying and vacuum drying, amongst others.<br>4) **Finishing:** Finishing operations enhance the appearance of the leather and provide the performance characteristics (e.g. colour, water resistance). These operations can be divided into mechanical finishing processes and surface coat applications. A wide range of processes exist for both types of finishing, including, but not limited to polishing, staking (softening and stretching of leather), plating (flattening) and spray coating (spraying the finishing material with pressurized air in spray cabinets). |

## C. ESRM Guidance Note for Cement Manufacturing Sector

### 1. Introduction

The objective of this Guidance Note on ESRM for the Cement Manufacturing Sector is to provide a high level indicative summary of potential environmental and social (E&S) risks and performance levels for transactions in the Cement Manufacturing sector in Bangladesh. The scope of application will be fully aligned with the Section 4 of Guidelines on ESRM for this policy. At all times, applicable national regulations are to be followed. Where national regulations differ from the levels and measures presented in this Guidance Note, loan proposals are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in this Guidance Note are appropriate, in view of specific loan proposal, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

### 2. Industry Specific Impacts and Management

#### *2.1. Environmental Issues:*

The major environmental concerns related to the cement sector in Bangladesh include the following: □

**Air emissions**

Air emissions are generated by the handling and storage of materials, and by the operation of kiln systems, clinker coolers, and mills. Dust emissions are a primary environmental concern in cement manufacturing. The main sources of dust emissions are the raw material preparation process (raw mills), fuel preparation and storage, the clinker burning process (kilns and clinker coolers), and cement grinding and drying units (cement mills). These sources of dust emissions are known as process dust or point sources which are emitted through stacks at various sections of the production line. Dust emissions can also arise during the storage and handling of materials and solid fuels, e.g., from open storage piles, conveyors of raw materials, etc. These are known as fugitive sources of dust emissions. While fugitive dust emissions generally have a more direct impact within the facility and the immediate surrounding area, process dust emissions from point sources can have an impact on the air quality of a larger area, including nearby communities. The point and fugitive sources for dust emissions are listed in following Table along with the control techniques to mitigate emissions.

**Table- Particulate Matter (Dust) Emission Sources and Control Techniques**

| Particulate Matter (Dust) Emissions Sources and Control Techniques |
|---|
| ***Particulate Matter (Dust) Point Source Emissions:*** For particulate matter emissions associated with the operation of kiln systems, clinker coolers, and mills, including clinker and limestone burning, pollution prevention and *control techniques*, in addition to proper smoothing (i.e., maintaining the kiln in consistently optimum operating conditions) of kiln operations, include: Capturing kiln and clinker cooler dusts using fabric (baghouse) filters and recycling the recovered particulates into the kiln feed and into the clinker, respectively;<br>• Using fabric (baghouse) filter systems as the preferred option, or electrostatic precipitators (ESPs) as an alternative option, to collect and control fine particulate ($PM_{10}$ and $PM_{2.5}$ emissions) in kiln exhaust gas and bypass gas dust, and exhaust air from coolers;<br>• Capturing mill dust by fabric (baghouse) filters and recycling within the mill. |

***Particulate Matter (Dust) Fugitive Emission Sources:*** Fugitive sources of PM emissions are mainly associated with intermediate and final materials handling and storage (including crushing and grinding of raw materials); handling and storage of solid fuels; transportation of materials (e.g. by trucks or conveyor belts), and bagging activities. *Measures to control fugitive emissions* include:

- Use of enclosed systems for handling material (for example, crushing operations, raw milling, and clinker grinding) maintained under negative pressure by exhaust fans with dedusting of ventilation air using fabric (baghouse) filters; Use of enclosed belt conveyors for materials transportation and emission controls at transfer points, including systems for cleaning return belts;
- Design sufficiently large covered storage for clinker and solid fuels to avoid the need for frequent double handling to and from outside stock piles;
- Use of automatic bag-filling / handling systems to extent possible, with fugitive emission control;
- Storage practices to reduce diffuse dust from material and fuel stocks include: covered or closed bays for crushed and preblended raw materials; silos for conventional fuels such as pulverized coal and petroleum coke (petcoke); areas protected from wind and precipitation for waste-derived fuels; covered/closed bays or silos for clinker with automatic dust extraction/reclamation; silos with automatic dust extraction/reclamation for cements connected to automated loading system for bulk tankers.
- PM emissions in storage/stockpile areas may also be reduced through the application of water spray and chemical dust suppressors, including humidification techniques, at material charging/discharging points;
- Implementation of routine plant maintenance and good housekeeping to keep small air leaks and spills to a minimum, and use of mobile and stationary vacuum systems for routine operations and upsets;
- Use of simple, linear layouts for materials-handling operations to reduce the need for multiple transfer points, including paving and wetting routines for road transport areas.

**Table- Other Air Emissions and Control Techniques**

**Other Air Emissions and Control Techniques**

***Nitrogen oxide (NOx)*** emissions are generated in the high temperature combustion process of the cement kiln. Primary techniques for the prevention and control of NOx emissions include:

- Process optimisation, including kiln smoothing (i.e., maintaining consistently optimum kiln operating conditions)
- Using low NOx burners (in the main kiln, as well as the precalciner, as applicable);
- Use of staged combustion, as applicable, in pre-heater and pre-heater precalciner kilns;
- Optimizing primary / secondary air flow to ensure appropriate combustion/burning conditions with tight control of excess oxygen thereby minimizing NOx formation and emissions;
- Employing flame cooling by adding water to the fuel or directly to the flame
- Secondary techniques to control NOx emissions include selective noncatalytic reduction (SNCR) or selective catalytic reduction (SCR).

***Sulfur dioxide ($SO_2$)*** is associated primarily with the content of volatile or reactive sulfur in the raw materials and, to a lesser degree, with the quality of fuels used in the kiln. Measures to control $SO_2$ emissions include:

- Process optimisation, including kiln smoothing (i.e., maintaining consistently optimum kiln operating conditions);
- Selection of raw materials and fuels with low volatile sulfur content;
- Use of a vertical raw mill, with gases passing through the mill to recover energy and to reduce the sulfur content in the gas
- Injection of absorbents and use of scrubbers

***Heavy metals:*** Emissions of heavy metals (for example, lead, cadmium, and mercury) during cement manufacturing can be significant depending on the presence of heavy metals in raw and waste materials, and fossil and waste-derived fuels. Nonvolatile metals are mostly bound to the particulate matter, and can be controlled using dust/PM measures, as discussed in the above section. Captured waste materials should be managed as a hazardous waste, as described in the General EHS Guidelines. Volatile metals such as mercury are only partly adsorbed by the raw gas dust, depending on the temperature of the waste gas. Recommended techniques to limit emissions of volatile heavy metals include the following:

- Implement controls for the volatile heavy metal content in the input materials and waste fuels through use of monitoring and materials selection (including selective quarrying techniques to avoid materials with high levels of metal concentrations).
- For high concentrations of volatile heavy metals (in particular mercury), use of absorption on activated carbon may be necessary. In addition, selective dust shuttling or —bleeding‖ of mercuryenriched kiln dust, combined with sorbent injection, can be used to limit the buildup of mercury levels within the kiln dust. The resulting solid waste should be managed as a hazardous waste. Multi-pollutant control measures can also be effective in controlling high concentrations of volatile heavy metals, such as wet scrubbers and adsorption on activated carbon.

***Waste fuels, waste, and associated air emissions:*** Cement kilns, due to their strongly alkaline atmospheres and high flame temperatures (up to 2000°C), are capable of using high-calorificvalue waste fuels: for example, used solvents, waste oil, used tires, RDF (refuse derived fuel), and waste plastics. In exceptional cases, cement kilns can also be used for the disposal of wastes that have little calorific or mineral value and do not contribute to the clinker production process. This co-processing of hazardous waste, including polychlorinated biphenyls (PCBs), obsolete organochlorine pesticides, and other chlorinated materials should be considered only if appropriate input controls (for example, control of heavy metal content, heating value, ash content, chlorine content), process controls, and emission controls are in place. While the use of waste fuels can allow for the substitution of fossil fuels, depending on their composition, use of waste fuels can lead to emissions of volatile organic compounds (VOCs), persistent organic pollutants such as polychlorinated dibenzodioxins (PCDDs) and dibenzofurans (PCDFs), in addition to hydrogen fluoride (HF), hydrogen chloride (HCl), and toxic metals and their compounds if not properly controlled and operated. Facilities using of waste fuel or co-processing hazardous waste raw material in cement manufacturing should document the amounts and types of waste that are used either as fuel or as raw material, and the quality standards such as minimum calorific value and maximum concentration levels of specific pollutants, such as PCB, chlorine, polycyclic aromatic hydrocarbon (PAH), mercury, and other heavy metals. Adequate monitoring should be conducted when wastes fuels are being fired in cement plants (either as an alternative fuel or for purpose of waste destruction). Recommended prevention and control techniques for these types of air pollutants include the following:

- Implement monitoring and control of the volatile heavy metal content in the input materials and waste fuels though materials selection and through control measures described in the Heavy Metals section. Nonvolatile metals should be managed according to the recommendations in the PM/Dust section.
- Implement proper storage and handling practices for hazardous and nonhazardous waste to be used as waste fuel or raw material, as described in the General EHS Guidelines.
- Directly inject fuels that have volatile metals or high VOC concentrations into the main burner rather than via the secondary burners.
- Avoid the use of fuels with high content of halogens during secondary firing and during startup and shutdown phases.
- Ensure rapid cooling of kiln exhaust gases to lower than 200 °C in long wet and long dry kilns without preheating (in modern preheater and precalciner kilns, this cooling feature is already inherent in the design).

**Energy consumption, fuels, and greenhouse gas emissions**

Cement is an energy-intensive industry. Electrical energy and fuel costs can represent 40–50 percent of total production costs. The following sector specific issues can be considered:

- **Kiln and cooler operations:** For new plants and major upgrades, good international practice for the production of cement clinker involves the use of a dry process kiln with multistage preheating and pre-calcination (PHP kilns). PHP kilns are the most common kiln used in the cement manufacturing industry. They have the lowest heat consumption (due to the high heat recovery from kiln gas in the cyclones and the low kiln heat losses), and no water to evaporate (compared to wet kiln which uses slurry), while also offering the highest production capacity. PH kilns are also used widely due to their ease of operation. Heat consumption for PH kilns is only slightly higher than for PHP kilns.The most common type of clinker cooler now being installed is the _grate cooler,' which is produced in many versions. To improve energy efficiency, the heat from the cooler should be used as hot process air, such as via a tertiary air duct in the precalciner.
- **Fuel consumption and GHG emissions:**Greenhouse gas emissions, especially carbon dioxide ($CO_2$), are mainly associated with fuel combustion and with the decarbonation of limestone, which in its pure form is 44 percent $CO_2$ by weight. Recommended techniques for CO2 emission

prevention and control, in addition to proper smoothing of kiln operations, include: Selection of fuel with a lower ratio of carbon content to calorific value (e.g. natural gas, fuel oil, or some waste fuel); production of blended cements, which have the potential for significant reduction in fuel consumption and subsequent CO2 emissions per ton of final product; process selection and operation to promote energy efficiency (dry/ pre-heater / precalciner); and selection of raw materials with lower organic matter content.

- **Wastewater**

Cement production process does not generally result in significant wastewater (effluent) loads. Wastewater streams in cement manufacturing result mainly from cleaning activities, surface runoff, and utility operations for cooling purposes in different phases of the process (e.g., bearings, kiln rings). The storage and handling of fuels and materials is a potential source of contamination of soil and groundwater if run-off streams are not controlled (e.g.,stormwater flowing through pet–coke, coal, and waste material stockpiles exposed to the open air may become contaminated).

Stormwater should be prevented from coming into contact with the stockpiles by covering or enclosing the stockpiles and by installing run-on controls. As discussed above, recommended pollution prevention techniques for dust emissions from stockpiles of raw materials, clinker and fuel may also help minimize contamination of stormwater. If stormwater does come in contact with the stockpiles, soil and groundwater may be protected from potential contamination by paving or otherwise lining the base of the stockpiles, and installing run-off controls around them to collect the stormwater in a lined basin and allow dust and other materials to settle before separation, control, recycling or discharge.

Contaminated streams should be routed to the treatment system for industrial process wastewater. Techniques for treating industrial process wastewater in this sector include flow and load equalization with pH adjustment; sedimentation for suspended solids reduction using settling basins or clarifiers; multimedia filtration for reduction in non-settling suspended solids.

- **Solid waste**

Solid waste originating from cement manufacturing primarily includesclinker production waste (mainly composed of spoil rocks, which are removed from the raw materials during the raw meal preparation), kiln dust removed from the bypass flow and the stack (if it is not recycled in the process) and dust collected from filters and precipitators. Other waste streams include packaging and maintenance-related waste (e.g., used oil and scrap metal).Some of these process wastes can be recycled and reused depending on the process requirements and product specifications. Collected dust should be recycled within the process wherever feasible. This recycling may take place directly into the kiln or kiln feed (alkali metal content being the limiting factor) or by blending with finished cement products. Wherever recycling is not feasible, process waste should be disposed-off through external waste recyclers / handlers. Contaminated / hazardous waste should be managed by licensed facilities.

- **Noise**

Noise pollution is related to several cement manufacturing phases including raw material extraction; grinding and storage; material handling and transportation; and operation of exhaust fans, and blowers. Control of noise emissions may include the use of silencers for fans, room enclosures for mill operators, and noise barriers, among other noise mitigation measures.

### *2.2. Health and Safety Issues:*

The occupational health and safety impacts of cement manufacturing projects are primarily associated with exposure to dust, heat, noise, and physical hazards.

**Table- Common Occupational Health and Safety (OHS) Issues**

| Hazard | Description | Prevention and Mitigation Measures |
|---|---|---|

| | | |
|---|---|---|
| Dust | Exposure to fine particulates is associated with work in most of the dust-generating stages of cement manufacturing, but most notably from raw material handling, and clinker / cement grinding. Exposure to active (crystalline) silica dust ($SiO_2$), when present in the raw | □ Control of dust through good housekeeping and maintenance (e.g., vacuum cleaning systems to prevent dust buildup on surfaces / paved areas)<br>□ Use of air–conditioned, closed cabins<br>□ Use of dust extraction and recycling systems to remove dust from work areas, |
| | materials, is a relevant potential hazard in the cement manufacturing sector. | especially in grinding mills<br>□ Use of air ventilation (suction) in cementbagging areas<br>□ Use of PPE, as appropriate (e.g. masks and respirators) to address residual exposures following adoption of the above-referenced process and engineering controls |
| Other Physical hazards | Injuries during cement manufacturing operations are typically related to slips, trips, and falls; contact with falling /moving objects; lifting / over-exertion; hazards involving moving machinery (e.g., trucks, loaders, bucket elevator, belt conveyor etc.); welding. Exposure to heat can occur during operation and maintenance of kilns and other hot equipment.<br>Exhaust fans and grinding mills are the main sources of noise and vibrations in cement plants. | □ Minimizing the work time required in high temperature environments by implementing shorter shifts at these locations<br>□ Shielding surfaces where workers' proximity and close contact with hot equipment is expected, using personal protective equipment (PPE), as needed (e.g., insulated gloves and shoes)<br>□ Making available and using, as needed, air or oxygen supplied respirators<br>□ Control of noise emissions may include the use of silencers for fans, room enclosures for mill operators, noise barriers, and, if noise cannot be reduced to acceptable levels, personal hearing protection |

**Table- Common Structural, Fire & Electrical Safety Issues in Bangladesh**

| Area | Issues commonly observed | Prevention and Mitigation Measures |
|---|---|---|
| Structural | Highly stressed columns; undocumented vertical extensions; localised areas of high loads in buildings; discrepancy between structural drawing and built structure; minor to major cracks in structural elements. | □ Compliance to regulatory requirements including the Bangladesh National Building Code (BNBC) (2015) or international codes, such as those compiled by the International Code Council (ICC), (2006).<br>□ Undertake periodic structural safety audits by accredited agencies. |

| | | |
|---|---|---|
| Fire | Inadequate, untested fire alarms; inadequate exit capacity compared to the occupancy load; lack of exit signage. | - Compliance with the by-laws of the Fire Regulation (2014), part of the Bangladesh Labor (Amendment) Act (2013), which includes requirements regarding the formation of a safety committees, and other measures such as emergency exits, access to stairs, and provision of personal protective equipment (PPE).<br>- Provisions for fire hydrants as per the requirements of BNBC (2015) and by Fire Regulation 2014, including water supply |
| | | specifications according to the building size / hazard.<br>- Undertake regular fire audits by accredited agencies, with mock drills to be conducted on a periodic basis as per the fire hazard assessment of the facility. |
| Electrical | Unsealed entry and exit points for electrical cable; excessive dust deposit on cables; cables laid on floor without guarding / protection; oil leaks in generator room; inadequate cable grounding. | - Undertake electrical safety assessment on a periodic basis, and ensure workers are trained and provided with appropriate PPE based on the risk assessment. |

### *2.3. Community Health & Safety:*

Common health and safety impacts on the community during the construction, operation, and decommissioning of cement manufacturing facilities include:

- Transport of materials
- Traffic safety
- Life and fire safety
- Emergency preparedness and response

### 2.4. Social Issues

This section will be same as described in the corresponding section of _Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector'

## 3. Performance Indicators and Monitoring

### 3.1. Wastewater Discharge Quality Standards

| Pollutants | Unit | Guideline Values | |
|---|---|---|---|
| | | GIIP | Bangladesh National Standards* |
| pH | S.U. | 6 – 9 | 6 – 9<br>(across all discharge locations, i.e., inland surface water, public sewer and irrigated land) |

| | | | |
|---|---|---|---|
| Total suspended solids (TSS) | mg/L | 50 | 150 (inland surface water),<br>500 (public sewer),<br>200 (irrigated land) |
| Temperature increase | °C | <3 | No national standard |

* *The Bangladesh National Standards are not specific to cement sector and are applicable for all the industrial units. The National standards are defined as per the location of disposal – inland surface water; public sewerage system connected to treatment at second stage; and irrigated land. In addition to the above mentioned pollutants, there are other pollutants as well for which standards are specified. Source: Bangladesh Environmental Conservation Rules, 1997.*

**3.2. Air Emission Standards**

| Pollutants | Unit | Guideline Values | | |
|---|---|---|---|---|
| | | *GII* | *Bangladesh National Standards* | |
| Particulate Matter | $mg/Nm^3$ | 30-100 | Integrated cement unit | 250 |
| | | | Clinker grinding unit (production capacity >1000 tons per day) | 200 |
| | | | Clinker grinding unit (production capacity 200-1000 tons per day) | 300 |
| | | | Clinker grinding unit (production capacity upto 200 tons per day) | 400 |
| Dust (other point sources: clinker cooling and cement grinding) | $mg/Nm^3$ | 50 | No national standards specific to cement industry | |
| $SO_2$ | $mg/Nm^3$ | 400 | No national standards specific to cement industry | |
| NOx | $mg/Nm^3$ | 600 | | |
| Hydrogen fluoride | $mg/Nm^3$ | 1 | | |
| TOC | $mg/Nm^3$ | 10 | | |
| HCl | $mg/Nm^3$ | 10 | 350 (generic value for HCl vapour/mist for industrial sectors) | |

**3.3. Resource and Energy Consumption Standards**

| Inputs per unit of product | Unit | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *Bangladesh National Standards* |
| Fuel energy – cement | GJ/t clinker | 3 - 4.2 | No national standards |
| Electric energy – cement | kWh/t equivalent cement | 90 – 150 | |
| Electric energy – clinker grinding | kWh/t | 40 – 45 | |

### 3.4. Waste Generation Standards

| Outputs per unit of product | Unit | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *National Standards* |
| Waste | Kg/t | 0.25-0.6 | No national standards |

### 5.1.1.1.1.1 3.5. Social standards

This section will be same as described in the corresponding section of _Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector'.

**4. General Description of Industry Activities**

| Sector Activity | Sub-sector Activities |
|---|---|
| Cement manufacturing | Integrated cement manufacturing units produce their own clinker which is a core raw material for manufacturing cement. The clinker production involves following steps:<br>□ Crushing of limestone |
| | • Mixing the crushed limestone with sand and clay<br>• Roasting the mixture at around 1500°C in a rotary kiln<br>• Quickly cooling down the roasted mixture to produce grey nodules of clinker<br>The clinker is then processed with gypsum and other additives in a grinding mill to produce finely powdered cement. |
| Clinker grinding | Clinker grinding units directly procure clinker as a raw material to produce cement. More than 80% of the clinker used in Bangladesh is imported. The clinker is grinded with gypsum to produce finely powdered cement. |

D. **ESRM Guidance Note for Ceramic Tile and Sanitary Ware Manufacturing Sector**

## 1. Introduction

The objective of this Guidance Note on ESRM for the Ceramic Tile and Sanitary Ware Sector is to provide a high level indicative summary of potential environmental and social (E&S) risks and performance levels for transactions in the Ceramic Tile and Sanitary Ware sector in Bangladesh. The scope of application will be fully aligned with the Section 4 of this policy. At all times, applicable national regulations are to be followed. Where national regulations differ from the levels and measures presented in this Guidance Note, loan proposals are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in this Guidance Note are appropriate, in view of specific loan proposal, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment. For the purposes of this Guidance Note, manufacturing activities in this sector include, but are not limited to: raw material processing; mixing; forming; shape drying; glazing; firing and finishing.

## 2. Industry Specific Impacts and Management

### *2.1. Environmental Issues:*

- **Air emissions**

Manufacturing activities in the ceramic sector may generate significant sources of air pollutants including from raw material processing, mixing, crushing, milling, drying, glazing and firing. The common sources of air emissions and related mitigation measures are listed below in Table. **Table - Sources of Air Emissions and Mitigation Measures**

| **Air emissions sources and mitigation measures** |
|---|
| **Raw material** processing, mixing and drying: Particulate matter (dust) is generated from crushing, grinding, screening and mixing activities. Measures to prevent and control dust emissions include:<br>• Segregation of material storage areas to minimize dust in operational areas.<br>• Use of enclosed silos to store bulk powder materials and use of wind protection (e.g., artificial barriers or vertical greenery, such as densely growing trees/shrubs) if raw materials are stored in open piles.<br>• Use of covered conveyor belts for transport of dusty raw materials.<br>• Use of covered and vented through or pan mixers.<br>• Use of enclosures for dusty operations (e.g., grinding, mixing), with maintenance of negative pressure in closed systems and dedusting of air from suction.<br>• Use of dust extraction equipment and fabric (bag house) filters, particularly for dry materials loading and unloading points, and where products are cut / ground and polished.<br>• Undertake regular maintenance to reduce air leakage and spillage points. |
| **Glazing / spraying**: Particulate matter (dust) is generated in mixing and milling processes during |

| |
|---|
| glaze preparation / spraying. Measures to prevent and control dust emissions include:<br>• Use of equipment enclosure for dust producing equipment and use of local exhaust ventilation with dust abatement (e.g., fabric [bag house] filters)<br>• Use of wet dust separators to control emissions from spray drying and glazing processes in fine ceramic manufacturing. Sintered lamellar filters may also be used to separate wet dust from spray glazing and to clean off-gas from the spraying cabins. |
| **Firing:** Kilns use primarily natural gas and to some extent coal and LPG. Emissions include particulate matter; carbon dioxide ($CO_2$); nitrogen oxides (NOx) from high kiln firing temperatures, nitrogen content in the raw materials, and the oxidation of nitrogen contained in fuels; and fluorides (Hydrofluoric acid, HF) and chlorides (hydrocholoric acid, HCl) emissions which are generated from impurities in clay materials. The heavy metal content of most ceramic raw materials is generally low and of limited concern, with the exception of some ceramic pigment glaze materials. Sulfur oxides ($SO_2$) emissions are generally limited due to the use of low sulfur fuel, however raw materials (e.g., pyrite, gypsum) may contain sulfur. The presence of carbonates in raw materials may, however, prevent the formation of sulfur emissions because of their reaction with $SO_2$. Measures to prevent and control emissions include:<br>• Use of raw materials and additives with low nitrogen, sulfur, chlorine, fluorine, and organic content to reduce NOx, SO2, HCl, HF, and VOC emissions.<br>• Optimizing peak flame temperatures in the kiln, and use of low NOx burners to reduce NOx emissions.<br>• Use of fabric (bag house) filters to reduce emissions of particulate matter.<br>• Use of activated carbon filters to reduce low off-gas volumes of VOCs.<br>• Use of commonly available glazes which do not contain lead or other toxic metals to minimize heavy metal emissions, and use of particulate matter abatement (e.g., fabric [bag house] filters).<br>• Use of dry scrubbers to control HCl and HF emissions.<br>• Optimizing/controlling the heating process and firing temperature, and use of dry or wet scrubbers, to control SO2 emissions.<br>Greenhouse gas (GHG) emissions, in particular $CO_2$, are mainly associated with the use of energy in the kiln and spray dryer. Please refer to the Energy Consumption section, below, for measures to improve energy use and reduce GHG emissions. |

- **Energy use and greenhouse gas emissions**

Ceramic and sanitary ware manufacturing generates greenhouse gas (GHG) emissions. The main sources of GHG emissions include the decarbonisation of the clay and some auxiliary materials with a natural carbon content that is released during the baking process and, secondly, the emissions generated by burning fossil fuels to power the manufacturing process. The emissions from the decarbonisation of clay are intrinsic process emissions and are therefore difficult to reduce. However, a focus on improvements to energy use and efficiency can result in opportunities to reduce GHG emissions.

The ceramic industry involves significant use of energy resources, for example as part of drying and firing operations and in activities involving wet treatments. While the industry currently uses natural gas as an energy resource, domestic natural gas reserves are depleting. As such, efforts to maintain the sector's access to low GHG emitting fuels such as natural gas or other low emitting alternative fuels should be a priority. In addition to energy resources, low to moderate cost energy efficiency and conservation techniques, as listed below, should be pursued. In order to identify such opportunities, facilities should undertake regular energy audits to identify potential energy efficiency measures, including:

- Continued use of low emissions fuels (e.g., natural gas, LPG), and alternative, low emitting fuels.
- Design modifications for ceramic tile and sanitary ware bodies to reduce drying and firing times.
- Improvements in design and performance of kilns and dryers, including:
  - ✓ Replace inefficient kilns (e.g. down-draft kilns) with tunnel or shuttle kilns or fast-firing kilns (e.g. roller hearth kilns).
  - ✓ Automatic control of dryer circuits.
  - ✓ Automatic control of humidity and temperature within the dryer.
  - ✓ Better sealing and improved thermal insulation of kilns.
  - ✓ Use of high velocity burners to improve combustion efficiency and heat transfer.
  - ✓ Minimisation of passage between dryer and kiln and use of preheating zone of kiln in finishing and drying process.
- Recovery of excess (waste) heat from kilns for drying and other production activities

- **Wastewater**

Water is used for various functions in the ceramic tile and sanitary ware manufacturing sector, including as a raw material, as a scrubbing and cleaning agent, and as a medium in the heat exchangers. In the manufacturing of ceramic products, wastewater is produced from mixing, casting moulds, glazing, and finishing activities. Process wastewater is generated mainly when clay materials are flushed out and suspended in running water during the manufacturing process. Typical pollutants include suspended solids (e.g. clays and insoluble silicates), suspended and dissolved heavy metals (e.g. lead and zinc), sulfates, boron, and traces of organic matter.
Measures to prevent and control wastewater effluents at different stages of ceramic manufacturing include:

- Use of high pressure system in the plant for cleaning purposes.
- Use of non-water consuming cleaning system such as a dry-off gas cleaning system instead of wet-off gas cleaning.
- Use of in-situ waste glaze collection system.
- Maximize re-use of process wastewater at each processing stage, including water used for cleaning purposes after suitable treatment (water recycling for ceramic tile manufacturing is typically in the range of 70–80 percent and 30–50 percent for sanitary ware manufacturing)
- Techniques for treating industrial process wastewater in this sector typically include flow and load equalization with pH adjustment; sedimentation for suspended solids reduction using settling basins or clarifiers; multimedia filtration for reduction in non-settling suspended solids; dewatering and disposal of residuals in landfills, or if hazardous in designated hazardous waste disposal sites. Additional engineering controls may be required for advanced metals removal using membrane filtration or other physical/chemical treatment technologies.

- **Solid and liquid/sludge wastes**

Solid and liquid wastes are generated in different stages of ceramic manufacturing. Solid waste consists mainly of different types of sludge, including sludge from process wastewater treatment, and process sludge resulting from glazing, plaster, and grinding activities. Other process wastes include broken ware from process activities (e.g. shaping, drying, and firing); broken refractory material; solids from dust treatments (e.g. flue-gas cleaning and dedusting); spent plaster molds; spent sorption agents (e.g. granular limestone and limestone dust); and packaging waste (e.g. plastic, wood, metal, paper).Waste production can be reduced through process enhancements including: replacing slip casting in plaster molds with pressure slip casting units with polymer molds; increasing the lifespan of plaster molds (e.g. using harder plaster molds obtained through use of automatic plaster mixers or vacuum plaster mixers); installing electronic controls for the firing curve (to optimize the process and reduce the amount of broken ware); and installing spray booths that allow reclaiming of excess glaze.Waste generation can also be reduced by recycling and internal reuse of cuttings, broken ware, used plaster molds, and other by-products, including sludge. Dust particles from loading, unloading, raw material handling, filter dust, and process losses before firing are mostly re-used in the production process. Dust from flue gas cleaning system can be also re-used in certain circumstances. Other solid wastes from fired products such as broken wares, and broken refractory materials from the kiln, can either be appropriately disposed of or used as a raw material in other industries. Liquid waste in the form of sludge is mainly generated from washing and cleaning process in different steps. Use of a sludge recycling system can lead to avoidance of waste generation, save raw material and improve water conservation. For example, sludge can be recycled into the ceramic molds, particularly in facilities where wet milling is implemented in raw material preparation. Sludge from fine ceramic and sanitary ware manufacturing can be reused as a raw material or additive in the manufacture of bricks or expanded clay aggregates; Management and disposal of hazardous and non-hazardous wastes should be undertaken in accordance with the Environmental Conservation Act, 1995 (ECA) and Environmental Conservation Rules, 1997 (ECR) that have provisions for environmentally sound use, storage, transportation, import and export of hazardous and non-hazardous wastes or its components.

### *2.2. Health and Safety Issues:*

In terms of occupational health and safety (OHS), key issues in the ceramic tile and sanitary ware sector include exposure to respiratory, heat, noise/vibration, physical, and electrical hazards. Facilities should ensure an effective emergency preparedness and response plan is in place. Table below, provides a list of commonly observed hazards in the ceramic industries and mitigation measures.

**Table -Common Occupational Health and Safety Issues**

| OHS Issues and prevention / control measures |
|---|
| **Respiratory:** Respiratory hazards primarily result from exposure to dust emissions, in particular, inhalation of silica dust. Other potential inhalation hazards may result from glaze application, airborne refractory ceramic fibers, and combustion by-products. Measures to prevent and mitigate respiratory hazards include:<br>• Segregate raw material storage from other operational areas<br>• Use of local exhaust ventilation with filter units<br>• Use of kiln venting systems (e.g., adjustable vents mounted over the top of the kilns) for loading and unloading<br>• Use of enclosed raw material conveyors<br>Regular housekeeping and dust removal from surfaces in working areas (e.g., vacuuming) and wet cleaning instead of dry sweeping |
| • Avoid use of low solubility glazes containing lead and heavy metals<br>• Use of well-ventilated areas for glazing and use of spray booths<br>• Use of personal protective equipment (PPE), such as facemasks with filters, goggles, gloves, and overalls<br>• Use of shift and task rotation strategies for workers to minimize exposure (e.g., VOC exposure) |

**Heat exposure:** Heat exposure may result from worker activities in the areas of high radiant heat and humidity (e.g., kiln area and handling of hot equipment). Measures to prevent and mitigate heat exposure related hazards include:

- Adequate ventilation in workplace, (e.g. ducting in air, allowing cross-ventilation, and installing exhaust fans)
- Provision of air cooled rest rooms for workers in the kiln area
- Reduce the time required for work in high temperature environments (e.g. shorter shifts at these locations)
- Provision of PPE, such as insulated gloves, shoes, and air- or oxygen supplied respirators), especially during maintenance operations

**Noise / vibration exposure:** Noise sources include raw material preparation (e.g. crushing, grinding, milling, dry and wet mixing, screening, and clarification), pressing and granulation processes, cutting, grinding and polishing, fan burners in kilns, and packaging activities. Measures to prevent and mitigate noise exposure include:

- Management of noise as per ECA 1995 and ECR 1997 (Rule 12, Schedule-4). Minimizing worker exposure to noise greater than 85 dB(A) for more than 8 hours per day without hearing protection
- Use of acoustic insulating materials, isolation of noise sources (e.g., enclosures), and other engineering controls
- Installing vibration dampening for mechanical equipment, and limiting duration of exposure □ Use of PPE such as hearing protectors (e.g., ear plugs or ear muffs).

**Physical:** Physical hazard from moving equipment (kilns, mills, conveyor belts and crushing equipment). Other physical hazards include handling sharp materials, lifting heavy objects, and repetitive motions. Chemical hazards may result from chemicals (metal oxides) for glazing.
Measures to prevent and mitigate physical hazards include:

- Implementation of machine guarding and lock-out-tag-out systems
- Use of closed conveyors to transport raw materials
- Incorporating rest breaks and job rotation into work processes
- Use of mechanical material lift assists to eliminate or reduce exertion
- Communicating chemical hazards to workers through labelling and according to national and internationally recognized standards (e.g., material data safety sheets, MSDS).
- Use of PPE such as helmets with top and side impact protection, safety glasses with sideshields, protective shades, gloves, overalls, and safety shoes / boots

**Electrical:** Electrical hazards due to the presence of electrical equipment. Measures to prevent and mitigate electrical hazards include:

- Marking of all energised devices and lines with warning signs

- Locking out (de-charging and leaving open with a controlled locking device) and tagging-out (warning sign placed on the lock) devices during service or maintenance, and use of appropriate PPE for electrical work
- Insulation and grounding of electrical equipment, including double insulating/grounding of all electrical equipment used in environments that are, or may become, wet, and using equipment with ground fault interrupter (GFI) protected circuits
- Protecting power ccords against damage from traffic by shielding or suspending above traffic areas

Structural safety is a serious safety concern in the industrial buildings of Bangladesh. The lack of structural safety in the industrial buildings can also increase the risk of fire and electrical hazards. Table below, provides a list of structural, fire, and electrical hazards observed in the cement sector and related prevention and mitigation measures.

**Table -Common Structural, Fire & Electrical Safety Issues in Bangladesh**

| Area | Issues commonly observed | Prevention and Mitigation Measures |
|---|---|---|
| Structural | Highly stressed columns; undocumented vertical extensions; localised areas of high loads in buildings; discrepancy between structural drawing and built structure; minor to major cracks in structural elements. | • Compliance to regulatory requirements including the Bangladesh National Building Code (BNBC) (2015) or international codes, such as those compiled by the International Code Council (ICC), (2006).<br>• Undertake periodic structural safety audits by accredited agencies. |
| Fire | Inadequate, untested fire alarms; inadequate exit capacity compared to the occupancy load; lack of exit signage. | • Compliance with the by-laws of the Fire<br>• Regulation (2014), part of the Bangladesh Labor (Amendment) Act (2013), which includes requirements regarding the formation of a safety committees, and other measures such as emergency exits, access to stairs, and provision of personal protective equipment (PPE).<br>• Provisions for fire hydrants as per the requirements of BNBC (2015) and by Fire Regulation 2014, including water supply specifications according to the building size / hazard.<br>• Undertake regular fire audits by accredited agencies, with mock drills to be conducted on a periodic basis as per the fire hazard assessment of the facility. |
| Electrical | Unsealed entry and exit points for electrical cable; excessive dust deposit on cables; cables laid on floor without guarding / protection; oil leaks in generator room; inadequate cable grounding. | Undertake electrical safety assessment on a periodic basis, and ensure workers are trained and provided with appropriate PPE based on the risk assessment. |

## 2.3. Community Health and Safety

Community health and safety impacts during the construction, operation, and decommissioning of ceramic tile and sanitary ware manufacturing facilities are common to those of most industrial facilities.

## 2.4. Social Issues

This section will be same as described in the corresponding section of ‗Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector'

# 3. Performance Indicators and Monitoring

## 3.1. Wastewater discharge quality standards

| Pollutants | Unit | Guideline Values | |
|---|---|---|---|
| | | GIIP | National Standards* |
| pH | S.U. | 6 – 9 | 6 – 9<br>(discharge locations to inland surface water, public sewer, irrigated land) |
| $BOD_5$ | mg/L | 50 | 50 – 250 |
| TSS | mg/L | 50 | 150 (inland surface water), 500 (public sewer), 200 (irrigated land) |
| Oil and Grease | mg/L | 10 | 10 |
| Lead | mg/L | 0.2 | 0.1-1 |
| Cadmium | mg/L | 0.1 | 0.05 – 0.5 |
| Chromium (total) | mg/L | 0.1 | 0.5 – 1 |
| Cobalt | mg/L | 0.1 | No National standard |
| Copper | mg/L | 0.1 | 0.5 – 3 |
| Nickel | mg/L | 0.1 | 1-2 |
| Zinc | mg/L | 2 | 5-10 |
| Temperature increase | $^0C$ | <3 | No National standard |

**The National Standards are not specific to ceramics sector and are applicable for all the industrial units. The National standards are defined as per the location of disposal – inland surface water; public sewer; irrigated land. Source: Bangladesh Environmental Conservation Rules, 1997.*

## 3.2. Air Emissions Standards

| Pollutants | Unit | Guideline Values | |
|---|---|---|---|
| | | GIIP | National Standards |
| Particulate Matter | mg/Nm3 | 50 | No national standards specific to the ceramic tile and sanitary ware sector |
| SO2 | mg/Nm3 | 400 | |
| NOX | mg/Nm3 | 600 | |
| HCl | mg/Nm3 | 30 | |
| HF | mg/Nm3 | 5 | |

| | | | |
|---|---|---|---|
| Lead | mg/Nm3 | 0.5 | |
| Cadmium | mg/Nm3 | 0.2 | |
| TOC | mg/Nm3 | 20 | |

### 3.3. Resource and energy consumption standards

| **Ceramic Tile manufacturing – Energy Consumption** | **Guideline Values** | |
|---|---|---|
| | **GIIP** | **National Standards** |
| | *Energy (KJ/kg)* | |
| Thermal energy: Spray drying process | 980–2,200 | No National standards |
| Thermal energy: Drying process | 250–750 | |
| Thermal energy: Firing: once-fired tiles (Tunnel kilns) | 5,400–6,300 | |
| Thermal energy Firing: twice-fired tiles (Tunnel kilns) | 6,000–7,300 | |
| Thermal energy Firing: once-fired tiles (Roller hearth kilns) | 1,900–4,800 | |
| Thermal energy Firing: twice-fired tiles (Roller hearth kilns) | 3,400–4,600 | |
| Electric energy Pressing | 50–150 (kWh/kg) | |
| Electric energy Drying | 10–40 (kWh/kg) | |
| Electric energy Firing | 20–150 (kWh/kg) | |

### 3.4. Resource and energy consumption standards

| **Sanitary Ware manufacturing – Energy Consumption** | **Guideline Values** | |
|---|---|---|
| | GIIP | National Standards |
| | Energy (KJ/kg) | |
| Conventional tunnel kiln | 9,100–12,000 | No National standards |
| Modern tunnel kiln with light fiber insulation | 4,200–6,500 | |
| Roller heath kiln | 3,500–5,000 | |
| Modern shuttle kiln | 8,500–11,000 | |

### 3.5. Waste generation standards

| **Outputs per unit of product** | **Unit** | **Guideline Values** | |
|---|---|---|---|
| | | GIIP | National Standards |
| Glaze waste produced in tile surface glazing | $g/m^2$ of tile surface | 100 | No national standards |
| Sludge | $g/m^2$ of tile surface | 90–150 | |

| | | | |
|---|---|---|---|
| Solid waste — cuttings and defective tiles | $g/m^2$ of tile surface | 700–1300 | |
| Recovery and re-use of glaze in sanitary ware manufacturing | $m^3$ /day | 0.08–0.1 | |
| Glaze used per sanitary ware item | kg/item | 1.5–3 | |

### 3.6. Social standards

This section will be same as described in the corresponding section of _Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector'.

## 4. General Description of Industry Activities

| Process stage | Activities |
|---|---|
| Raw material processing | The major raw materials used in the manufacture of ceramics range from unprocessed clays and other mined minerals to high purity powders produced from chemical synthesis. Naturally occurring raw materials include varieties of clay such as ball clay, fire clay and common clay; feldspar; talc; silica and nepheline syenite. Bangladesh imports 100% of the raw materials for production of ceramic tiles and sanitary wares. The raw materials typically account for 35 - 40% of the total production cost. The majority of raw materials and machines are imported mainly from China, Romania, Indonesia, Italy and Germany. |
| Mixing | The purpose of mixing is to combine the constituent raw materials to provide more chemically and physically uniform material for forming activities. Binders and additives are added to the mixture to form temporary bonds between raw material grains so that the shape is maintained until it is fired |
| Forming | The ceramic mix is moulded and consolidated in specific molds for the desired shape and size which is achieved through dry forming, plastic molding or wet forming. |
| Shape drying | Drying is undertaken either by continuous or periodic dryers which are used to reduce the moisture content of the products and prevent any shrinkage, distortion, cracking, and spalling. |
| Glazing | Glazing provides a smooth and shiny finish on the products. |
| Firing | Firing is done either through continuous or batch process mainly to increase the structural integrity of the product by reducing the number of pores, increasing the density, and bonding the individual grains into a strong hard mass. |
| Finishing | At the finishing stage, machining operations may be necessary to produce ceramic products whose final shape or dimensional tolerance cannot be achieved technically or with sufficient accuracy during primary processing (especially for larger shapes or blocks). Porcelain tiles may be further polished to achieve a shiny, unglazed homogenous tile surface. |

E. **ESRM Guidance Note for Fertilizer Manufacturing Sector**

**1. Introduction**

The objective of this Guidance Note on ESRM for the Fertilizer Manufacturing Sector is to provide a high level indicative summary of summary of potential environmental and social (E&S) risks and performance levels for transactions in the Fertilizer Manufacturing sector in Bangladesh. The scope of application will be fully aligned with the Section 4 of this policy. At all times, applicable national regulations are to be followed. Where national regulations differ from the levels and measures presented in this Guidance Note, loan proposals are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in this Guidance Note are appropriate, in view of specific loan proposal, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

**2. Industry Specific Impacts and Management** *2.1.*

***Environmental Issues:***

□ **Air Emissions – Nitrogenous fertilizer manufacturing processes**

Air emissions from nitrogenous fertilizer manufacturing facilities generally consist of greenhouse gases (GHGs, mainly carbon dioxide and nitrous oxide), other gaseous inorganic compounds, and particulate (dust) emissions (in particular dust emissions of less than 10 microns in aerodynamic diameter, [$PM_{10}$] from prilling activities).

The air emissions sources and pollutants are listed by production process in Table below, along with prevention and control techniques to mitigate emissions.

## Table - Air Emissions Sources and Prevention/Control Measures for Nitrogenous Fertilizers Manufacturing

| ***Sources and Prevention/Control of Air Emissions for Nitrogenous Fertilizers Manufacturing*** |
| --- |
| ***Ammonia production:*** Process Air Emissions from Ammonia Production consist mainly of natural gas, hydrogen ($H_2$), carbon dioxide ($CO_2$), ammonia ($NH_3$), and carbon monoxide (CO). Hydrogen sulfide ($H_2S$) may be present depending on the fuel used. Fugitive emissions of ammonia ($NH_3$) from storage tanks, valves, flanges, and tubing may also occur, especially during transportation or transfer. Non-routine emissions associated with process upsets or accidents may contain natural gas, carbon monoxide, hydrogen, carbon dioxide, Volatile Organic Compounds (VOCs), nitrogen oxide ($NO_X$), and ammonia. |
| • Use synthesis $NH_3$ purge gas treatment to recover $NH_3$& $H_2$ before combustion of remainder in primary reformer<br>• Increase the residence time for off-gas in the high temperature zone of the primary reformer<br>• Ammonia emissions from relief valves / pressure controls should be collected and sent to a flare or wet scrubber<br>• Install leak detection methods to detect fugitive emissions of ammonia from process and storage<br>• Implement maintenance programs, particularly in stuffing boxes on valve stems and seals on relief valves<br>• Where ammonia and urea facilities are integrated, ammonia process-derived CO2 can be consumed almost completely if the produced ammonia is transformed into urea. |

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| ***Urea production:*** Process emissions from urea production consist mainly of ammonia and particulate matter (dust). Fugitive emissions of ammonia from tanks, valves, flanges, and tubing may also occur. Prilling towers and granulators are a major source of emission of urea dust. The final product is prilled or granulated requiring a large volume of cooling air, which is subsequently discharged to the atmosphere. |
| • Reduction of dust emissions by producing granular rather than prilled product<br>• Installation of prilling towers with natural draft cooling instead of towers with forced/induced draft air cooling<br>• Scrubbing of off-gases with process condensate prior to discharge to atmosphere, and reprocessing the recovered urea solution<br>• Use of baghouse filters to prevent the emission of dust laden air from transfer points, screens, bagging machines, etc., coupled with an urea dust dissolving system which allows recycling of urea to the process<br>• Flash melting of solid urea over-size product which allows urea recycling to the process;<br>• Collection of solid urea spillages on a dry basis, avoiding washing of surfaces<br>• Connection of both safety relief valves/seals of the ammonia/urea pumps, and tank vents to a flare. |
| ***Nitric Acid production:*** Process Emissions from Nitric Acid Manufacturing consist primarily of nitric oxide (NO), nitrogen dioxide ($NO_2$), and nitrogen oxide from the tail gas of the acid absorption tower, nitrous oxide ($N_2O$), trace amounts of nitric acid ($HNO_3$) mist from the filling of acid storage tanks, and ammonia. |
| Recommendations to prevent and control NOx emissions include the following:<br>• Ensure that a sufficient air supply is provided to the oxidizer and absorber<br>• Ensure that high pressure conditions are maintained, especially in nitric acid production absorption columns<br>• Prevent high temperatures in the cooler-condenser and absorber<br>• Develop a maintenance program to prevent operation with faulty equipment such as compressors or pumps that lead to lower pressures and leaks, and decrease plant efficiency<br>• Reduce NOx emissions by increasing the efficiency of the existing process absorption tower or incorporating an additional absorption tower<br>• Apply a catalytic reduction process to treat tail gases from the absorption tower<br>• Install active molecular sieves to catalytically oxidize NO to NO2 and selectively adsorb NO2, returning the thermally stripped NO2 to the absorber<br>• Install wet scrubbers with an aqueous solution of alkali hydroxides or carbonates, ammonia, urea, potassium permanganate, or caustic chemicals (e.g. caustic scrubbers with sodium hydroxide, sodium carbonate, or other strong bases), recovering NO and NO2 as nitrate or nitrate salts<br>Recommendations to prevent and control N2O emissions include the following:<br>• Install selective catalytic reduction (SCR) units operating around 200°C with various catalysts (platinum, vanadium pentoxide, zeolites, etc.) or, less frequently, non-selective catalytic reduction (NSCR) units<br>• Integrate a decomposition chamber in the burner to reduce the production of N2O by increasing the residence time in the oxidation reactor<br>• Use a selective de-N2O catalyst in the high temperature zone (between 800 and 950 °C) of the oxidation reactor<br>• Install a combined N2O and NOX abatement reactor between the final tail gas heater and the tail gas turbine. |

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| ***Ammonium Nitrate and Calcium Ammonium Nitrate Manufacturing:*** Process emissions from ammonium nitrate and calcium ammonium nitrate manufacturing consist mainly of ammonia and dust from neutralizers, evaporators, prill towers, granulators, driers and coolers. Fugitive emissions of ammonia arise from storage tanks and process equipment. |
| • Install steam droplet separation techniques (e.g., knitted wire, mesh demister pads, wave plate separators and fibre pad separators using, for example, polytetrafluoroethylene [PTFE] fibres) or scrubbing devices (e.g., packed columns, venturi scrubbers and irrigated sieve plates) to reduce emissions of ammonia and ammonium nitrate in the steam from neutralizers and evaporators.<br>• Treat and re-use contaminated condensate using techniques including stripping with air or steam with the addition of alkali to liberate ionized ammonia if required, or use distillation and membrane separation processes such as reverse osmosis<br>• Adopt the lowest practical melt temperature to reduce emissions of ammonia and ammonium nitrate (and calcium carbonate in calcium ammonium nitrate (CAN) production) from prilling and granulation emissions<br>• Remove ammonia emissions from prilling and granulation by neutralization in a wet scrubber. Wet scrubbers normally use an acid circulating solution. The solution from a wet scrubber will normally be recycled to the process<br>• Remove ammonium nitrate fumes from prilling through scrubbing<br>• Remove small particles of ammonium nitrate (mini prills), carried out with the air stream through cyclones, bag filters and wet scrubbers<br>• Adopt an enclosed granulation process instead of prilling technique where feasible<br>• Install an extraction, capture and filter system for ventilation air from areas with dustgenerating product-handling activities to prevent fugitive emissions of particulates. |

**Table -Sources and Prevention/Control of Air Emissions for Phosphate Fertilizers Manufacturing**

| Production processes and related air emissions sources | Mitigation measures |
|---|---|
| ***Process Emissions from Phosphoric Acid Production:*** Process emissions from phosphoric acid production include gaseous fluorides in the form of hydrofluoric acid (HF) and silicon tetrafluoride ($SiF_4$), released during the digestion of phosphate rock, which typically contains 2-4% fluorine. The emissions generally associated with the thermal production process of phosphoric | Recommended emission prevention and control measures include the following:<br>• Properly select the phosphate rock (in terms of P2O5-content, F-content, CaO/ P2O5 ratio, and physical quality) to minimize the amount of acid required in the wet production process, reduce emissions into the environment and increase the possibility of phosphor-gypsum reuse<br>• Select proper size of screens and mills (e.g. roller or chain mills |

| | |
|---|---|
| acid include phosphate, fluoride, dust, cadmium (Cd), Lead (Pb), zinc (Zn), and radionuclides (Po-210 and Pb-210). Dust emissions, containing water-insoluble fluoride, may occur during the unloading, storage, handling and grinding of the phosphate rock, which is transferred to storage and grinding sections by conveyor belts or trucks. | • Use covered conveyor belts and indoor storage<br>• Apply good housekeeping measures (e.g. frequently cleaning / sweeping facility surfaces and the quay)<br>• Recover dust from phosphate rock grinding through use of properly operated and maintained fabric filters, ceramic filters, and / or cyclones<br>• Treat gaseous fluoride emissions using scrubbing systems (e.g. void spray towers, packed beds, cross-flow venture, and cyclonic column scrubbers). Fluorine is recovered as fluosilicic acid, from which silica is removed through filtration. A diluted solution of fluosilicic acid ($H_2SiF_6$) may be used as the scrubbing liquid. Recovering of $H_2SiF_6$ is an additional possibility for fluoride emission reduction |
| ***Process emissions from superphosphate phosphate fertilizer production*** include dust emissions during unloading, handling, grinding, and curing of phosphate rock, in addition to granulation and crushing of superphosphates. Emissions of gaseous hydrofluoric acid (HF), silicon tetrafluoride ($SiF_4$), and chlorides may also be generated from acidulation, granulation and drying. Ammonia ($NH_3$) and nitrogen oxides ($NO_x$) may be generated during the drying and neutralization phases of ammonium nitrate fertilizers. In addition, during the reaction of phosphate rock with acid, limited amounts of organic compounds (including mercaptans), present in the phosphate rock, are released and may cause odor. | Recommended emission prevention and control measures include the following:<br>• Use of direct granulation may reduce the levels of fugitive emissions compared with curing emissions from indirect granulation. If indirect granulation is used, the curing section should be an indoor system with vents connected to a scrubbing system or to the granulation section<br>• Use of plate bank product cooling systems to reduce air flow requirements (e.g. instead of rotary drums or fluid bed coolers)<br>• Consider use of fabric filters or high efficiency cyclones and/or fabric filters rather than a wet scrubbing system to treat exhaust air from neutralization, granulation, drying, coating and product coolers and equipment vents, in order to avoid creation of additional wastewater. Filtered air should be recycled as dilution air to the dryer combustion system<br>• Emissions from granulation should be minimized through application of surge hoppers to product size distribution measurement systems for granulation recycle control. |
| ***Process Emissions from Compound Fertilizer Production.*** Compound fertilizers (NPK) are typically produced | Recommended measures to prevent and control air emissions include the following: |

| | |
|---|---|
| | - Reduce NOX emission from nitric acid use in phosphate rock digestion by controlling the reactor temperature optimizing the rock / acid ratio, and adding urea solution<br>- Treat gases from the digestion reactor in a spray tower scrubber to recover NOX and fluorine compounds. The pH may be adjusted by the addition of ammonia<br>- Reduce NOx and odor emissions by selecting high grade phosphate rock with low contents of organic compounds and ferrous salts<br>- Control particulate matter emissions, as discussed in the phosphoric acid production section<br>- Prevent and/or control emissions from granulation and product cooling include:<br>    o Scrubbing of gases from the granulator and the dryer in venturi scrubbers with recirculating ammonium phosphate or ammonium sulfo-phosphate solution<br>    o Discharge of scrubbed gases through cyclonic columns irrigated with an acidic solution<br>    o Use of high efficiency cyclones to remove particulates from dryer gases prior to scrubbing<br>    o Recycling of the air coming from the cooling equipment as secondary air to the dryer after dedusting<br>    o Treating ammonia emissions by scrubbing with acidic solutions<br><br>- Fluoride emissions should be controlled through scrubbing systems, as discussed for phosphoric acid production<br>- Emissions to air from phosphate rock digestion, sand washing and CNTH filtration should be reduced by applying appropriate controls (e.g. multistage scrubbing, conversion into cyanides)<br>- Ammonia in off-gases from the Nitrophosphoric neutralization steps should be removed through counter current scrubbers, with pH adjustment to most efficient scrubbing condition (pH 3-4), with a mixture of HNO3 and/or H2SO4 |

| | |
|---|---|
| | Ammonia emissions from the granulation / |
| | drying sections should be treated by scrubbing with acidic solutions<br>Minimize contact between wastes containing NOX and NH3 to prevent aerosol formation in NPK nitrophosphate route<br>Reduce aerosol emission by installing cyclones and scrubbers<br>Reduce fluorides emissions by recycling of warm air |

- **Industrial Wastewater from Nitrogenous Fertilizer Manufacturing**

Process water discharges from nitrogenous fertilizer manufacturing plants are limited typically to acid wash from scheduled cleaning activities and purges, effluents from wet scrubbers, accidental releases, leaks of small quantities of liquids from product storage tanks, and acidic and caustic effluents from the boiler feed water preparation.

***Effluent from Ammonia Plants*:** During normal operations, plant discharges may include releases of process condensates or scrubbing effluents of waste gases containing ammonia and other byproducts. Process condensates typically arise from condensation between shift reactors and absorption of carbon dioxide, and from carbon dioxide overheads. Such condensates may contain ammonia, methanol, and amines (e.g., methylamines, dimethylamines and trimethylamines). In partial oxidation, soot and ash removal may impact water discharges if not handled adequately. Recommended pollution prevention and control practices include:

- Condensates should be steam-stripped to reduce the ammonia content also steam-stripper emissions may require additional ammonia emissions controls
- Ammonia absorbed from purge and flash gases should be recovered in a closed loop to avoid the occurrence of aqueous ammonia emissions
- Soot from gasification in partial oxidation processes should be recovered and recycled to the process.

***Effluent from Urea Plants*:** A urea plant generates a significant stream of process water containing ammonia, carbon dioxide, and urea (e.g., a 1,000 ton per day plant generates approximately 500 cubic meters per day [$m^3/d$] of process water). Other sources include ejector steam, flush, and seal water. Recommended pollution prevention and control practices include:

- Improve evaporation heater/separator design to minimize urea entrainment;
- Remove NH3, CO2, and urea from the process water in a process water treatment unit, and recycle the gases to the synthesis to optimize raw material utilization and reduce effluents;
- Provide adequate storage capacity for plant inventory to prepare for plant upset and shutdown conditions;
- Install submerged tanks to collect plant washings and other contaminated streams from drains for recycling to process or conveying to the process water treatment unit.

***Effluents from Nitric Acid Plants*:** Liquid effluents from a nitric acid plant includes diluted ammonium nitrite/ nitrate solution from periodic washing (typically once per day) of the NOx compressor and from the cooler-condenser drain for a period after plant start-up; aqueous ammonia solution from evaporator blow down; blow down of water containing dissolved salts from the steam drum; and occasional emissions from the purging and sampling of nitric acid solutions.

Recommended pollution prevention and control practices include:

Steam Steam-inject the NOX compressor to avoid any liquid effluent;

- Arrange for acidification during start-up to avoid the need to drain the cooler-condenser
- Conduct steam stripping to recover the ammonia into the process and limit emissions of aqueous ammonia from the evaporator blow down.

***Effluents from Ammonium nitrate (AN) / Calcium Ammonium Nitrate (CAN) Plants*:** AN/CAN plants produce a surplus of water to be treated for discharge or possibly recycled to other units in the nitrogenous fertilizers production complex. Their process effluents typically include condensates containing up to 1percent ammonia and up to 1percent ammonium nitrate from reactors (neutralizers) and evaporator boil-off, and ammonium nitrate and nitric acid from plant wash-down. Unabated emissions into water can be up to 5,000mg AN as N/l and 2,500mg NH3 as N/l (6 and 3 kilograms per ton (kg/t) of product respectively).
**Recommended** pollution prevention and control practices include:

- Internally recovery of ammonium nitrate and ammonia (e.g. scrubber liquor from the granulation plant air cleaning section being recycled through the further evaporation stages on the granulation plant)
- Integrate AN/CAN plants with nitric acid production
- Treat steam contaminated with ammonia or ammonium nitrate, before condensation, by droplet separation techniques and scrubbing devices (as discussed under Air Emissions in this document)
- Treat process water (condensate) by stripping with air or steam with the addition of alkali to liberate ionized ammonia as needed; ion exchange; distillation; or membrane separation processes.

Techniques for treating industrial process wastewater in this sector include filtration for separation of filterable solids; flow and load equalization; sedimentation for suspended solids reduction using clarifiers; ammonia and nitrogen removal using physical-chemical or biological nitrificationdenitrification treatment methods; dewatering and disposal of residuals in designated waste landfills. Additional engineering controls maybe required for capturing ammonia from air stripping operations and for odour control.

- **<u>Industrial Wastewater from Phosphate Fertilizer Manufacturing</u>**

Effluents from phosphoric acid plants: Consist of discharges from the vacuum cooler condensers and the gas scrubbing systems used for condensation and cleaning of vapors from process operations. Condensed acidic vapors may contain fluorine and small amounts of phosphoric acid. Water from the slurry used to transport phosphor-gypsum, the by-product from wet phosphoric acid production, may be released as effluent if it is not recirculated back into the process. Emissions to water for the disposal of gypsum may contain a considerable amount of impurities, such as phosphorus and fluorine compounds, cadmium and other heavy metals, and radio-nuclides. Drainage from material stockpiles may contain heavy metals (e.g. Cadmium, Mercury and Lead), fluorides, and phosphoric acid. Specific emissions to water from the thermal process of phosphoric acid production may include phosphorus and fluorine compounds, dust, heavy metals, and radionuclides.
**Recommended effluents management measures** include the following:

- Select phosphate rock with low levels of impurities to produce clean gypsum and reduce potential impacts from disposal of gypsum;
  Consider dry systems for air pollution abatement (versus wet scrubbing) to reduce wastewater. To reduce fluoride emissions, the installation of scrubbers with scrubber liquids may be necessary;
  Recover fluorine released from the reactor & evaporators as a commercial by-product (fluosilicic acid);
- Scrubber liquors should be disposed of after neutralization with lime or limestone to precipitate fluorine as solid calcium fluoride, if the fluorine is not to be recovered;
- Recycle water used for the transport of phosphogypsum back into process following a settling step;
- Where available, consideration should be given to use seawater as scrubbing liquid, to facilitate reaction of fluorine to harmless calcium fluoride.
- Minimize contamination of the scrubber effluent with phosphorus pentoxide (P2O5) by conveying vapors from vacuum flash coolers and vacuum evaporators to a separator to remove phosphoric acid droplets
- Minimize contamination of the scrubber effluent with phosphorus pentoxide P2O5 using entrainment separators. Additional phosphate removal can be achieved by applying magnesium ammonium phosphate (struvite) or by calcium phosphate precipitation
- Consider decadmation of H3PO4 up to 95% by reactive extraction with an organic solvent.

**Effluent from Superphosphate Fertilizer Production:**The main source of wastewater in phosphate fertilizer production is the wet scrubbing systems to treat off-gases. Contaminants may include filterable solids, total phosphorus, ammonia, fluorides, heavy metals (e.g. Cd, Hg, Pb), and Chemical Oxygen Demand (COD).

Recommended effluents management measures include the following:

- Recycling of scrubber liquids back into the process should be maximized.
- Production of Acidulated Phosphate rock (PAPR), a fertilizer product consisting of a mixture of superphosphate and phosphate rock, in addition to Superphosphate (SSP), and Triplesuperphosphate (TSP) products can reduce wastewater volumes.

**Effluent from compound fertilizer production:** Effluents are usually limited from NPK mixed acids route facilities, mainly consisting of wastewater from granulation and exhaust gas scrubbing. Effluent from NPK facilities employing the nitrophosphate route may contain ammonia, nitrate, fluoride and phosphate. Ammonia is found in the effluents of the condensates of the ammonium nitrate evaporation or the neutralization of the nitro phosphoric acid solution. Solutions containing ammonium nitrate must be pumped with care to limit the risks of explosions. The main sources of nitrate and fluoride levels in effluent are the scrubber liquors from phosphate digestion and sand (removed from the process slurry) washing. Washing of sand also generates phosphate content in the effluent.

**Recommended** effluent management measures include the following:

- Recycle the sand washing liquor to reduce phosphate levels in wastewater effluents
- Avoid co-condensation of vapors from ammonium nitrate evaporation
- Recycle NOX scrubber liquor to reduce ammonia, nitrate, fluoride and phosphate levels
- Recycle liquors resulting from scrubbing of exhaust gases from neutralization
- Consider reusing effluents as scrubber medium
- Treat multi-stage scrubbing liquors, after circulation, through settling (separation of solids), and recycle the thickened portion back to the reactors.

  Consider combined treatment of exhaust gases from neutralization, evaporation and granulation. This enables a recycling of all scrubber liquids to the production process and reduce waste water generation

  Treat waste water through a biological treatment with nitrification/denitrification and precipitation of phosphorous compounds.

- **<u>Hazardous Materials</u>**

Nitrogenous and phosphate fertilizer manufacturing plants use, store, and distribute hazardous materials (e.g., acids and ammonia, among others). Manufacture and distribution of materials should be conducted according to applicable international requirements where applicable.

- **<u>Waste</u>**

Waste from nitrogenous fertilizer manufacturing facilities: Spent catalysts are the most common hazardous waste produced by nitrogenous fertilizer manufacturing facilities after their replacement in scheduled turnarounds of gas desulphurization, ammonia plants, and nitric acid plants. The most common non-hazardous wastes are nitrogen-containing dust particulates from prilling and granulators dust control systems. Recommended management strategies for spent catalysts include:

- Proper on-site management, including submerging pyrophoric spent catalysts in water during temporary storage and transport until final treatment to avoid uncontrolled exothermic reactions
- Return to the manufacturer for regeneration or recovery
- Off-site management by specialized companies that can recover the heavy or precious metals through recovery and recycling processes whenever possible, or who can otherwise manage spent catalysts or their non-recoverable materials.

Recommended management strategies for recovered dust and off-spec products include the following:

- Recycling to their specific production units or to fertilizer mixing units in the manufacturing plant
- Providing to third party users (merchants and farmers) for their subsequent utilization.

**Waste from phosphate fertilizer manufacturing facilities:** Non-hazardous solid wastes may be generated from some phosphate fertilizer manufacturing processes, including phosphogypsum from wet phosphoric acid production, and quartz sand from NPK production using the nitrophosphate route. Quartz sand should be separated, washed, and recycled as a building material. There is limited hazardous waste generated from the phosphate fertilizer manufacturing processes.

Phosphogypsum is the most significant by-product in wet phosphoric acid production (approximately 4 - 5 tons of phosphogypsum is produced for every ton of phosphoric acid produced). Phosphogypsum contains a wide range of impurities (residual acidity, fluorine compounds, trace elements such as mercury, lead, and radioactive component). Industry-specific pollution prevention and control practices include

- Depending on its potential hazardousness (e.g. whether it emits radon) phosphor-gypsum may be processed to improve its quality and reused (e.g. as building material). Possible options include: 1) Production of cleaner phosphor-gypsum from raw materials (phosphate rock) with low levels of impurities and 2) Use of repulping
- Use of di-hemihydrate recrystallization process with double stage filtration;

  If phosphor-gypsum cannot be recycled due to the unavailability of commercially and technically viable alternatives, it should be managed as a hazardous or nonhazardous industrial waste, depending on its characteristics.

  Additional management alternatives may include backfilling in mine pits, dry stacking and wet stacking.
- **Noise**

Typical sources of noise emissions in both nitrogenous and phosphate fertilizer manufacturing operations include large size rotating machines such as compressors and turbines, pumps, electric motors, air coolers, rotating drums, spherodizers, conveyors belts, cranes, fired heaters, and from emergency depressurization.

### *2.2. Health and Safety Issues:*

The occupational health and safety impacts of fertilizer manufacturing facilities are primarily associated with process safety, chemical and fire/explosion hazards, and hazardous materials. Tables below, provide a list of commonly observed hazards and related prevention and mitigation measures.

**Table - Occupational Health & Safety Issues: Nitrogenous Fertilizer Manufacturing**

| Hazard | Description | Prevention and Mitigation Measures |
|---|---|---|
| Process Safety | Process safety programs should be implemented, due to industry-specific characteristics, including complex chemistry reactions, use of hazardous materials (e.g., toxic, reactive, flammable or explosive compounds) and multistep organic synthesis reactions are conducted. | Process safety management includes the following actions:<br>• Physical hazard testing of materials and reactions;<br>• Hazard analysis studies to review the process chemistry and engineering practices, including thermodynamics / kinetics;<br>• Examination of preventive maintenance and mechanical integrity of the process equipment and utilities;<br>• Worker training;<br>• Development of operating instructions and emergency response procedures |

| | | |
|---|---|---|
| Chemical Hazards | Toxic chemicals in the nitrogenous fertilizer facilities include ammonia, nitric acid vapor, gaseous formaldehyde, and urea or AN dust. | • Installation of gas detectors in hazard areas;<br>• Avoid nitric acid spills or take precautions to control and minimize them. Nitric acid is highly corrosive and any form of dermal contact should be avoided;<br>• Provide adequate ventilation in all areas where ammonia, nitric acid and aqueous formaldehyde is handled;<br>• Provide air extraction and filtration in all indoor areas where urea and AN dust can be generated.<br>• Use refrigerated storage for large quantities of liquid ammonia since the initial release of ammonia in the case of line or tank failure is slower than in pressurized ammonia storage systems;<br>• Implement and maintain a specific Emergency Management Plan, per below section on Community Health and Safety.<br>• Provide training and personal protection equipment for personnel |

| | | |
|---|---|---|
| Fire & Explosion Hazards | Common causes of fire and explosions in nitrogenous facilities include: fires and explosions due to accidental release of synthetic gas in ammonia plants; formation of explosive gas mixture in the inert gas scrubbers and ammonia release in urea facilities; explosions of air/ammonia mixture and nitrite/nitrate salts in nitric acid plants; initiation of fire and explosion by ammonium nitrate, an oxidizing agent in the AN plants; and fires of fertilizer products or dust contaminated with oil or other combustible materials in the presence of a heat source. | • Install leak detection units and other devices (alarm detection systems, such as automatic pH monitoring in nitric acid plants) to detect releases early;<br>• Segregate process areas, storage areas, utility areas, and safe areas, and adoption of safety distances. Avoid siting ammonia storage tanks close to areas where there is a risk of fire / explosion;<br>• Limit the inventory which may be released through isolation of large inventories from facility operations, and isolation and blow down of pressurized flammable gases inventories;<br>• Remove potential ignition sources;<br>• Implement procedures to avoid and control hazardous gas mixtures, for instance reducing below 10 parts per million(ppm) hydrogen content in CO2 feed in urea plants,<br>• Control the ammonia-to-air ratio with automatic shutoff valves in nitric acid plants;<br>• Avoid pressurizing large quantities of nitric acid for loading/unloading;<br>• Use carbon austenitic stainless steel for nitric acid tanks, vessels and accessories;<br>Design AN/CAN storage according to internationally recognized guidance and requirements. These requirements generally cover the storage areas with respect to their structural and operational requirements. An adequate fire detection and fighting system should be installed;<br>• Remove or dilute the release and limiting the area affected by the loss of containment. |

**Table - Occupational Health & Safety Issues: Phosphate Fertilizer Manufacturing**

| Hazard | Description | Mitigation Measures |
|---|---|---|
| Process Safety | Please refer to Table above for Process Safety considerations. | |
| Chemical Hazards | Ammonia and acids vapors, especially HF, are common toxic chemicals in phosphate fertilizer plants. | • Avoid contact of acids with strong caustic substances. The resulting reaction is exothermic and may cause splashes;<br>• Control fluoride gas build up in phosphoric acid storage tanks;<br>• Install gas detectors in hazard areas;<br>• Provide adequate ventilation (e.g. air extraction/filtration systems) in all areas where products are produced, stored, and handled;<br>• Provide training and personal protection equipment for personnel |
| Fire & Explosion Hazards | Decomposition, fire and explosion hazards may be generated from slurry pump explosions due to insufficient flow through the pump or incorrect design; slurry decompositions due to low pH, high temperature and contaminated raw materials; and hydrogen gas generation due to phosphoric acid contact with ferrous metals. | • Inventory of ammonia, nitric and sulfuric acids should be kept as low as possible. Supply by pipeline is recommended in integrated chemical complexes;<br>• NPK fertilizer decomposition hazard should be prevented through temperature control during production, adjustment of formulations, and reduction of impurities. Compound build–up on the inlet vanes in the dryer should be avoided and uniform temperature profile of the air inlet should be ensured;<br>• Segregating process areas, storage areas, utility areas, and safe areas, and adopting of safety distances.<br>• Implementing well controlled operation and procedures in avoiding hazardous gas and slurry mixtures;<br>• NPK storage should be designed according to internationally recognized guidance and requirements. Adequate fire detection and fighting system should be installed.<br>• Storage areas should be cleaned before any fertilizer is introduced. Spillage should be cleared up as soon as practicable. Fertilizer contamination with organic substances during storage should be prevented; and<br>• Fertilizers should not be stored in proximity of sources of heat, or in direct sunlight or in conditions where temperature cycling can occur.<br>• Contact of phosphoric acid with ferrous metal component should be prevented. Stainless steel |

| | | |
|---|---|---|
| | | should be used for components possibly in contact with the acid. |

**Table -Common Structural, Fire & Electrical Safety Issues in Bangladesh**

| Area | Issues commonly observed | Prevention and Mitigation Measures |
|---|---|---|
| Structural | Highly stressed columns; undocumented vertical extensions; localised areas of high loads in buildings; discrepancy between structural drawing and built structure; minor to major cracks in structural elements. | • Compliance to regulatory requirements including the Bangladesh National Building Code (BNBC) (2015) or international codes, such as those compiled by the International Code Council (ICC), (2006).<br>• Undertake periodic structural safety audits by accredited agencies. |
| Fire | Inadequate, untested fire alarms; inadequate exit capacity compared to the occupancy load; lack of exit signage. | • Compliance with the by-laws of the Fire Regulation (2014), part of the Bangladesh Labor (Amendment) Act (2013), which includes requirements regarding the formation of a safety committees, and other measures such as emergency exits, access to stairs, and provision of personal protective equipment (PPE).<br>• Provisions for fire hydrants as per the requirements of BNBC (2015) and by Fire Regulation 2014, including water supply specifications according to the building size / hazard.<br>• Undertake regular fire audits by accredited agencies, with mock drills to be conducted on a periodic basis as per the fire hazard assessment of the facility. |
| Electrical | Unsealed entry and exit points for electrical cable; excessive dust deposit on cables; cables laid on floor without guarding/protection; oil leaks in generator room; inadequate cable grounding. | • Undertake electrical safety assessment on a periodic basis, and ensure workers are trained and provided with appropriate PPE based on the risk assessment. |

### *2.3. Community Health & Safety:*

Community health and safety hazards during the operation of phosphate and nitrogenous fertilizer manufacturing facilities relate to the management, storage and shipping of hazardous materials and products (e.g., ammonia, nitric acid, ammonium nitrate for nitrogenous fertilizer facilities), with potential for accidental leaks / releases of toxic and flammable gases, and the disposal of wastes (e.g., phosphogypsum, off-spec products, sludge). Plant design and operations should include safeguards to minimize and control hazards to the community, including the following measures:

- Identify reasonable design leak cases;
- Assess the effects of potential leaks on surrounding areas, including groundwater and soil pollution;

- Assess potential risks arising from hazardous material transportation and select the most appropriate transport routes to minimize risks to communities and third parties;
- Select plant location with respect to the inhabited areas, meteorological conditions (e.g. prevailing wind directions) and water resources (e.g., groundwater vulnerability). Identify safe distances between the plant area, especially the storage tank farms, and the community areas;
- Identify prevention and mitigation measures required to avoid or minimize community hazards
- Develop an Emergency Management Plan with the participation of local authorities and potentially affected communities

**2.4. Social Issues**

This section will be same as described in the corresponding section of _Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector'

**3. Performance Indicators and Monitoring**

### 3.1. Air Emissions Standards for Nitrogen Fertilizer Manufacturing plants

| Pollutants | Unit | Guideline Values | |
|---|---|---|---|
| | | GIIP | National Standards |
| Ammonia Plants | | | |
| $NO_X$ | mg/Nm3 | 300 | No national standards specific to fertilizer sector |
| $NH_3$ | mg/Nm3 | 50 | |
| PM | mg/Nm3 | 50 | 150 |
| Nitric Acid Plants | | | |
| $NO_X$ | mg/Nm3 | 200 | No national standards specific to fertilizer sector |
| $N_2O$ | mg/Nm3 | 800 | |
| $NH_3$ | mg/Nm3 | 10 | |
| PM | mg/Nm3 | 50 | 150 |
| Urea / UAN Plants | | | |
| Urea (prilling/granulation) | mg/Nm3 | 50 | 150 dry de dusting, 50 wet de dusting and new plant |
| $NH_3$ (prilling/granulation) | mg/Nm3 | 50 | No national standards specific to fertilizer sector |
| PM | mg/Nm3 | 50 | 150 |
| AN / CAN Plants | | | |
| PM | mg/Nm3 | 50 | 150 |
| $NH_3$ | mg/Nm3 | 50 | No national standards specific to fertilizer sector |

### 3.2. Effluents Levels for Nitrogenous Fertilizers Manufacturing plants

| Pollutants | Unit | Guideline Value | |
|---|---|---|---|
| | | *GIIP* | *National Standards* |
| pH | S.U. | 6-9 | 6 – 9 |

| | | | |
|---|---|---|---|
| | | | (across all discharge locations i.e. inland surface water, public sewer and irrigated land) |
| Temperature Increase | °C | <3 | No national standards specific to fertilizer sector |
| Ammonia Plant | | | |
| $NH_3$ | mg/l | 5 | No national standards specific to fertilizer sector |
| Total nitrogen | mg/l | 15 | 100 (old); 250 (new) |
| TSS | mg/l | 30 | 150 (inland surface water), 500 (public sewer), 200 (irrigated land) |
| Nitric Acid Plants | | | |
| NH3 | mg/l | 5 | No national standards specific to fertilizer sector |
| Total Nitrogen | mg/l | 15 | 100 (old); 50 (new) |
| TSS | mg/l | 30 | 150 (inland surface water), 500 (public sewer), 200 (irrigated land) |
| Urea Plants | | | |
| Urea (prilling/granulation) | mg urea/l | 1 | No national standards specific to fertilizer sector |
| $NH_3$ (prilling/granulation) | mg/l | 5 | |
| AN / CAN Plants | | | |
| AN | mg/l | 100 | No national standards specific to fertilizer sector |
| $NH_3$ | mg/l | 5 | |
| Total Nitrogen | mg/l | 15 | 100 (old); 250 (new) |
| TSS | mg/l | 30 | 150 (inland surface water), 500 (public sewer), 200 (irrigated land) |

** Please note that not all the parameters of the National Standards are specific to Nitrogenous fertilizer sector. The national standards are defined as per the location of disposal – inland surface water; public sewer; irrigated land. For ease of comparison, here the national standards are given as range and not as per the location of disposal. In addition to the above mentioned pollutants, there are other pollutants as well for which standards are specified.*

### 3.3. Air Emissions Standards of Phosphate Fertilizers Manufacturing plants

| Pollutants | Unit | Guideline Values | |
|---|---|---|---|
| | | ***GIIP*** | ***National Standards*** |
| Phosphoric Acid Plants | | | |
| Fluorides (gaseous) as HF | mg/Nm3 | 5 | 25 |
| Particulate Matter | mg/Nm3 | 50 | 150 |
| Phosphate Fertilizer Plants | | | |
| Fluorides (gaseous) as HF | mg/Nm3 | 5 | 25 |
| Particulate Matter | mg/Nm3 | 50 | No National standards specific to fertilizer sector |

| | | | |
|---|---|---|---|
| Ammonia | mg/Nm3 | 50 | No National standards specific to fertilizer sector |
| HCL | mg/Nm3 | 30 | |
| $NO_X$ | mg/Nm3 | 500 Nitro-phosphate unit 70 mix acid unit | |

** Please note that not all the parameters of the National Standards are specific to Phosphate Fertilizer Manufacturing.*

### 3.4. Effluents Levels for Phosphate Fertilizers Manufacturing plants

| Pollutants | Unit | Guideline Values | |
|---|---|---|---|
| | | ***GIIP*** | ***National Standards*** |
| pH | S.U | 6-9 | 6 – 9<br>(across all discharge locations, i.e. inland surface water, public sewer and irrigated land) |
| Total Phosphorus | mg/L | 5 | 5 |
| Fluorides | mg/L | 20 | 10 at the exhaust of Fluoride removal plant (as F) |
| | kg/ton NPK | 0.03 | No National standards specific to fertilizer sector |
| | kg/ton Phosphorus Oxide (P2O5) kg/ton | 2 | No National standards specific to fertilizer sector |
| TSS | mg/L | 50 | 150 (inland surface water), 500 (public sewer), 200 (irrigated land) |
| Cadmium | mg/L | 0.1 | No National standards specific to fertilizer sector |
| Total Nitrogen | mg/L | 15 | |
| Ammonia | mg/L | 10 | |
| Total Metals | mg/L | 10 | |

** Please note that not all the parameters of the National Standards are specific to Phosphatic fertilizer sector. The national standards are defined as per the location of disposal – inland surface water; public sewer; irrigated land. For ease of comparison, here the national standards are given as range and not as per the location of disposal. In addition to the above mentioned pollutants, there are other pollutants as well for which standards are specified.*

### 3.5. Resource and energy Consumption/Generation for Phosphate Fertilizer Manufacturing

| Pollutants | Unit | Industry Benchmark |
|---|---|---|
| Phosphoric Acid | Ton phosphate rock/ton $P_2O_5$ | 2.6-3.5[a] |
| | Ton H2SO4/ton $P_2O_5$ | 2.1-2.3 [a] |
| | KWh/ton $P_2O_5$ | 120-180 [a] |
| | m3 cooling water/ton $P_2O_5$ | 100-150 [a] |
| NPK Plant A | KWh/ton NPK | 30-33 a,b |

| | | |
|---|---|---|
| | Total energy for drying MJ/ton NPK | 300-320 [a,b] |
| NPK Plant B | KWh/ton NPK | 50 [a,b] |
| | Total energy for drying MJ/ton NPK | 450 [a,b] |
| NPK Plant C | KWh/ton NPK | 50-109 [b] |
| | $m^3$ cooling water/ton NPK | 17 [b] |
| | Ton $CO_2$ required/ton $P_2O_5$ | 1 [a,b] |
| SSP | KWh/ton SSP | 19-34 [b] |
| | $m^3$ water/ton SSP | 0.1-2 [b] |

### 3.6. Resource and energy consumption/generation in Nitrogenous fertilizer production

| Pollutants | Unit | Industry Benchmark |
|---|---|---|
| Ammonia | GJ lower heating value (LHV)/ton NH3 | 28.4 to 32.0 [a] |
| Urea | GJ/ton urea | 0.4-0.45 [a,b] |
| AN/CAN | KWh/ ton AN/CAN | 25-60/10-50 [a,b] |
| | kg Steam/ton AN/CAN | 0-50/150-200 [a] |
| Nitric Acid(Energy Generation) | GJ/ton HNO3 (100%) | 2.4 – 1.6 [b] (BAT –Average) |

### 3.7. Social standards

This section will be same as described in the corresponding section of _Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector'.

### 4. General Description of Industry Activities

| Sector Activity | Sub-sector Activities |
|---|---|
| Nitrogenous fertilizers | |
| Ammonia | Ammonia production from natural gas includes the following process steps: removal of trace quantities of sulfur in the feedstock; primary and secondary reforming, carbon monoxide shift conversion, removal of carbon dioxide, methanation, compression, ammonia synthesis, and ammonia product refrigeration. Carbon is removed in the form of concentrated CO2, which can be used for urea manufacture or other industrial purposes to reduce its release to the atmosphere. Another form of ammonia production is through partial oxidation of heavy fuel oil or vacuum residue. Two other nonconventional processes include:<br><br>• Addition of extra process air to the secondary reformer with cryogenic removal of the excess nitrogen.<br><br>Heat-exchange auto-thermal reforming. |

| | |
|---|---|
| Urea | The synthesis of urea involves the combination of ammonia and carbon dioxide at high pressure to form ammonium carbamate, which is subsequently dehydrated by the application of heat to form urea and water. The first step is fast and exothermic and essentially goes to completion under reaction conditions used Industrially. The second step is slower and endothermic, and does not go to completion. Conversion (on a $CO_2$ basis) is usually in the order of 50-80 percent and increases with increasing temperature and $NH_3/CO_2$ ratio. |
| Nitric Acid | The production stages for nitric acid manufacture include the following: vaporizing liquid ammonia; mixing the vapour with air and burning the mixture over a platinum/rhodium catalyst; cooling the resulting nitric oxide (NO) and oxidizing it to nitrogen dioxide ($NO_2$) with residual oxygen; and absorbing the nitrogen dioxide in water in an absorption column to form nitric acid. |
| Ammonium Nitrate (AN) and Calcium Ammonium Nitrate (CAN) | Ammonium nitrate is produced by the reaction between gaseous ammonia and aqueous nitric acid. The production process comprises three main unit operations: neutralization, evaporation, and solidification (prilling and granulation). |
| Ammonium Sulphate | The main volumes of ammonium sulfate are produced as a by-product from caprolactam, acrylonitrile, $SO_2$ abatement, and coke production |

| **Phosphatic/ Compound fertilizers** | |
|---|---|
| Phosphoric acid | Phosphoric acid ($H_3PO_4$) is primarily used in the manufacture of phosphate salts.<br>Two different processes can be used in the manufacture of phosphoric acid<br>• Thermal Process<br>• Wet Process |
| Sulphuric acid | Sulfuric acid ($H_2SO_4$) is used in the phosphate fertilizer industry for the production of phosphoric acid. Sulfuric acid is manufactured mainly from sulfur dioxide ($SO_2$), produced through the combustion of elemental sulfur. The exothermic oxidation of sulfur dioxide over several layers of a suitable catalyst (e.g. vanadium pentoxide) to produce sulfur trioxide ($SO_3$) is the most common process in sulfuric acid manufacturing plants. |
| Compound Fertilizers(NPK) | Compound fertilizers are a large group of products, varying based on the particular nitrogen / phosphorus / potassium (N/P/K) ratios. Production processes are also numerous and product types include PK, NP (e.g. DAP), NK and NPK. This can be achieved by using two different routes, namely production by the nitro-phosphate route, and production by the mixed acid route |

| | | |
|---|---|---|
| Phosphate (SSP / TSP) | Fertilizers | Phosphate fertilizers are produced by adding acid to ground or pulverized phosphate rock. If sulfuric acid is used, single or normal, superphosphate (SSP) is produced, with a phosphorus content of 16–21 percent as phosphorous pentoxide ($P_2O_5$).SSP production involves mixing the sulfuric acid and the rock in a reactor. The reaction mixture is discharged onto a slow moving conveyor belt. If the reaction The mixture is directly fed to a granulator, the process is the so called —direct‖ granulation. In —indirect‖ granulation, the reaction mixture is stored for —curing‖ for 4 to 6 weeks before bagging and then granulated. |

## F. ESRM Guidance Note for Pharmaceutical Sector

### 1. Introduction

The objective of this Guidance Note on ESRM for the Pharmaceutical Sector is to provide a high level indicative summary of potential environmental and social (E&S) risks and performance levels for transactions in the Pharmaceutical sector in Bangladesh. The scope of application will be fully aligned with the Section 4 of this policy. At all times, applicable national regulations are to be followed. Where national regulations differ from the levels and measures presented in this Guidance Note, loan proposals are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in this Guidance Note are appropriate, in view of specific loan proposal, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment. For the purposes of this Guidance Note, Pharmaceuticals sector activities include, but are not limited to: 1.Primary manufacturing of Active Pharmaceutical Ingredients (APIs), 2. Formulation, mixing and compounding of API intermediaries.

### 2. Industry Specific Impacts and Management

#### *2.1. Environmental Issues:*

- **Air emissions**

Both gaseous organic and inorganic compounds, as well as particulates, may be emitted during pharmaceutical manufacturing and formulation from both point sources and fugitive emissions in addition to Greenhouse Gas emissions. Some of the volatile organic compounds (VOC) and inorganic gases that are emitted are classified as hazardous air pollutants (HAPs).

Bulk Manufacturing: The industry manufactures most bulk pharmaceutical substances and intermediates in campaigns via batch processes. Following the completion of one campaign, another bulk substance or intermediate is typically made using the same equipment (e.g., reactors, filters, dryers). The reactants and solvents used in manufacturing the next bulk substance or intermediate may vary greatly from the ones previously used. While some reactions may require the use of halogenated solvents, the next reaction may use another solvent or no solvent at all.

Chemical synthesis and extraction process result significant emissions of volatile organic compounds (VOCs) which are generated from reactor vents, filtering systems in the separation process, solvent vapours from purification tanks and dryers (including loading and unloading operations), fugitive emissions from valves, tanks, pumps, and other equipment (e.g., centrifuges), solvents and other VOCs related to extraction chemicals in natural product extraction, prefermentation and fermentation solvents, and wastewater collection and treatment units.

Formulation: During mixing, compounding, formulation, and packaging steps, both particulate matter and VOCs may be emitted and as these compounds may pose a danger to workers, through direct inhalation they are a principal concern. Depending on the process and the batch record requirements, the particulates (e.g., tablet dusts) may be recycled back into the formulation process.

However, sometimes the particulates are collected for destruction or disposal.

The following measures can be taken to mitigate VOC emissions:

- ✓ Reducing or substituting the use of solvents and other materials which have a high VOC content, and substitution with products that have lower volatilities, and switching to aqueousbased coating films and aqueous-based cleaning solutions. Implementation of VOC leak prevention, detection and control strategies from operating equipment (as for e.g. equipment modifications could include seal less pumps or closed vent system or dual mechanical seal with barrier fluid maintained at a higher pressure than the pumped fluid etc.
- ✓ Implementation of VOC loss prevention and control strategies in open vats and mixing processes including installation of process condensers after the process equipment to support a vapor-to-liquid phase change and to recover solvents

- ✓ Collection of vapors (e.g., from sterilization chambers, reactors, distillation units) through air extractors / ventilation hoods and subsequent treatment of gas stream by removing VOCs with control devices such as condensers, activated carbon absorption, catalytic converters / incinerators, and wet scrubbers (or gas absorbers)
- ✓ Reduction of equipment operating temperatures, where possible
- ✓ For drying operations, adoption of closed circuits under a Nitrogen atmosphere
- ✓ Use of closed-loop liquid and gas collection equipment for cleaning of reactors and other equipment.

The following measures can be taken to mitigate particulate emissions:

- ✓ Collection with air filtration units and recycling of particulate matter into the formulation process (e.g. tablet dust), depending on batch record requirements and on process characteristics
- ✓ Installation of dedicated filtration systems (sometimes double stages of filtration) in granulation equipment. An abatement room should be also provided where the particulate is removed from the air, decreasing flow speed
- ✓ Installation of high efficiency particulate air (HEPA) filters in the heating, ventilating and air conditioning (HVAC) systems;
- ✓ Segregation of air ducts to prevent air cross-contamination from different processes and to ease the air stream treatment;
- ✓ Installation of dedicated air filtration units typically bag house/fabric filters;
- ✓ Depending on the volume of emissions and prevailing size of particulate matter, use of additional particulate emissions control methods, such as wet scrubbing and wet electrostatic precipitators, especially after combustion / thermal oxidation treatments

**Combustion sources emissions:** Exhaust gas emissions produced by the combustion of gas or diesel in turbines, boilers, compressors, pumps and other engines for power and heat generation, are a significant source of air emissions from pharmaceuticals manufacturing facilities. Guidance for the management of small combustion source emissions with a capacity of up to 50 megawatt thermal (MWth), including air emission standards for exhaust emissions.

**Odours:** The main source of odour emissions is typically associated with fermentation activities. Recommended odour management strategies include:

- ✓ Considering the location of new facilities, taking into account proper distances to neighbours and the propagation of odours
- ✓ Post-combustion of venting gases
- ✓ Use of exhaust stack heights that are consistent with practices as described in the General EHS Guidelines
- ✓ Use of wet scrubbers to remove odours with a high affinity to water
- ✓ Condensation of vapours combined with scrubbers

- **<u>Wastewater</u>**

Water is used for both process and non-process purposes in a pharmaceutical manufacturing facility. Process wastewater includes water that was used or formed during the reaction, water used to clean process equipment and floors, and pump seal water etc. Non-process wastewater includes noncontact cooling water (e.g., used in heat exchangers), noncontact ancillary water (e.g., boiler blow-down, bottle washing), sanitary wastewater, and wastewater from other sources (e.g., storm water runoff). The use, discharge pattern and characteristics of the wastewater will differ according to the type of operations conducted at the facility. Water is also formed as a part of a chemical reaction in some of the processes. The waste water to be generated from bulk manufacturing may include streams such as chemical reactions streams, spent acid, caustic, condensed steam from sterilization and strippers, scrubber blow-down and equipment and vessel wash water. While waste water to be generated from formulation may include streams such as equipment and vessel wash water, condensed steam from sterilization and strippers, scrubber blow-down etc.The main conventional pollutants of concern in these wastewater streams are parameters such as biochemical oxygen demand (BOD), chemical oxygen demand (COD), Total Suspended Solids (TSS), Ammonia, Toxicity, Biodegradability, and pH. Other chemical compounds may also be present including, but not limited to, solvents, organic acids, organic halides, inorganic acids, ammonia, cyanide, toluene, and active pharmaceutical ingredients (API).Measures to reduce the generation of wastewater at source include adoption of biodegradable materials where possible (e.g., tablet coating), recovering aqueous ammonia and solvents from the waste stream, and combining solvent waste streams can help in reducing the pollutants load in wastewater. **Industrial Process Wastewater treatment measures include:**

- ✓ Grease traps, skimmers, dissolved air floatation or oil water separators for separation of oils and floatable solids
- ✓ Filtration for separation of filterable solids
- ✓ Flow and load equalization
- ✓ Sedimentation for suspended solids reduction using clarifiers
- ✓ Biological treatment, typically aerobic treatment, for reduction of soluble organic matter (BOD)
- ✓ Biological nutrient removal for reduction in nitrogen and phosphorus
- ✓ Chlorination of effluent when disinfection is required
- ✓ Dewatering and disposal of residuals in designated hazardous waste landfills  Additional engineering controls may be required for:
- ✓ Containment and treatment of volatile organics stripped from various unit operations in the wastewater treatment system
- ✓ Advanced metals removal using membrane filtration or other physical/chemical treatment technologies
- ✓ Removal of recalcitrant organics and active ingredients using activated carbon or advanced chemical oxidation
- ✓ Residual colour removal using adsorption or chemical oxidation
- ✓ Reduction in effluent toxicity using appropriate technology (such as reverse osmosis, ion exchange, activated carbon, etc.)
- ✓ Reduction in TDS in the effluent using reverse osmosis or evaporation  Containment and neutralization of nuisance odours.

- **Solid waste**

In general primary pharmaceutical manufacturing process especially natural product extraction and fermentation are typically characterized by low ratio of finished products to raw material, resulting in significant quantities of residual waste. Both non-hazardous and hazardous wastes are generated which can include off-spec or obsolete raw materials or products, spent solvents, reaction residues, used filter media, still bottoms, used chemical reagents, dusts from filtration or air pollution control equipment, raw material packaging wastes, laboratory wastes, spills, as well as wastes generated during packaging of the formulated product. Filter cakes and spent raw materials (plants, roots, animal tissues etc.) from fermentation and natural product extraction are two of the largest sources of residual wastes in the pharmaceutical industry. A number of practices are implemented by the industry to reduce waste generation and material losses. Typical practices include process optimization, production scheduling, materials tracking and inventory control, special material handling and storage procedures, preventive maintenance programs, material substitution (e.g. use of water based solvents etc), spent solvent recycling & reuse and waste stream segregation. Residual wastes should be segregated as hazardous and non-hazardous wastes and managed/ disposed in accordance with national regulations and licensed waste management facilities. Potentially pathogenic waste from biotechnology manufacturing should be inactivated through sterilization or chemical treatment before final disposal. The typical material inputs and potential releases during various steps in pharmaceutical manufacturing are summarized in the table below:

**Table - Summary of typical material inputs and pollution outputs in the Pharmaceutical industry**

| Process | | Air Emissions | Wastewater | Residual Solid Wastes |
|---|---|---|---|---|
| Chemical Synthesis | *Reaction* | VOC emissions from reactor vents, manways, material loading and unloading, acid gases (halogen acids, sulfur dioxide, nitrous oxides); fugitive emissions, from pumps, sample collections, valves, tanks etc | Process waste waters with spent solvents, catalysts, reactants; pump seal waters, wet scrubber wastewater; equipment cleaning wastewater etc | Reaction residues and reactor bottom wastes. |
| | *Separation* | VOC emissions from filtering systems which aren't contained; and fugitive emissions from valves, tanks and centrifuges etc | Equipment cleaning wash waters, spills, leaks, spent separation solvents. | |
| | *Purification* | Solvent vapors from purification tanks; fugitive emissions etc. | Equipment cleaning wash waters, spills, leaks, spent purification solvents. | |
| | *Drying* | VOC emissions from manual loading and unloading of dryers | Equipment cleaning wash waters, spills, leaks etc | |
| Natural luct Extraction | | Solvent vapors & VOC's from extraction chemicals | Equipment cleaning wash water, spent solvents (ammonia); natural product extraction wastewater. | Spent raw materials (plants, roots etc.) |
| Fermentation | | Odoriferous gases, extraction solvent vapors, particulates | Spent fermenter broth, Fermentation wastewater containing sugars, starches, nutrients, etc.; | Waste filter cake, fermentation residues |
| Formulation | | Dusts | Equipment cleaning wash waters (spent solvents), spills, leaks; wash waters; rejected liquid products such as syrups, injections etc | Particulates, Waste packaging, rejected solid products such as tablets, capsules etc. |

| | | | |
|---|---|---|---|
| Utilities (water and waste water treatment) | - | Rejected water; back wash water; blowdowns etc | Sludge from water treatment plant; effluent treatment plant; sewerage treatment plant etc |

- **Hazardous Materials Management**

Pharmaceutical ingredient manufacturing plants should assess the risks associated with the use and handling of hazardous materials and implement practices to prevent and minimize such risks. The application of these management practices should be documented in a written Hazardous Materials Management Plan. The purpose of this plan is to establish and implement a systematic set of preventive actions against accidental releases of substances that can cause serious harm to the environment, and to health and safety or workers and the public from short-term exposures and to mitigate the severity of releases that do occur. In establishing the hazardous material management plan facilities should:

✓ Conduct a Hazard Assessment considering accident history in the last five years, worst case scenario, and alternative release analysis

✓ Identify and implement management procedures including process safety, training, management of change, incident investigation, employee participation, contractor training and oversight

✓ Implement prevention measures including process hazard analysis, operating procedures, mechanical integrity, prestart review, work permit, and compliance audits

✓ Develop and implement an Emergency Response Program including emergency response procedures, emergency equipment, training, review and updates.

- **Threats to biodiversity**

Bioprospecting - The process of collection of genetic resources (bioprospecting), which may be part of certain pharmaceutical projects, may include access to different types of habitats. In addition to the potential for negative impacts to the biodiversity of these habitats, which may also depend on the physical nature of the collection activities and the types of genetic material involved, bioprospecting may also raise issue about the rights of local communities to consent in the use or to a share in the benefits of the commercialization of their cultural heritage or the genetic resources extracted.

**Recommended management practices include:**

✓ Avoiding or minimizing harm to biodiversity in compliance with applicable legal requirements

✓ Development and application of bio prospecting procedures that are consistent with internationally recognized standards and guidelines, including aspects of:

- Coordination with representatives from the National Focal Point prior to the undertaking of bio prospecting activities to identify national and local requirements
- Obtaining Prior Informed Consent (PIC) from the State which is party to the Convention on Biological Diversity (CBD) in material screened for genetic use according to the basic principle of the CBD and Development and implementation of contracting agreements for the sharing of benefits arising from the development and commercialization of genetic resources.

**Bio-safety** - For projects or facilities involved in research, manufacture, or trading of living modified organisms, the risks associated with their production, handling, storage, transport, and use may include threats to biological diversity due to the controlled or uncontrolled release of the organism into the environment. Recommended bio-safety management practices include:

✓ Development of a risk-based approach to the identification of key control points in the process cycle, including in-plant handling, off-site transport, and use of modified organisms. □ Implementation of in-plant and transport safety measures including specialized training of personnel, primary containment (e.g. containment barriers) and secondary containment (e.g. airlocks, differential pressure, exhaust air filters and treatment of contaminated material and wastes).

✓ Preparation and implementation of Transportation Safety Plans specific to the type of organism being handled and consistent with the objectives of applicable international conventions and treaties.

✓ Implementation of risk-management measures for controlled releases applicable to the specific organism including, as appropriate, training of those involved, monitoring of the activity, controlling access to the site, and application of isolation methods.

- **Bioethics**

The ethical issues faced by the pharmaceutical or biotechnology industry are potentially complex and depend significantly on the activity of the company. These issues may include the development of genetically modified foods; gene therapy experiments and stem cell research; human participant trials; animal testing; handling of genetic information; sale of genetic and biological samples; and the creation of transgenic animals, among others.

Recommended bioethics management approaches include:

✓ Well established ethics mechanisms including management commitment; dedicated internal ethics personnel; access and use of external expertise (e.g. consultants and advisory boards); internal training and accountability mechanisms; communications programs to engage with suppliers and external stakeholders; and evaluation and reporting mechanisms.

✓ Adherence to internationally accepted ethical principles applicable to genetic research, clinical trials involving human participants, and any other activities with critical bioethical issues

✓ The use of animals for experimental and scientific purposes should be conducted according to industry good practice which includes reduction of the numbers of animals used in each study to the absolute minimum necessary to obtain valid results and refinement of the use of research animals to use less painful or the least invasive procedures whenever possible. Animal breeding, husbandry, and care facilities of the company or its suppliers should be designed and operated according to internationally certifiable methodologies.

### *2.2. Health and Safety issues:*

**Table - Common Structural, Fire & Electrical Safety Issues in Bangladesh**

| Area | Issues commonly observed | Prevention and Mitigation Measures |
|---|---|---|
| Structural | Highly stressed columns; undocumented vertical extensions; localised areas of high loads in buildings; discrepancy between structural drawing and built structure; minor to major cracks in structural elements. | • Compliance to regulatory requirements including the Bangladesh National Building Code (BNBC) (2015) or international codes, such as those compiled by the International Code Council (ICC), (2006).<br>• Undertake periodic structural safety audits by accredited agencies. |

| | | |
|---|---|---|
| Fire | Inadequate, untested fire alarms; inadequate exit capacity compared to the occupancy load; lack of exit signage. | Compliance with the by-laws of the Fire Regulation (2014), part of the Bangladesh Labor (Amendment) Act (2013), which includes requirements regarding the formation of a safety committees, and other measures such as emergency exits, access to stairs, and provision of personal protective equipment (PPE).<br><br>Provisions for fire hydrants as per the requirements of BNBC (2015) and by Fire Regulation 2014, including water supply specifications according to the building size/hazard.<br><br>Undertake regular fire audits by accredited agencies, with mock drills to be conducted on a periodic basis as per the fire hazard assessment of the facility. |
| Electrical | Unsealed entry and exit points for electrical cable; excessive dust deposit on cables; cables laid on floor without guarding/protection; oil leaks in generator room; inadequate cable grounding. | Undertake electrical safety assessment on a periodic basis, and ensure workers are trained and provided with appropriate PPE based on the risk assessment. |

Process safety programs should be implemented, due to industry-specific characteristics, including complex chemical reactions, use of hazardous materials (e.g., toxic and reactive materials, and flammable or explosive compounds) and multistep reactions. **Process safety management includes the following actions:**

- ✓ Physical hazard testing of materials and reactions
- ✓ Hazard analysis studies to review the process chemistry and engineering practices, including thermodynamics and kinetics
- ✓ Examination of preventive maintenance and mechanical integrity of the process equipment and utilities
- ✓ Worker training
- ✓ Development of operating instructions and emergency response procedures.

Workers may be exposed to drug substances by inadvertently breathing airborne dust or vapours or accidentally swallowing contaminated foods or beverages. Occupational Exposure Limits (OELs) are developed by toxicologists and occupational hygienists to provide guidance on limiting worker exposures to drug substances.

**Table - Common Occupational Health Issues**

| Hazard | Description | Mitigation Measures |
|---|---|---|

| | | |
|---|---|---|
| Chemical | Acute and chronic health risks may result from worker exposures to hazardous chemicals during synthesis operations.<br><br>Chemicals with acute health effects can damage the eyes and skin, be corrosive or irritating to body tissues, cause sensitization or allergic reactions or be asphyxiants, causing suffocation or oxygen deficiency. | □ Provision of adequate Personal Protective Equipments (PPEs) like facemasks with appropriate filters for air purification (chemicals, mists, vapors and gases), safety shoes and boots for protection against corrosive chemicals etc. and toxic gas detection systems with alarms Use of partitioned workplace areas with good dilution ventilation and/or differential air pressures<br>□ When toxic materials are handled, laminar ventilation hoods or isolation devices should be installed;<br>□ Manufacturing areas should be equipped with suitable heating ventilation and air conditioning (HVAC) systems including use of high efficiency particulate air<br>□ (HEPA) filters in ventilation systems, particularly in sterile product manufacturing areas;<br>□ Use of local exhaust ventilation (LEV) with flanged inlets to capture fugitive dusts and vapors released at open transfer points<br>□ Conducting liquid transfer, liquid separation, solid and liquid filtration, granulation, drying, milling, blending, and compression in work areas with good dilution and LEV<br>□ Enclosing of granulators, dryers, mills, and blenders, and venting to air-control devices<br>□ Fire and explosion hazards may arise during solvent extractions. Preventive measures such as - Storage of incompatible materials (acids, bases, flammables, oxidizers, reactive chemicals) in separate areas and with containment facilities; provision of material-specific storage for |
| | | extremely hazardous or reactive materials; use of flame arresting devices on vents from flammable storage containers; provision of grounding and lightning protection for tank farms, transfer stations, and other equipment that handles flammable materials; selection of materials of construction compatible with products stored for all parts of storage and delivery systems, and avoiding reuse of tanks for different products without checking material compatibility should be considered. |

| | | |
|---|---|---|
| Physical | Worker safety hazards may be posed by moving machine parts and equipment; high pressure steam, hot water, heated surfaces and hot workplace environment High noise levels may be generated by manufacturing equipment and utilities (e.g., compressed air, vacuum sources, ventilation systems, manufacturing activities, electricity generator etc). | - Steam and thermal fluid pipelines should be insulated, marked, and regularly inspected<br>- Steam vents and pressure release valves should be directed away from areas where workers have access<br>- High temperature areas of presses should be screened to prevent ingress of body parts.<br>- Use of noise control techniques such as: using acoustic machine enclosures; selecting structures according to their noise isolation effect to envelop the building; using mufflers or silencers in intake and exhaust channels; using sound absorptive materials in walls and ceilings; using vibration isolators and flexible connections (e.g., helical steel springs and rubber elements); applying a carefully detailed design to prevent possible noise leakage through openings or to minimize pressure variations in piping |
| Pathogenic & biological | Exposure to pathogens may occur during isolation and growth of micro-organisms in laboratory and in fermentation processes. | - Use of any harmful biological agents should be avoided and replaced with an agent that, under normal conditions of use, is not dangerous or less dangerous to workers<br>- Work processes, engineering, and administrative controls should be designed, maintained, and operated to avoid or minimize release of biological agents into the working environment. The number of employees exposed or likely to become exposed should be kept at a minimum.<br>- Review and assess known and suspected presence of biological agents at the place of work and implement appropriate safety measures, monitoring, training, and training verification programs. |
| | | - Measures to eliminate and control hazards from known and suspected biological agents at the place of work should be designed, implemented and maintained in close co-operation with the local health authorities and according to recognized International standards. |

| | | |
|---|---|---|
| Radiological | Research and development operations may include the use of radiological materials which should be managed to prevent and control worker exposures according to licensing requirements. | □ Places of work involving occupational and/or natural exposure to ionizing radiation should be established and operated in accordance with recognized international safety standards and guidelines.<br>□ Exposure to non-ionizing radiation (including static magnetic fields; sub-radio frequency magnetic fields; static electric fields; radio frequency and microwave radiation; light and nearinfrared radiation; and ultraviolet radiation) should be controlled to internationally recommended limits. |

### *2.3. Community Health & Safety:*

The common health and safety impacts on the community during the construction, operation, and decommissioning of pharmaceutical manufacturing facilities are:

- ✓ Noise, vibration, dust creation, traffic movement, road safety, emissions and air quality, fire, explosion & toxic hazards due to accidental release of chemicals and waste water discharge
- ✓ Strain on transport networks and local infrastructure - disruption to road users both pedestrian and other vehicles

The common health and safety impacts on the community during the construction, operation, and decommissioning of tanneries include:

**Table - Community health & safety impacts and mitigation measures**

| | |
|---|---|
| Risk of road accidents during transportation of materials | Traffic safety:<br>• Road safety measures like emphasizing safety aspects among drivers, improving driving skills and requiring licensing of drivers, adopting limits for trip duration and arranging driver rosters to avoid overtiredness, use of speed control devices (governors) on trucks and remote monitoring of driver actions<br>Transportation of hazardous materials:<br>• To ensure compliance with local laws and international requirements applicable to the transport of hazardous materials (Hazmats)<br>• Standard operating procedures for transportation of Hazmats - proper labelling of containers, shipping manifest, ensuring adequate transport vehicle specifications, , use of labelling and placarding (external signs on transport vehicles) |
| | □ Training of employees in shipping procedures and emergency procedures |

| | |
|---|---|
| Respiratory problems arising out of exposure to dust and other gaseous emissions | □ Inclusion of buffer strips or other methods of physical separation around project sites to protect the public from major hazards associated with hazardous materials incidents or process failure<br>□ Modifying process or storage conditions to reduce the potential consequences of an accidental off-site release. Provisions to alert the public, provide for evacuation of surrounding areas, establish safety zones around a site, and ensure the provision of emergency medical services to the public<br>□ Improving shut-down and secondary containment to reduce the amount of material escaping from containment and to reduce the release duration<br>□ Reducing the probability that releases will occur through improved site operations and control and through improvements in maintenance and inspection |
| Risk of fire and structural damage | □ Fire prevention measures such as fuel load & control of combustibles, ignition sources, interior finish flame spread characteristics, interior finish smoke production characteristics, human acts, and housekeeping and maintenance<br>□ Fire suppression system – fire hydrants<br>□ Emergency response plan to assist staff and emergency response teams during real life emergency and training exercises |
| Noise pollution | □ Noise monitoring may be carried out for the purposes of establishing the existing ambient noise<br>□ Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas<br>□ Improving the acoustic performance of constructed<br>□ Installing vibration isolation for mechanical equipment<br>□ Re-locating noise sources to less sensitive areas to take advantage of distance and shielding buildings, apply sound insulation |

### *2.4. Social Issues:*

This section will be same as described in the corresponding section of _Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector'

## 3. Performance Indicators and Monitoring

### 3.1. Wastewater discharge quality standards

| Pollutants | Unit | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *National Standards** |
| pH | -- | 6 – 9 | 6-9 (across all locations) |

| | | | |
|---|---|---|---|
| BOD | mg/L | 30 | 50 (Inland surface water), 250 (Public Sewerage system connected to treatment at second stage), 100 (Irrigated land) |
| COD | mg/L | 150 | 200 (Inland surface water), 400 (Public Sewerage system connected, to treatment at second stage), 400 (Irrigated land) |
| TSS | mg/L | 10 | 150 (Inland surface water), 500 (Public Sewerage system connected to treatment at second stage), 200 (Irrigated land) |
| Oil and Grease | mg/L | 10 | 10 (Inland surface water), 20 (Public Seweragesystem connectedto treatment atsecond stage), 10 (Irrigated land) |
| Cadmium | mg/L | 0.1 | 0.50 (Inland surface water), 0.05 (Public Sewerage system connected to treatment at second stage), 0.05 (Irrigated land) |
| Chromium (hexavalent) | mg/L | 0.1 | 0.1 (Inland surface water), 1.0 (Public Sewerage system connected to treatment at second stage), 1.0 (Irrigated land) |
| Mercury | mg/L | 0.01 | 0.01 (across all locations) |
| Active ingredient (each) | mg/L | 0.05 | NA |
| Total nitrogen | mg/L | 10 | 50 (Inland surface water), 75 (Public Sewerage system connected to treatment at second stage), 75 (Irrigated land) |
| Ketone | mg/L | 0.2 | NA |
| Benzene | mg/L | 0.02 | NA |
| Ammonia | mg/L | 30 | 5 (Inland surface water), 5 (Public Sewerage system connected to treatment at second stage), 15 (Irrigated land) |
| Total nitrogen | mg/L | 10 | 100 (across all locations) |
| Total phosphorus | mg/L | 2 | 8 (Inland surface water), 8 (Public Sewerage system connected to treatment at second stage),15 (Irrigated land) |
| Ketones (each)(1) | mg/L | 0.2 | NA |
| Acetonitrile | mg/L | 10.2 | |
| Acetates (each)(2) | mg/L | 0.5 | |
| Benzene | mg/L | 0.02 | |
| Chlorobenzene | mg/L | 0.06 | |
| Chloroform | mg/L | 0.013 | |
| o-Dichlorobenzene | mg/L | 0.06 | |
| 1,2-Dichloroethane | mg/L | 0.1 | |
| Amines (each)(3) | mg/L | 102 | |
| Dimethyl sulfoxide | mg/L | 37.5 | |
| Methanol / ethanol (each) | mg/L | 4.1 | |
| n-Heptane | mg/L | 0.02 | |
| n-Hexane | mg/L | 0.02 | |

| | | | |
|---|---|---|---|
| Isobutyraldehyde | | mg/L | 0.5 |
| Isopropanol | | mg/L | 1.6 |
| Isopropyl ether | | mg/L | 2.6 |
| Methyl cellosolve | | mg/L | 40.6 |
| Methylene chloride | | mg/L | 0.3 |
| Tetrahydrofuran | | mg/L | 2.6 |
| Toulene | | mg/L | 0.02 |
| Xylenes | | mg/L | 0.01 |
| Bioassays | 1. Toxicity to fish<br>2. Toxicity to Daphnia<br>3. Toxicity to algae<br>4. Toxicity to bacteria | T.U.(4) | 2<br>8<br>16<br>8 |

** The National Standards are not specific to pharmaceutical sector and is applicable for all the industrial units. The national standards are defined as per the location of disposal – inland surface water; public sewer; irrigated land. For ease of comparison, here the national standards are given as range and not as per the location of disposal.*

### 3.2. Facility specific air emissions standards

| Pollutants | Unit | Guideline Values |
|---|---|---|
| | | GIIP |
| Active Ingredient (each) | mg/Nm$^3$ | 0.15 |
| Particulate Matter | mg/Nm$^3$ | 20 |
| Total Organic Carbon | mg/Nm$^3$ | 50 |
| Hazardous Air Pollutants | kg/year | 900 – 1800 (3) |
| Total Class A (1) | mg/Nm$^3$ | 20 (4) |
| Total Class B (2) | mg/Nm$^3$ | 80 (5) |
| Benzene, Vinyl Chloride, Dichloroethane (each) | mg/Nm$^3$ | 1 |
| VOC | mg/Nm$^3$ | 20-150 (6) 50 (7) |
| Bromides (as HBr) | mg/Sm$^3$ | 3 |
| Chlorides (as HCl) | mg/Sm$^3$ | 30 |
| Ammonia | mg/Sm$^3$ | 30 |
| Arsenic | mg/Sm$^3$ | 0.05 |
| Ethyene Oxide | mg/Sm$^3$ | 0.5 |
| Mutagenic Substance | mg/Sm$^3$ | 0.05 |

### 3.3. Acceptable Effective Dose Limits for Workplace Radiological Hazards

| Exposure | Workers (min.19 years of age) | Apprentices And students (16-18 years of age) |
|---|---|---|
| Five consecutive year average – effective dose | 20 mSv/year | |
| Single year exposure – effective dose | 50 mSv/year | 6 mSv/year |
| Equivalent dose to the lens of the eye | 150 mSv/year | 50 mSv/year |
| Equivalent dose to the extremities (hands, feet) or the skin | 500 mSv/year | 150 mSv/year |

### 3.4. Social standards

This section will be same as described in the corresponding section of _Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector'.

## 4. General Description of Industry Activities

Manufacturing of Pharmaceuticals can be divided into **two major production lines:**

- The first step involves production of bulk substances i.e. production of active pharmaceutical ingredients. Active Pharmaceutical Ingredients (APIs) typically consist of organic molecules or salts of such molecules that have been synthesized or extracted from natural ingredients. APIs are subsequently used for production of medicinal products.
- The second and final step consists of formulation, mixing, compounding and packaging. Active ingredients, produced during the primary manufacturing, are treated and modified into final products. The products can have different forms like solids (e.g. tablets, coated or not and capsules), liquids (e.g. solutions, emulsions, injectable), creams and ointments, or aerosols.

| Sector Activity | Sub-sector Activities |
|---|---|
| Primary manufacturing | Bulk pharmaceutical substances, normally crystalline solid salts, organic acids or bases, containing an active pharmaceutical ingredient (API) are produced through a chain of intermediary steps and precisely controlled reactions. These substances are eventually used to produce formulated pharmaceutical products which can be used in a dosage form. The formulated product can be manufactured from bulk substances by processes such as Chemical synthesis; Fermentation; Isolation/recovery from natural sources, or; a combination of these processes |

| | |
|---|---|
| Formulation, mixing and compounding of API intermediaries | The second and final step consists of formulation, mixing, compounding and packaging. Active ingredients, produced during the primary manufacturing, are treated and modified into final products. The products can have different forms like solids (e.g. tablets, coated or not and capsules), liquids (e.g. solutions, emulsions, injectable), creams and ointments, or aerosols. |

## G. ESRM Guidance Note for Ship Breaking Sector

### 1. Introduction

The objective of this Guidance Note on ESRM for the Ship Breaking Sector is to provide a high level indicative summary of summary of potential environmental and social (E&S) risks and performance levels for transactions in the Ship Breaking sector in Bangladesh. The scope of application will be fully aligned with the Section 4 of this policy. At all times, applicable national regulations are to be followed. Where national regulations differ from the levels and measures presented in this Guidance Note, loan proposals are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in this Guidance Note are appropriate, in view of specific loan proposal, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

### 2. Industry Specific Impacts and Management

#### *2.1. Environmental Issues:*

The extraction of the ship structure and its components and parts, resulting in a flow of materials for reuse, recycling and disposal, creates the potential of releases to the environment due to:

- Insufficiencies in preparatory procedures prior to the dismantling process
- Inability to collect/ remove/ secure on board substances of concern during dismantling
- Insufficiencies in procedures related to the collection, transport and storage/disposal of substances

The nature of the operational procedures and the resulting flow of materials represent potential releases to water, air and ground. In order to safeguard against this, it is necessary to consider all steps in the decommissioning-for-disposal-process in order to allocate corrective actions at the appropriate stages.
The decommissioning for disposal is a step by step process:

1. Decommissioning and sale
2. The dismantling process
3. Sorting for reuse, recycling and disposal The key activities in ship decommissioning are:

1. **Inventory of wastes** - Prior to arrival, or alternatively on arrival at the dismantling facility, an inventory survey of the vessel should be carried out. The survey will identify, quantify and locate the types of wastes on board and will result in an inventory list of hazardous wastes and other wastes. A thorough vessel survey can also be used for the purpose of planning the sequence and nature of the work to be executed, for example, can asbestos-containing structures be marked to facilitate the removal. Following the inventory of hazardous substances on-board the ship, chemical safety data sheets should be made available for each of the hazardous substances identified in the inventory. The requirements of the UN Globally Harmonized System for the Classification and Labelling of Chemicals as well as the UN Recommendations on Transport of Dangerous Goods should be followed concerning the labelling of hazardous chemicals and their storage. Reference should also be made to the information on the ILO international instruments (Conventions, Recommendations, Codes of Practice) relevant to shipbreaking operations, as well as on important information sources on chemical safety.
2. **Removal/ cleaning**– liquids, including fuels and oils - Prior to cutting, the ship should be cleared of all residual materials. This may be carried out prior to step II or at a cleaning station at the facility. Cleaning of, for example, cargo tanks, bunker and fuel tanks, bilge and ballast compartments, sewage tanks, etc. should be performed in order to ensure that the ship is presented for dismantling in a clean and safe condition. Wastewater and any used solvents from the cleaning station must be contained and properly treated. All combustible liquids and materials are removed to make the vessel safe for hot work. This process will continue during the entire dismantling process (see next section). During removal, actions should include containment; whilst wet - booms should be placed around the ship,

when dry – transfer arrangements (pumping/ pipe-work, etc.) should include arrangements for the containment of any leakage.

3. **Securing -** To ensure that working procedures and operations are undertaken in a safe manner, a process of securing the vessel is required. This should emphasis two aspects:
   - Safe access to all areas, compartments, tanks, etc. ensuring breathable atmospheres
   - Safe conditions for hot work, including cleaning/ venting, removal of toxic or highly flammable paints from areas to be cut, and testing/ monitoring before any hot work is performed
4. **Removal of equipment -**Consumable and loose equipment is removed first. Reusable components are removed as they become accessible. Fixtures, anchors, chains, engine parts and propellers are examples of components that are removed during this step.
5. **Removal of hazardous/ polluting substances -** The pre-prepared inventory identifies hazardous/polluting substances (asbestos-containing material, PCB-containing material, etc). These are carefully removed and disposed of as they become accessible. In cases where these substances are encased or enclosed in components or structural parts, removal can take place after these have been brought ashore.
6. **Dismantling -**A safe and practical cutting sequence is dependent upon which adopted method is used (dry-dock, moored, beached). A specific plan for an actual dismantling facility should be drawn up. This should form a base frame for the ship-specific dismantling plan.
7. **Storage, recycling and disposal -**The waste stream arriving from dismantling is sorted/ segregated, and materials for recycling are separated and prepared for processing. Hazardous wastes and other wastes must be stored and disposed of according to applicable laws and regulations.

**Possible negative impacts** during ship recycling may be divided into four main categories:

- Releases of Hazardous Materials to ground and sediments
- Releases of Hazardous Materials to water
- Emissions of Hazardous Materials to air
- Noise/ vibrations

**<u>Hazardous materials and waste management</u>**

Ship dismantling generates a stream of waste consisting of a mixture of materials including: 
Ferrous and non-ferrous scrap including coatings

- Components: machinery, electrical/ electronic equipment, joinery, minerals, plastics  Consumables: oils, chemicals, gas
- Hazardous Wastes: asbestos, coatings, PCBs, materials such as electronic waste, which may be hazardous depending on its components and the manner in which it is disposed

The following Hazardous Materials, at the very least, should be addressed in the Ship Recycling Facility Plan:

**a) Hazardous materials contained in the ship's structure and equipment (IHM, Part I):**

- Asbestos
- Polychlorinated biphenyls (PCBs)
- Ozone-depleting substances (ODSs)
- Anti-fouling compounds and systems
- Cadmium and cadmium compounds
- Hexavalent chromium and hexavalent chromium compounds
- Lead and lead compounds
- Mercury and mercury compounds
- Polybrominated biphenyls (PBBs)

- Polybrominated diphenyl ethers (PBDEs)
- Polychlorinated naphthalenes (PCNs)
- Radioactive substances
- Certain short-chain chlorinated paraffins

**b) Operationally generated wastes (IHM, Part II):**

- Waste oil (sludge)
- Bilge and/or waste water generated by the after-treatment systems fitted on
- Machineries
- Oily liquid cargo residues
- Ballast water
- Raw sewage
- Treated sewage
- Non-oily liquid cargo residues
- Dry cargo residues
- Medical/infectious waste
- Incinerator ash
- Garbage
- Fuel tank residues
- Oily solid cargo tank residues
- Oily or chemical contaminated rags
- Dry tank residues
- Cargo residues

**c) Stores including regular consumable goods (IHM, Part III).** A list of these is shown in appendix 6 of the IMO guidelines

It is recommended that the following aspects of proper management of Hazardous Materials should be clearly addressed for each of the potentially Hazardous Materials identified above: □ identification, marking and labelling and potential on-board locations

- recycling approach
- removal, handling and remediation
- storage and labelling
- treatment, transportation and disposal.

The Ship Recycling Facility should identify the location and quantity of asbestos and materials containing asbestos by actively utilizing the IHM. Identification, marking and labelling should be conducted by the Ship Recycling Facility before asbestos and materials containing asbestos are removed. **Asbestos:**
In order to safely remove asbestos and materials containing asbestos, the following protective measures should be taken, and the Ship Recycling Facility Plan (SRFP) should describe how they are implemented by the Ship Recycling Facility.
The environmentally sound management plan should consider the following:

1. The area in which the removal of asbestos and materials containing asbestos is to be conducted should be isolated from the other work areas and entry should be allowed only to appropriately trained personnel. The area should be clearly posted with a caution that asbestos removal work is occurring
2. If the removal work includes cutting, boring, grinding or otherwise disturbing friable asbestos and materials containing asbestos which may scatter into the environment, appropriate protection should be provided, so as not to release the asbestos in the air, by isolating the area in the room or space where the removal will occur
3. A common approach is as follows:

- seal the room or space with plastic sheets
- the plastic sheets should be of sufficient strength where the machines, equipment, pipes or spaces cannot be isolated or sealed (for example, a complex and narrow area under a floor plate in the engine room), partial protection may be provided with plastic sheets
- the isolated area should be maintained under negative pressure where possible
- practices for dealing with materials containing asbestos under a partial pressure chamber system and the use of wet methods should be encouraged as far as possible

4. After removal of asbestos, the area should be cleaned in the following manner:
   - Equipment and tools should be washed/cleaned and then removed from the area
   - The asbestos and materials containing asbestos should be packed and sealed in plastic containers prior to being removed from the area
   - The plastic sheets used for isolating the area should be moistened with water and handled carefully to prevent the asbestos from scattering
5. An efficient vacuum cleaner should be used for cleaning the area such as one equipped with a high efficiency particulate air (HEPA) filter
6. The airborne asbestos in the air and/or space should be checked before removing the plastic isolation sheets and allowing other work to continue in the area

**PCBs (Polychlorinated Biphenyls)**

In order to safely remove PCBs and materials containing PCBs, the following protective measures should be taken and the SRFP should describe how they are implemented by the Ship Recycling Facility:

- Removal of Hazardous Materials and wastes containing PCBs should be carefully performed to avoid spills, volatilization or scattering, in the following manner:
  - Spill prevention measures should be taken when draining or removing liquid-filled equipment, including booms, drip pans, liners and/or absorbent materials placed around the system or piece of equipment
  - Most solid materials containing PCBs can be removed by using manual, chemical or mechanical means such as blasting, scraping, cutting, stripping or gouging equipment used to remove PCB-containing materials should be decontaminated appropriately after use (a common decontamination process for equipment would be to rinse with non-polar organic solvent such as kerosene or diesel, then wash with soap and water and rinse with clean water); any water or other liquid used should be appropriately managed as waste
- Removed PCBs and materials containing PCBs should be appropriately stored in properly labelled, leak-proof containers that are made for transport and are sealed (liquids) or covered (solids)
- Separate storage area should be set up for PCB wastes, in accordance with the following points:
  - Hazardous Materials and wastes containing PCBs should not be stored or kept with other Hazardous Materials and wastes
  - the storage area should be clearly marked on the exterior with warnings that it contains PCBs
  - the storage area should provide protection from rain o containers should be regularly inspected for leaks and damage
- Containers or vehicles used for packing and transporting the removed PCB materials should be properly labelled and the possibility of accidental release during transport should be minimized
- PCBs should not be reused or recycled and their management and final disposal should comply with national requirements.

**Ozone Depleting Substances (ODS):**

The Ship Recycling Facility should identify the location and quantity of Ozone-Depleting Substances (ODSs) prior to removal by actively utilizing the Inventory of Hazardous Materials (IHM). The indicative list for ODSs in the Inventory Guidelines (section 2.2.2.3 of appendix 5 of the IMO guidelines) can be used as the supporting material if an additional survey and sampling are required. The SRFP should describe how the Ship Recycling Facility implements the following protective measures to safely remove and manage ODSs:

- Extraction of ODSs from the system should be done by persons who are trained and authorized for handling such materials
- ODSs on board in containers, equipment and piping systems should not be released into the atmosphere
- Management or destruction of ODSs should comply with National requirements
- ODSs used as blowing agents and trapped in insulation foam in refrigerated areas should not be released into the atmosphere and environmentally sound management should be observed while dismantling and disposing of the foam waste.

**Paints and coatings:**

The SRFP should describe procedures for properly managing any paints and coatings that are highly flammable or that may release toxins during cutting.

- Anti-fouling compounds and systems (organotin compounds including tributyltin (TBT)) - Organotin compounds include tributyltin (TBT), triphenyltin (TPT) and tributyltin oxide (TBTO). Organotin compounds have been commonly used as anti-fouling paint on the bottom of ships. Organotin paint should not be released into the sea or soil during the ship recycling process. If it is possible that organotin paint might be removed as a result of work (whether it is intentionally removed, or the collateral effect of some other effort, such as dragging), the work should be conducted in an environmentally sound manner to ensure that any organotin paint removed is not released into the sea. Organotin paint may be removed using techniques such as blasting, chemical stripping or mechanical removal. However, special attention should be given to preventing scattering of the paint chips in the air or adjacent areas. Blasted paints should be collected, stored and disposed of in an environmentally sound manner in accordance with National requirements.
- Toxic and highly flammable paints - The removal of paints prior to cutting during ship recycling may not be necessary unless the process leads to the release of toxic compounds or the paint is highly flammable. Prior to cutting painted surfaces, the Ship Recycling Facility should check the flammability and toxicity of the paint or coating. If it is toxic or flammable, it is suggested that, prior to hot cutting, a sufficiently wide band of paint is mechanically or chemically removed (for example, through blasting, scraping or stripping) from along the cut line. Appropriate PPE should be worn, and a containment system for paint particles should be used (especially for blasting operations). If removal is not possible or feasible, cutting can proceed in a controlled manner provided that the workers are well protected with PPEs specifically designed for breathing and eye protection.
- Hazardous liquids, residues and sediments (such as oils, bilge and ballast water) - Identification, marking and labelling of the tanks and other areas should be conducted by the Ship Recycling Facility before the liquids are removed. The residual oil storage tank should be protected against leakage, overflow, fire and other potential accidents. Hazardous liquids, residues and sediments in stores, tanks, machines, equipment and piping should be removed under safe and environmentally sound conditions. Ballast water should be handled in accordance with relevant national requirements.
- Heavy metals (lead, mercury, cadmium and hexavalent chromium) - Heavy metals are found in batteries, galvanized materials, level switches, gyro compasses, thermometers, coatings, etc. Radioactive substances may be found in level indicators and smoke detectors. Equipment and other instruments containing heavy metals should be removed carefully to ensure that they do not break and to avoid contamination of the environment. Reusable equipment and instruments should be stored properly. Broken equipment and instruments should be delivered to the appropriate companies for repair, recycling or disposal in accordance with national requirements. Anodes fitted

to the ship's hull as sacrificial metal should be removed in the course of block cutting and should be managed properly.

**Spill prevention, control and countermeasures**

The SRFP should include a programme that defines the Ship Recycling Facility's procedures for spill prevention, response and countermeasures. The programme should define proactive approaches to spill prevention and procedures to be implemented in the event of spills.

At a minimum, the programme should demonstrate that the Ship Recycling Facility has adequate containment and spill clean-up equipment and procedures, by identifying the following:

- containment and diversionary structures in place to prevent discharged Hazardous Materials from contaminating soil and water
- Facility drainage areas
- Location of spill response equipment
- Environmental protection measures to be implemented during transfer and offloading of fuels □ Location of other oils and bilges
- Fuel storage locations
- Inspection and record-keeping procedures
- Security measures
- Personnel training programmes
- Spill prevention and reporting procedures
- The history of incidents at the Ship Recycling Facility

As part of the procedures for spill prevention, response and countermeasures, the SRFP should identify the designated in-house and subcontracted personnel who will be responsible for managing the programme and for responding to spills or similar emergencies, as well as the local authorities (such as the fire department) that may have jurisdiction at the Ship Recycling Facility. This SRFP should include 24-hour contact information. The SRFP should include both a narrative and graphic description of the Facility layout, including the location of any water bodies or other routes of migration, the storage location of oil or other Hazardous Materials, procedures for fuel transfer from ship to shore, procedures to be implemented in the event of a spill and the types and locations of emergency-response equipment (such as absorbent materials, personal protective equipment and first-aid equipment).

**Storm water pollution prevention**

Storm-water run-off from industrial facilities has the potential to adversely affect the environment. Improper storage and handling of Hazardous Materials and wastes could increase the risk of environmental degradation through contact with water. Following compilation of the relevant site information, an assessment should be conducted in order to determine the appropriate control measures. Control measures should be implemented to reduce the threat of storm-water pollution, to control erosion and sediment and to protect nearby natural resources. Control measures can include best management practices, maintenance and inspection programmes, employee training and reporting. The development of preventive measures is the most effective way to minimize the discharge of pollutants via storm water. It is important to maintain records on maintenance, inspections and employee training. Periodic review of the storm-water management programme is also an effective tool for determining which best management practices are fulfilling their intended function and for identifying weaknesses in the programme.

**Debris prevention and control**

The introduction of debris into the marine environment by ship recycling activities has the potential to adversely affect the environment. The SRFP should include a programme that defines measures to be implemented and maintained to minimize the potential for debris deposition into the water, including the maintenance of areas from which debris might be transported into the marine environment by wind, storm drains, tides or run-off. Control measures should be implemented to reduce the likelihood of debris deposition.

**Noise/ vibrations**

Ongoing varying types of dismantling activities will result in noise and vibrations. The monitoring programme for noise and vibrations must include location of the monitoring stations, detailed procedures for the measurements, frequency of measurements, and reporting. The monitoring station for noise and vibrations should be located at the dwelling closest to the ship dismantling facility. Meteorological conditions should also be recorded as they may affect the spread of noise. The highest noise level will most likely be measured at a monitoring station located down-wind from the ship dismantling facility. Influence from other sources in the area (e.g. traffic, industry) should be evaluated, since these could affect the resulting noise level at the monitoring stations.

### *2.2. Health and Safety Issues:*

**Table - Common Occupational Health Issues**

| Hazard | Description | Mitigation Measures |
|---|---|---|
| Chemical | Workers exposure to PCBs found in softener of plastics, insulators, sealing materials and cables can lead to cancer, liver damage, reproductive impairments, immune system damage, and behavioural and neurological damage.<br><br>Workers exposure to hydrogen chloride gas produced after combustion of PVCs found in cables, floor coverings and plastic devices leads to lung cancer and supress immune system.<br><br>Workers exposure to dioxins produced after combustion of PVCs and PCBs leads to lung cancer and supress immune system.<br><br>Workers exposure to PAHs produced after combustion of PVCs produced during torch cutting and smoldering of paints leads to malignant tumors, affects the lungs, stomach, intestine and skin.<br><br>Workers exposure to asbestos dust found in gaskets, cables, adhesives, valves, etc. leads to cancer of lungs, stomach, esophagus, pancreas and kidneys. | □ The SRFP should identify one or more key personnel who possess the level of training and experience necessary to effectively ensure that safe conditions are maintained during operations at the Ship Recycling Facility, including one or more competent persons for the performance of specific work. Depending upon the size of the Ship Recycling Facility and the number of workers, the SRFP could include a hierarchy of safety and health management staff, including an overall manager, supervisory staff and general workers.<br>□ The SRFP should include the procedures to be implemented to conduct a jobhazard assessment to determine the proper approach to maximizing worker safety. Responsibility for job hazard assessments should be assigned to a competent person for the specific hazards of each job.<br>□ Establish and utilize procedures to prevent explosions by ensuring that Safe-for-hot-work and Safe-for-entry conditions are established and maintained throughout the ship recycling process. To prevent other accidents that cause or have the potential to cause damage to human health and to prevent spills of cargo residues and other materials which may |

| | | |
|---|---|---|
| | Workers exposure to heavy metals found in paints, coatings, anodes and electrical equipments such as mercury (Minamata disease), lead (kidney and brain damage and increased blood pressure), arsenic (cancer), chromium (lung cancer) etc.<br><br>Workers exposure to fumes, smoke and particulate produced during torch cutting of metals which may lead to toxic effects.<br><br>Workers exposure to release of poisonous gas from toxic organics during bilge and ballast water removal may cause serious health effects.<br><br>Workers exposure to toxic fumes released during removal of oil and fuel.<br><br>Workers exposure to accidents while working in confined spaces | □ cause harm to human health and/or the environment.<br>The Ship Recycling Facility should ensure that spaces or adjacent spaces that contain or have contained liquids, gases or solids that are toxic, corrosive or irritant are visually inspected and tested by a competent person prior to initial entry by workers. If a space contains an air concentration of a material which exceeds 50 per cent of their OEL, then no one should enter the space and it should not be labelled "Safe-for-entry". Ventilation should be provided at volumes and flow rates sufficient to ensure that air concentrations are maintained below 50 per cent of their OEL.<br>□ The SRFP should include procedures for handling, transporting and storing pressure vessels containing flammable gases, such as acetylene (C2H2), propane gas (C3H8) or oxygen (O2) for welding, heating and cutting works, in order to avoid any human injuries, caused by external forces, shock or heat to such vessels. |

| | | |
|---|---|---|
| Physical | Risk of falling from height inside ship structures or on the ground<br><br>Risk of fire and explosion while working on flammable materials<br><br>Risk of cuts and bruises while working with sharp edged tools, saws, grinders abrasive cutting wheels, shackles, hooks, chains, cranes, hoisting & hauling equipments etc.<br><br>Risk of heavy metals falling from height on workers. | - The SRFP should include procedures for using personal flotation devices, guarding deck openings, deck edges and platforms, utilizing personal fall arrest systems and guard rails and ensuring safe access to ships to prevent slip-and-fall accidents and the dropping and scattering of objects. Communication of daily work plan to workers.<br>- The SRFP should include procedures for testing and inspecting ropes, chains, slings, hooks, chain-falls and hoisting and hauling equipment. It should further include a description of operations using cranes, machines, mobile equipment and aerial and man-lift systems and a list of qualifications required for the operators. |
| | | - The SRFP should include procedures for work areas, such as aisles, passageways and temporary deck openings.<br>- Respiratory protection and hearing conservation programmes should be developed for all employees who could be exposed to excessive levels. The SRFP should describe how the programmes are in compliance with national regulations. In the absence of domestic law, the Ship Recycling Facility should utilize best industry practices to provide effective respiratory protection and hearing conservation programmes. |

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| | | ☐ Emergency preparedness and response plan (EPRP) - establish and maintain an emergency preparedness and response plan (EPRP). The EPRP should, at a minimum, include the Facility's response to:<br>• fire or explosion or ingress of water on the ship being recycled or awaiting recycling, within the perimeter of the Facility, or in an adjacent facility<br>• accidents to workers within the Facility<br>• spillages of Hazardous Materials<br>• probable acts of nature in the area concerned, such as earthquakes or flooding. |

### *2.3. Community Health & Safety:*

The common health and safety impacts on the community living nearby ship breaking yards are:

- High traffic density along with traffic insecurity
- Air pollution and dust accumulation due to excessive vehicular movement
- Presence of sharp iron and glass pieces on the beach area
- Scattered waste in ship breaking yard and beach area including waste oil and asbestos causes various health issues such as tuberculosis, asthma and various types of cancer.
- Lack of medical facilities for the local community
- High noise levels from cutting and moving metals in ship breaking yards cause disturbance to nearly community
- Decreased fish population (major source of food for community) due to contamination of sea water.

### 2.4. Social Issues

This section will be same as described in the corresponding section of _Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector.

## 3. Performance Indicators and Monitoring

### 3.1. Wastewater discharge quality standards

| Pollutants | Unit | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *National Standards** |
| Ammonical Nitrogen | mg/L | No standard available | 50 (Inland surface water)75 (Public Sewerage system connected to treatment at second stage)75 (Irrigated land) |
| Ammonia | mg/L | | 5 (Inland surface water)5 (Public Sewerage system connected to treatment at second stage)15 (Irrigated land) |
| Arsenic | mg/L | | 0.2 (Inland surface water)0.05 (Public Sewerage system connected to treatment at second stage)0.2 (Irrigated land) |
| $BOD_5$ at 20°C | mg/L | | 50 (Inland surface water)250 (Public Sewerage system connected to treatment at second stage)100 (Irrigated land) |
| Boron | mg/L | | 2 (across all locations) |

| | | | |
|---|---|---|---|
| Cadmium | mg/L | | 0.50 (Inland surface water)0.05 (Public Sewerage system connected to treatment at second stage)0.05 (Irrigated land) |
| Chloride | mg/L | | 600 (across all locations) |
| Chromium (as Cr) | mg/L | | 0.5 (Inland surface water)1.0 (Public Sewerage system connected to treatment at second stage)1.0 (Irrigated land) |
| COD | mg/L | | 200 (Inland surface water)400 (Public Sewerage system connected to treatment at second stage)400 (Irrigated land) |
| Chromium (hexavalent chromium) | mg/L | | 0.1 (Inland surface water)1.0 (Public Sewerage system connected to treatment at second stage)1.0 (Irrigated land) |
| Copper | mg/L | | 0.5 (Inland surface water)3.0 (Public Sewerage system connected to treatment at second stage)3.0 (Irrigated land) |
| Dissolved oxygen | mg/L | | 4.5-8 (across all locations) |
| Electroconductivity | Micro mho/cm | | 1200 (across all locations) |
| Total Dissolved Solids | mg/L | | 2100 (across all locations) |
| Fluoride | mg/L | | 2 (Inland surface water)15 (Public Sewerage system connected to treatment at second stage)10 (Irrigated land) |
| Sulphide | mg/L | | 1 (Inland surface water)2 (Public Sewerage system connected to treatment at second stage)2 (Irrigated land) |
| Iron | mg/L | | 2 (across all locations) |
| Total Kjeldahl Nitrogen | mg/L | | 100 (across all locations) |
| Lead | mg/L | | 0.1 (Inland surface water)1 (Public Sewerage system connected to treatment at second stage)1 (Irrigated land) |
| Manganese | mg/L | | 5 (across all locations) |
| Mercury | mg/L | | 0.01 (across all locations) |
| Nickel | mg/L | | 1.0 (Inland surface water)2.0 (Public Sewerage system |
| | | | connected to treatment at second stage)1.0 (Irrigated land) |
| Nitrate | mg/L | | 10 (Inland surface water) 10 (Public Sewerage system connected to treatment at second stage)10 (Irrigated land) |
| Oil & grease | mg/L | | 10 (Inland surface water)20 (Public Sewerage system connected to treatment at second stage)10 (Irrigated land) |
| Phenolic compounds | mg/L | | 1.0 (Inland surface water)5 (Public Sewerage system connected to treatment at second stage)1 (Irrigated land) |
| Dissolved phosphorous | mg/L | | 8 (Inland surface water)8 (Public Sewerage system connected to treatment at second stage)15 (Irrigated land) |
| pH | mg/L | | 6-9 (across all locations) |
| Selenium | mg/L | | 0.05 (across all locations) |
| Zinc | mg/L | | 5 (Inland surface water)10 (Public Sewerage system connected to treatment at second stage)10 (Irrigated land) |

| | | | |
|---|---|---|---|
| Suspended solids | mg/L | | 150 (Inland surface water)500 (Public Sewerage system connected to treatment at second stage)200 (Irrigated land) |
| Cyanide | mg/L | | 0.1 (Inland surface water)2.0 (Public Sewerage system connected to treatment at second stage)0.2 (Irrigated land) |

** The National Standards are not specific to ship breaking and is applicable for all the industrial units. The national standards are defined as per the location of disposal – inland surface water; public sewer; irrigated land. For ease of comparison, here the national standards are given as range and not as per the location of disposal.*

### 3.2. Gaseous emission standards (from point source)

| Pollutants | Unit | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *National Standards** |
| Chlorine | $mg/Nm^3$ | No standards available | 150 |
| Hydrochloric acid vapour and mist | $mg/Nm^3$ | | 30-120 |
| Oxides of Nitrogen | $mg/Nm^3$ | | 30-100 |
| Total fluoride | $mg/Nm^3$ | | 25 |
| Sulphuric acid mist | $mg/Nm^3$ | | 50 |
| Lead particulate | $mg/Nm^3$ | | 10 |
| Mercury particulate | $mg/Nm^3$ | | 0.2 |

** The National Standards are not specific to ship breaking and is applicable for all the industrial units.*

## 4. General Description of Industry Activities

| Sector Activity | Description |
|---|---|
| Mooring | Ship dismantling operations start after the ship is beached safely and evenly supported by the mooring mechanisms. The vessel which is usually a massive structure, has to be moored and secured properly for safe dismantling operation. During available high tide water level, the partially dismantled structure has to be slide up facilitating further dismantling of parts of ships that have emerged out of water. Any of the ship breaking yards follow the generalized procedure after towing the ship on site for scrapping. |
| Gas freeing | The ship is surveyed to identify the probable scraps to be taken off and various compartment of ship to plan the work based on the potential location of hazardous materials. Gas freeing is the method used for removal of oil and inflammable vapour of oils so that the dismantling of ship's parts using _hot works' can be undertaken without any fire hazard. Inflammable materials remaining in tanks or piping such as fuel, lubricating oils, hydraulic fluids, |
| | cargos, their residues and grease are removed. The vessel is then cleared off gas and oil residues. Removal of fuel oil and other combustible materials is continued throughout the ship breaking operations. |
| Removal of paints | Prior to ship dismantling, paint removal is done along the marking for cutting of blocks and pieces. This enables fire hazard free cutting operation. All paints are highly inflammable and any trace of paint present in the cutting line can cause fire hazard. |

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| Cutting and handling | The term handling is used to describe the process of supporting, moving, and releasing of dismantled products. The ship is dismantled starting from easily accessible area from the topo bottom. The workers firstly work on the upper decks and the superstructure for cutting which is followed by the middle and lower decks. They use saw and cutting torches to dismantle the ship where large blocks are cut and allowed to fall freely or separated by using the crane to the stack location for further cutting. As the structures are cut in due course of time, the weight of the ship reduces and the lower regions of the ship rises up. |
| Lifting | Removal of dismantled hull, outfit and machinery of the dismantled ship either using a frame, chain pulley block and or using crane is considered as lifting. The lifting arrangement and procedures should be taken into account in the cutting plan. The lifting operations include vertical and horizontal movement of dismantled products within the dismantling yard. Bilge water is sampled and discharged with remaining structure pulled ashore and further cut. Fixtures, anchors, chains and other small equipments are removed initially. Other large equipments are dismantled in due course as they become accessible. Reusable equipments can be sold directly by the scrapping facility directly. The propellers are also removed from the ship so that the base of the ship is pulled towards the beach in the shallow water. Asbestos containing material is removed from the cut lines so as to remove larger sections of the ship. |
| Buffering and sorting | Buffering and secondary cutting activity involve stacking the dismantled parts of the ship and preparation of these for further cutting into smaller components such as plates, stiffeners, brackets and cut pieces. The PCB material is also cut and removed simultaneously. The scrap metals including steel, aluminum, copper, copper-nickel alloy and other metals are sorted, graded and sold to scrap metal brokers and melting firms. Some valuable materials such as copper in the electric cable are mixed with the non-ferrous material and recovered by using shredders and separators. The shredders after mixing produce a gravel like mixture from which metal is taken out using magnetic separators, air flotation, separator columns, or shaker tables. |
| Disposal | Some equipments such as engine, auxiliary diesel motors, cranes, radar, electronic equipments which and be directly used are sold to the vendors. Tools, auxiliaries, lamps, TVs, fax machines, radios, tables, beds, fluorescent tubes, kitchen fittings, benches, ropes, safes, cables, ornamental plastic sheeting can be marketed to resellers. |

**H. ESRM Guidance Note for Power Sector**

## 1. Introduction

The objective of this Guidance Note on ESRM for the Power Sector is to provide a high level indicative summary of potential environmental and social (E&S) risks and performance levels for transactions in the Power sector in Bangladesh. The scope of application will be fully aligned with the Section 4 of this policy. At all times, applicable national regulations are to be followed. Where national regulations differ from the levels and measures presented in this Guidance Note, loan proposals are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in this Guidance Note are appropriate, in view of specific loan proposal, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment. For the purposes of this Guidance Note, Conventional Power plants include, but are not limited to: a) Coal based power plant, b) Gas based power plant, c)Heavy Fuel Oil (HFO) and High Speed Diesel (HSD) based power plant

## 2. Industry Specific Impacts and Management

### *2.1. Environmental Issues:*

- **Air Emissions**

Combustion of fossil fuels or biomass release pollutants such as sulphur dioxide (SO2), nitrogen oxides (NOX), particulate matter (PM), carbon monoxide (CO), and greenhouse gases, such as carbon dioxide (CO2). Depending on the fuel type and quality other substances such as heavy metals (e.g., mercury, arsenic, cadmium, vanadium, nickel, etc.), halide compounds (including hydrogen chloride and hydrogen fluoride), dioxins and furans, unburned hydrocarbons and other volatile organic compounds (VOCs) may be emitted in smaller quantities, but may have a significant influence on the environment due to their toxicity and/or persistence. The amount and nature of air emissions depends on factors such as the fuel (e.g., coal, fuel oil, natural gas, or biomass), the type and design of the combustion unit (e.g., reciprocating engines, combustion turbines, or boilers), operating practices, emission control measures (e.g., primary combustion control, secondary flue gas treatment), and the overall system efficiency. Natural gas-fired plants generally produce negligible quantities of particulate matter and sulphur oxides. The levels of nitrogen oxides in these plants are about 60% of those using coal for combustion (without emission reduction measures). Natural gas-fired plants also release lower quantities of carbon dioxide gas.

**Table - Sources of Air Emissions and Mitigation Measures**

| Air emission/ pollutant | Source | Mitigation measures |
|---|---|---|
| Particulate matter (point sources) | Particulate matter is emitted from the combustion process, especially from the use of heavy fuel oil, coal, and solid biomass | Installation of dust controls capable of over 99% removal efficiency, such as ESPs or fabric filters (bughouses), for coal-fired power plants |

| | | |
|---|---|---|
| Particulate matter (fugitive sources) | Particulate mattercan also beased ng transfer and age of coal and as[itives,1 lime. | • Use of loading and unloading equipment that minimizes the height of fuel drop to the stockpile to reduce the generation of fugitive dust and use of cyclone dust collectors<br>• Use of water spray systems to reduce the formation of fugitive dust from solid fuel storage  Use of enclosed conveyors and extraction / filtration equipment on conveyor transfer points<br>• For solid fuels of which fine fugitive dust could contain vanadium, nickel and Polycyclic Aromatic Hydrocarbons (PAHs) (e.g., in coal and petroleum coke), use of full<br>• enclosure during transportation and covering stockpiles where necessary<br>• Design and operate transport systems to minimize the generation and transport of dust on site<br>• Storage of lime or limestone in silos with well designed, extraction and filtration equipment  Use of wind fences in open storage of coal or use of enclosed storage structures to minimize fugitive dust |
| Sulphur Dioxide | Emissions of sulphur oxides mainly result from the presence of sulphur in the fuel. | • Use of fuels with the lowest sulphur content economically feasible<br>• Use of lime (CaO) or limestone ($CaCO_3$) for integrated desulfurization in coal-fired fluidized bed combustion boilers. This can achieve a removal efficiency of up to approximately 95 percent<br>• Depending on the plant size, fuel quality, and potential for significant $SO_2$ emissions, use of flue gas desulfurization (FGD) for large boilers using coal or oil and for large reciprocating engines. The optimal type of FGD system (e.g., wet FGD using limestone with up to 98 percent removal efficiency, semi-dry FGD using lime with up to 94 percent removal efficiency, seawater FGD with up to 90 percent removal efficiency) depends on the capacity of the plant, fuel properties, site conditions, residual life of the facility and the cost and availability of reagent as well as by-product disposal and utilization. However, if biomass is used as fuel, FGD may not be necessary as it contains lesser amount of coal. |

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| | | • Oil-fired reciprocating engine plants are generally too small in capacity to justify wet scrubbing, due to costs. If reducing fuel sulphur is insufficient, these plants would generally use semi-dry scrubbing using either slaked/hydrated lime ($Ca(OH)_2$) or sodium bicarbonate ($NaHCO_3$) |
| Nitrogen Oxides | | • Use of low NOX burners with other combustion modifications, such as low excess air (LEA) firing, for boiler plants<br>• Installation of additional NOX controls for boilers may be necessary to meet emissions limits; a selective catalytic reduction (SCR) system can be used for pulverized coal fired, oil-fired, and gas-fired boilers or a selective non-catalytic reduction (SNCR) system for a fluidized-bed boiler<br>• Use of dry low-NOX combustors for<br>• combustion turbines burning natural gas<br>• Use of water injection or SCR for combustion turbines and reciprocating engines burning liquid fuels<br>• Optimization of operational parameters for existing reciprocating engines burning natural gas to reduce NOx emissions<br>• Use of lean-burn concept or SCR for new gas engines |
| Carbon monoxide | Carbon monoxide (CO) is an intermediate product of the combustion process. | • Complete combustion of fuel<br>• Good furnace design, the use of high performance monitoring and process control techniques, and maintenance of the combustion system |
| Heavy metals | The emission of heavy metals, also known as trace metals, results from their presence as a natural component in fossil fuels. Examples of heavy metals include mercury in coal and Vanadium in heavy fuel oil. | • Use of conventional secondary controls such as fabric filters or ESPs operated in combination with FGD techniques, such as limestone FGD, Dry Lime FGD, or sorbent injection<br>• Additional removal of metals such as mercury can be achieved in a high particulate SCR system along with powdered activated carbon, bromineenhanced Powdered Activated Carbon (PAC) or other sorbents |

- **Energy efficiency and Greenhouse Gas Emissions**

Carbon dioxide, one of the major greenhouse gases (GHGs) under the UN Framework Convention on Climate Change, is emitted from the combustion of fossil fuels. The CO2 emission is directly related to the carbon content of fuels, where gaseous fuels have significantly lower CO2 emissions than other fossil fuels. The content of carbon varies for coal and lignite (hard and brown coal) between 61 and 87 wt-%, for wood it is about 50 wt-%, and for gasoil and heavy fuel oil about 85 wt-%. Potential emissions mitigation measures from the outset of thermal power plant design should be adopted and some recommendations are

- Use of less carbon intensive fossil fuels (i.e., fuel that contains less carbon per unit of calorific value—gas is less than oil and oil is less than coal) or co-firing with low-carbon fuels (e.g., biomass).
- Use of higher energy conversion efficiency technology, subject to its technical suitability for the application and financial feasibility. For example, supercritical plants have a higher energy conversion efficiency than subcritical plants, combined cycle gas turbine (CCGT) plants have a higher energy conversion efficiency than simple cycle plants, and CHP have higher energy conversion efficiency than power only plants.
- Other elements of the plant can also affect efficiency such as steam cycle parameters (e.g., pressure and temperature) for power plants based on the steam Rankine cycle, cooling and abatement technologies, electrical efficiency (e.g., electrical motors for fans and pumps, ESP), energy conversion efficiency and energy conservation. Use of high performance monitoring and process control techniques, good design and maintenance of the combustion system so that initially designed efficiency and GHG emission performance can be maintained.

- **Water consumption and wastewater effluents**

Conventional power plant requires large amounts of cooling water for steam condensation during operation. Water is also required for boiler makeup, auxiliary station equipment, ash handling, and FGD systems. The withdrawal of such large quantities of water has the potential to compete with other important water uses such as agricultural irrigation, drinking water sources or maintaining other ecosystems services. The mitigation measures to reduce water consumption and some good practices include:

- Maximize recycle/reuse of treated waste water to ensure zero water discharge to conserve water.
- Installation of rain water harvesting structures in and around the project site.
- Installation of water meters throughout the power plant to monitor the usage of water at different sections.

Combustion facilities using once-through cooling systems require large quantities of water which are discharged back to receiving surface water with elevated temperature. Withdrawal and discharge with elevated temperature and chemical contaminants such as biocides or other additives, if used, may affect aquatic organisms, including phytoplankton, zooplankton, fish, crustaceans, shellfish, and many other forms of aquatic life. Aquatic organisms drawn into cooling water intake structures are either impinged on components of the cooling water intake structure or entrained in the cooling water system itself. In the case of either impingement or entrainment, aquatic organisms may be killed or subjected to significant harm. There may be special concerns about the potential impacts of cooling water intake structures located in or near habitat areas that support threatened, endangered, or other protected species or where local fishery is active. **Recommendations** to minimize, and control environmental impacts associated with water withdrawal by power plants include:

- Use of multi-port diffusers.
- Adjustment of the discharge temperature, flow, outfall location, and outfall design to minimize impacts to acceptable level (i.e., extend length of discharge channel before reaching the surface water body for pre-cooling or change location of discharge point to minimize the elevated temperature areas).

- Use of a closed-cycle, re-circulating cooling water system as described above (e.g., natural or forced draft cooling tower), or closed circuit dry cooling system (e.g., air cooled condensers) if necessary to prevent unacceptable adverse impacts. Cooling ponds or cooling towers are the primary technologies for a re-circulating cooling water system.
- In order to prevent the aquatic life including threatened, endangered, or other protected species within the hydraulic zone during water withdrawal, barrier nets, fish handling and return systems, fine mesh screens and aquatic filter barrier systems should be used.

Depending upon the type of combustion technology and fuel used, several wastewater streams arise from conventional power plants including:

- ✓ Cooling tower waste water
- ✓ Ash handling wastewater
- ✓ Material storage runoff
- ✓ Metal cleaning wastewater
- ✓ Air pollution control equipment wastewater (e.g., wet FGD discharges)
- ✓ Boiler related wastewater
- ✓ Boiler chemical cleaning waste
- ✓ Rejects from water treatment plant

These wastewater effluent streams are usually generated in power plants which burn coal or biomass. Some of these streams (e.g., ash handling wastewater) may be generated in reduced quantities or may not be present at all in oil-fired or natural gas-fired power plants. The characteristics of the wastewaters generated depend on the ways in which the water has been used. Contamination arises from demineralizers; lubricating and auxiliary fuel oils; trace contaminants in the fuel (introduced through the ash-handling wastewater and wet FGD system discharges); and chlorine, biocides, and other chemicals used to manage the quality of water in cooling systems. Cooling tower blow down tends to be very high in total dissolved solids but is generally classified as non-contact cooling water and, as such, is typically subject to limits for pH, residual chlorine, and toxic chemicals that may be present in cooling tower additives (including corrosion inhibiting chemicals containing chromium and zinc whose use should be eliminated).Techniques for treating industrial process wastewater in this sector include flow and load equalization with pH adjustment; sedimentation for suspended solids reduction using settling basins or clarifiers; multimedia filtration for reduction in non-settle able suspended solids, oil skimmers for oil & grease removal, and activated sludge for biodegradable organic material removal. Additional engineering controls may be required for advanced metals removal using membrane filtration or other physical/chemical treatment technologies. Recommended measures to prevent, minimize, and control wastewater effluents from thermal power plants include:

- Recycling of wastewater in coal-fired plants for use as FGD makeup. This practice conserves water and reduces the number of wastewater streams requiring treatment and discharge
- In coal-fired power plants without FGD systems, treatment of process wastewater in conventional physical-chemical treatment systems for pH adjustment and removal of total suspended solids (TSS), and oil / grease, at a minimum
- Collection of fly ash in dry form and bottom ash in drag chain conveyor systems in new coal-fired power plants;
- Use of infiltration and runoff control measures such as compacted soils, protective liners, and sedimentation controls for runoff from coal piles
- Spraying of coal piles with anionic detergents to inhibit bacterial growth and minimize acidity of leachate
- Treatment of low-volume wastewater streams that are typically collected in the boiler and turbine room sumps in conventional oil-water separators before discharge

- Treatment of acidic low-volume wastewater streams, such as those associated with the regeneration of makeup demineralizer and deep-bed condensate polishing systems, by chemical neutralization in-situ before discharge
- Pre treatment of cooling tower makeup water, installation of automated bleed/feed controllers, and use of inert construction materials to reduce chemical treatment requirements for cooling towers
- Elimination of metals such as chromium and zinc from chemical additives used to control scaling and corrosion in cooling towers
- Use the minimum required quantities of chlorinated biocides in place of brominated biocides or alternatively apply intermittent shock dosing of chlorine as opposed to continuous low-level feed.

Sanitary wastewater from industrial facilities may include effluents from domestic sewage, food service, and laundry facilities serving site employees. Recommended sanitary wastewater management strategies include:

- Segregation of wastewater streams to ensure compatibility with selected treatment option (e.g., septic system, sewerage treatment plant etc. which can only accept domestic sewage)  Segregation and pre-treatment of oil and grease containing effluents (e.g., use of a grease trap) prior to discharge into sewer systems; etc.

Stormwater includes any surface runoff and flows resulting from precipitation, drainage and other sources. If the water is exposed to fuel or material stored, there are chances of contamination. Typically stormwater runoff may contains suspended sediments, metals, petroleum hydrocarbons, Polycyclic Aromatic Hydrocarbons (PAHs), coliform, etc. Rapid runoff, even of uncontaminated stormwater, also degrades the quality of the receiving water by eroding stream beds and banks. Following options may be considered for proper handling of stormwater:

- Stormwater should be separated from process and sanitary wastewater streams in order to reduce the volume of wastewater to be treated prior to discharge;
- Stormwater should be managed as a resource, either for groundwater recharge or for meeting water needs at the facility if found below prescribed standards as per ECR 1997.  Oil water separators and grease traps should be installed and maintained as appropriate at refuelling facilities, workshops, parking areas, fuel storage and containment areas; etc.

- **Solid waste generation**

Coal or biomass-fired power plants generate large amount of solid wastes due to ash content in the fuel. The solid waste from coal combustion wastes includes fly ash (coarse and fine), bottom ash, boiler waste, and FGD sludge, which is a common solid waste generated from combustion of high sulphur content fuel. Metals are constituents of concern in both coal combustion wastes and lowvolume solid wastes. For example, ash residues and the dust removed from exhaust gases may contain significant levels of heavy metals and some organic compounds, in addition to inert materials. Other solid wastes from coal-fired power plants and other plants include coal mill rejects, cooling tower sludge, and wastewater treatment sludge. Oil combustion in oil-fired power plants generate wastes which includes fly ash and bottom ash, but are generated in significant quantities when residual fuel oil is burned in oil-fired steam electric boilers. But oil combustion wastes are generated in much smaller quantities as compared to large-volume coal fired power plants. Natural gas-fired power plants generate virtually no solid waste because of the negligible ash content, regardless of the combustion technology. The high-volume coal combustion wastes are typically managed in landfills or surface impoundments or, increasingly, may be applied to a variety of beneficial uses. Low-volume wastes are also managed in landfills or surface impoundments, but are more frequently managed in surface impoundments. Recommended measures to prevent, minimize, and control the volume of solid wastes from conventional power plants include:

- Dry handling of the coal combustion wastes, in particular fly ash. Dry handling methods do not involve surface impoundments and, therefore, do not present the ecological risks identified for impoundments (e.g., metal uptake by wildlife).

- Reuse of sludge from treatment of waste waters from FGD plants. This sludge may be reused in the FGD plant due to the calcium components. It can also be used as an additive in coalfired plant combustion to improve the ash melting behaviour.
- Dry collection of bottom ash and fly ash from power plants combusting heavy fuel oil if containing high levels of economically valuable metals such as vanadium and recycle for vanadium recovery (where economically viable) or disposal in a permitted landfill with environmental controls
- Management of ash disposal and reclamation so as to minimize environmental impacts – especially the migration of toxic metals, if present, to nearby surface and groundwater bodies, in addition to the transport of suspended solids in surface runoff due to seasonal precipitation and flooding. In particular, construction, operation, and maintenance of surface impoundments should be conducted in accordance with internationally recognized standards.

Ash residues are not typically classified as a hazardous waste due to their inert nature. However, where ash residues are expected to contain potentially significant levels of heavy metals, radioactivity, or other potentially hazardous materials, they should be tested at the start of plant operations to verify their classification as hazardous or non-hazardous according to local regulations or internationally recognized standards. There are multiple ways through which fly ash can be beneficially used such as use as raw material for manufacturing concrete.

- **Hazardous Materials and Oil**
  - Hazardous materials and petroleum products stored and used in conventional power plants include solid, liquid, and gaseous fuels; wastewater treatment chemicals; and equipment and facility maintenance chemicals (e.g., paint, lubricants, and cleaners). The other sources of hazardous materials are petroleum, including spills during transport and storage. Use of double-walled, underground pressurized tanks for storage of pure liquefied ammonia (e.g., for use as reagent for SCR) in quantities over 100 m3; tanks of lesser capacity should be manufactured using annealing processes
  - Establishing hazardous materials management priorities based on hazard analysis of risky operations identified through Social and Environmental Assessment
  - Where practicable, avoiding or minimizing the use of hazardous materials. For example, non-hazardous materials have been found to substitute asbestos in building materials, PCBs in electrical equipment, persistent organic pollutants (POPs) in pesticides formulations, and ozone depleting substances in refrigeration systems
  - Preventing uncontrolled releases of hazardous materials to the environment or uncontrolled reactions that might result in fire or explosion
  - Using engineering controls (containment, automatic alarms, and shut-off systems) commensurate with the nature of hazard
  - Implementing management controls (procedures, inspections, communications, training, and drills) to address residual risks that have not been prevented or controlled through engineering measures

## 2.2. *Health and Safety Issues:*

In Bangladesh, Occupational health and safety risks and mitigation measures during construction, operation, and decommissioning of conventional power plants are similar to those at other large industrial facilities, the additional safety issues in the power sector is related to working at heights, fire, electrical, noise and heat in the power plants. The table below enlists the various occupational health and safety issues that are commonly observed in the power plants in Bangladesh which need to be addressed immediately to ensure sustainable growth of the sector. The table below is a list of commonly observed hazards mainly categorised into chemical and physical hazards in the power sector and its mitigation measures.

**Table - Common Occupational Health & Safety Issues**

| Hazard | OHS risks | Description | Mitigation Measures |
|---|---|---|---|
| Physical | Electric Hazards | Workers may have a high exposure to electric and magnetic fields (EMF) due to working in proximity to electric power generators, equipment, and connecting high-voltage transmission lines. Exposure to EMF can cause Non-ionising radiation. | Occupational EMF exposure should be prevented or minimized through an EMF safety program:<br>• Identification of potential exposure levels, including the use of personal monitors during<br>• working activities;<br>• Training of workers in the identification of occupational EMF levels and hazards;<br>• Establishment and identification of EMF safety zones, and limiting access to elevated EMF zones to properly trained workers;<br>• Actions to address occupational exposure may include limiting exposure time through work rotation, increasing the distance between the source and the worker, or use of shielding |
| | Heat | Physical contact of workers with hot surfaces such as boilers, pipes, and related hot equipment in conventional power plants or moving equipment during operation and maintenance. | • Use of warning signs near high temperature surfaces and personal protective equipment (PPE).<br>• Provision of adequate ventilation in work areas to reduce heat and humidity.<br>• Regular inspection and maintenance of pressure vessels, piping, and boilers safety controls etc. |
| | Fire & Fire and explosion hazards | Fire and explosion hazards from handling and storage of fuels such as coal, HSD/LDO & natural gas and other chemicals and gases. | Storing flammables away from ignition sources and oxidizing materials. Further, flammables storage area should be:<br>• Remote from entry and exit points into buildings<br>• Away from facility ventilation intakes or vents<br>• Have natural or passive floor and ceiling level ventilation and explosion venting<br>• Use spark-proof fixtures |

| | | | |
|---|---|---|---|
| | | | • Be equipped with fire extinguishing devices and selfclosing doors, and constructed of materials made to withstand flame impingement for a moderate period of time<br>• Providing bonding and grounding of, and between, containers and additional mechanical floor level ventilation if materials are being, or could be, dispensed in the storage area<br>• Where the flammable material is mainly comprised of dust, providing electrical grounding, spark detection, and, if needed, quenching systems<br>• Defining and labelling fire hazards areas to warn of special rules (e.g. prohibition in use of smoking materials, cellular phones, or other potential spark generating equipment)<br>• Providing specific worker training in handling of flammable materials, and in fire prevention or suppression<br>• Preparation of on-site and off-site emergency preparedness plan.<br>• Implementation of OSHA,<br>• NIOSH or ISO 18001 in the plant to ensure use of safe work practices. |

| | | | | |
|---|---|---|---|---|
| | Noise | Noise pollution sources in thermal power facilities include turbine generators, boilers, diesel generators, reciprocating engines, fans and ductwork, pumps, compressors, condensers, piping and valves, motors, transformers, switchyard area and cooling towers.. | • | Use PPEs in high noise areas such Turbine-generator area, boiler area, Diesel generator areas etc. |
| | | | • | Use of noise control techniques such as: using acoustic machine enclosures; selecting structures according to their noise isolation effect to envelop the building; using mufflers or silencers in intake and exhaust channels; using sound absorptive materials in walls and ceilings; using vibration isolators and flexible connections; prevent possible noise leakage through openings and minimize pressure variations in piping. |
| | | | • | Siting new facilities with consideration of distances from the noise sources to the receptors (e.g., residential receptors, schools, hospitals, religious places) to the extent possible. |
| | | | • | Provision of green belt around the plant will further reduce noise levels. |
| | Working at Heights | Workers may be exposed to fall hazard when they are working at height more than two meters. Risks include fall into operating machinery; into water or other liquid; into hazardous substances; or through an opening in a work surface. | □ | Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area |
| | | | □ | Proper use of ladders and scaffolds by trained employees Use of fall prevention devices, including safety belt and lanyard travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self-retracting inertial fall arrest devices attached to fixed anchor point or horizontal life-lines |
| | | | □ | Appropriate training in use, serviceability, and integrity of the necessary PPE |

| | | | | |
|---|---|---|---|---|
| | | | □ | Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall |
| Chemical | Dust | Exposure to fine particles such as dust which is associated with handling of solid fuels, additives, and solid wastes (e.g. ash) can lead to serious respiratory diseases such as silicosis, skin & lung cancer, black lung etc. | □<br>□<br>□ | Use of dust controls (e.g., exhaust ventilation) to keep dust below applicable guidelines<br>Control of dust through implementation of good housekeeping and maintenance Use of water sprinkling system to suppress dust in solid fuel handling areas and ash dykes. |
| | | | □ | Regular inspection and maintenance of asbestos containing materials (e.g., insulation in older plants may contain asbestos) to prevent airborne asbestos particles; etc. |
| | | | □ | Implementation of OSHA, NIOSH or OHSAS in the plant to ensure use of safe work practices. |
| | Hazardous chemicals | Exposure to chemicals while handling hazardous chemicals such as corrosives (acids & bases), oxidizers, solvents etc. mainly in water treatment plant for production of demineralised water used in conventional power plants.<br><br>Exposure to Ammonia and chlorine near NOx control systems and cooling towers and boilers can lead to major respiratory and allergic contact dermatitis. | □<br>□<br>□<br>□ | Use of personal protective equipment (PPE)<br>Fixture of local alarm with a flash light to indicate emergency in control room in case of hazard.<br>A Material Safety Data Sheet (MSDS) should be fixed in hazardous chemicals storage areas.<br>Training workers in the use of the available information (such as MSDSs), safe work practices, and appropriate use of PPE. |

### 2.3. *Community Health & Safety:*

- **Water consumption:** Convectional power plant utilizes large amounts of water for electricity generation. Water is usually taken from surface waters, but sometimes ground waters or municipal supplies are also used which may affect supply of water for local communities. Water consumption should be minimized as discussed in above in Section 1: Environment. The potential effects of water use should be assessed at the project's design phase to ensure that the project does not compromise the availability of water for personal hygiene, agriculture, recreation, and other community needs

- **Traffic safety:** During operation of power plant there is a heavy vehicular movement for transportation of fuels, chemicals and additives which may be a risk to local community pertaining to traffic related injuries.

- **Air quality:** Installation and operation of conventional power plants may attract locally based cement plants in the vicinity which may deteriorate ambient air quality of nearby areas due to stack and fugitive emissions.

### *2.4. Social Issues:*

This section will be same as described in the corresponding section of _Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector'

## 3. Performance Indicators and Monitoring

### 3.1. Wastewater discharge quality standards

(To be applicable at relevant wastewater stream: e.g., from FGD system, low volume waste sources, wet ash transport, metal cleaning waters, boiler blow down, washing boiler / air pre heater and precipitator, boiler acid washing, regeneration of demineralizers and condensate polishers, oilseparated water, site drainage, coal pile runoff, once through cooling water and cooling water)

| | | | |
|---|---|---|---|
| COD | mg/L | 250 | 200 - 400 |
| Total Suspended Solids | mg/L | 50 | 150 (inland surface water), 200 (irrigated land), 500 (public sewer |
| Sulphide | mg/L | 1.0 | 1-2 |
| Chromium (hexavalent) | mg/L | 0.1 | 0.5 - 1 |
| Chromium (total) | mg/L | 0.5 | 0.1 – 1 |
| Chloride | mg/L | 1000 | 600 |
| Sulphate | mg/L | 300 | 400 |
| Ammonia | mg/L | 10 | 5 |
| Oil & grease | mg/L | 10 | 10 |
| Total nitrogen | mg/L | 10 | 50-75 |
| Total phosphorus | mg/L | 2 | 8-15 |
| Phenols | mg/L | 0.5 | 1 |
| Total coliform bacteria | MPN/100 ml | 400 | No national standard |
| Temperature increase | °C | <3 | No national standard |

* *The National Standards are not specific to power sector and is applicable for all the industrial units. The national standards are defined as per the location of disposal – inland surface water; public sewer; irrigated land.*

### 3.2. Emission Levels

Emissions levels for the design and operation of each project should be established through the EA process on the basis of country legislation and the recommendations provided in this guidance document, as applied to local conditions. The emissions levels selected should be justified in the EA. The maximum emissions levels given here can be consistently achieved by well designed, well-operated, and well-maintained pollution control systems. In contrast, poor operating or maintenance procedures affect actual pollutant removal efficiency and may reduce it to well below the design specification. Dilution of air emissions to achieve these guidelines is unacceptable. Compliance with ambient air quality guidelines should be assessed on the basis of good international industry practice (GIIP) recommendations.

### 3.3. Ambient air quality standards

| Pollutants | Unit | Guideline Values | | |
|---|---|---|---|---|
| | | GIIP | | National Standards* |
| | | Averaging period | Value | |
| Particulate Matter PM10 | μg/m³ | 1 year | 70 (Interim target-1)<br>50 (Interim target-2)<br>30 (Interim target-3)<br>20 (guideline) | 100 – 500 |
| | μg/m³ | 24 Hour | 150 (Interim target-1)<br>100 (Interim target-2)<br>75 (Interim target-3)<br>50 (guideline) | |
| Particulate Matter | μg/m³ | 1 year | 35 (Interim target-1) | |
| PM2.5 | | | 25 (Interim target-2)<br>15 (Interim target-3)<br>10 (guideline) | |
| | μg/m³ | 24 Hour | 75 (Interim target-1)<br>50 (Interim target-2)<br>37.5 (Interim target-3)<br>25 (guideline) | |
| Sulphur Dioxide | μg/m³ | 24 hour | 20 | 30 – 120 |
| | | 10 minute | 500 | |
| Oxides of Nitrogen | μg/m³ | 1 year | 40 | 30 – 100 |
| | | 1 hour | 200 | |
| Ozone | | 8-hour daily maximum | 160 (Interim target-1)<br>100 (guideline) | |

** The National Standards are not specific to power sector and is applicable for all the industrial units. The national standards are defined as per the categories of areal – industrial and mixed; commercial and mixed; residential and rural; sensitive. For ease of comparison, here the national standards are given as range and not as per the location of disposal. Also, no limit has been set for Ozone in the national standard*

### 5.1.1.1.1.2 3.4. Gaseous emission standards (in mg/Nm3 or as indicated)

| Pollutants | Particulate Matter (PM) | | Sulphur Dioxide (SO2) | | Nitrogen Oxides (NOx) | | Excess Dry Gas O2 Content (%) |
|---|---|---|---|---|---|---|---|
| | NDA | DA | NDA | DA | NDA | DA | |
| | Reciprocating Engine | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Natural Gas | N/A | N/A | N/A | N/A | 200 (Spark Ignition)<br>400 (Dual Fuel) | 200 (Spark Ignition)<br>400 (Dual Fuel) | 15 |
| Liquid Fuels (Plant ≥50MWth to <300MWth) | 50 | 30 | 1,170 or use of 2% or less S fuel | 0.5% S | 1,460 (Compression Ignition, bore size diameter [mm] < 400)<br>1,850 (Compression Ignition, bore size diameter [mm] ≥ 400) | 400 | 15 |
| Liquid Fuels (Plant ≥300MWth) | 50 | 30 | 585 or use of 1% or less S fuel | 0.25% S | 740 | 400 | 15 |
| Biofuels / Gaseous Fuels | 50 | 30 | N/A | N/A | 30% higher limits than those provided above for Natural | 200 (Spark Ignition) | 15 |
| other than Natural Gas | | | | | Gas and Liquid Fuels. | 400 (Dual Fuel) | |
| Combustion Turbine | | | | | | | |
| Natural Gas (Unit ≥ 50MWth | N/A | N/A | N/A | N/A | 50 (~25ppm) | 30 (~15ppm) | 15 |
| Distillate/ Light Fuel Oil (Unit ≥ 50MWth) | 50 | 30 | Use of 1% or less S fuel | Use of 0.5% or less S fuel | 150 (~74ppm) | 100 (~50ppm) | 15 |
| Boiler | | | | | | | |
| Natural Gas | N/A | N/A | N/A | N/A | 200 | 180 | 3 |
| Other Gaseous Fuels | 50 | 30 | 400 | 300 | 240 | 200 | 3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Liquid Fuels (Plant ≥50MWth to <600MWth) | 50 | 30 | 400 – 1000 | 400 | 400 | 200 | 3 |
| Liquid Fuels (Plant ≥600MWth) | 40 | 25 | 200-600 | 200 | 400 | 200 | 3 |
| Solid Fuels (Plant ≥50MWth to <600MWth) | 50 | 30 | 400 – 1000 | 400 | 500 | 200 | 6 |
| Solid Fuels (Plant ≥600MWth) | 40 | 25 | 200-600 | 200 | | | 6 |

**3.5. Social standards**

This section will be same as described in the corresponding section of _Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector'.

## 4. General Description of Industry Activities

| Power generation sources | Power plant type | Description |
|---|---|---|

| | | |
|---|---|---|
| Conventional power | Coal/Gas/Oil based power plant | A conventional power plant burns coal, oil, gas to produce electricity. Mechanical power is produced by a heat engine, which transforms thermal energy from combustion of fossil fuel into mechanical energy. Mechanical power is produced by a heat engine, which transforms thermal energy from combustion of fossil fuel into mechanical energy. A generator converts mechanical energy into electrical energy by creating relative motion between a magnetic field and a conductor. The type of power plant employed depends on the source of energy and type of energy being produced.<br>Power plants can be divided based on the type of combustion or gasification: boilers, internal reciprocating engines, and combustion turbines.<br>Some common technologies for steam generation are Conventional or Sub-critical boilers, Supercritical steam boilers and Ultra supercritical steam boilers. |

# I. ESRM Guidance Note for Pulp & Paper Sector

## 1. Introduction

The objective of this Guidance Note on ESRM for the Pulp & Paper Sector is to provide a high level indicative summary of summary of potential environmental and social (E&S) risks and performance levels for transactions in the Pulp & Paper sector in Bangladesh. The scope of application will be fully aligned with the Section 4 of this policy. At all times, applicable national regulations are to be followed. Where national regulations differ from the levels and measures presented in this Guidance Note, loan proposals are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in this Guidance Note are appropriate, in view of specific loan proposal, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment. Going by the process, pulping process used by manufacturers in Bangladesh is namely mechanical pulping & chemical pulping. Chemical pulping relies mainly on chemical reactants and heat energy to soften and dissolve lignin in wood chips, followed by mechanical refining to separate the fibre. Mechanical pulping often involves some pre-treatment of wood with steam heat and/or weak chemical solution, but relies primarily on mechanical equipment to reduce wood into fibrous material by abrasive refining or grinding. Different pulping processes result in pulp with specific properties suited for different end uses. This Guidance Note therefore focuses primarily on environmental and social issues associated with Pulp & Paper industry units.

## 2. Industry Specific Impacts and Management

### *2.1. Environmental Issues:*

- **Wastewater**

Pulp and paper manufacturing activities may generate wastewater discharges at a rate of 10250cubic meters permetric ton (m3/t) of product. Product is measured as air dry pulp in pulp mills, and as weight of paper sold in paper and board mills. Pollutants present in effluent streams from pulp and paper manufacturing include:

- Total suspended solids (TSS; mainly from cooking and pulping process screening, washing, and bleaching stages as well as from debarking residue, chemical recovery inorganics and fillers).
- Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and dissolved organic compounds mainly arising from wet debarking cooking/pulping, screening, washing, bleaching, and chemical recovery plant liquor spills).
- Bleach plant effluents may include PCDD (poly chlorinateddibenzodioxins) and PCDF (poly chlorinated dibenzofurans), commonly referred to as chlorinated dioxins and furans. When Elemental Chlorine Free (ECF) or Total Chlorine Free (TCF) bleaching technologies are used, the concentrations of dioxins and furans in the effluents are below the detection limits. Among the sources of Nitrogen and Phosphorus compounds released into wastewaters, and potentially contributing toeutrophication of receiving waters, is the wood raw material which is also a source of resin acids. Resin acids, especiallythose based on coniferous wood pulp, can be toxic to fish andbenthic invertebrates. Chlorinated phenols can be produced byelemental chlorine based

bleaching of pulp. Other issues related to wastewater discharges may include fishtainting, colour related to COD content and discharges of black liquor, pulp spills from overflowing tanks, and runoff from log yards. This last source may contain toxic chemicals (such astannins, phenols, resins, and fatty acids) leached from the timber, and soil and other materials washed out of the bark. Industry-specific wastewater prevention strategies potentially applicable to most pulp and paper manufacturing processes are presented below.

**Recommended wastewater prevention and control methods include the following:**

- Dry debarking of wood
- Systems for collection and recycling of temporary and accidental discharges from process water spills

- Sufficient and balanced volumes of pulp storage, broke storage and white water storage tanks to avoid or reduce process water discharges
- Recycling of wastewater, with or without simultaneous recovery of fibers (using filters or flotation plants)
- Separation of contaminated and non- contaminated (clean) wastewaters with collection and reuse of clean non-contact cooling waters and sealing waters
- Potentially contaminated storm water includes runoff from log and wood handling areas, process equipment, building roofs and areas immediately around the mill process areas. This should be combined with process effluent for treatment.

**Table - Sources of Wastewater discharge and control techniques**

| **Control techniques** | |
|---|---|
| ***Wastewater Management –Kraft and Sulphite Pulp Mills*** | |
| Bleach plant | Oxygen delignification ahead of the bleach plant |
| Bleaching | Efficient washing of the pulp ahead of the bleaching |
| Eliminating the formation of 2,3,7,8-TCDD and 2,3,7,8-TCDF in wood and non-wood bleaching processes | Replacement of elemental chlorine bleaching with Elemental Chlorine Free (ECF) bleaching or total chlorine free (TCF) bleaching |
| Removal of hexenuronic acids | Use of mild hydrolysis for hardwood pulp, especially eucalyptus |
| Collection and recycling of spent cooking liquor spills | Stripping and reuse of evaporation and digester condensates in order to reduce odour producing Total Reduced Sulfur (TRS) compounds (Kraft and Sulfite mills). |
| Neutralization of spent cooking liquor before evaporation and reuse of condensate in order to reduce dissolved organics (Sulfite mills) | Chemical recovery in Sulfite as well as Kraft mills. |
| **Wastewater Management – Mechanical and Chemical Mills** | |
| Minimizing reject losses | Maximizing water recirculation in mechanical pulping process |
| Application of thickeners to | Separation of pulp mill and paper mill water systems as |
| effectively separate water systems from the pulp and paper mills | well as use of counter-current water system from paper to pulp mill to reduce overall water consumption, TSS and dissolved organics. |
| ***Wastewater Management –Paper & Integrated Mills*** | |

| | |
|---|---|
| Recycling of white water with fibre recovery by means of disc filters, drum filters or micro flotation units and minimization of the number of fresh water intake points to the white water system | Fiber recovery via disc filters, drum filters or micro flotation units |
| Separate treatment of coating wastewaters | Separate treatment of coating wastewaters, e.g. by ultra filtration – recycling of coating chemicals |
| ***Wastewater Treatment*** | |
| Removal of suspended solids | Primary mechanical treatment (such as neutralization, screening, and sedimentation processes) |
| Removal of organic content and toxic organics | Secondary treatment (biological treatment) - The most commonly used systems include a combination of i) activated sludge; ii) aerated lagoons; iii) biological filters of various types, often used in combination with other methods; iv) anaerobic treatment used as a pre-treatment stage, followed by an aerobic biological stage; and v) combinations of different methods, when very high efficiencies are necessary; |
| **Treatment of toxic compounds (e.g., resins, fatty acids)** | **Extended aeration time** |
| Effluents high in BOD/COD & low in toxic substances (e.g., sulfite pulping condensates and mechanical pulping and RCF effluents) | Anaerobic biological pre-treatments |

- **Air Emissions**

The principal air emissions in pulp and paper production consist of process gases which vary by type of pulping process and which may include sulfur compounds (with associated odor issues), particulate matter, nitrogen oxides, volatile organic compounds, chlorine, carbon dioxide, and methane. Other common sources of emissions include flue gases from incineration plants and from auxiliary steam and power generating units emitting particulate matter, sulfur compounds and nitrogen oxides. Exhaust stacks should be designed according to the Good International Industry Practice (GIIP). For pulp mills, this may consist of a high single stack typically over 100 meters in height above immediately surrounding land or as defined by atmospheric emissions dispersion modeling.

**Table - Sources of emission and control techniques**

| **Control techniques** | |
|---|---|
| ***Process Gases – Kraft and sulfite mills*** | |
| Malodorous gases - Kraft pulping | Incineration |

| | |
|---|---|
| processes typically emit highly malodorous reduced sulfur compounds denoted as total reduced sulfur (TRS). | |
| High concentration gases | Stand-by incinerator system |
| The point of discharge of the necessary emergency vents to atmosphere should be a high, hot stack, such as the recovery or power boiler | When waste water treatment plant odors are problematic, considering use of oxygen activated sludge with capture and subsequent incineration of gaseous emi ssions |
| *Recovery boilers – Kraft and sulfite mills:* Emissions from recovery boilers are typically characterized by the presence of particulate matter and sulfur dioxide. Other key constituents include nitrogen oxides and sometimes hydrogen sulfide in kraft mills. Sulfur dioxide recovery is considered fundamental in sulfite mills. | |
| Oxidation of black liquor prior to direct contact evaporation (applicable to existing facilities, as direct contact evaporators should not be used in new facilities). Reducing sulfur emissions by concentrating black liquor in the evaporator (Kraft mills) above 75% dry solids before incineration in the recovery boiler | Reducing sulfur emissions by controlling combustion process parameters in the recovery boiler including temperature, air supply, distribution of black liquor in the furnace, and furnace load (Kraft mills) |
| Reduced emissions of nitrogen oxides (NOx ) by control of firing conditions (e.g. excess air) | Absorption in alkaline solution (can generate new cooking liquor for sulphite pulp mills) |
| *Lime Kilns – Kraft mills:* The calcination reaction process results in emissions of NOx, SO2, and particulate matter. TRS gases may also be released due to poor removal of sodium sulfide ($Na_2S$) from the lime mud. | |
| Sulfur dioxide emission | Primary emissions control through sse of low sulphur content fuel and control of excess oxygen |
| NOx emission | Primary emissions control through controlled firing conditions |
| Hydrogen sulfide emissions | Primary emissions control through treatment of residual sodium sulphide in the lime mud (e.g., proper lime mud washing and filtering to remove sodium sulfide and decrease water content (to about 20 to 30 percent) which permits on- filter air oxidation of residual sulfide prior to the dried mud entering the kiln) |
| Particulate matter emissions | Electrostatic precipitators |

| | |
|---|---|
| Residual sulfur dioxide emissions | Use of secondary SO2 emissions controls such as alkaline wet scrubbers for removal of acid gases and by-products of the incineration of TRS gases |

*Volatile Organic Compounds – All types of mills:* Volatile organic compounds (VOCs) are emitted to the atmosphere from poorly designed utility boilers burning bark and other woodbased fuel. At mechanical pulping mills, principal sources of VOC emissions include evacuation of air from wood-chip washing and from the condensing shower, where steam released in mechanical pulping processes, contaminated with volatile wood components, is condensed. The concentrations of VOCs depend on the resin content of the wood and the specific defiberizing techniques applied.

*VOC emissions*

- In addition to the guidance for malodorous emissions, above, recover VOCs in the heat recovery units and the start-up scrubber, and collect and further treat volatile compounds
- Operating bark boilers with excess oxygen sufficient to prevent VOC (and CO) emissions while minimizing formation of NOx. Fluidized bed technology is preferred for solid waste boilers

*Combustion Sources:* Pulp and paper mills are large energy and steam consumers sometimes making use of auxiliary boilers (bark boilers and additional steam boilers) for the generation of steam energy.
Emissions related to the operation of these steam energy sources typically consists of combustion by-products such as NOx, SOx, PM, and volatile organic compounds (VOCs), and greenhouse gases. Recommended management strategies include adoption of a combined strategy which includes a reduction in energy demand, use of cleaner fuels, and application of emissions controls where required. In energy efficient non-integrated pulp mills, the heat generated from black liquor and bark combustion should exceed the energy requirement for the entire production process.

| | |
|---|---|
| Reducing heat losses and heat consumption by increasing dry solids content of bark which is burnt; increasing efficiency of steam boilers (e.g. use of economizers | Increasing effectiveness of the secondary heating system (e.g. hot water about 85 °C) |
| Increasing use of secondary heat to heat buildings | Increasing high pulp concentration, as well as maintaining a tightly closed water system and a partially closed bleaching plant |
| Reducing electric power consumption by maintaining as high a pulp consistency as possible in screening and cleaning; controlling the speed of large motors rather than using throttling valves or dampers for flow control; using efficient vacuum pumps; and proper sizing of pipes, pumps and fans | Maximizing the generation of electric power by maintaining high boiler pressure; keeping outlet steam pressure in the back-pressure turbine as low as technically feasible; using a condensing turbine for power production from excess steam and maintaining high turbine efficiency; and preheating of air and fuel charged to boilers |

- **Residues and Waste**

Pulp and paper mills typically generate significant quantities of non-hazardous solid wastes but very little hazardous wastes. Industry specific wastes include bark from debarking of wood, residual pith from bagasse pulping, inorganic sludge (e.g. green liquor sludge, lime sludge) from chemical recovery, trash (e.g. plastics) separated from paper/card in RCF plants, and fiber(i.e., primary clarifier) sludge and biological sludge from wastewater treatment. A small amount of hazardous waste is generated in all mills, and includes oil and grease residues, scrap electrical equipment, and chemical residues which normally amount to about 0.5-1kg/ton of product. The classification of solid wastes as hazardous or non-hazardous should be established based on local regulatory criteria. Hazardous and non-hazardous wastes should be carefully segregated to reduce the volume of wastes that could be contaminated with hazardous material and hence classified as hazardous.The applicability of sludge management methods depends on the actual quality and type of sludge. The table below demonstrates this concept through examples. **Table -Sources of Residues or Waste and control techniques**

| **Section:** | **Control techniques** |
|---|---|
| Fibre Sludge | Recycling, incineration & land filling or can be used by other mills, or sent off-site for use in other products |
| Debarking waste | Clean wood handling, segregation & land filling |
| Deinking sludge | Filler in other paper grades or can be used for preparation of soil products or Incinerated |
| Bark ash, wood ash and other ashes | • Recycling & land filling<br>• Incineration in a bark boiler or separate incinerator is feasible only for sludge with relatively high contents of organics and high contents of dry solids |
| Lime mud | Recycling, liming of acid soils & land filling |
| Green liquor sludge | Land filling after improved dewatering or can be used as forest fertilizer or as a neutralization agent for acidic wastewater; |
| Pith | Composting with other organic materials for preparation of soil products or else incinerated. Composting is feasible only for sludge with high contents of organics |
| Biological sludge | • Composting with other organic materials for preparation of soil products or else incinerated.<br>• Incineration in the recovery boiler is typically only applicable for biological sludge in Kraft mills |
| Tertiary treatment sludge | Composting with other organic materials for preparation of soil products or blended with other sludge for incineration in the bark boiler. Sludge from a waste treatment plant needs to be evaluated on a case-by -case basis to establish whether it constitutes a hazardous or a non-hazardous waste and its potential impacts from land application |

- **Noise**

Pulp and paper mills are inherently noisy due to the large amount of mechanical equipment, transport vehicles, physical activities, and energy usage, notably vacuum pumps, liquid pumps and steam generation systems.

### *2.2. Health and Safety Issues:*

The occupational health and safety impact of Pulp & Paper manufacturing projects are primarily associated with dust, gases, fumes, noise and vibrations. The table below is a list of commonly observed hazards in the Pulp & Paper sector and its mitigation measures. **Table -Common Occupational Health hazards**

| Hazard | Description | Mitigation Measures |
|---|---|---|
| Chemical hazards | Numerous chemicals are used and manufactured in the pulp and paper industry that can have adverse impacts on worker health and safety. These include: **Gases**—such as reduced sulfur compounds (kraft pulping),oxidized sulfur compounds, mainly sulfur dioxide (kraft and sulfite pulping), chlorine, chlorine dioxide, terpenes and other volatile organic compounds, and oxygen; **Liquids**—including sodium hydroxide and other caustics, acids such as sulfuric acid, cooking byproducts such as turpentine, sodium hypochlorite, aqueous solution of chlorine dioxide, hydrogen peroxide, biocides, papermaking additives, solvents, and dyes and inks; and **Solids**—including sodium chlorate, sodium sulfate, lime, calcium carbonate, ash, and asbestos (used for insulation). | Automate pulping & bleaching operations<br>Provide engineering controls<br>Install continuous gas monitors with alarms.<br>Maintain a current database of all chemicals used and manufactured in the mill<br>All chemicals used or manufactured at the site should be reviewed for reactivity with other classes of chemicals used at the facility;<br>Label, mark, package and store all chemicals and hazardous materials according to national and internationally recognized requirements and standards;<br>Ensure contractor personnel, including maintenance contractors retained during shutdowns, are trained in and follow site safety procedures, including use of personal protective equipment and handling of chemicals;<br>Train workers in handling of chlorine dioxide and sodium chlorate. Wet sodium chlorate spills with water and keep any contaminated clothing wet until laundered;<br>Avoid the use of elemental chlorine for bleaching;<br>Keep sulfur storage bins free of sulfur dust accumulation;<br>Implement an inspection and maintenance program to prevent and identify leaks, equipment failure, etc. |

| | | |
|---|---|---|
| | | Use water-based (rather than solventbased) inks and dyes |
| Physical hazards | The most severe injuries in this sector are often attributable to the failure of lockout -tagout systems.<br>Machine Safety<br>Logging Activities<br>Confined Spaces: Operation and especially maintenance work may include confined space entry. Examples include: boilers, dryers, degreasers, digesters, blow pits, pipeline pits, process and reaction vessels, tanks, and vats. Impacts and mitigation. | Install catch platforms under conveyors that cross passageways or roadways;<br>Quickly clean up spills;<br>Use non-skid walking surfaces that allow drainage;<br>Install guard rails on walkways adjacent to production lines or at height, and clearly mark traffic lanes for vehicles an pedestrians;<br>Equip mobile equipment with roll-over protection.<br>Establish routines to ensure that heavy loads are not moved by crane over personnel<br>Equipment with moving parts should be fitted with safety guards or interlocks capable of preventing access to moving parts<br>Equipment must be shut off and locked out before maintenance, cleaning, or repairs are undertaken;<br>Workers should be trained specifically in the safe use of debarking, chipping, and other equipment;<br>Work stations should be aligned to minimize human danger from fragments which could arise from breakage;<br>Equipment should be regularly inspected and maintained to prevent equipment failure;<br>All personnel operating cutting equipment should use protective eyewear, and other PPE as necessary.<br>Establish and follow safety practices for unloading logs, lumber and chips. |

| | | |
|---|---|---|
| | | - Complete mechanization of log yard activities should be considered to reduce human contact with logs during handling and stacking activities; |
| | | - Transport routes within log yards should be clearly demarcated and vehicle movement should be closely controlled;<br>- Log stacks should not be higher than a safe height defined by risk assessment which should take account of sitespecific circumstances including stacking methodology;<br>- Access to log yards should be restricted to authorized personnel;<br>- Log decks should have stops, chains, or other guards to prevent logs from rolling down and off the deck;<br>- Workers should be trained in safe working procedures in log stack and deck areas, including avoidance of falling logs and planning of escape routes;<br>- Workers should be provided with protective steel capped boots, hardhats, and high visibility jackets;<br>- All mobile equipment should have audible reversing alarms.<br>- Impacts and mitigation measures for confined space entry are addressed. |
| Respiratory Hazard | - Exposure to wood dust is a potential concern in the wood handling area of pulp mills (e.g. in semi-mechanized chippers),as well as in the initial stages of pulping. Exposure to fibre dustcan occurs in paper mills. Paper fibre dust is also a fire hazard. | - Enclose and ventilate saws, shredders, dusters, and woodchip conveyors;<br>- Consider enclosed chip storage;<br>- Avoid use of compressed air to clear wood dust and wastepaper;<br>- Enclose and ventilate areas where dry, dusty additives are unloaded, weighed, and mixed, or use additives in liquid form;<br>- Regularly inspect and clean dusty areas to minimize dust explosion risk. |

| | | |
|---|---|---|
| Biological Exposure | Biological agents include microorganisms such as bacteria, fungi and viruses, some of which may be pathogenic. Microorganisms develop particularly in paper machines' closed-loop systems, biological treatment plants for mill wastewaters, and water cooling towers. | Design biological treatment plants to minimize the potential for growth of pathogenic organisms;<br>Use biocides in cooling water and in pulping and paper making processes to minimize growth of microorganisms. |
| Heat Exposure | Many pulping operations, including pulp cooking, pulping chemical recovery, lime production, and paper drying involve high temperatures and, in some cases, high pressures. | Provide air-conditioned control rooms, including in wood preparation, pulping, bleaching, and paper-making areas;<br>Schedule work in hot areas to allow acclimatization and rest periods;<br>Automate smelt removal from the chemical recovery boiler. Provide heavy-duty protective clothing to workers potentially exposed to molten smelt or other high-temperature materials.<br>Implement safety procedures to minimize the potential for smelt/water explosions.<br>Consider use of mobile equipment with air-conditioned enclosed cabs. |

**Exposure to radiation:** Certain measurement equipment, particularly in paper mills, contains radioactive material. These units are typically sealed, but damage to or maintenance of devices containing radioactive material may result in exposure. These devices should be designed and operated according to applicable national requirements and internationally accepted standards for occupational and/or natural exposure to ionizing radiation, such as ―International Basic Safety Standard for protection against Ionizing Radiation and for the Safety of Radiation Sources‖ and its three interrelated Safety Guides.

**Structural safety** is a serious safety concern in the industrial buildings of Bangladesh. There have also been incidents in the pulp and paper sector involving the collapse of factory buildings which have resulted in fatalities The lack of structural safety in the industrial buildings can also increase the risk of fire and electrical hazards. Table 8, below, provides a list of structural, fire, and electrical hazards observed in the pulp and paper sector and related prevention and mitigation measures.

**Table - Common Safety Issues in Bangladesh**

| Area | Issues commonly observed | Prevention and Mitigation Measures |
|---|---|---|

| | | |
|---|---|---|
| Structural | Highly stressed columns; undocumented vertical extensions; localised areas of high loads in buildings; discrepancy between structural drawing and built structure; minor to major cracks in structural elements. | □ Compliance to regulatory requirements including the Bangladesh National Building Code (BNBC) (2015) or international codes, such as those compiled by the International Code Council (ICC), (2006).<br>□ Undertake periodic structural safety audits by accredited agencies. |
| Fire | Inadequate, untested fire alarms; inadequate exit capacity compared to the occupancy load; lack of exit signage. | □ Compliance with the by-laws of the Fire Regulation (2014), part of the Bangladesh Labor (Amendment) Act (2013), which includes requirements regarding the formation of a safety committees, and other measures such as emergency exits, access to stairs, and provision of personal protective equipment (PPE).<br>□ Provisions for fire hydrants as per the requirements of BNBC (2015) and by Fire Regulation 2014, including water supply specifications according to the building size / hazard.<br>□ Undertake regular fire audits by accredited agencies, with mock drills to be conducted on a periodic basis as per the fire hazard assessment of the facility. |
| Electrical | Unsealed entry and exit points for electrical cable; excessive dust deposit on cables; cables laid on floor without guarding/protection; oil leaks in generator room; inadequate cable grounding. | □ Undertake electrical safety assessment on a periodic basis, and ensure workers are trained and provided with appropriate PPE based on the risk assessment. |

### *2.3. Community Health & Safety:*

Common health and safety impacts on the community during the construction, operation, and decommissioning of cement manufacturing facilities include:

- Chemical storage, use, and transport
- Odours
- Traffic

### 2.4. Social Issues

This section will be same as described in the corresponding section of _Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector.

## 3. Performance Indicators and Monitoring

### *3.1. Energy and water consumption*

| Mill type | Reported ranges | | |
|---|---|---|---|
| | Water Consumption (m3/t)a | Heat Energy (GJ/t) | Electrical Energy (kWh/t) |
| Kraft Pulping, bleached | 20 – 100[b] | 10 - 14 | 600 – 1200[i] |
| Sulfite Pulping (magnesium base) | 40-100 | | |
| Mechanical Pulping- Groundwood | 5 – 15 | | 1100 – 2200[c] |
| Mechanical Pulping-TMP | 4 – 10 | | 1800 – 3600[d] |
| Mechanical Pulping—CTMP | - 50 | | – 4300[e] |
| Recovered Paper Mill—Uncoated Folding Boxboard | – 10 | | |
| Recovered Paper Mill—Coated Folding Boxboard | 7-15 | | |
| Recovered Paper Mill—Corrugated Medium and Packaging Paper | 1.5-10 | | |
| Recovered Paper Mill—Newsprint | 10-20 | | |
| Recovered Paper Mill—Tissue | – 100[c] | | |
| Recovered Paper Mill—Writing and Printing Paper | - 20 | | |
| Paper Mill—Tissue | – 50[f] | | – 3000 |
| Paper Mill—Printing and Writing Paper, Uncoated | – 40[g] | | – 650 |
| Paper Mill—Printing and Writing Paper, Coated | – 50[g] | | - 900 |
| Paper Mill—Paper Board | – 20[h] | | ~550 - 680 |
| Paper Mill—Specialty Paper | 10-300 | | |

**3.2. Emission Guidelines for Pulp and Paper Facilities**

| Parameter | Type of mill | Units | Guideline value |
|---|---|---|---|
| Total Suspended Particulate | Kraft, bleached | kg/ADt | 0.5 |
| | Kraft, unbleached— Integrated | kg/ADt | 0.5 |
| | Sulfite, integrated and nonintegrated | kg/ADt | 0.15 |
| SO2 as S | Kraft, bleached | kg/ADt | 0.4 |
| | Kraft, unbleached | kg/ADt | 0.4 |
| | Sulfite, integrated and nonintegrated | kg/ADt | 1.0 |
| NOx as NO2 | Kraft, bleached | kg/ADt | 1.5 for hardwood pulp<br>2.0 for softwood pulp |
| | Kraft, unbleached-integrated | kg/ADt | 1.5 for hardwood pulp<br>2.0 for softwood pulp |
| | Sulfite, integrated and nonintegrated | kg/ADt | 2.0 |
| Total Reduced Sulfur compounds | Kraft, bleached | kg/ADt | 0.2 |
| | Kraft, unbleached-integrated | kg/ADt | 0.2 |

*Note: Kg/ADt = kilograms of pollutant per 1,000 kg of air dry pulp*

### 3.3. Effluent Guidelines for pulp and paper facilities-Unbleached Kraft Pulp, Integrated

| Parameter | Units | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *National Standards** |
| Flow[a] | m3/ADt | 25 | - |
| pH | | 6-9 | 6-9(across all discharge locations i.e. inland surface water, public sewer and irrigated land) |
| TSS | kg/ADt | 1.0 | 150 (Inland surface water) 500 (Public Sewerage system connected to treatment at second stage) 200 (Irrigated land) |
| COD | kg/ADt | 10 | 200 (Inland surface water) 400 (Public Sewerage system |
| | | | connected to treatment at second stage) 400 (Irrigated land) |
| $BOD_5$ | kg/ADt | 0.7 | 50 (Inland surface water) 250 (Public Sewerage system connected to treatment at second stage) 100 (Irrigated land) |
| Total N | kg/ADt | 0.2[b] | 100 (across all locations) |
| Total P | kg/ADt | 0.02 | 8 (Inland surface water) 8 (Public Sewerage system connected to treatment at second stage) 15 (Irrigated land) |

* *The National Standards are corresponding to large plant with production capacity of above 50 tons per day.*

### 3.4. Effluent Guidelines for pulp and paper facilities-Bleached Kraft Pulp, Integrated

| Paramete r | Units | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *National Standards** |
| pH | | 6-9 | 6-9(across all discharge locations i.e. inland surface water, public sewer and irrigated land) |
| TSS | kg/ADt | 1.5 | 150 (Inland surface water)500 (Public Sewerage system connected to treatment at second stage)200 (Irrigated land) |
| COD | kg/ADt | 20 | 200 (Inland surface water)400 (Public Sewerage system connected to treatment at second stage)400 (Irrigated land) |
| $BOD_5$ | kg/ADt | 1 | 50 (Inland surface water)250 (Public Sewerage system connected to treatment at second stage)100 (Irrigated land) |
| AOX | kg/ADt | 0.25 | - |
| Total N | kg/ADt | 0.2[b] | 100 (across all locations) |
| Total P | kg/ADt | 0.03 | 8 (Inland surface water)8 (Public Sewerage system connected to treatment at second stage)15 (Irrigated land) |

* *The National Standards are corresponding to small plant with production capacity of less than 50 tons per day.*

### 3.5. Effluent Guidelines for Sulfite Pulp and Paper Facilities—Sulfite Pulp, Integrated and Non-Integrated

| Parameter | Units | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *National Standards** |
| Flow[a] | m3/ADt | 55[d] | |
| pH | | 6-9 | 6-9(across all discharge locations i.e. inland surface water, public sewer and irrigated land) |
| TSS | kg/ADt | 2.0 | 150 (Inland surface water) 500 (Public Sewerage system connected to treatment at second stage) 200 (Irrigated land) |
| COD | kg/ADt | 30[c] | 200 (Inland surface water) 400 (Public Sewerage system connected to treatment at second stage) 400 (Irrigated land) |
| $BOD_5$ | kg/ADt | 2.0 | 50 (Inland surface water) 250 (Public Sewerage system connected to treatment at second stage) 100 (Irrigated land) |
| AOX | kg/ADt | 0.05 | - |
| Total N | kg/ADt | 0.5 | 100 (across all locations) |
| Total P | kg/ADt | 0.05 | (Inland surface water) 8 (Public Sewerage system connected to treatment at second stage) 15 (Irrigated land) |

### 3.6. Effluent Guidelines for CTMP Facilities

| Parameter | Units | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *National Standards* |
| Flow[a] | m3/ADt | 20 | - |
| pH | | 6-9 | 6-9(across all discharge locations i.e. inland surface water, public sewer and irrigated land) |
| TSS | kg/ADt | 1.0 | 150 (Inland surface water) 500 (Public Sewerage system connected to treatment at second stage) 200 (Irrigated land) |
| COD | kg/ADt | 5 | 200 (Inland surface water) 400 (Public Sewerage system connected to treatment at second stage) 400 (Irrigated land) |
| $BOD_5$ | kg/ADt | 1.0 | 50 (Inland surface water) 250 (Public Sewerage system connected to treatment at second stage) 100 (Irrigated land) |
| Total N | kg/ADt | 0.5 | 100 (across all locations) |
| Total P | kg/ADt | 0.05 | 8 (Inland surface water) 8 (Public Sewerage system connected to treatment at second stage) 15 (Irrigated land) |

### 3.7. Effluent Guidelines for pulp and paper facilities-Mechanical Pulping, Integrated

| Parameter | Units | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *National Standards* |
| pH | | 6-9 | 6-9 (across all discharge locations i.e. inland surface water, public sewer and irrigated land) |
| TSS | kg/ADt | 0.5 | 150 (Inland surface water) 500 (Public Sewerage system connected to treatment at second stage) 200 (Irrigated land) |
| COD | kg/ADt | 5.0 | 200 (Inland surface water) 400 (Public Sewerage system connected to treatment at second stage) 400 (Irrigated land) |

| | | | |
|---|---|---|---|
| $BOD_5$ | kg/ADt | 0.5 | 50 (Inland surface water) 250 (Public Sewerage system connected to treatment at second stage) 100 (Irrigated land) |
| AOX | kg/ADt | 0.005 | - |
| Total N | kg/ADt | 0.05 | 100 (across all locations) |
| Total P | kg/ADt | 0.005 | 8 (Inland surface water) 8 (Public Sewerage system connected to treatment at second stage) 15 (Irrigated land) |

**3.8. Effluent Guidelines for Pulp and Paper Facilities—Recycled Fibre, without Deinking, Integrated**

| Parameter | Units | Guideline Values | |
|---|---|---|---|
| | | ***GIIP*** | ***National Standards**** |
| Flow[a] | m3/ADt | 10 | - |
| pH | | 6-9 | 6-9 (across all discharge locations i.e. inland surface water, public sewer and irrigated land) |
| TSS | kg/ADt | 0.15 | 150 (Inland surface water) 500 (Public Sewerage system connected to treatment at second stage) 200 (Irrigated land) |
| COD | kg/ADt | 1.5 | 200 (Inland surface water) 400 (Public Sewerage system connected to treatment at second stage) 400 (Irrigated land) |
| $BOD_5$ | kg/ADt | 0.15 | 50 (Inland surface water) 250 (Public Sewerage system |
| | | | connected to treatment at second stage) 100 (Irrigated land) |
| AOX | kg/ADt | 0.005 | - |
| Total N | kg/ADt | 0.5 | 100 (across all locations) |
| Total P | kg/ADt | 0.005 | 8 (Inland surface water) 8 (Public Sewerage system connected to treatment at second stage) 15 (Irrigated land) |

**3.9. Effluent Guidelines for Pulp and Paper Facilities—Recycled Fibre, with Deinking, Integrated**

| Parameter | Units | Guideline Values | |
|---|---|---|---|
| | | ***GIIP*** | ***National Standards**** |
| Flow[a] | m3/ADt | 15 | - |
| pH | | 6-9 | 6-9 (across all discharge locations i.e. inland surface water, public sewer and irrigated land) |
| TSS | kg/ADt | 0.3 | 150 (Inland surface water) 500 (Public Sewerage system connected to treatment at second stage) 200 (Irrigated land) |
| COD | kg/ADt | 4.0 | 200 (Inland surface water) 400 (Public Sewerage system connected to treatment at second stage) 400 (Irrigated land) |
| $BOD_5$ | kg/ADt | 0.2 | 50 (Inland surface water) 250 (Public Sewerage system connected to treatment at second stage) 100 (Irrigated land) |
| AOX | kg/ADt | 0.005 | - |
| Total N | kg/ADt | 0.1 | 100 (across all locations) |
| Total P | kg/ADt | 0.01 | 8 (Inland surface water) 8 (Public Sewerage system connected to treatment at second stage) 15 (Irrigated land) |

**3.10. Effluent Guidelines for Pulp and Paper Facilities—Recycled Fiber Tissue Mills**

| Parameter | Units | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *National Standards* |
| Flow[a] | m3/ADt | 25 | - |
| pH | | 6-9 | 6-9 (across all discharge locations i.e. inland surface water, public sewer and irrigated land) |
| TSS | kg/ADt | 0.4 | 150 (Inland surface water) 500 (Public Sewerage system connected to treatment at second stage) 200 (Irrigated land) |
| Flow [a] | m3/ADt | 25 | - |
| COD | kg/ADt | 4.0 | 200 (Inland surface water) 400 (Public Sewerage system connected to treatment at second stage) 400 (Irrigated land) |
| $BOD_5$ | kg/ADt | 0.5 | 50 (Inland surface water) 250 (Public Sewerage system connected to treatment at second stage) 100 (Irrigated land) |
| AOX | kg/ADt | 0.005 | - |
| Total N | kg/ADt | 0.25 | 100 (across all locations) |
| Total P | kg/ADt | 0.015 | 8 (Inland surface water) 8 (Public Sewerage system connected to treatment at second stage) 15 (Irrigated land) |

**3.11. Effluent Guidelines for Pulp and Paper Facilities—Uncoated Fine Paper Mills**

| | | | |
|---|---|---|---|
| pH | | 6-9 | 6-9 (across all discharge locations i.e. inland surface water, public sewer and irrigated land) |
| TSS | kg/ADt | 0.4 | 150 (Inland surface water) 500 (Public Sewerage system connected to treatment at second stage) 200 (Irrigated land) |
| COD | kg/ADt | 2.0 | 200 (Inland surface water) 400 (Public Sewerage system connected to treatment at second stage) 400 (Irrigated land) |
| $BOD_5$ | kg/ADt | 0.25 | 50 (Inland surface water) 250 (Public Sewerage system connected to treatment at second stage) 100 (Irrigated land) |
| AOX | kg/ADt | 0.005 | - |
| Total N | kg/ADt | 0.2 | 100 (across all locations) |
| Total P | kg/ADt | 0.01 | 8 (Inland surface water) 8 (Public Sewerage system connected to treatment at second stage) 15 (Irrigated land) |

**3.12. Effluent Guidelines for Pulp and Paper Facilities—Coated Fine Paper Mills**

| Parameter | Units | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *National Standards* |
| Flow[a] | m3/ADt | 25 | - |
| pH | | 6-9 | 6-9 (across all discharge locations i.e. inland surface water, public sewer and irrigated land) |
| TSS | kg/ADt | 0.4 | 150 (Inland surface water) 500 (Public Sewerage system connected to treatment at second stage) 200 (Irrigated land) |

| | | | |
|---|---|---|---|
| COD | kg/ADt | 1.5 | 200 (Inland surface water) 400 (Public Sewerage system connected to treatment at second stage) 400 (Irrigated land) |
| $BOD_5$ | kg/ADt | 0.25 | 50 (Inland surface water) 250 (Public Sewerage system connected to treatment at second stage) 100 (Irrigated land) |
| AOX | kg/ADt | 0.005 | - |
| Total N | kg/ADt | 0.2 | 100 (across all locations) |
| Total P | kg/ADt | 0.01 | 8 (Inland surface water) 8 (Public Sewerage system connected to treatment at second stage) 15 (Irrigated land) |

### 3.13. Effluent Guidelines for pulp and paper facilities-Tissue Mills

| Parameter | Units | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *National Standards* |
| Flow[a] | kg/ADt | 25 k | - |
| pH | | 6-9 | 6-9 (across all discharge locations i.e. inland surface water, public sewer and irrigated land) |
| TSS | kg/ADt | 0.4 | 150 (Inland surface water) 500 (Public Sewerage system connected to treatment at second stage) 200 (Irrigated land) |
| COD | kg/ADt | 1.5 | 200 (Inland surface water) 400 (Public Sewerage system connected to treatment at second stage) 400 (Irrigated land) |
| $BOD_5$ | kg/ADt | 0.4 | 50 (Inland surface water) 250 (Public Sewerage system connected to treatment at second stage) 100 (Irrigated land) |
| AOX | kg/ADt | 0.01 | - |
| Total N | kg/ADt | 0.25 | 100 (across all locations) |
| Total P | kg/ADt | 0.015 | 8 (Inland surface water) 8 (Public Sewerage system connected to treatment at second stage) 15 (Irrigated land) |

### 3.14. Effluent Guidelines for pulp and paper facilities-Fibre Preparation, Non-Wood

| Parameter | Units | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *National Standards* |
| Flow[a] | kg/ADt | 50 | - |
| pH | | 6-9 | 6-9 (across all discharge locations i.e. inland surface water, public sewer and irrigated land) |
| TSS | kg/ADt | 2.0 | 150 (Inland surface water) 500 (Public Sewerage system connected to treatment at second stage) 200 (Irrigated land) |
| COD | kg/ADt | 30 | 200 (Inland surface water) 400 (Public Sewerage system connected to treatment at second stage) 400 (Irrigated land) |
| $BOD_5$ | kg/ADt | 2.0 | 50 (Inland surface water) 250 (Public Sewerage system connected to treatment at second stage) 100 (Irrigated land) |
| AOX | kg/ADt | 2.0 | - |
| Total N | kg/ADt | 0.5 | 100 (across all locations) |

| | | | |
|---|---|---|---|
| Total P | kg/ADt | 0.05 | 8 (Inland surface water) 8 (Public Sewerage system connected to treatment at second stage) 15 (Irrigated land) |

### 3.15. Social standards

This section will be same as described in the corresponding section of _Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector'.

### 4. General Description of Industry Activities

| Sector Activity | Sub-sector Activities |
|---|---|
| Raw Material Preparation | Wood is the predominant source of cellulose fiber for paper products, although other fiber sources, such as straw, bagasse, and bamboo, are used in areas with limited access to forest resources, especially in developing countries. |
| Pulping Processes | In the pulping process, the raw cellulose-bearing material (raw plant material or recycled paper) is broken down into its individual fibers, known as pulp. Pulping processes are generally categorized as :<br>• Chemical<br>• Mechanical<br>Chemical pulping relies mainly on chemical reactants and heat energy to soften and dissolve lignin in wood chips, followed by mechanical refining to separate the fibers. Mechanical pulping often involves some pre-treatment of wood with steam heat and/or weak chemical solution, but relies primarily on mechanical equipment to reduce wood into fibrous material by abrasive refining or grinding. Different pulping processes result in pulp with specific properties suited for different end uses. |
| Kraft Pulping | In the Kraft pulping process, wood chips are combined in a digester with |
| | white liquor, an aqueous solution comprising principally sodium sulfide (Na2S) and sodium hydroxide (NaOH), which breaks down lignin and, to a lesser extent, hemicelluloses under elevated temperature and elevated pressure, freeing the cellulose fibers (pulp). Following digestion, the resulting black liquor, which contains dissolved organic substances, is separated from the pulp, called brown stock. The brown stock is treated with oxygen in the presence of sodium hydroxide to remove some of the residual lignin in a process referred to as oxygen delignification. The brown stock is then bleached, as described below, to achieve desired brightness, strength, and purity of the final pulp product. |
| Bleaching | Bleaching is any process that chemically alters pulp to increase its brightness. Bleached pulps create papers that are whiter, brighter, softer, and more absorbent than unbleached pulps. Bleached pulps are used for products where high purity is required and yellowing is not desired (e.g. printing and writing papers). Unbleached pulp is typically used to produce boxboard, linerboard, and grocery bags. |

| | |
|---|---|
| Papermaking | After pulping (and bleaching, if applicable), the finished pulp is processed into the stock used for paper manufacture. Market pulp, which is to be shipped offsite to paper or paperboard mills, is simply dried and baled during this step. Processing of pulp in integrated mills includes pulp blending specific to the desired paper product desired, dispersion in water, beating and<br>Refining to add density and strength, and addition of any necessary wet additives. Wet additives are used to create. |

## J. ESRM Guidance Note for Steel Re-rolling Sector

### 1. Introduction

The objective of this Guidance Note on ESRM for the Steel Re-rolling Sector is to provide a high level indicative summary of summary of potential environmental and social (E&S) risks and performance levels for transactions in the Steel Re-rolling sector in Bangladesh. The scope of application will be fully aligned with the Section 4 of this policy. At all times, applicable national regulations are to be followed. Where national regulations differ from the levels and measures presented in this Guidance Note, loan proposals are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in this Guidance Note are appropriate, in view of specific loan proposal, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment. For the purposes of this Guidance Note, Steel re-rolling units activities include, but are not limited to: 1.Steel Melting Works (SMW), 2.Steel Re-rolling Mills (SRRM).

### 2. Industry Specific Impacts and Management

#### *2.1. Environmental Issues:*

- **Air emissions**

A steel re-rolling mill releases significant amount of particulates matter, sulphur dioxide, oxides of nitrogen, VOC and PAH, Fluorides, Chlorides, heavy metals, carbon monoxide and carbon dioxide to the air during operations.

**Table - Sources of Air Emissions and Mitigation Measures**

| Emissions | Sources | Mitigation Measures |
|---|---|---|
| Particulate matter (PM) | Sources include melting and refining activities (BF, BOF, EAF) and heating furnaces (depending of type of fuels used); mechanical actions (e.g. scarfing and grinding); and handling of materials (e.g. raw materials, additive, recycled and waste materials, and by-products). Additional sources of particulate matter (PM) emissions include coal storage, conveying, charging, coking, pushing, and quenching. | Use of primary controls for the flue gas of the BOF, including venturi scrubbers with or without complete combustion techniques Installation of secondary controls to capture off-gas escaping from the BOF process Encapsulation of metal pouring lines with fitted extractors in BOF Quick cooling of gas followed by bag filters in EAF. The bag filters can be primed with absorbents (e.g. lime or carbon) to further capture volatile impurities<br>Use of direct off-gas extraction and canopy hood enclosures and cleaning in EAF |
| VOC and PAH | Volatile organic compounds | Pre-treat mill scales through such |

| | | |
|---|---|---|
| | (VOC) and polynuclear aromatic hydrocarbons (PAH) may be emitted from various stages in steel manufacturing | practices as pressure washing to reduce oil content<br>☐ Optimize operation practices, particularly combustion and temperature controls<br>☐ Minimize oil input via dust and mill scale through use of —good housekeeping‖ techniques in the rolling mill<br>☐ Use of advanced emission collection and demisting systems (e.g. precoated bag filters)<br>☐ Recirculation of off-gas<br>☐ Treat the captured off-gas through post combustion, chemical scrubbing, or biofiltration |
| Carbon monoxide | ☐ Sources of carbon monoxide (CO) include waste gases from the BOF, BF and EAF. CO is generated from the oxidation of the graphite electrodes and the carbon from the metal bath during melting and refining phases in EAFs. | ☐ Full capture of off-gases BF and BOF<br>☐ Recycling gases containing CO<br>☐ Use of foamy slag practices in EAF process |
| Nitrogen oxides | ☐ Nitrogen oxides (NOX) emissions are caused by high furnace temperature and the oxidation of nitrogen. | ☐ Application of waste gas recirculation<br>☐ Use of oven batteries with multistage air supply systems<br>☐ Adoption of suppressed combustion in BOF |
| Sulphur Dioxides | ☐ The SO2 emission level in waste gases from reheating and annealing furnaces depends on the sulphur-content in the available fuel. | ☐ Selection of raw feedstocks with low sulphur content<br>☐ Minimizing the sulphur content of the fuel<br>☐ Addition of absorbents such as hydrated lime [Ca(OH)2], calcium oxide (CaO), or fly ashes with high CaO content injected into the exhaust gas outlet before filtration<br>☐ Installation of gas wet scrubbing systems in dedicated collecting and dedusting system |

| | | |
|---|---|---|
| Chlorides and Fluorides | - HF and HCl may arise from off gas in the EAF process, depending on the quality of the scrap charged. | - Use of dry dedusting or wet scrubbing techniques, which are also typically installed to control particulate matter and sulphur oxide emissions respectively<br>- Control the input of chlorine via raw materials through the materials selection process<br>- Avoid spraying with sea water |
| Heavy metals | - Heavy metals may be present in off gas fumes from thermal processes. The amount of metal emissions depends on the particular process type and on the composition of raw materials (iron ore and scrap). Particulates from BF, BOF, and EAF may contain zinc (which has the highest emission factor in EAFs, particularly if galvanized steel scrap is used); cadmium; lead; nickel; mercury; manganese; and chromium | - Metal particulate emissions should be controlled with high-efficiency dust abatement techniques applied to particulate emissions control as discussed above.<br>- Gaseous metal emissions are typically controlled through the cooling of gases followed by bag filters |

| | | |
|---|---|---|
| Dioxins and Furans | Olychlorinated dibenzodioxin and dibenzofuran (dioxins and furans or PCDD/F) emissions. PCDD/F may be produced if chloride ions, chlorinated compounds, organic carbon, catalysts, oxygen, and certain temperature levels exist simultaneously in the metallurgical process. Another potential PCDD/F emissions source is off-gas in the EAF. The potential presence of polychlorinated biphenyls (PCB), PVC, and other organics in the scrap input (shredded scrap mainly obtained from old equipment) may be a source of concern, due to its high potential for PCDD/F formation. | Use of clean scrap for melting<br>Use of post combustion of the EAF off gas to achieve temperatures above 1200°C, and maximizing residence time at this temperature. The process is completed with a rapid quenching to minimize time in the dioxin reformation temperature range Use of oxygen injection to ensure complete combustion<br>Injection of additive powders (e.g. activated carbons) into the gas stream to adsorb dioxins before the dust removal by filtration (with subsequent treatment as a hazardous waste)<br>Installation of fabric filters with catalytic oxidation systems |

- **Wastewater**

Effluent streams normally present in the sector include cooling water, stormwater, rinse water, and several different process effluent streams. Process effluents are mainly generated from blow down from cooling system, degassing process, gas scrubbers, descaling etc. which mainly contains, pH, TDS, SS, oil & grease etc. From pickling and cleaning, major sources of wastewater effluents are the acid pickling rinse water and acid fume scrubber, acid regeneration plant scrubber, and alkaline cleaning. The largest volume of wastewater derives from rinsing, whereas the most significant contamination load comes from the continuous or batch exchange of pickle baths. The wastewater effluents contain suspended solids, oil and grease, metals and acids. Recommended techniques to prevent effluent from pickling plants include the following:

- Install acid recovery and recycling unit;
- Reduce effluent volume and minimize contaminant loading of the waste streams through optimization of the pickling process;
- Apply counter flow cascading and, in some cases, recycling of acid-pickling rinse water discharges to the acid regeneration plant.

In the rolling process, effluent from scale removal contains suspended solids and emulsified oil, in addition to coarse scale. Treatment of effluent includes a sedimentation basin in which solids, mainly iron oxides, are allowed to settle at the bottom of the basin and the oil pollutants on the surface are removed by means of skimmers and discharged to collecting basins. Cooling water from rolling processes should be collected and treated prior to reuse. Other techniques for treating industrial process wastewater in this sector include source segregation and pre-treatment of wastewater streams for (i) reduction in ammonia using air stripping, (ii) reduction in toxic organics, such as phenols using biological treatment and (iii) reduction in heavy metals using chemical precipitation, coagulation and flocculation, etc. Typical wastewater treatment steps include oil water separators or dissolved air floatation for separation of oils and floatable solids; filtration for separation of filterable solids; flow and load equalization; sedimentation for suspended solids reduction using clarifiers; dewatering and disposal of residuals in designated hazardous waste landfills. Additional engineering controls may be required for (i) advanced metals removal using membrane filtration or other physical/chemical treatment technologies, (ii) removal of recalcitrant organics using activated carbon or advanced chemical oxidation, and (iv) reduction in effluent toxicity using appropriate technology (such as reverse osmosis, ion exchange, activated carbon, etc.). Wastewater treatment methods typically include coagulation / flocculation / precipitation using lime or sodium hydroxide; pH correction / neutralization; sedimentation / filtration / flotation and oil separation; and activated carbons. Cooling water is normally recycled within the process. Rinse water may contain suspended solids, dust, lubricating oil, and other pollutants depending on the process. Contaminated streams should be routed to the treatment system for industrial process wastewater. Contaminated stormwater may result from coal, coke and other material storage areas. Soil surrounding outdoor coal storage areas may be impacted by highly acidic leachate containing polycyclic aromatic hydrocarbons (PAHs) and heavy metals. Industry-specific recommendations include:

- Store scrap and other materials, (e.g. coke and coal) under cover and / or in bunded area to limit contamination of stormwater and collect drainage
- Pave process areas, segregate contaminated and non-contaminated stormwater, and implement spill control plans. Route stormwater from process areas into the wastewater treatment unit
- Design leachate collection system and location of coal storage facilities to prevent impacts to soil and water resources. Coal stockpile areas should be paved to segregate potentially contaminated stormwater for pre-treatment and treatment in the wastewater treatment unit

- **Solid waste**

Solid wastes from this industry primarily include slag. Other solid wastes include sludge from effluent treatment and dust from dry dust collectors. Dust may contain dioxins and furans due to largely external (dirty) scrap consumption. The steel skulls are usually recycled, and other solid wastes are recycled, when appropriate, or disposed of in a landfill site. Slag residues may be sold as by-products (e.g. slag from BF or from BOF for use in civil engineering, road construction, and in the cement industry). EAFs produce a significant amount of slag. Where reuse of EAF slag is not financially or technically feasible, it should be disposed of, along with the dust from the treatment of off-gas, in a landfill designed with consideration of slag and dust characteristics. Local geological conditions also should be considered when locating slag heaps. Pickling acid regeneration sludge can be recycled in steel plants (EAF and blast furnace) or processed for the production of iron oxides. The iron oxide from hydrochloride acid regeneration can be used in several industries as a high quality input (e.g. production of ferromagnetic materials, iron powder, or construction material, pigments, glass and ceramics).Metallic waste and by-products from rolling and finishing operations (*e.g.* scarfing scale, dusts from scarfing, rolling mill scale, water treatment and mill scale sludge, grinding sludge, and oil/greases) should be reused in the process. Some byproducts (*e.g* oily mill scale and grinding sludge from water treatment plants), should be conditioned before internal recycling, such as reduction of oil content and depending on process requirements. Sludge from wastewater treatment may contain heavy metals (*e.g* chromium, lead, zinc, and nickel) and oil and grease. Part of the sludge from wastewater treatment may be internally recycled or else deposited in special landfills. Sludge reuse may require a pretreatment stage, which typically consists of pressing, drying, and granulation.

- **Noise**

Steel Mills generate noise from various sources including scrap and product handling; waste or byproduct gas fans; process cooling and draft fans; rotating equipment in general; dedusting systems; furnace charging; EAF melting processes; fuel burners; cutting activities; wire rod pay-off units; and transport and ventilation systems. Recommended techniques to reduce, prevent, and control noise include the following:

- Enclose the process buildings and / or insulate structures
- Cover and enclose scrap and plate / slab storage and handling areas
- Enclose fans, insulate ventilation pipes, and use dampers
- Adopt foaming slag practice in EAFs
- Limitation of scrap handling and transport during night time, where required

## 2.2. Health and Safety Issues

Occupational health and safety issues during the construction, operation, maintenance, and decommissioning of Steel re-rolling mills include physical hazards, heat, radiation, dust, chemical hazards, electrical hazards, noise, entrapment hazards, moving equipment, suspended loads, working at heights fire and explosions.

**Table - Common Structural, Fire & Electrical Safety Issues in Bangladesh**

| Area | Issues commonly observed | Prevention and Mitigation Measures |
|---|---|---|
| Structural | Highly stressed columns; undocumented vertical extensions; localised areas of high loads in buildings; discrepancy between structural drawing and built structure; minor to major cracks in structural elements. | - Compliance to regulatory requirements including the Bangladesh National Building Code (BNBC) (2015) or international codes, such as those compiled by the International Code Council (ICC), (2006).<br>- Undertake periodic structural safety audits by accredited agencies. |
| Fire | Inadequate, untested fire alarms; inadequate exit capacity compared to the occupancy load; lack of exit signage. | - Compliance with the by-laws of the Fire Regulation (2014), part of the Bangladesh Labor (Amendment) Act (2013), which includes requirements regarding the formation of a safety committees, and other measures such as emergency exits, access to stairs, and provision of personal protective equipment (PPE).<br>- Provisions for fire hydrants as per the requirements of BNBC (2015) and by Fire Regulation 2014, including water supply specifications according to the building size / hazard.<br>- Undertake regular fire audits by accredited agencies, with mock drills to be conducted on a periodic basis as per the fire hazard assessment of the facility. |
| Electrical | Unsealed entry and exit points for electrical cable; excessive dust deposit on cables; cables laid on floor without guarding/protection; oil leaks in generator room; inadequate cable grounding. | - Undertake electrical safety assessment on a periodic basis, and ensure workers are trained and provided with appropriate PPE based on the risk assessment. |

**Table - Common Occupational Health Issues**

| Hazard | Description | Mitigation Measures |
|---|---|---|

| | | |
|---|---|---|
| Physical | Handling of large and heavy raw materials and product, heavy mechanical transport, grinding and cutting activities, rolling processes and work at heights<br>High temperatures can cause fatigue and dehydration<br>Handling of liquid metal may result in explosions causing melt run out and | • Clear signage in all transport corridors and working areas<br>• Appropriate design and layout of facilities to avoid crossover of different activities and flow of processes<br>• Implementation of specific load handling and lifting procedures, including:<br>• Description of load to be lifted (dimensions, weight, position of centre |
| | burns<br>Noise pollution from blower plants, oxygen plants, gas-discharge blowers and high-power electric furnaces | of gravity), specifications of the lifting crane to be used (maximum lifted load, dimensions);<br>• Train staff in the handling of lifting equipment and driving mechanical transport devices; etc<br>• The area of operation of fixed handling equipment (e.g. cranes, elevated platforms) should not cross above worker and preassembly areas;<br>• Material and product handling should remain within restricted zones under supervision;<br>• Regular maintenance and repair of lifting, electrical, and transport equipment should be conducted<br>• Shield surfaces where close contact with hot equipment or splashing from hot materials is expected<br>• Implement safety buffer zones to separate areas where hot materials and items are handled or temporarily stored □ Wherever possible, sources of noise should be isolated<br>• Hearing protectors (earmuffs or earplugs) should be provided in high noise areas<br>• Reducing exposure time may also prove effective |

| | | |
|---|---|---|
| Chemical | Workers may be exposed to iron oxide and silica dust that can be contaminated with heavy metals such as chromium (Cr), nickel (Ni), lead (Pb)<br>Workers may be exposed to gas inhalation hazards, which may contain heavy metals. Further inhalation hazards include sulfur oxides and Volatile Organic Compounds (VOC) and polycyclic aromatic hydrocarbons (PAH). | • Sources of dust and gases should be separated and enclosed;<br>• Design natural ventilation system in hot shops to maximize air circulation.<br>• Exhaust ventilation should be installed at the significant point sources of dust and gas emissions, particularly the Induction Furnace (IF), Electric Arc Furnace (EAF), continuous casting etc.<br>• Provide a sealed cabin with filtered air conditioning if an operator is needed in a contaminated area;<br>• Use of filter respirators when exposed to heavy dust;<br>• For light, metallic dust and gases, fresh- |
| | | air supplied respirators should be used.<br> Alternatively, a complete facial gas mask (or an —overpressure‖ helmet) may be used, equipped with electrical ventilation  For carbon monoxide (CO) exposure, detection equipment should be installed to alert control rooms and local personnel. In case of emergency intervention in areas with high levels of CO, workers should be provided with portable CO detectors, and fresh-air supplied respirators |

## 2.3. Community Health & Safety Issues

The common health and safety impacts on the community during the construction, operation, and decommissioning of steel re-rolling facilities are:

- Noise, vibration, dust creation, traffic movement, road safety, emissions and air quality, fire, explosion & toxic hazards due to accidental release of molten steel and chemicals, waste water discharge and water quality, disposal of solid waste
- Strain on transport networks and local infrastructure - disruption to road users both pedestrian and other vehicles

## 2.4. Social Issues

This section will be same as described in the corresponding section of _Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector'

## 3. Performance Indicators and Monitoring

**5.1.1.1.1.3 3.1. Wastewater discharge quality standards**

| Pollutants | Unit | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *National Standards** |

| | | | |
|---|---|---|---|
| pH | -- | 6 – 9 | 6 - 9 |
| BOD | mg/L | - | 50 - 100 |
| COD | mg/L | 250 | 200 - 400 |
| TSS | mg/L | 35 | 150 - 200 |
| Oil and Grease | mg/L | 10 | 10 |
| Cadmium | mg/L | 0.01 | 0.05 – 0.5 |
| Chromium (total) | mg/L | 0.5 | 0.5 - 1 |
| Chromium (hexavalent) | mg/L | 0.1 | 0.1 - 1 |
| Copper | mg/L | 0.5 | 0.5 - 3 |
| Lead | mg/L | 0.2 | NA |
| TIn | mg/L | 2 | NA |
| Mercury | mg/L | 0.01 | NA |
| Nickel | mg/L | 0.5 | 1 |
| Zinc | mg/L | 2 | 5 |
| Cyanides (Free) | mg/L | 0.1 | NA |
| Cyanides (Total) | mg/L | 0.5 | NA |
| Total Nitrogen | mg/L | 30 | NA |
| Total Phosphorus | mg/L | 2 | NA |
| Phenol | mg/L | 0.5 | 1 |
| Flouride | mg/L (as F) | 5 | NA |
| Sulfide | mg/L | 0.1 | 1 - 2 |
| Ammonia | mg/L (as N) | 5 | 5 |
| Iron | mg/L | 5 | NA |
| PAH | mg/L | 0.05 | NA |
| Toxicity | To be determined on a case basis | | |

** The National Standards are not specific to steel re-rolling sector and is applicable for all the industrial units. The national standards are defined as per the location of disposal – inland surface water; public sewer; irrigated land. For ease of comparison, here the national standards are given as range and not as per the location of disposal.*

**3.2. Point Emission Sources**

| Pollutants | Unit | Guideline Values | |
|---|---|---|---|
| | | *GIIP* | *National Standards** |
| Particulate Matter | $mg/Nm^3$ | 20-50 (a) | NA |
| Oil Mist | $mg/Nm^3$ | 15 | NA |
| NOx | $mg/Nm^3$ | 500 | NA |
| SO2 | $mg/Nm^3$ | 500 | NA |
| VOC | $mg/Nm^3$ | 20 | NA |

| | | | |
|---|---|---|---|
| PCDD/F | ng TEQ/ Nm3 | 0.1 | NA |
| Carbon Monoxide (CO) | mg/Nm$^3$ | 100 (EAF) | NA |
| Chromium (Cr) | mg/Nm$^3$ | 4 | NA |
| Cadmium (Cd) | mg/Nm$^3$ | 0.2 | NA |
| Lead (Pb) | mg/Nm$^3$ | 2 | 10 |
| Nickel (Ni) | mg/Nm$^3$ | 2 | NA |
| Hydrogen Chloride (HCl) | mg/Nm$^3$ | 10 | 350 |
| Fluoride | mg/Nm$^3$ | 5 | NA |
| Hydrogen Fluoride (HF) | mg/Nm$^3$ | 10 | NA |
| $H_2S$ | mg/Nm$^3$ | 5 | NA |
| Ammonia | mg/Nm$^3$ | 30 | NA |
| Benzo(a)pirene | mg/Nm$^3$ | 0.1 | NA |
| Tar fume (b) | mg/Nm$^3$ | 5 | NA |

** The National Standards are not specific to steel re-rolling sector and is applicable for all the industrial units. The national standards are defined as per the categories of areal – industrial and mixed; commercial and mixed; residential and rural; sensitive. For ease of comparison, here the national standards are given as range and not as per the location of disposal.*

### 3.3. Resource and energy consumption standards

| **Inputs per unit of Product** | **Unit** | **uideline Values** | | | | |
|---|---|---|---|---|---|---|
| | | | **G** | **IP** | | **National Standards** |
| | | BF | BOF | EAF | Rolling | |
| Electricity, | MJ/t | 270-370 | 40-120 | 1250-1800 | 70-140 | No national |
| direct | product | | | | kWh/t | standards |
| Fuel | MJ/t product | 1050-2700 | 20-55 | - | 1100-2200 | |
| Water | m$^3$/t product | 1-50 | 0.5-5 | 3 | 1-15 | |

### 3.4. Social standards

This section will be same as described in the corresponding section of _Guidance Note on Environmental & Social Risk Management (ESRM) for Textile and Apparel Sector'.

### 4. General Description of Industry Activities

| **Sector Activity** | **Sub-sector Activities** |
|---|---|

| | |
|---|---|
| Steel Melting Works (SMW) | In the first part, SMW uses scraps to produce MS Billets/ slabs/ blooms/ ingots/slabs. Scrap is directly charged into Induction Furnace (IF) or Electrical Arc Furnace (EAF) for melting. Sponge iron may also be added along with scrap as it does not contain any impurities, melts quicker and it is easier to control the chemistry of melt. Sizing of scrap before charging into furnace is important to maximize bucket density, better capacity utilization and minimizing energy losses. Flux (lime or dolo lime) can also be added along with the scrap for refining which result in slag formation. |
| Steel Re-Rolling Mills (SRRM) | Semi-finished products are first heated in a re-heat furnace until they are red hot (around 1200o C). On all types of mill the semi-finished products go first to a roughing stand. A stand is a collection of steel rolls (or drums) on which pressure can be applied to squeeze the hot steel passing through them, and arranged so as to form the steel into the required shape. The roughing stand is the first part of the rolling mill. The large semi-finished product is often passed backwards and forwards through it several times. Each pass gradually changes the shape and dimension of the steel closer to that of the required finished product. |