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དཔལ་ལྡན་འབྲུག་གཞུང་།
National Environment Commission
Royal Government of Bhutan

NECS/EACD/Notification/2021/ 1391 **August 13, 2021**

To,
Refer distribution list

Subject: Practical Guide for preparation of Environment Assessment studies for Ferro Silicon and alike Industries

Dasho/Sir/Madam,

The National Environment Commission Secretariat (NECS) is pleased to share the 'Practical Guide: For preparation of Environment Assessment studies for Ferro Silicon (FeSi) and alike Industries, 2021', which is developed in accordance with Section 41 (a) and (d) of the National Environment Protection Act, 2007.

The guide will essentially assist the project proponents in preparing the Environment Assessment (EA) studies and reporting to NECS in the event of mechanical and technical breakdowns requiring maintenance.

The NECS would like to extend our sincere appreciation to all FeSi Industries and CAs for the unwavering support and invaluable feedback received during the formulation of this guide.

Sincerely,

(Sonam P Wangdi)
SECRETARY

NATIONAL ENVIRONMENT COMMISSION * THIMPHU : BHUTAN *

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PRACTICAL GUIDE

For preparation of Environment Assessment studies for Ferro Silicon and alike Industries

National Environment Commission

August 2021

PRACTICAL GUIDE:

For preparation of Environment Assessment studies for Ferro Silicon and alike Industries

Background

The Ferro silicon and alike industries are listed under the 'Red category project' and require Environmental Assessment (EA) in accordance with the Environmental Assessment Act 2000 and its Regulation 2016. However, EA entails detailed study and information as a result of which the applicants are most often unable to fulfill the studies.

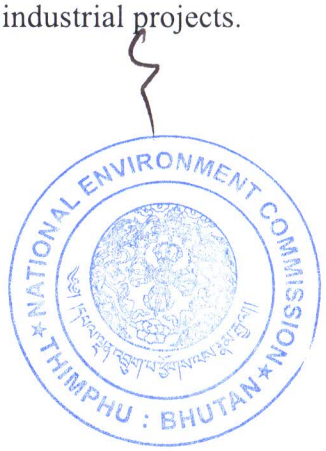
Purpose of this practical guide

The aim of this guide is to firstly provide practical help to the project proponents for the preparation of EA studies for ferro silicon and alike industries in order to ensure that the EA report prepared is of better quality and preferably complete at one attempt. This, in turn, will entail less requirement of seeking additional clarification and thus faster service delivery. Furthermore, the guide will also assist the existing industries to report to NECS for approval as and when there are mechanical and technical glitches.

Structure of the guide

The structure of the guide is aligned with the Environmental Assessment (EA) Form for Red Category Projects 2020-Industrial Projects and predominantly focuses, but not limited to, on the technical details of the form.

This guide is applicable for Ferro Silicon and alike industries proposed within an earmarked industrial estate (IE). However, if the industry is proposed outside the IE, information on baseline data, water requirement, ancillary facilities and others will be required depending on the project location and as required by the EA form for red category projects - industrial projects.



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List of acronyms

CEMS - Continuous Emissions Monitoring System

CO - Carbon Monoxide

ES - Environmental Standards

ETP - Effluent Treatment Plant

KLD - Kiloliters per Day

LAMC - Low Ash Metallurgical Coke

NOx - Nitrogen oxides

PAH - Polycyclic Aromatic Hydrocarbons

PCD - Pollution control device

RPC - Raw Petroleum Coke

SEZ - Special Economic Zone

SPM - Suspended Particulate Matter

SO2 - Sulphur dioxide

TPA - Tonnes Per Annum

TPH - Tonnes Per Hour

VOCs - Volatile Organic Compounds

1. Project background and location

- Provide information on project background, location, cost, area, and applicant's details in line with the Section 1, 2 and 3 of the EA form

2. Raw materials, handling, storage, and transfer

2.1 *Raw material consumption and its source*

2.1.1 List all primary raw materials including its annual consumption (TPA) and their sources:

- Ores (Quartz/Quartzite, etc.)
- Reductants (LAMC, charcoal, semi-coke, RPC, etc.)
- Iron additions (mill scale, etc.)
- Fluxes (Limestone, dolomite, wood chips, bamboo chips, etc.)

2.1.2 Provide elemental composition of reductants (moisture content, ash content, volatile matter, fixed carbon, and total sulphur).

2.1.3 Provide information on other raw materials:

- Source of water, quantity of water to be consumed and quantity recycled/reused in KLD, and water balance covering water use for raw material, process (cooling/boiler), domestic (drinking and sanitation), etc.
- Source of energy and its requirements in appropriate units.

2.2 Handling, storage, and transfer of primary raw materials to the production unit

- Provide information on requirements for drying, washing, crushing, pelletizing/sintering, dosing station, and preheating as appropriate.
- Provide the type of storage yard for the raw materials (open/semi-closed).

  (Note:*Storage for fine materials should be enclosed. However, granular materials (quartz/quartzite, wood chips, bamboo chips, etc.) may be stored in open stockpiles but with adequate measures to address fugitive emissions*)

- Provide information on raw material feeding/conveyance/transfer system. Type of conveyor systems should be enclosed. However, if open conveyor systems are proposed, adequate measures including but not limited to water spraying/misting systems and extraction and filtration at delivery points/transfer points/material dropping points should be submitted.
- Ensure that the incoming trucks with raw materials consignment are fully covered.

3. Furnace and smelting operation

3.1 *Furnace and related aspects*

- Specify the type of furnace for bulk ferroalloys (electric arc furnace, submerged arc furnace, blast furnace, coke oven, etc.) and special ferroalloys (induction furnace, vacuum induction furnace, multiple hearth furnaces, etc.), numbers of furnaces, capacity of each

furnace, manufacturer details along with brochures from the company and justification for selecting the technology.

3.2 Furnace commissioning, startup, and maintenance

3.2.1Commissioning of new furnace/Plant

- Provide duration required for initial startup and commissioning of furnace and Plant starting from preheating, charging the furnace with feed till smelting operation including justification (N*ote: Maximum days to commission the new furnace, and stabilize and synchronize the whole production system is 1 month*)

- Specify the furnace load of both star and delta mode required to transition from preheating to production (Note*: If the PCD cannot be operated during the transition phase, the furnace load should be 45% or below of the installed capacity)*

3.2.2 Major furnace maintenance

- Provide a plan for routine maintenance of furnace in a year and the duration required for startup after furnace shutdowns starting from preheating, charging the furnace with feed till smelting operation. (Note*: Preheating requires maximum 20days to transition from star to delta mode of operation with gradual increase in charge feed. If the PCD cannot be operated during the transition phase, the furnace load should be 45% or below of the installed capacity*).

3.2.3 Minor furnace maintenance

- Provide a plan for furnace maintenance during operation such as transformer tripping, water leakages, etc. (Note*:PCD is usually kept operational for minor maintenance requiring duration 1-4 hours. For maintenance requiring more than 4 hours, PCD is usually switched off. The furnace load should be 45% or below of the installed capacity to transition from star to delta mode)*

3.3 Stoking

- Specify the method of stoking, frequency of stoking per day on average, and duration of each stoking (Note: *Ensure that the hydraulically operated doors are closed after stoking to prevent fugitive emission from the furnace*)

4. Tapping system

- Specify the type of tapping system (ladle/runner, etc.), number of tap holes, tapping frequency per day and tapping time/duration every cycle, and manner of opening the tap holes (oxygen lancing, tapping gun, etc.)
- Provide the dimensions of the tapping fume suction hoods along with information on design/technology and suction capacityfor maximum capture of fumes. If the manner of tapping is the runner system, an enclosed runner equipped with suction hoods is required.

5. Downstream processing

5.1. Refining & Casting

- Provide information on the method of refining (for example, ladle refining by injecting gas into the ladle to adjust the chemical composition of the product), if required.
- Provide information on the method of casting the product into molds/beds.

5.2. Crushing and resizing

- Provide information on methods of crushing and resizing (manually or using a crusher) including the installed capacity of the crusher in TPH and mechanisms to arrest dust/suppress dust, if required.

6. Environmental issues of furnace operation

6.1. Point source emission (particulate and gaseous emissions)

- Provide sources of off-gases/flue gases/emissions (furnace, smelting process and tapping) and their contribution to the total emissions.
- Provide the temperature, composition of the off-gases/flue gases/emissions (SO2, NOx, CO, PAH, organic pollutants, and VOCs) and volumetric flow rate (m^3/hr) of the off-gases/flue gases before passing it to the duct.

6.2. Fugitive/diffuse emission

- Provide sources of fugitive dust emission (from sources such as raw material handling and storage, raw material transfer to the production unit, casting, crushing, screening, packaging, micro silica collection and handling unit, vehicular movement, etc.)

6.3 By-products and other wastes

6.3.1 List all the by-products (micro silica dusts, slag, off-grade ferro silicon, charcoal fines, quartz/quartzite chips, gangue,etc.) that will be generated along with its quantity in TPA.

6.3.2 List other wastes along with its quantity (in appropriate units):

- **Construction phase:** Provide list of wastes such as, but not limited to, excavated materials, domestic wastes and other construction related wastes.
- **Operation phase:** Provide lists of wastes with quantity/annum such as, but not limited to, electrode pastes, used refractory lining, damaged filter bags, damaged packaging/gunny bags, cyclone dusts, domestic wastes, etc.

6.4 Heat emission/loss/recovery

- Is there any potential for heat/energy recovery? If yes, provide an explanation/description on the mechanism of the heat/energy recovery system (Note*: For detailed guidance, refer to the report on 'Energy efficiency improvements - training and joint assessment studies* (Bhutan)' prepared by The Energy and Resources Institute (TERI), 2016)

6.5 Pollution control device

- Specify and describe the intermediary steps/components such as cooling, heat exchanger, spark arrestors, etc. before the off gases/flue gases enter the PCD.

6.5.1 Control for point source emission (Particulate emissions)

- Specify the type of PCD for particulate emissions (SPM).
- Specify duration (in months) required for the installation of the PCD.

Note: Following are the many pollution control devices which could be selected, however with the advancement in science and technology, better and improved devices could also be opted. If other devices other than the listed below are selected, information for the device should be submitted in the same format as below, as relevant:

a. **Electrostatic precipitator**: Information on the type (wet/dry/semi-dry), justification for selection of the technology with brochures, suppliers/manufacturers details, mechanism of cleaning and schematic diagram should be submitted.

b. **Cyclone separator**: Information on the type (reverse/uniflow, etc.), justification for selection of the technology with brochures, suppliers/manufacturers details, mechanism of cleaning and schematic diagram should be submitted.

c. **Bag house**: Information on the type of bag house (pulse jet/reverse air, etc.), justification for selection of the bag house along with brochures, number of bag houses to be installed, number of chambers in each bag house, filter bags per chamber, cloth material of the filter bags, air to cloth ratio ($Nm^3/m^2/hr$), filtration area of the filter bags (m^2), temperature (°C) and pressure (mmWC) that the filter bags can withstand/ resist, number of ID fans, inlet and outlet pressure (mmWC) of the ID fan, fan speed of the ID fan (RPM), mechanism of cleaning and schematic diagram/layout should be submitted.

6.5.2. Control for point source emission (SO2, NOx, CO)

- Specify the type of pollution control device for gaseous emission.
- Specify duration (in months) required for the installation of the PCD.

Following are the many pollution control devices which could be selected, however with the advancement in science and technology, better and improved devices could also be opted. If other devices other than the listed below are selected, information for the device should be submitted in the same format as below, as relevant:

a. **Wet Scrubbing System**: Information on type of wet scrubber (jet/rotation/venturi/dry tower/spray/packed tower), type of scrubbing solution (water/caustic soda solution/milk of lime solution/sodium carbonate/calcium hydroxide, etc.) and quantity (m^3/annum) to be used, mechanism of cleaning, quantity (m^3/annum) and management plan for the effluent generated, quantity (m^3/annum) and management plan for the slurry generated along with its schematic diagram should be submitted.

   If a wet scrubber is installed, provide an effluent discharge parameter (mg/l) of the treated effluent in line with the Industrial Effluent Discharge Standards of the ES 2020. The applicant is also required to submit specifications, capacity, and working mechanism of the ETP including its layout.

b. **Dry Scrubbing System**: Information on the type of dry scrubber and type of reagent (sodium hydroxide/quicklime/hydrated lime/limestone powder/ sodium bicarbonate) and reagent quantity (m^3/annum) to be used, quantity (m^3/annum) of residues to be generated, management plan for the same including its schematic diagram should be submitted.

c. **Dry Lime Injection:** Information on the mechanism of cleaning and its schematic diagram should be provided. However, this system is applicable only if the sulphur content of the raw materials is higher than 0.5%.

- Majority of the existing industries are found to exceed the permissible limit of CO prescribed in the ES 2020. As it is scientifically established that high concentration of CO is correlated to incomplete combustion; measures to control CO emission could include information on, but not limited to, selection of electrode, selection of reductant and optimization of furnace operation/condition.

6.5.3 Control for tapping fumes

- Since a major source of off-gas/flue gas emission is from tapping, clarify if a dedicated PCD for tapping fumes is to be installed or if the main PCD will serve to control the tapping fumes. If yes, provide justification on how efficient it would be in capturing and cleaning the fumes.

6.5.4 Details of stack

- Provide stack details such as number of stacks to be installed, its height (meters - ideally stack height is preferred at a minimum distance of 30 meters above the ground for proper dispersion), its diameter (millimeter), height (meters) of the sampling port from ground, dimensions of the sampling platform (appropriate unit) and provision of access facilities such as ladder, railings, etc.

- Provide information on bypass stack at the furnace top along with justification, if required.
- Provide the expected emission parameters/pollution concentration (mg/Nm^3) at the stack exit in line with Industry Emission Standards of the ES 2020.
- Provide the parameters of treated off-gas/flue gas such as temperature (°C), pressure (mmWC), volumetric flow (m^3/hr).

6.5.5 PCD maintenance issues

- Provide a plan for routine maintenance of pollution control device and its components; and time required to restore/repair the device to full operation *(*Note*: If the PCD maintenance and mechanical issues require switching off the PCD, the furnace load should be 45% or below of the installed capacity until the problem is rectified)*
- In case a bag house is installed, provision for compartmentalizing the baghouse chambers to ensure its continuous operation during maintenance/bags replacement should be provided. If this provision does not fit the operating procedure of the plant, additional information on measures to ensure continuous operation of the bag house during its maintenance should be provided.

6.6 Control for fugitive emissions

- Provide information on measures (water sprinkler/manual/concreting plant premise) and frequency of dust suppression per day to minimize fugitive emission.
- Clarify if there will be provision for machinery such as mechanical sweeper to remove dirt and debris within the plant premise. (Note*: This is optional, and the plant can resort to manual sweeping which is the common practice in all the existing plants*).

6.7 Management of by-products and other wastes

6.7.1 Construction phase:

- Provide management plans to manage wastes generated during the construction phase as listed under section 6.3 of the practical guidance.

6.7.2 Operation phase:

- Provide management plan for wastes such as cyclone dusts, un-densified micro silica dusts,raw material fines, damaged filter bags, damaged furnace lining, damaged electrode paste, packaging wastes, metal scraps, used chemicals, domestic wastes, etc. (Note*: The management plan should specify the provisions for handling and storage including transfer mechanism of these wastes to the disposal site, and the identified disposal site for the wastes. However, should these wastes be reused/recycled/sold, the management plan should indicate the method of reusing/recycling of wastes, and the market for selling these wastes*).
- In order to manage the micro silica dust (applicable for baghouse), provide information on provision for a densification unit or silo. Further, provide information on micro silica dust transfer mechanism from baghouse to densification unit/silo, capacity of the densification unit/silo, provision for enclosures around the densification unit/silo

collection area, and type of micro silica dust packaging system (manual/auto) to ensure minimal generation of emissions from the densification unit/silo.

7. Others

7.1 Housekeeping

- Provide a management plan to maintain proper housekeeping during construction and operation of the plant.

7.2 Buffer stock

- Provide information on the provision to be kept for stand-by ID fans, buffer stock of filter bags, accessories of pollution control devices, and other spare parts and accessories of the industrial plant to ensure mechanical/technical problems are rectified immediately during operation of the plant.

7.3 Self-monitoring requirements

- Every industry is required to have a dedicated environmental focal person or an environment unit to carry out self-monitoring.
- Provide information on the CEMS to be installed along with the brochures from the manufacturer. The CEMS should cover the parameters listed in the Industry Emission Standards of the ES 2020.
- Provide a plan to fulfill self-monitoring and reporting requirements in line with the EC terms and conditions.

7.4 Layout plan

- Provide layout plan of the plant showing the raw materials storage yard, raw material feeding/conveyance/transfer unit, furnace, PCD and its components, by-products and wastes handling/storage area, administrative/office building, green space, internal roads, transportation route, and other infrastructures.
- The layout map/plan should also show utilities such as power supply (substation/transformer area), water supply, fuel station, weigh bridge, etc.
  (Note*: The layout plan should include dimensions of each component in relevant units and should be in readable print out format)*
- Provide the area allocated for each component of the plant. (For example: if the total plant area is 10 acres, then the raw material storage yard covers 2.5 acres, furnace area occupies 3 acres and so on).
  (Note*: The area allocated for each component can either be indicated in the layout plan or provided separately)*

7.5 Process flow and schematic diagram (in readable print out format)

- Provide description of the manufacturing process and process flow along with a schematic diagram. The process flow should indicate sequential flow starting from raw materials handling and feeding to production of final products including indication of

area/points where there will be emissions and discharges and generation of by-products and wastes. The process flow should also indicate stoichiometric reactions/mass balance with temperature change, if applicable. Provide a schematic diagram of the PCD covering all of its components such as fume extraction system (from furnace, tap holes, casting area), heat exchangers, primary cleaners, main PCD, stack, and ETP.

7.6 Green space

- Provide the total area for the green space/ area including the selection of the plant species. (Note: *A minimum of 10% of the total plant area should be kept as green space/area*)

7.7 Noise level and Workplace Emissions

- Provide maximum noise level at the project boundary in line with the Noise Level Limits of ES 2020. Provide management plan, should the noise level exceed the maximum permissible limit.
- Provide expected workplace emissions as per the Workplace Emission Standard of the ES 2020. Provide management plan, should the workplace emissions exceed the maximum permissible limit.

7.8. Product diversification

In case the existing plant intends to diversify the products, the following information should be provided:

- Information on the raw materials required for the production of the new proposed products.
- Whether there is an increase in the installed capacity.
- List of wastes that will be generated along with its quantity. In addition, provide the management plan for the wastes.
- The expected emission parameters/pollution concentration (mg/Nm^3) at the stack exit in line with Industry Emission Standards of the ES 2020.
- Justification that the existing furnace, PCD and other components will be adequate for the proposed products.