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Sectoral EIA Guidelines

Flue Gas Desulphurisation Projects applied to Large Combustion Plants

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Joint Assistance to Support Projects in European Regions

Name of Guideline:

Sectoral EIA Guidelines for Flue Gas Desulphurisation Projects applied to Large Combustion Plants

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Acronyms

BAT	Best Available Techniques
BREF	Reference documents on BAT
EIA	Environmental Impact Assessment
ELV	Emission Limit Values
FGD	Flue Gas Desulphurisation
GHG	Greenhouse gases
IED	Industrial Emission Directive
IPPC	Integrated Pollution Prevention and Control
LCP	Large Combustion Plant
LWD	Landfill of Waste Directive
MWEP	Ministry of Water and Environment Protection
NTR	Non-Technical Report
SNCR	Selective Non-Catalytic Reduction

Preface

This Guidance document is primarily aimed at the EIA practitioners in the Romanian environmental authorities and at consultants. It is also envisaged to be of interest for the other authorities that must be consulted with in accordance with legal provisions, for Non-Governmental Organizations as well as the public and should facilitate their enhanced participation in the EIA process. The contained recommendations will be of practical benefit to those involved in the EIA process for Flue Gas Desulphurisation Projects applied to Large Combustion Plants.

Note: This Guidance document does not attempt to reproduce the work of the statutory EIA Guidance documents that already exist in Romania and so should be read in conjunction with them.

1 BACKGROUND

1.1 INTRODUCTION

The overall objective of this Guidance document is to improve the content of the environmental reports carried out for projects prepared for EU funding in the energy sector that uses fossil fuels, specifically FGD capability retrofitting Large Combustion Plants and to ensure that those responsible for carrying out the assessment and preparing the report are fully aware of the key issues for the FGD and address these issues adequately.

Large Combustion Plants (LCPs) are defined in the Romanian legislation (HG nr.440/2010 on measures to LIMIT emissions of certain pollutants into the air from large combustion plants) as "burning thermal input power of which is equal to or greater than 50 MW, ..., regardless of the used fuel type respectively solid, liquid or gaseous". A LCP burns variuos types of fuels and contributes greatly to emissions of polluting substances (SO_2, NOx, dust, etc.) into the air resulting in a significant impact on human health and the environment. In this respect, achieving compliance for polluting substances emissions should be done through implementation of specific BATs.

Flue Gas Desulphurisation (FGD) is an SO_2 abatement technique for treatment of flue gas to remove sulphur dioxide (SO_2) formed during combustion of fossil fuels, to meet Emission Limit Values (ELV). Flue gas desulphurisation is recognised as the best practicable means for sulphur abatement systems. There are two basic SO_2 removal mechanisms: absorption into a liquid and adsorption onto a solid.

The efficiency of sulphur removal in a FGD installation could be characterized by the "**rate of desulphurisation**" that means the ratio over a given period of time of the quantity of sulphur which is not emitted into air by a combustion plant to the quantity of sulphur contained in the solid fuel which is introduced into the combustion plant facilities and which is used in the plant over the same period of time.

An Energy System that uses fossil fuels includes as main components: fuel processing, fuel combustion with energy recovery, abatement units (for NOx, dust, SO_2), stack for gas discharge. The SO_2 abatement technology (FGD) includes as main components:

- Sorbent/reagent preparation;
- Sorption/reaction inside scrubber;
- Sludge/residue processing, transport, storage, recovery or disposal;
- Water management and wastewater treatment (for wet FGD).

During the environmental impact assessment process all the above mentioned components have to be considered.

1.2 LEGISLATIVE CONTEXT

The present Guidance document is prepared, as comprised in the **Governmental Decision no. 445/2009** transposing **EIA Directive**, for the following type of projects:

- Thermal power stations and other combustion installations with a heat output of 300 megawatts or more (Annex I, item 2(a)
- Industrial installations for the production of electricity, steam and hot water (projects not included in Annex I) (Annex II, item 3(a));
- Any change or extension of projects listed in Annex I or Annex II, already authorized, executed or in the process of being executed, which may have significant adverse effects on the environment (Annex II, item 13).

The **Large Combustion Plant Directive (2001/80/EC)** sets ELVs for SO_2, NOx and dust for combustion plants (existing and new), the rated thermal input of which is equal to or greater than 50 MW, irrespective of the type of fuel used (solid, liquid or gaseous).

For compliance with existing European legislation concerning industrial emissions and Accession Treaty commitments, the minimum requirements of the LCP Directive have to be met. But meeting these requirements is not necessarily sufficient. to comply with the IPPC Directive on the use of BATs. Romania is committed to achieving significant reductions of emissions including SO_2. The main technique to reduce sulphur oxide emissions is flue-gas desulphurization and, in this respect existing coal based LCPs have to be retrofitted with FGD technology.

The Combustion installations with a rated thermal input exceeding 50 MW fall under the provisions of **Directive 2008/1/EC concerning integrated pollution prevention and control (IPPCD)**. The IPPC Directive’s goal is to provide an integrated approach to environment protection by improvement of management and control systems; this means that emissions into air, water and land, together with a range of other environmental impacts must be considered. Such an approach is supported by the adoption of appropriate preventive measures to protect the environment, in particular through the application of Best Available Techniques (BAT).

The proposed entry into force date of new Industrial Emission Directive is 1st January 2011. The directive will include issues relating to Large Combustion Plants (derogations, 20-50MW threshold, special rules for refineries, compliance). It will introduce stricter emission limit values than LCP Directive **aligning them with BAT emission levels from LCP BREF** (2006), values that have to be **achieved by enforcement of existing IPPC Directive** for IPPC installations, with some exceptions for those installations benefiting of transition periods..

Even if at the time of project drafting the new directive on industrial emissions is not in force, due to long period needed for development of FGD retrofitting project, we consider absolutely necessary that IED requirements must be taken into consideration from early stages of the project planning and design.

All FGD solutions must take into account the existing waste management legislation (for recovery or disposal of the FGD) as well as any relevant regional development plan.

1.3 MAIN PRINCIPLES

The governing principles in preparation of this Guidance document can be found in its specific purposes:

- to support the relevant environmental authorities when preparing the guideline regarding the information to be included in the report, so-called scoping report (in Romanian so-called “indrumar”);
- to support the final beneficiaries/project developers to draft the terms of reference for the external support (EIA Consultants in Romanian so-called “evaluatori de mediu”).

This guidance document comprises concise but tailored standardized recommendations regarding the content of the EIA reports and should be read in conjunction with National Romanian Guidance document and methodology for EIA;

The overall purpose of this guideline document is to ensure that those responsible for actually carrying out the assessment and preparing the report are fully aware of key issues for FGD retrofit and that all specific issues are addressed adequately. Furthermore, after compilation and the formal submission of the report, the guidance document should also be used by the relevant environmental authorities to review the quality of the information, in particular to ensure that none of the key issues have been overlooked.

The structure of the Guidance document follows, to a large extent, the requirements provided in Annex IV of the EIA Directive with respect to the information referred to in article 5 (1), i.e. the information which the developer has to supply to the competent authority or authorities for projects subjected to an environmental impact assessment.

These guidance document are not exhaustive. Thus, some issues common to all type of projects may not be mentioned or addressed.

The guidance document address all type of projects mentioned in section 1.3 in a unique document commenting on those issues which are specific to one or another type.

The order/ place of some subsections addressed in each of the following sections might be changed by the Reporter who also may introduce new subsections according to the specificity of each project with regard to its objectives, technical characteristics, location, natural and constructed environment and other elements.

In a large scale project many different experts are involved in different phases of the project development which require the study of various project related aspects. Without forgetting the analysis of environmental effects within the alternative selection phase and the assessment of impacts on the NATURA 2000 sites, important in case of LCP projects, in general, and FGD installations projects, in particular, are the studies on air and water quality, geology, flora and fauna, noise and vibrations, landscape or archeological heritage.

It is recommended that the separate reports and documents delivered as results of these analyses and studies to be easy readable and understandable in connection with other project related documents.

2 DESCRIPTION OF PROJECT

The purpose of this section is to highlight the main issues to be addressed for each of the sub-sections below when describing a project selected for FGD retrofit:

- **Sub-Section 2.1:** a description of the physical characteristics of the whole project and the land-use requirements during the construction and operational phases, including:
  - the retrofitting FGD;
  - the land-use requirements during the construction and operational phases including the demolition works;
- **Sub-section 2.2:** a description of the main characteristics of the FGD processes, for instance, nature of sorbent material, and by-products/residue processing;
- **Sub-section 2.3:** an outline of the main alternatives studied by the developer and an indication of the main reasons for this choice, taking into account the environmental effects.

A FGD process is a treatment that involves the addition of a specialized unit (sorption unit) and other secondary equipment/facilities having also important roles in the FGD installation. The FGD installation does not only reduce SO_2 from gaseous emissions, but generate other type of emissions. The EIA has to consider ALL installation components and ALL possible emissions other than flue gases.

The techniques that are considered to be BAT are mainly the **wet scrubber** (reduction rate 92 – 98 %), and the **spray dry scrubber** desulphurisation (reduction rate 85 – 92 %), which already have together a market share of more than 90 %. Dry FGD techniques such as dry sorbent injection are used mainly for plants with a thermal capacity of less than 300 MWth. The wet scrubber has the advantage of also reducing emissions of HCl, HF, dust and heavy metals. Because of the high costs, the wet scrubbing process is not considered as BAT for plants with a capacity of less than 100 MWth.

Only the two techniques that are considered as BAT (highlighted above) will be discussed in this document.

2.1 PHYSICAL CHARACTERISTICS OF THE PROJECT & LAND USE REQUIREMENTS

2.1.1 Description of Site Layout

The Reporter should consider the location of the planned FGD installation in relation to existing installations on the LCP site. The generated FGD by-products/residues will be temporarily stored and/or landfilled in proper facilities that will require extra land that has to be available.

When describing the LCP location and site the following shall be considered:

- location of the existing LCP (including existing ash disposal area): latitude, longitude, site elevation (map);
- location of the FGD installation inside the LCP site (describe by plant layout) mentioning if and what demolition works will be needed;
- *A retrofited LCP is currently on a large industrial site. A FGD installation itself does not involve usually negative impacts on any habitat. However, depending on necessity to develop an FGD by product disposal area/landfill, natural habitats could be disturbed.*

- location of temporary storage facility/landfill for FGD by-product/residues;
- existing geological barrier in the new landfill area; the outcomes of geotechnical study have to be presented;

Where the geological barrier does not naturally meet the conditions state by LWD/National legislation it can be completed artificially and reinforced by other means giving equivalent protection, BUT it should be no less than 0,5 metres thick. Also the materials that will be used for artificially established geological barrier have to be tested. The adopted solution has to eliminate risks of soil, surface water and groundwater contamination from leachates.

- location of any other new facility included by the retrofitting process (such as a new wastewater treatment plant);
- land surface area occupied by the FGD installation and by the temporary storage facility or landfill;
- distances from the boundary of the site to residential and recreation areas, waterways, water bodies and other agricultural or urban sites; distance to the available mineral resources in the region: clay, gravel and soil for the landfill construction
- risk of flooding (developers of landfills should ensure that the landfill is not located within the floodplain of rivers), subsidence, landslides or avalanches on the site;
- accessibility to and from FGD installation site for the construction stage;
- site topography and site specific information;
- meteorological factors;
- availability of appropriate materials (limestone, lime, etc) and transportation ways;
- consideration of potential current and future land use conflicts: e.g. in the case of a new landfill, the residential area development.

2.1.2 Description of Design including Size or Scale

The two main components of an FGD retrofitting project are the FGD installation itself and the landfill for the FGD by- product/residue generated in the desulphurization process. Even if the residue is recyclable (see below), a lower capacity landfill is still needed for low quality, non-recyclable by-product.

FGD installation description will include:

- FGD technology type (see **Error! Reference source not found.** below) and its capacity; FDG design has to be integrated in the exiting LCP
- Estimated FGD by-product or residue, composition and quantities;
- Auxiliary developments (waste processing installation, waste landfill, sorbent storage facilities, wastewater treatment plant, etc.) and their capacities and characteristics arising either directly or indirectly from the project operation.
- *For each auxiliary development there should be presented technical characteristics of each facility/ object/ works and the resources / quantities of necessary materials (aggregates and minerals, water, energy, including electricity and fuels, others).*

Box 1. General FGD classification

A FGD process is based on the contact of the flue gases with a sorbent/reagent that reacts or adsorbs the SO_2 and the other acid gases (SO_3, HCl, HF) that are present. The common flue-gas desulphurisation (FGD) technologies can be classified in:

- **Regenerative** – the spent sorbent is re-used after thermal or chemical treatment to produce concentrated SO_2 which is then usually converted to elemental sulphur. These are complex processes requiring high capital costs, as well as more energy to operate. This technology is not widely used in FGD primarily due to the costs and the very low commercial value of the sulphur

- **Non-regenerative** - the sorbent is not re-used. These are the leading FGD technologies. The sorbent/reagent can be in a
  - "wet" form (as suspension or solution; flue gas is saturated with water),
  - "semi-dry" (controlled humidification, wet sorbent become solid during the SO_2 sorption process);
  - "dry" (no water used; zero humidification).

Wet non-regenerative processes use as sorbent/reagents limestone, lime, magnesium hydroxide, ammonia, sea water. The wet limestone scrubbers are the most widely used of all the FGD systems.

New landfill for FGD residue/by-product

The landfilling of the FGD by-product can only be considered once all other alternatives have been explored (refer to section 2.3.2 – Alternatives) for further details.

On an existing LCP site there will already be a slag and ash landfill. The newly generated residue/by-product can only be landfilled in the existing ash landfill (that has to be in compliance with LWD) if there are research results clearly demonstrating that a final stabilized product (chemically, physically and mechanically) can be developed and can be deposited in a separate cell.

When a new landfill is constructed specifically for disposal of FGD by-product, it has to be designed for in accordance with LWD; the EIA Report has to include a brief description with graphic support of the following key components in risk mitigation:

- new landfill capacity (in m^3);
- surface (ha) and life time.

2.1.3 Description of Existing Development

Existing LCP

A brief description of general LCP features should be included. Main aspects concerning existing LCP that should be presented are:

- electrical and thermal capacities;
- type and quality of fuel, consumption rate and combustion technique; (*Natural gas is generally considered free from sulphur, but industrial gases and desulphurisation of the gaseous fuel might then be necessary)*
- main structural components of the LCP and their capacities;
- exiting techniques applied for NOx and dust abatement and the emission level values;
- existing emission monitoring system;
- main characteristics of existing water and wastewater management system (used and generated flows, quality, source and point(s) of discharge;
- compliance with IPPC Directive;

Existing landfill for ash/slag

- the ash/slag discharging method, processing facilities (if it is the case), transport and the landfill;
- total and free capacity and remaining lifetime;
- wastewater (in the case of ash hydraulic discharge) and run-off water management;
- compliance with IPPC Directive;

2.2 THE EXISTENCE OF THE PROJECT – MAIN PROCESSES

This section includes only aspects connected to FGD and new related facilities.

2.2.1 Description of Construction

- investigations preliminary to the construction phase (e.g. geotechnical investigation, drillings);
- number of workers involved during construction;
- phasing;
- **specific works** involved for **FGD** site preparation will refer to any of the following, as applicable:
    - demolition and clearing of the existent site or clearing the land of vegetation;
    - demolition techniques;
    - remove of demolition waste;
- **specific works** involved for **landfill** site preparation will refer to any of the following, as applicable:
    - demolition and clearing of the existent site or clearing the land of vegetation;
    - remove and stockpile topsoil;
    - excavations/ blasting/ backfilling: estimated volume will be indicated;
    - land improvement works;
    - installation of drainage system;
- **general works**
    - arrangements for transport of necessary equipments/machinery, goods and materials;
    - temporary storage of necessary goods and materials if outside of the building yard;
    - use of substances or materials which may be risky or toxic for the health of the population or the environment (flora, fauna, water supplies): type, quantity, purpose, way of handling;
    - arrangements for water supply (domestic and technologic if any);
    - installations for treatment and/ or removal of liquid effluents or suspensions (technological water, wastewater, run-off water etc.);
    - constructions to be erected/assembled on site;
    - building of access roads (if it is the case).

During site construction and landfill closure, a quality control program should be followed to ensure that the landfill is constructed and capped in accordance with the design plans. These programs should be briefly described.

2.2.2 Description of main Residues and Emissions from Construction

Actual residues and emissions (including their estimated volumes/ quantities) to be generated due to the specificity of the respective project with respect to works, equipment, materials, climatic/ seasonal meteorological conditions, construction methods, and mitigation measures envisaged to be taken or applied.

The main impact during decommissioning is the disposal of soil that might be contaminated with spilled fuel and lubricants. The reporter has to be aware of and check the existence of any polychlorinated biphenyls or asbestos, which were typically used in power plants built before 1980s.

Other types of waste can be generated during construction: material resulted from excavation/ blasting, humus layer, contaminated soils or other materials, domestic waste, hazardous waste, waste resulted from constructions or demolitions etc.

2.2.3 Description of Project Operation

Only the facilities that are strictly related with the FGD installation will be included.

FGD installation

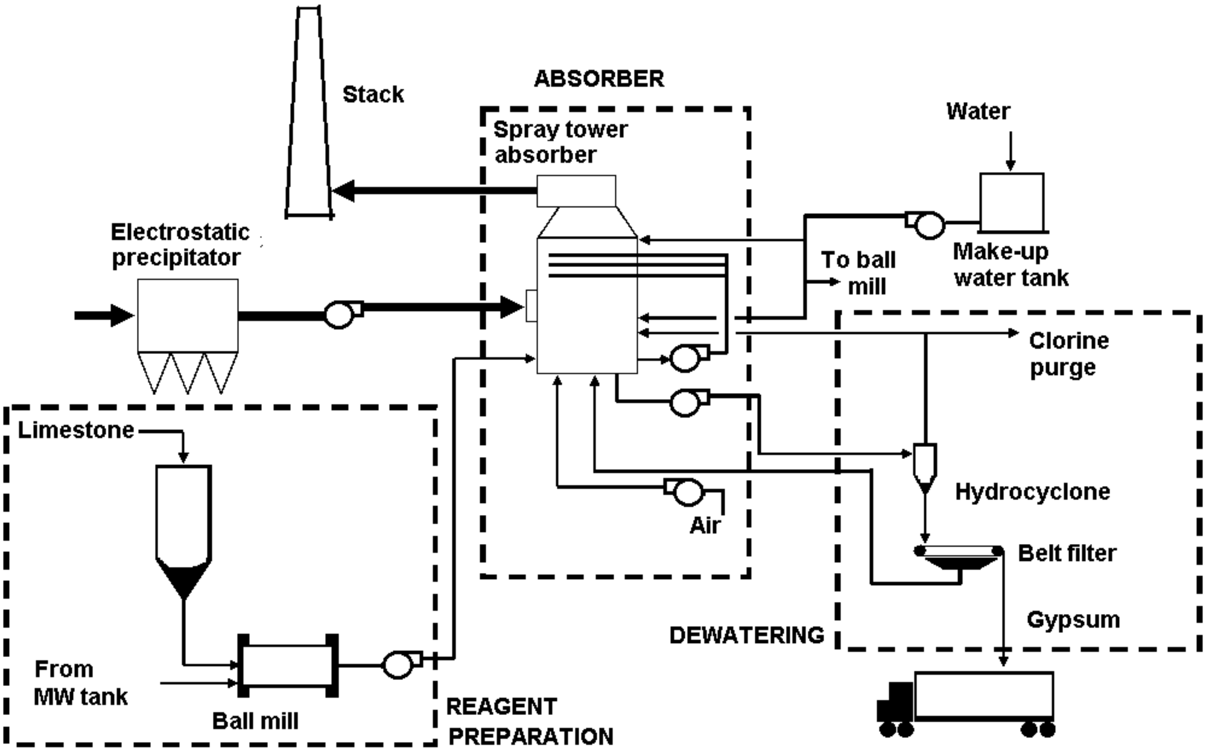
The common flue-gas desulphurization technologies are classified as non-regenerative and regenerative (refer to section 2.2.1 above), of the two, non-regenerative technology is the more widely used..

In the EIA Report, the FGD technique, operations and related issues are to be described in general terms. A description should be provided also for all facilities (e.g., for FGD residue processing and/or disposal, for wastewater treatment, etc.) that will be included in the retrofitting project.

The presentation of each stage will include:

- type of technology (wet, dry or semi-dry) and sorbent (lime, limestone, etc);
- **a flow diagram** of the FGD process (refer to figure 1 below for an example);
- sorbent consumption rate and oxidation process;
- brief description of sorbent preparation/processing, transport;
- brief description sludge/solid residue/by-product management system including storage, transport, dewatering techniques, storage, etc.;
- residue transport to landfill, with or without fly ash stabilization/fixation;
- values of desulphurization efficiency based on a sulphur balance related to sulphur content of coal;
- description of the input and output gas flow characteristics and existence of the particulate control system;
- contribution to the reduction of other emissions (e.g. HCl, HF, dust, heavy metals).

Figure 1 Example of wet FGD technology



Water/Wastewater management

- description of the use, recirculation, treatment and/or discharge;

Wastewater from the wet desulphurisation plant (the purge) contains salts such as chlorides and sulphates. Additional wastewater comes from saleable gypsum processing that requires washing during a secondary dewatering to remove soluble salts such as chlorides. After mixing, wastewaters are recirculated and used as make-up waters.

FGD Residue/by-product Landfill

- area, capacity, liner system description in accordance with WLD and layout;
- landfill liner system;
- surface and groundwater monitoring equipment;
- landfill final cover.
- construction techniques/ method(s), as adopted, including the nature of construction works and scale of machinery to be used.
- perimeter security / control / access (for example: fences, access control, etc.);
- transport of waste from FGD installation to landfill;
- management/ maintenance discharging equipment;
- operational monitoring and maintenance of equipment, including post-closure monitoring;
- environmental monitoring facilities;
- runoff/leachate management:
    - production: rates, quantity and estimated composition
    - brief description of drainage and collection system;
    - brief description of the leachate management system

  - information on the temporary storage capacity of collected leachate and resulted treated water;
  - identification and description of the receptor (water body of local sewage system) of the treated leachate (if it is the case);
  - fate of the resulted residues;
- final profile and landscape rehabilitation;
- management/ maintenance procedures: envisaged routine maintenance programmes including emergency intervention measures etc.

The existing LCP may already include a bottom ash/slag landfill. In the case that the characteristics (capacity, liner system, wastewater drainage system, etc.) of the existing landfill allow and an improvement in the landfill stability, leachability, hydralulic conductivity, etc. is proven, the existing landfill may be taken into consideration for disposal of FGD residue.

2.2.4 Description of main Residues and Emissions from FGD Process

Air emissions

Process emissions

The emissions to the atmosphere from the stack of a Combustion Plant that are of possible concern are nitrogen oxides (NOx), sulphur dioxide (SO_2), carbon monoxide (CO), particulate matter (dust) and carbon dioxide (CO_2).

- qualitative and quantitative estimation of stack emissions, as resulted and included in the feasibility study;
- possible other emissions related to raw materials (mercury, HCl, HF) or other abatement techniques (NH_3 for SNCR[1]);

Transport emissions

- additional emissions generated due to the traffic and maintenance operations related to FGD installation (e.g. sorbent transport).

Wastewater

- collection and fate of run-off water;
- estimated flows and fate of wastewater collected on site including domestic wastewater;
- qualitative and quantitative estimation of treated water and its fate.

By-products

- quantity and quality of FGD by-product which would be taken off site and used, for example, to replace virgin material in plasterboard manufacturing;

Other potential uses include use as a set controller in cement manufacture or in the manufacture of anhydrite floor screeds, building plasters, in road construction or in fertilizer production. The quality of the FGD by-product is strongly correlated with the coal quality and abatement techniques.

Waste

- estimated quantities of sludge or solid waste resulted from FGD process that will be disposed of;

[1] The selective non-catalytic reduction (SNCR) process is another secondary measure to reduce nitrogen oxides already formed in the flue-gas of a combustion unit. It is operated without a catalyst at a temperature of between 850 and 1100 °C. The temperature range strongly depends on the reagent used (ammonia, urea or caustic ammonia).

- estimated quantities of sludge resulted from wastewater treatment (e.g., coagulation-flocculation process) and their fate.

The two main listed possible wastes are "calcium-based reaction waste from flue gas desulphurisation in solid form" (code 10 01 05) or "calcium-based reaction waste from flue gas desulphurisation in sludge form" (10 01 07). In many cases wet FGD by-product is ponded or landfilled but needs blending first with fly ash and lime because of its thixotropic nature (LCP BREF)

2.2.5 Description of Decommissioning and Site Restoration

Decommissioning and site restoration for the LCP site includes dismantling, demolition and decontamination operations, and also rehabilitation of the site. It also includes long term aftercare activities that are necessary to be under taken in relation to the landfill for the purposes of preventing environmental pollution following the closure of landfill activities. This phase includes also monitoring activities.

A description should include the following:

- above mentioned operations
- landfill closure and related issues
    - cover and final profile description.
- post-closure monitoring facilities and parameters.

2.2.6 Description of Changes to the Project

- Descriptions of any anticipated changes to the project:
    - any eventual future phases (e.g. extention of landfill) of the project;
    - ageing of structural components causing deterioration and weathering of equipment and materials, with anticipated time horizon depending on the maintenance system.

2.2.7 Other developments

The following type of developments carried out by parties other than the applicant could directly arise:

- changes in national strategies concerning the energy, especially related to climate change;
- implementation of Directive 2009/31/EC on the geological storage of carbon dioxide.

If it is the case, out of the potential developments in this category mentioned above, there should be mentioned only those which are *envisaged/ likely* to occur.

2.3 MAIN ALTERNATIVES STUDIED

Presentation and consideration of the various alternatives investigated by the applicant is an important requirement of the EIA process.

Note: Alternatives referred to as part of this section refers specifically to Annex IV paragraph (2) of the EIA Directive – *Information Referred to in Article 5 (1)* – unless otherwise specified.

(2) An outline of the main alternatives studied by the developer and an indication of the main reasons for this choice, taking into account the environmental effects.

An outline of the main alternatives examined throughout the design and consultation process needs to be described. This serves to indicate the main reasons for choosing a particular on-site or off site locations,

desulphurization technology, FGD residue/by-product management option, landfill site selection etc., taking into consideration the environmental effects. However, as part of the EIA process for an FGD retrofitting project, it is important that an assessment, as required under Article 6 of the Habitats Directive 92/437EEC, is carried out when analyzing main alternatives as required by the EIA Directive.

For the purposes of these guidance document therefore, taking into consideration the requirements of the EIA Directive and addressing requirements of Article 6 of the Habitats Directive, alternatives, specifically in the case FGD projects, may be described at three levels:

- Alternative locations for FGD and related installation (on site) and for the landfil (including assessment as required under Article 6 of the Habitats Directive);
- Alternative processes;
- Alternative designs.

2.3.1 Description of alternative locations (including assessment as required under Article 6 of the Habitats Directive)

The on site location of a FGD retrofitting of existing LCP has to be identified in such way as the costs concerning piping system and connection to other facilities should be minimised. Alternatives for landfill location are limited by land availability and proximity to LCP.

The description of alternatives considered in the EIA is, in effect, a summary of the location selection process. This should include a description of the main alternatives considered, the criteria used for comparing and choosing between alternatives, and the main reasons for the choosing of the preferred location.

The new installation will be sited in an existing industrial area that normally is placed far from protected areas. In case that the FGD residue landfill has to be built in a non-industrial area, in the earliest stage of the project in accordance with ***the potential impact upon protected areas*** criteria, as outlined in Articles 3 and 4 of the Habitats Directive – Natura 2000 sites,, a summary of all findings, conclusions and recommendations provided under the assessment required by Article 6 of the Habitats Directive have to be presented.

In conjunction with the above, the alternative locations of the on-site FGD installation and landfill are described. It is also important that the engineering and economic criteria are also assessed and described in detail.

Main ***engineering and economic criteria*** considered for landfill location include:

- site topography, hydrogeology, hydrology. The location considered for landfill or storage area is usually (has to be) closed to the existing industrial site. The surface has to be enough to cover the needs for landfilling for a long period;
- location access;
- proximity to existing and future developments;
- any development plans for the proposed location(s).

Exclusion criteria that should be taken into consideration when carrying out a by-product management selection process include but are not limited to:

- existing or planned (i.e. already officially registered) drinking water-protection- and catchment-areas;
- insufficient land;
- high-flood-areas or areas with an extreme morphology (steep slopes)
- karst and areas with soil conditions which allow a fast penetration and permeation of water or possible leachate to the next aquifer;

- areas with unstable or weak soils: organic soil, soft clay or clay-sand mixtures, soils that lose strength with compaction or with wetting, clays with a shrink-swell character, sand subject to subsidence and hydraulic influence;

Any assessment carried out as a requirement under Article 6 of the Habitats Directive may also add a number of constraints to those characteristic for the natural and constructed environment mentioned above (natural barriers, proximity to towns, site topography etc.) which together with the technical, economical and social constraints should be considered when the final location solution is analysed and decided.

Integration of requirements of Article 6(3) and (4) of the Habitats Directive in the assessment carried out for choosing the preferred alternative as required by the EIA Directive arises clearly inclusive from the Methodological guidance on assessment of plans and projects significantly affecting Natura 2000 sites (please refer to Box 1). In case the assessment of alternative solutions (stage three) is carried out, that guidance shows that '*they could involve alternative locations,………..*'. Obviously it would be counterproductive to choose a location and the assessment of its effects on the Natura 2000 site(s) with all possible implications to be carried out only afterwards.

Description of the alternative locations is recommended to present all constraints and motivations discussed above in an integrated fashion.

Box 2 Addressing the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC

In order to assist Member States in interpreting the requirements of Article 6 of the Habitats Directive and to provide guidance in carrying out the assessment required by Article 6 of the Habitats Directive, the document entitled ***"Assessment of plans and projects significantly affecting Natura 2000 Sites – Methodological guidance on the provisions of Article 6 (3) and (4) of the Habitats Directive 92/43/EEC"*** has been published by the European Commission (DG Environment). The document proposes the assessment as a four stage process:

- *Stage One: Screening* — the process which identifies the likely impacts upon a Natura 2000 site of a project or plan, either alone or in combination with other projects or plans, and considers whether these impacts are likely to be significant;
- *Stage Two: Appropriate assessment* — the consideration of the impact on the integrity of the Natura 2000 site of the project or plan, either alone or in combination with other projects or plans, with respect to the site's structure and function and its conservation objectives. Additionally, where there are adverse impacts, an assessment of the potential mitigation of those impacts;
- *Stage Three: Assessment of alternative solutions* — the process which examines alternative ways of achieving the objectives of the project or plan that avoid adverse impacts on the integrity of the Natura 2000 site;
- *Stage Four: Assessment where no alternative solutions exist and where adverse impacts remain* — an assessment of compensatory measures where, in the light of an assessment of imperative reasons of overriding public interest (IROPI), it is deemed that the project or plan should proceed. (it is important to note that this guidance does not deal with the assessment of imperative reasons of overriding public interest)

Each stage determines whether a further stage in the process is required. If, for example, the conclusions of stage 1 are that there will be no significant impacts on Natura sites, there is no requirement to proceed further.

However, if, based on the screening decision, appropriate assessment is required (stage 2), the results of the appropriate assessment may illustrate the necessity to carry out the Assessment of alternative solutions (stage 3). In this stage, the alternative solutions are tested against their implication for the Natura 2000 site and, as stated in the Methodological guidance, "the conservation objectives and status of the Natura 2000 site will outweigh any consideration of costs, delays or other aspects of an alternative solution" i.e. "other assessment criteria, such as economic criteria, cannot be seen as overruling ecological criteria".

2.3.2 Description of Alternative Design

The **alternative design of FGD retrofitting installation** is strongly correlated with LCP characteristics and type of fuel. The possible FDG alternatives (wet (see **Error! Reference source not found.**), dry or semi-dry (see **Error! Reference source not found.**)) have to be consider as BATs (the LCP BREF must be used as information source to determine BAT for installations). The following aspects should be described for each alternative FGD technique:

- SO_2 removal efficiency,
- type of used sorbent and resulted by-product/residue;
- possible use of gypsum by-product and its purity
- operating temperature;
- energy consumption as % of electrical capacity;
- residence time and pressure drop;;
- removal rate for HCl, HF, SO_3, Hg;
- special requirements for construction materials;
- type of flue gas discharge;
- other specific aspects;
- design flexibility to allow for future extension or retrofitting.

Box 3 Main characteristics of the wet limestone/lime process

Technology
A brief description of the technology is provided by BREF for LCPs: The flue-gas leaving the particulate control system usually passes through a heat-exchanger and enters the FGD absorber, in which SO_2 is removed by direct contact with an aqueous suspension of finely ground limestone whereas limestone should have more than 95 % of CaCO3. Fresh limestone slurry is continuously charged into the absorber. The scrubbed flue-gas passes through the mist eliminator and is emitted to the atmosphere from a stack or a cooling tower. Reaction products are withdrawn from the absorber and are sent for dewatering and further processing.

A key process and a possible alternative during process selection is oxidation of calcium sulphite or bisulphite (generated by the reaction of SO_2 with limestone/lime). It can be made by forced oxidation (FO) or natural oxidation (NO) mode. The oxidation conditions have an important influence on the resulting by-product quality.

Sorbent/Reagent
Limestone is commonly used as a sorbent because of its large availability and low price. The proprieties of limestone has an important influence on the efficiency of a FGD system in general and scrubber performance in particular:

- high calcium carbonate content;
- low Al, F and Cl content;
- reactivity (dolomitic fraction);
- granulometry.

Lime can also be used, but presents the risk of calcination. The sorption efficiency is the same.

By-product/residue
From wet process, results sludge of gypsum or calcium sulphate/sulphite mixture and fly ash. The by-product quality depends on the oxidation mode. Wet limestone/lime scrubber technique requires large areas of land for sludge disposal.

If the gypsum has a high quality it can be sold. If the ash or sulphite content in gypsum is high, it cannot be used and will be disposed of in special landfills (for nonhazardous waste).

Box 4 Main characteristics of the spray dry scrubbers

Technology

The sorbent (lime) is mixed with an excess of water or is slaked to produce lime slurry, which is also called lime milk. Lime slurry is atomised to a cloud of fine droplets in the spray dry absorber where SO_2 is also removed from the flue-gas. Water is evaporated by the heat of the flue-gas, usually with a sufficient residence time (about 10 seconds) for the SO2 and other acid gases such as SO_3 and HCl to react simultaneously with hydrated lime to form calcium sulphite/sulphate and calcium chloride. No wastewater results because all the water is completely evaporated in the spray dry absorber.

Although the spray dry scrubber process is sometimes called a *semi-dry process* because it uses lime slurry, the residue is dry powder, which is collected by either the ESP or the fabric filter. As this residue contains some unreacted lime, part of it is generally recycled and mixed with fresh lime slurry to enhance lime utilisation.

Sorbent/Reagent

The sorbent for SO2 absorption is typically lime (calcium oxide).

By-product/residue

The by-product is a dry mixture of calcium sulphite, sulphate, fly ash and unreacted lime. The most common means of disposal and utilisation of the spray dry scrubber product is in stabilised landfills. As the by-product contains unreacted lime, it is not possible to dispose of untreated, because it produces dust and there may be a risk of an uncontrolled leaching of hazardous components. Therefore, it is specially conditioned by mixing with water and fly ash to produce a disposable fixed product.

Specific disadvantages

- cost of the lime sorbent is four to five times higher in relation to limestone;
- efficiency very much depends on the dedusting equipment used (e.g. fabric filter or ESP), because desulphurisation occurs to a certain extent, for instance, in the filter-cake of the fabric filter;
- generate a residue that must be landfilled.

2.3.3 Description of Alternative Processes

Within each design solution there can be a number of different options as to how the processes or activities of the development can be carried out. As there are only two main SO_2 abatement techniques that are considered BAT (described above), the alternative processes could be:

- choice of sorbents,
- technologies for by-product/residues processing for recovery/disposal and wastewater recycling/treatment,
- traffic planning during construction etc.

Consideration of environmental factors can influence the selection of processes which avoid adverse impacts.

FGD by-product management alternatives

After the decision on FGD technique considering BATs, FGD by-product management represents the main issue, both from qualitative (FGD technique) and quantitative (depends on S content in coal and LCP capacity) point of view. The two options are **recovery or disposal**.

Stricter environmental regulations for LCP resulting in an increased output of FGD by-product, the high cost of environmental measures and waste disposal currently are strong motivations for power companies to look for alternatives to landfilling of the by-product in particular recycling and reuse.

After the final decision for desulphurization technique has been made, analysis of alternative processes within each technique can become extremely laborious due to the multiple processes that directly or indirectly have an impact on the environment.

For example, for **Wet FGD**, such alternatives to be considered:

Sludge oxidation

- In natural oxidation mode, calcium sulphite is partly oxidized by the oxygen contained in the flue-gas. The main product is calcium sulphite hemi-hydrate and a mixture of calcium sulphite hemi-hydrate and gypsum is produced in a sludge form. Size of by-product crystals is small, dewatering is difficult needing two stages: thickener and filter. The by-product goes to landfill.

- In forced oxidation calcium sulphite is oxidized by the oxygen contained in air injected into the scrubber, dewatering is easy because the gypsum crystals are relatively large. The primary dewatering is usually accomplished by hydro-cyclones followed by secondary dewatering in filters or centrifuges. The final product, containing about 90 % solids, is easy to handle and is either sold mainly as gypsum for plaster, cement, and wallboard, replacing natural gypsum utilised to fill mines or landfilled.

Transport of sludge

- hydraulic;
- mechanical (e.g., by conveyor belt)

Dewatering

the complexity of the dewatering process is determined by the chemical composition and crystalline formation of the spent sorbent and whether the end product is to be utilized or disposed of; dewatering reduce sludge moisture, depending on the equipment and number of steps of dehydration, moisture-product quality will vary. In the same time a good quality for gypsum means higher energy consumption.

- primary stage: in hydrocyclone, centrifuge, by thickening;
- secondary stage: in hydrocyclone, centrifuge, filters.

Gypsum storage

depends mainly on the sludge humidity and its utilization.

- in ponds: storage lined ponds;
- in stockpiles: for highly dewatered gypsum from where it could be sent directly to beneficiary.

Stabilisation/fixation for wet FGD by-product:

It involved chemical and/or physical treatment for improving chemical and/or physical properties (mechanical strength, permeability, and leachability) in order to improve the landfilling process:

- Stabilisation with non-alkaline fly ash, soil or other additive reduce moisture content and improve handling characteristics without chemical reactions.
- Fixation with reagents (alkaline fly ash with or without lime, limestone, commercial products) causing chemical reaction with the sludge. Fixation generates a solid product due to the pozzolanic properties of alkaline fly ash, binding also heavy metals and trace elements. The properties of fly ash depends on coal quality and have to be investigated before a decision concerning landfilling is taken. Based on a laboratory research the final decision of gypsum disposal and its stabilization will be taken.

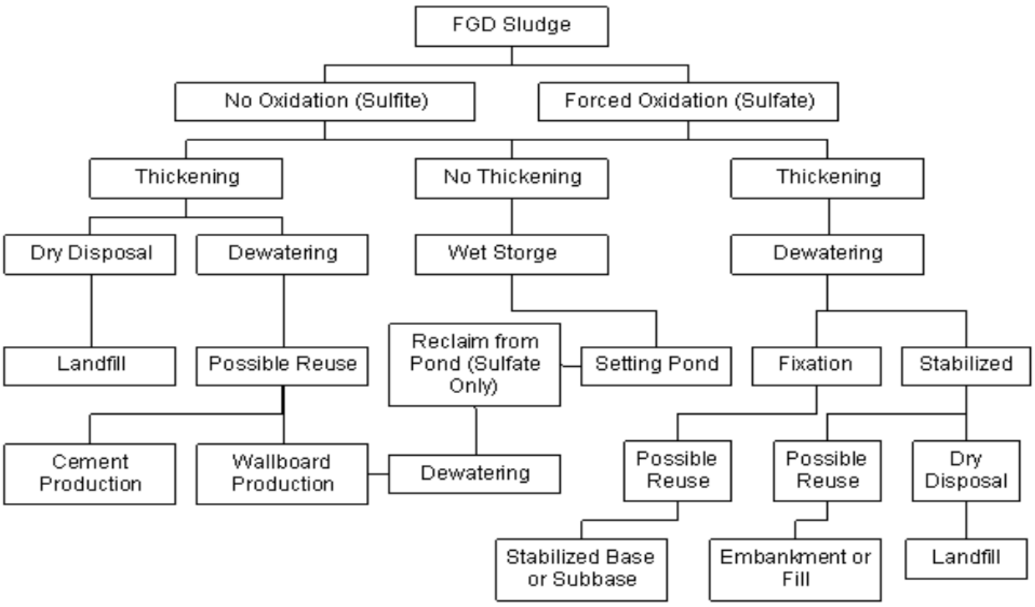
FGD by-product transport system:
From storage area saleable gypsum has to be loaded and transported to the customer e.g., by truck or rail and the unsaleable product/residue has to be transported to landfill directly from dewatering, from stabilization or from storage area mechanical (e.g., by conveyor belt).

Flue gas discharge
- maintaining the old stack
- building a new stack
- evacuation of treated flue gases through a cooling tower

Disposal technique
As is specified in the LCP BREF, in cases when there is no market potential for gypsum, FGD residue is disposed of in a controlled manner:
- in landfill, next to the LCP site, single or stabilized with fly ash;
- in landfill for the restoration of exhausted open-cast lignite mines.

All considered alternatives for installations has to be BAT. An example of multiple options that should be considered in by-product management is presented in **Error! Reference source not found.**.

Figure 2 Chart for FGD by-product management options



2.3.4 Alternative selection

A summary of the analysis used to compare the different options/ alternatives technically identified in order to select the best one should be presented in a dedicated sub-section. It should provide the reviewers with the main elements necessary to follow the selection process. Reference should be made to the detailed analysis (performed within the process of carrying out the Feasibility Study) as comprised in a separate document (attached to the EIA Report or otherwise made available to any interested party).

FGD technique alternative selection

The main criteria are for FGD best available technique selection, based on related parameter values (thermal capacity and removal rate) are presented in **Error! Reference source not found.**. A general chart of selection process is shown in **Error! Reference source not found.**.

Box 5 Criteria for FGD BAT selection

1) Power plant thermal capacity

wet scrubber - is considered as BAT for plants with a rated thermal input of more than 100 MWth.
spray dry scrubber– is considered BAT for plants with a thermal capacity of less than 300 MWth.

In these conditions the type of FGD for the existing plants could be (only single absorber modules are considered):

- for < 100 MWth spray dry scrubber
- for 100 -300 MWth spray dry scrubber or wet scrubber
- for > 300 MWth wet scrubber

2) SO_2 removal efficiencies

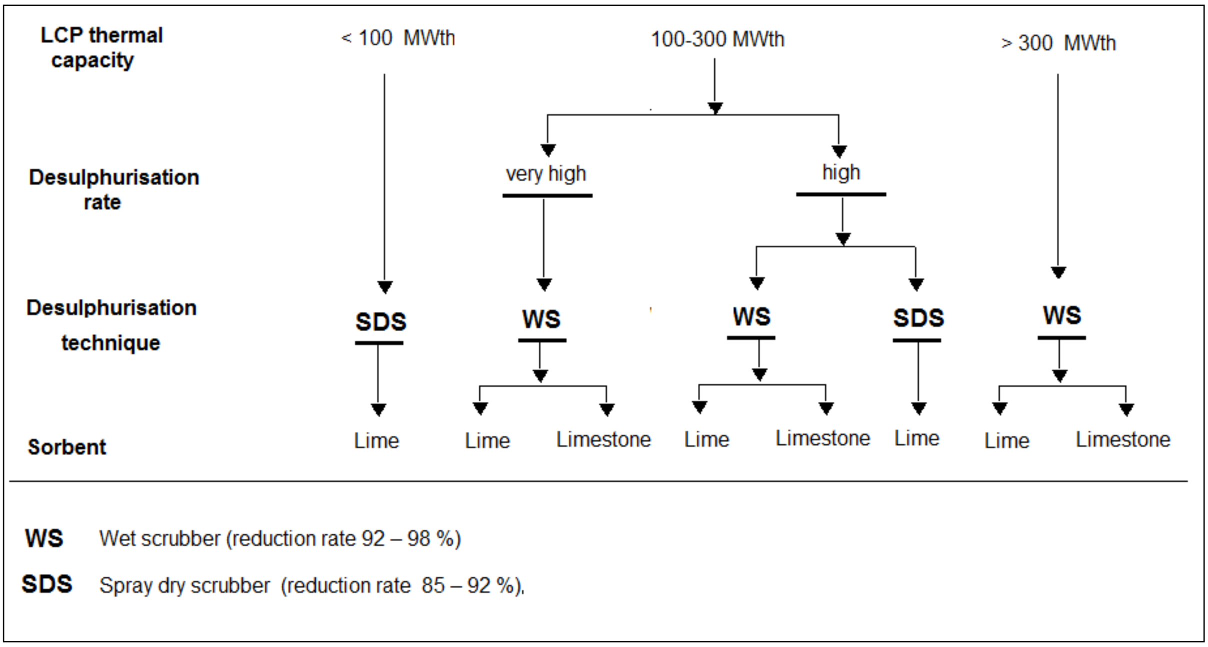
- wet scrubber - reduction rate 92 – 98%
- spray dry scrubber -reduction rate 85 – 92 %

Based on the amount of discussion and research that is currently underway, carbon capture and sequestration techniques appear to be the near term solution for CO_2 emission reduction from coal fired power plants. A major consideration for either technique is the requirement for nearly all SO_2 (and NOx) to be removed from flue gas prior to being treated with scrubbing solutions. In this regard, it is strongly recommended to consider installing FGD systems that achieve very high removal efficiency.

3) Sorbent and product related issues – have to be considered simultaneous and will support the decision concerning the utilisation or disposal or a combination for FGD residue:

- Availability of resources/ reagents - i.e. water, limestone, lime
- By-product/residue properties
- Land availability for disposal
- Marketability of by-product

Figure 3 Chart for FGD BAT selection based on coal LCP thermal capacity and SO_2 removal rate



The advantages and disadvantages have to be taken into consideration for the two main BATs alternatives of FGD retrofitting; a comparative list is are presented in **Error! Reference source not found.**.

Box 6 Wet V Semi Dry – advantages and disadvantges

Wet FGD Retrofit	Semi-Dry FGD Retrofit
Advantages	
• Suitable for all coals • High removal efficiency • Uses low-cost limestone • Sales of ash and gypsum possible • Greater reliability • Module sizes to 1000 MW • Low dust emissions	• Lower investment cost • Best H_2SO_4 control, lower corrosivity • Dry waste easy to handle • No very special alloys required • Reduced plume visibility • Can reuse existing stack • Lower Auxiliary Load
Disadvantages	
• Higher investment cost • Lower H_2SO_4 control, high corosivity • Visible plume • Wastewater discharge • New stack typically required • Higher Auxiliary Load • Generate CO_2 if limestone is used	• Lower removal efficiency (lime spray drying) • Requires use of more expensive reagent (lime) • Requires landfill of all fly ash and FGD waste • Requires multiple modules for large units • Higher pressure drop, due to baghouse (required) • Need for dedusting equipment before discharge to stack
Common characteristics	
• Reduction of SO_2, HF, HCl, dust, Hg emissions • Retrofitting of existing plants with FGD provides co-benefits in the control of fine dust and Hg	

FGD by-product management alternative selection

A thorough analysis is required to be included in the EIA Report as to the proposed management of the FGD by-product. In determining the favoured management solution there are a number of issues that must be taken into consideration including:

- Reuse and recycling of the by-product
- Cost minimisation
- Potential environmental impacts if landfilled

The main issue in considering the best management alterative for the FGD by-product is the reuse/recycling of the by-product.

Finding potential markets for FGD by-product is a not an easy task and does not exclude the construction of a disposal area (landfill) for by-product that is not suitable for reuse/recycling.

A landfill, as a final FGD by-product management option should only be considered once all other potential avenues have been explored.

Only based on the conclusions of analysis for reuse/recycling of the FGD by-product and associated market analysis can the landfilling of FGD by-product as a management solution be considered and justified.

The market analysis for the FGD by-product should include, but not be limited to:

- What are the sources of gypsum at national level?
- Will the main users of natural gypsum switch to synthetic gypsum from FGDs?
- Are there and where are located the wallboard plants?
- How much gypsum is used by cement companies?

- Where are prices likely to go over the next few years?
- What is the forecast for national and European gypsum consumption?

As is specified in the LCP BREF, in case when the market analysis has concluded that there are no other option but landfilling, the landfill alternative may be taken into account.

In presenting this information, some EIAs use a matrix to demonstrate how each alternative preformed against each selection criteria. While this may be a simplification of the selection process, it provides a useful aid to the reader of the EIA in understanding how the chosen abatement technology was arrived at and the range of environmental factors considered.

3 DESCRIPTION OF EXISTING ENVIRONMENT

This section should highlight key issues as regards carrying out baseline assessment (description of the aspects of the environment likely to be significantly affected by the proposed project, including, in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, landscape and the inter-relationship between the above factors.). The existing environment is an existing LCP and thus is an industrial site that may be extended beyond existing footprint to a new area for new landfill construction.

3.1 CONTEXT

Human beings

- nature of surrounding environment and presence of air and noise sensitive receivers (including homes, farms, forest areas, industry, small business enterprises and other establishments) and proximity to these;
- describe existing land uses of the land to be occupied by the FGD installation and auxiliary facilities (e.g. new landfill) and the surrounding area people living on or using the land;
- traffic conditions along the major supply routes for sorbent supply;
- indicate an estimation of number of inhabitants likely to be affected by the new facilities;
- add the nearest localities and distances to them;
- provide information on topics like: employment, welfare, health, occupation, recreational habits but only if they have direct/ indirect relation with the FGD project.

Fauna & Flora

- brief description of terrestrial and/or aquatic habitats, which are likely to be disturbed or obliterated during land preparation, construction, operation, reclamation. The distribution data should be presented as habitat or species location maps, shown in relation to position of the proposed project;
- existing habitats with their flora (focusing more on natural areas), locations of sensitive or rare species illustrated with a scaled map or plan.

Soil & Geology

The footprint of FGD site and surroundings should be described taking into account the conditions that have to be fulfilled in terms of geotechnical and hydrogeological aspects, the potential project impact on soil and underground water and their influence on the project features. Information on soil and geology are particularly relevant for areas selected for the area where the landfill will be built. The geology of the existing site was probably investigated at the moment of LCP construction. If data are no available, a geological study shall be done including the new landfill.

- a general description of the overall setting would include a description of the principal lithologies (types of strata) present, the structure and the relationship between the geology and the geomorphology of the area.
- the site characterisation should be presented in the form of a descriptive manner including maps and cross-sections.

Water & Groundwater

- maps and text describing the nearest surface water bodies;

- the direction and relative magnitude of flow of all water movements both surface and groundwaters.

Air quality & climate

- indicate the features of the development which could potentially impact the air quality, for example the transport during all stages (construction, operation, decommission and land reclamation), stack emissions, landfill dust emissions;
- identify the air sensitive receivers;
- describe existing potential sources of air pollution from existing site or other industrial areas, roads, etc.

Noise & Vibration

- describe features of the development which could potentially impact the noise environment;
- identify the noise and vibration sensitive locations and/or, fauna.

Landcape

- describe and illustrate the principal landscape features including the topography and drainage; natural features and vegetation, settlement patterns and land-uses; circulation routes etc;
- areas from which the new facilities can be seen are generally noted giving particular attention to views from– designated tourism routes and view points, roads, residences, hotels and amenities, sites and monuments of archaeological, architectural or historical interest.

Material Assets

- describe and illustrate the principal material assets (including buildings, other structures) in the area that may be affected by the project components;
- describe existing economic activities close to the area (agriculture, industry, commerce, etc.);
- describe and illustrate the main natural material assets including mineral resources (soil), water resources in the area that may be affected;
- evaluate evolution of investment in the area, price of land and its dynamics;
- local population environmental culture and awareness.

Cultural Heritage

- describe and illustrate the principal archaeological, architectural, historical or cultural features, etc. existing close to the existing site/selected location.

3.2 CHARACTER

Human beings

- indicate the occupations, activities or interests of principal potential receptors, like farming etc.

Fauna & Flora

- flora and fauna species of special interest (in terms of abundance, distribution and diversity);
- the activities for which the animals use the site;
- special requirements of the fauna, e.g. territory size, habitat quality, current management, lack of disturbance;
- description of plant community based on dominant species, species diversity, dependence on particular environmental factors etc.

Soil & Geology

Geological surveys and site visits conducted by certified geologists will provide the following information:

- description of the existing topography of the proposed areas which are likely to be affected by any aesthetic impact;
- determination of the geology of the area through a geological description of borings, soils samples, and geophysical surveys, as well as review of available literature and existing well logs on record for the region.
- each soil type present at a site will be described in terms of classification, profile, properties such as permeability, texture, structure, colour and root development;
- information has to be provided for the existing geological barrier. Based on that data the decision for the landfill bottom and side sealing design will be taken;
- description of all groundwater recharge areas and use of groundwater down gradient from the site.

Water & Groundwater

Baseline data collected shall be sufficient for predicted calculated conditions. The water indicators must be assessed for watercourses to which the treated/drainage/runoff water will be discharged: water flow (average and fluctuation range during the year), total soluble salts TSS, COD and BOD, aquatic biological indicators (invertebrates), nutrients (nitrogen and phosphorus), etc. Data should be obtained from a sufficient distance upstream of existing/proposed discharge location(s) to be able to estimate background conditions for the area/length of the watercourse affected, or likely to be affected. The information on

Hydrological characteristics may either be affected by the construction, operation, decommission and land reclamation. The issues to consider include:

- existing drainage patterns, identification of areas prone to flash floods, the range of water heights/depths in the area, daily flushing regime, storm surge or flood levels;
- groundwater regime, e.g. flow, depth to groundwater level, ;
- presence and importance of structures likely to be affected by changes in groundwater levels;
- aquifer vulnerability
- condition and present and planned use of the receiving water and discharge standards.

The existence of other discharges between the proposed discharge point and the point used for sampling background conditions and the parameters likely to be influenced has to be mentioned.

Air quality & climate

- background air quality in the vicinity of the site. The data should cover not only SO2, but for <u>all regulated emissions</u> for LCPs and other pollutants specific to any industrial objective existing in the zone of influence;

In the case retrofitted by FGD retrofitting, it is expected a significant decrease of SO_2 emissions and therefore much lower concentrations in the surrounding area. The values of the background concentrations that will describe the air quality in the area must have been measured during a LCP shut-down *period, without any on site air emission interference. The air quality indicators during LCP operation phase (before FGD implementation) could be mentioned, if available, to emphasise the improvement.*

- both the climate and the micro-climate conditions (precipitation and evapo-transpiration rate, annual rainfall , wind strength and wind patterns, atmospheric stability probability, etc.). The source of the data has to be mentioned (the metrological station, data bases).

Noise & Vibration

- if it is the case, assess, measure, model and include in the report the values of noise/vibration level during daytime and the main sources; data from on site measurements, for example existing equipment, other existing industrial installation/industry closed to the FGD location.

Landcape

- describe the character of landscape and assess by reference to both natural and cultural criteria.

Material Assets

- evaluate the character of natural resources, related to a sustainable use (e.g., soil), that might be affected by the project.

Cultural Heritage

- describe the character of a archaeological, architectural, historical or cultural features in terms of age, size/area, etc.

3.3 SIGNIFICANCE

Human beings

- indicate the significance of the principal groups or activities likely to be affected;
- provide information about any archaeological, historic, architectural or other community or cultural importance in the area that may be affected, including any designated or protected sites, or bisected by collection vehicles routes.

Fauna & Flora

- significant habitats, whether they are terrestrial or aquatic, paying special attention to species that are rare, vulnerable, threatened, or likely to be designated as threatened or vulnerable, and endangered species;
- description of diversity, population size or density in the national and European context;
- use of the vegetation by significant fauna;
- current use of land, wildlife and plant resources, both terrestrial and aquatic, for traditional purposes (if relevant, specify the use of land and resources by local communities);.

Soil & Geology

- The value of soils and geological deposits as non-renewable natural resources are examined where the site will be extended. The use of the soil removed during the excavations for landfill base construction has to be presented.

Water & Groundwater

- describe the possible use of abstracted water (both for surface and underground water) for human consumption and/or industrial use in the area;
- describe the significance including designations, standards or publications which comment on any aspect of the quality of the water.

Air quality & climate

- describe the air quality with reference to existing or pending designations, standards or limits;
- highlight locations with particularly low or high levels of pollution.

Noise & Vibration

- describe the noise environment/background on the existing site with reference to established criteria, and formal noise zoning if relevant;
- highlight areas with especially low, or high noise levels.

Landcape

- mention if the project outcome(s) will intrude upon any designated views or is within or adjacent to any designated landscape or amenity area;
- for FGD residue landfill, mention if any part of the site will be visible from a wide area; consider also the highest level (the stack) for FGD installation.

Material Assets

- identify the nature and degree of significance of the resources that will be affected, i.e. rarity, representivity, integrity, etc.

Cultural Heritage

- identify the nature and degree of significance of a heritage resource, i.e. rarity, integrity, authenticity, legibility and associational values.

3.4 SENSITIVITY

Human beings

- describe any significant concern known to exist among residences/receptor groups. Identify, where possible, the particular aspect which is of concern, together with the part of the existing environment which may be threatened, mainly related to the industrial site expansion (if it is the case).

Fauna & Flora

- describe if any of the fauna of the site is known to be particularly sensitive to, or dependent on, the continued availability of some aspect of the existing environment such as food, shelter, isolation.

Soil & Geology

A landfill construction assumes a high vulnerability of soils and geological formations to gross degradation or destruction by contamination, compaction and removal. Where the site will be extended or deep excavations works will be developed for the on-site new FGD installation, such vulnerabilities have to be considered:

- Compaction leading to loss of structure and changes in soil drainage;
- Hydrology - changes to the water table affecting many processes, both biotic and chemical;
- Hydrogeology - changes in soils and geological formations may increase or decrease the exposure of groundwater to infiltration.

Water & Groundwater

- describe any of the water's characteristic natural properties or beneficial uses critically respondent on any aspect of the quality of the characteristics of water;
- where water quality or availability is found to be vulnerable to significant impacts due to changes in any of its key properties; also the mechanisms which can trigger such changes and levels/values of the characteristics have to be clearly identified.

Air quality & climate

- consider how FGD retrofitting could be affected by changes in the air quality of the environment.
- Noise & Vibration
- describe how the identified noise sensitive locations (areas with existing humans and fauna) could be affected by changes in the noise environment.

Landcape

- valuable landscape features including their characteristics such as visibility at different times of the year.

Material Assets

- evaluate if the natural material resources are used in a sustainable way;
- evaluate if the disturbance of soil surface horizon will cause the change in local flora (for new LCP and FGD residue landfill).

Cultural Heritage

- mention if the project components (e.g., stack, landfill) will be visible and intrude upon any archaeological, architectural, historical or cultural areas.

3.5 SUFFICIENCY OF DATA

"Sufficiency" is regarded as enough information upon which to base a decision whether to grant or withhold approval of project from environmental point of view.

Both the competent authority, the developer and ultimately the Reporter should be assured that the EIA contains sufficient data. The following criteria can provide useful guidance on this matter:

- Is the information necessary for identification of the main effects available?
- Is the information focused on effects which are *likely* and *significant*?

The certainty or confidence which the information provides is a good basis for evaluating the quality of data. In practice unsatisfactory information is more likely to result from omissions than from inaccuracy.

Where it is the case that incomplete information is provided in the Report, it must be made clear that this information has not been withheld intentionally and that all parties are aware of the incompleteness of the information. The resulting decision will usually be qualified or conditional on the information being provided at a later stage.

In the case of LCP retrofitting, sufficient data should be available from the monitoring programs, permits, studies and scientific literature, and even from various events, complains, etc.

Box 7 Example of a report on Flora and Fauna which is qualified due to necessity of being carried out at an unsuitable time of year

> The site was examined and was deemed to be grassland of a type which is very common throughout the region. It should be noted that the examination was carried out in December when the full range of potential flora and fauna was not evident. A further study will be made, of the damp areas in particular, to determine whether any significant species are present during May – July. The detailed design may need to be altered/adjusted if anything of significance is encountered.

3.6 REGULATORY FRAMEWORK

The purpose of this section is to give an overview of the national and EU legislation that has been taken into consideration in carrying out the environmental impact assessment.

The EU Directives and the international agreements and protocols applicable for road transport sector should be quoted together with the national legislative acts ensuring their transposition/ ratification and implementation. Simply listing relevant legislation and regulatory acts does not suffice.

A brief description of the content should be given to provide the context as well as the reporters notes or comments on how the requirements of the relevant legislation will be addressed.

Furthermore, it is imperative that all relevant national, regional and local/municipal plans and strategies are clearly highlighted and their relevance and association to the proposed development described. As well as providing the national and regional strategic and planning context of the proposed project, it will also illustrate to the reviewer of the report, the development history of the proposed project.

4 SIGNIFICANT ENVIRONMENTAL EFFECTS AND MITIGATION MEASURES

The purpose of this section is to provide recommendations for addressing in the EIA Report the aspects related to:

- the description of the likely significant effects of the FGD project on the environment resulting from:
  - the existence of the FGD project;
  - the use of natural resources (e.g., limestone);
  - the emission of pollutants and FGD by-product recovery/disposal;
- the description of the forecasting methods used to assess the effects on the environment (e.g., environmental monitoring and modelling);

the general and particular mitigation measures that should be considered i.e. measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment during construction, operation, site decommissioning and reclamation.

The potential effects and mitigation measures are project component and phase specific. The amount of detail that will be provided in EIA Report will be determined by the circumstances of each project component. Environmental effects and impact will be different for components located within the site, an industrial area, compared to those which will be located in a natural environment (e.g., landfill).

The EIA has to cover all activities involved by FGD installation construction and running. It is not allowed to postpone the carrying out of the EIA for any of project components (e.g. FGD residue landfill, by-product processing facility, wastewater treatment plant, etc.), on the reasons either that the appropriate techniques was not yet identify or later investments.

Description of the impacts

In general, the effects and their sources/ causes (works, actions, material etc.) as well as the associated impacts are well known. Each sub-section below covers an environmental factor on which a FGD project is likely to have significant effects and presents briefly which these might be.

The Reporter is recommended to not describe the general potential impacts but rather to present in the EIA Report those effects which have been identified and assessed for the proposed project and the causes for their appearance due to original LCP design, any specific conditions of the site, supply with sorbent, waste transport and disposal and so on as well as due to the characteristics of the receptors previously identified. If any significant effects have been identified in relation with a certain environmental factor, it is strongly recommended to present the similar specific conditions and the mitigation measures taken from the start which make unlikely the appearance of any effects.

The requisite criteria for the presentation of the characteristics of potential impacts sets out potential significant effects of the proposed development will be described with regards to:

- extent of the impact (e.g., size of the area of the affected population that will be impacted by gaseous and dust emissions);
- magnitude and complexity of the impact;
- probability of the impact (probability of leachate infiltration in aquifer at the FGD residue landfill due to liner damage);
- duration, frequency and reversibility of the impact;

- transfrontier nature of the impact (if applicable).

The description of impacts is usually subjected to closer scrutiny than any other part of the EIA report. Clarity of method, language and meaning are vital to accurately explain the full range of impacts. The description should clearly and consistently identify four key aspects of any impact, namely its *character*, *magnitude*, *duration* and *consequence* (refer to Box 8 for further details).

Box 8 Impacts: key aspects

Character and Duration of Impacts

- Identify the aspect of the environment affected; Identify the receptors which will be affected, indicating their sensitivity and significance;
- Describe whether the impact is positive, neutral or negative; Highlight significant impacts (positive and negative).
- State whether the impact will be continuous, intermittent or occasional;
- Indicate whether the impact will be temporary, short, medium or long-term; Highlight permanent impacts.
- Indicate if the impact is reversible or irreversible

Extension, Magnitude and Complexity

- Quantify the amount or intensity by which the character/quality of any aspect of the environment will change (i.e. how much pollution);
- Indicate the spatial extent of the impact (will some, much or all of the areas be affected);
- Describe the degree of change; (i.e. imperceptible, slight, noticeable or significant);
- Highlight profound (i.e. complete) changes of character.

Consequences

- Indicate whether the impact can be avoided mitigated or remedied; Highlight irreversible impacts
- State whether compensation is available, possible or acceptable;
- Highlight when the consequence cannot be determined

Description of the mitigation measures

The central purpose of Environmental Impact Assessment is to identify potentially significant adverse impacts, as outlined above, and to propose measures to mitigate such impacts. There are three established strategies for impact mitigation – avoidance, reduction, remedy. Refer to Figure 4 below for further details.

It may be the situation that the design was not much advanced when the EIA Report was prepared and explicit mitigation measures could not be specified. If so, the EIA Report should include any formal commitment of the developer regarding proposals for establishing the appropriate mitigation measures. The options in this respect include: preparation of the technical documentation for sustaining the building permit issuing (for measures to be taken in the design stage contributing to mitigation in both construction and operation stage), preparation and implementation of the Environmental management plan for measures applicable during both construction and operation stage, etc.

The specified mitigation measures should be traceable in the project bill of quantities and further on presented in the Project Financing Application.

Figure 4 Mitigation of impact

Mitigation by Avoidance

Avoidance is generally the fastest, cheapest and most effective form of impact mitigation:

- consideration of alternatives and environmental effects;
- early on site location selection and design process stage

Example

- Optimize the sitting of FGD avoiding extensive and unnecessary demolition works of the existing constructions
- Recover by-product to avoid landfilling of FGD residue.residue.

Mitigation by Reduction

- concentrating on the effects;
- attempting to limit exposure.

"End of pipe" approach does not seek to affect the source of the problems, but in the case of using coal as fuel, the FGD is the most efficient reducing the SO_2 emiisions in air

Mitigation by Remedy

Improve adverse conditions which exist by carrying out further works to:

- restore the environment to an approximation of its previous condition;
- restore environment to a new equilibrium.

Example

Increased planting of specific trees/shrubs closed to plant to compensate unavoidable loss of vegetation.

Reducing the effect

Intercept emissions, effects and wastes before they enter the environment.

Example

Recover gypsum

Reducing exposure to the impact

Install barriers between the location of likely sensitive receptors and source of the impact.

Example

Noise barriers along the closest side to receptors.

Mitigation measures appropriate for each effect/impact of FGD installation are described in each subsection below. The Reporter should select and describe those actually envisaged for the proposed project, as concisely and accurately as possible.

4.1 SOILS & GEOLOGY

4.1.1 Possible Effects and Impacts

Describe the possible impacts on soil and underground water caused by:

Construction

- temporary land use change (e.g., working zone outside LCP area);
- loss of topsoil;
- soil pollution due to on-site storage of fuels;
- improper manipulation of demolition waste - risk of ground contamination associated with decommissioning of hydrocarbon handling facilities, as well as transformers and dealing with the arising waste;
- infiltration in soil of runoff water and water from uncontrolled deposits of wastes and construction materials.

Operation

- landfill liner failure during the construction and operational phases;;
- leakage of landfill wastewater collection system (if there is any);
- leakage of wastewater/leachate ponds/storage tanks;
- spreading on soil of by-product during transfer/transport.

Decommissioning

- dismantling process of technical infrastructure - risk of ground contamination associated with decommissioning of hydrocarbon handling facilities, as well as transformers and dealing with the arising waste;
- for landfill postclosure period: need for material capping; instability of the covered landfill and deterioration of capping soils by heavy rains.

4.1.2 Potential Mitigation Measures

Construction

Describe mitigation measures proposed to:

- remove and recycle of demolition waste off site;
- prevent and control pollution: proper maintenance of transport and construction equipment, handling and transport of raw and excavated materials, temporary storage of materials in the special designed areas and in proper conditions etc;
- for the FGD residue landfill, prevent and control pollution generated by the leachate: design and install the artificial geological barrier, liner and drainage system in accordance with the legal provisions; design and install runoff water/leachate/water collecting and recycling system.

Operation

- prevent spills during storage of all oil and other hazardous substances in appropriately designed bunded storage areas;
- avoid pollution through wastewater leakage and infiltration, by a proper and safe management;
- prevent infiltration of surface run-off into soil of possible contaminated water.

Decommissioning

- all dismantling installations and equipment will be emptied before dismantling and all chemical materials/waste will be safely removed from the facility area to avoid soil contamination;
- remove and recycle of demolition waste off site;
- implementation of cover monitoring plan for closed landfill.

4.2 WATER & GROUNDWATER

4.2.1 Possible Effects and Impacts

Describe the potential impact of emissions to water (including groundwater) arising from FGD installation and by-product processing and disposal including:

Construction

- surface water pollution and groundwater contamination by uncontrolled surface run-off, altering the water's physical, chemical and biological qualities;
- potential contamination of the surface water arising from any earthworks operation.

Operation

- surface water acidification due to acid deposition of SO_2;
- surface water pollution and groundwater contamination by runoff water/leachate infiltration;
- direct impact generated by treated effluent discharges on the receptor water quality;
- direct impact accidental spills of non-treated wastewater or liquid fuels.

Decommissioning

- surface water pollution and groundwater contamination by uncontrolled surface run-off water, spillages from the removed equipment and landfill.

4.2.2 Potential Mitigation Measures

Construction

The mitigation measures applied for preventing and minimization of soil contamination are valid also for water protection,

Operation

- design on-site rain water collection, clarifing and recycling back to the water treatment plant;
- assure process wastewater streams recycling;
- assure adequate separate stormwater drainage system for all concrete platforms and roads;
- assure adequate containment systems for by-products processing and storage areas;
- assure that the roads and platforms/storage areas are impermeable (i.e. a recognised sealed surface, e.g. asphalt or concrete, that is not readily permeable to liquids);
- all chemicals, liquid fuel and oil storage facilities equipped with secondary containment oil separators installed at places where liquid fuel and oils are stored or handled;
- prevent spillage or escape of substances that could pollute the surface water system through and suitable emergency procedures should be provided (for example, fuel/oil);
- surface water monitoring at discharge points;
- regular inspection of adjacent surface water courses.

Describe specific mitigation measures proposed at FGD residue landfill to:

- minimise and contain the generation of leachate/run-off water. These measures will reduce the risk of its migration beyond the site boundary, where it could pollute groundwater, and enable its removal and treatment;
- ensure that the lining system is not damaged prior to and during the waste emplacement;
- minimise the amount of water getting into the landfill.

Decommissioning

- contain the dismantle equipment in sealed and safe area to avoid spillage infiltration in soil;
- landfill cover and site rehabilitation.

4.3 AIR & CLIMATE

4.3.1 Possible Effects and Impacts

Construction

- dust possibly contaminated with other air pollutants resulting from earthworks, demolition works, transport traffic, loading and unloading of raw materials and demolition waste etc;
- emissions of from transport and construction motors;

Operation

The emissions to the atmosphere from a LCP that are of main concern are nitrogen oxides (NOx), sulphur dioxide (SO_2), carbon monoxide (CO), particulate matter and carbon dioxide (CO_2). In this chapter not only the effects and impacts of SO_2 should be considered, but also:

  - dust - the retrofitting project includes the FGD installation that impacts dust content in stack emissions;
  - CO_2 , as a GHG - generated in the reaction of SO_2 with the limestone.
- decrease of rainwater pH due to acid wet deposition;
- increase the CO_2 in atmosphere affect global warming due to emission of supplementary CO_2 (GHG) during the FGD process using limestone;
- dust generation during transport and on site storage/processing of sorbent (lime, limestone).

A dispersion modeling analysis has to demonstrate, through the use of air quality dispersion models, that allowable emissions from the proposed source will not cause or contribute to violations of any national ambient air quality standards.

Decommissioning

- dust possibly contaminated with other air pollutants resulting from earthworks, demolition works, transport traffic, loading and unloading of demolition waste and soil, etc;
- gaseous emissions of from transport and demolition equipment;.

4.3.2 Potential Mitigation Measures

Construction

Dust control measures during construction should include

- proper location of material stockpiles, especially sand and soil downwind from the commercial, residential and other establishments;

- cover construction materials and stockpiled soils if they are a source of fugitive dust.
- periodic water spraying during transfer of excavated material;
- frequent wetting of the stockpile and working area;
- screening of or providing wind breaks for stockpiles;
- covering of trucks carrying limestone/lime; and
- proper selection of equipment and control of speed limits in construction area.

Operation

Describe the measures that will be taken for prevention and reduction of harmful gaseous emissions and dust, like:

- implementation of primary (e.g., use of low sulfur fuel) and secondary measures to reduce sulphur oxide emissions;
- design a stack in accordance with local conditions to allow a good dispersion;
- enclosed conveyors, pneumatic transfer systems and silos with well designed, robust extraction and filtration equipment on delivery and conveyor transfer points to prevent the emission of dust.
- storage of all powder materials (limestone, lime, soda ash) and powder wastes (fly ash, gypsum) in silos equipped with de-dusting systems;
- use proper routes and covered vehicles for transport of sorbent, materials for construction and waste from demolition;
- controlling of the transport vehicles and construction equipment;
- water sprinklers operated in limestone/lime storage and waste disposal area;
- regular sweeping of access road and area of hard-standing area.

Decommissioning

- periodic water the demolition waste piles;
- recover as much as possible of demolition waste.

4.4 HUMAN BEINGS

4.4.1 Possible Effects and Impacts

Construction

- population disruption in localities crossed by the vehicles transporting building materials;
- disturbance and discomfort due to noise & vibration and air pollution;

Operation

- positive effects on public health (reduce the risk of respiratory illnesses) due to significant reduction of SO_2 emissions and impacted area;
- population disturbance in localities crossed by the sorbent supply vehicles;
- disturbance and discomfort due to noise & vibration and air pollution;
- negative health effects caused by release of toxic substances into underground and/or surface water (used as source for water treatment plant) from landfill.

Decommissioning

- population disruption in localities crossed by the vehicles transporting demolition waste;
- disturbance and discomfort due to noise & vibration and air pollution during demolition and transport of demolition waste.

4.4.2 Potential Mitigation Measures

Construction

- reduce workplace health risks:
  - use of personal protective equipment and seasonal working outfits;
  - use high quality fuels, transport and construction equipment;
  - emission control;
- reduce workplace and surrounding residential area health risks:
  - technical measures: use of new, highly efficient and reliable equipment;

Operation

- reduce public health risks with view of noise & ambient air pollution by
- analysis of ambient air quality;
- introduce new measures for noise and pollution reduction adapted to the monitoring results.

Decommissioning

- reduce the time allocated for demolitions to reduce population disruption by contact with dust in air.

4.5 FAUNA & FLORA

4.5.1 Possible Effects and Impacts

Construction

- stress induced by the increased noise and vibration level to fauna (e.q., birds, bats and small mammals) which may even relocate from the location of new landfill;
- direct effects on flora consisting in possible total or partial vegetation destruction due to soil removal, vegetation cuttings and clearness;
- indirect effects on flora due to dust deposited on soil and plants.

Operation

- damage of the acid deposition in forest ecosystems and sometimes in agricultural crops;
- indirect effects on flora due to dust deposited on soil and plants;
- change of migration routes for some animal species (birds, mammals).

Decommissioning

- reduce the time allocated for demolitions to reduce fauna/flora disruption by contact with dust in air.

4.5.2 Potential Mitigation Measures

Construction

- apply measures to mitigate the effects on soil, surface and underground waters and air quality;
- prevent and reduce the accidents and incidents during the construction and operational traffic to mitigate the impact on flora;
- measures specific for vegetation protection during construction and operation, such as:
  - maximum conservation of tree vegetation (save as many as possible trees and shrubs from cutting in the working areas);
  - enfolding trees and shrubs with protective nets and spraying them with water to wash down the deposited dust.

Operation

- restore as much vegetation as possible in the affected areas.

Decommissioning

- landfill closure and site restoration;
- leveling after decommissioning and planting with ingidenous vegetation.

4.6 NOISE AND VIBRATION

4.6.1 Possible Effects and Impacts

Construction

- motor vehicle traffic and construction equipments traffic and activity will generate noise which can affect workers, population and animals living in the vicinity of working points;
- vibration generated during construction from activities like soil compression cause disturbance or annoyance on people or affect a person's ability to work.

Operation

- road noise generated by motor vehicle traffic can be a nuisance if it reaches the population settlements,;
- however, new roads (if any) which divert traffic away from population centre have a positive impact relieving the in those inhabited areas;
- operational vibration (ground vibration produced by road traffic, clay barrier installation) is generally deemed unlikely to cause perceptible structural vibration in properties located near to well-maintained and smooth road surfaces.

Decommissioning

- motor vehicle traffic and demolition equipments traffic and activity will generate noise which can affect workers, population and animals living in the vicinity of working points;
- vibration generated during demolition works.

4.6.2 Potential Mitigation Measures

- elimination or control of noise at source for fixed and mobile equipment ;
- reduction in noise propagation and level by use of noise barriers, and by ensuring sufficient distance to receivers;
- control of the time periods during which noise occurs.

4.7 LANDSCAPE

4.7.1 Possible Effects and Impacts

- impacts on the physical structure and aesthetics of landscape depends on the changes in scale and dimensions, introduced by project structures in comparison with the existing landscape characteristics (height, plan dimensions and homogeneity), therefore a possible new landfill will introduce a significant impact on landscape;
- impacts on the visual amenity of the scenery to receptors: more people living in the local settlement - more sensitive receptors due to the permanent exposure to the project once it is build;

Each kind of impact and its level of significance may be different and should be assessed in various sections of the project in relation with the initial landscape features and likely presence of receptors.

4.7.2 Potential Mitigation Measures

- include landscape engineering considerations into retrofiting design;
- any possible aftercare measure that is necessary to be taken in relation to the restoration of the site.

4.8 MATERIAL ASSETS

4.8.1 Possible Effects and Impacts

Construction

- effect on residential/ economic planned developments (for all project phases);
- positive influences on the labour market (employment, qualifications of the work force).

Operation

- acceleration of the deterioration of buildings, metal structures, etc. due to acidic deposition;
- impact on agricultural land use contributing to a yield reduction;
- increase in energy tariffs
- negative impact on land and house prices;
- increase in heavy vehicle.

Decommissioning

- if closure and rehabilitation not completed properly, land and house prices may continue to suffer

4.8.2 Potential Mitigation Measures

Construction

- measures aiming to mitigate the direct effects on water & groundwater, soil, air quality (for all project phases);
- usual measures for accidents prevention;
- avoid usage of roads inside cities/villages, if possible.

Operation

- optimisation of the major haul routes and divert traffic away from city/village centres;
- operators could offer compensation (for example, rehabilitation of parks, public green areas inside the city/village to communities whose property would be in close proximity to landfills);

Decommissioning

- set up measures for monitoring of underground water and keep population informed about any change in water quality;
- set up an intervention plan and provide the necessary equipment for intervention in case of incidents.

4.9 CULTURAL HERITAGE

In the case of retrofitting of an existing LCP, it could be considered that an additional effect on the cultural heritage will be not involved as long as the FGD installation will be constructed on the same industrial site and SO_2 emission will be lowered. However when the construction of a new landfill for the FGD residue will be built the effect on cultural heritage has to be taken into account.

4.9.1 Possible Effects and Impacts

- like in case of other large projects involving earthworks, there is a possibility of unearthing objects of archaeological, cultural and architectural heritage significance;
- dicreased atmospheric aggressiveness as well as vibrations will positively influence the constructed environment including architectural and archaeological monuments, e.g. acceleration of the deterioration of monuments.

4.9.2 Potential Mitigation Measures

- Include any necessary measure to ensure the protection of such objects under the legal provisions.

4.10 NATURAL PROTECTED AREAS, NATURA 2000 SITES

When natural protected areas other than Natura 2000 sites do exist in the project “zone of influence” the effects on habitats and on protected species of flora and fauna within each such natural proteted area will be presented. For identification of the potential effects and mitigation measures see the sections 4.6. and 4.7. above.

If, according to Art. 9(1)c) of the MO 135/76/84/1284 from 2010, the Project was initially evaluated as falling under the scope of the Art. 28 of Emergency Ordinance of the Government no. 57/2007 regarding the natural protected areas, conservation of the natural habitats and of wild flora and fuana, (i.e. provisions for assessment of impact on the Natura 2000 sites), The EIA Report should present a description of the appropriate assessment procedural stages carried out and of their results.

It is mentioned that the methodological recommendations for the assessment of plans and programms significantly affectong the Natura 2000 sites are comprised in the *Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC* adapted through Ministerial order no. 19/ 13 January 2010 of the Ministry of Environment and Forests and thus the current guidance document will not repeat the issues described in that Methodological Guidance.

4.11 MONITORING

- The on-site monitoring presumes both operational and environmental monitoring. Monitoring regimes are run during construction, operational and post closure phases, in accordance with European and national legislation in force (on LCPs and waste landfills), and have to be described in the EIA report. It is considered that a monitoring system for environment quality is already in place and together with compliance and operational monitoring systems it will be upgraded if it is the case.

Compliance and Environment monitoring:

- continuous or discontinuous compliance monitoring and systematic collection of relevant data/information (eg., of stack emissions, discharged/treated water); as long as the stack, in most of the cases, is included within retrofitting FGD project, its design has to take into consideration the

monitoring/sampling system (in-situ or extractive) to determine substances in the clean gas emission. See examples of monitoring parameters in Box 9.

- conduction of the survey and sampling program for environment quality monitoring;
- analysis of samples and data/information collected, and interpretation of data and information; and
- preparation of reports to support environmental management;
- meteorological data monitoring that could be done on site with operator equipment or based on data received from the nearest meteorological station;
- surface water and groundwater monitoring quality data;
- air quality outside LCP site.

Box 9 Example of parameters to be monitored at stack

Stack emission monitoring:

- **Continuous measurements:**
  - concentrations of SO_2, NOx and dust from each combustion plant of 100 MW or more;
  - oxygen content, temperature, water vapor content (not if sampled waste gas is dried before the emissions are analyzed) in the waste gases, static pressure in the off-gas duct - to convert the emission concentrations obtained to standard conditions;
- **Discontinuous measurements:**
  - CO at least once every six months;
  - mercury at least once per year;
- **Other measurements:**
  - the atmospheric pressure;
  - monitoring period/averaging period.

Operational monitoring:

Continuous technological monitoring: quality and quantity of inflows (e.g., coal, sorbent, water) and outflows (e.g. FGD residue/by-products, recycled and/or treated wastewater, discharged treated water, etc);

- flue gas temperature;
- flue gases flow rate or dynamic pressure of flue gases;
- quality and generation rate of FGD by-product;
- quality and quantity of leachate and treated water (if it is the case);
- quality and quantity of wastewater/leachate collected through the FGD residue landfill drainage system;
- landfill stormwater (runoff) quality before recirculation or discharge;
- state of the bearms, roads; slope stability at landfill;
- height of the landfill and state of the final cover, etc.

The main monitored parameters should be presented in a tabular format including the responsibility and frequency of measurement. They depend, in accordance with European and national legislation in force (see Sub-chapter 1.2), on type of fuel, total rated thermal input, plant life span, local conditions. In this respect the stack emissions monitored parameters will be SO_2, NOx, CO, dust, mercury, sulphur content of the fuel. The monitoring conditions depend on parameter, type of fuel, total rated thermal input and competent authority decision (for some particular cases). As long as the emission in air is done through the stack, which is design in line with the after retrofitting emissions, all regulated parameters should be mentioned.

4.12 CUMULATIVE ENVIRONMENTAL EFFECTS AND INTERACTION OF THE FOREGOING

4.12.1 Cumulative Effects Assessment

The assessment of cumulative impacts can be most appropriately addressed at the strategic level rather than through project level EIA. However, cumulative impacts are relevant for retrofitting FGD project EIAs and are specified as issues to be addressed by the EIA Directive. The most effective way for cumulative impacts to be dealt with in the context of retrofitting FGD project EIA is to coordinate the assessment process with adjacent industrial sites or LCPs where relevant. This approach should be clearly identified in the EIA. It is important for the EIA Team to be conscious of the potential for cumulative impacts and also to have an awareness of ”other approved developments” in the area.

The following cumulative potential effects for an FGD Project should be considered:

- *Air quality*

  The reduction of SO_2 emissions will significantly improve the air quality within the region and reduce the existing acidic rain cumulative impact (if any) before retrofitting.

- *Surface water quality*

  The known and future regulated point source discharges in the sub-watershed closed to LCP have to be identified and presented. The on site mitigation measures and the available evidence should indicate that the proposed project would not significantly impaired to the water quality and its uses.

- *Groundwater quality*

  In unlined areas of the FGD residue landfill, leachate can potentially percolate downwards and/or laterally away from the source, transporting contaminants, mainly mineral salts, that may affect the groundwater quality.

- *Dust and noise.*

  For example, noise and dust generated by construction/demolition activity and transport of materials from/to two adjacent projects could cumulate if the work period or track trips coincide.

  The existing traffic will overlap with an increasing number of vehicles both during the construction and operation stage roads and will generate cumulative effects on air quality and noise.

Elaboration of studies concerning the potential for cumulative impacts are not always necessary and the best expert judgment considering all assumptions and reasoning may be enough. Any other projects and/ or activities planned to be constructed and/ or commissioned in parallel with the assessed project, the “zone of influence” of which overlap totally or partially with the one of the assessed project should have been identified and briefly presented here.

4.12.2 Interaction of the foregoing

Interactions relate to the reactions between impacts within a project and the inter-relationship between impacts identified under one topic with impacts identified under another topic.

The consideration of impact inter-relationships and interactions provides an opportunity to consider the overall impacts of a scheme which might not be immediately apparent particularly when the EIA is

structured around individual topics. These impacts can be addressed in the EIA by including a section at the end of each topic chapter dealing with impact inter-relationships and interactions or by including a separate chapter, normally towards the end of the EIA, dealing with the issue.

Error! Reference source not found. shows an example of how impact interactions can be highlighted in an EIA Report through the use of a matrix.

Figure 5 Sample Impact Inter-relationship Matrix

Inter Relationship Matrix	Soils & geology	Water & Groundwater	Air Quality	Noise & Vibration	Climate	Fauna	Flora	Landscape	Human Beings	Arch Heritage	Material assets
Soils & geology						◆	◆		◆		◆
Water & Groundwater						◆	◆		◆		◆
Air Quality	◆				◆	◆	◆		◆		◆
Noise & Vibration	◆					◆	◆		◆		◆
Climate			◆			◆	◆		◆		◆
Fauna	◆	◆					◆	◆	◆		
Flora	◆	◆	◆			◆		◆	◆		◆
Landscape						◆	◆		◆	◆	◆
Human Beings											
Arch Heritage								◆	◆		◆
Material assets									◆		

An example of how interactions and inter-relationships may be presented is outlined in Box 10 below. Air and noise have been selected as an example to illustrate how interactions and relationships could be summarized in the report.

Box 10 Example of a Summary of Potential interactions & inter-relationships - Air

Subject	Interaction with	Interactions/relationships
Air	Human beings	Air quality is a major concern both at the local community level and on a broader national/global scale. In terms of the proposed development, dust (both during the construction and operational phases) and emissions and its impact on the communities and residents adjacent to the proposed development will be the main issues.
	Flora and Fauna	Vegetation can act as a purifier for air in absorbing CO_2 and giving out oxygen. Dust from the proposed development could affect fauna and flora.
	Water	Dust from the proposed development could affect surrounding watercourses
	Geology/Hydrogeology/ Soils	Dust from exposed soils during construction could cause deterioration of air quality in the immediate vicinity of the development.
	Climate	Emissions to the air will potentially effect/impact on air quality.
		Reduction in air quality caused by dust could impact on agricultural enterprises in the vicinity of the development particularly during construction.
Noise	Human Beings	Sensitive receptors located close to the proposed development may experience some increase in noise particularly during the construction stage of the proposed development.
	Landscape	The construction of landscaping berms and planting will mitigate the effect/impact of noise.
	Flora and Fauna	Construction and operation proposals could result in significant noise disturbance, which may impact on the fauna currently using the area.
	Material Assets	Dairy cattle and other sensitive animals are reputed to be sensitive to sudden noise events that may occur as part of the construction. Any sensitive agricultural enterprise will be facilitated through consultation with landowners.

4.12.3 Summary of Impacts, Mitigation, Residual Impacts

Such a summary is usually presented in tabular format which allows an overview of the impacts on each environmental factor corresponding to each stage of IWMS project realization for each site (if the case).

The format might be rather simple or more complicated to address also the impact characteristics: magnitude and significance, duration (permanent/ temporary), extent (coverage and receptors), nature (direct/ indirect, adverse /beneficial), reversibility (reversible/ irreversible), sensitivity of receptors, probability of occurrence, confidence limits to prediction, mitigation and monitoring measures, scope of mitigation/ monitoring, residual impact.

5 NON TECHNICAL SUMMARY

5.1 PRINCIPLE

Annex IV of the EIA Directive setting requirements for the information to be supplied to the competent authority by the project developer, mentions in its point 6 “A non-technical summary of the information provided under the above headings.” i.e. of the information contained in the EIA Report.

A NTS is required because one of the fundamental objectives of the EIA process is to ensure that the public is made aware of the environmental implications of anti-decisions about whether to allow new developments to take place.

It is often useful to prepare a NTS as a separate and self contained document, which can be widely distributed to the public who are likely to be affected by the proposed development.

5.2 STRUCTURE AND CONTENT

The NTS is laid out in a similar, but condensed, format to the main EIA Report. i.e. describing the project, existing environment, impacts (including both negative and positive) and mitigation measures. It should include a site location and site layout plan (showing context) together with easily interpreted graphical representation of the proposed development, such as a perspective drawing.

Also it may contain an overview of the approach to the assessment and some brief explanations related to the development consent process for the project and the role of EIA in this process; It is recommended to include in the NTS data about stage’s sequence of EIA procedure for the project component accomplished so far and foreseen (Screening and Scoping Decisions of EPA, previous public consultation).

5.3 PURPOSE AND LANGUAGE

As stated above, the main purpose of the NTS is to communicate to the public the EIA Report findings.

To achieve this goal, it should use a language easy understandable, without a scientific and technical jargon. In this respect, the copy and paste exercise by which some entire paragraphs are transferred from the EIA Report itself into NTS, is contra-productive and should be avoided. Instead, the text needs to be rephrased.

The NTS length should not be a matter of concern. Examples are available of short but intelligent prepared NTS (23 pages including 6 with photos and diagrams for a 280 pages coordinated EIA Report), in comparison with a long but fluffy NTS (about 100 pages for a 300 pages coordinated EIA Report).

Recommendation is to attach the tables with Summary of Impacts, Mitigation, Residual Impacts to the NTS when made available to the public.

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