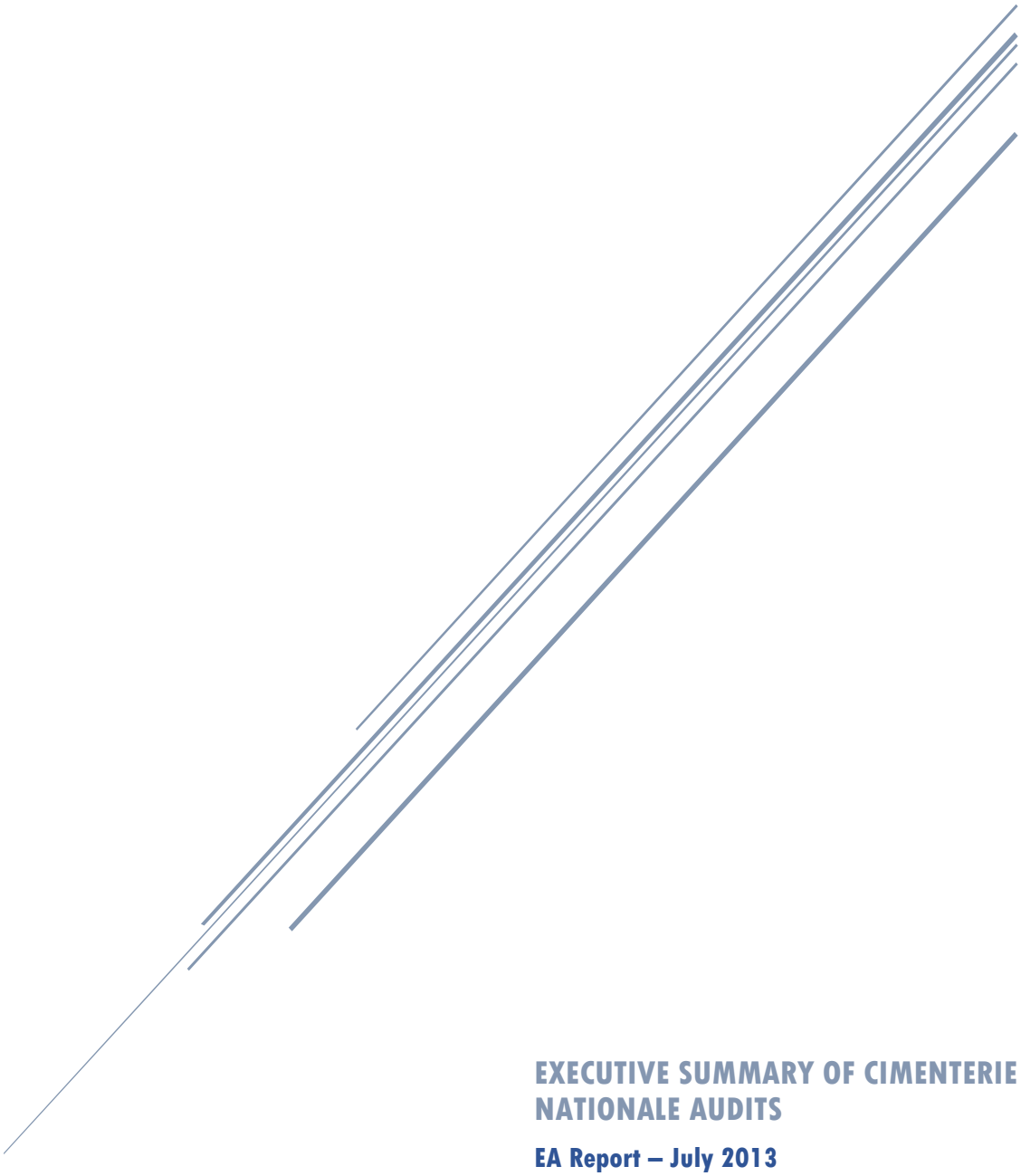
EXECUTIVE SUMMARY OF CIMENTERIE NATIONALE AUDITS



EXECUTIVE SUMMARY OF CIMENTERIE NATIONALE AUDITS

EA Report – July 2013

Addendum 1 to EA Report – November 2014

Addendum 2 to EA Report – March 2015

Addendum 3 to EA Report – October 2015

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Introduction and Scope

This report presents an executive summary for the Environmental Audit (EA) reports conducted by Sustainable Environmental Solution (SES) company for Cimenterie Nationale (CN). CN is located in Chekka-North Lebanon, it was founded in 1953, and it is one of the regional and largest leading cement producers in Lebanon with an annual cement production capacity that exceeds 2.6 million tons.

This summary is based on the EAs that was submitted in 2013 in addition to all addenda submitted afterwards. The environmental audit report was conducted and completed in accordance with the National Environmental Auditing Manual developed by the Lebanese Ministry of Environment (MoE)/ Strengthening the Permitting & Auditing System for Industries (SPASI) to assess the environmental issues and in compliance with the plant facilities. This summary is prepared in accordance with the Environmental and Socioeconomic Impact Assessment Framework (ESIAF) and the Load Agreement (LA) requirements of the Lebanese Environmental Pollution Abatement Project (LEPAP). The initial EA was accepted by the MoE conditional to the addressing certain issues and comments. Since certain aspects of the EA did not meet the requirements of the LA of LEPAP, further field visits and consultation meetings were conducted between the MoE and CN management which complemented this summary.

The main issues that were covered in the EA study include:

- Production processes;
- Air emissions;
- Noise pollution;
- Water consumption and wastewater generation;
- Solid waste generation;
- Energy consumption;
- Environmental management practices;
- Health and safety.

Consultation with Cimenterie Nationale

After the completion of the EA reports multiple consultation meeting and field visits had been done by the MoE with the presence of the LEPAP Project Management Unit (PMU). The meetings were done on the following dates included the resulting discussions:

- Field visit at CN facility (23/3/2017): visual inspection of the mitigation measures in the implementation and in the design phase, and discussion about establishing and improving monitoring and reporting activities;
- Meeting including CN management, Chekka municipality and the MoE with the presence of the Minister (30/3/2017): discussions about the importance of implementing the planned mitigation measures and the approval of the municipality in continuing with the given actions;
- Consultation meeting at CN in the presence of the operation management, the environmental and safety officers and the CEO of the company, and the MoE Safety and Urban Environment Department (24/5/2017): discussion about the mitigation measures and monitoring plans in terms of estimated cost, responsibilities, technical requirements and existing challenges,; to be included in the Compliance Action Plan (CAP). Follow-up reports and documentations related to mitigation measure designs and permitting updates were submitted following this meeting.

Description of the Cimenterie Nationale Facility and Production

Site location

Cimenterie Nationale is located in Chekka village, North Lebanon within the jurisdiction of the Municipality of Chekka, Caza of Batroun, Mohafaza of North Lebanon at approximately 64 m above mean sea level, within a 2,500,000 m^2 plot of land. The facility is located approximately 65 km away from Beirut and 16.28 km away from Tripoli. The total area of the cement facility includes operational and administrative buildings, storage areas, parking and auxiliary facilities. The facility is in a zone classified as industrial.

Facility Description

The infrastructure of the cement facility has three distinct areas: production area, maintenance and quarry area, and port facility. CN has 746 employees, 527 of them work on site in administration and production, while the rest are contractors outside the cement facility (sales representatives, truck drivers, etc).

Table 1. Structures, utilities and operations within the Cimenterie Nationale facility

Area	Description
Production	• Administrative and laboratory buildings, and parking areas; • Production machineries: Kilns 1,2 & 3, grinding plant, clinker cooler, cement mills, homogenization and storage silos, packaging, cement loading and bagging machinery; • Storage areas for clinker, petcoke and lubricating oil; • Fuel tanks for heavy fuel oil (HFO) and diesel, and sludge collection tanks; • Groundwater wells and pumping stations, and water tanks; • Seawater pumping station; • Power sources: power station with four generators and Electricite du Liban (EDL) electricity room; • Electrostatic Precipitators (ESP) units and Baghouse filters; • Sludge and waste lube oil mixing area; • Septic tanks for domestic wastewater; • Workshop including instrumentation, electrical and mechanics work; • Road weighbridges.
Maintenance and quarry area	Maintenance and machinery area: • Workshop for repair and maintenance; • Spare parts and maintenance tools storage area; • Used tires and lube oil storage area; • Parking area for trucks; • Oil/sand/water separator unit; • Septic tank for wastewater storage; Quarry area: • Crushers: “Polysius” (500 tons/hour) and Krupp and Hishmann (1200 tons/hour); • Material transport: Belt conveyor, stacker, and old and new reclaimers.
Port facility	• Sea port jetty and infrastructure (including fenders and used tires); • Hoppers, movable and fixed belt conveyors; • Oil and styropane booms (for containment); • Fuel-oil pipelines;

	• Fire extinguishers and foam trolleys;

Production Process

CN uses dry production process through the utilization of three rotary kilns, with total daily clinker production capacity between 6950-7250 tons and cement production between 8000-9000 tons. The usual operation is 12 hours a day, six days a week. The production process consists of 8 main phases: raw material preparation, crushing and pre-blending, raw material grinding and homogenization, pre-heating and clinkerization process, clinker cooling and storage, cement grinding and storage, and final packing delivery as described below.

Phase I: Raw material Extraction

The raw materials such as pure limestone, bauxite and red mineral as well as other materials containing the required proportions of calcium, silicon, aluminum and iron oxides are used in the production process. The raw materials of limestone and gypsum are transported by trucks for crushing and to the production area through a belt conveyor that connects the quarry to the production facility.

Phase II: Crushing and Pre-Blending

Crushing: The excavated material is fed to a combination of crushers [500 tons/h (“Polysius” NEW) and 1500 tons/h (Krupp and Hishmann)] to reduce the material to the required size for processing. The raw materials then are conveyed to a storage area.

Longitudinal Blending Mixing Bed for Limestone: The crushed limestone is stacked in a long-layered stockpile. It is fed to a longitudinal storage via a slewing stacker where the pre-blending takes place.

Phase III: Raw material grinding and homogenization

The raw materials are milled and dried by means of hammer mill and/or ball mill, then transported to homogenizing and storage silos.

Phase IV: Coal and Petroleum-Coke Grinding Unit

A single grinding unit (two ball mills and two vertical roller mills) grinds the fuels in separate campaigns. The grinded fuels are stored in two separate areas with no certain coverage or containment. The stored fuel is later used in the process (main and calciner burners).

Phase V: Pre-heating and Clinkerization Process

The finely grounded and blended raw material is extracted from the mixing silo and fed to a pre-heating tower. The preheating tower has 4 cyclone stages and a pre-calciner section, and is used to heat the raw material, this step is followed transporting the raw material to the rotary kiln for heating (temperatures reaching up to 2000°C resulting in the formation of cement clinker). There are three operating kilns at CN with the following capacities and specifications:

- Kiln 2: capacity of 1100 tons/day
- Kiln 3: capacity of 1700 tons/day
- Kiln 4: capacity of 3800 tons/day

Phase VI: Clinker Cooling and Storage

A pendulum grate cooler is used to cool the clinker. The clinker cooling operation recovers up to 30% of the kiln system heat, preserves the ideal product qualities, and enables the cooled clinker to be moved by conveyors. There is a clinker cooler de-dusting system, it consists of an Air-Heat Exchanger (protects the filter bags) and an Impulse Bag Filter System. The amount of gas to be cleaned following the cooling process is decreased when a portion of the gas is used for other processes (e.g. coal drying).

The cooled clinker is conveyed to the main clinker silo (45,000), and it is later discharged in two extraction lines by special dustless discharge devices and conveyed to the cement feed bins.

Phase VII: Cement Grinding

Three cement mills (CM-5, CM-8 & CM-9) are currently in operation at CN. Cement mill 5 & 8 have an operating capacity of 100 tons/hour each, while mill 9 has a capacity of 200 ton/hour. All the cement mills are provided with high efficiency separators and operated in closed circuit. Cement mill 5 & 8 are operated with pre-grinder.

Phase VIII: Cement storage, Packaging and Delivery

Once the production of the cement is complete, the cement withdrawn from the cement silos is conveyed (via air slides, bucket elevator and vibrating screen) into the bagging bin. The packaging machine has a capacity of 2,200-2,400 bags/h utilizing 50 kg bags. The filled bags are removed automatically by the bag conveyor. As for the spilled cement, it is collected in a hopper and returned into the feed by return screw. The method of transport selected varies according to location and may include transport via trucks (pre-bagged or bulk) and/or vessels.

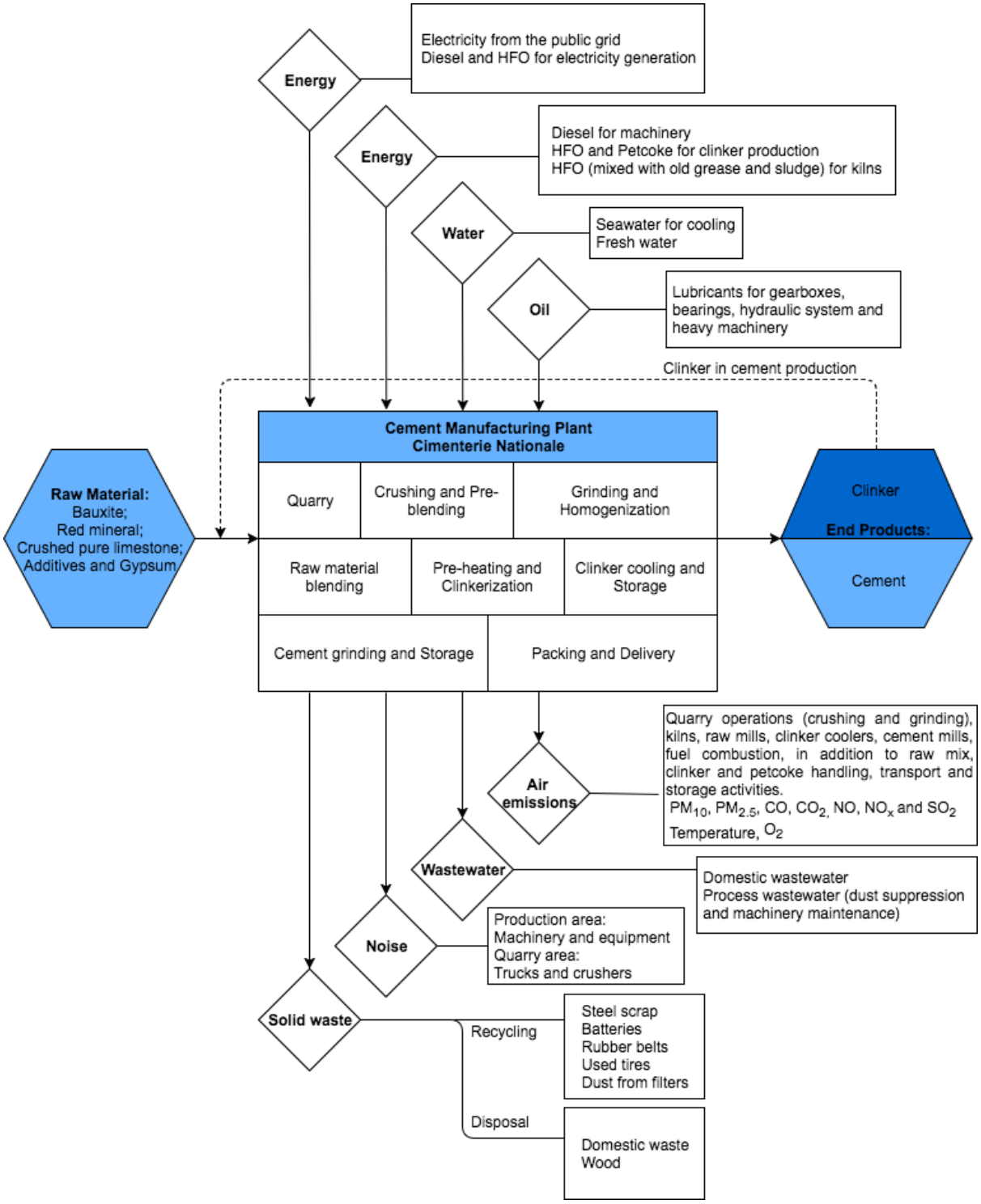

Figure 1. CN mass flow diagram

Environmental Conditions and Measurements

Various potential sources of pollution were assessed at CN and respective measurements were conducted to ultimately recommend mitigation and monitoring measures. This section summarizes the sources of environmental concerns in addition to resource consumption and health and safety aspects.

Air Emissions

There are several sources of air pollution at CN, including power generation, manufacturing activities and vehicles. Measurements of PM_{10}, $PM_{2.5}$, CO, NO, NO_x and SO_2 were conducted during the audit at major stacks.

Power generation

The facility decommissioned an old power station and currently operates with a new power station that includes 4 interconnected generators: two of them with an individual capacity of 7.2 MW, and the remaining two with individual capacity of 11.3 MW. The generators operate on HFO and are equipped with separate stacks. The facility has a regular maintenance program and installed the generators with mufflers for noise control and air filters for exhaust emission control. The generator emissions are continuously monitored.

During the measurements, elevated levels above the national standards were recorded for NO_x emissions. It is important to note that power generation contributes to 55.7% of the NO_x emissions by CN.

Manufacturing Activities

The sources of air emissions (mainly dust emissions) from the manufacturing activities are: quarry operations (crushing and grinding), kilns, raw mills, clinker coolers, cement mills, fuel combustion, in addition to raw mix, clinker and petcoke handling, transport and storage activities.

The facility has installed various de-dusting units, bag filters and ESP units for fugitive emission control, and owns 3 sweepers to remove dust from the operation area. The collected dust is recycled back to the process. The facility also installed different types of gas analyzers on major stacks that continuously monitor dust, SO_2 and NO_x emissions beside gas flow. In addition, the facility has a landscaping program at the quarry and production areas that includes tree planting and benching to minimize bust propagation.

Vehicles and Port Vessels

The facility includes various types of heavy vehicles that operate at the quarry area: hauling trucks, loaders, shoving dozers, excavators and levelling graders; vehicles that operate at the production and storage areas include: bobcats, sweepers, tankers, pickups and forklifts. The transportation between the storage area of the raw mix and the production facility takes place through a conveyor belt. The transportation activities within the quarry area is a significant source of fugitive dust emissions. Vessels of different sizes are used to import raw material and export products (clinker and cement). The vessels use mainly diesel oil for operation that involves unavoidable air emissions.

Noise Pollution

The cement manufacturing industries require the use of noisy machinery. The main areas where noise levels are of concern are the quarry area, crushers, air fans, the processing system areas, packing machines, maintenance (garage) area, and the movement of the overall vehicles and trucks within the facility. The workers at these areas are provided with Personal Protective Equipment (PPEs) to minimize the impact of noise. Since the generators are installed with mufflers and fully enclosed, the noise levels are reduced in the surrounding of the location. Noise measurements were carried out at both the quarry and operation areas under normal operating conditions at selected points during day, evening, and night.

Water Consumption

The cement manufacturing process and facility require the use of important quantities of water. This water is needed for cooling purposes, washing, dust suppression, irrigation of landscape planting and domestic activities. The facility obtains the required water from two wells located in the premises and stores them in steel tanks at the quarry and the operation area. The facility also includes seawater pumping station for cooling the engines as well as for supplying the fire-extinguishing system.

Wastewater Generation

Wastewater is mainly generated from the overall production activities such as water spraying or dust suppression activities, machinery maintenance, washing and cleaning, and domestic use.

Wastewater generated from maintenance activities are drained along with lube oil to a water/oil separator tank. The separated water is discharged into nearby river, while the oil is collected into a sludge collection tank. The washing water is drained into a settling tank. The remaining sediments and the oily sludge is re-introduced to the combustion process. All the collected waste oil from various activities is mixed with heavy fuel oil and used as a fuel for the kilns. The petcoke dust suppression water is treated by filtration, the sludge is used in the heating and the water is recirculated for the same purpose. Domestic wastewater is collected in seven septic tanks and regularly pumped by the municipality and discharged in the existing wastewater network without prior treatment. The wastewater network is not connected to wastewater treatment plant and has a final discharge point to the sea.

The pH, Temperature, TSS and Oil and Grease measurements taken at the maintenance machinery area (Oil/water separator) and the pet-coke/water separator showed compliant results with the national wastewater discharge standards.

There are 6 fuel storage tanks around the facility. The fuel oil storage tanks and all the related control valves are inspected and monitored regularly. Nevertheless, inventory monitoring control of input and output of fuel oil is being used as a quality control measure for potential leakage or loss of products. In addition, all fuel tanks are made of steel and bounded by a concrete elevated wall that acts as secondary containment spill control.

Energy Consumption

Cement manufacturing industries are considered as high energy consuming facilities. 72% of the power requirements at CN are supplied through the HFO generators that is used for the overall production process while the remaining is supplied from the national grid that is used for non-critical loads like crushers and cement mills. The major electrical energy consuming equipment within the facility includes the ball mills for raw meal grinding, cement grinding, crushers, kilns, and the packing plant. Moreover, there are other auxiliaries that consume electricity such as the fans located all over the plant, compressors and pumps. The reuse of sludge and used oils in the kilns reduces the consumption of fuel oil for the burning processes.

Solid Waste Generation

During the production process and shipping, several types of solid waste: domestic, scrap, steel, wood, paper, tires and other hazardous and non-hazardous waste is generated. Generated waste is collected, sorted, stored on-site on weekly basis before final management or disposal. Hazardous waste such as lube oil generated at the maintenance department is collected to a nearby pond and reused for burning within the kilns in addition to the HFO residues. Batteries and tires are stored separately and then sold to local recycling facilities.

Health and Safety Aspects

Health, Safety and Environmental (HSE) officers are responsible for the development and implementation of several programs in order to ensure:

- Implementation of safety protocols throughout the facility;
- Development and implementation of emergency response plans;
- Training of staff for emergency responses;
- Establishment of preventive measures for fire, mechanical and electrical hazards;
- Promotion of awareness of indecent reporting procedures.

Moreover, the Occupational Health and Safety (OHS) program at CN includes: continuous healthcare coverage and services for all employees; OHS measures planning and implementation through the facility; and development of emergency preparedness procedures.

Environmental Management Plan

Environmental Management Plan (EMP) set by CN is set to establish, improve and maintain environmental conditions within the facility and its surrounding during the continuous development of the facility. The plan considers compliance with environmental laws and regulations, production processes and environmental monitoring aspects. Figure 2 provides a summary of the EMP implemented at CN.

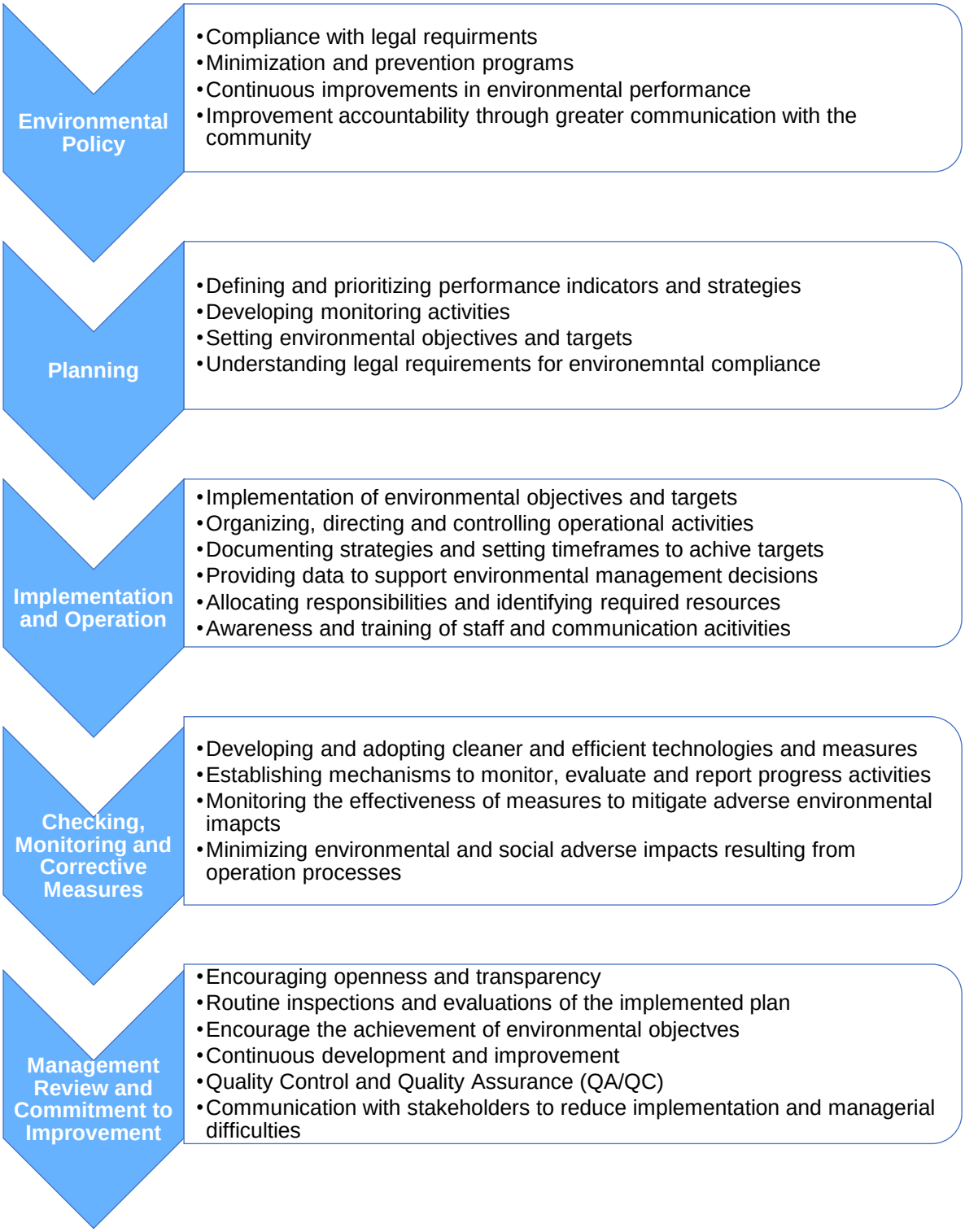

Figure 2. Environmental Management Plan of CN

Rehabilitation of the Quarry

CN is implementing a Green Belt project, which includes environmental aspects. The project creates a green separation zone between the quarry and the neighbouring villages, limiting the quarry expansion and rehabilitating the exploited areas. The first phase of the project was completed in October 2012, the long-term rehabilitation plan and creation of conservation zone of CN extends to 2031.

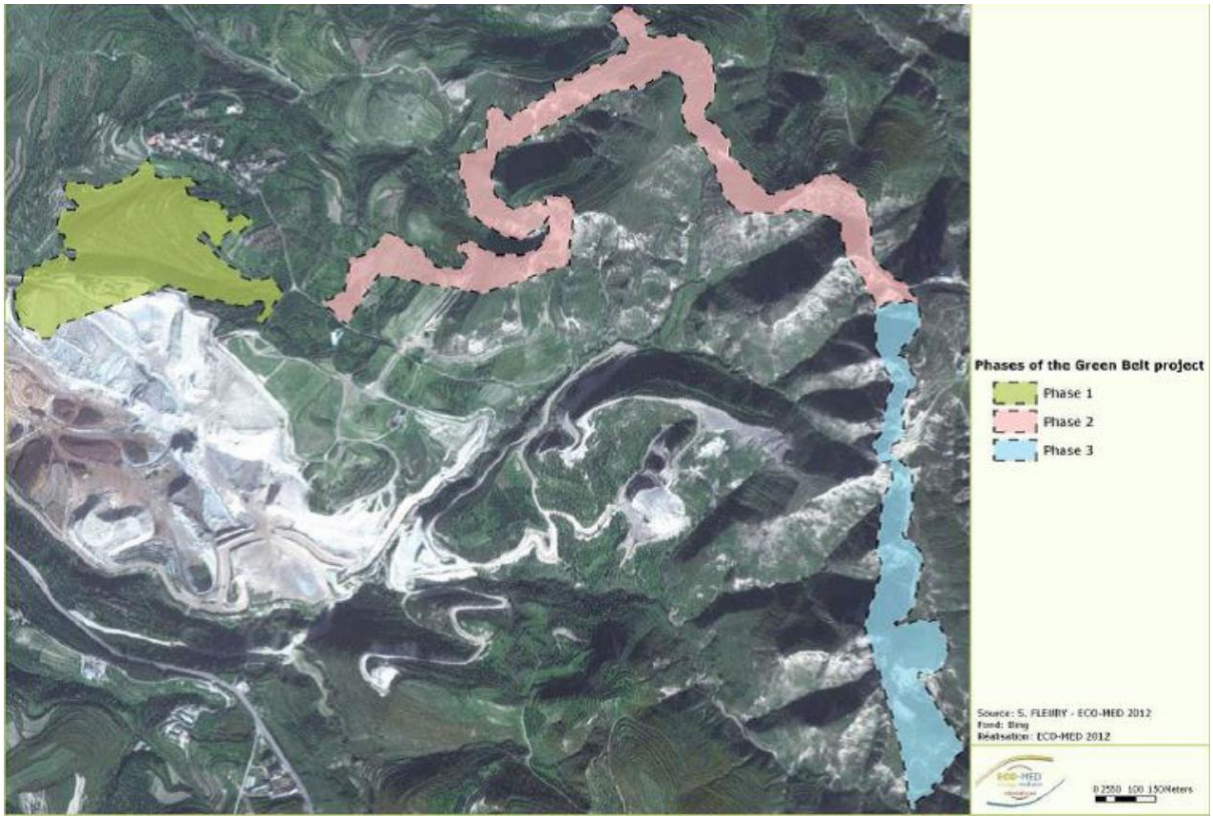

Figure 3. Phases of the Green Belt Project

Mitigation Measures

The mitigation plan identifies the actions that can be undertaken to alleviate, significantly reduce and effectively control the adverse environmental impacts associated with the operating activities of the facility.

Table 2. Environmental issues and mitigation measures at the cement manufacturing facility of Cimenterie Nationale

Issue	Mitigation measures	Responsibility	Estimated Cost
• Incidental exceedances of dust emissions from the Kiln no. 4 due to the ESP unit operation • Impact on ambient air quality	**Mitigation Measure:** Conversion of Kiln no. 4 ESP to High Efficiency Bag Filter	• CN Management (Design/Construction) • EHS Officer and Operations Manager (Operation)	EUR 709,100
	Monitoring: 1. Visual inspection of implemented mitigation measures 2. Air emissions at Kilns: Dust, O_2, CO, CO_2, SO_2, SO_x, NO, NO_X 3. Ambient Air Quality measurements inside the premises of CN: Dust, O_2, CO, CO_2, SO_2, SO_x, NO, NO_x 4. Check compliance with National Standards (or EU standards in case not provided)	• EHS Officer/ Facility Operators • Environmental Auditors (private consultant)	1. – 2. USD 750/ per measurement 3. USD 750/ per measurement 4. -
	Institutional strengthening: Instruction training to kiln operators and quality control (QC)	• CN Management • EHS Officer	USD 500/day
• Elevated NOx emissions from generators (An issue to be further assessed through additional testing)	**Mitigation Measures:** 1. Utilize end-of-pipe de-NOxing technology 2. Recirculating heat from exhaust gas 3. Exchanging the HFO with NG	• CN Management (Design/Construction)	1. EUR 2.5 million for two engines (Wartsila I/II) 2. – 3. USD 3.16/1,000,000 BTU of NG

	Monitoring: 1. Visual inspection of implemented mitigation measures 2. Air Emission monitoring of generators: Dust, O_2, CO, CO_2, SO_2, SO_x, NO, NO_x	• EHS Officer/Facility Operators • Environmental Auditors	1. - 2. USD 750/ per measurement
	Institutional strengthening: Training of generator operators	• CN Management	USD 500/day
• Propagation of dust during loading/unloading of raw material, clinker and petcoke • Propagation of dust during uncovered transportation of material within the facility and from the quarry to the production facility • Propagation of dust from long distance transportation and truck mobility, in addition to air pollution resulting from consumption of fuel	**Mitigation Measures:** 1. Install a storage area (hangar) for raw mix material (limestone/gypsum) 2. Install an enclosed conveyor belt 3. Install a storage area (hangar) for petcoke 4. Install a storage area (silo) for clinker 5. Construct a new vehicle garage in close vicinity to the working area	• CN Management (Design/Construction) • EHS Officer and Operations Manager (Operation)	1. USD 3 million 2. USD 6 – 6.1 million 3. USD 12 million 4. USD 8 million 5. USD 5 million
	Monitoring: 1. Visual inspection of implemented mitigation measures 2. Ambient Air Quality measurements inside the premises of CN 3. Check compliance with national standards (or EU standards in case not provided)	• EHS Officer/Facility Operators/Environmental Auditors	1. - 2. USD 750/ per measurement 3. -
	Institutional strengthening: • Training of workers for proper handling, transportation and storage of raw material • Establishment of good management and operation practices	• CN Management • EHS Officer and Operations Manager	USD 500/day
• Ecosystem degradation of the quarry area • Damage to the landscape • Loss of biodiversity	**Mitigation Measures:** • Rehabilitation of the quarry area and creation of conservation zones	• Quarry operations department	USD 4.37/m^2 (for year 2016)
	Monitoring: 1. Visual inspection of implemented mitigation measures 2. Submission of reports to the MoE, concerning the progress in planting trees and rehabilitation of the areas Quarry Operation/Raw Material Preparation	• EHS Officer / Quarry Operation/Raw Material Preparation. Manager • Environmental Auditors	-

	Institutional strengthening: **-**	• CN Management / Human resources	-
• Elevated noise levels around the quarry and the production area • Exposure of workers, personnel and the local community to noise pollution	**Mitigation Measures:** 1. Regular maintenance and repair of machinery 2. Use of silencers and insulating enclosures on noisy equipment 3. Organize noisy activities in separate insulated rooms 4. Place operators constantly present in noisy areas in noise proof rooms 5. Provision of workers with ear protection 6. Control of traffic speed	• CN Management • EHS Officer/ Facility Operators	1. USD 10,000/day 2. USD 112-270/m^2 of insulation 3. USD 112-270/m^2 of insulation 4. USD 112-270/m^2 of insulation 5. USD 27/person 6. USD 135/ traffic speed sign
	Monitoring: • Visual inspection of insulation installation and usage of ear protection by workers and personnel • Noise measurements at various locations close to noisy activities and nearby sensitive receptors • Check compliance with national standards	• EHS Officer/ Facility Operators • Environmental Auditors (private consultant)	1. – 2. 500-750/per measurement 3. –
	Institutional strengthening: • Training of workers to use personal protective equipment (PPE) and abiding by speed limits	• EHS Officer in collaboration with CN Management / Human resources	USD 500/day
• Dust, air and other emissions due to improper management and maintenance of machinery and equipment	**Mitigation Measures:** 1. Continuous inspection and maintenance of machinery and equipment to keep small air leaks and spills to minimum 2. Regular maintenance of vehicles (heavy vehicles, forklifts, tankers, and trucks) is essential to reduce gaseous emissions	1. CN Management / External contractors 2. CN Management	1. USD 10,000/day 2. -

	Monitoring plan: • Continuous monitoring equipment should be operated, maintained and calibrated in accordance with the manufacturers' instructions, which should be made available for inspection by the facility's operator, taking into consideration: downtime for maintenance, sudden breakdown or malfunction, spare parts replacement, fire, etc.	• CN Management / Facility Operators	-
	Institutional strengthening: • Training of operation and maintenance department staff for machinery and equipment maintenance activities based on manufacturer's instruction for all existing and newly installed units • Establishment and maintenance of proper record keeping system for monitoring maintenance and repair activities	• CN Management / Facility Operators	-

Monitoring Plan

Overall monitoring activities and responsibilities at CN is summarized in Figure 4. Table 3 reviews the monitoring indicators that are included the monitoring plan of CN.

Table 3. Characteristics of the monitoring plan

Indicators	Parameters	Frequency	Cost	Responsibility
Air Quality	Dust, O_2, CO, CO_2, SO_2, SO_x, NO, NO_x	Bi-annually (Generator stacks)	2,400 USD/year	Facility Operator/ Environmental Auditor
		Continuous (Kiln stacks)	10,000 USD/year	Facility Operator/ Environmental Auditor
	Dioxins, Furans, HF, HCL, Cd, Tl, HG, Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V	Annually (Kilns and raw mill generators during co-firing with sludge and used oil)	50,000 USD/year	Facility Operator/ Environmental Auditor
	NO_2, SO_2, $PM_{2.5}$, PM_{10} and CO	Continuous ambient air quality measurements	750 USD/year	Facility Operator/ Environmental Auditor
Wastewater effluent	pH, TSS, Temperature, Oil and Grease	Bi-annually or as requested by the MoE	500 USD/year	Facility Operator/ Environmental Auditor
Noise Level	$L_{minimum}$, $L_{maximum}$, and $L_{equivalent}$	Annually	1210 USD/ round of measurements	Facility Operator/ Environmental Auditor
Solid Waste	Domestic waste	Continuous	Not Available	Related maintenance department and Supply Chain
	Old panels & equipment, cables, and damaged parts or A/C units and Damaged electronic card			
	Old batteries			
	Corrosive fluids			
	Empty refrigerant canisters			
Soil	Dioxins, Furans, Heavy metals, PAH, PCB, HCB	Annually	1000 USD/year	Facility Operator/Environmental Auditor

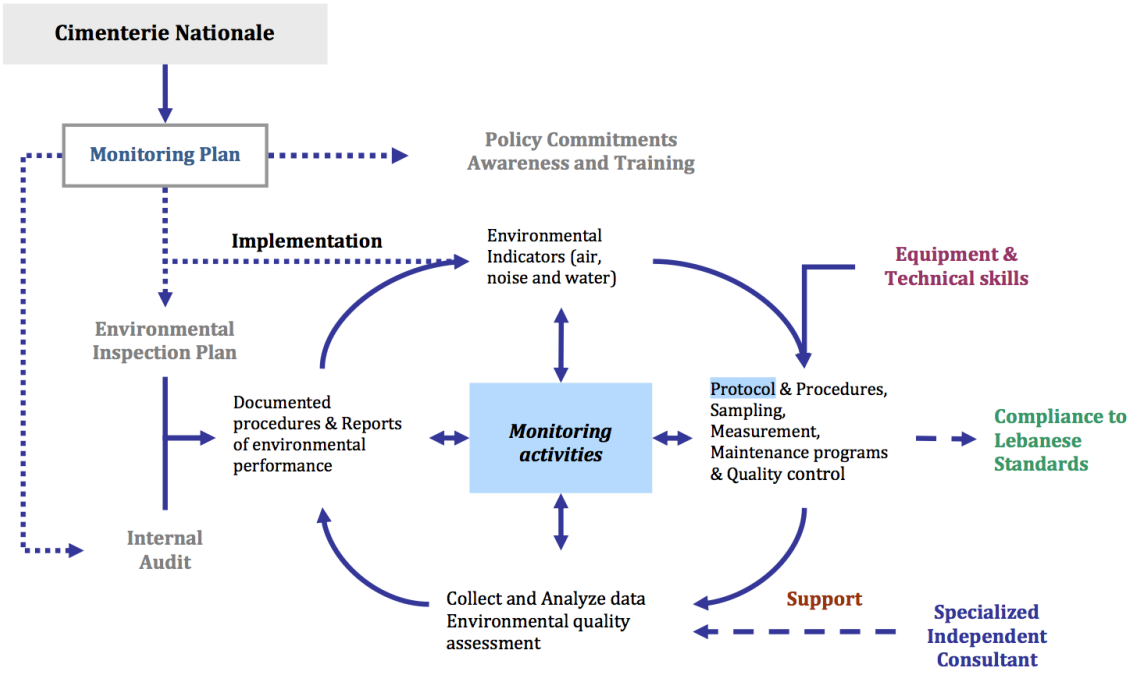

Figure 4. Monitoring activities and responsibilities