THE PROPOSED NANOTECHNOLOGY LABORATORY, WASTE WATER TREATMENT PLANT, INCINERATOR INSTALLATION, BOILER INSTALLATION, LPG BULK STORAGE AND UNDERGROUND FUEL STORAGE TANKS SEIA STUDY REPORT ON PLOT NUMBER 209/5811, DUNGA ROAD, SOUTH 'B' NAIROBI

CERTIFICATION

Certification by the EIA/EA Lead Expert(s)

I hereby certify that this Environmental Impact Assessment (EIA) project report was done under my supervision and that the assessment criteria, methodology and content reporting conforms to the requirements of Environmental Management and Coordination Act, 1999 and EMCA (amendment) 2015 and Provisions of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations 2003 which dictate the submission of such an assessment to National Environment Management Authority (NEMA).

Signature: _____ Date_____

Name:

EIA/EA Lead Expert

NEMA Reg. No. 0148

Certification by Proponent(s)

I hereby confirm that the contents of this SEIA project report are true and shall implement the mitigation measures proposed and undertake to implement further instructions as NEMA may deem appropriate in relation to the findings and from time to time as inspections may inform.

Signature: _____ Date _____

KIRDI
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ACRONYMS

DOSH - Directorate of Occupational Health and Safety

EIA - Environmental Impact Assessment

EMCA - Environmental Management and Coordination Act

EMP - Environmental Management Plan

KIRDI - Kenya Industrial Research and Development

MoH - Ministry of Health

NACOSTI- National Council for Science, Technology & Innovation

NEC - National Environmental Council

OHSMS - Occupational Health and Safety Management System

PPE - Personal Protective Equipment

WRMA - Water Resource Management Authority

WHO- World Health Organization

ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

Project description

The proposed KIRDI Research, Technology and Innovation Techno Centre intents to put up a Nanotechnology laboratory. The facility will be put up in Basement four (4) of the proposed KIRDI Research, Technology and Innovation Techno Centre in South B, off Dunga Road. The Nanotechnology laboratory is however interrelated to other development components that all require approval and licensing from NEMA. To function properly, the laboratory will require a water treatment plant to ensure waste water emanating from the specialized lab is treated as per the approved schedules before disposal to the main public sewers operated by Nairobi Water and Sewerage Company. The solid waste from the facility will mostly be autoclaved and combusted and the services of an incinerator are required which in turn require a stable fuel source from either an underground fuel storage or LPG bulk storage. A boiler shall also be installed alongside the incinerator in the ground floor to supply heated water or steam as need arises. These related infrastructures require EIA License for their installation but the proponent will seek an umbrella license covering all those subcomponents since they will be installed in the same parcel of land and run by the proponent and they are all related to functionalities of Nanotechnology laboratory.

The consultant, Prof George Ngugi and Associates undertook EIA study for the Techno centre and came up with a report that NEMA reviewed and issued an umbrella license Ref. No. PR/ 10,279 on 16th day of November 2012 that covered the whole development project. Nanotechnology laboratory's requirement for Social Environmental Impact Assessment license is a specific subset of the whole Techno Centre EIA study report.

Social Environmental Impact Assessment study was conducted for and on behalf of the proponent in compliance with Environmental Management and Coordination Act, 1999 and EMCA (amendment) 2015 and Provisions of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations 2003 also dictate the submission of such an assessment to the National Environment Management Authority (NEMA). The Terms of Reference covers all the other four (5) components that are related to the establishment of a Nanotechnology laboratory. These related components are:-

- Installation and operation of Incinerator
- Installation of the boiler
- Installation of waste water treatment plant
- Installation of an underground oil storage
- Installation of LPG Bulk storage

The study examined the potential impact of each of the above components' proposed project activities on the staff and surrounding environment during installation, operational and decommissioning phases of the project. It encompassed all aspects on the physical, economical, ecological, socio-cultural, health and safety conditions at the site and its environs and was based on laid down scientific qualitative procedures with the most recent methodologies and analysis required in establishing a Nanotechnology laboratory. The relevant legislative framework governing the installation, operationalization and decommissioning were adhered to as well as the draft National Nanotechnology Policy 2015.

Kenya's quest for Nanotechnology Laboratory is purely to boost Industrialization as a key priority area in the country's agenda 4 development plan. Industrialization is a major ingredient for wealth creation and employment and the government of Kenya intends to transform the country from a low to a middle income economy by the year 2030. World-wide, nanotechnology was incorporated into manufacturing goods worth over $30 billion in 2005 and the projections for 2015 indicated business worth over $2.6 trillion. Nanotechnology promises more for less. This is because nanotechnology products are smaller, affordable, lighter and faster with greater functionality, using fewer raw materials and consuming less energy as compared to conventional technologies.

Currently, Kenya is lagging behind in research, development and uptake of Nanotechnology. Nanotechnology can be applied across various fields including: the ICT sector especially in Nanoelectronics, National Security and Safety, Water and sanitation, Energy sector, Nano-materials and manufacturing, Nano-agriculture, Nano-medicine and health, Public awareness through education on Nanotechnology, Infrastructure development, Mining and Chemical technology.

Nanotechnology has enormous potential for socio-economic and environmental benefits from innovative medical techniques to savings on material and energy as well as advances in detection and remediation of pollution. Nano science and Nanotechnology have been identified as priority areas for development by the National Science, Technology and Innovation policy. Nanotechnology is the manipulation of matter on an atomic and molecular scale. Generally, nanotechnology works with materials, devices, and other structures with at least one dimension sized from 1 to 100 nanometres. Nanotechnology today is regarded as a revolutionary technology. Worldwide, there has been an increasing interest in nanotechnology as evident from the rising trends in investment and policy initiatives directed towards this end. The national Nanotechnology policy takes cognizance of the need to diversify and expand markets for nanotechnology value added products and services.

Key benefits of Nanotechnology will include:

- Energy generation, storage and saving
- Nano-medicine through cheaper diagnosis and pharmaceuticals
- Enhanced agricultural productivity by efficient farming methods
- Environmental management and protection
- Health and Sanitation through water Nano-filters
- Enhancing research and technology transfer
- Advanced Information communication technology systems

EIA objectives

The objectives of the assessment were:

- To provide a description of the proposed project cycle activities and the required legislative compliances
- To predict and/or determine the potential impacts of the development in terms of the economic, social and environmental considerations for all the five related facilities
- To propose appropriate mitigation measures to minimize or eliminate the environmental impacts associated with the development of all the five related facilities
- To promote sustainable industrial development for the production, commercialization and procurement of nanotechnology-derived products
- To establish mechanisms to address ethical issues relating to nanotechnology
- To undertake a public consultative process aimed at obtaining the views of project stakeholders so as to mainstream their concerns and impact mitigation proposals into the Environmental Management Plan (EMP)
- To analyze the project alternatives
- To promote the creation of Nanotechnology centers of excellence
- To promote public awareness on the potential benefits of nanotechnology

Consultation and Public participation

An extensive public consultation process was undertaken including guidelines on the legislative framework for Nanotechnology as laid down by the National Commission of Science, Technology and Innovation (NACOSTI) National Nanotechnology policy under ministry of Education. The development shall recognize the need to exploit nanotechnology in order to increase productivity and competitiveness in all sectors of the economy. The Kenya Association of Manufacturers (KAM) is an umbrella body that encompasses all manufacturing firms and private sector players who can shape adoption of the applications of Nanotechnology laboratory. Ministry of Health (MoH) and World Health Organization (WHO) are also key partners. The

neighbouring establishments were also adequately consulted to array any fears and concerns that may arise from this establishment and the related facilities. Data collection on these responses will be actualized through use of a tailor made data collection tool for semi-structured questionnaires and interviews. The consultation process revealed the stakeholders wish to see the actualization of the proposed EMP and their recognition of the enormous economic opportunities which this project presents.

Environmental Impacts and Mitigation

The EIA team noted positive and negative impacts from installation, operationalization and possible decommissioning of the Centre and related facilities with ecological and socio-economic dimensions. The overall aim of the project is ensuring an environmentally friendly development through maximum containment of the Centre and minimized negative effects that may endanger the lives of the staff or the surrounding environment. The activities that are likely to lead to significant environmental impacts were installation of equipment, the handling of the chemicals, handling of fuels, air quality impacts from incinerator combustion, generated waste water, addressing health and safety of the staff through Personal Protective Equipment (PPEs), the generation and decontamination of lab effluent, solid and liquid waste handling. Appropriate mitigation measures have been discussed and an elaborate EMP outlined.

Conclusion

On the basis of the evaluation of the development proposal, the EIA team concludes that:

- The project is a new innovation that requires specialized training and precision and there is need to adhere to both national Nanotechnology policy and WHO biosafety manual and any other regulations from relevant authorities.
- The development of this project is considered economically viable, socially acceptable and environmentally sound if EMP outlined is adhered to and regular audits for continual improvement undertaken.
- This SEIA project report therefore presents findings of "no significant impacts".

Recommendation

The EIA team recommends that:

- The proponents be issued with an EIA license on condition that the proposed EMP will be implemented in line with other conditions that NEMA may impose during the decision making process.
- The proponents should use the EMP as monitoring and evaluation tool to submit an Environmental Audit report to NEMA annually or as may be directed by the Authority without fail.

- ❖ The proponents are obliged to undertake all the operations within the applicable legal limits.
- ❖ The proponent conducts regular EIA audit based on the Environmental Management Plan (EMP) for this Nanotechnology laboratory for continuous improvement

CHAPTER ONE

1.0 Introduction

For a long time, policy makers the world over have been directing all their energy in economic development at the expense of the environment on which economic development depends on. There had been no integration of environmental concerns into the project design, planning and management. As a result, there has been unprecedented degradation of the environment during project implementation, operational and decommissioning phases. Realizing that human welfare is endangered, there has been global consensus to revitalize the degraded environments and promote sustainable economic development. Nowadays, all proposed development activities and their subsequent operations are required by law to be examined critically so as to identify and evaluate the impacts (both positive and negative) that they are likely to have on the environment and propose possible mitigation measures prior to their implementation.

The Environmental Management tool that ensures integration of environmental concerns in a new project before its implementation is the Environmental Impact Assessment (EIA) study as emphasized in the Environmental Management and Coordination Act (EMCA) of 1999 amended 2015. EIA identifies both negative and positive impacts of the proposed project on people, their property and the general environment and should only be carried out by the National Environmental Management Authority (NEMA) registered experts as stipulated in the EMCA, Environmental Impact Assessment and Audit Regulations of 2003.

1.1 Scope and Criteria

The study was carried out to identify and evaluate the environmental impacts of the proposed development of a nanotechnology laboratory and related facilities at KIRDI South B complex off Dunga Road in Nairobi County as a subset of KIRDI Research, Technology and Innovation Techno Centre EIA study report (Ref. No. PR/ 10,279) issued by NEMA on 16th day of November 2012. Upon evaluation, recommendations were made on the enhancement of positive impacts and mitigation of negative ones. The scope for the assessment dwelled on the likely impacts the project would have on the following:

- Physical environment of KIRDI Research and Technological Centre and her neighbours
- Socio-cultural environment.
- Equipment Installation and setup of the Nanotechnology laboratory and integration to surrounding environment
- Operationalization of the Laboratory, use and maintenance of equipment
- Staff and support staff/ visitors safety through continuous training

- Health and safety of staff and the surrounding community
- Decommissioning of the Laboratory and the related facilities.

The study was commissioned largely to comply with provisions of the Environmental Management and Coordination Act (EMCA) of 1999, (amended) 2015 and the Environmental (Impact Assessment and Audit) Regulations of 2003. However, due to the nature of operations envisaged in the Laboratory, the expert has also taken due consideration to WHO Guidelines and common international best practices, equipment licensing from Kenya Nuclear Regulatory Authority (KNRA) in set up of this calibre of projects to inform Social Environmental Impact assessment undertaken.

1.2 Terms of Reference

The SEIA specific terms of reference are:

- Prepare an executive summary
- Provide in-depth description of the proposed project with description of site inclusive;
- Providing baseline information
- Undertake baseline air quality monitoring and reporting as per air quality guidelines 2014
- Undertake baseline soil analysis for presence of hydrocarbons
- Description of key components of each of the 5 related subcomponents of works such as installation, operationalization and decommissioning
- A review of the policy, legislative and administrative framework for the proposed development project and related infrastructure likely to negatively affect environment;
- Public participation for each of the 5 related subcomponents for the study report and a stakeholder mapping and analysis for the Laboratory;
- Identify and assess sources of adverse environmental impacts for each of the 5 installations for the components (installation, operationalization and decommissioning) of works;
- Assessment of economic and socio-cultural impacts to the local community and the nation in general for each of the 5 subcomponents;
- Provisions for Health and safety of workers including support staff and Operations and maintenance workers for each of the 5 installations
- Provide analysis of alternatives to each of the proposed development project components including project site, design and technologies and the reasons for preferring the proposed site, design and technologies
- Prepare an elaborate Environmental Management and Monitoring Plan (EMMP) for each of the 5 components of the study
- Give a conclusion and recommendations that ensure the proposed project's sustainability
- Prepare the SEIA report
- Submit the required hard copies and soft copy of the SEIA report to NEMA to allow review and approval of the proposed project by NEMA

1.3 Location of the site

The proposed project is situated on LR. No **209/5811**, South B area of Nairobi County, off Dunga road. The parcel of land lies on coordinates 1^0 18'36.00 S and $36^0$49'58.80 E. The Nanotechnology Laboratory project site is at basement four (4) of the proposed KIRDI Technology Centre (Research, Technology and Innovation Laboratories and related infrastructure). The basement 4 is the last basement floor and shall house the Nanotechnology Laboratory. The only other use of the floor is the showers for the staff, nano pits in the middle of the Laboratory, lifts for VIPs, staff and goods, and a conservancy tank where all Nanotechnology effluents shall be held prior to decontamination and pumping to the main Effluent(waste water) treatment plant on the 3rd floor podium (utility room). The Incinerator is located in back rooms at ground floor alongside the boiler situated adjacent to each other while the Underground storage tanks (for providing fuel for the incinerator, boilers and the generator) are located 30 feet away on the backside of the building as well though they are installed underground but inlets and outlets are on the ground floor surface. Further from USTs is the bullet tanks (LPG Bulk storage). The overall site is located in a fully developed mixed land use area with neighboring government and private commercial firms. The current land use is commercial establishments but this project aspires to establish a research hub for public utility and support of private entities through commercialized technologies.

Fig 1.1: Photo of the Nanotechnology Laboratory in KIRDI's Research, Technology and Innovation Laboratories complex's Basement 4

Fig 1.2: Nano pits within the Nanotechnology Laboratory

Fig 1.3: Photo of the proposed KIRDI's Research, Technology and Innovation Laboratories complex in South B off Dunga Road extended view

1.4 Project Justification

Nanotechnology is an emerging technology with unlimited potential in shaping many spheres of industrial applications in Kenya and her neighbors with potential to reach transformational benefits that have not been realized even during the revolutionary technologies of the past. This will be achieved by purposeful design, characterization, production and application of structures, devices and systems by controlling shape and size at nanometer scale 1-100 nm. Applications for nanotechnology will include manufacturing various products, measuring, imaging and manipulating matter on nanoscale. Currently, there are other Nanotechnology laboratories in South Africa, Botswana and Egypt. Kenya aspires to establish the first laboratory of its kind in Eastern Africa. There are varied highly desirable applications of nanomaterials based on physiochemical characteristics like electrical conductivity, thermal conductivity, mechanical and imaging properties to suit commercial, medical and environmental sectors. Nanomaterials have the ability to improve the quality and performance of many consumer products. Understanding of characterization in the laboratory and industrial applications will inform the use of nanomaterials for developing nanoparticles for nanocomposites, biocomposites, optical applications, biomedical and electronic manufacturing. The nanomaterials

will make the products better in terms of functionality, weight savings, less energy consumption and a cleaner environment as less waste is generated during production. The composites that will be utilized like graphene are consumed in very small quantities with amplified benefits. Exceptional size dependent functions and properties like surface activity, electrical, magnetic and optical properties and shape as well will influence applications of nanomaterials to cancer diagnosis, high-performance batteries based on nanostructured electrodes, single walled carbon nanotubes for diverse information and communication technology devices and antimicrobial nanomaterials for the cosmetics, food and clothing industries using intelligent multifunctional nanoparticles.

There will be diverse applications for nanotechnology in various sectors as outlined:-

Automotive sector will apply nanomaterial properties to ensure light weight construction, painting effectiveness, better tire properties, improved sensors and hybrid automoblies

Chemical industry will benefit from more effective fillers for paints, production of composite materials, impregnation of papers, more effective adhesives

Construction industry will benefit from development of materials with better insulation properties, flame retardancy and improved surface coatings scrapping multifunctional film coatings for one layer coating

Cosmetics industry will seek cheaper and more effective sunscreens, lipsticks and toothpaste

Electronics will be improved better lighting systems, more efficient fuel cells like solar cells, batteries and capacitors

Data memories will be improved through production of improved fibre optics, optical switches

Engineering tools will be improved by protective coatings for tools and machines as well as production of lubricant free bearings

Environmental Monitoring shall be improved by development of devices for soil and ground water remediation using toxic Exposure Sensors and Fuel changing catalysts

Food and drink industry will be improved through enhanced packaging, developing storage life sensors

Household products will be improved through ceramic coating for irons, production of odor removers and developing glass cleaners

The medicine industry will be enhanced through Drug delivery systems,rapid testing systems, prostheses and implants , developing anti microbial agents and In-body Diagnostic systems

Sporting industrial applications shall include manufacture of tennis balls and racquets, golf club balls, anti fouling coatings for spotting boats as well as manufacture of anti fogging coatings for glasses and googles.

Security applications shall include manufacture of neutralization materials for chemical weapons while in textile industry can have applications for surface coatings to produce ‘smart’clothes.

1.5 Methodology

Participatory methodologies were employed during the study. They included consultations and observations with a wide variety of stakeholders. The tools employed for this assessment were:

- Desktop review pertaining to project activities and salient environmental, socio-economic and other features of the project area;
- Analysis of topographical and other relevant demographic documentation;
- On site reconnaissance surveys to interrogate the various expected impacts
- Structured interviews with key project stakeholders through administration of questionnaires

CHAPTER TWO

STUDY AREA

2.0 Environmental Baseline

This section presents a status report on the situation of the development within the context of Nairobi County as a whole. The baseline offers both the present and future states of the environment and also takes into account changes which might be occasioned by both natural and anthropogenic activities.

2.1 Administrative location

South B is a suburb of Nairobi that was until the early 1980s composed of residential homes and a few shops. The area has since developed into a major commercial and economic area outside the Central Business District of Nairobi.

2.2 Climate

Nairobi County has a fairly cool climate resulting from its high altitude. Temperature ranges from a low of 10^{o}C to a high of 29^{o}C. It has a bi-modal rainfall pattern. The long rains season fall between March and May with a mean rainfall of 879 millimetres (mm) while the short rains season fall between October and December with a mean rainfall of 638 mm. The mean annual rainfall is 750.5 mm (Nairobi County Integrated Development Plan, 2014.

2.3 Physical Environment

Topography: The land gently slopes at an altitude of 1688m.

Hydrology: The closest river to the project site is Ngong River at a distance of about 500metres from the project site. This is the nearest surface water.

Geology: The rocks in the Nairobi area mainly comprise a succession of lavas and Pyroclastic of the Cainozoic age and overlying the foundation of folded Precambrian schist's and gneisses of the Mozambique belt (Saggerson, 1991). The crystalline rocks are rarely exposed but occasionally fragments are found as agglomerates derived from former Ngong volcano. Geotechnical investigations of the site are ongoing. This will give more detailed information on the geology.

Soils: The project site is characterized by black cotton soils plus rock. The soils of the Nairobi area are products of weathering of mainly volcanic rocks. A number of subdivisions are recognized in the Nairobi area according to drainage, climatic regions and slopes, and other categories have been introduced for lithosols and regosols. A baseline soil analysis will be undertaken to establish the level of hydrocarbons prior to the operationalization of the Nanotechnology Laboratory. This will form a

basis for continual monitoring and audit of the impacts of the incinerator activities, Nanotechnology lab, underground storage tanks and bullet tanks (LPG Bulk Storage) to assess the effectiveness of the Environmental Management plan as the monitoring tool for levels of hydrocarbons and heavy metals pollution on the surrounding environment especially negative impacts on underground water resources that are likely to negatively affect human health when there are seepages to drilled boreholes or surface run offs to downstream water users. The deviations from the baseline surveys will call for mitigation measures especially where allowable levels of heavy metals and hydrocarbons as per WHO or any other guidelines adopted by Kenya government are exceeded. The SEIA report will be accompanied by baseline soil analysis results from a NEMA registered laboratory attached as an appendage.

2.4 Socio-economic setting

The KIRDI National research, technology and Innovation Centre has been flagged as one of the national projects to drive the manufacturing agenda of the current big four agenda under Medium Term Plan MTP 3(2018-2022). The Nanotechnology Centre of excellence is expected to be completed and offer requisite skills and technology for the MsMEs streamlined manufacturing sector. Kenya Association of Manufacturers is the umbrella body that can help in advocating for the uptake of Nanotechnology among the sector players in the manufacturing field.

2.4.1 Infrastructure facilities

i. **Energy Sources:** The proposed project area gets the bulk of its energy supply from the Kenya Power and Lighting Company (KPLC). The site will be connected to the national grid. The incinerator will as well get bulk fuel supply through underground fuel storage or LPG bulk storage to be installed as a related facility to the Nanotechnology Laboratory. Hot water and steam shall be sourced from a boiler to be installed adjacent to the incinerator. 3 generators (two of 630 KVA each and one of 300 KVA shall be installed at the mezzanine floor to ensure continuous activity during power interruptions.

ii. **Water Sources:** The project area is well served with piped water from the Nairobi Water and Sewerage Company (NCWSC). The proponent will also sink a borehole to augment the supply from the NCWSC.

iii. **Transport and communication: -**

Roads: The project area is well served by a good road network which is tarmacked. The site is accessed via Dunga road and Lusaka road and is in close proximity to the Jomo Kenyatta International Airport and Syokimau Railway station.

Communication: The area is well covered by all mobile service providers (Safaricom, Airtel, Orange and YU) and Telkom Kenya (Land line).

Sanitation: The project area has a sewer line connection. It is served by the Nairobi City Water and Sewerage Company. The proponent will as well install a waste water treatment plant at the utility room of the third floor where all waste water shall be pumped to so as to be decontaminated and treated for reuse in gardening, urinals and toilet flushing according to specified schedules as per water regulations 2009.

2.5 Solid Waste

The main waste generation sources are domestic (offices), commercial ventures and institutions common manufacturing facilities. The types of waste that are generated can be classified as follows.

- Mixed heavy plastics -Soft drink bottles, detergent bottles, cooking oil/fat bottles, household plastics etc.
- Ash from the incinerator
- Mixed paper - Books, office paper, newspapers carton pieces etc.
- Metals -Pieces and sheets of aluminum, steel and other metals
- Mixed glass - Colored and non-colored, broken or whole glass bottles, panes, household glass items etc
- Organics - Food remnants, wooden debris
- Nanowaste

All types of solid wastes will be sorted at the source, reused, recycled or disposed by incineration to be installed at the ground floor, next to the boiler as per the set out legal requirements.

CHAPTER THREE

3.0 Policy, Institutional and Legal Framework

3.1 Introduction

The Environmental Management and Coordination Act, 1999 and EMCA (amendment) 2015 and Provisions of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations 2003 was enacted to harmonize and co-ordinate environmental management issues in Kenya by providing for the establishment of an appropriate legal and institutional framework for the management of the environment. Topmost in the administration of EMCA is the National Environmental Council (NEC) which formulates policies, sets goals and promotes environmental protection programs while the implementing institution is NEMA.

Many other institutions (both national and international) deal with environmental issues and they include the Kenya Forest Service (KFS), the Kenya Wildlife Service (KWS), Water Resource Management Authority (WRMA), the National Museums of Kenya (NMK), Kenya Maritime Authority (KMA), World Bank among others.

According to Kenya National Nanotehnology draft policy 2015, Kenya does not have a comprehensive law on nanotechnology. However, the Kenya Nuclear Regulatory Authority (KNRA) will undertake the inspection of the premises as it shall install equipment that release X-Ray radiations to the environment so as to ensure there are means in place for the containment of rooms that host them. On the other hand, many of the areas in which nanotechnology finds application is subject to different regulatory regimes and policy frameworks including Science, Technology and Innovation Act 2013, Environmental Management and Coordination Act No.8 of 1999 amended 2015, Standards Act Cap 496, Food Drugs and Chemical Substances Act Cap 254, Public Health Act Cap 242, Animal Diseases Act Cap 364, OSHA Act 2007, KIPI Act 2013.These are complex issues from a regulatory perspective. It is therefore anticipated that going forward, one of the main challenges regulatory institutions in Kenya will face will be in the area of regulatory capacity, information asymmetry and the question of inter-agency coordination.

The relevant regulations which were reviewed prior to carrying out this EIA for submission to NEMA and subsequent approval are:

3.2 Environmental Management and Coordination Act No 8 of 1999, Amended 2015

The proponents have undertaken this EIA in order to comply with sections 58 to 67 and 138 of EMCA No. 8 of 1999, amended 2015 and the Environmental (Impact Assessment and Audit) Regulations 2003 (Legal Notice No. 101) which require that all projects listed under the second schedule of the Act undertake an EIA before commencement. The EIA reports are then to be

submitted to the National Environment Management Authority (NEMA) for review and eventual licensing before a development commences. This should be followed by annual environmental audits to determine the project compliance with the environmental regulations.

3.3 Environmental (Impact Assessment and Audit) Regulations 2003, amended 2019, Legal notice No. 31 and 32 of 2019.

These Regulations stipulate how an EIA will be undertaken and what the EIA study report should contain. It also provides regulations on Environmental Audits (EA), which the proponent will be required to undertake.

NB: It is important to note that the proponent will fully comply with section 17 part 1 of EMCA regulation which states that "During the process of conducting an environmental impact assessment study under these Regulations, the proponent shall in consultation with the Authority, seek the views of persons who may be affected by the project"

3.4 The Waste Management Regulations-2006

The EMCA Waste Management Regulations, 2006 is the governing law for waste management in Kenya. This regulation is described in Legal Notice No. 121 of the Kenya Gazette Supplement No. 69 of September 2006. The objective of this Regulation is to protect human health and the environment. The regulations consist of eight parts and classify various types of waste and recommended appropriate disposal methods for each waste type. This also contains requirements for handling, storing, transporting and treatment of all waste categories as provided therein. The regulations also specified a series of responsibilities for the waste generator. As Kenya develop towards achieving Vision 2030 its imperative that all forms of development and waste associated with it is managed in a responsible manner. All waste (other than the hazardous waste) at all phases of the project shall be separated at source and disposed off in accordance with this act. Waste production shall be minimized as much as possible.

3.5 The Water Quality Regulations -2006

The EMCA Water Quality Regulation – 2006 deals with protection of water quality and applies to drinking water, industrial water, effluent discharge, water used for agricultural, recreational, fisheries, wildlife and other purposes. This Act is divided into 6 Parts as follows:

- Quality standards for sources of domestic water;
- Monitoring for sources of domestic water;
- Standards for effluent discharge into the environment;
- Monitoring guide for discharge into the environment;

- ❖ Standards for effluent discharge into public sewers and,
- ❖ Monitoring for discharge of treated effluent into the environment

3.6 Physical Planning Act, (Rev 2009)

Section 36 states that if in connection with development application a local authority is of the opinion that, the proposed activity will have injurious impact on the environment, the applicant shall be required to submit together with the application an Environmental Impact Assessment report. The environmental impact assessment report must be approved by the National Environmental Management Authority (NEMA) and followed by annual environmental audits as spelled out by EMCA 2015. Section 38 states that if the local authority finds out that the development activity is not complying to all laid down regulations, the local authority may serve an enforcement notice specifying the conditions of the development permissions alleged to have been contravened and compel the developer to restore the land to its original conditions

3.7 Public Health Act Cap 242 (Revised 1986)

Part IX section 115 of the Act states that no person or institution shall cause nuisance or condition liable to be injurious or dangerous to human health. Section 116 requires that local authorities take all lawful necessary and reasonable practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable to injuries or dangerous to human health. Nuisances under this Act include any noxious matter or waste water, flowing or discharged from any premises wherever situated, into any public street, or into the gutter or side channel of any street or watercourse, or any accumulation or deposit of refuse or other offensive matter. Every municipal council and every urban area council may make by-laws as to buildings and sanitation

3.8 Occupational Safety and Health Act, 2007

The Act covers provisions for health, safety and welfare of workers in any place of work. The Act states that before any premises are occupied, or used, a certificate of registration must be obtained from the chief inspector. The occupier must keep a general register.

3.8.1 Safety

Training and supervision of inexperienced workers should also be conducted. Floors, passages, gangways, stairs, and ladders must be soundly constructed and properly maintained and handrails must be provided for stairs. Adequate and suitable means for extinguishing fire must be provided in addition to adequate means of escape in case of fire must be provided.

3.8.2 Health

The premise must be kept clean, daily removal of waste from the site, free from effluvia arising from any drain, sanitary convenience or nuisance and without prejudice to the generality of foregoing provision. The circulation of fresh air must secure adequate ventilation of the development. There must be sufficient and suitable lighting in every part of the workplace in which persons are working or passing.

3.9 Building Code 2000

This by-law recognizes the Local authorities as the leading planning agencies. It compels potential developers to submit development application for the approval. The local authorities are hence empowered to approve or disapprove any plans if they do or don't comply with the law respectively.

Any developer who intends to erect or renovate a building as herein proposed must give the respective local authority a notice of inspection before the erection of the structure. On completion of the structure, a notice of completion shall be issued by the local authority to facilitate final inspection and approval. No person therefore shall occupy a building whose certificate of completion has not been issued by the local authority.

Section 214 of the by law requires that any public building where the floor is more than 20 feet above the ground level should be provided with firefighting equipment that may include one or more of the following: - hydrants, hose reels and fire appliances, external conations portable fire appliances, water storage tanks, dry risers, sprinkler, drencher and water spray spring protector system.

3.10 Environmental Management and Coordination (Noise and Excessive Vibration, and Pollution Control) Regulations, 2008

The contractor shall put in place all applicable measures in order to manage impacts of noise, vibration and pollution. These measures will save the proponents the costs of applying for noise licenses from the Authority as under r*egulation 16 (1)* as stated below.

> *Where a sound source is planned, installed or intended to be installed or modified by any person in a manner that such source will create or is likely to emit noise, or excessive vibrations, or otherwise fail to comply with the provisions of these Regulations, such person shall apply for a license to the Authority.*

3.11 Air Quality Regulations 2014

The proponent shall ensure the Nanotechnology Laboratory and the related facilities that are likely to negatively affect air quality which is a level 4 biosafety laboratory as per the WHO manual categorization is well contained to prevent, control and abate air pollution to ensure clean and healthy

ambient air for both internal and external environment as set out under part 1 of the Fifth Schedule. The proponent shall as well file an emission assessment report with NEMA on a regular basis. The incinerator emissions shall be monitored so that they do not pose negative health impacts to the surrounding population.

The objective of these Regulations is to provide for prevention, control and abatement of air pollution to ensure clean and healthy ambient air. The overall objective is to protect human health and to allow for safety. The regulations under section 31 require an owner or occupier of a controlled facility shall- (a) inform the workers of the hazards in specific work environments; (b) train the workers on the potential hazards of any hazardous substance to which they are exposed and the safety precautions to be taken to prevent any harm to their health; (c) Take exposure reduction measures recommended under Part IX of the Fifth Schedule of these regulations The regulations prohibit, any person from causing the emission of air pollutants (such as liquid and gaseous substances) and suspended particulate matter listed under Second Schedule (Priority air pollutants) to exceed the ambient air quality levels as stipulated under the Second Schedule (Ambient air quality tolerance limits) and Seventh Schedule (Emission limits for controlled and non-controlled facilities). The proponent will engage a NEMA accredited laboratory to undertake baseline ambient air quality assessment prior to installation of the facilities. This will form the basis for continuous monitoring and mitigation as per the second schedule and seventh schedule as well as the Environmental management plan. The results of the air quality baseline survey results from the contracted laboratory shall be attached to the SEIA report during submission for issuance of the NEMA SEIA license. The parameters to be tested are SO_2, NO_2, CO, O_3, TVOCs, $PM_{2.5}$ and PM_{10}

3.12 Rio Declaration on Environment and Development (1992)

Principle No. 10 of the declaration underscores that environmental issues are best handled with participation of all concerned citizens at all the relevant levels. At all levels, each and every individual shall have appropriate access to information concerning the environment that is held by public authorities. The proponents encouraged and facilitated public participation at the site.

CHAPTER FOUR

4.0 Project Description

4.1 Introduction

Nanotechnology is the manipulation of matter on an atomic and molecular scale. Generally, nanotechnology works with materials, devices, and other structures with at least one dimension sized from 1 to 100 nanometres. Nanotechnology today is regarded as a revolutionary technology. Worldwide, there has been an increasing interest in nanotechnology as evident from the rising trends in investment and policy initiatives directed towards this end. The national Nanotechnology policy takes cognizance of the need to diversify and expand markets for nanotechnology value added products and services.

Key benefits of Nanotechnology will include:

- Energy generation, storage and saving
- Nano-medicine through cheaper diagnosis and pharmaceuticals
- Enhanced agricultural productivity by efficient farming methods
- Environmental management and protection
- Health and Sanitation through water Nano-filters
- Enhancing research and technology transfer
- Advanced Information communication technology systems

Nanoscale materials also have far larger surface areas than similar volumes of larger-scale materials, meaning that more surface is available for interactions with other materials around them, making nanomaterials ideal for many applications that require high surface area, such as batteries. If you have block of a material, only its surface will interact with its surroundings. If more surface is exposed, then more of the material is available for a reaction. Cutting up that block of material will increase its surface area while keeping the total amount of material the same. Using high-powered microscopes and precision instruments, scientists and engineers can manipulate and control nanoscale materials in a purposeful way.

The KIRDI Research, Technology and Innovation Laboratory complex envisioned the role that a nanotechnology laboratory will play in this Multi-disciplinary research entity and purposed for the inclusion of this facility to not only promote research on applications of nanotechnology but also play an integral role of enhancing the desired qualities of materials to optimize usefulness while greatly reducing the required quantities of the resources used. The end users are a mix of public and private entities that are involved in productions, processes and manufacturing of different categories of consumer products. It will play a key role in uplifting SMEs, reduce the trade imbalance as local manufacturing will be promoted and create employment opportunities

and promote both internal trade and boost exports especially in the Eastern African Regional market.

The following fields have experienced transformational changes and much can still be done in the Kenyan context

Nanomedicine

The application of nanotechnology in medicine enables precise solutions for disease prevention and diagnostic treatment. This includes new imaging tools like improved on-a-chip technologies for rapid testing in a doctor's office gene sequencing technologies; nanoparticles that can transport medication directly to cancer cells, minimizing damage to tissue; and graphene nanoribbons to help repair spinal cord. Scientists are developing smaller and more affordable sensors that can be worn on the body to detect disease or to monitor physiological functions such as temperature or heartbeat. For example, nanomaterials are being used to make flexible, stretchable substrates that conform to the body, allowing doctors to remotely monitor your health and vital signs. Coaches and trainers could use these sensors to monitor athletes to help them reach their peak performance.

Environmental Monitoring and Clean-up

Nanotechnology-enabled sensors and solutions are now able to detect and identify chemical or biological agents in the air, water, and soil with much higher sensitivity than ever before. A smartphone extension has been developed to help firefighters monitor air quality around fires. Researchers have also tested a reusable carbon nanotube sponge for cleaning up oil that can absorb up to 100 times its weight. Drinkable water purification using nanomaterials. Nanocoatings that can be used to prevent organisms from growing on membranes and other surfaces are also being used. Flexible, bendable, foldable, rollable, and stretchable electronics are being integrated into a variety of applications in medicine, athletics, aerospace, and the Internet of Things.

Future potential uses include tablet computers that can roll up to fit in your pocket or clothing and appliances with built-in, flexible displays. Companies have developed novel methods for using nanomaterials to refine crude oil into high-value products. Nanomaterials are also reducing cost and improving production. Scientists have developed sensors that can quickly detect e leaks for faster repairs and less waste. Transistors, the basic switches that enable computing, have gotten smaller with nanotechnology. Smaller, faster, and better transistors brought about smartphones, wearables, and many other accessories we use every day. Novel nanoscale electronic devices may help achieve quantum computers, or an entirely new type supercomputer that can learn and solve problems like a human.

Strong Structures

Embedded nanoscale sensors and devices will provide cost- effective continuous monitoring of the structural integrity and performance of bridges, tunnels, railways, parking structures, and

pavement over time. Corrosion-resistant, self-healing nano-enabled paints can help bridges and concrete last longer. Nanocoatings could be used to increase the life span of water and sewer pipes.

Nanofilms and Coatings

Clear nanoscale films on displays, windows, and other surfaces can make them water-repellent, antireflective, self-cleaning, resistant to ultraviolet or infrared light, anti-fogging, antimicrobial, scratch- resistant, or electrically conductive. Antibacterial coatings are being developed for use in hospitals. Super hydrophobic coatings make smartphones waterproof. Paints use nanoscale materials to resist marks and scuffs. Stain-resistant pants, shirts, ties, and more are now widely available for purchase. There are also Nano-enabled uniforms that are not only stain- and dirt-resistant, but protect against chemicals and germs.

Food Safety

Nano sensors in food packaging can measure pathogens and other contaminants in food, indicating if it is safe to eat. Similarly, a sensor has been developed to tell you when a pear is ripe. Nano- enabled packaging protects food from moisture and better traps in carbonation. Scientists have also developed sensors to measure pesticide levels in the field, allowing farmers to use less while still protecting their plants. Today, creative scientists and engineers are finding new ways to use nanotechnology to improve the world in which we live. These researchers envision a world in which new materials, designed at the atomic and molecular level, provide **cost-effective methods** for harnessing energy sources through movement. They foresee Nano-enabled diagnostics that will allow doctors to detect disease at its earliest stages—and the treatment of illnesses such as cancer, heart disease, and diabetes with **safer and more effective medicines**. We may soon develop methods of growing artificial muscle to give improved mobility to amputees and wounded veterans. Vaccine scaffolds could enable faster and more effective inoculations for the flu and many other contagious diseases. Although there are many research challenges ahead, nanotechnology is already producing a wide range of beneficial materials, and shows promise for more breakthroughs in many fields. Scientific inquiry at the level of molecules has opened up a world of new opportunities.

4.2 Project Description for the Incinerator

The proponent intends to install a waste handling incineration plant as a related facility to the Nanotechnology Laboratory. The incinerator to be installed has a horizontal chamber of 950mm diameter with a refractory chamber with a maximum surface temperature of 1600 degrees. The capacity of the incinerator is 75 kg per hour and works 10 hours per day.

The control panel for adjusting of the plant operation comprises of the following;-

- The main switch, on / off buttons for the burners and the ventilator
- Hand adjustable time-clocks for the burners and the ventilator

- Digital displays of the electronic burner temperature controls
- One layer of zinc silicate and a layer of heat resisting paint, colour aluminum will minimize the risk to human health and the environment.

Means of Monitoring temperature in both primary & secondary chambers

The proposed incinerator will have 2 main burners with a preset temperature of 850^0 C for primary burner and 850-900^0 C for secondary burner.

Methods of Disposing off the Incineration ash.

At the plant Facility, an ash bin will be sourced where the ash will be placed after incineration. If full, the ash will be collected by the registered Municipal waste collection company bins and taken to Dandora landfill or any other land fill that is NEMA approved

Proposed operations procedure for the proposed incinerator

- Start, load, and adjust equipment settings as specified by the manufacturer to ensure effective and efficient incineration of materials.
- Adhere to specified secondary burner pre-heat and post-incineration burn-down times.
- Complete all data on the Monthly Incineration Record form as presented in the standard operating procedure Waste Incinerator-Operating Permit Requirements.
- Monitor automated incinerator operating systems, coordinate a response to system failures and document corrective actions. Examples include: burners failing to operate at appropriate temperatures or for appropriate time cycles, stack fan failures, continuous afterburner temperature monitoring or recording device failures, etc.
- Perform minor equipment maintenance such as cleaning around burner nozzles, changing paper in the continuous afterburner temperature recorder
- Coordinate, direct, and document the work of journey-level personnel in the repair and maintenance of incinerator components and systems, as needed.
- Clean ash and bone out of the primary burn chamber after completing each daily burn event.
- Periodically clean ash out of the secondary burn chambers. Store ash and bone in metal waste containers labeled "Bottom Ash" with lids kept closed.
- Once ash is cool, transfer to open top metal drum. Make sure lids are closed after adding ash.
- Maintain cleanliness in areas surrounding the incinerator

4.2.2 Detailed Incineration Processes and Environmental Releases

Waste incineration is one of many societal applications of combustion. The waste- incineration facility includes the following operations:

- Waste storage and feed preparation.
- Combustion in a furnace, producing hot gases and a bottom ash residue for disposal.
- Gas temperature reduction, frequently involving heat recovery via steam generation.
- Treatment of the cooled gas to remove air pollutants, and disposal of residuals from this treatment process.
- Dispersion of the treated gas to the atmosphere through an induced-draft fan and stack.

There are many variations to the incineration process, but these unit operations are common to most facilities. This section of the SEIA study report addresses the combustion and air-pollution control operations that will be used in incinerating municipal solid-waste, hazardous-waste, and nano waste being the proposed project.

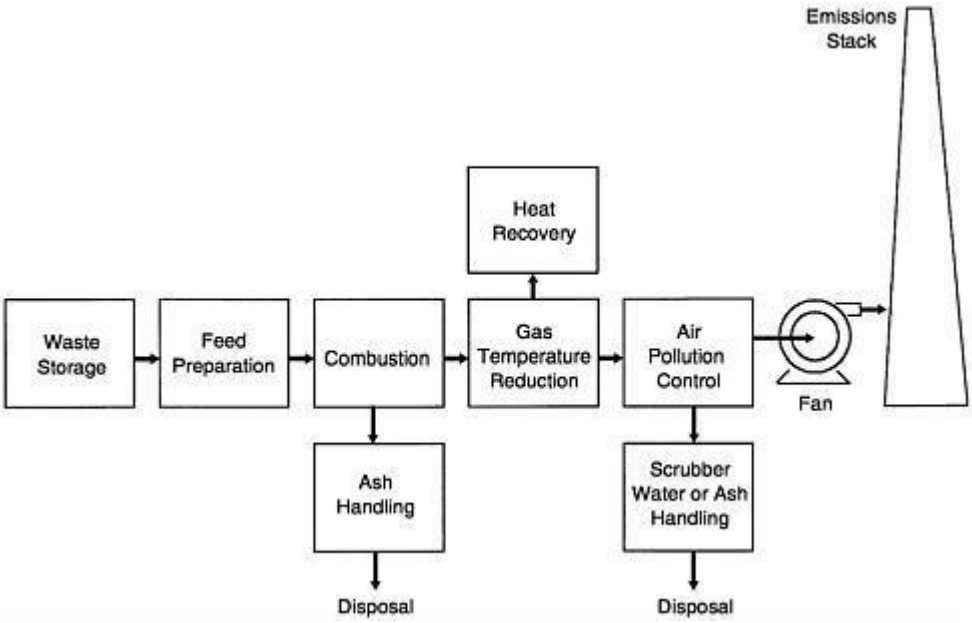

Fig 4.1 Proposed waste-incineration facility schematic

4.2.3 Waste storage, feed preparation, and feeding

There are common waste storage, waste staging, feed preparation and feeding practices for municipal solid-waste, hazardous-waste, and medical-waste incinerators. These practices are highly waste-and facility-specific. Proper design and operation of these “front-end” plant operations have been considered and are important for several reasons:

- While the plant is operating, the potential for worker exposure to hazardous materials is the greatest in this part of the facility. Without appropriate engineered and administrative controls, including personnel protective equipment, operators can be exposed to hazardous dust and vapors.
- This part of the plant is the highest potential source of fugitive dust and vapor emissions to the environment, and the greatest potential fire hazard.

- ❖ Without proper waste preparation and feeding, the furnace combustion performance may be impaired.

4.2.4 The combustion processes

Proposed considerations

Combustion is a rapid, exothermic reaction between a fuel and oxygen (O_2). In incineration applications, the fuel is predominately waste (although fossil fuels may be co-fired) and the oxygen source is air. Combustion produces many of the same stable end products, whether the material burned is natural gas, coal, wood, gasoline, municipal solid waste, industrial wastes, hazardous waste, or medical waste. The flame zone of a well-designed incinerator is sufficiently hot to break down all organic and many inorganic molecules, allowing reactions between most volatile components of the waste and the oxygen and nitrogen (N_2) in air. The predominant reactions are between carbon (C) and oxygen, producing carbon dioxide (CO_2), and between hydrogen (H) and oxygen, producing water vapor (H_2O). Incomplete combustion of organic compounds in the waste feed stream produces some carbon monoxide (CO) and carbon-containing particles. Hydrogen also reacts with organically-bound chlorine to produce hydrogen chloride (HCl). In addition, many other reactions occur, producing sulfur oxides (SO_x) from sulfur compounds, nitrogen oxides (NO_x) from nitrogen compounds (and, a little, from the nitrogen in the air), metal oxides from compounds of some metals, and metal vapors from compounds of others. The furnace is designed to produce good mixing of the combustion air and the gases and vapors coming from the burning waste. Nevertheless, in parts of the furnace where combustion is not complete (for example, near the walls of the furnace), combustible components of organic compounds are burned off, leaving the incombustible particulate matter known as fly ash entrained in the flue gas. The incombustible portion of the waste (known as bottom ash) is left behind.

The proposed incinerator facility incorporate a number of general methods for ensuring proper combustion and reducing emissions. A steady situation with no major fluctuations in the waste-feed supply rate, combustion-air flows, or other incineration conditions promotes efficient combustion. Inefficient combustion can result in higher levels of products of incomplete combustion. Similarly, the more often the facility is started up and shut down (for maintenance or because of inadequate or varying waste stream volume), the more uneven the combustion and the greater the potential for increased emissions.

Optimal design and operation of a furnace requires attention to incineration temperature, turbulence of the gas mixture being combusted, and gas-residence time at the incineration temperature. To achieve efficient combustion, every part of the gas stream must reach an adequately high temperature for a sufficient period of time, and there must be adequate mixture of fuel and oxygen.

The temperature achieved is the result of heat released by the oxidation process, and has to be maintained high enough to ensure that combustion goes to completion, but not so high as to damage

equipment or generate excessive nitrogen oxides. Temperatures will be controlled by limiting the amount of material charged to the furnace to ensure that the heat-release rate is in the desired range, and then tempering the resulting conditions by varying the amount of excess air through controls for the fan.

Turbulence will be needed to provide adequate contact between the combustible gases and oxygen across the combustion chamber (macroscale mixing) and at the molecular level (microscale mixing). Proper operation is indicated when there is sufficient oxygen present in the furnace, and the gases are highly mixed. Cool spots can occur next to the furnace's walls; where heat is first extracted from the combustion process. Such cool spots on walls are more substantial in water wall furnaces than in refractory-lined furnaces which are applicable in the incinerator that is to be installed.

The design features and operating techniques with controls will serve to increase temperature, extend residence time, and increase turbulence in the proposed waste incinerator in order to improve combustion efficiency and provide other benefits like improved ash quality. They include high-efficiency burner systems, waste-pretreatment practices such as shredding and blending and oxygen enrichment.

Grates

The improved incinerator to be installed is fitted with grate systems designed to agitate the waste in various ways, causing it to be broken into smaller pieces as combustion proceeds. This process permits exposure of a larger surface area of waste to air and high temperatures, assisting complete combustion by preventing unburnt material from simply being transported through on the grate.

Air-Injection Systems

For complete combustion to occur, the fans inject air into the furnace in two locations: under the grate that carries burning waste (primary or underfire air) and above the grate to mix additional oxygen with the combustion gases (secondary or over-fire air). Additional controls have been provided in the modern proposed solid-waste incinerator to better regulate both the under-fire air at various points on the grate, depending upon burning conditions, and the over-fire air in response to temperature and heat transfer taking place in the furnace.

Arches and bull Noses

To achieve complete combustion, gases produced must remain in the high-temperature zone of the furnace for a minimal residence time, usually 1-2 seconds. The facility is configured to achieve improved combustion efficiency by using arches and bull noses. Arches, which are structures above the burning and burnout zones, are used to prolong the stay of combustion gases above the grate area. Bull noses are protrusions that are built into the furnace walls, usually near the point of injection of over-fire air, to upset the normal upward flow of the heated gases volatilizing from the burning waste. The induced gas redirection retards the movement of the combustion gases out of the furnace and promotes mixing with air

Flue-gas Recirculation

Flue-gas recirculation systems will be used to recycle into the furnace relatively cool flue gas (extracted after the heat exchangers have reduced its temperature) that contains combustion products and an oxygen concentration lower than air. The process will lower nitrogen oxide formation by limiting the flame temperature and by slightly diluting the flame oxygen concentration.

Auxiliary Burners

Waste feedstock is heterogeneous and its components, or even the whole waste stream, may vary in combustibility. That can make it difficult to maintain the minimal temperature necessary throughout a furnace. Maintenance of temperature will be aided by auxiliary burners that are typically set to come on automatically when the furnace temperature falls below a predetermined point; the location of the auxiliary burner, which is close to the chamber exit. The auxiliary burners are fed fossil fuels and are particularly intended to be used during system startup, shutdown, and upsets.

Gas-temperature reduction techniques

The most common combustion-gas cooling techniques for incinerators are waste-heat boilers, and direct-contact water-spray quenches. Gas cooling techniques are integral to incineration system design, and can be important with respect to emissions of certain pollutants. Emissions of mercury, dioxins and furans can be affected by the rate of gas cooling and the air pollution control device (APCD) operating temperature. Dry APCDs, including scrubbers and particulate control devices, achieve the highest degree of reduction of mercury, dioxins and furans, and acid gases when flue-gas temperatures are lowered to about 300°F or less at the APCD inlet. Combustion gases will be quenched by water sprays atomized into the hot gas flow.

Air-pollution control techniques

Incinerator APCDs are designed to remove two classes of pollutants which are particulate matter and acid gases. In Kenya, NO_x emission limits have been established for incinerators. Increasingly stringent regulations proposes use of more than one particulate-control device or more than one type of scrubber in a given incineration facility. Proposed incinerator is equipped for particulate, acid gas, and as well as dioxin and mercury removal as follows;

- The incinerator will employ fabric filters.
- Spray dryer absorbers (wet scrubber) systems will be used for acid gas HCl and sulfur dioxide (SO_2) removal.
- Dry powdered activated carbon injection systems will provide dioxin and furan and mercury removal.

Particulate Collectors

Fine-particle control devices fall into three general categories, which are **filtration collectors**, including fabric filters (baghouses); **electrostatic collectors**, including dry and wet electrostatic precipitators (ESPs) and ionizing wet scrubbers; and **wet inertial-impaction collectors**, including venturi scrubbers and advanced designs that use flux-force condensation-enhancement

The proposed incinerator will use wet inertial-impaction scrubbers.

The primary performance criterion for most wet inertial-impaction scrubbers is the gas-pressure drop, a measure of the energy applied to atomize scrubbing liquid and create fine droplets for particle impaction.

Acid Gas Scrubbers

The proposed method used in APCD for removal of acid gases is a packed-bed absorber. A scrubbing liquid is trickled through a matrix of random or structured packings through which the gas is simultaneously passed, resulting in gas-liquid contact over a relatively large surface area. The scrubbing liquid will be water which reacts with the acid-gas constituents to form neutral salts. The wastewater discharge from the packed-bed absorber is a salt-water brine that must be managed properly. This effluent may contain unreacted acids, trace organics, metals, and other solids removed from the gas stream.

NO_xControls

Combustion-process modifications that reduce NO_xformation include controlling the amount of oxygen available during the combustion process, and operating within a specific temperature range. Solid-waste incineration facilities tend to create the most NO_x when furnace temperatures are higher than is necessary (higher than 2,000°F) to destroy products of incomplete combustion (PICs). To minimize NO_x formation, the furnace will be operated within fairly narrow ranges of temperature and excess oxygen (9-12%, 850-900^0 C) with turbulent (well-mixed) conditions.

Some NO_x formation is inevitable from nitrogen present in the fuel and from atmospheric nitrogen, and it may be necessary to use flue-gas controls to achieve further reduction of these emissions

Proposed system operation

Many variables that affect incinerator operation are controlled by operators, so the combustion conditions that control emission rates may be substantially affected by operator decisions. Poor operator control either of the furnace (by permitting temperature or oxygen concentration to decrease) or of the stoking operation can cause reduced combustion efficiency. In the proposed incinerator, mixing and charging of waste into the incinerator, grate speed, over-fire and under-fire air-injection rates, and selection of the temperature set point for the auxiliary burner will entirely or partially be controlled by plant personnel.

Operators must be attentive to the flow rate of waste into the incinerator and furnace operation so as to allow for effective function of APCDs.

There will always be a need for operator to deal with unexpected situations. The incinerator will require calibration and maintenance, as the combustor parts can wear out or malfunction. Examples of what can go wrong include clogged air injection into the incineration chamber, fouled boiler tubes, a hole in the fabric filters, and a clogged scrubber nozzle.

Worker Training

In compliance with OSHA 2007, proponent will be required to undertake worker training in

hazardous-material management. Annual refresher courses will also be required, as is supplemental training for supervisory personnel. The training is an important requirements for inspection plans and worker-training plans for the proposed incinerator that manages hazardous waste, including combustion facilities. The inspection plans address facility maintenance, leak inspections, and calibration schedules for monitoring equipment. The training plans are intended to address hazardous-material safety and facility operations.

Monitoring and Data Collection

Environmental regulations particularly EMCA Air Quality Regulation of 2014 as well as Waste Management Regulations of 2006 have led to extensive monitoring of key incineration process conditions, including waste feed rates; feed rates of ash, chlorine, and toxic metals (determined by sampling and analysis of the waste stream); combustion temperatures; gas velocity (or gas residence time); facility-specific air-pollution control-system operating measures; and stack-gas concentrations of O_2, CO, total hydrocarbons, HCl, NO_x, and SO_x, and opacity.

The SEIA experts proposes that the proponent adopts a computerized system that collect and record process data, automatically control such process conditions as combustion temperature (by varying fuel feed and air flow rates), and automatically cut off waste feeds if operating conditions stray outside limits set by permits.

Possible process emissions

The principal products of combustion are CO_2, water vapor, and ash, which are respectively oxidation-reaction products of carbon, and hydrogen, and non-combustible materials in the fuel. However, when the combustion reactions do not proceed to their fullest extent, other substances, some of which are potentially harmful, can be produced. The types and concentrations of contaminants in the waste stream (flue gas) flowing from any incineration process depend on the process type, the waste being burned, and combustion conditions.

Particulate Matter

Particulate matter consists primarily of entrained noncombustible matter in the flue gas, and the products of incomplete combustion that exist in solid or aerosol form.

Particulate matter from waste combustors includes inorganic ash present in the waste and carbonaceous soot formed in the combustion process. These materials are conserved in the combustion process and leave the combustion chamber as bottom ash or fly ash. Soot is a product of incomplete combustion that consists of unburned carbon in the form of fine particles or as deposits on inorganic particles.

Acid Gases

Acid gases are flue-gas constituents that form acids when they combine with water vapor, condense, or dissolve in water. Acid gases include NO_x, SO_x, HCl, hydrogen bromide, hydrogen fluoride, and hydrogen iodide.

Mercury

Heavy metals in waste are not destroyed by incineration. Metallic elements with high vapor pressures, or with compounds that have high vapor pressures, can be converted to the vapor phase in the combustion chambers and tend to condense as the flue gas is cooled.

Mercury emission from waste combustors is determined largely by the mercury feed rate and by whether mercury- specific APCDs are used.

Lower scrubber-water temperatures lead to vapor condensation, and reduced mercury vapor pressure. Soluble forms of mercury, such as $HgCl_2$, are preferentially removed in wet scrubbing systems.

Lead

Lead (Pb) emissions from the proposed waste incinerator will be influenced by the concentration of Pb in the waste feed, the chemical form of Pb. The concentration of Pb in the waste is important because Pb is conserved in the combustion process; all the Pb fed to the combustor exists with the bottom ash, is collected as fly ash, or is emitted as fine particles in the stack gas.

There are four general methods proposed for limiting Pb emissions from waste combustors:

- Limiting the Pb content of the waste feed via source control.
- Designing and operating the combustion process to minimize Pb vaporization.
- Designing and operating the primary combustion chamber to minimize fly-ash carryover.
- Using well-designed and properly operated APCDs.

Products of Incomplete Combustion

Dioxins and Furans

The proposed incinerator can produce dioxins and furans from three points in the process: stack-gas emissions, bottom ash, and fly ash. Often, bottom ash and fly ash are mixed for waste management purposes, but they may contain different amounts of dioxins and furans.

All types of organic chemicals, including polychlorinated dioxin and furans, can be destroyed under high- temperature oxidizing conditions. Destruction can occur at around 1800°F or higher if oxygen and organic molecules are well mixed as in practical combustion devices.

There is evidence that sulfur and ammonia can inhibit dioxin and furan formation.

The only consensus at this point seems to be that good combustion efficiencies and low post-combustion temperatures reduce the secondary dioxin formation.

Fugitive emissions

The most common fugitive emissions are (from liquid wastes) vapors from tank vents, pump seals, and valves; and (from solid wastes) dust from solid-material handling, together with possible

fugitives from particulate APCDs.

Fugitive emissions, consisting of vapors or particles from waste tipping, waste feeding, incineration, and ash handling are mitigated by designing buildings to be under negative pressure. Air is drawn from the waste-handling areas into the combustion chamber, where it is mixed with the combustion gases. Potential fugitive emissions collected in this manner and drawn through the combustion chamber and emission-control devices leave the plant with odors virtually destroyed and dust removed by the particle-control devices.

Ash and other residues

Residues that will be generated by the proposed incinerator include bottom ash, fly ash, scrubber water, and various miscellaneous waste streams. Bottom ash is the remains of the solid waste that is not burned on the grate during the combustion process and consists of unburned organic material (char), large pieces of metal, glass, ceramics, and inorganic fine particles. Bottom ash is collected in a quench pit beneath the burnout section of the grate.

Fly ash is the solid and condensable vapor-phase matter that leaves the furnace chamber suspended in combustion gases and is later collected in APCDs.

Ash Handling

Two concerns of on-site ash management at incineration facility are the safety of workers and the possibility that fugitive ash will escape into the environment during handling or removal of the ash for disposal. In the facility, water will be used to quench the ash, simultaneously reducing dust generation and minimizing the possibility of ash-dust inhalation or ingestion by workers.

Ash and Scrubber-Waste Disposal

It is important for ash to be tested to determine whether it is hazardous. If it is hazardous according, it must be disposed of as hazardous waste.

Ash from hazardous-waste combustion must be handled and disposed in a secure hazardous-waste landfill that is designed to ensure that there will be no groundwater pollution. Dry and spray-dry scrubber waste is incorporated in the fly ash, because the APCD is where the injected material is collected. Wet-scrubber wastewater should be discharged to on-site wastewater-treatment systems.

4.2.5 Proposed best practices for reducing Incineration emissions for the proposed project

The EIA Experts proposes the proponent;

- Screen incoming wastes at the plant to reduce incineration of wastes (such as batteries) that are noncombustible and are likely to produce pollutants when burned.
- Maintain a continuous, consistent thermal input rate to the incinerator to the extent possible. In municipal solid-waste facilities, optimize mixing of waste in pit
- Optimize furnace operation, including temperature, oxygen concentration, and carbon monoxide concentration.

- Survey furnace emission-control devices and related equipment regularly to ensure that they continue to be operative and properly sealed and insulated.
- Select correct type of nitrogen-reducing reagent (either ammonia or urea) and optimize the injection rate and location, if add-on of NOx control is required.
- In dry air pollution control systems, optimize flue-gas temperature in control devices (to minimize dioxin formation and to maximize condensation and capture of pollutants while avoiding gas dewpoint problems.
- Select correct alkaline reagent (e.g., lime slurry, dry lime, Na_2CO_3 or $NaHCO_3$) to maximize absorptive capacity and optimize injection rate and location.
- Optimize type of sorbent (such as carbon) used (to maximize adsorptive capacity) and optimize injection rate and location for removal of mercury and dioxins and furans.
- Optimize baghouse pressure drop, bag-break detection, wet-scrubber pressure drop, pH, and liquid-to-gas ratio.
- Maintain a maximum gas flow-rate limit to ensure adequate residence time in the combustion chamber and proper operation of the air pollution control equipment.
- Implement a training and certification program for plant operators.
- Inspect and calibrate continuous emission monitors and other process instrumentation.
- Adequate operator training and certification is needed with monitoring of performance conditions to ensure that emission targets are met.

4.3 Boiler Installation

A steam boiler using light diesel oil as fuel is to be installed at the KIRDI Techno Centre as a tower facility. The steam produced by the boiler will be discharged into a steam header which is a distribution unit. The steam from the header will be directed to various end uses including the hot water calorifiers, the Research Laboratories, the restaurant and laundry.

The steam is directed to calorifiers to generate hot water for the laboratories and the accommodation unit.

Cold water for the boiler is obtained from a high level tank on the roof and is delivered by gravity to a feed water tank. The water is then pumped into the boiler which converts it to steam.

The energy for conversion of water to steam is provided by burning fuel (light oil) in the boiler burner. The fuel for the burner is stored in an underground fuel storage tank and pumped to a fuel day tank which is located in the boiler room. The fuel at the day tank is fed by gravity into the boiler burner for combustion.

The steam boiler to be installed is as “IVAR model BHP 800” Rated as follows:

- Nominal capacity-554 kw
- Furnace capacity- 616kw
- Steam production – 800 kg/h
- Maximum Steam operating pressure – 11.8 bar
- Combustion chamber pressure (mbar)- 5
- Water content when full (dm^3) – 1280
- Stack connection (mm diameter) – 250
- Steam connection (mm diameter) –50
- Empty weight (kg) - 2550

4.4 Project Description for Wastewater Treatment Plant

The proposed project has been designed to treat wastewater from both Nanotechnology laboratory and other facilities within KIRDI’s Techno Centre.

The WWTP will treat effluent from the Nanotechnology centre up to Primary Level to meet discharge standards to the public sewer level as per 5th Schedule of the Legal Notice No.120 (EMCA) of 2006. This plant is dimensioned to a capacity of $5M^3$. The waste water from Nanotechnology Laboratory will be held in conservancy tank in basement 4 and will be pumped to WWTP plant installed in 3rd floor utility room for treatment prior to release by gravity to the main sewer.

The Waste Water Treatment Plant that will treat all influent waste water from the other sources within KIRDI Techno Centre, including all labs, conferencing facilities including all other uses within the building to discharge to environment as per 3rd Schedule of the Legal Notice No.120 (EMCA) of 2006.

4.4.1 Wastewater Treatment Process

The wastewater will undergo various stages including Preliminary treatment, primary treatment, secondary treatment and tertiary treatment as explained below

Preliminary Treatment

Preliminary treatment will involve a number of unit processes to eliminate undesirable characteristics of wastewater. Processes include use of screen devices, grit chambers, oil and grease removal tanks, pH correction and flow equalization tanks.

Primary Treatment

It involves removal of settable solids prior to biological treatment. The general treatment units include:

- Flash mixer for coagulation
- Flocculation for flock formation

- ❖ Sedimentation for precipitation

Secondary Treatment

Secondary treatment will involve purification of wastewater primarily with dissolved organic matter by microbial action. Anaerobic and/or aerobic treatment methods will be used. Chemical treatment followed by extended aeration and Sequential Batch Reactor (SBR) will be used at this stage

Tertiary Treatment

Tertiary treatment will mainly include physical and chemical treatment processes that will be used after the biological treatment to meet the treatment objectives. Chlorination will be used at this stage.

i) Chemical Treatment followed by Extended Aeration

The physico chemical treatment reduces COD by 60 %, BOD 65% and suspended solids 70 % with less power input. The chemical treatment followed by Extended Aeration is suitable for treatment of industrial wastewater since the power requirement is less than SBR and MBR processes and thus recommended however TDS of treated effluent will be higher than prescribed limit if not segregated at source. The method is well suited for small and medium size flow.

ii) Chemical Treatment followed by Sequential Batch Reactor (SBR)

The flow scheme of SBR is similar to extended aeration except secondary settling tank is not provided. It provides highest treatment efficiency possible in a single-step biological process. Primary treated Effluent shall be fed into the Cyclic Activated Sludge/SBR Basins for biological treatment to remove BOD, COD and Suspended Solids. These basins work in sequence and influent flow is controlled using motorized sluice gates. The C-Tech Basins shall be complete

with Single Stage Direct Drive Centrifugal Turbo Blowers, Diffusers, Grid Piping, Return Activated Sludge (RAS) Pumps, Surplus Activated Sludge (SAS) Pumps, Stainless Steel Decanters, Auto Valves and PLC. All cycles will be automatically controlled using PLC. Excess sludge at a consistency level of 0.8% will be pumped intermittently with the help of SAS Pumps. This can be taken further for sludge dewatering or drying as per process requirement. The treated effluent from the C-Tech Basins shall be routed to the downstream Tertiary Treatment Units as per specifications i.e. chlorination.

The C-Tech System is operated in a batch reactor mode and this eliminates all the inefficiencies of the continuous process. A batch reactor is a perfect reactor, which ensures 100% treatment. Two modules shall be provided to ensure continuous treatment. The complete process takes place in a single reactor, within which all biological treatment steps take place sequentially. No additional Settling Unit or Secondary Clarifier is required. The complete biological treatment is divided into Cycles with each Cycle taking 3-4 hours duration, during which all treatment steps take place. A basic cycle comprises of the following phases which take place independently in sequence to constitute a cycle then gets repeated.

- Filling
- Aeration
- Settlement
- Decanting

The basin is filled to a predetermined level then aeration is done for a set duration using blowers. After aeration settling occurs under perfect settling conditions. After settlement the supernatant is removed by a decanter. A series of basins, in this case 2 No. are provided to conduct the phases simultaneously with all sequences contributing to the reaction time for EBPR and co-current nitrification/denitrification.

The Sequential Batch Reactor was selected as the Secondary Treatment for the 10 MLD WWTP.

4.4.2 Tertiary Treatment

Tertiary treatment will mainly include physical and chemical treatment processes that will be used after the biological treatment to meet the treatment objectives. Chlorination will be used.

- Screening (bar, self-cleaning)1
- Pumping/lifting
- Fine screening
- Equalization and sulphide oxidation
- Chemical treatment (coagulation, flocculation)
- Settling
- Settling- primary sedimentation
- Sludge dewatering
- Sludge thickening
- Centrifuge

The parameters to be closely monitored include COD (Chemical Oxygen Demand), BOD5 (Biological Oxygen Demand), SS (Suspended Solids),TKN (Total Kjeldahl Nitrogen) and Chrome.

4.4.3 Waste Management

Sludge Management

Sludge from Chemical Precipitation

Chemicals are used in the treatment process and these chemicals determine the properties of sludge. If heavy metals are present in industrial wastewater then those heavy metals precipitate along with the sludge. The sludge has 3% to 4% solid content. The sludge will be collected into the sludge sump and then pumped to a thickener. Gravity thickness is proposed to increase the solid content. The sludge will then be dried on sludge drying beds or centrifuge.

Biological Sludge

Biological sludge is rich in nutrients such as Nitrogen and Phosphorous and also with valuable organic matters. Sludge conditioning may be proposed to reduce the water content. The sludge from extended aeration will be dried on sludge drying beds or dewatered with centrifuge.

Reuse of Water and By-product Recovery

Wastewater resulting from the treatment process will be of very high quality and it is recommended that the water be harvested and stored in tanks for use in the irrigation of flower beds and other areas within the project area.

Sludge Utilization

The sludge should be composited or exposed to sunlight before use for killing of unwanted organisms.

4.5 Diesel Generating Set

For WWTP and CETP Critical Load such as Area Lighting, Indoor, Outdoor and Control Circuit for Switchgear, Control Panel, diesel generating set of adequate capacity considering critical Loads will be provided to keep the pumping station working during power failure period. The adequate capacity diesel storage tanks are also proposed. The capacity of diesel generating set will be suitable to meet the demand of Critical Loads during failure of electrical supply from power Distribution Company.

4.5.1 Illumination and ventilation system

The internal and external illumination system is proposed to have good visibility in operation and maintenance of the pumping plant. The luminous fixtures will be energy efficient. Ventilation system for substation building and Sewerage Treatment Plant (STP) building shall be provided as per National Building Code.

4.6 Underground Fuel Storage Tanks

4.6.1 Construction and Installation Works

The foundation depth was determined on site on a minimum of 700mm below reduced ground level

All service pipes will be of a minimum 450mm below reduced ground level. All the constructions will be in line with the Kenya Bureau of Standards code of practice.

Water meters will be to a minimum of 300mm above ground level. All soil vent pipe, waste drain pipes passing under the project will be encased in 150mm concrete surround. All reinforced concrete works are to be to the exact structural Engineer’s details and specifications. All mechanical works will be done by a qualified Mechanical Engineer. All fuel tanks will be checked and tested by a

Chemical Engineer. All plumping works and water rectification to be done by a qualified plumber. All inspection chambers will be accessible from outside and will be left clean.

In general, the design of the project has and/will optimize the best use of the available technology to prevent or minimize potentially significant environmental impacts associated with the project and to incorporate efficient operational controls.

4.6.2 Project Design

The design is based on information and consultations with the proponent; the architects, details contained in the architectural plans and drawings (of the project) and approvals from relevant statutory departments.

The facility will comprise of the following:

- Forecourt paving: 50mm thick quarry dust blinding on hardcore and fixing of 80mm thick precast concrete block paving on 50mm thick sand bed.
- An impermeable concrete surface under the canopy
- A u-shaped drainage tunnel with a steel grill top
- Underground fuel tanks
- Breather points
- A Heavy duty covered man hole for each of the underground tanks
- A steel canopy
- Ribbed concrete finish under the steel canopy
- Pump isles
- Digital fuel pumps
- Associated piping work

4.7 LPG Bulk Storage Tank Installation

The proposed project will have features such as mounted type 3LPG bullet tanks, loading and off-loading area, LPG pump compressor and shed. The task will involve

- Excavation through soil to a depth not exceeding 0.8m to hard rock and cart away debris
- Construction of a tank foundation
- Fabrication of loading and offloading area
- Casting a reinforced concrete slab for LPG pump
- LPG piping work
- Painting work
- Purge air from tank and pipelines and commission

4.7.1 Technology

The primary technologies used for the design, construction and operation of the LPG storage facility include various international code of practice, Standards, Government Acts and Local Authority Regulations. In Kenya there are a limited number of regulations covering the technology to be used in the design, construction and operation of LPG station. Subsequently the country relies on international codes of practice, standards and guidelines for the design, construction and operation of such facilities.

The final product after construction phase is LPG storage facility which will comprise of mounded 3LPG bullet storage tanks, associated Pipe work and a Gas filling area.

4.8 Sewage Management

Waste water emanating from the proposed *nanotechnology* will be managed by first decontaminating it. Thereafter, the waste water will be treated in a waste water treatment plant installed in the project area as a related facility before establishing the water schedule of the effluent as per the water quality regulations 2006 and then directed to the Nairobi Water and Sewarage Company connected sewer for common treatment in the holding facility in Ruai.

4.9 Solid Waste Management

All solid wastes from the facility will be decontaminated first and hazardous solid wastes shall be autoclaved. The facility will have an incinerator for combustion of chemical materials emanating from the Biosafety level 4 containment Lab. The proponents will designate a common refuse disposal point and provide bins for temporary waste storage of other normal solid wastes. Records of estimates of quantities of waste generated and collected will also be maintained. The proponents will also adopt a recycle and reuse policy for most of the solid waste that do not pause safety threats to the staff and the surrounding environment. What cannot be reused/recycled will be collected by the County

Government of Nairobi or other NEMA licensed private waste transporter. Furthermore, segregation at the source will be done before the waste is collected and taken to the Dandora land fill or incinerated.

4.10 Project Cost

The total project implementation cost for the proposed KIRDI Techno Centre where Nanotechnology laboratory and related facilities is estimated at KShs 7 billion. However, this cost is a subset of the whole cost of KIRDI Research, Technology and Innovation Laboratories and related infrastructure proposed development on plot number 209/5811, Dunga Road, South B Nairobi county. The Nanotechnology costs will include *modification of basement 4 floor to suit a biosafety level 4 containment facility as per WHO guidelines, the National Nanotechnology policy by NACOSTI under ministry of education, Kenya Nuclear Regulatory Authority (KNRA), Ministry of Health's regulations and any other regulatory authority like NEMA among others. Then installation of equipment required, certification of the Lab, Hiring and training of the specialized personnel and then operationalization for the stipulated time period by the regulator and decommissioning upon completion of the useful life of the facility.*

4.11 Project Alternatives

The proponents intend to introduce the Nano material technology into the Eastern Africa region to help in advancing manufacturing and processing processes. This will help the region attain the Sustainability Development Goals as the extraction of virgin materials shall be greatly reduced as the special abilities of Nano materials will ensure the quantities of materials required for production of consumer goods is greatly reduced because only an insignificant quantity of these materials are required to achieve the desired results. The new opportunities will lead to establishment of many start up SMEs as the old norm shall be disrupted. Many job opportunities shall be created and higher institutions of learning will get a chance to result oriented research. Some new courses are likely to be added by the institutions to tap on this new opportunity. The no option alternative will mean that the Nanotechnology Laboratory is not established and new innovations in Nano material investments will not be introduced which will be a disadvantage to the region that has identified manufacturing as a key pillar in industrial growth.

4.11.1 The "no project alternative"

This option means that the project will not be undertaken and the facility will NOT be established. The possible scenario can be summarized as follows:

Decreased investor confidence

The “no option alternative” runs counter to the government’s stated objective of attracting and sustaining foreign and local investment.

Employment creation

The “no option alternative” means that the extra jobs that would be created during installations, operation periods and trade with spin off companies would be missed opportunities.

Pressure for land

The alternative of looking for land to put up the Centre elsewhere necessitates increased pressure for the limited land in Nairobi County. It is highly unlikely that the proponent will get an alternative piece of land for this project.

Loss of government revenue

Without the development, the government would miss out on revenues that would inevitably accrue. The same can be said of the County Government of Nairobi.

4.11.2 The “yes project alternative”

This is comparatively the preferred option because of the following reasons:

Research Opportunities for Research institutions and Academia

With the operationalization of the Lab, academia will develop new courses at universities and Technical training colleges, more students will get an opportunity to explore this space of opportunities which are largely application based. The imparted technical skills will be necessary for employment in industries or employment creation.

Increased incomes

The amount of taxes and levies that the proponents would be paying out to government and other regulatory bodies will definitely increase.

Job creation

With the current depressed economic growth, this project will open up opportunities for employment creation not just within the premises, but also in the many multi displinary sectors where nanotechnology has opportunities for growth. Many MsME are likely to be started in order to tap into these innovations.

Boost in investor confidence

The project will serve as an opportunity in which local and external investors will be encouraged in the demonstrated ability to invest and profit from the Kenyan investment environment as there will be opportunities for assessing critical technologies within the country.

Environmentally friendly design

The nanotechnology Laboratory shall be a containment facility that is categorized as Biosafety Level 4 containment lab. The internal environment shall be regulated so that not even air shall be released to the surrounding environment without being purified. The released effluents will be already decontaminated and treated in a waste water treatment plant to be installed as a related facility so that effluents will have no negative impacts on the surrounding environment. This design is thus both environmentally friendly and economically sensible as it will entail minimal structural changes to the already existing Research, Technology and Innovation Labs complex.

Alternative use of land

Currently, there is no other conceivable, environmentally sound economic activity that the basement 4 of the KIRDI Techno Centre would be put to apart from converting it into a Nanotechnology Laboratory.

4.12 Alternative project site

Any other alternative project site would have more negative impacts since the land would have to be cleared and vegetation disturbed. In addition, the proponents would have to contend with other socio-economically undesirable impacts like resettlement and/or compensation.

4.13 Project Decommissioning

All installations and equipment determined to be removed from the Centre site shall be deconstructed, removed and disposed of using the following procedures:

- All on site equipment, reagents and chemicals shall be assessed to determine the presence of hazardous conditions, materials, or waste and a report prepared for the Management teams;
- All Lab components shall be surveyed to determine if they have potential for local re-use or recycling. The local stakeholders shall be given preference for re-use of the materials that cannot be sold;
- Quantities of all components to be removed, relocated, sold, recycled or donated shall be estimated by site assessment;
- All hazardous materials are to be removed by specialist sub-contractors and disposed of in accordance with good environmental practice. Hazardous materials may include, but not limited to, lead painted surfaces, light ballasts, coolants, potential ignition sources and potential shock hazards.
- All utility connections, power, water, sanitary connections, etc., shall be identified, disconnected, capped and properly closed prior to or at the time of Lab demolition;

- Dust controls shall be used during general demolition to minimize airborne dust levels both during demolition, loading and transport activities. Dust emissions shall be kept below industry standards in accordance with guidelines contained in NEMA emissions standards;
- All loads for transport outside the premises shall be covered and secured;
- All installed materials to be disposed of shall be taken to a licensed disposal facility, scrap yard or recycling centre. Manifests of all loads, including detailed material descriptions shall be maintained;
- For all buildings, including the latrines, to be dismantled and removed from the premises the concrete foundations should be broken up and buried on the site. Interior walkways, roads and above ground utilities should be removed and the materials that are free of defects and hazards provided to the local population for building materials and fuel wood;
- A final Decommissioning Report shall be completed upon completion of the decommissioning activities; and,
- On site security shall be maintained throughout the decommissioning phase of the Project.

CHAPTER FIVE

CONSULTATION AND PUBLIC PARTICIPATION

5.0 Introduction

Public participation entails involving, informing and consulting the public in planning, management and other decision-making activities. Public participation tries to ensure due consideration is given to public values, concerns and preferences when decisions are made. It encompasses the public actively sharing in the decisions that government and other agencies make in their search for solutions to issues of public interest.

Consultative Public participation (CPP) process is a policy requirement by the Government of Kenya and a mandatory procedure as stipulated in EMCA CAP 387 section 58, on Social Environmental Impact Assessment for the purpose of achieving the fundamental principles of sustainable development. CPP basically entails engaging members of the public to express their views about a certain project. Public participation tries to ensure that due consideration will be given to public values, concerns and preferences when decisions are made. If well conducted CPP is beneficial in various ways:

- Obtains local and traditional knowledge that may be useful for decision-making;
- Facilitates consideration of alternatives, mitigation measures and tradeoffs;
- Ensure that important impacts are not overlooked and benefits are maximized;
- Reduces conflict through the early identification of contentious issues;
- Provides an opportunity for the public to influence project design in a positive manner;
- improve transparency and accountability of decision-making; and
- Increase public confidence in the EIA process.

The exercise was conducted in February and March in 2021 and later in June 2021 for the other related facilities

Public consultation in this project was done with the following aims:

- To inform the surrounding community and other stakeholders about the proposed project and its objectives
- To seek views, concerns and opinions of neighbors and stakeholders concerning the project
- To establish if the local people foresee any positive or negative environmental effects from the project and if so, how they would wish the perceived impacts to be addressed.

5.1 Methodology for Consultation and Public Participation

Public participation was mainly achieved through direct interviews, observations and questionnaire administration. Traditionally the tool used to collect information is the administration of open-ended

questionnaires where the respondent is free to comment on issues at own thinking. After individuals complete the questionnaires individually and the expert finds some divergent and conflicting responses, usually Focus Group Discussions are held only on the conflicting ideas for the respondents to discuss the contentious issues and come to an agreement by themselves after informing each other. Scoping entailed identification of key stakeholders and subsequent use of a questionnaire and a major focus group discussion (FGD) to gather information on concerns regarding the project from stakeholders. For this study, interviews were conducted individually on a pre-set open-ended questionnaire to collect the views of various stakeholders. Respondents were selected among the communities surrounding the site of the proposed development, traders and firms that will utilize the facility. All the stakeholders accepted to respond but some answered with a few words. Most of those consulted however, were happy to fill the questionnaire freely.

Direct Interviews

Direct interviews were used to get responses from stakeholders whose comments were sought through engaging them in discussions about the proposed project and other related issues.

Questionnaire Administration

Questionnaires were uniformly distributed to the identified stakeholders as per stakeholder mapping and analysis, neighboring residents and firms. Respondents were informed of the proposed project and requested to share their views concerning the project. The views were categorized as either positive or negative impacts anticipated for the project and the mitigation measures considered for adoption or devised where non was given or the option given was not viable under the prevailing circumstances.

5.2 Identified Positive Impacts

a) Employment Opportunities

The persons interviewed were positive the project will create numerous opportunities for the local firms and general public, more specifically the youth.

b) Improved Security and Trade

According to most respondent's completion of the project will boost trading activities and at the same time improve security. Security will be enhanced as a result of completion of the project that has stalled for many years and the building will then be functional and occupied with records of the flow of people and vehicles to the establishment well monitored and recorded.

c) Increased specialized services in the area

Most of the consulted people said the proposed project will lead to opening of the area due to technological innovations and appeal to the public and this will raise the general status of the project area and set it out as a government preferred destination for various services.

5.3 Identified Negative Impacts

a) Health and safety

There was concern over the possibility of health related effects from neighbors from handling of the Nano materials both now and as a result of bioaccumulation where the cumulative effects of the exposure will be felt in later stages of life. The safety from occurrence of fire and explosions was also anticipated by neighbors but the proponent assured them that the regulations in place will address their fears because Laboratory containment shall be assessed and confirmed to be biosafety level 4 status laboratory with regular audit. The staff are the front workers including the management and cannot allow any cross contamination as they are more prone to any adverse effects.

Increased traffic of people

The neighbors were concerned about the services to be offered and the many clusters of people that will require to use the services. This could lead to a lot of traffic of people and could interfere with accessibility of services provided by the other firms. The proponent will maintain a very restrictive approach to accessibility of the Centre as a biosecurity measure and as well as to grant staff humble time to concentrate on the project activities.

b) Hazardous waste generation

The neighbors felt that there will be more hazardous waste that will be generated and could lead to health related issues when there are leakages of both air, liquid or solid waste. The proponent will have to ensure that all the generated waste is decontaminated prior to release. The proponent will have an incinerator for waste management and any solid hazardous waste shall be combusted on site with eventual disposal contracted to a NEMA licensed person of good repute

5.4 Conclusion on findings

The overwhelming majority of the members of the public and key stakeholders could see enormous benefits accruing to the region. The respondents had no fears against the proposed project. No major impact that could not be mitigated that was foreseen.

5.5 Issues Raised in the CPP Meetings

The issues raised in the three different meetings for Consultation and Public Participation have been summarized below with the whole summary of the signed minutes of the meetings, participants list, CPP filled questionnaire attached to the appendix of this study report

Brian Lusimba was concerned that if scuff holding is not done properly to the incinerator, the health and safety of the workers will be compromised leading to injuries or death	Mr. Gaita the clerk of works assured them of the proper workmanship under his watch and the project manager, Habitech Consultants to ensure all the constructions will be done as per the drawings and every activity of the project work will have to be inspected.
Constant Wamalwa feared for contamination of ground water resources from wastes emanating from boiler fuel	The project mechanical Engineer, Eng. Muma assured him of proper containment of dust and smoke particles from the boiler so that they do not find their way into water bodies and cause pollution
Juliet Khisa was worried about fly ash emanating from the incinerator and posing health risks to the neighbours. She needed assurance that there shall be installation of dust receptacles to mitigate against this hazard	Mechanical Engineer noted that he concern was already factored in the installation phase of the incinerator and dust sacks were part of the bill of quantities to be purchased
Langat Gilbert wondered whether there will be measures put in place to prevent sewage leaking or getting into contact with water line	The project surveyor Mr. Wambua assured him that the installation works for sewerline will follow the set guidelines as per the KEBS standards and that the bill of quantities has captured the appropriate materials
Cyrus Wachira sought to know measures in place to prevent the wastes in underground fuel storage tanks from polluting the underground water sources.	The architect assured him that the guidelines in place on materials for installing underground storage tanks and guidelines on infrastructure set up including underground depths and casing will alleviate his fears

PLATE OF PHOTOS TAKEN DURING CONSULTATION AND PUBLIC PARTICIPATION MEETING HELD AT THE SITE

5.6 Sample Questionnaire

SAMPLE QUESTIONNAIRE FOR IMPACTS OF SETTING UP NANOTECHNOLOGY LABORATORY IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Nanotechnology Laboratory Installation and operationalization. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the Nanotechnology Laboratory.

Project Name: Installation of a Nanotechnology Laboratory in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	
ID Number Interviewee's	
Interviewee's Contact (phone)	
Date of Interview	

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

……
……

Environment risks

……
……...

Social risks

……
……

Hydro- geological (ground water)resources

…….....
.....

Do you think there will be any wastes generated and how do you propose it to be handled?

……
……

How can the impacts you have highlighted be mitigated?

.....
.....

Does the proposed project negatively affect your business or operations?

……
……

What positive impacts will the proposed project have on your operations?

……

……

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

……
……

Do you have any specific complains to make about this project?

……
……....

In your conclusion, do you welcome this project in the said area?

……

General comments, recommendations or observations on this project?

……
……....

Respondent Sign

……..

CHAPTER SIX

6.0 Potential Environmental Impacts

This Chapter identifies both positive and negative environmental impacts likely to be occasioned by the project's installation, operations and decommissioning phases. It discusses the nature of impacts, their magnitude, spatial, time extent and significance. The table below shows how the impacts are assessed.

Table 6.1: Scale for evaluation of project impacts

SCORE	**(-1) +1**	**(-2) +2**	**(-3) +3**	**(-4) +4**	**(-5) +5**
PARAMETER					
Magnitude	Impacts occur or are felt on site		Impacts affect more than 3 kilometers radius		Impacts affect the region
Significance	**Low** Small changes which are hardly detectable	**Moderate** Impact measurable but does not alter processes	**High** Many people, animals, plants affected. Disruption to ecosystems and social systems.	**Very high** Loss of biodiversity, property, livelihood systems	**Unknown effects** Insufficient information available. Apply precautionary principle
Probability of occurrence	**Possible** Impacts can occur but are controllable		**Probable** The impact is likely to occur but can be controlled by effective measures.		Definitely will occur
Duration of occurrence	**Short term** During construction phase only	**Medium term** Impacts will be during operational phase only		**Long term** Impacts will be there for entire operation phase	**Very Long term** For the entire operational phase and after closure

The impacts identified are discussed in the following sub-sections below.

6.1 Occupational Health and Safety

To ensure the health and safety of workers at the site, the contractor and the proponents must establish an Occupational Health and Safety Management System (OHSMS) which will be managed and operated for the proposed activities. The system will basically contain the following features:

- Occupational Health and Safety Policy
- Organizational Framework of the OHSMS. This includes:
  - ✓ Staffing of OHSMS
  - ✓ Competence requirements
  - ✓ Operating procedures
  - ✓ Training programmes
  - ✓ System documentation
  - ✓ Communication.
- OHSMS objective
- Hazard prevention. This involves:
  - ✓ Risk assessment
  - ✓ Prevention and control
  - ✓ Management of changes
  - ✓ Emergency preparedness and response
  - ✓ Procurement (tools, equipment, services, contractors)
- Performance monitoring and measurements. This includes:
  - ✓ Hazard prevention measures
  - ✓ Ambient working environment
  - ✓ Occurrence of work related injuries, ill health, disease and injuries
  - ✓ Record keeping with regard to occurrence of incidents and actions taken.
- Evaluation. This will involve:
  - ✓ Formative and summative evaluation
  - ✓ Feedback
  - ✓ Remedial actions
  - ✓ Incident re-occurrence prevention plan (IRPP)
  - ✓ Performance improvement

6.2 Safety of workers During Installation and Operationalization

The levels of implementation of occupational health and safety considerations at the workplace shall begin with the deliberate effort by the contractor and the proponents to protect the employees at the modification and installation site. In this regard the following recommendations shall be adhered to:

- Registration of the proposed Nanotechnology Laboratory as a workplace with the Directorate of Occupational Health and Safety (DOHS)
- Provision of appropriate and adequate Personal Protective Equipment (PPE) to employees.
- Enforcement and proper use of PPE by all workers.
- Provision of appropriate tools, equipment and machinery in sound working conditions to workers to avoid accidents.
- Development of a clear policy on treatment of injured personnel.
- Provide insurance cover to workers on site.

6.3 Safety of visitors, neighbors and general public

The proponents and the contractor will have the obligation to put in place measures that will protect visitors to the site, neighbors, and the general public in the following ways

- Informing neighbors in writing on the commencement of the project at least two weeks in advance
- Providing visitors to the project site with protective clothing at all times
- Restricting access to the site by the public through signage
- Providing security services during installation and operationalization of the facility.
- Placing notices and safety slogans at strategic points (entry of the site and around the containment walls) to inform and educate neighbors and the general public of ongoing works and safety requirements

6.4 Tools, Equipment, Machinery Use and Electrical Safety

During installation, it is expected that different machines, tools and equipment of different specialties will be used. Most of this equipment will be powered internally by use of diesel. In regard to electrical safety, the following will have to be undertaken:

- Installation and fitting of proper electrical system to enable supply of electrical energy to utility point
- All electrical installations and fittings should be done according to electrical safety rules.
- All electrical wires must be safely insulated.
- Sockets and other electrical outlets must be securely fitted.
- When not in use, all machines should be put off.

- Qualified and experienced electrician should be hired to carry out all electrical works in the building
- Safety slogans should be strategically posted as a reminder to employees.
- All machine operating manuals should be clearly archived and availed for use when needed.
- Each machine operator should be conversant with the use of machine operating manuals.

6.5 First aid

The following should be adhered to;

- Setting up of an appropriately equipped first aid station that is easily accessible at the site
- Provision of first-aid services to all employees at all times
- There shall be a well-trained first aider on site at all times during installation and operationalization
- An eye-wash station and/or emergency shower shall be provided where the recommended first aid response is immediate flushing with water,
- The first aid station shall be equipped with gloves, gowns and masks for protection against direct contact with blood and other body fluids,
- A written emergency response plan will be in place and drills conducted to familiarize employees.

6.6 Anticipated Impacts of the Proposed Incinerator

The anticipated impacts emanating from a proposed project can either be positive or negative, direct or indirect, immediate or long term. Some impacts can work in synergy to cause a greater impact. Environmental impacts for the project shall be determined by breaking down the project into its activity components and examining the tasks in each component. The pollutants of concern including dioxins and furans, heavy metals (in particular, cadmium, mercury, and lead), acid gases, and particulate matter, either are formed during waste incineration or are present in the waste stream fed to the incineration facility.

Emissions of dioxins and furans result, in part, by the processes in the combustion chamber that lead to the escape of products of incomplete combustion (PICs) that react in the flue gas to form the dioxins. PICs are formed when combustion reactions are quenched or incompletely mixed. The combustion chamber for incineration must therefore be designed to provide complete mixing of the gases evolved from burning of wastes in the presence of air and to provide adequate residence time of the gases at high temperatures to ensure complete reactions. The operation of the combustion chamber also affects the emission of pollutants, such as heavy metals, that are present in the waste feed stream. Such compounds are conserved during combustion and are partitioned among the bottom ash, fly ash, and gases in proportions that depend on the compounds' volatility and the combustion conditions.

Mercury and its salts, for example, are volatile, so most of the mercury in the waste feed is vaporized in the combustion chamber. In the cases of lead and cadmium, the partitioning between the bottom ash and fly ash will depend on operating conditions. More of the metals appear in the fly ash as the combustion-chamber temperature is increased. In general, there is a need for the combustion conditions to maximize the destruction of PICs and to minimize the vaporization of heavy metals. It is also important to minimize the formation of NO_x (which is favored by high temperatures or the presence of nitrogen-containing fuels).

In addition to the composition of the waste feed stream and the design and operation of the combustion chamber, a major influence on the emissions from waste-incineration facilities is their air-pollution control devices. Particulate matter can be controlled with electrostatic precipitators, fabric filters, or wet inertial scrubbers. Hydrochloric acid (HCl) and sulfur dioxide (SO_2) can be controlled with wet scrubbers, spray dryer absorbers, or (to a lesser extent) dry-sorbent injection and downstream bag filters. NO_x can be controlled, in part, with combustion-process modification and with ammonia or urea injection through selective or nonselective catalytic reduction. Concentrations of dioxins and mercury can be reduced substantially by injecting activated carbon into the flue gas, or by passing the flue gas through a carbon sorbent bed, which adsorbs the trace gaseous constituents and mercury.

The application of improved combustor designs, operating practices, and Air-Pollution Control Devices (APCDs) and changes in waste feed stream composition have resulted in a dramatic decrease in the emissions that used to characterize uncontrolled incineration facilities. Rates of emission of mercury have decreased, at least in part, as a consequence of changes in the waste feed streams resulting from the elimination of mercury in some waste stream components, such as alkaline batteries.

To maximize combustion efficiency, it is necessary to maintain the appropriate temperature, residence time, and turbulence in the incineration process. Optimal combustion conditions in a furnace ideally are maintained in such a manner that the gases rising from the grate mix thoroughly and continuously with injected air; the optimal temperature range is maintained by burning of auxiliary fuel in an auxiliary burner during startup, shutdown, and upsets; and the furnace is designed for adequate turbulence and residence time for the combustion gases at these conditions.

6.7 Anticipated Impacts from Waste Water Treatment Plant

Positive Environmental Impacts

The quality of surface and ground water under the optimal proposed waste water treatment plant will not be negatively affected and discharges of the treated water will be useful to the recipient environment

The residents of the area will experience net positive environmental benefits from the project.

The public health of the community will be upgraded due to improved standard of wastewater management

Income opportunities will be created for local people during the construction and operational phases.

Negative impacts during operation phase of the treatment plant

The plant may also not be able to perform effectively if it is not well maintained and operated optimally

Haphazard dumping of accumulated sludge from the digesters might create contamination of local water resources and the soils

If sludge drying is not done during the dry season, there is the possibility that part of the sludge may be driven with the runoff, which can result in the contamination of surface water resources within the vicinity of the project site

Measures will be taken to:-

- Test wastewater quality on a regular basis to ensure that its characteristics are within the set standard as per third schedule of Water Quality Regulations 2006
- Take measures to avoid accidental surface runoff intrusion from the manholes of the sewerage network,
- Proper handling and drying of sludge will be done in drying beds, during dry season.
- With continuous sampling and laboratory tests, the performance of the WWTP will be optimized
- Impacts of odors as a result of mismanagement of solid wastes

The removed greasy material from the grease and sand trap if not properly stored and managed on regular basis can cause odors.

The staff of the plant will be properly trained, to enable them to handle grease and sand removal and taking samples for lab testing

Produced residuals will be stored in closed containers and transported in enclosed container trucks to landfill site.

Aeration tanks will always be kept at an optimum aeration rate

Odors will be reduced or prevented through normal housekeeping and improved operation and maintenance design procedures.

Sludge transfer systems such as conveyors, screw pumps, and conduits will be kept clean in order not to generate odors.

Regular cleaning of aeration tank walls and floors, washing weirs, and removing scum regularly, will be done to help in odor reduction.

Flow regulating chambers, drainage valves, standby pumps, as well as electric standby generators shall be provided to reduce the possibility of wastewater flooding within the wastewater treatment plant site, which results in possible generation of obnoxious smell

6.8 LPG Bulk Storage Impacts

Contamination of soil

The potential sources of soil contamination during construction phase are leaks or spills from machinery used in site preparation and demolition.

Depending on the size and source of the spill, liquid and gaseous phase petroleum hydrocarbons may remain mobile for long periods of time, and can potentially pollute groundwater.

During operation phase soil contamination is not anticipated because of the presence of the concrete paved surface which will prevent any potential contaminant from reaching the subsurface layers and is thus not assessed. However accidental release of stored or handled fuels due to leaks from storage tanks, piping systems, and fittings under fuel dispensers may occur. Releases may also result from surface spills and overfills during delivery and fueling. Tank and piping system failures may result from aging (e.g. corrosion of steel components) or from structural stress due to improper installation.

The impacts from such releases depends on numerous factors including the amount of materials released, local geologic conditions, and proximity to environmental receptors such as subsurface utilities or water resources

During decommissioning phase, soil contamination could occur especially with the use of machinery in demolition of the facility

Leak Mitigation Measures

Fuel loading trucks should be keenly observed not to leak oils on the ground. This can be done through regular maintenance.

Any maintenance work should be carried out in a designated area (protected service bays) and where oil spills are completely restrained from reaching the ground. Such areas should be cemented and enclosed to avoid storm water from carrying away oil into the soil

Car wash areas and other places handling oil activities within the site should be well managed and the drains from these areas controlled. Oil interceptors should be installed along the drainage channels leading from such areas

Develop a spill prevention and control plan to counter and manage emergencies that may occur/arise in the event of accidental spills

Underground Storage Tanks (USTs) whether constructed from steel or fiberglass-reinforced plastic will be inspected first to ensure it is built according to recognized industry standards.

USTs will have secondary containment systems to prevent the uncontrolled release of fuel.

Secondary containment systems includes double wall construction for Underground Storage Tanks (USTs) and the bottom of Above ground Storage Tanks (ASTs), equipped with an interstitial monitoring devise. Other containment measures are connection to a continuous leak detection system:-

- Use of vaults or membranes in single wall Underground Storage Tanks (USTs)
- Use of composite tanks

- Leak detection systems will be able to detect the presence of liquid or petroleum vapor within the interstitial space

Use of corrosion protection in steel tanks and piping. Corrosion protection may consist of coating with a suitable dielectric material or by cathodic protection.

Tanks should be equipped with devices that prevent spills and overfills, such as overfill alarms, automatic shut-off devices and catch basins around fill pipes. Fill pipes on the above ground Storage Tanks (ASTs) should be located within the tank's secondary containment structures.

UST piping, fittings, and connections should be designed and built according to recognized industry standards. Buried piping joints and fittings made of metal should be kept to a minimum and, when necessary, should be welded rather than threaded. The use of polyethylene piping and continuous, flexible composite piping from specially developed thermoplastic composites with no joints should be considered.

Pressure piping systems should include secondary containment with plastic. Tank and piping installation procedures should be consistent with recognized industry standards and equipment manufacturer recommendations. Installation procedures designed to reduce the likelihood of tank and piping structural failure include:

- Proper care and handling of tank and piping materials prior to installation
- Preparation of foundations with the use of backfill that support tank and piping securely and evenly to prevent movement, uneven settlement, or concentrated loading, especially for fiber- glass-reinforced plastic USTs and flexible composite piping.
- Overlying concrete or pavement should be designed to handle dynamic loads to prevent stress on buried tank and piping.

Prioritizing the upgrade of equipment and installation for existing facilities of a network according to local regulatory standards (which may require the upgrade or replacement of tanks and other infrastructure after they reach a certain age) or according to the potential likelihood of a release and the potential severity of the consequences in the event of a release. Examples of risk-based criteria applicable to USTs include:

- Evidence of system leaks such as loss of product from inventory or reports of fuel vapors in underground utilities or nearby buildings.
- Age and type of construction of existing tank and piping infrastructure.
- Soil characteristics that may contribute to the corrosion of underground systems
- Location in, or in close proximity to, underground mining areas.
- Proximity to environmental receptors such as underground infrastructure (e.g. underground public utilities such as sewers, tunnels / vaults for electric or telephone utilities, or building basements), private or public water supply wells, surface water reservoirs, aquatic habitats for critically endangered species.

All storage tanks should undergo periodic inspection for corrosion and structural integrity and be subject to regular maintenance and replacement of equipment (e.g. pipes, seals, connectors, and valves)

Facilities should develop a formal spill prevention and control plan that addresses significant scenarios and magnitude of releases. The plan should be supported by the necessary resources and training. Spill response equipment should be conveniently available to address all types of spills, including small spills.

Facilities should also have a formal procedure developed by network operators and managers to respond to the discovery of leaks in USTs, including means for confirming the presence of the release; investigating potential impacts to environmental media; and, based on the result of the assessment or on confirmation of the significance of the release, implementing corrective actions to repair or replace damaged or leaking equipment and address risks of the resulting impacts to soil and water resources.

Groundwater monitoring should be included as part of a spill / leak detection strategy. This should typically consist of at least three monitoring points to also establish the direction of groundwater flow.

6.9 Fire hazards and Fighting

Install an automatic fire alarm system for the entire project mostly on operation.

Install firefighting equipment, heat and smoke detectors, static water storage tanks for pressurized firefighting as approved by the Nairobi County Council.

All fire control and fighting facilities to be installed as per the requirements stipulated in the approved plans.

The management shall ensure that the requirements of the Fire Risk Reduction Rules, 2007 are in place.

In addition to the above, the project management should consider the following:-

Conduct regular fire drills/simulations to sensitize workers during construction phase

Adapt an emergency response plan for the entire project during operational phase

Ensure that all firefighting equipment are strategically positioned, regularly maintained and serviced

Provide fire hazard signs such as ‘No Smoking’ signs, Direction to exit in case of any fire incidence and emergency contact numbers should be provided.

Provisions of marked fire exits and ensure that all fire exits are unobstructed at all times.

The proponent to put up a trained firefighting team in accordance with the sec. 20& 21 of the Fire Risk Reduction Rules, 2007.

CHAPTER SEVEN

7.0 NANOTECHNOLOGY LAB INSTALLATION AND OPERATIONAL PHASE IMPACT MITIGATION

7.1 Code of practice

The Centre status on biosafety level shall be well communicated for both users and the general public to influence behavioral adaptation to the likely impacts and the authority for the lab. The international biohazard warning symbol and sign shall be displayed on laboratory access doors and must identify the lab as biosafety level 4 with the name of the Centre supervisor who controls access indicated, and further indicate any special conditions for entry into the area, e.g. immunization.

The Laboratory protective clothing must be of the type with solid-front or wrap-around gowns, scrub suits, coveralls, head covering and, where appropriate, shoe covers or dedicated shoes. Front-buttoned standard laboratory coats are unsuitable, as are sleeves that do not fully cover the forearms. Laboratory protective clothing must not be worn outside the Lab, and it shall be decontaminated before it is laundered.

Open manipulations of all potentially infectious material shall be conducted within a biological safety cabinet or other primary containment.

The two-person rule should apply, whereby no individual ever works alone. A complete change of clothing and shoes will be done prior to entering and upon exiting the laboratory. Personnel shall be trained in emergency extraction procedures in the event of personnel injury or illness. A method of communication for routine and emergency contacts shall be established between personnel working within the containment laboratory (Biosafety Level 3) and support personnel outside the Centre.

7.2 Nanotechnology Lab Design and Facilities

The Lab shall be separated from the areas that are open to unrestricted traffic flow within the building. Additional separation will be achieved by locating the lab at the last underground floor at basement 4 where no one passes there. Artificial pressure differential shall be created between the Lab and its adjacent space. The basement 4 anteroom will have facilities for separating clean and dirty clothing and a shower will be installed. Anteroom doors shall be self-closing and interlocking so that there is only one door that is open at a time. A break-through panel shall be provided for emergency exit use. Surfaces of walls, floors and ceilings shall be water-resistant and easy to clean. Openings through these surfaces (e.g. for service pipes) shall be sealed to facilitate decontamination of the room(s). The whole laboratory room shall be sealable for decontamination. Air-ducting systems will be constructed to permit gaseous decontamination. All windows shall be

kept closed, sealed and break-resistant.

A hand-washing station with hands-free controls shall be provided near each exit door. There shall be a controlled ventilation system that will maintain a directional airflow into the laboratory room. A visual monitoring device with or without alarm(s) should be installed so that staff can at all times ensure that proper directional airflow into the laboratory room is maintained. The building ventilation system shall be so constructed that air from the containment laboratory is not recirculated to other areas within the building. Air will be high-efficiency particulate air (HEPA) filtered, reconditioned and recirculated within the Labs. When exhaust air from the laboratory (other than from biological safety cabinets) is discharged to the outside of the building, it shall be dispersed away from occupied buildings and air intakes. Depending on the agents in use, this air shall be discharged through HEPA filters. A heating, ventilation and air-conditioning (HVAC) control system will be installed to prevent sustained positive pressurization of the laboratory. Consideration will be given to the installation of audible or clearly visible alarms to notify personnel of HVAC system failure. All HEPA filters will be installed in a manner that permits gaseous decontamination and testing.

All biological safety cabinets will be sited away from walking areas and out of cross- currents from doors and ventilation systems

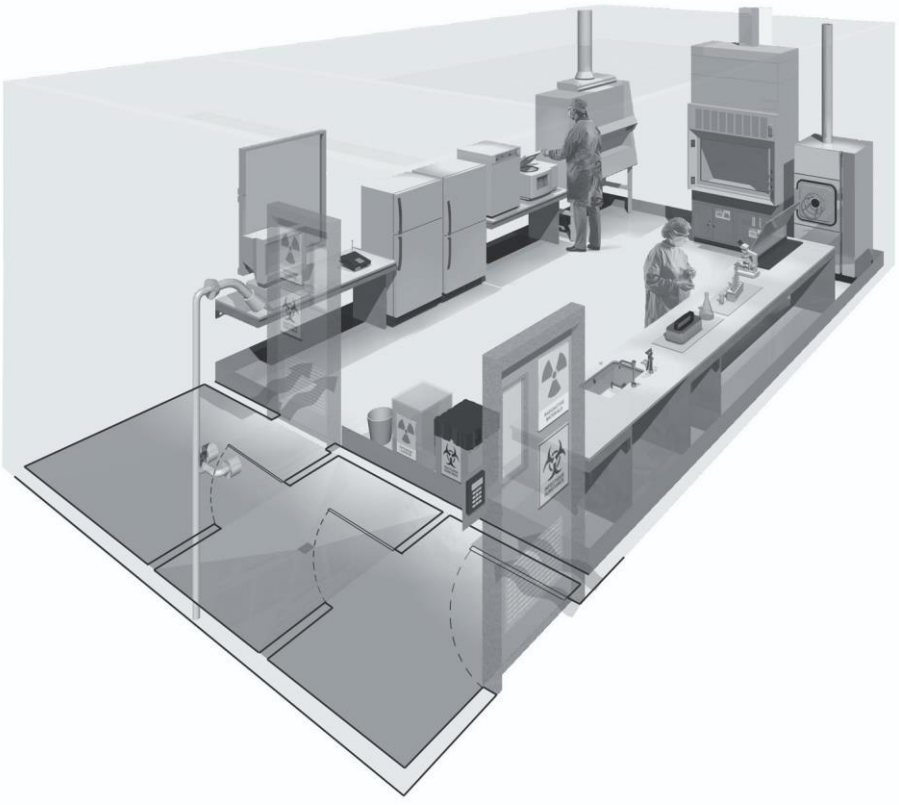

Fig 7.1 A typical Biosafety Level 4 laboratory
(Graphics kindly provided by CUH2A, Princeton, NJ, USA). The laboratory is separated from general traffic flow and accessed through an anteroom. An autoclave is available within the facility for decontamination of wastes prior to disposal. A sink with hands-free operation is available. Inward directional airflow is established and all work with infectious materials is conducted within a biological safety cabinet.

The exhaust air which will have been passed through HEPA filters, shall be discharged in such a

way as to avoid interference with the air balance of the cabinet or the building exhaust system. An autoclave for the decontamination of contaminated waste material will be available in the containment laboratory. If infectious waste has to be removed from the maximum containment laboratory for decontamination and disposal, it shall be transported in sealed, unbreakable and leak proof containers according to NEMA waste regulations. Backflow-precaution devices shall be fitted to the water supply. Vacuum lines will be protected with liquid disinfectant traps and HEPA filters, or their equivalent. Alternative vacuum pumps will also be properly protected with traps and filters. The facility design and operational procedures shall be documented.

7.3 Lab Equipment

Manipulation of all potentially infectious material shall be conducted within a biological safety cabinet or other primary containment device. Consideration shall be given to equipment such as centrifuges, which will need additional containment accessories, for example, safety buckets or containment rotors. Some centrifuges and other equipment, such as cell-sorting instruments for use with infected cells, shall require additional local exhaust ventilation with HEPA filtration for efficient containment. The following equipment shall be available:-

1. ***Primary containment***. An efficient primary containment system shall be in place, consisting of one or a combination of the following.

***Class III cabinet laboratory*.** Passage through a minimum of two doors prior to entering the rooms containing the Class III biological safety cabinet(s) (cabinet room) is required. In this laboratory configuration the Class III biological safety cabinet provides the primary containment. A personnel shower with inner and outer changing rooms is necessary. Supplies and materials that will not be brought into the cabinet room through the changing area shall be introduced through a double-door autoclave or fumigation chamber. Once the outer door is securely closed, staff inside the laboratory shall open the inner door to retrieve the materials. The doors of the autoclave or fumigation chamber shall be interlocked in such a way that the outer door cannot open unless the autoclave has been operated through a sterilization cycle or the fumigation chamber has been decontaminated.

***Suit laboratory*.** The rooms in the protective suit laboratory are arranged so as to direct personnel through the changing and decontamination areas prior to entering areas where infectious materials are manipulated. A suit decontamination shower will be provided and used by personnel leaving the containment laboratory area. A separate personnel shower with inner and outer changing rooms is also provided. Personnel who enter the suit area will be required to don a one-piece, positively pressurized, HEPA-filtered, supplied-air suit. Air to the suit shall be provided by a system that has a 100% redundant capability with an independent source of air, for use in the event of an emergency. Entry into the suit laboratory is through an airlock fitted with airtight doors. An appropriate

warning system for personnel working in the suit laboratory will be provided for use in the event of mechanical system or air failure.

Controlled access. The facility shall be located in a separate building or in a clearly delineated zone within a secure building. Entry and exit of personnel and supplies shall be through an airlock or pass-through system. On entering, personnel will put on a complete change of clothing; before leaving, they shall shower before putting on their street clothing.

Controlled air system. Negative pressure will be maintained in the facility. Both supply and exhaust air shall be HEPA-filtered. Redundant exhaust fans will be required to ensure that the facility remains under negative pressure at all times. The differential pressures within the suit laboratory and between the suit laboratory and adjacent areas must be monitored. Airflow in the supply and exhaust components of the ventilating system shall be monitored, and an appropriate system of controls will be used to prevent pressurization of the suit laboratory. HEPA-filtered supply air shall be provided to the suit area, decontamination shower and decontamination airlocks or chambers. Exhaust air from the suit laboratory will be passed through a series of two HEPA filters prior to release outdoors. Alternatively, after double HEPA filtration, exhaust air will be recirculated, but only within the suit laboratory.

All HEPA filters need to be tested and certified annually. The HEPA filter housings are designed to allow for in situ decontamination of the filter prior to removal. Alternatively, the filter can be removed in a sealed, gas-tight primary container for subsequent decontamination and/or destruction by incineration.

Decontamination of effluents. All effluents from the suit area, decontamination chamber, decontamination shower, or Class III biological safety cabinet shall be decontaminated before final discharge. Heat treatment is the preferred method. Effluents may also require correction to a neutral pH prior to discharge. Water from the personnel shower and toilet may be discharged directly to the sanitary sewer without treatment.

Sterilization of waste and materials. A double-door, pass-through autoclave shall be available in the laboratory area. Other methods of decontamination shall be available for equipment and items that cannot withstand steam sterilization.

Airlock entry ports for specimens, materials and animals shall be provided.

Emergency power and dedicated power supply line(s) will be provided.

Containment drain(s) will be installed.

7.4 Health and medical surveillance

1. Medical examination of all laboratory personnel who work in containment laboratories shall be mandatory. This shall include recording of a detailed medical history and an occupationally-targeted physical examination.
2. After a satisfactory clinical assessment, the examinee will be provided with a medical contact card

stating that he or she is employed in a facility with a containment laboratory. This card shall include a picture of the card holder, be wallet-sized, and always be carried by the holder. The name(s) of the contact persons to be entered will need to be agreed locally but might include the laboratory director, medical adviser and/or biosafety officer.

A. Front of card

TO THE EMPLOYEE

Card holder's Picture

Keep this card in your possession. In case of unexplained febrile illness, present the card to your physician and notify one of the following in the order listed.

Dr. _____

Tel (Work): _____

Tel (Home): _____

Back of card

TO THE PHYSICIAN

The holder of this card works in an area at _____ in which pathogenic viruses, rickettsia, bacteria, protozoa or helminths are present. In the event of an unexplained febrile illness, please call the employer for information on agents to which this employee may have been exposed.

Name of laboratory: _____

Address: _____

Tel: _____

Fig 7.2. Suggested format for medical contact card

7.5 Laboratory Premises Suitability

The Nanotechnology Laboratory is a specialized, high precision environment. Its establishment requires adherence to national Nanotechnology policy as per NACOSTI under the Ministry of

Education as well as Ministry of Health guidelines and international guidelines outlined in WHO Biosafety manual program. The premises will meet national and local building requirements, including those relating to natural disaster precautions. The premises shall be generally uncluttered, clean and free from obstructions. The floors and stairs shall be free from any structural defects, uniform and slip-resistant. The working space will be adequate for safe operation. The circulation spaces and corridors shall be adequate for the movement of people and large equipment. The benches, furniture and fittings to be installed shall be in good condition and bench surfaces shall be resistant to solvents and corrosive chemicals. Each laboratory room shall have a hand-washing sink.

The finishing of the laboratory shall be designed in such a way to prevent entry and harborage of rodents and arthropods with regular maintenance. All exposed steam and hot water pipes shall be insulated or guarded to protect personnel. The lab shall have an independent power support unit provided in case of power breakdown. Access to laboratory areas shall be restricted to authorized personnel with access cards designed to display important details. Prior to commissioning the Laboratory, risk assessment will be performed to ensure that appropriate equipment and facilities are available to support the work being considered

7.5.1 Storage facilities

The basic storage facilities like shelves shall be arranged so that stores are secure against sliding, collapse or falls. They shall be kept free from accumulations of rubbish, unwanted materials and objects that present hazards from tripping, fire, explosion and harborage of pests. All freezers and storage areas shall be lockable

7.5.2 Services

Each of the laboratory rooms shall be provided with enough sinks, water, electricity and gas outlets for safe working with an adequate inspection and maintenance program for fuses, lights, cables, pipes, etc. with notable faults corrected within a reasonable time. The premise has internal engineering and maintenance services available, with skilled engineers and craftsmen who also have some knowledge of the nature of the work of the laboratory. The access of engineering and maintenance personnel to various Lab areas shall be controlled and documented. In case of more delicate assignments that internal engineering and maintenance services are unable to undertake, local engineers and builders shall be contacted and familiarized with the equipment and work of the Lab. Cleaning services shall be available with the access of cleaning personnel to various areas controlled and documented. The information technology services shall also be available and secured.

7.5.3 Laboratory biosecurity

The Lab will undergo a qualitative risk assessment to define risks that a security system should protect against. The staff will define acceptable risks and incidence response planning parameters. The whole premise will be securely locked when unoccupied and all the doors and windows shall be break-proof. The rooms containing hazardous materials and expensive equipment will always be locked when unoccupied with access to such rooms, equipment and materials appropriately controlled and documented.

7.5.4 Fire prevention and fire protection

The Lab will have a fire alarm system with the fire alarm stations easily accessible and shall be fitted with fire doors in good order. The fire detection system shall be regularly tested to ensure it is in good working order.

The incinerator, generator, underground storage tanks and the LPG Bulk storage tanks shall be equipped with fire extinguishers that use fire balls as they are cheaper and effective.

The parking lots of basement three (3), two(2) and basement one(1) will be fitted with pressurized water systems for firefighting using water that shall be stored in a water pump room for the specific purpose of emergency fire outbreak fighting. The mechanical ventilation ducts in the basements will also serve to improve air circulation and minimize the chances of fires.

All exits will be marked by proper, illuminated signs with access to exits marked where the routes to them are not immediately visible. All exits shall be unobstructed by decorations, furniture and equipment, and unlocked when the building is occupied. Access to exits will be arranged so that it is not necessary to pass through a high-hazard area to escape and all exits shall as well lead to an open space.

Corridors, aisles and circulation areas shall be kept clear and unobstructed for movement of staff and fire-fighting equipment. All fire-fighting equipment and apparatus shall be easily identified by an appropriate color code. The portable fire extinguishers shall be maintained fully charged and in working order, and kept in designated places at all times. The laboratory rooms with potential fire hazards shall be equipped with appropriate extinguishers and/or fire blankets for emergency use and if flammable liquids and gases are used in any room, the mechanical ventilation shall be sufficient to ensure vapors are removed before they reach a hazardous concentration. All personnel including cleaners and operation and maintenance workers shall undergo training to respond to fire emergencies

7.5.5 Flammable liquid storage

The storage facility for bulk flammable liquids shall be separated from the main building and clearly labelled as a fire-risk area. It shall have a gravity or mechanical exhaust ventilation system that is separate from the main building system. The switches for lighting shall be sealed or placed outside this building. The light fittings inside storage shall be sealed to protect against ignition of vapors by sparking. The flammable liquids will be stored in proper, ventilated containers that are made of non-combustible materials with the contents of all containers correctly described on the labels. The appropriate fire extinguishers and/or fire blankets will be placed outside but near to the flammable liquid store. "No smoking" signs will be clearly displayed inside and outside the flammable liquid store with only minimum amounts of flammable substances stored in laboratory rooms. Flammable liquids shall be stored in properly constructed flammable storage cabinets adequately labelled with "Flammable liquid – Fire hazard" signs. The personnel will be trained to properly use and transport flammable liquids?

7.5.6 Compressed and liquefied gases

Each portable gas container shall be legibly marked with its contents and correctly color- coded while compressed-gas cylinders and their high-pressure and reduction valves shall be regularly inspected and maintained. The pressure-relief device shall always be connected when a cylinder is in use. The protection caps shall be in place when cylinders are not in use or are being transported. All compressed gas cylinders shall be secured so that they cannot fall, especially in the event of natural disaster while cylinders and liquid petroleum gas tanks will be kept away from sources of heat. Personnel will be trained to properly use and transport compressed and liquefied gases.

7.5.7 Electrical hazards

All new electrical installations, replacements, modifications or repairs shall be made and maintained in accordance with a national electrical safety code. The interior wiring shall have an earthed/grounded conductor (i.e. a three-wire system) for safety from electric shocks with circuit-breakers and earth-fault interrupters fitted to all laboratory circuits. All electrical appliances to be installed will have testing laboratory approval as per the national or international standards e.g. KEBS diamond mark of quality. The flexible connecting cables of all equipment will be as short as practicable, in good condition, and not frayed, damaged or spliced with each electric socket outlet used for only one appliance (no adapters to be used).

7.5.8 Personal Protection

The personnel protective clothing will be of approved design and fabric and shall be provided for all

staff for normal work, e.g. gowns, coveralls, aprons, gloves. Additional protective clothing shall also be provided for work with hazardous chemicals and radioactive and carcinogenic substances, e.g. rubber aprons and gloves for chemicals and for dealing with spillages; heat-resistant gloves for unloading autoclaves and ovens. Safety glasses, goggles and shields (visors) shall be provided with eye-wash stations clearly marked in case of chemical splashes. The proponent shall as well install emergency showers (drench facilities). Radiation protection installations shall as well be provided in accordance with national and international standards, including provision of dosimeters. Respirators shall be available, regularly cleaned, disinfected, inspected and stored in a clean and sanitary condition. Appropriate filters will be provided for the correct types of respirators, e.g. HEPA filters for microorganisms, appropriate filters for gases or particulates. The respirators shall be fit-tested as well.

7.5.9 Health and safety of staff

The institutional' occupational health and safety policy shall apply with further additions for the containment Lab as follows:-

- First-aid boxes shall be provided at strategic locations
- Qualified first-aiders shall be available to the lab
- The first-aiders shall be further trained to deal with emergencies peculiar to the laboratory, e.g. contact with corrosive chemicals, accidental ingestion of poisons and infectious materials
- The non-laboratory workers, e.g. domestic and clerical staff shall be instructed on the potential hazards of the laboratory and the material it handles
- Notices shall be prominently posted giving clear information about the location of first-aiders, telephone numbers of emergency services, etc.
- All women of childbearing age working in the lab shall be warned of the consequences of work with certain microorganisms, carcinogens, mutagens and teratogens.
- All women of childbearing age will be prior informed that if they are, or suspect that they are pregnant, they shall inform the appropriate member of the medical/scientific staff so that alternative working arrangements may be made for them if necessary.
- There shall be an immunization program relevant to the work of the laboratory.
- Skin tests and/or radiological facilities shall be available for staff who work with tuberculous materials or other materials requiring such measures.
- The lab shall maintain proper records of illnesses and accidents.
- There shall be warning and accident prevention signs strategically placed to minimize work hazards
- Personnel shall be trained to follow appropriate biosafety practices

- All laboratory staff will be encouraged to report potential exposures

7.5.10 Laboratory equipment

Prior to installation, all equipment shall be certified safe for use with all procedures made available for decontaminating equipment prior to maintenance. Biological safety cabinets and fume cupboards shall be regularly tested and serviced. Autoclaves, centrifuge buckets and rotors and other pressure vessels shall be regularly inspected. HEPA filters shall be regularly changed while pipettes shall be used instead of hypodermic needles. All cracked and chipped glassware shall always be discarded and not reused. The lab shall have safe receptacles for broken glass. Plastics shall be used instead of glass where feasible. The lab shall have a sharps disposal containers.

7.5.11 Infectious materials

The Lab management shall put necessary measures in place to ensure specimens are received in a safe condition. There shall be proper records kept for incoming materials. All specimens shall be unpacked in biological safety cabinets with care and attention to possible breakage and leakage. The staff shall always wear gloves and other protective clothing for unpacking specimens. The personnel shall be trained on best practices to ship infectious substances according to current national and/or international regulations. The work benches shall be kept clean and tidy and all discarded infectious materials removed daily or more often and disposed of safely.

All members of the staff shall be aware of procedures for dealing with breakage and spillage of cultures and infectious materials. Performance of sterilizers shall be checked by the appropriate chemical, physical and biological indicators. A procedure for decontaminating centrifuges regularly shall be developed as well as sealed buckets be provided for centrifuges. Appropriate disinfectants shall be used correctly in right quantities, concentrations and mix. Only staff with special training shall work in containment laboratories of the Centre.

7.5.12 Chemicals and radioactive substances

Incompatible chemicals shall be effectively separated when stored or handled and be correctly labelled with names and warnings. Chemical hazard warning charts shall be prominently displayed in the Lab and spill kits shall be provided with staff well trained to deal with spills. All flammable substances shall be correctly and safely stored in minimal amounts in approved cabinets and sufficient bottle carriers shall be provided.

For radioactive substances, a radiation protection officer or appropriate reference manual shall be available for consultation. Staff shall be appropriately trained to safely work with radioactive materials with proper records of stocks and use of radioactive substances maintained. The lab will provide radioactivity screens and personal radiation exposures shall be monitored.

International radiation hazard symbol

7.6 The Nanotechnology Lab Waste management Plan

Effluent Management Plan

Waste water emanating from the proposed development will be managed by decontamination and disposal at the connecting sewer run by Nairobi Water and Sewerage Company after establish the schedule as per water quality regulations 2006.

Solid waste management plan

All solid waste from the development will be fist decontaminated or autoclaved depending on level of toxicity before being treated according to the Waste Management Regulations (Legal Notice No. 121 of 2006). Solid waste produced by the proposed project will be segregated at source into organic and inorganic with the inorganic being further separated into combustible and non-combustible. The following sections briefly describe the waste management plan.

Waste Minimization Strategies

Waste management by whatever means is an expensive proposition especially given the nature of the project and its location. The project proponents will bear this cost and therefore will aggressively pursue other less expensive options as long as they are compatible with maintaining sound environmental practices. With this in mind, the development of a solid waste management plan will resort to the ***three R***s referring to Recycling, Reusing and Reduction.

If incorporated, these practices will greatly reduce the solid waste volume produced by the project and overhead expenditures that accompany the solid waste management programs.

- **Reduction** – The project proponents will work with all the staff and transient visitors create a hierarchy of waste management where simply reducing the amounts of waste produced by these individuals should be a priority.

- **Reuse** - Once materials for the project are bought they should be reused as many times as possible. There are many opportunities for reusing resources like treated water recirculation and exhaust air from the HEPA filters being recirculated
- **Recycle** – Project proponents should strictly buy items with some degree of recyclability. This may entail buying aluminum materials, glass and plastics.

Educational and sensitization program

The Solid Waste Management Program for the proposed project will also include an educational and sensitization component to inform staff on the importance of solid waste management and its impact to the receiving environment. In addition, collection schedules, receptacle locations and other component will also be made known. It is anticipated that this component will be a dynamic and continuous effort in achieving the program's goal. The project will also be utilizing signs and notices to convey the message of solid waste management. These signs and notices will be placed at strategic locations around the Laboratory and will be aimed at conservation of the receiving environment.

Final waste disposal

For the wastes that could not be re-used, composted or recycled, a NEMA licensed waste handler will be engaged to facilitate a final disposal of such waste in the designated site.

E-waste management

NEMA has published guidelines for E-waste management in Kenya. A key strategy for the proponents and the occupants of the Lab will be the collection and conveyance of the e-waste to licensed recycling centers.

7.7 Disaster and emergency situations

The project proponents will develop and implement Nanotechnology Lab responsive Disaster Management Plan for identifying the different potential disasters that could impact the Lab. Once in operation, a more comprehensive and detailed plan will be developed and implemented for the project focusing on dealing with the potential disaster types identified above. The below provides a summary that can be used in preparing a comprehensive disaster management plan which is dynamic and responsive on a need to need basis. Depending on the scale of the disaster, the disaster management policy of 2009 will take effect and will be coordinated by either the County/National governments.

Summarizing guidelines in the preparation of a comprehensive disaster management plan.

Disaster	Description	Response plan	Stages

Fire	Fire outbreaks can vary in size and location and can cause irreparable damage to the project's infrastructure and are a serious threat to human life	Fire Prevention and Response Plan	Response
Medical	Medical emergencies can occur at any moment without giving notice and therefore requires a quick and coordinated effort to respond to this need.	Medical Emergency Plan (Transportation & Evacuation)	Response, Recovery

The proposed project will take into consideration these two potential disasters among others and plan accordingly in order to mitigate and remediate any negative effects these types of disasters could have on the infrastructure, operation and management of the project.

Disaster management plan

- The proponents and Lab staff to formulate an Emergency Committee to address the aforementioned Disaster Management Plan.
- The committee will be charged with the task of electing an Emergency Coordinator and his/her subordinate, who shall direct and execute all the activities outlined by the response plans.
- The emergency committee must conduct periodic meetings to address important issues concerning the disaster management plans.
- Such important issues should be the objectives of the committee, their roles and responsibilities, updates, training, drills as well as their terms of reference (TOR) which they will abide by.

Fire prevention and response plan

Fire outbreaks whether small or large can be detrimental to the project and in some instances be life threatening. It is therefore important to consider its likelihood and the circumstances surrounding its propagation. The proponents will therefore develop a Fire Prevention Response Plan aimed at addressing the awareness and the mechanism necessary for its response.

Purpose of plan

The purpose of the Fire Prevention and Response plan for the proposed project is to:

- Increase awareness among guests, management and others of the need for a fire prevention and response plan,
- To establish the coordinating mechanisms necessary for management to prepare and implement measures to safeguard property and lives of all concerned should a fire occur in a building

- Indicate all possible evacuation routes for each accommodation unit, restaurants, bars etc and other buildings on the property.

7.8 Fire prevention

Fire prevention will be achieved through:

- Use of retardant material.
- Use of qualified personnel to install electrical systems for the project.
- Ensuring engineering standards to meet provisions for adequate and safe wiring, plumbing, heating, and cooling systems.

7.8.1 Fire protection equipment/systems

The proponents will install fire protection systems to protect lives and property. The following are fire detection, notification and suppression systems that will be used to control a fire:

- Fire alarm detection and notification systems*:* - Install smoke and heat detectors or manually activated pull station.
- Fire Suppression Systems: - Hydrants and Fire Extinguishers. The proponents will install multi-purpose dry chemical (Class ABC) fire extinguishers. Dry chemical extinguishers will range in sizes of 2.5 to 5 Kgs and will be installed at strategic places.

7.8.2 Fire Response

Fire outbreaks are unpredictable but can be prevented. It is difficult to portray a response plan for the project site considering the different scenarios that might arise from a fire. It is important though, to have in mind certain tips and guidelines as to the advent of a fire. These guidelines may come in the form of a fire combating plan whereby trained staff may utilize the different fire controls to extinguish the fire. Fire outbreaks often require an evacuation plan and for this reason, a comprehensive evacuation plan will be required to be developed.

7.9 Medical Response Plan

The proposed development will implement a medical response plan in the event of a medical emergency. In general, the proposed response plan will cater for basic first aid health care and will include emergency transportation to a recognized health institution capable of treating the patient.

7.9.1 Components of the plan

The medical plan should include;

- Basic first aid personnel and first aid kit (Most first aid kits contain bandages for controlling bleeding, personal protective equipment such as gloves and a breathing barrier for performing rescue breathing and CPR (cardiopulmonary resuscitation), and sometimes instructions on how to perform first aid)
- Transportation of patients when conventional First Aid requires additional medical attention, the patient must be transported to a recognized health institution for further treatment. A standby ambulance should be provided.
- Contact information, an important factor in considering emergency situations. It can be used in cases of fire, medical and other emergencies

7.9.2 Training and development

The proponent will acknowledge the importance of having well qualified personnel working in the Lab for the day to day operations as well as disaster preparedness for any incidences and occurrences. This will entail making investments in quality personnel training through recognized institution for both the main staff and the support staff. The training will be tailored to achieve the objectives of the Lab as envisioned by the laboratory manager, biosafety officer, experienced members of staff or the consultant company that will help in running the lab and initiating members of staff into the operationalization of Biosafety Level 4 status Nanotechnology Lab.

7.10 Noise abatement

The proponents will adhere to the Excessive Noise and Vibrations Pollution Control Regulations, 2009. (Legal Notice No. 61 of 2009) to ensure co-existence with neighborhood and safety of staff through providing the prescribed Personal Protective Equipment (PPEs),

7.11 Decommissioning Phase

Most installation impact mitigation measures are similar to those of decommissioning. However, the mechanisms proposed to mitigate the impacts of decommissioning include due diligence survey, where the proponents will undertake safety and environmental audit to identify and mitigate any impacts that may arise from any left-over material and substances that could be harmful to people and/or the environment.

CHAPTER EIGHT

8.0 Environmental Management Plan

8.1 Introduction

The objectives of the Environmental Management Plan are:

- To guide the project implementers in project planning,
- To guide the Project implementers on the likely impacts of the project and when they are likely to occur.
- To guide the project implementers to allocate adequate resources for the implementation of the mitigating measures.

8.2 Plan Period

The EMP provided is for the installation phase, the operationalization phase and especially the first year of the Lab operations and lastly the decommissioning of the Lab. It is expected that an Environmental Audit will be undertaken at the end of the first year of operation to evaluate conformity to the EMP as well as identify any gaps and recommend corrective adjustments to the plan. This will then be addressed through a loop mechanism from installation to operational phase to identify the success of the project versus the failures. This should be analyzed through the environmental management criteria of impact and mitigation.

8.3 EMP Outline

The tables below outline the environmental management plans (installation, operation and decommissioning) for the proposed nanotechnology Lab. The plan considers the following:

- Predicted environmental impact
- Proposed mitigation measures
- Responsible party / parties
- Timeframe
- Costs

8.4 EMP for the Installation Phase of Nanotechnology Lab

Anticipated Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Approx. Cost (KShs.)
Impact of sourcing of materials and equipment on environment	❖ Obtain equipment and materials from sources that are compliant with NEMA Regulations. ❖ Procure quantities that are sufficient for the intended works only. ❖ Re-use as far as practical to stem waste accumulation. ❖ Commit to extensive use of recycled raw materials where appropriate and in a manner that does not compromise the safety of the laboratory. ❖ Register the site as a workplace with the Directorate of Occupational Health and Safety (DOSH). ❖ Employees using equipment that produce peak sounds shall be provided with earmuffs ❖ Comply with the provisions of Noise Regulations (Legal Notice No. 61 of 2009)	Proponents and Contractor	Throughout installation and operationalization period	No cost
X-ray radiation levels at the nanotechnology Laboratory	❖ Install appropriate x-ray containment around the x-ray machine ❖ Install the X-ray machine in compliance with the radiation protection Act Cap 243.	Project Architect and the Mechanical services Engineer	Installation phase	Ksh. 10,000,000

Steam boiler installation	❖ Install in compliance with the occupational safety and health Act 2007.	Project Architect and the Mechanical services Engineer	Installation phase	Ksh. 3,000,000
Injuries and incidents of staff/support staff arising from lack of adequate training on safety	❖ A continuous, on-the-job safety training programme to maintain safety awareness among laboratory and support staff ❖ Testing of equipment after servicing, e.g. testing the efficiency of biological safety cabinets after new filters have been fitted, may be carried out by or under supervision of the biosafety officer ❖ The Laboratory management shall establish good relationships with local service providers to familiarize them with the equipment and work of the laboratory if internal engineering and maintenance services are not satisfactory ❖ Engineering and maintenance staff shall only enter laboratory with clearance and supervision by the laboratory manager ❖ Laboratory supervisors, with the assistance of the biosafety officer and other resource persons to play key role in staff training ❖ Ensure effectiveness of biosafety training on safety and health through full commitment of management. ❖ Laboratory manager to establish the tasks involved, the order of importance (in terms of frequency, criticality,	Proponent and Lab manager	Throughout installation and operating period	Contingency fund to be established

	complexity) and details of the steps necessary to accomplish them during training ❖ Laboratory manager to set training objectives that can demonstrate observable behaviors that the trainee is expected to demonstrate on the job after accomplishing the training ❖ Laboratory manager in conjunction with staff who know the operations of the lab to set the content and media of training that the trainee shall master to be able to meet the behavioral objectives envisioned after the biosafety training program ❖ Training to as well focus on the products of problem-solving exercises or the design of learning measures to correct mistakes people have made in using a skill ❖ Training to essentially aspire to fulfill the specific training needs considering the make-up of the trainee group ❖ Effective training to take into account the characteristics or attributes of the trainees as individuals and groups may differ in aptitude, literacy, culture, spoken language and pre-training skill levels thus the importance they attach to the training on improving their safety and job performance shall dictate the approach to be used. ❖ Training evaluation shall be undertaken on trainees. There shall as well be continuous training revision to ensure content mastery through application on job and safe behavior of the trainee.			

8.5 EMP for the Operational Phase of Nanotechnology Lab

Anticipated Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Approx. Cost (KShs)
X-ray radiation levels at the nanotechnology Laboratory	❖ Maintain appropriate x-ray containment around the x-ray machine ❖ Maintain the X-ray machine in compliance with the radiation protection Act Cap 243.	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	Ksh. 150,000
Emissions due to Steam boiler operation	❖ Maintain boiler in compliance with the occupational safety and health Act 2007. ❖ Monitor and control emissions in compliance with the Environmental Management and coordination (air quality) regulations 2014.	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	Ksh 120,000
Solid waste	❖ Provide trash bins that promote separation at source. ❖ Contract a private waste handler who is registered with both NEMA and the County Government of Nairobi and proper records kept for collection and disposal. ❖ Manage waste through the hierarchy of options that including reduction at source, separation of wastes to make it easier to undertake recycling / reusing. ❖ Create awareness among workforce and visitors on the importance of proper disposal of solid wastes.	Proponents, contractor and project manager.	Throughout operational phase	2,000 per month for the contractors managing solid wastes

Anticipated Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Approx. Cost (KShs)
	❖ Generally solid wastes will be managed in line with Legal Notice No. 121 of 2006			
Possible fire hazards	❖ Prepare and implement a Fire Hazard Response Plan ❖ Use of retardant material in installation works of the laboratory ❖ Only qualified personnel (electrical engineers) to install electrical systems for the plant ❖ Engineering standards shall meet provisions for adequate and safe wiring; plumbing, heating, and cooling systems will also be in conformity with acceptable building codes ❖ Install fire alarm detection and notification systems i.e. install smoke and heat detectors or manually activated pull station. ❖ Install fire Suppression Systems such as Sprinkler system, hose reels, Dry risers (hydrants) and portable fire extinguishers ❖ Prominently display guidelines on what guests, visitors and staff should do in the event of a fire ❖ Undertake bi-annual fire audits ❖ County Government of Nairobi to issue a fire safety certificate	Proponents, Contractor, Management Staff, Visitors, Fire auditors and County government of Nairobi	Throughout operational phase of the project cycle	10,000.00

Anticipated Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Approx. Cost (KShs)**
Climate change	❖ Prepare and implement Contingency Plans for Phenomena associated with climate change such as flooding as provided for in the engineering designs of the development	Project architects and engineers	During design, implementation and operational stages of the project	Included in professional fees for consultants
Medical emergencies	❖ Have well trained first aid personnel on site at all times during installation, operationalization and decommissioning ❖ Have an adequately equipped first aid kits within the laboratory premises at all times ❖ Have contact numbers of reliable health facilities and professional health practitioners	Proponents, management and medical practitioners	Operational phase of the project cycle	Contingency fund to be established
Accidents and incidents	❖ Formulate and implement a health and safety program to address internal accidents and incidents.	Proponents, Management Occupants and Staff	Operational phase of the development	Contingency fund to be established

8.6 EMP for Decommissioning Phase

Anticipated Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Approx. Cost (KShs)
Legislative compliance	❖ Give adequate notice to the staff / stakeholders. ❖ Engage the services of legal experts ❖ Undertake due diligence environmental audit for the decommissioning and submit to NEMA at least 3 months prior to decommissioning for approval ❖ Obtain demolition permit from the County Government of Nairobi.	Proponents and management	At least 3 months to decommissioning	To be calculated at the time
Demolition waste	❖ Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3.Composting and reuse 4. Incineration 5. Sanitary Land filling. ❖ All laboratory equipment, set up structures and any other accessories within the Lab premises that will not be used for other purposes shall be removed and recycled/reused as far as possible ❖ All structures will be removed and recycled, reused or disposed of at a licensed disposal site as per the guidelines of	Proponents and contractor	Throughout decommissioning phase	200,000.00

Anticipated Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Approx. Cost (KShs)
	WHO on Biosafety Level 4 laboratories and NEMA guidelines and as per manufacturer's instructions and toxicity levels ❖ Where recycling/reuse is not possible, the materials should be taken to a licensed waste disposal site by a NEMA licensed waste handler. ❖ Donate reusable demolition waste to charitable organizations, individuals and institutions with similar undertakings			

EMP FOR INCINERATOR INSTALLATION PHASE

Anticipated Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Approx. Cost (KShs.)**
Emissions from Harzadous waste incinerator	❖ Install Incinerator in compliance with EMCA 387 ❖ Install a scrubber to capture toxic emissions from the incinerator ❖ Install an online emissions monitoring instrument	Project Architect and the Mechanical services Engineer	Installation phase	Ksh. 5,000,000

EMP FOR INCINERATOR OPERATIONAL PHASE

Anticipated Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Approx. Cost (KShs.)**
Emissions from Harzadous waste incinerator	❖ maintain Incinerator in compliance with EMCA 387 ❖ maintain the scrubber to capture toxic emissions from the incinerator ❖ maintain online emissions monitoring instrument	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	Ksh. 100,000
Mercury Emissions	Injecting activated carbon into the flue gas, or by passing the flue gas through a carbon sorbent bed.	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	Contingency fund to be established

Anticipated Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Approx. Cost (KShs.)
Lead Emissions	Limiting the Pb content of the waste feed via source control (**Highly recommended**)	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	No cost
Fly ash	❖ The ash be contained at all times both inside and outside the facility. ❖ Use of water to quench the ash ❖ Enclosed ash-handling systems throughout the incinerator ❖ Fly ash residues are to be transported and disposed of only after it has been solidified in the incineration plant. ❖ Ash be handled and disposed in a secure hazardous-waste landfill registered and licensed by NEMA that is designed to ensure that there will be no groundwater pollution. ❖ Regular testing of ash to determine its toxicity	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	Contingency fund to be established
Incinerator Gas Emissions	❖ Computerized continuous emission monitors (CEMs) for CO, O2, SOx, NOx, and HCl ❖ Use and continued calibration and maintenance of continuous monitors of emissions and process characteristics ❖ Survey furnace emission- control devices and related	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	Contingency fund to be established

Anticipated Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Approx. Cost (KShs.)
	equipment regularly to ensure that they continue to be operative and properly sealed and insulated.			
Products of Incomplete Combustions (PICs)	❖ Screening incoming wastes at the plant to reduce incineration of wastes (such as batteries) that are non-combustible and are likely to produce pollutants when burned. ❖ Certification procedure for incinerator control- room operators. ❖ Emissions be reduced by modifying operating characteristics such as furnace temperature, air- injection rate, flue-gas temperature, reagent type, and injection rate,	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	No cost

EMP for Waste Water Treatment Plant

Anticipated Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Approx. Cost (KShs.)

Effluent from Grey water recycling plant	❖ Treat to ensure effluent to the sewer is in compliance with the water quality regulations 2006	Project Architect and the Mechanical services Engineer	Installation phase	Ksh. 5,000,000

Anticipated Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Approx. Cost (KShs.)**
Effluent from Grey water recycling plant	Treat to ensure effluent to the sewer is in compliance with the water quality regulations 2006	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	Ksh 100,000
Increased water demand	❖ Ensure sources of water for use meets the standards specified under schedule I of Legal Notice No. 120 of 2006 (standards for domestic supply) ❖ Install self-regulating water taps for sinks and basins ❖ Create awareness among staff on the importance of conservation of water resources	Proponents	Throughout operational phase	150,000.00

Anticipated Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Approx. Cost (KShs.)**
Effluent generation	❖ Sewage/waste-water will be managed by decontamination at the laboratory before connecting to the effluent that feed to sewage as per NEMA and the County Government of Nairobi according to the waste water handling regulations in place. ❖ Decontamination system shall be set up as per the contracted consultant / laboratory manager while the connection to the sewer system and piping shall be fitted by a qualified trades person to ensure that no leakage occurs. ❖ Conduct regular inspections for decontamination facility, sewage pipe blockages or damages and fix appropriately.	Proponents and hired contractor.	Throughout operational phase	5,000.00 annually for sewer system maintenance
Possible pollution of streams or groundwater	A water quality monitoring programme must be in place to detect any contamination that may be linked with the treatment plant Immediately institute appropriate mitigation measures if contamination is discovered A groundwater quality monitoring programme must be in place to detect any contamination that may be linked with the treatment plant Immediately institute appropriate mitigation measures if contamination is discovered	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	Contingency fund to be established

Anticipated Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Approx. Cost (KShs.)**
Lack of skills on the part of the plant operator	❖ Plant operators must be appropriately skilled and experienced for the task at hand ❖ Site operator/s must receive continuous training in all aspects of daily management of the plant (technical or administrative) ❖ Technical support must be available to the sewage plant operator	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	Contingency fund to be established
Irregular or Inadequate maintenance could compromise functionality	❖ Regular checking of key components of the system to verify continuing functionality ❖ Regular replacement of key components as a preventative measure, even if components still appear to be functional ❖ It must be ensured that monitoring systems and gauges are in good working order at all times in order facilitate informed management of the treatment system. ❖ A maintenance plan must be in place to ensure that planning, such as budget allocation or procurement of service providers. ❖ Have a maintenance plan that takes into account the lead times applicable to certain types of maintenance, e.g. long delivery times for certain components of the system.	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	Contingency fund to be established

LPG Bulk Storage Installation Phase EMP

Anticipated Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Approx. Cost (KShs.)**
Gas leakage from the LPG Bulk storage tanks	❖ Install LPG leak detection sensors and an alarm to communicate to the building management system ❖ Install a fire suppression system at the bulk storage tank location ❖ Provide an emergency response plan ❖ Comply with LPG regulations 2019	Project Architect and the Mechanical services Engineer	Installation phase	Ksh. 3,000,000

LPG Bulk Storage Operational Phase EMP

Anticipated Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Approx. Cost (KShs.)**
Minimization of Health, Safety and Fire risks	❖ Ensure all fire safety equipment are inspected regularly ❖ Conduct Occupational Health and Safety, Fire and risk assessment audits annually	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	Contingency fund to be established
Gas leakage from the LPG Bulk storage tanks	❖ Maintain LPG leak detection sensors and an alarm to communicate to the building management system ❖ Maintain a fire suppression system at the bulk storage tank location ❖ Provide an emergency response plan Comply with LPG regulations 2019	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	Contingency fund to be established

Fuel Oil Underground Storage Tanks

Installation Phase

Anticipated Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Approx. Cost (KShs.)**
Diesel fuel spillage & Leakage from underground tanks	❖ Provide a spill response kit ❖ Allow for construction of a spill containment facility ❖ Install a fire suppression system at the bulk storage tank location ❖ Provide an emergency response plan	Project Architect and the Mechanical services Engineer	Installation phase	Ksh. 3,000,000

Operational phase of Fuel Oil Underground Storage

Anticipated Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Approx. Cost (KShs.)
Asphyxiation of tank cleaners	Develop and implement plans for maintenance of the facility Ensure use of appropriate PPEs for tank cleaners including oxygen masks.	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	Contingency fund to be established
Diesel fuel spillage & Leakage from underground tanks	❖ Provide a spill response kit ❖ Maintain a fire suppression system at the bulk storage tank location ❖ Provide an emergency response plan	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	Contingency fund to be established
Generation of sewerage, waste water	Ensure the sewage waste water is collected and disposed off into waste water treatment plant	Proponents, Management Occupants and Staff	Throughout operational phase of the project cycle	Contingency fund to be established

CHAPTER NINE

9.0 Environmental Monitoring and Auditing.

For effective implementation of the EMP, a monitoring and evaluation (M & E) process should be instituted to act as a self-assessment tool to ensure compliance with the various components of the EMP. The Nanotechnology lab and related facilities management are encouraged to formulate their own monitoring tools, with the fore knowledge that they will use it to judge their own performance without expert help. Of necessity, the M & E plan should include verifiable indicators to assist the management to:

a) Continuously check their compliance with the EMP and to accurately record stages of progress
b) Continuously observe and record any changes, positive and negative, to the environment as a direct or indirect consequence of their operations
c) Use government limits for various pollution control parameters as the basis for close monitoring of water, waste-water, air quality, hydrocarbons and heavy metals presence in the soil, solid waste and other environmental benchmarks
d) Use stated limits and M & E to alleviate negative impacts and seek expert advice on matters which merit such attention
e) Use the EMP and M & E tool to submit an Environmental Audit report to NEMA annually or as may be directed by the Authority without fail.

CHAPTER TEN

10.0 Conclusions and Recommendations

10.1 Conclusion

Application of nanotechnology has the potential of enabling a rapid transition of Kenya into a knowledge driven economy and securing its strategic leadership as a manufacturing hub in East and Central Africa as the only other labs of this kind have been established in South Africa, Botswana and Egypt. It creates an enabling framework through which all stakeholders – including public and private actors, civil society and other non-state actors and international partners can efficiently engage.

The measures put in place at Environmental Management plan will ensure there are very limited chances for occurrence of negative impacts categorized to be of low severity and spatial/temporal significance. On the basis of the evaluation of the development proposal, the project does not occasion environmentally significant negative impacts that could lead to environmental degradation on an appreciable scale throughout the project cycle. This EIA project report therefore presents findings of **"no significant impacts". The development of this project is considered economically viable, socially acceptable and environmentally sound.**

10.2 Recommendations

This report therefore recommends issuance of an EIA license on condition that the proposed EMP contained in this report will be implemented in line with other conditions that NEMA may impose during the decision making process. The proponents should use also the EMP as monitoring and evaluation tool to submit an Environmental Audit reports to NEMA annually or as may be directed by the Authority without fail.

11.0. REFERENCES

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- Legal Notice No. 61 EMCA (Noise and Excessive Vibration Pollution Control) Regulations, 2009
- Legal Notice No. 121: EMCA (Waste Management) Regulations, 2006
- The Water Act No. 8 of 2002 (Effective implementation of provisions in 2003)
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- Nairobi County Government Integrated Development Plan

12.0 APPENDICES

Appendix 1: Consultancy and Public participation Questionnaires

Appendix 2: CPP Meeting Attendance lists

Appendix 3: Signed Public Participation and Consultations Meeting Minutes

Appendix 4: KIRDI Title deed

Appendix 5: KIRDI Techno Centre Building Plan

Appendix 6: EIA License

Appendix 7: KIRDI KRA Pin

Appendix 8: Baseline Soil Analysis Results for Hydrocarbons

Appendix 9: Baseline Air Quality Regulations Set Tolerance Limits

Appendix 10: Baseline Air Quality Monitoring Results

Appendix 11: Baseline Soil Analysis Results for Heavy Metals

KIRDI

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ATTENDANCE LIST

1ST MEETING ON PROPOSED KIRDI NANOTECHNOLOGY LABORATORY AND RELATED FACILITIES PUBLIC PARTICIPATION AND CONSULTATION MEETING AT KIRDI TECHNO CENTRE, SOUTH B, DUNGA ROAD

Venue: KIRDI TECHNO CENTRE Date: 18.02.2021 Time: 10:00 am

S/NO.	NAME OF PARTICIPANT	ORGANIZATION	MOBILE PHONE	SIGN.
1	KIPNGENO PAUL	RESIDENT	0740551412	
2	HENRY WERE	RESIDENT	0748322165	
3	SIMON OMONDI	"	0721613631	
4	EDWIN KIPNGETICH	"	0724017920	
5.	Kevin Zionye	"	0742431528	
6.	Solomon Mwaura	"	0734 060 558	
7.	MILKA Lydia	Business	0715021808	
8.	VITALIS HAMBUA	"	0739022193	
9.	Nyamongo Joseph	"	0700122170	
10	JOSEPH MUSOVYA	"	0726276961	
11	Kodi JOHN	"	0720202336	
12	Kelvin Kimtai	"	0757125113	

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ATTENDANCE LIST

3RD MEETING ON PROPOSED KIRDI NANOTECHNOLOGY LABORATORY AND RELATED FACILITIES PUBLIC PARTICIPATION AND CONSULTATION MEETING AT KIRDI TECHNO CENTRE, SOUTH B, DUNGA ROAD

Venue: KIRDI TECHNO CENTRE Date: 2nd MARCH 2021 Time: 10:00 am

S/NO.	NAME OF PARTICIPANT	ORGANIZATION	MOBILE PHONE	SIGN.
1	DAVID ORIWO	PLENCER	0780205080	[signature]
2.	Brian Ogolo Agwanda	Vel	0718215500	[signature]
3.	Raphael	carpentry VEL	0727620824	Raphael
4	Martin N3amu	steel fixer VEL	0723498186	[signature]
5	Kenneth KEGA	~~Plaster~~ VEL.	0757983091	[signature]
6.	EMMANUEL	VEL	0708550999	[signature]
7.	DAVID MWALIMU	Plaster/mason	0725261562	[signature]
8.	Lydia Kariuki	Resident	0734423382	[signature]
9.	Juliet Khira	"	0719 224100	Khira.
10.	Constance Wamalwa	"	0732 114 962	[signature]
11	Augustine Kisko	Vel	0722707360	[signature]
12.	Otieno Erick Ochieng	Readel.	0729 929676	[signature]
13.	Esther Biyaki	Vel	0796746167	[signature]

KIRDI
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KENYA VISION 2030

ATTENDANCE LIST

2ND MEETING ON PROPOSED KIRDI NANOTECHNOLOGY LABORATORY AND RELATED FACILITIES PUBLIC PARTICIPATION AND CONSULTATION MEETING AT KIRDI TECHNO CENTRE, SOUTH B, DUNGA ROAD

Venue. KIRDI TECHNO CENTRE **Date.** 10.02.2021 **Time.** 10:00 am

S/NO.	NAME OF PARTICIPANT	ORGANIZATION	MOBILE PHONE	SIGN.
1	Constantine Isindu	Resident	0743563954	
2	BRIAN OLUSIMBA	"	0797945564	
3	James Mbogo	"	0728831912	
4	Martin Mbatha	"	0701702025	
5	Boniface Chikuba	"	0751058778	
6	Esther Ndindi	"	0712681278	
7	Richard Omondi	"	0721 782919	
8	David Mutuanga	"	0751 492144	
9	Martin Edwin Nzamu	"	0734 559429	
10	Joy Muasya	"	0721 429211	
11	Benjamin Omiko	"	0725 499221	
12	Caroline Nduku	"	0708 421189	
13	Cyrus Wanjiru	"	0725 321125	

1ST MEETING ON PROPOSED KIRDI NANOTECHNOLOGY LABORATORY AND RELATED FACILITIES PUBLIC PARTICIPATION AND CONSULTATION MEETING AT KIRDI TECHNO CENTRE, HELD ON 10.02.2021 AT 10:00AM

In Attendance:

Arch. Joan Ebuyi-	Habitech consultants
Eng. Lawrence Muma-	EMS Consultants
QS Wambua-	Kanjumba Consultants
Prof George Ngugi-	Prof Ngugi Njuguna & Associates
Ashley Nyakara-	Gedox Associates
Kariuki Kiarie-	Vaghjiyani Enterprises Limited
Dan Mbingo-	KIRDI

Stakeholders in Attendance:

As per the attendance sheet

Agenda

1. Introduction
2. Project Briefing
3. Plenary
4. A.O.B

Minute No.	Details	Response/Action
1.00	<u>Introduction</u> The meeting started with a word of prayer from Henry Were. Arch. Joan thanked all the stakeholders for turning up for the meeting.	
2.0	Briefing Prof Ngugi informed the stakeholders that the KIRDI Techno Centre project was started in February of 2013. The centre is in the process of installing a Nanotechnology Laboratory and as per the NEMA guidelines, there are related facilities that need to accompany this facility. These related facilities (Boiler, underground fuel storage tanks, incinerator, LPG Bulk storage tanks, Effluent Treatment Plant) require a SEIA report and an eventual acquisition of	

	license from NEMA. This is to ensure that all stakeholders that are directly and indirectly affected by the project are safe of any environmental hazards that they feel the project could bring about. He also noted that the Kenyan Constitution 2010 and the SEIA process greatly emphasizes on Public Participation. He added that each person's views will be captured and all questions pertaining the project shall be answered accordingly. He continued saying that he had a set of questionnaires which, through his guidance, needed to be filled by each person in attendance and the report shall be submitted to National Environmental Management Authority (NEMA) for approval and subsequent issuance of SEIA license.	
3.0 3.01 3.02 3.03	<u>Plenary</u> Brian Lusimba was concerned that if scuff holding is not done properly to the incinerator, the health and safety of the workers will be compromised leading to injuries or death. Constant Wamalwa feared for contamination of ground water resources from wastes emanating from boiler fuel Juliet Khisa was worried about fly ash emanating from the incinerator and posing health risks to the neighbours. She needed assurance that there shall be installation of dust receptacles to mitigate	Mr. Gaita the clerk of works assured them of the proper workmanship under his watch and the project manager, Habitech Consultants to ensure all the constructions will be done as per the drawings and every activity of the project work will have to be inspected. The project mechanical Engineer, Eng. Muma assured him of proper containment of dust and smoke particles from the boiler so that they do not find their way into water bodies and cause pollution Mechanical Engineer noted that he concern was already factored in the installation phase of the incinerator and

	against this hazard	dust sacks were part of the bill of quantities to be purchased
4.0	A.O.B There being no other business, all stakeholders were given copies of questionnaires and with assistance of Prof. Ngugi Njuguna they filled and handed them back to him. The meeting ended at 12.30.00pm	

Signed:

Secretary…….

Date……..

Chairman……

Date……..

2ND MEETING ON PROPOSED KIRDI NANOTECHNOLOGY LABORATORY AND RELATED FACILITIES PUBLIC PARTICIPATION AND CONSULTATION MEETING AT KIRDI TECHNO CENTRE, HELD ON 18.02.2021 AT 10:00AM

In Attendance:

Arch. Joan Ebuyi-	Habitech consultants
Eng. Lawrence Muma-	EMS Consultants
QS Wambua-	Kanjumba Consultants
Prof George Ngugi-	Prof Ngugi Njuguna & Associates
Ashley Nyakara-	Gedox Associates
Kariuki Kiarie-	Vaghjiyani Enterprises Limited
Dan Mbingo-	KIRDI

Stakeholders in Attendance:

As per the attendance sheet

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2. Project Briefing
3. Plenary
4. A.O.B

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	license from NEMA. This is to ensure that all stakeholders that are directly and indirectly affected by the project are safe of any environmental hazards that they feel the project could bring about. He also noted that the Kenyan Constitution 2010 and the SEIA process greatly emphasizes on Public Participation. He added that each person's views will be captured and all questions pertaining the project shall be answered accordingly. He continued saying that he had a set of questionnaires which, through his guidance, needed to be filled by each person in attendance and the report shall be submitted to National Environmental Management Authority (NEMA) for approval and subsequent issuance of SEIA license.	
3.0 3.01 3.02	<u>Plenary</u> Langat Gilbert wondered whether there will be measures put in place to prevent sewage leaking or getting into contact with water line. Cyrus Wachira sought to know measures in place to prevent the wastes in underground fuel storage tanks from polluting the underground water sources	The project surveyor Mr. Wambua assured him that the installation works for sewerline will follow the set guidelines as per the KEBS standards and that the bill of quantities has captured the appropriate materials. The architect assured him that the guidelines in place on materials for installing underground storage tanks and guidelines on infrastructure set up

		including underground depths and casing will alleviate his fears
4.0	A.O.B There being no other business, all stakeholders were given copies of questionnaires and with assistance of Prof. Ngugi Njuguna they filled and handed them back to him. The meeting ended at 12.00pm	

Signed:

Secretary…….

Date……..

Chairman……

Date……..

3RD MEETING ON PROPOSED KIRDI NANOTECHNOLOGY LABORATORY AND RELATED FACILITIES PUBLIC PARTICIPATION AND CONSULTATION MEETING AT KIRDI TECHNO CENTRE, HELD ON 18.02.2021 AT 10:00AM

In Attendance:

Arch. Joan Ebuyi-	Habitech consultants
Eng. Lawrence Muma-	EMS Consultants
QS Wambua-	Kanjumba Consultants
Prof George Ngugi-	Prof Ngugi Njuguna & Associates
Ashley Nyakara-	Gedox Associates
Kariuki Kiarie-	Vaghjiyani Enterprises Limited
Dan Mbingo-	KIRDI

Stakeholders in Attendance:

As per the attendance sheet

Agenda

1. Introduction
2. Project Briefing
3. Plenary
4. A.O.B

Minute No.	Details	Response/Action
1.00	Introduction The meeting started with a word of prayer from Henry Were. Arch. Joan thanked all the stakeholders for turning up for the meeting.	
2.0	Briefing Prof Ngugi informed the stakeholders that the KIRDI Techno Centre project was started in February of 2013. The centre is in the process of installing a Nanotechnology Laboratory and as per the NEMA guidelines, there are related facilities that need to accompany this facility. These related facilities (Boiler, underground fuel storage tanks, incinerator, LPG Bulk storage tanks, Effluent Treatment Plant) require a SEIA report and an eventual acquisition of	

	license from NEMA. This is to ensure that all stakeholders that are directly and indirectly affected by the project are safe of any environmental hazards that they feel the project could bring about. He also noted that the Kenyan Constitution 2010 and the SEIA process greatly emphasizes on Public Participation. He added that each person's views will be captured and all questions pertaining the project shall be answered accordingly. He continued saying that he had a set of questionnaires which, through his guidance, needed to be filled by each person in attendance and the report shall be submitted to National Environmental Management Authority (NEMA) for approval and subsequent issuance of SEIA license.	
3.0 3.01 3.02	<u>Plenary</u> Stephen Waweru was concerned that leakages from LPG Bulk storage tanks could contaminate underground water sources wondered whether there will be measures put in place to prevent sewage leaking or getting into contact with water line. Constantine Isindu sought to know measures in place to prevent dust and spillages from incinerator that could pose health risks.	The project surveyor Mr. Wambua assured him that the installation works for sewerline will follow the set guidelines as per the KEBS standards and that the bill of quantities has captured the appropriate materials. The architect assured him that the guidelines in place on materials for installing incinerators and guidelines on infrastructure set up

3.03	Constantine Isindu was worried about small businesses like hers being kicked out once the project starts	including safety guidelines will alleviate his fears Prof Ngugi informed her though it is up to the proponent to decide, it is expected that businesses in informal structures will be displaced but the increased flow of people may reach her if she finds another structure nearer.
4.0	A.O.B There being no other business, all stakeholders were given copies of questionnaires and with assistance of Prof. Ngugi Njuguna they filled and handed them back to him. The meeting ended at 11.50am	

Signed:

Secretary…….

Date……..

Chairman……

Date……..

Issues Raised in the CPP Meetings

The issues raised in the three different meetings for Consultation and Public Participation have been summarized below with the whole summary of the signed minutes of the meetings, participants list, CPP filled questionnaire attached to the appendix of this study report

Brian Lusimba was concerned that if scuff holding is not done properly to the incinerator, the health and safety of the workers will be compromised leading to injuries or death	Mr. Gaita the clerk of works assured them of the proper workmanship under his watch and the project manager, Habitech Consultants to ensure all the constructions will be done as per the drawings and every activity of the project work will have to be inspected.
Constant Wamalwa feared for contamination of ground water resources from wastes emanating from boiler fuel	The project mechanical Engineer, Eng. Muma assured him of proper containment of dust and smoke particles from the boiler so that they do not find their way into water bodies and cause pollution
Juliet Khisa was worried about fly ash emanating from the incinerator and posing health risks to the neighbours. She needed assurance that there shall be installation of dust receptacles to mitigate against this hazard	Mechanical Engineer noted that he concern was already factored in the installation phase of the incinerator and dust sacks were part of the bill of quantities to be purchased
Langat Gilbert wondered whether there will be measures put in place to prevent sewage leaking or getting into contact with water line	The project surveyor Mr. Wambua assured him that the installation works for sewerline will follow the set guidelines as per the KEBS standards and that the bill of quantities has captured the appropriate materials
Cyrus Wachira sought to know measures in place to prevent the wastes in underground fuel storage tanks from polluting the underground water sources.	The architect assured him that the guidelines in place on materials for installing underground storage tanks and guidelines on infrastructure set up including underground depths and casing will alleviate his fears

(17)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP LPG BULK STORAGE TANKS (BULLETS IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed LPG Bulk Storage Tanks Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the LPG Bulk Storage Tanks.

Project Name: Installation of a LPG Bulk Storage tanks in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	JANE kMUU
ID Number Interviewee's	28229586
Interviewee's Contact (phone)	0751545466
Date of Interview	26/6/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

Non

Environment risks

Pollution

Social risks

Non Death

Hydro- geological (ground water)resources

Yes ~~Wet~~ ~~disposals~~ Non

Do you think there will be any wastes generated and how do you propose it to be handled?

Yes Wast disposals

How can the impacts you have highlighted be mitigated?

Manage Wastes

No

Does the proposed project negatively affect your business or operations?

What positive impacts will the proposed project have on your operations?
Boost business

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?
Neighbors

Do you have any specific complains to make about this project?
yes

In your conclusion, do you welcome this project in the said area?
Yes

General comments, recommendations or observations on this project?
Neighbourhood

Respondent Sign

Jane

(16)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP UNDERGROUND FUEL STORAGE TANKS IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Underground Fuel Storage Tanks Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the Underground Fuel Storage Tanks.

Project Name: Installation of Underground Fuel Storage tanks in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	JOHN OMERO
ID Number Interviewee's	21864614
Interviewee's Contact (phone)	0719-436667
Date of Interview	23-6-2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

No

Environment risks

fuel leakage in to water body

Social risks

No

Hydro- geological (ground water)resources

fuel leakage

Do you think there will be any wastes generated and how do you propose it to be handled?

waste oil

regular mopping

How can the impacts you have highlighted be mitigated?

Management

.....

Does the proposed project negatively affect your business or operations?

.....No.....

.....

What positive impacts will the proposed project have on your operations?

.....No.....

.....

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

.....Ensure proper environmental proper.....

....management.....

Do you have any specific complains to make about this project?

.....No.....

.....

In your conclusion, do you welcome this project in the said area?

.....Yes.....

General comments, recommendations or observations on this project?

.....None.....

.....

Respondent Sign

.....

15

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP A WASTEWATER TREATMENT PLANT IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Waste Water Treatment Plant Installation and its operationalization. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the boiler.

Project Name: Installation of a Boiler in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	JOHN M RUSU
ID Number Interviewee's	20631234
Interviewee's Contact (phone)	0723358911
Date of Interview	28-05-21

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

NONE

Environment risks

NONE

Social risks

NONE

Hydro- geological (ground water)resources

Pollution of the waste water is not properly treated.

Do you think there will be any wastes generated and how do you propose it to be handled?

Sludge

How can the impacts you have highlighted be mitigated?

TREATMENT

Does the proposed project negatively affect your business or operations?

NO

What positive impacts will the proposed project have on your operations?

CREATION OF EMPLOYMENT

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

PROPER HANDLING OF WASTES.

Do you have any specific complains to make about this project?

NONE

In your conclusion, do you welcome this project in the said area?

YES

General comments, recommendations or observations on this project?

Project Must be completed in time so as to impact positively to the general public

Respondent Sign

(14)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP LPG BULK STORAGE TANKS (BULLETS IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed LPG Bulk Storage Tanks Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the LPG Bulk Storage Tanks.

Project Name: Installation of a LPG Bulk Storage tanks in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Mwalwa Mutua
ID Number Interviewee's	10319248
Interviewee's Contact (phone)	0720777334
Date of Interview	28th June 2024.

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks Air Contamination due to fumes from boiler exhaust & Spills from oil/water.

Environment risks Contamination to water (underground)

Social risks Air pollution, Water Contamination.

Hydro- geological (ground water)resources Contamination due to oil Spills.

Do you think there will be any wastes generated and how do you propose it to be handled?

Yes.

How can the impacts you have highlighted be mitigated? Proper Containment of waste.

and waste management

Does the proposed project negatively affect your business or operations?

No

What positive impacts will the proposed project have on your operations?

No

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

maintain proper waste management

Do you have any specific complains to make about this project?

No

In your conclusion, do you welcome this project in the said area?

Yes

General comments, recommendations or observations on this project?

maintain proper waste management

Respondent Sign

(13)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP LPG BULK STORAGE TANKS (BULLETS IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed LPG Bulk Storage Tanks Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the LPG Bulk Storage Tanks.

Project Name: Installation of a LPG Bulk Storage tanks in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	EDWIN KIPNGETIT
ID Number Interviewee's	26347286
Interviewee's Contact (phone)	0714022193
Date of Interview	26/6/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

No

Environment risks

Pollution

Social risks

Death

Hydro- geological (ground water)resources

No

Do you think there will be any wastes generated and how do you propose it to be handled?

Well disposed

How can the impacts you have highlighted be mitigated?

.....

Does the proposed project negatively affect your business or operations?

.....yes.....

.....

What positive impacts will the proposed project have on your operations?

.....yes.....

.....

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

.....yes.....

.....

Do you have any specific complains to make about this project?

.....yes.....

.....

In your conclusion, do you welcome this project in the said area?

.....yes.....

General comments, recommendations or observations on this project?

.....

.....

Respondent Sign

.....

12

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP NANOTECHNOLOGY LABORATORY IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Nanotechnology Laboratory Installation and operationalization. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the Nanotechnology Laboratory.

Project Name: Installation of a Nanotechnology Laboratory in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Alaine Wangui
ID Number Interviewee's	33214647
Interviewee's Contact (phone)	0715024841
Date of Interview	28/04/020

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

No

Environment risks

leakages of the water tank

Social risks

None

Hydro- geological (ground water)resources

Under ground water.

Do you think there will be any wastes generated and how do you propose it to be handled?

Proper waste.

How can the impacts you have highlighted be mitigated?

Does the proposed project negatively affect your business or operations?
No

What positive impacts will the proposed project have on your operations?
Business boost

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?
Good neighborhood:

Do you have any specific complains to make about this project?
No.

In your conclusion, do you welcome this project in the said area?
Yes

General comments, recommendations or observations on this project?
Great Project Within our neighborhood.

Respondent Sign
[signature]

(12)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP LPG BULK STORAGE TANKS (BULLETS IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed LPG Bulk Storage Tanks Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the LPG Bulk Storage Tanks.

Project Name: Installation of a LPG Bulk Storage tanks in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	JAMES MUTINDA
ID Number Interviewee's	31958622
Interviewee's Contact (phone)	0751636570
Date of Interview	26/6/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

NO

Environment risks

NO

Social risks

NO

Hydro- geological (ground water)resources

NO

Do you think there will be any wastes generated and how do you propose it to be handled?

NO

How can the impacts you have highlighted be mitigated?

NO

.....

Does the proposed project negatively affect your business or operations?

.....yes.....

.....

What positive impacts will the proposed project have on your operations?

.....yes.....

.....

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

.....yes.....

.....

Do you have any specific complains to make about this project?

.....yes.....

.....

In your conclusion, do you welcome this project in the said area?

.....yes.....

General comments, recommendations or observations on this project?

.....yes.....

.....

Respondent Sign

.....

(9)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP LPG BULK STORAGE TANKS (BULLETS IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed LPG Bulk Storage Tanks Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the LPG Bulk Storage Tanks.

Project Name: Installation of a LPG Bulk Storage tanks in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	ALEX WAMBUA
ID Number Interviewee's	30549566
Interviewee's Contact (phone)	0733 43 54 60
Date of Interview	26/6/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

……NO……

Environment risks

……NO……

Social risks

……NO……

Hydro- geological (ground water)resources

……NO……

Do you think there will be any wastes generated and how do you propose it to be handled?

……DISPOSAL……

How can the impacts you have highlighted be mitigated?

……MANAGE WASTES……

.....

Does the proposed project negatively affect your business or operations?

..... NO .....

What positive impacts will the proposed project have on your operations?

..... NO .....

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

..... NO .....

Do you have any specific complains to make about this project?

..... NO .....

In your conclusion, do you welcome this project in the said area?

..... Yes .....

General comments, recommendations or observations on this project?

..... Yes .....

Respondent Sign

.....

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP AN INCINERATOR IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Incinerator installation and operationalization. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the incinerator.

Project Name: Installation of an Incinerator in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Stoma Mwaura
ID Number Interviewee's	22235453
Interviewee's Contact (phone)	0734 060 558
Date of Interview	28/06/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

If Chemicals are in use, it'll cause health risks if not well managed.

Environment risks

dust and spillages which can cause environmental challenges.

Social risks

Non

Hydro- geological (ground water)resources,

If contaminated, it can cause health hazards.

Do you think there will be any wastes generated and how do you propose it to be handled?

Yes, it should be handled and disposed in a manner that will not put People's health at risk.

How can the impacts you have highlighted be mitigated?

Proper and planned Waste Management.

.....

Does the proposed project negatively affect your business or operations?
yes, for Small Scale businesses operating next to the project can be displaced.

What positive impacts will the proposed project have on your operations?
Incase we'll not be displaced, It will boost our small Scale businesses.

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?
Proper disposal of Waste not to affect the environment.

Do you have any specific complains to make about this project?
NO

In your conclusion, do you welcome this project in the said area?
Yes

General comments, recommendations or observations on this project?
Great Project

Respondent Sign

.....

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP LPG BULK STORAGE TANKS (BULLETS IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed LPG Bulk Storage Tanks Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the LPG Bulk Storage Tanks.

Project Name: Installation of a LPG Bulk Storage tanks in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	James Mawia
ID Number Interviewee's	30259384
Interviewee's Contact (phone)	0707503492
Date of Interview	26/6/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

……house scaffolding can lead to damage……

Environment risks

……Proper disposal of waste……

Social risks

……no……

Hydro- geological (ground water)resources

……water could lead to diseases……

Do you think there will be any wastes generated and how do you propose it to be handled?

……will dispossed……

How can the impacts you have highlighted be mitigated?

……Waste management……

.....

Does the proposed project negatively affect your business or operations?

.....NO.....

What positive impacts will the proposed project have on your operations?

.....NO.....

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

.....NO.....

Do you have any specific complains to make about this project?

.....NO.....

In your conclusion, do you welcome this project in the said area?

.....YES.....

General comments, recommendations or observations on this project?

.....NIL.....

Respondent Sign

.....

(6)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP AN INCINERATOR IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Incinerator installation and operationalization. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the incinerator.

Project Name: Installation of an Incinerator in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Juliet Khisa
ID Number Interviewee's	34282172
Interviewee's Contact (phone)	07192241 00
Date of Interview	28/6/2022

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

Ash dust from the burning

Environment risks

Air pollution

Social risks

None

Hydro- geological (ground water)resources

Improper handling of waste

Do you think there will be any wastes generated and how do you propose it to be handled?

Fly ash ; Having dust receptacles

How can the impacts you have highlighted be mitigated?

Dust Collection bags Installation

.....

Does the proposed project negatively affect your business or operations?

.....No.....

What positive impacts will the proposed project have on your operations?

.....None.....

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

.....Proper waste handling.....

Do you have any specific complains to make about this project?

.....No.....

In your conclusion, do you welcome this project in the said area?

.....Yes.....

General comments, recommendations or observations on this project?

.....Good receptor bags will contain particles in the air.

Respondent Sign

.....

(4)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP A BOILER IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Boiler Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the boiler.

Project Name: Installation of a Boiler in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Lydia Kariuki
ID Number Interviewee's	33246894
Interviewee's Contact (phone)	0734423332
Date of Interview	28/6/2020

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

None

Environment risks

None

Social risks

None

Hydro- geological (ground water)resources

None

Do you think there will be any wastes generated and how do you propose it to be handled?

Provision of bins

How can the impacts you have highlighted be mitigated?

Using Regular cleaning

Does the proposed project negatively affect your business or operations?

No

What positive impacts will the proposed project have on your operations?

None

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

None

Do you have any specific complains to make about this project?

None

In your conclusion, do you welcome this project in the said area?

Yes

General comments, recommendations or observations on this project?

Its well

Respondent Sign

(5)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP A BOILER IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Boiler Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the boiler.

Project Name: Installation of a Boiler in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Kaloki Mulolq
ID Number Interviewee's	31697542
Interviewee's Contact (phone)	0732697483
Date of Interview	28/06/2020

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

NO

Environment risks

NO

Social risks

NO

Hydro- geological (ground water)resources

NO

Do you think there will be any wastes generated and how do you propose it to be handled?

None

How can the impacts you have highlighted be mitigated?

proper disposal

Does the proposed project negatively affect your business or operations?

No

What positive impacts will the proposed project have on your operations?

Good preservation

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

Well management

Do you have any specific complains to make about this project?

No

In your conclusion, do you welcome this project in the said area?

YES

General comments, recommendations or observations on this project?

Nice building

Respondent Sign

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP AN INCINERATOR IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Incinerator installation and operationalization. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the incinerator.

Project Name: Installation of an Incinerator in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	James Mbogo
ID Number Interviewee's	25439805
Interviewee's Contact (phone)	0728 531 912
Date of Interview	28/06/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

.....Fall..... Scaffoldings..... can..... lead..... to..... damage.....

Environment risks

.....Improper..... disposal..... of..... waste and..... masks.....

Social risks

.....None.....

Hydro- geological (ground water)resources

.....Stagnant..... water..... Could..... lead..... to.....
diseases.....

Do you think there will be any wastes generated and how do you propose it to be handled?

.....It..... should..... be..... well disposed.....

How can the impacts you have highlighted be mitigated?

.....Proper & Planned..... Waste..... management.....

.....

Does the proposed project negatively affect your business or operations?
.....businesses.....around.....the.....Premise.....can.....be.....demolished.....
.....

What positive impacts will the proposed project have on your operations?
.....People.....working.....for.....the.....project.....will.....Promote.....
.....business.....

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?
.....Proper.....disposal.....of.....waste.....not.....to.....affect.....the.....environment.....
.....

Do you have any specific complains to make about this project?
.....NO.....
.....

In your conclusion, do you welcome this project in the said area?
.....Yes.....

General comments, recommendations or observations on this project?
.....Great.....project.....
.....

Respondent Sign

.....

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP AN INCINERATOR IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Incinerator installation and operationalization. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the incinerator.

Project Name: Installation of an Incinerator in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	BRIAN LUSIMBA
ID Number Interviewee's	35004525
Interviewee's Contact (phone)	0797945564
Date of Interview	28TH JUN 2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

If Scaff holding is not well constructed could lead to injuries or even death.

Environment risks

Nails not well disposed or other metallic steffs could be dangerous

Social risks

NIL

Hydro- geological (ground water)resources

Availability of water would lead to efficient running of day to day activities.

Do you think there will be any wastes generated and how do you propose it to be handled?

Not sure of any wastes generated

How can the impacts you have highlighted be mitigated?

Every individual to do what is expected of them with alot of carefulness

Does the proposed project negatively affect your business or operations?

Not really

What positive impacts will the proposed project have on your operations?

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

Proper disposal of debri and other remains

Do you have any specific complains to make about this project?

Not really

In your conclusion, do you welcome this project in the said area?

General comments, recommendations or observations on this project?

Respondent Sign

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PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP UNDERGROUND FUEL STORAGE TANKS IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Underground Fuel Storage Tanks Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the Underground Fuel Storage Tanks.

Project Name: Installation of Underground Fuel Storage tanks in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Agnes Wallua
ID Number Interviewee's	29345745
Interviewee's Contact (phone)	0725321125
Date of Interview	28/6/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks
Incase of a Sewage leak, Contamination it Possible

Environment risks
Ambune Diseases

Social risks
Non

Hydro- geological (ground water)resources
When waste come into Contact with water

Do you think there will be any wastes generated and how do you propose it to be handled?
yes

How can the impacts you have highlighted be mitigated?
Proper Management

.....

Does the proposed project negatively affect your business or operations?

..... No .....

.....

What positive impacts will the proposed project have on your operations?

..... Job creation .....

.....

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

..... Good Corporation with

..... the neighbours .....

Do you have any specific complains to make about this project?

..... No .....

.....

In your conclusion, do you welcome this project in the said area?

..... yes .....

General comments, recommendations or observations on this project?

..... Project is well done .....

.....

Respondent Sign

.....

(27)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP UNDERGROUND FUEL STORAGE TANKS IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Underground Fuel Storage Tanks Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the Underground Fuel Storage Tanks.

Project Name: Installation of Underground Fuel Storage tanks in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Nguji Kimani
ID Number Interviewee's	29284212
Interviewee's Contact (phone)	0739 492908
Date of Interview	28/6/2024

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

Non

Environment risks

Health issues

Social risks

Non

Hydro- geological (ground water)resources

Non

Do you think there will be any wastes generated and how do you propose it to be handled?

Yes. Manage waste properly.

How can the impacts you have highlighted be mitigated?

Good waste management.

(50)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP A WASTEWATER TREATMENT PLANT IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Waste Water Treatment Plant Installation and its operationalization. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the boiler.

Project Name: Installation of a Boiler in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Langat Gilbert
ID Number Interviewee's	24032520
Interviewee's Contact (phone)	0710440199
Date of Interview	28/06/21

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks
Sewage lines leaking to the water line.

Environment risks
- Health risks like diseases

Social risks
- Death

Hydro- geological (ground water)resources
Waste coming in contact with water

Do you think there will be any wastes generated and how do you propose it to be handled?
Yes, disposing them well

How can the impacts you have highlighted be mitigated?
→ Proper disposal of all waste.

Does the proposed project negatively affect your business or operations?

- NO.

What positive impacts will the proposed project have on your operations?

- Great more jobs

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

- Respect all the proponents of it

Do you have any specific complains to make about this project?

- cause noise pollution

In your conclusion, do you welcome this project in the said area?

- Yes, Great more jobs

General comments, recommendations or observations on this project?

- This project is very good not just to the neighbouring community but also to the entire country

Respondent Sign

Kangat

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP NANOTECHNOLOGY LABORATORY IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Nanotechnology Laboratory Installation and operationalization. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the Nanotechnology Laboratory.

Project Name: Installation of a Nanotechnology Laboratory in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Esther Nzilani
ID Number Interviewee's	↑↓ 0700 292982
Interviewee's Contact (phone)	↑↓ 32452491
Date of Interview	28/06/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

……Non……

……

Environment risks

……pollution from the Laboratories.……

……

Social risks

……Non……

……

Hydro- geological (ground water)resources

……Wastes Mixing with Underground Water Tanks.……

……

Do you think there will be any wastes generated and how do you propose it to be handled?

……Yes.……

……

How can the impacts you have highlighted be mitigated?

Proper Waste disposal.

Does the proposed project negatively affect your business or operations?

No

What positive impacts will the proposed project have on your operations?

It will create good business opportunities to the traders next to the project.

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

Maintain good hygiene

Do you have any specific complains to make about this project?

No.

In your conclusion, do you welcome this project in the said area?

Yes.

General comments, recommendations or observations on this project?

Ensure proper waste Management.

Respondent Sign

[signature]

(18)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP UNDERGROUND FUEL STORAGE TANKS IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Underground Fuel Storage Tanks Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the Underground Fuel Storage Tanks.

Project Name: Installation of Underground Fuel Storage tanks in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Joy Muasya
ID Number Interviewee's	39245453
Interviewee's Contact (phone)	0721 429211
Date of Interview	28/6/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

Non

Environment risks

Air pollution

Social risks

Death

Hydro- geological (ground water)resources

Non

Do you think there will be any wastes generated and how do you propose it to be handled?

Yes. Well disposals

How can the impacts you have highlighted be mitigated?

Manage wastes

Does the proposed project negatively affect your business or operations?

NO

What positive impacts will the proposed project have on your operations?

Boost businesses

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

good relationship with the neighbors

Do you have any specific complains to make about this project?

NO

In your conclusion, do you welcome this project in the said area?

yes

General comments, recommendations or observations on this project?

welcome to the neighborhood

Respondent Sign

Muasya

(28)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP A BOILER IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Boiler Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the boiler.

Project Name: Installation of a Boiler in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Edwin Mutemi
ID Number Interviewee's	32459129
Interviewee's Contact (phone)	0703493411
Date of Interview	28/6/2020

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

.....Alot of dust.....

Environment risks

.....Leads of air pollution.....

Social risks

.....None.....

Hydro- geological (ground water)resources

.....Improperne disposal of waste.....

Do you think there will be any wastes generated and how do you propose it to be handled?

.....Yes.....

How can the impacts you have highlighted be mitigated?

.....Collection.....

.....

Does the proposed project negatively affect your business or operations?

.....No.....

What positive impacts will the proposed project have on your operations?

.....None.....

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

.....Handling of water.....

Do you have any specific complains to make about this project?

.....NO.....

In your conclusion, do you welcome this project in the said area?

.....Yes.....

General comments, recommendations or observations on this project?

.....Provision of bins.....

Respondent Sign

.....

(27)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP UNDERGROUND FUEL STORAGE TANKS IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Underground Fuel Storage Tanks Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the Underground Fuel Storage Tanks.

Project Name: Installation of Underground Fuel Storage tanks in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Ndindi Nyoro
ID Number Interviewee's	35694444
Interviewee's Contact (phone)	0712346789
Date of Interview	28/06/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

No

Environment risks

No

Social risks

No

Hydro- geological (ground water)resources

No

Do you think there will be any wastes generated and how do you propose it to be handled?

Yes

How can the impacts you have highlighted be mitigated?

Proper disposal.

.....

Does the proposed project negatively affect your business or operations?

.....No.....

What positive impacts will the proposed project have on your operations?

.....None.....

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

.....Proper neighbour hood.....

Do you have any specific complains to make about this project?

.....No.....

In your conclusion, do you welcome this project in the said area?

.....Yes.....

General comments, recommendations or observations on this project?

.....Its good.....

Respondent Sign

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(26)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP AN INCINERATOR IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Incinerator installation and operationalization. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the incinerator.

Project Name: Installation of an Incinerator in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Otieno Ochieng
ID Number Interviewee's	
Interviewee's Contact (phone)	
Date of Interview	

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

None

Environment risks

Waste accumulation and smell

Social risks

Bad sight due to waste accumulation

Hydro- geological (ground water)resources

Infiltration into water body

Do you think there will be any wastes generated and how do you propose it to be handled?

How can the impacts you have highlighted be mitigated?

.....

Does the proposed project negatively affect your business or operations?

.....

.....

What positive impacts will the proposed project have on your operations?

.....

.....

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

.....

.....

Do you have any specific complains to make about this project?

.....

.....

In your conclusion, do you welcome this project in the said area?

.....

General comments, recommendations or observations on this project?

.....

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Respondent Sign

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PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP AN INCINERATOR IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Incinerator installation and operationalization. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the incinerator.

Project Name: Installation of an Incinerator in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Martha Wanza
ID Number Interviewee's	23734516
Interviewee's Contact (phone)	0723498186
Date of Interview	25/6/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

Dust particles

Environment risks

Waste accumulation

Social risks

None

Hydro- geological (ground water)resources

None

Do you think there will be any wastes generated and how do you propose it to be handled?

Yes. By proper management through storage, capture and disposal

How can the impacts you have highlighted be mitigated?

Proper handling according to WEMA

.....

Does the proposed project negatively affect your business or operations?

.....NO.....

What positive impacts will the proposed project have on your operations?

.....Increased flow of customers.....

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

.....Ensure there is NEMA guidelines follow up.....

Do you have any specific complains to make about this project?

.....NO.....

In your conclusion, do you welcome this project in the said area?

.....Yes.....

General comments, recommendations or observations on this project?

.....None.....

Respondent Sign

.....

(24)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP NANOTECHNOLOGY LABORATORY IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Nanotechnology Laboratory Installation and operationalization. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the Nanotechnology Laboratory.

Project Name: Installation of a Nanotechnology Laboratory in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Joseph Musonya
ID Number Interviewee's	32664719
Interviewee's Contact (phone)	0726276961
Date of Interview	28/6/2024

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

Safety of staff from emissions

Environment risks

Particulate waste generation

Social risks

None

Hydro- geological (ground water)resources

None

Do you think there will be any wastes generated and how do you propose it to be handled?

Proper waste management

How can the impacts you have highlighted be mitigated?

.....
.....

Does the proposed project negatively affect your business or operations?

..... No. .....

What positive impacts will the proposed project have on your operations?

..... None .....

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

..... Ensure Environmental Health & Safety are followed

Do you have any specific complains to make about this project?

..... No .....

In your conclusion, do you welcome this project in the said area?

..... Yes .....

General comments, recommendations or observations on this project?

..... None .....

Respondent Sign

.....

(23)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP A BOILER IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Boiler Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the boiler.

Project Name: Installation of a Boiler in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	FAITH MWENDE
ID Number Interviewee's	34364495
Interviewee's Contact (phone)	0725414102
Date of Interview	26/06/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

..... NONE .....

Environment risks

..... NONE .....

Social risks

..... NONE .....

Hydro- geological (ground water)resources

..... NONE .....

Do you think there will be any wastes generated and how do you propose it to be handled?

..... NONE .....

How can the impacts you have highlighted be mitigated?

..... NO .....

Does the proposed project negatively affect your business or operations?

N.O

What positive impacts will the proposed project have on your operations?

SHOPPING

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

N.O

Do you have any specific complains to make about this project?

YES

In your conclusion, do you welcome this project in the said area?

YES

General comments, recommendations or observations on this project?

YES

Respondent Sign

[redacted]

(22)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP NANOTECHNOLOGY LABORATORY IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Nanotechnology Laboratory Installation and operationalization. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the Nanotechnology Laboratory.

Project Name: Installation of a Nanotechnology Laboratory in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	CAROLINE OMONDI
ID Number Interviewee's	26254993
Interviewee's Contact (phone)	0708 321211
Date of Interview	28/6/2020

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

NONE

Environment risks

NONE

Social risks

NONE

Hydro- geological (ground water)resources

NONE

Do you think there will be any wastes generated and how do you propose it to be handled?

NO

How can the impacts you have highlighted be mitigated?

.....
.....

Does the proposed project negatively affect your business or operations?

.....NO.....

What positive impacts will the proposed project have on your operations?

.....Easy Shopping.....

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

.....NONE.....

Do you have any specific complains to make about this project?

.....NO.....

In your conclusion, do you welcome this project in the said area?

.....YES.....

General comments, recommendations or observations on this project?

.....The project is good.....

Respondent Sign

.....

(32)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP A BOILER IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Boiler Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the boiler.

Project Name: Installation of a Boiler in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Augustine Kieko Muumbi
ID Number Interviewee's	20091318
Interviewee's Contact (phone)	0722707370
Date of Interview	28/6/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

NO

Environment risks

If not well managed it may cause some diseases

Social risks

—

Hydro- geological (ground water)resources

Waste may come into contact with water

Do you think there will be any wastes generated and how do you propose it to be handled?

Should be well handled and disposed properly

How can the impacts you have highlighted be mitigated?

Proper disposal

Does the proposed project negatively affect your business or operations?

NO.

What positive impacts will the proposed project have on your operations?

Job Creation

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

Respect to all the Stakeholders

Do you have any specific complains to make about this project?

NO

In your conclusion, do you welcome this project in the said area?

Yes

General comments, recommendations or observations on this project?

the project will steamhead many testings

Respondent Sign

AKW

(31)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP AN INCINERATOR IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Incinerator installation and operationalization. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the incinerator.

Project Name: Installation of an Incinerator in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Constantine Irindu
ID Number Interviewee's	25683201
Interviewee's Contact (phone)	0743563954
Date of Interview	28/06/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

If Chemicals are in use it" cause health risks if not well managed

Environment risks

dust and spillages which can cause environment challenges

Social risks

Non

Hydro- geological (ground water)resources

If contaminated, it can cause health hazards.

Do you think there will be any wastes generated and how do you propose it to be handled?

Yes. It should be handled and disposed in a manner that will not put people health ~~and~~ at risk.

How can the impacts you have highlighted be mitigated?

proper and planned waste management.

Does the proposed project negatively affect your business or operations?
Yes for small scale businesses opening next to the project can be displaced.

What positive impacts will the proposed project have on your operations?
Incase well not be displaced. It will boost our small scale businesses.

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?
Proper disposal of waste not to affect the environment

Do you have any specific complains to make about this project?
No

In your conclusion, do you welcome this project in the said area?
Yes

General comments, recommendations or observations on this project?
Great Project!

Respondent Sign

(30)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP UNDERGROUND FUEL STORAGE TANKS IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Underground Fuel Storage Tanks Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the Underground Fuel Storage Tanks.

Project Name: Installation of Underground Fuel Storage tanks in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	VITALIS INGAMBUA
ID Number Interviewee's	25349586
Interviewee's Contact (phone)	0739022193
Date of Interview	28/6/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

NO

Environment risks

NO

Social risks

NO

Hydro- geological (ground water)resources

IN CASES OF SPILLAGES

Do you think there will be any wastes generated and how do you propose it to be handled?

USED OIL MOPPING

How can the impacts you have highlighted be mitigated?

REGULAR MOPPING

Does the proposed project negatively affect your business or operations?

NO

What positive impacts will the proposed project have on your operations?

Continuous operation

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

NO

Do you have any specific complains to make about this project?

NO

In your conclusion, do you welcome this project in the said area?

Yes

General comments, recommendations or observations on this project?

NO

Respondent Sign

Mulola

29

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP UNDERGROUND FUEL STORAGE TANKS IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Underground Fuel Storage Tanks Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the Underground Fuel Storage Tanks.

Project Name: Installation of Underground Fuel Storage tanks in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	LYDIA MILKA
ID Number Interviewee's	33213697
Interviewee's Contact (phone)	0715021808
Date of Interview	26/6/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

NO

Environment risks

NO

Social risks

NO

Hydro- geological (ground water)resources

In case of SPILLEAGE

Do you think there will be any wastes generated and how do you propose it to be handled?

Used OIL MOPPING

How can the impacts you have highlighted be mitigated?

Regular MOPPING

Does the proposed project negatively affect your business or operations?

NO

What positive impacts will the proposed project have on your operations?

CONTINOUS OF PRODUCTION

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

NO

Do you have any specific complains to make about this project?

NO

In your conclusion, do you welcome this project in the said area?

YES

General comments, recommendations or observations on this project?

NO

Respondent Sign

[illegible]

(35)

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP UNDERGROUND FUEL STORAGE TANKS IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Underground Fuel Storage Tanks Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the Underground Fuel Storage Tanks.

Project Name: Installation of Underground Fuel Storage tanks in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Juma Sam
ID Number Interviewee's	36849324
Interviewee's Contact (phone)	0722139427
Date of Interview	28/01/21

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

Air contamination due to fuel from boilers

Environment risks

Containment of water

Social risks

Air pollution

Hydro- geological (ground water)resources

Contamination due to oil spills

Do you think there will be any wastes generated and how do you propose it to be handled?

Yes

How can the impacts you have highlighted be mitigated?

Proper Containment of water

and waste Management.

Does the proposed project negatively affect your business or operations?

No

What positive impacts will the proposed project have on your operations?

NA.

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

Mentain proper waste Management and handling.

Do you have any specific complains to make about this project?

N.B.

In your conclusion, do you welcome this project in the said area?

Yes

General comments, recommendations or observations on this project?

Mentain proper waste Management

Respondent Sign

28/06/

3rd

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP A BOILER IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Boiler Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the boiler.

Project Name: Installation of a Boiler in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Juliet Khisa Wekesa
ID Number Interviewee's	37161130
Interviewee's Contact (phone)	0719 224100
Date of Interview	28/6/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

Leaking of sewer lines leading to health hazards

Environment risks

diseases emanating from beneath,

Social risks

Death & permanent incapacitations

Hydro- geological (ground water)resources

Non

Do you think there will be any wastes generated and how do you propose it to be handled?

Yes. Management of waste.

How can the impacts you have highlighted be mitigated?

Proper waste Management

Does the proposed project negatively affect your business or operations?

No

What positive impacts will the proposed project have on your operations?

Employment

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

No

Do you have any specific complains to make about this project?

No

In your conclusion, do you welcome this project in the said area?

Yes

General comments, recommendations or observations on this project?

Such a great project [illegible]

Respondent Sign

[signature]

PUBLIC PARTICIPATION AND CONSULTATION

QUESTIONNAIRE FOR IMPACTS OF SETTING UP A BOILER IN KIRDI SOUTH B COMPLEX OFF DUNGA ROAD

The consultant is preparing Social Environmental Impact Assessment project report for proposed Boiler Installation. The process requires adequate community consultations on the anticipated positive or negative impacts. The expected impacts have been categorized as per their effects on social wellbeing, economic progress or environmental aspects that might result from installation of the boiler, operationalization and eventual decommissioning. You are therefore requested to list your concerns in the spaces provided below for the purposes of consideration and inclusion in the Environmental Management Plan to mitigate negative impacts of the boiler.

Project Name: Installation of a Boiler in KIRDI South B

Project Proponent: Kenya Industrial Research &Development Institute (KIRDI)

Interviewee's Name	Constant Wamalwa
ID Number Interviewee's	32721990
Interviewee's Contact (phone)	0732 114962
Date of Interview	28/06/2021

Physical, biological and socio-economic concerns

In your views, what health, social, hydro- geological (ground water) resources and environmental issues will this project pose to the community?

Health risks

……Non……

Environment risks

……Illnesses from poor environmental Management……

Social risks

……Non……

Hydro- geological (ground water)resources

……Contamination……

Do you think there will be any wastes generated and how do you propose it to be handled?

……Yes……Well Management……

How can the impacts you have highlighted be mitigated?

……Proper Waste disposal……

.....

Does the proposed project negatively affect your business or operations?

.....No.....

What positive impacts will the proposed project have on your operations?

.....Job..... Creation.....

What suggestions can you give the proponent as a neighbor so that they do not affect the environment negatively?

.....Work harmoniously with all neighbors.....

Do you have any specific complains to make about this project?

.....No.....

In your conclusion, do you welcome this project in the said area?

.....Yes.....

General comments, recommendations or observations on this project?

.....Great project.....

Respondent Sign

.....

KENYA REVENUE POUNDS 0001 HR. 1040

COLLECTOR OF STAMP DUTIES -7.2.02 NAIROBI

(47)

(T/

Cf 41163

SME 1. JO. 30/1/2002.

REPUBLIC OF KENYA

THE REGISTRATION OF TITLES ACT
(*Chapter* 281)

DEPARTMENT OF LANDS CENTRAL REGISTRY 458 14 FEB 2002 16:05 NAIROBI

GRANT: NUMBER I.R. 88086

ANNUAL RENT: KSH. 72/= (REVISABLE)

TERM: 99 YEARS FROM 1.11.1996

KNOW ALL MEN BY THESE PRESENTS that THE PRESIDENT OF THE REPUBLIC OF KENYA hereby Grants Unto KENYA INDUSTRIAL RESEARCH AND DEVELOPMENT INSTITUTE A body duly established under the provisions of Cap 250 of the laws of Kenya of NAIROBI (Post Office Box Number 30650)

(hereinafter called "the Grantee ") All that piece of land situate in the city of Nairobi in NAIROBI area ~~District~~ containing by measurement nought decimal six five six four (0.6564) of a hectares/~~acres~~ or thereabouts that is to say L.R. No. 209/5811 which said piece of land with the dimensions abuttals and boundaries thereof is delineated on the plan annexed hereto and more particularly on Land Survey Plan Number 236608 deposited in the Survey Records Office at Nairobi

TO HOLD

for the term of ninety nine (99) years from the first day of November One thousand nine hundred and Ninety six **SUBJECT** to (*a*) the payment in advance on the first day of January in each year of the annual rent of shillings seventy two (Ksh.72/=) (revisable) w.e.f 1.11.1996 (*b*) the provisions of the Government Lands Act (Chapter 280) and (*c*) the following Special Conditions (namely):—

[P.T.O.

Scanned with CamScanner

SPECIAL CONDITIONS

1. No buildings shall be erected on the land nor shall additions or external alterations be made to any buildings otherwise than in conformity with plans and specifications previously approved in writing by the Commissioner of Lands and the Local Authority. The Commissioner shall not give his approval unless he is satisfied that the proposals are such as to develop the land adequately and satisfactorily.

2. The Grantee shall within six calender months of the actual registration of the Grant submit in triplicate to the Local Authority and the Commissioner of Lands plans (including block plans showing the positions of the buildings and a system of drainage for disposing of sewage surface and sullage water) drawings elevations and specifications of the buildings the Grantee proposes to erect on the land and shall within 24 months of the of the actual registration of the Grant complete the erection of such buildings and the construction of the drainage system in conformity with such plans drawings elevations and specifications as amended (if such be the case) by the Commissioner PROVIDED that notwithstanding anything to the contrary contained in or implied by the Government Lands Act if default shall be made in the performance or observance of any of the requirements of this condition it shall be lawful for the Commissioner of lands or any person authorized by him on behalf of the President to re-enter into and upon the land or any part thereof in the name of the whole and thereupon the term hereby created shall cease but without prejudice to any right of action or remedy of the President or the Commissioner of Lands in respect of any antecedent breach of any condition herein contained.

3. The Grantee shall maintain in good and substantial repair and condition all buildings at any time erected on the land.

4. Should the Grantee give notice in writing to the Commissioner of Lands that [illegible] unable to complete the buildings within the period aforesaid the Commissioner of Lands shall (at the Grantee's expense) accept a surrender of the land comprised herein.

(i) Provided further that if such notice as aforesaid shall be given within 12 months of the actual registration of the Grant the Commissioner of Lands shall refund to the Grantee 50 per centum of the stand premium paid in respect of the land, or

(ii) At any subsequent time prior to the expiration of the said building period the Commissioner of Lands shall refund to the Grantee 25 per centum of the said stand premium. In the event of notice being given after the expiration of the said building period no refund shall be made.

5. The land and the buildings shall only be used for Industrial Research Laboratories and Offices

6. The buildings shall not cover a greater area of the land than that prescribed by the Local Authority in its by-laws.

7. The land shall not be used for any purpose which the Commissioner of Lands considers to be dangerous or offensive.

8. The Grantee shall not subdivide the land, without the prior written consent of the Commissioner of Lands

9. The Grantee shall not sell transfer sublet charge or part with the possession of the land or any part thereof or any buildings thereon except with the prior consent in writing of the Commissioner of Lands. No application for consent (except in respect of a loan required for building purposes) will be considered until special condition No. 2 has been performed.

10. The Grantee shall pay to the Commissioner of Lands on demand such sum as the Commissioner of Lands may estimate to be the proportionate cost of constructing all roads and drains and sewers serving or adjoining the land and the proportionate cost for the supply of both the water and the electric power to the land and shall on completion of such construction and the ascertainment of the actual proportionate cost either pay within 30 days of demand or be refunded the amount by which the actual proportionate cost exceeds or falls short of the amount paid as aforesaid.

11. The Grantee shall from time to time pay to the Commissioner of Lands on demand such proportion of the cost of maintaining all roads and drains serving or adjoining the land as the Commissioner may assess.

12. Should the Commissioner of Lands at any time require the said roads to be constructed to a higher standard the Grantee shall pay to the Commissioner on demand such proportion of such construction as the Commissioner may assess.

13. The Grantee shall pay such rates taxes charges duties assessments or outgoings of whatever description as may be imposed charged or assessed by any Government or Local Authority upon the land or the buildings erected thereon including any contribution or other sum paid by the President in lieu thereof.

14. The President or such person or authority as may be appointed for the purpose shall have the right to enter upon the land and lay and have access to water mains service pipes and drains telephone or telegraph wires and electric mains of all descriptions whether overhead or underground and the Grantee shall not erect any buildings in such a way as to cover or interfere with any existing alignments of main or service pipes or telephone or telegraph wires and electric mains.

15. The Commissioner of Lands reserves the right to revise the annual ground rental payable hereunder after the expiration of the thirty third and sixty sixth year of the term hereby granted. Such rental will be at the rate of per cent of the unimproved freehold value of land as assessed by the Commissioner of Lands.

16. The Grantee shall construct at his own expense all internal infrastructure to the standard approved by the Local Authority and the Commissioner of Lands.

GPK 6339—5m—8/92

17. Notwithstanding anything to the contrary contained here in or implied by the said Government Land Act the Grantee shall on receipt of six months noticein writting in that behalf surrender all or any part of the land required for public purpose without payment of any compensation save in respect of such of the approved buildings as may have to be evacuated or demolished.

IN THE WITNESS WHEREOF I, SAMMY SILAS KOMEN MWAITA the Commissioner of Lands have by order of the President hereunto set my hand this 30th day of JAN. Two thousand and Two in the presence of:

J.K. WANJAU (006)
REGISTRAR OF TITLES

LAND TITLES REGISTRY - NAIROBI REGISTRY
REGISTRATION OF TITLES ACT
REGISTERED AS No. I.R. 88086/1
PRESENTED 14th February 2002
TIME 16:05 Hrs
Registrar of Titles
JANE KANJA (013)

DRAWN BY

J.K. WANJAU
REGISTAR OF TITLES
P.O BOX 30089
NAIROBI

REPUBLIC OF KENYA

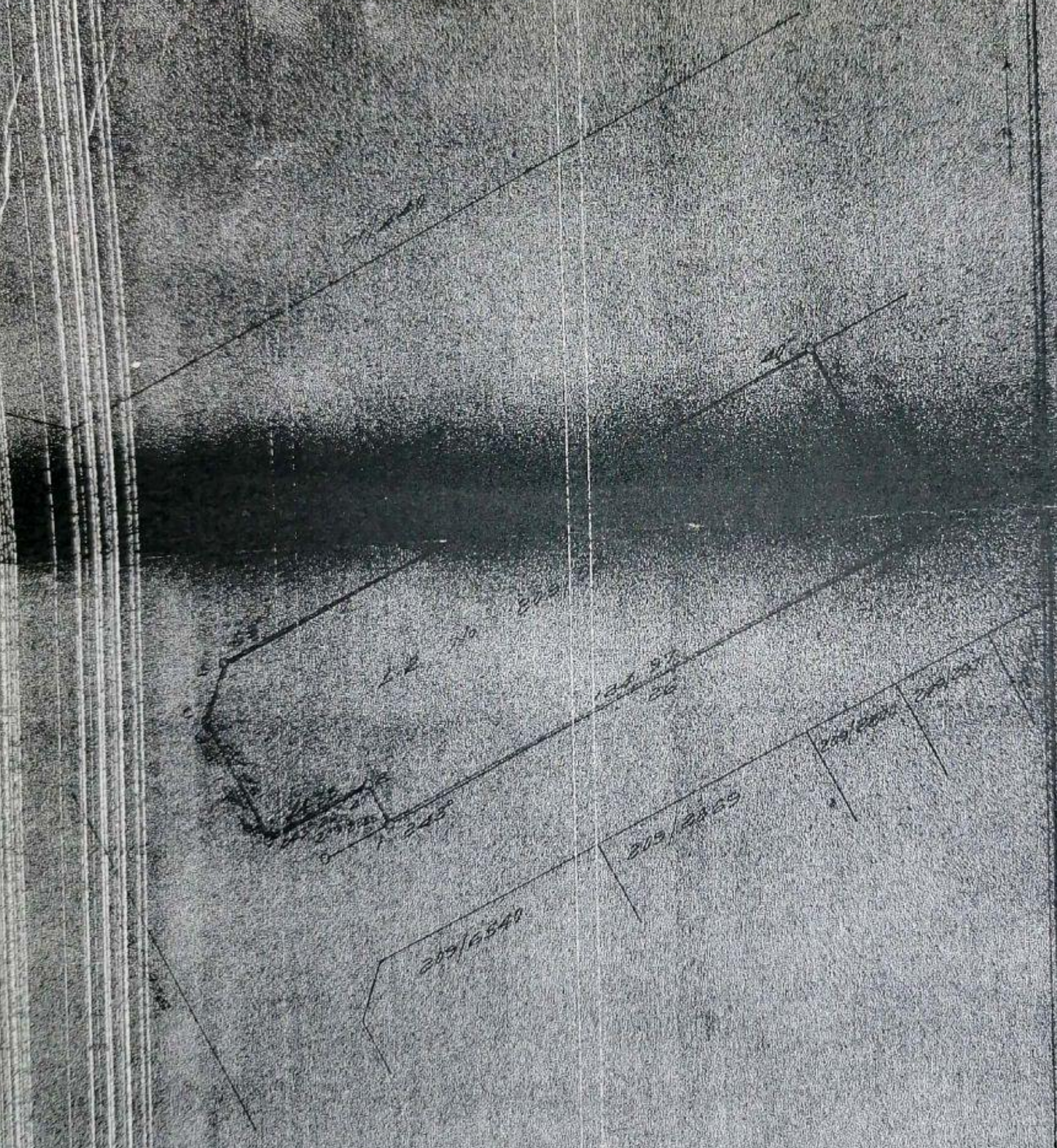
Land Reference No.

Orig. No.

Sub-division No. Orig. No.

of Section No.

Area



B. ... Kumu
... Surveyor

for Director of Surveys

Scale 1 in 1000

Nairobi 30th Aug 2001

Traced by
Compared by

DEED PLAN No. 236608

FOR ENQUIRIES ASK FOR:
.....
TEL NO:
EXT: .....
AND QUOTE

NAIROBI CITY COUNTY

CITY HALL
P.O BOX 30075
NAIROBI,

URBAN PLANNING

REF: **CPRN-AA744**

DATE: **08 February 2020**

To **Kenya Industrial Research Development Institute (KIRDI)**

C/o HABITECH CONSULTANTS (A721), Kenya

Dear Sir/Madam,

COUNTY GOVERNMENT (ADOPTIVE BY-LAW) (BUILDING) ORDER 1968 L.N. 15/1969, CITY OF NAIROBI (BUILDING) BY-LAW 1948 G.N. 313/1939.

Your Plan Reg. No **CPRN-AA744** for the proposed **- Proposed renewal to the previous approved plan no. AC524 & CPRN-AA111 (Industrial Research Laboratories and Offices)**

To be erected on **209/5811**

Is hereby approved pursuant with the provisions of the above mentioned By-laws subject to:-

a) Structural details and calculations

d) Installation of satisfactory septic tank or structurally sound water proofed conservancy tank or Letter of approval from relevant authority for mechanical disposal.

g) Satisfactory plumbing and drainage details

k) Structures coloured yellow being demolished to Council's satisfaction

s) Pretreatment of all effluents to the City Council's and/or NEMA's/Nairobi Water Company's satisfaction before discharge.

v) Install a project signboard as per M.O.W. standards, approved by City Council of Nairobi indicating names, addresses and telephone numbers of developers, contractors, project consultants e.t.c

x) X-solar energy for hot water

The passing of this plan operates as an approval thereof only for the purpose of requirements of the County Government (Adopt By-Laws) (Building) order 1968 L.N. 15/1969, the City of Nairobi (Building) By-Laws, 1948 G.N. 313/1949,

the Public Health (Cap 242), the Physical Planning Act Sections 36, 41 and 52; and any rules made thereunder.

If the proposals shown thereon have not been commenced within twelve months of the date of this approval or are not completed within two years of such date, this approval will be null and void and the carrying out of any work thereunder after such lapse will constitute a contravention of the Coumty\'s Building By-Laws.

Stamped copies of your plan returned herewith.....sets.

Yours truly, faithfully,

FOR: CHIEF OFFICER URBAN PLANNING
ON BEHALF OF THE COUNTY SECRETARY

CC. i) Secretary of Lands, P.O. Box 30089, ii) Kenya Railways,

RECEIPT

P.O. Box 5087-00506 Nairobi Kenya Tel: 0774 239 594
Email: eikenya2013@gmail.com Web: www.eik.co.ke

ENVIRONMENT INSTITUTE OF KENYA
05 JAN 2021
Email: eikenya2013@gmail.com
P. O. Box 5087-00506, NAIROBI

No. 15352 Date: 05/01/21

Received from Prof. George N. Nyaguna

The sum of Shillings Two Thousand Only

Being payment of EIK Subscription - Legal - 148

Kshs. 2000/= Cash/Cheque No. **Received by** Selina

With thanks

Stamp
Environment Institute of Kenya

FORM 7 (r.15(2))

nema
mazingira yetu | uhai wetu | wajibu wetu

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY(NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT (EIA/EA) PRACTICING LICENSE

License No : NEMA/EIA/ERPL/12246

Application Reference No: NEMA/EIA/EL/16388

M/S **Prof. George N. Njuguna**
(individual or firm) of address

P.O. Box 26442, NAIROBI

is licensed to practice in the

capacity of a (Lead Expert/Associate Expert/Firm of Experts) **Lead Expert**
registration number **0148**

in accordance with the provision of the Environmental Management and Coordination Act Cap 387.

Issued Date: **3/3/2020**

Expiry Date: **12/31/2020**

Signature.....

(Seal)
Director General
The National Environment Management Authority

P.T.O.

ISO 9001: 2008 Certified

Kenya Revenue Authority

DOMESTIC TAXES DEPARTMENT

PERSONAL IDENTIFICATION NUMBER CERTIFICATE

P051098783T

KENYA INDUSTRIAL RESEARCH &
DEVELOPMENT INSTITUTE

//

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Signature

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KIRDI TECHNO CENTRE
SOUTH B, DUNGA ROAD
NAIROBI, KENYA

TEST REPORT NO: 202116020121B	
SAMPLE	SOIL
DATE & PLACE SAMPLED	22nd February, 2021 at Kirdi Techno Centre, Nairobi.
DATE ANALYSIS STARTED	25th February, 2021
SAMPLING METHOD	POL/FTS/002
MARKINGS	Incinerator area

TEST	METHOD	RESULTS	UNITS	CLIENT SPECIFICATIONS
BTEX				
Benzene	PQA/LIM/002	<0.01	mg/Kg	-
Toluene	PQA/LIM/002	<0.01	mg/Kg	-
Ethyl benzene	PQA/LIM/002	<0.01	mg/Kg	-
Xylene	PQA/LIM/002	<0.01	mg/Kg	-
TPH				
Total Petroleum Hydrocarbons	PQA/LIM/003	3.19	mg/Kg	-
PAH				
Naphthalene	PQA/LIM/004	<0.01	mg/Kg	-
Acenaphthylene	PQA/LIM/004	<0.01	mg/Kg	-
Acenaphthene	PQA/LIM/004	<0.01	mg/Kg	-
Fluorene	PQA/LIM/004	<0.01	mg/Kg	-
Phenanthrene	PQA/LIM/004	<0.01	mg/Kg	-
Anthracene	PQA/LIM/004	<0.01	mg/Kg	-
Fluoranthene	PQA/LIM/004	<0.01	mg/Kg	-
Pyrene	PQA/LIM/004	<0.01	mg/Kg	-
Benzo(a)anthracene	PQA/LIM/004	<0.01	mg/Kg	-
Chrysene	PQA/LIM/004	<0.01	mg/Kg	-
Benzo(b)fluoranthene	PQA/LIM/004	<0.01	mg/Kg	-
Benzo(k)fluoranthene	PQA/LIM/004	<0.01	mg/Kg	-
Benzo(a)pyrene	PQA/LIM/004	<0.01	mg/Kg	-

**********End of test results**********

Limit of detection (LOD) = 0.01 mg/kg

Mombasa Lab
03rd March, 2021

Analyst

K. Murimi – *Chemist*

POLUCON SERVICES KENYA LTD. P.O. Box 99344 - 80107 MOMBASA

Technical signatory

G. Nduko - *Ass Lab manager*

Where a statement of conformity is made, the following decision rules are applied not considering uncertainties: 'conform/comply' – Results are within limits while 'does not conform/comply' –Results exceed limits

"Unless otherwise stated the results shown in this test report refer only to sample(s) tested and such sample(s) are retained for 90 days only (if non-perishable)."

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2.0 LEGISLATIONS AND GUIDELINES

2.1 EMC (Air Quality) Regulation, 2014

The objective as per EMC (Air Quality) Regulations, 2014, is to provide for prevention, control and abatement of air pollution to ensure clean and healthy ambient air. Part 65 and 66 details the requirements on monitoring and assessment of ambient air quality, part 85 shows the need for establishment of Initial levels of priority air pollutants listed in the first schedule of the guideline. The measurements were done to evaluate concentrations of the following: particulate matter both ($PM_{2.5}$ and PM_{10}), Sulphur Dioxides (SO_2), Nitrogen Dioxides, (NO_2), Carbon Monoxide, (CO), Ozone (O_3) and Carbon dioxide (CO_2) in the vicinity of the selected monitoring location in relation to the applicable guidelines provided by the Air Quality 2014 guidelines.

Table 2: Ambient air Quality Tolerance Limited

	Pollutant	Time weighted Average			
			Industrial area	Residential, Rural & Other area	Controlled areas***
1.	Respirable particulate matter (<10 µg/m³) (RPM)	24 hours**	150 µg/Nm³	150µg/Nm³	75µg/Nm³
2.	$PM_{2.5}$	24 hours	75 µg/m³		
3.	Sulphur dioxide	24 hours		125 µg/m³	
		Instant peak (10min)	0.191 ppm		
4.	Oxides of Nitrogen	24 hours		0.4 PPM	
5.	Ozone	8 hours		1.25 PPM	
6.	Carbon monoxide / carbon dioxide	One Hour	10 mg/m³	10 mg/m³	10 mg/m³
		8 hours**	5.0 mg/m³	2.0 mg/m³	1.0 mg/m³

Extract of the Ambient Air Quality (Tolerance Limits)

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4.0 PRESENTATION, DISCUSSIONS OF RESULTS AND CONCLUSIONS

4.1 Results of findings

Table 3: Sampling Locations and Measurement Results

Location	CO (mg/m^3)	NOx (ppm)	SO_2 ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	TVOCs ($\mu g/m^3$)
Measured Location Run 1	0.05	0.09	0.0	18	32	35
Run 2	0.02	0.00	0.0	16	29	41
Hourly average	**0.035**	**0.045**	**0.0**	**17**	**30.5**	**38**
Precision	0.035±0.03	0.045±0.09	0.0	17±2	30.5±3	38±6
ENVIRONMENTAL MANAGEMENT CO-ORDINATION (AIR QUALITY) REGULATIONS, 2014 TOLERANCE LIMITS	**4.0 mg/m^3**	**0.8ppm**	**-**	**75$\mu g/m^3$**	**150$\mu g/Nm^3$**	**600$\mu g/Nm^3$**

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At your service

KIRDI TECHNO CENTRE
SOUTH B, DUNGA ROAD
NAIROBI, KENYA

TEST REPORT NO: 202116020121A	
SAMPLE	SOIL
DATE & PLACE SAMPLED	22nd February, 2021 at Kirdi Techno Centre, Nairobi.
DATE ANALYSIS STARTED	25th February, 2021
SAMPLING METHOD	POL/FTS/002
MARKINGS	Incinerator area

TESTS	TEST METHOD	RESULTS	UNITS	CLIENT SPECIFICATIONS
Copper as Cu	ICARDA 5.18.1	1.25	mg/kg	-
Lead as Pb	ICARDA 5.19.3	0.04	mg/kg	-
Chromium as Cr	ICARDA 5.19.3	1.56	mg/kg	-
Nickel as Ni	ICARDA 5.19.3	0.02	mg/kg	-
Silver as Ag	ICARDA 5.19.1	<0.01	mg/kg	-
Iron as Fe	ICARDA 5.18.1	0.80	mg/kg	-
Manganese as Mn	ICARDA 5.18.1	0.32	mg/kg	-
Cadmium as Cd	ICARDA 5.19.3	0.11	mg/kg	-
Zinc as Zn	ICARDA 5.18.1	2.24	mg/kg	-

**********End of test results**********

Mombasa Lab
03rd March, 2021

Analyst

K. Murimi – *Chemist*

Technical signatory

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G. Mduko – *Ass Lab Manager*

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