ENVIRONMENTAL MANAGEMENT PLAN

FOR THE OPERATION OF

RUACANA HYDRO POWER STATION

July 2020

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1. GLOSSARY OF TERMS

Term	Definition
Corrective action	Action to eliminate the cause of a detected non-conformance
Document	Information and its supporting medium. The medium can be paper, magnetic, electronic or optical computer disc, photograph or master sample or a combination thereof.
Environment	Surroundings in which NamPower operates, including air, water, land, natural resources, flora, fauna, humans and their interrelations.
Environmental aspect	Element of NamPower's activities/ products / services that can interact with the environment.
Environmental Management Plan (EMP)	An action plan or system which addresses the how, when, who, where and what of integrating environmental mitigation and monitoring measures throughout an existing or proposed operation or activity. It encompasses all the elements that are sometimes addressed separately in mitigation, monitoring and action plans.
Environmental impact	Any change to the environment (whether adverse or beneficial), wholly or partly resulting from the organisations environmental aspects.
Environmental objective	Overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve
Environmental target	Detailed performance requirement applicable to NamPower or part thereof, that arises from the environmental objectives and that needs to be set in order to achieve those objectives.
Procedure	Specified way to carry out and activity or process
Record	Document stating results achieved or providing evidence of activities performed

2. DETAILS OF PROJECT STAFF

This Operational Environmental Management Plan was generated by staff members permanently employed by NamPower within the Safety, Health, Environmental and Wellness (SHEW) Section. The following individuals took part in the execution of the Operational Environmental Management Plan:

Project Manager – EMP (Operational)

Nadia Haihambo is a fulltime employee of NamPower for the past 9 years and served as the Project Manager for this assessment. She was responsible for ensuring that the correct procedures are adhered to. Ms Haihambo has no vested interest in the outcome of the process. All communication with regard to the project should be addressed to her and she can be contacted at:

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Environmental Assessment Practitioner (EAP)

Martha Ndapona is a fulltime employee of NamPower for the past 3 years in the Environmental sub section. She has nine years of experience in Environmental Management having worked in various sectors such as the mining, exploration and energy. She has drafted a number of Environmental Management Plans (EMPs) and have been involved in the revision of a number of EIA reports, Specialist reports, scoping reports and Environmental Management Plans generated for projects by external consultants. Ms Ndapona has no vested interest in the outcome of the process. Ms Ndapona can be contacted at:

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3. INTRODUCTION

3.1 Overview of the Ruacana Power Station

Ruacana Power Station is the largest power station in Namibia with an installed capacity of 347 Mega Watts (MW). It continues to be a paramount contributor to meeting Namibia's energy demand. Situated in the

Kunene River in northern Namibia, the Ruacana falls and its meandering nature creates a natural setting for the Ruacana Hydroelectric scheme. The Ruacana Hydro Power Station forms part of the Kunene River scheme which consist of five components, namely, the Gove Dam (with a capacity of 2600 Mm^3, situated about 430km upstream of Ruacana), Calueque Dam (with a capacity of 475 Mm^3, situated about 46km upstream of Ruacana), the Diversion Weir (with a capacity of 20Mm^3) and the 525km, 330kV Omburu Transmission Line that carries most of the power generated by the power station to central Namibia. Gove Dam, located upstream in Angola, was constructed to facilitate the construction of the Calueque Dam and for the subsequent regulation of the river flow at Ruacana Power station for the ultimate purpose of maximizing its power generation.

Figure 1. Arial photograph of the Ruacana Hydro Power Station

Ruacana Power Station has two main functional areas, namely the operations and maintenance sections, responsible for the day-to-day operation of the power station in order to generate electricity and for the maintenance of the hydro turbines and related power station infrastructure respectively. The following process outlines the hydro-power generation at Ruacana Power Station:

Table 1: Ruacana power station process outline

Diversion Weir	The first component of the Ruacana power station is the Diversion Weir, situated in the Angolan territory. The weir includes two sour gates for flow control and level regulation. Seven flap gates also form part of the dam structure, which are used for flood control. The diversion weir also incorporates the intake of the pressure tunnel leading to the power station. The diversion weir has a capacity of approximately 20Mm^3.
The Pressure Tunnel	From the diversion weir, a 10m diameter, 1500m long pressure tunnel runs along the southern bank of the river, approximately 30m below the surface. After crossing the border, the pressure tunnel continues through a fault zone in the Palmwash ravine, and then feeds into an oval-shaped Surge Headbay.
Surge Headbay	The surge headbay is 31.5m deep. Its main purpose is absorbing water surges. From here, water is fed to the underground turbines via 4 (four) separate penstocks.
Penstock	Water is fed from the surge headbay to the turbines, located 134m underground via 4 penstocks of 3.6m diameter. The control of the water flow is done at the inlet of the penstock inlet Valve (PIV).
Underground Cavern	The largest cavern underground is the Machine Hall which houses the generating units, a control building and the workshop area. Next to the Machine Hall cavern on the northern side is a 120m long Transformer Hall cavern. A third chamber on the southern side of the machine hall forms the surge chamber (70m long and 28m high), where water from the turbines is fed via Draft Tubes and then ultimately directed through the Tall Race Tunnel (675m long) back to the Kunene River.
Francis Turbines	Water is fed from the Penstock into the spiral casing and through the turbines runner, where the potential energy of the water is converted into rotating mechanical energy, driving the rotor of each generator. The capacity of Units 1, 2 and 3 hydro turbines are rated at 85MW each and the unit 4 hydro turbine is rated at 92 MW, giving a total capacity 347 MW. Each hydro turbine has a digital hydraulic governor which controls its speed and power output (after synchronisation with the grid). The original turbine runners of Units 1, 2 and 3 were replaced with new, state-of-the-art X-blade design runners from 2014-2016, which increased the capacity of each individual turbine from 80 MW to 85 MW due to higher efficiencies gained from the new design.
Generator	Energy conversion takes place from mechanical energy to electrical energy in generator Units 1, 2 and 3, rated at 11kV, 88, 888 MVA each, as well as in the Unit 4 generator rated at 11kV, 105 MVA.
Generator Transformer	Electricity is fed from each generator to a dedicated generator transformer, which steps the voltage up from 11kV to 330kV. Unit 1, 2 and 3 generator transformers are rated at 90 MVA each and the Unit 4 generator transformer is rated at 105 MVA.

Gas Insulated Switchgear (GIS) and Busbars	330kV-rated GIS conducts the electricity via a double-busbar system from under-to-above-ground and connects to the 330kV Omburu feeder to evacuate the power to the grid. A percentage of the power use also transmitted to the northern region via the 132kV Omatando line.
High Voltage Yard (HVY)	Electricity is also tapped from the above-mentioned Busbars and stepped-down to distribution voltages of 11kV and 66kV, via two 330/11kV coupling transformers, which supply electricity to the towns of Opuwo, Ruacana, Omatando and Angola as well as the auxiliary loads of the power station.
Surge chamber	Water exits the turbines via individual draft tunnel tubes, which lead to the surge chamber.
Tail Race and Tail-Race Tunnel	The surge chamber is connected to the Tail-Race via a Tail-Race Tunnel, whereby water is returned back to the natural river course.
Plant automation system	There are several Programmable Logic Controllers (PLC) that allows for the automation of the plant system. This system allow operators to monitor and control the plant via both client/workstation PCs for redundancy. The control system is highly automated to allow operations of the power station as per Functional Design Specification (FDS). Operators monitor turbines operating variables such as Megawatts, Voltage, Temperatures, Levels, Pressures, and flows and respond to any alarms and/or warnings generated by the control system to ensure that the power station is operated within its design limits.

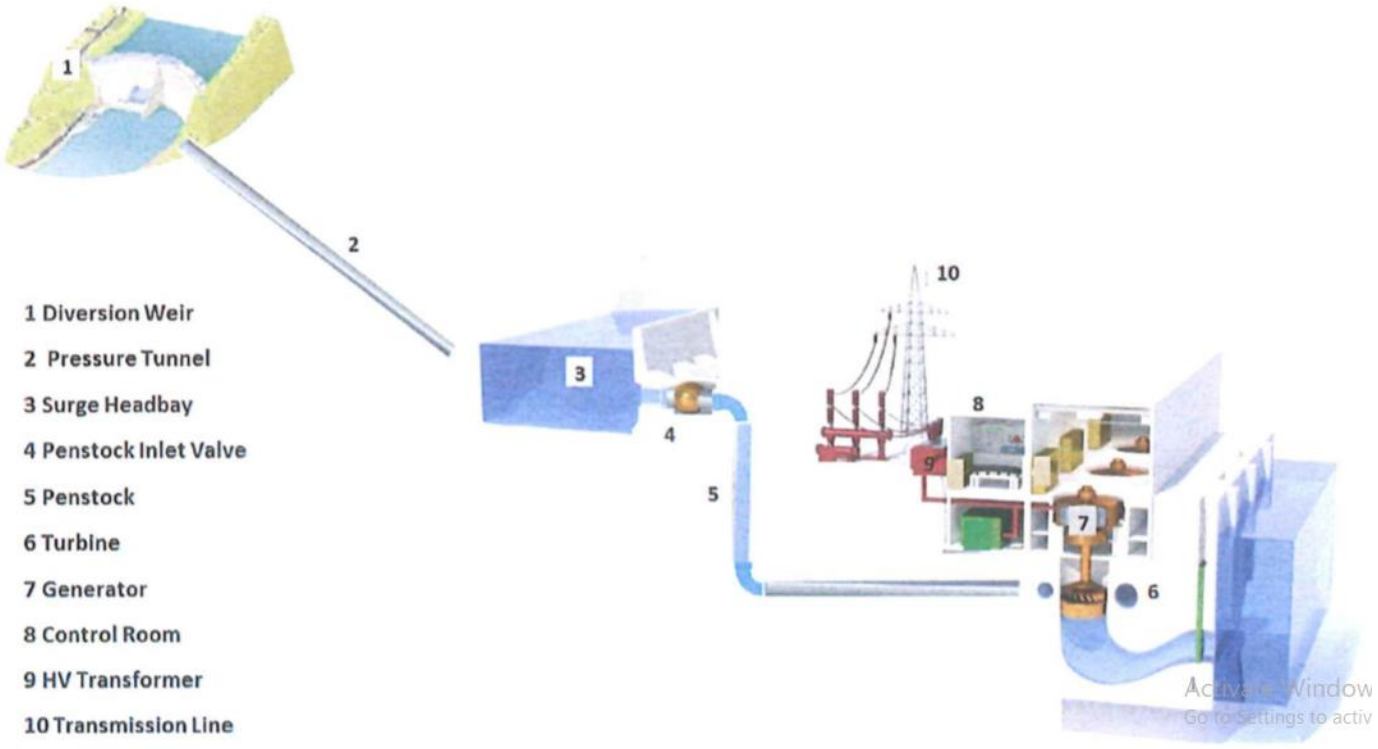

Figure 2: Ruacana Power Station Flow Chart

2.2 Area description

Ruacana Power Station form part of Ruacana constituency, Omusati Region in northern Namibia. The district capital is Outapi town, which is about 80 km from the power station. Ovazemba and Ovahimba people are native to the area.

The climate at Ruacana is considered to be a semi-arid climate with little rainfall. The annual average rainfall is 374 mm with the driest month being May, with an average of 0 mm of rain, and the wettest being February, with an average of 109 mm. The average annual temperature is 22.1 °C. Generally November is the warmest month of the year with temperatures averaging 24.9 °C and July is the coolest with the lowest average temperature of 17.3 °C. Omusati Region is characterised by recurrent droughts and flash floods (Aurecon, 2019).

The study area is located in the Savanna biome; it is dominated by species such as Mopane (*Colophospermum mopane*) and Shepard's tree (*Boscia albitrunca*). The biome supports a high concentration of various species which are endemic to the region. Due to variable climatic events, the biome is vulnerable to inappropriate management and over-use, resulting in degradation and loss of productive potential. The large blocks of porphyroblastic gneiss, pink to grey in colour, characterise the geology at Ruacana, with incidental intercalation of chlorite-schists, hornblende schists and mica-schists materials (Aurecon, 2019).

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Agricultural activities in the wider Ruacana area include livestock, crop and poultry production, feedlots, aquaculture and irrigation schemes. More specifically within the study area there was evidence of mahangu crops, also known as pearl millet, a rain fed cereal crop. Cattle and goat farming is the main subsistence activity for local communities. These activities are adapted the low rainfall and soil conditions of the area. The Hippo Pools (Otjipahuriro) community camp site which is situated on the bank of the Kunene River downstream of the power station. The camp fall within a conservancy and generates income for the local community.

The famous Ruacana Falls located in the area is about 120 m . tall and 700 m. wide. This epic waterfall is one of the largest in Africa. Ruacana falls and the power station are known as tourist destinations or used as a signpost to other popular tourist destinations such as the Epupa Falls (over 100 km to the north-west) and Etosha National Park (over 200 km to the south-east) and Kaokoland (Aurecon, 2019).

4. Purpose of this Environmental Management Plan (EMP)

The purpose of this Environmental Management Plan (EMP) is to provide procedures, methods and specific environmental guidance that will be used to control and minimize the environmental and social impacts of all operational activities associated with the Ruacana Hydro Power Station (RHPS). The EMP is intended to manage, mitigate and uphold commitment made by the Ruacana Hydro Power station management team in order to minimize related environmental and social impacts throughout its operational activities. The EMP further aims at ensuring continuous improvement of environmental performance and reducing negative impacts by following sound environmental protection services.

The scope of this EMP covers the activities at the Diversion weir (located approximately 1 kilometre upstream from the power station in the Angolan territory), the Hydro Power station itself and the Ruacana substation. The activities covered include those related to the operation and the upgrades of the power station.

4.1 Objectives of the EMP

- To ensure that all environmental aspects are effectively identified monitored and managed and effective mitigation measures are taken;
- To ensure that the operation activities associated with the power station do not result in undue or reasonably avoidable adverse environmental impacts;
- Environmental impacts, and ensure that any potential environmental benefits are enhanced;
- To ensure that all relevant legislation are complied with during the operation of the power station;
- To identify key personnel who will be responsible for the implementation of the EMP and outline functions and responsibilities towards environmental and social management;

- To propose mechanisms for monitoring compliance, and preventing long term or permanent environmental degradation through an adaptive management approach to continuous improvement;
- To promote environmental awareness and understanding among employees and contractors through training;
- To ensure that communities living around the station are not negatively affected by the operations of the station

5. POLICY AND LEGAL FRAMEWORK

Legal compliance is an important aspect of sound environmental management. The table below list all related legislations which are applicable to the operation of the Ruacana Hydro power station.

Table 2 Legislation applicable to the operation of the Ruacana Hydro Power Station

Legislation	Section	Implication
Environmental Management Act no 7 of 2007	**Section 3** **Section 33** **Section 27**	• All activities performed should be in line with the following principles: o Interested and affected parties should have an opportunity to participate in decision making o Listed activities should be subject to an EIA o Polluter should pay for rehabilitation o Pollution should be minimized • Environmental assessments should be carried out for listed activities. The proposed activity can be classified under the following range of activities: o Generation of electricity o Transmission of electricity • These sections details the process to be followed in order to obtain a clearance certificate • All existing listed activities must obtain a clearance certificate within one year of the law coming into effect (February 2013). Therefore, all existing activities which can be considered a listed activity should apply for clearance.
EMA Regulations GN 28-30 (GG 4878) (February 2012)	**Listed activity: 5.1, 6 – 9, 13, 15 and 21 -24**	• This activity can be considered as electricity generation and transmission. These sections details the process to be followed in terms of producing an Environmental Assessment, and this process should be adhered to during the generation of information for this document
Labour Act no 11 of 2007	**Section 3** **Section 4** **Section 8 - 9** **Section 9**	• Children under the age of 16 may not be employed • Forced labour may not be used during any construction activities • Basic conditions of employment, as stipulated by the law, must be met. • The employer shall ensure the health and safety of all employees and non-employees on site. Employees must fulfil their duties in order to ensure their own health and safety and that of other employees and persons. Employees may leave the work site if reasonable measures to protect their health are not taken.

	Section 39 - 42	• These sections sets out the rights and duties of employers and employees in order to ensure the health, safety and welfare of employees at the work place. • Employer is also required to conduct its business operations on its premises in a manner that, as far as is reasonably practicable, persons who are not employees of that employer are not exposed to the risk of their safety or health.
Electricity Act no 4 of 2007	**Section 17** **Section 33**	• NamPower shall hold a licence for each of the activities stated under section 17 (1) of this Act if it intends to carry out these activities. • Installations used for the provision of electricity should be operated with due compliance with the requirements of laws relating to health, safety and environmental standards. Therefore – any company involved within the Electricity Supply Industry must adhere to the laws covering the previously stated aspects or stand to lose their licenses to operate.
Water Act no 54 of 1956	**Section 21 and 22** **Section 23**	• Conditions in terms of the disposal and management of effluent are to be adhered to • Prohibits pollution of public or private water and any person causing pollution to a water source shall be guilty of an offence.
Public Health Act no 36 of 1919	**Section 122**	• It is an offence to cause any form of a nuisance which includes water pollution
Water Resources Management Act no 11 of 2013	**Section 53** **Section 56** **Section 58** **Section 59**	The objective of this Act is to ensure that and the country's water resources are conserved and protected.in ways consistent with or conducive to fundamental principles set out in section 3 of this Act. • Namibia uphold principles and rules of customary regional and international laws on shared water sources. It is NamPower's obligation to ensure that its operations are within these guidelines. • No wastewater, effluent or waste water is to be discharged or deposited directly or indirectly into a water resource without a permit o Effluent is defined under this Act as any liquid discharge that occurs as a result of domestic, commercial, industrial or agricultural activities. • A person may not discharge effluent from a sewer directly to any water resource on or under the ground, unless the discharge is in compliance with a permit issued under section 60. • A person may apply for a permit to construct an effluent treatment facility or disposal where it is likely to constitute a direct or indirect source of pollution.
Hazardous Substances Ordinance 14 of 1974		• To provide for the control of substances which may cause injury or ill-health to or death of human beings by reason of their toxic, corrosive, irritant, strongly sensitizing or flammable nature or the generation of pressure thereby in certain circumstances; to provide for the division of such substances into groups in relation to the degree of danger; to provide for the prohibition and control of the importation, manufacture, sale, use, operation, application, modification, disposal or dumping of such substances; and to provide for matters connected therewith.

Heritage Act 27 of 2004		• The objective of this Act is to provide for the protection and conservation of places and objects of heritage significance. • All heritage resources are to be identified and either protected or removed/mitigated with a permit from the National Monuments Council, before any development may take place • A chance find procedure should be followed in case of discovery of a heritage resource.

The Power Station manager shall ensure that the employees and external service providers comply with the requirements outlined in this EMP. In the event of non-compliance, the following recommended process shall be followed:

- Non-compliances will be identified during inspections or audits carried out by the Safety, Health, Environment and Wellness (SHEW) Section and reported to the Power station Manager for corrective actions.
- The Power Station manager shall notify the station employees about the non-compliance.
- Corrective and preventative actions must be implemented on an agreed timeframe.
- Follow – up inspections shall be conducted to assess whether the corrective and preventative actions were implemented effectively.

6. EMP ROLES AND RESPONSIBILITIES

It is the responsibility of the Ruacana Hydro Power Station management to ensure that all the environmental management actions are carried out effectively and timeously. It is important to note that the successful implementation of the EMP is, however dependent on clearly defined roles and responsibilities by several stakeholders. Below are the key employees that are responsible for the management of environmental and social issues during the operation of the power station:

The Power Station Manager shall ensure that:

- Environmental requirements are adequately covered in any external service provider's contracts.
- Corrective actions are identified for non-compliances.
- Appropriate records and information regarding compliance with environmental requirements are maintained.
- That the power station remains in compliance with the requirements of this EMP, through regular communication and monitoring.
- SHE requirements are included in the tender documents sent to the contractors.

The NamPower SHEW Section shall:

- Ensure that all requirements with regards to this EMP are fulfilled.
- Assist the Power station Manager in ensuring the station remains in compliance with this EMP.
- Provide SHEW inductions for the external service providers and awareness training for the employees.
- Organize and implement monitoring and audit functions, in consultation with the Power station Manager.
- Audit the implementation of this EMP by the power station.
- Advise the power station employee on actions or issues impacting on the environment and provide appropriate recommendations to address these matters.
- Ensures that continual improvement is made with regard to the environmental performance at the power station.
- Provide SHEW induction training to all external service providers and awareness training to employees.

SHE representative shall:

- Discuss toolbox topics with fellow employees
- Conduct inspection in his/her area
- Making recommendation to the SHEW section regarding environmental performance of his area.
- Reporting any environmental incidents or non-conformances with the EMP to the SHEW section.

7. ENVIROMENTAL ASPECTS, IMPACTS AND MANAGEMENT AND MITIGATION MEASURES

7.1 Description environmental aspects and impacts related to the operation of the power station

The table below outline the activities which are undertaken as part of the operation of the power station as well as the aspects and impacts associated with these activities.

Table 3: The Power station activities and associated environmental aspects and impacts

Activities	Aspect	Aspect Description	Potential Impact
Diversion weir - opening and closing of gates	Hydraulic oil leaks	Hydraulic oils can leak from the operations of the sour and flap gates at the diversion weir.	Hydraulic oils can end up in the river and cause water pollution.
	Waste generation	Waste such as used rags/absorbents can be generated from spill clean-up.	Waste generated can cause soil contamination and increase hazardous waste landfill space
	Use of natural resources	Hydraulic oil is a natural resource which is used in the operations of gates at the diversion weir.	The continuous use of hydraulic oil for lubrication contributes to the depletion of this natural resource in the long run.
	Animal death	Due to the nature of how the diversion weir is set up, animals could accidently walk and fall into the diversion weir	Accidental falling of animals in the diversion weir can lead to loss of animal lives
	Drowning of people	Accidental drowning of people especially kids can happen at the diversion weir since it is not fenced off.	Loss of human life
Surge head bay - Operation and maintenance of the crane	Grease and oil leaks	Grease and oil leaks could occur from the operation and maintenance of the crane's gear box.	Very small quantities of oil and grease used. Potential for negligible soil and water pollution.
Penstock Inlet Valve - Opening and closing of the PIV	Hydraulic oil leaks/spill	Hydraulic oil leaks could occur from the hydraulic system. The spill can also occur from a potential pipe burst.	Soil or water contamination

Power generation - Power generation involves a conversion of potential energy to electrical energy by turning the runner which is coupled to the generator and auxiliary services (oil cooling)	Oil spills	Oil can leak from bearings, governors, pumps, pipes, oil tanks. Oil spills could also occur as a result of damaged transfer pipes or overfilling oil tanks.	Water pollution
	Waste generation	Used absorbents can be generated from the spill clean-up. Waste can also be generated from empty oil containers	Increased hazardous waste landfill space
	Use of natural resources	Oil is used in the power generation process including the maintenance of auxiliary services.	Contribute to resource (oil) depletion)
	Altered water flow	The flow of the water discharged from the power station is different from the natural flow of the river. This can cause disturbance in the natural flow of the river	Change in localised river ecosystem
	All industrial effluent	Industrial effluent from consisting of water with oil, chemicals resulting from cleaning throughout the power station could end up in the river.	Water pollution
		Electricity is generated from the hydropower plant.	Provision of electricity that enables economic development and improves living standard of Namibian citizens.
Storage and disposal of waste	Littering	Non- Hazardous solid waste is stored and transported from a demarcated area to the Ruacana landfill site.	Improper storage and disposal of waste can lead to visual pollution and off odours
	Oil Spills	Spillage of hazardous waste can occur during storage and transportation of (used oil, blasterite, batteries and other hazardous waste) due to leakages. Spillage can also occur during transportation and storage as a result of an accident.	Soil, water, air, visual pollution and off odours. Impacts on human health. Increase hazardous waste landfill site.

	Releases to air, water and soil (fluorescent tubes)	Fluorescent tubes bulbs are used to provide lighting throughout the power station. Heavy metals contained in these bulbs could end up in the environment.	Air, water and soil pollution
Waste water treatment	Sludge and solid waste generation	Sludge generated from the water treatment plant	Filling up of disposal site.
	Waste generation	Waste is generated from the water treatment plant activities (chemical containers)	Filling up of landfill space
	Releases to water	Water from the treatment plant is released into the river. There is a possibility that the released water will not meet special standards (under abnormal conditions).	Water pollution
Domestic effluent / sewage disposal	Waste water releases	Domestic effluent is generated from day to day use of power station toilets, kitchens and washrooms this effluent can end up in natural water system.	Water pollution
		Oil spill can occur from the generator transformers (inside the power station)	Water pollution
		Oil spill can occur from the station transformers 1 & 2; transformers behind the diesel room; transformers in the HV yard and transformers in the reactor yard	Soil and water pollution
High voltage switchgear room - High voltage switching	Greenhouse gas emissions (SF6 gas release)	SF6 gas may escape into the atmosphere during operation and maintenance of the SF6 switch gear.	Contribution to global warming
Diesel room - Diesel generators are kept on site to provide emergency power in the case of	Air emissions	Exhaust gases are emitted from the diesel room during the operation of the diesel generators	Air pollution
	Noise		Noise pollution

power failures. (Operation and maintenance of diesel generators)		Noise is emitted during the operation of the diesel generators	
	Oil and diesel spills	Oil and diesel spills can occur during operation and maintenance of diesel generators. Spill can also occur from the make-up tanks and the bulk tank	Soil and water pollution
PV Plant - operations and maintenance of the PV plant	The use of renewable energy (solar)	There is a PV plant at the station which generates and supply electricity to the power station for use.	The PV plant has a positive impact of reducing the power station's carbon footprint.
Workshops - Maintenance and operations	Oil spills	Spillage of oil, detergents and other chemicals can occur from the workshop's day to day activities.	Soil and water pollution
	Waste Generation	Waste such as off cuts, empty chemical containers, domestic waste, absorbents are generated during the day to day workshop activities.	Filling up land fill space, littering, soil and water pollution
	Waste water	Waste water is generated from washing of cars and workshop floors	Soil and water pollution
Clinic	Waste Generation	Hazardous waste such as gloves, human tissues, pills or needles is generated from the Clinic.	Human health impact
Administrative work and gardening	Use of water	Water is consumed for domestic purposes such as drinking, cleaning and watering the garden.	Contribution to the depletion of water resources
	Waste generation	Waste such as cans, paper, food packages, boxes and plastic is generated during day to day office and other activities. Garden waste is generated during maintenance and upkeep of the garden area.	Filling up land fill space, littering, soil and water pollution

7.2 Mitigation and management measures

In order to ensure that the potential impacts are prevented and/or minimised, it is necessary to ensure that the various activities related to the operation of the power station are adequately managed and monitored. This section presents the measures for mitigating and managing environmental and social impacts arising from operational activities. Table 4 below outlines mitigation measures as well as objectives to be achieved. Each mitigation measure is also tied to a responsible person.

Table 4 Mitigation measures to prevent and/or minimise potential impact associated with operational activities.

Aspect	Mitigation objectives	Management and Mitigation measure	Responsible person
Social: creation of jobs, indirect impact on the environment	To promote socio-economic developments	• No management measures required as this have positive impacts.	Power Station manager
Environmental awareness	Minimise the occurrence of environmental impact on the work and surrounding area.	• All staff to receive environmental awareness training. Refresher environmental awareness training to be available when required. • The SHE representative shall erect and maintain information posters at key locations at the power station. • All staff are to be made aware of their individual roles and responsibilities in achieving compliance with the EMP. • All visitors to receive induction prior to conducting any work at the power station. • Awareness meetings with communities nearby should be conducted.	SHEW section Operating superintendent
Petroleum product spills	Ensure that the petroleum product spills are prevented and if not, the impacts are minimised.	• All service providers delivering fuel to site should receive induction prior to entering site. • The fuel truck driver should be licensed to transport dangerous goods. • Spill kits must be made available onsite • Employees must receive training on spill response	Operating superintendent Power Station manager

		• In an event of a spill, contaminated soil must be collected. The contaminated soil should be bio-remediated. • Planned and corrective maintenance should be done on all containers/tanks/pipes containing or conveying petroleum product. • Regular visual inspection of the bund walls. • NamPower Spill Response procedure to be implemented.	
Water use	To ensure that the resources are used sustainably in order to prevent resource depletion	• The closed circuit water system to enable water re – use should be used where possible. • Awareness on water and power saving measures should be provided to employees. • Planned and corrective maintenance on water taps and pipes. • Corrective action shall be taken immediately should there be any leaking tap or pipe. • Water meter readings should be analyzed on a monthly basis • Conduct monthly inspection within the power station to identify water leaks	Power Station manager Operating Superintendent
Noise	Confine noise levels within acceptable limits	• Proper operation, maintenance of vehicles and equipment • Regular noise monitoring must be conducted	SHEW Section Operating Superintendent

			Power Station manager
Dam wall management	To prevent dam wall failure	• Prepare and implement a dam inspection and maintenance plan • Proper management and operation of flap gates in order to prevent dam wall failure.	Power station manager
Biodiversity	To prevent biodiversity loss	• Harvesting of plant material or other damage to fauna and flora must be prevented and avoided, and disciplinary measures including dismissal to be put in place. • Capture and release of stranded crocodiles and snakes • Training of employees on snake handling	Power station manager
General and Hazardous waste Management	To avoid manage and mitigate potential impacts on the environment caused by waste water, incorrect storage, handling and general disposal of general and hazardous solid waste.	• Waste shall be segregated into separate bins and clearly marked for each waste type. • Compile a waste management procedure detailing appropriate waste storage and disposal. • Staff shall be trained in waste management. • Bins shall be emptied regularly. • Keep a waste manifest for the hazardous waste produced • General waste shall be disposed of at recognised and registered waste disposal sites/recycling companies. • Hazardous waste shall be disposed of at a registered hazardous waste disposal site. Safe disposal certificates should kept onsite and a copy should be emailed to SHEW.	Power Station manager Operating Superintendent

		• Recycling of waste should be promoted. • Sufficient covered waste collection bins shall be available onsite. • Inspect and maintain the waste management facilities.	
Hazardous Substances	Minimise the risk of impact to the environment through safe storage, handling use and disposal of hazardous substances	• Drip trays must be available to contain accidental spills. • Machinery must be properly maintained to prevent oil leaks. • All hazardous substance will be stored in suitable containers as defined in the Material Safety Data Sheets (MSDS). • Containers should be clearly marked to indicate contents, quantities and safety requirements. • Ensure availability of MSD Sheets • A hazardous substances management compiled must be developed and implemented. • Ensure all employees are trained on the new requirements and monitor all storage areas for deviations from developed guidelines. • Use and/or storage of materials, fuels and chemicals which could potentially leak into the ground must be controlled in a manner that prevents such occurrences.	Power Station manager Operating Superintendent

		• All fuel storage tanks should be bunded. The bunded area must be of sufficient capacity to contain a spill/leak from stored containers, 110% of the total volume. • Ensure that diesel and other liquid fuel, oil and hydraulic fluid is stored in appropriate storage tanks or in bowsers. • Flammable materials should be stored in clearly labelled designated areas with safety signage's. • Adequate firefighting equipment shall be made available at all hazardous storage areas. • No smoking shall be allowed within the vicinity of the hazardous storage area.	
Water quality management	Minimize water and soil pollution	• Water from the station (water used for cleaning station floors, sewage water) should be treated first before being released in the environment. • An effluent discharge permit should be obtained from the Ministry of Agriculture, Water and Forestry. • Water monitoring program should be implemented • Monitor the amount of effluent released from the sump • The water flows (for outflow water from the generation process) should be regulated.	Power station manager
CFC's and SF6 gas	Minimize green-house effect	• Make use of environmentally friendly gases to minimize green-house effect	SHEW section Power Station manager

		• Ensure that SF6 gas cylinders are properly stored and chained in an upright position.	
Emergency procedure	Enable a rapid and effective response to all types of environmental Safety and health emergencies	• Emergency numbers to be readily posted on a notice board on site • NamPower emergency procedures to be consulted in case of emergency • If a dam burst were ever to actually occur there should be no loss of human life. • Warning systems for the opening of the gate must be installed and tested on a frequent basis. • Warming signs must be installed at hippo pool to give warnings to people on the risk of swimming in the river. • Awareness meetings with nearby downstream villages conducted.	Power Station manager
Prevention of disease	To minimize the spread of HIV/AIDS	• Condoms should be made available to the employees. • Support awareness raising campaigns to be conducted on HIV/AIDS prevention, diagnosis, and treatment to reduce the stigma of the disease among employees. • Employees to be encouraged to do voluntary HIV testing. HIV results to be kept confidential.	Power Station manager SHEW

8. MONITORING AND AUDITING

Environmental monitoring and inspections must be conducted during the operation phase of the power station. The environmental monitoring and audits conducted at the power station will cover all management procedures, the requirements of this plan, ISO 14001 standard, this will be carried out by the NamPower SHEW section. Monitoring and auditing is important in order to measure the success of proposed mitigation measures and to ensure continuous improvement through continuous review of operation activities. Monitoring and inspection reports detailing the monitoring results and inspection findings shall be prepared by the SHEW section and communicated to the power station management.

The following activities should be monitored:

- Water quality
- Noise
- Air quality

9. COMMUNICATION AND REPORTING

Effective communication and reporting are key components in implementing an effective EMP. Reports shall be produced through the course of the implementation of monitoring programs, incidents reports, non-compliance reports, environmental monitoring reports and auditing performance reports should be kept and documented for review.

10. RECORD KEEPING

Record keeping is important for the effective implementation of an EMP. A record keeping system must be established to ensure adequate control of updating and readily availability of all documents required for the effective implementation of the EMP. EMP documentation must be kept in both the hard copy and electronic format for safe keeping. These must include:

- A copy of an EMP
- EMP implementation activities;
- Induction records;
- Monitoring reports;
- Audit and Inspection reports

11. NON-COMPLIANCE PROCEDURES DURING OPERATION

The power station manager shall ensure that the employees and external service providers comply with the requirements outlined in this EMP. In the event of non-compliance the following recommended process shall be followed:

- Non-compliances will be identified during inspections or audits carried out by the SHEW Section and reported to the power station manager for corrective actions.
- Power station manager shall notify the employees about the non-compliance
- Corrective and preventative actions must be implemented on an agreed timeframes
- Follow – up inspections shall be conducted to assess whether the corrective and preventative actions were implemented effectively

12. TRAINING

In order to ensure a successful EMP effective capacity building and continuous training of operational employees and all others (contractors and sub-contractors) involved in the EMP is key. All those responsible for the management, implementation and operation of any aspect of the EMP shall be adequately trained for their role. Training records shall be maintained on site, for each employee, to provide evidence for auditing/inspection purposes.

13. ENVIRONMENTAL REVIEW AND UPDATE OF THE EMP

In terms of review, the environmental unit shall review the EMP to assess its effectiveness and relevance annually, after a reportable incident or significant non-compliance and or following an addition/up-date or change to the EMP. The EMP shall also be reviewed to evaluate environmental controls and procedures to make sure they are still applicable to the activities being carried out. When reviewing the environmental team should consider all the non-compliances reported, corrective action reports and all the data collected and analysed onsite.

14. CONCLUSION

All management measures and legal requirements outlined in this EMP should be complied to in order to ensure environmental compliance by all parties undertaking the operational activities. This will ensure that potential negative impacts are identified, avoided or mitigated.