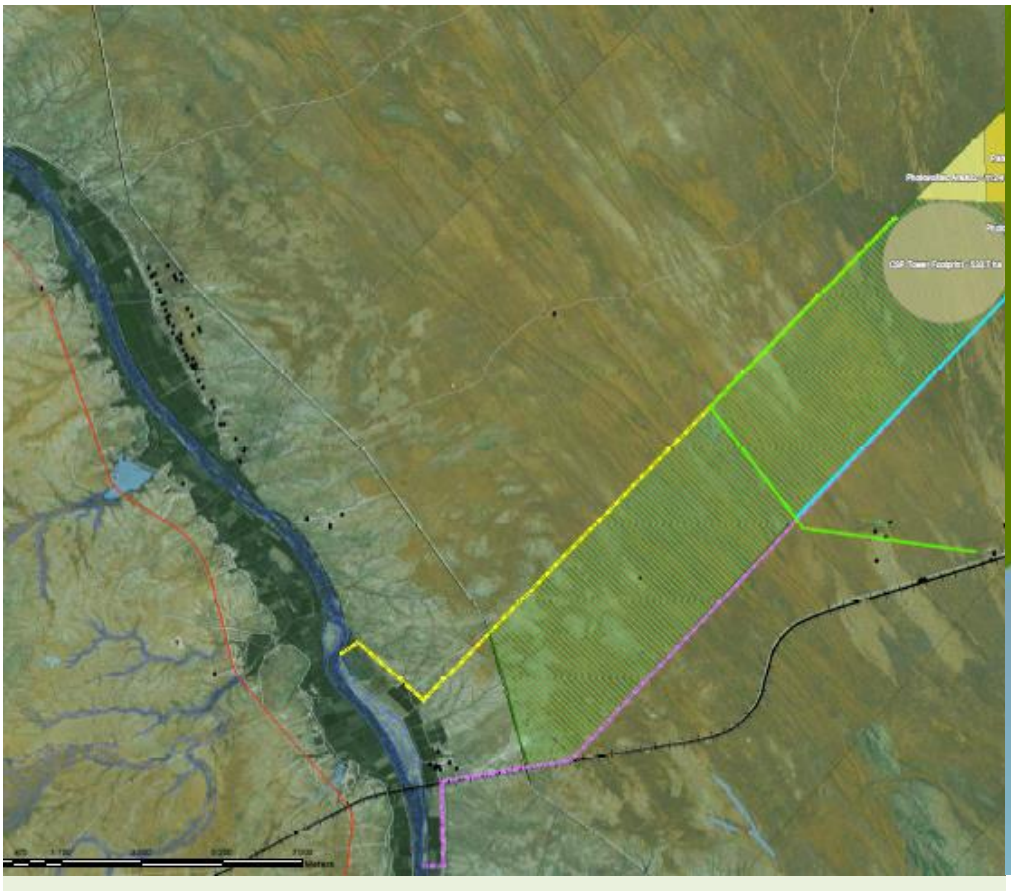

Sand Draai Concentrated Solar Park

SolAfrica

Scoping Report for Waste Impact Assessment

29 September 2014

A project for:

Solafrica Thermal Energy (Pty) Ltd

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Definitions

By-product	Means a substance that is produced as part of a process that is primarily intended to produce another substance or product and that has the characteristics of an equivalent virgin product or material.
Constitution	Means the Constitution of the Republic of South Africa, 1996.
Container	Means a disposal or re-usable vessel in which waste is placed for the purposes of storing, accumulating, handling, transporting, treating or disposal of that waste, and includes bins, bin-liners and skips.
Decommissioning	In relation to waste treatment, waste transfer or waste disposal facilities, means the planning for and management and remediation of the closure of a facility that is in operation or that no longer operates;
Disposal	Means the burial, deposit, discharge, abandoning, dumping, placing or release of any waste into, or onto any land.
Domestic waste	Means waste, excluding hazardous waste, that emanates from premises that are used wholly or mainly for residential, educational, healthcare, sport or recreation purposes.
Environment	Means the surroundings within which humans exist and that are made up of- (i) The land, water and atmosphere of the earth; (ii) Micro-organisms, plant and animal life; (iii) Any part or combination of (i) and (ii) and the interrelationship among and between them; and (iv) The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.[1]
Extended producer responsibility measures	Means measures that extend a person's financial or physical responsibility for a product to the post-consumer stage of the product that includes – (a) Waste minimisation programmes (b) Financial arrangements for any fund that has been

[1] National Environmental Management Act 107 of 1998

	established to promote the reduction, re-use, recycling and recovery of waste. (c) Awareness programmes to inform the public of the impacts of waste emanating from the product on health and the environment; and (d) Any other measures to reduce the potential impact of the product on health and the environment.
General waste	Means waste that does not pose an immediate hazard or threat to health or to the environment, and includes- (a) Domestic waste; (b) Building waste and demolition waste; (c) Business waste; (d) Inert waste.
Hazardous waste	Means any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment.
Inert waste	Means waste that- (a) Does not undergo any significant physical, chemical or biological transformation after disposal; (b) Does not burn, react physically or chemically biodegrade or otherwise adversely affect any other matter or environment with which it may come into contact; and (c) Does not impact negatively on the environment, because of its pollutant content and because the toxicity of its leachate is insignificant.
Landfill	The waste body created by landfilling. This may be above or below grade, or both.[2]
Minimisation	When used in relation to waste, means the avoidance of the amount and toxicity of waste that is generated and, in the event where waste is generated, the reduction of the amount and toxicity of waste that is disposed of.
Materials Recovery Facility	A specialized plant that receives, separates and prepares recyclable materials for marketing to the end-user manufacturers. Generally there are two types of MRF's: (a) Clean MRF which accepts recyclable commingled materials that have already been separated at the source from the MSW.

[2] Department of Water Affairs and Forestry, Second Edition, 1998. Waste Management Series. Minimum Requirements for waste disposal by Landfill

	(b) Dirty MRF accepts a mixed solid waste stream and then proceeds to separate designated recyclable materials through combination of manual and mechanical sorting.[3]
Pollution	Means any change in the environment caused by- (i) Substances; (ii) Radioactive or other waves; or (iii) Noise, odours, dust or heat, emitted from any activity, including the storage or treatment of waste or substances, construction and the provision of services, whether engaged in by any person or an organ of state, where that change has an adverse effect on human health or well-being or on the composition, resilience and productivity of natural or managed ecosystem, or on materials useful to people, or will have such an effect in the future.[4]
Recovery	Means the controlled extraction of a material or the retrieval of energy from waste to produce a product.
Recycle	Means a process where waste is reclaimed for future use, which process involves the separation of waste from a waste stream for further use and the processing of that separated material as a product or raw material.
Re-use	Means to utilise articles from the waste stream again for a similar or different purpose without changing the form or properties of the articles.
Storage	Means the accumulation of waste in a manner that does not constitute treatment or disposal of that waste.
Treatment	Means any method, technique or process that is designed to- (a) Change the physical, biological or chemical character or composition of a waste; or (b) Remove, separate, concentrate or recover a hazardous or toxic component of a waste; or (c) Destroy or reduce the toxicity of a waste, in order to minimise the impact of the waste on the environment prior to further use or disposal.
Waste	Means any substance, whether or not that substance can be reduced, re-used, recycled and recovered- (a) That is surplus, unwanted, rejected, discarded, abandoned or disposed of.

[3] http://en.wikipedia.org/wiki/Materials_recovery_facility
[4] National Environmental Management Act 107 of 1998

(b) Which the generator has no further use of for the purposes of production.

(c) That must be treated or disposed of; or

(d) That is identified as a waste by the Minister by notice in the Gazette, and includes waste generated by the mining, medical or other sector, but-

(i) A by-product is not considered a waste; and

(ii) Any portion of waste, once re-used, recycled and recovered, ceases to be waste.

Acronyms

BPEO	Best Practicable Environmental Option
CSP	Concentrating Solar Panel
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
D:EA&DP	Department of Environmental Affairs and Development Planning
DEA	Department of Environmental Affairs
DWAE	Department of Water Affairs and Environment
DWAF	Department of Water Affairs and Forestry
EIA	Environmental Impact Assessment
EPR	Extended Producer Responsibility
GHG	Greenhouse Gas
H_2S	Hydrogen sulphide
I&AP	Interested and Affected Parties
IEM	Integrated Environmental Management
IPC	Integrated Pollution Control
IPWC	Integrated Pollution and Waste Control
IPWIS	Integrated Pollutant Waste Information System
IWM (P)	Integrated Waste Management (Plan)
LWMA	Listed Waste Management Activities
MRF	Materials Recovery Facility
MSW	Municipal Solid Waste
NEAS	National Environmental Authorisation System
NEMA	National Environmental Management Act 107 0f 1998
NEMWA	National Environmental Management: Waste Act 59 of 2008
NWMS	National Waste Management Strategy
OCGT	Open Cycle Gas Turbine
PCF	Prototype Carbon Fund
POPs	Persistent Organic Pollutants
SANS	South African National Standards
SAWIS	South African Waste Information System
SDP	Site Development Plan
SMME	Small, Medium and Micro Enterprise
UNFCCC	United Nations Framework Convention on Climate Change
WMO	Waste Management Officer

1 INTRODUCTION AND BACKGROUND

Increasing focus on climate change, sustainable economic growth and social development within South Africa is placing a growing demand on renewable energy supply.

Whilst South Africa relies heavily on coal to meet its energy needs, the country is well endowed with renewable energy resources that offer sustainable alternatives to fossil fuels. Renewable energy harnesses naturally occurring non-depletable sources of energy, such as solar, wind, biomass, hydro, tidal, wave, ocean current and geothermal, to produce electricity, gaseous and liquid fuels, heat or a combination of these energy types[5]. The successful use of renewable energy technology in South Africa still requires extensive investigation, however, Concentrating Solar Power (CSP) and Photovoltaic (PV) technologies have been identified as being potentially viable and capable of being employed on a large scale.

Solafrica Thermal Energy (Pty) Ltd (Solafrica) is currently assessing the feasibility of constructing two CSP plants and one PV plant including the associated infrastructure with a maximum generation capacity of 100 MW (CSPs) & 75 MW (PV) respectively. The proposed plants are required to be sited on a technically and environmentally feasible site and to this end, Solafrica has considered land availability, land use capability, fuel availability and costs, grid connection capacity and strengthening effects, and other related aspects in the consideration of feasible sites. With consideration of the aforementioned aspects, Solafrica has identified a site in the Northern Cape Province as a feasible locality for the establishment of the CSP and PV plants.

A waste assessment needs to be undertaken to be undertaken to define the nature and scale of the potential environmental impacts associated with the project, specifically in terms of the amount and type of wastes generated during construction and options to avoid and manage the wastes. Both construction and operational phase impacts will be considered and assessment of these in terms of waste management mitigation will be identified to determine whether any residual impacts can be reduced. A review of the legal requirements is also included.

2 SCOPE OF WORK

The scoping study for the waste assessment will focus on the key waste generating activities during construction, operation and site closure.

Each stream will be assessed in terms of the legislative context nationally.

Through the process of considering the various activities on site during construction and operation, waste streams will be generated. Each of these waste stream will be identified for now as part of the scoping exercise. In the

next phase these waste streams will be assessed in terms of the waste management, onsite treatment, re-use, recovery and disposal strategy.

3 ACTIVITY DESCRIPTION AND WASTE STREAM IDENTIFICATION

3.1 Construction related activity

Construction related waste will relate to:

- Excavation material
- Sanitary waste during construction (effluent and solids)
- Treatment of construction equipment waste streams (engine oils, lubricants)
- General waste (packaging, cleaning fluids)

3.2 Operational Activity

The process flow diagram for the solar plant is shown in **Figure 1**. The main activities associated with the plant are thermal storage solar field, primary solar field, generation, transmission, heat transfer fluid recirculation, heat transfer fluid conditioning.

The fundamental principle of CSP technologies is to collect the energy carried by sunrays, allowing a heat transfer fluid (HTF) to absorb the collected energy and thereby converting the thermal energy. The thermal energy bis used to raise steam which drives a turbine which in turn drives an alternator to generate electricity. The generated electricity is transmitted into the Eskom grid. PV technologies also collect energy carried by sunrays, absorbing the collected energy and converting it straight to electricity. This conversion process is made possible through the use of photovoltaic modules.

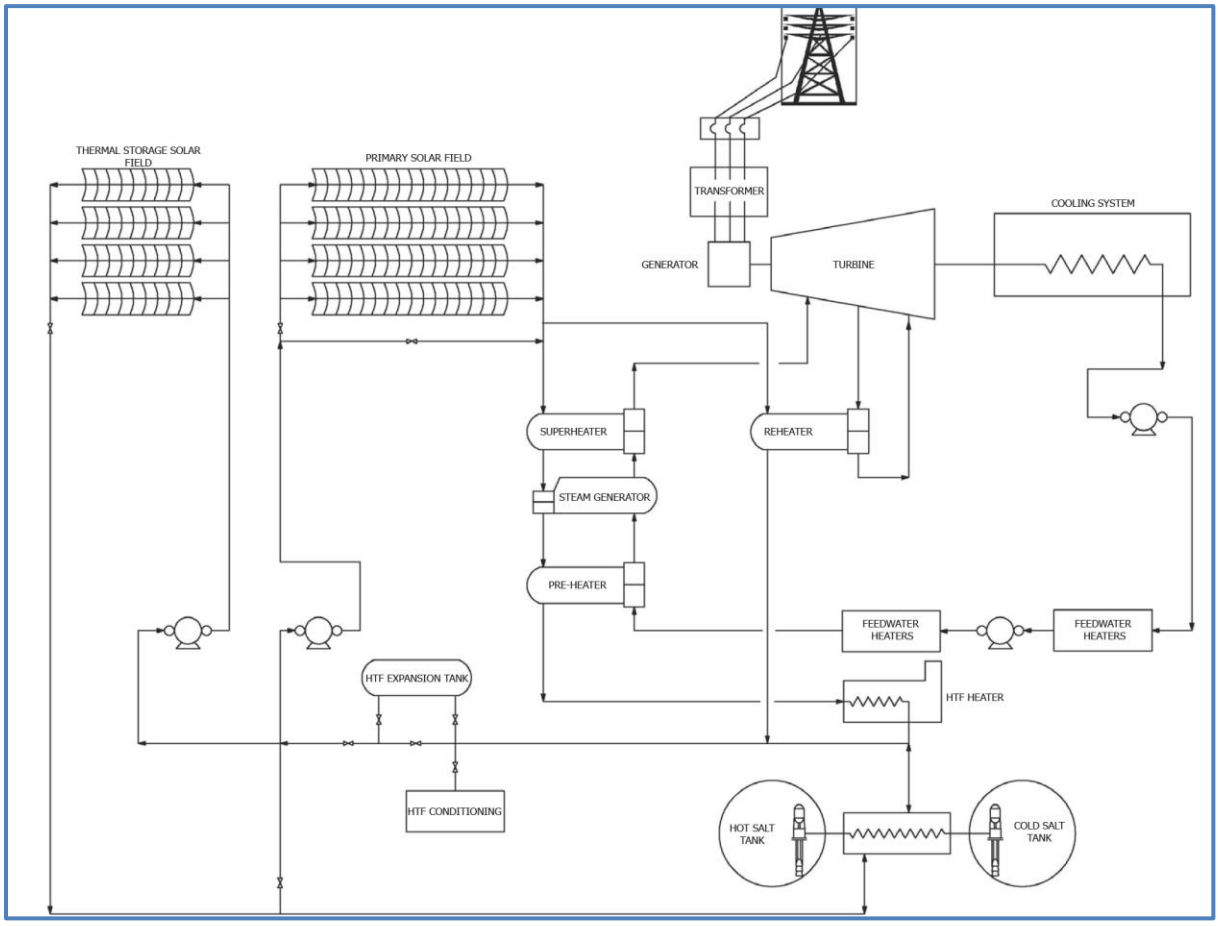

Figure 1: Process flow diagram for CSP Plant

3.3 Parabolic Trough

Parabolic trough concentrated solar thermal power (CSTP) technology uses very precise parabolic shaped, sun-tracking mirrors to concentrate and collect sunlight on thermally efficient receiver tubes running through the optical focal line of the parabolic mirror troughs. The parabolic troughs, orientated along the north-south directional plane, are designed to track the sun along one axis as it moves from east to west. A heat transfer fluid (HTF), such as synthetic thermal oil, is heated by the focused sunlight as it circulates through the receivers and is then pumped through a series of heat exchangers where thermal energy is transferred to water. This happens until the temperature of the water side of the system is heated sufficiently to generate high-pressure preheated, evaporated, and then superheated steam.

After passing through the heat exchangers and transferring the absorbed thermal heat, the cooled HTF is re-circulated through the solar field receivers to repeat the process. The heat transfer (exchange) system is a closed system resulting in the re-use of the HTF. Due to wear and tear, the HTF will require replacement and small volumes are continuously bled off with new fluid being introduced into the system.

Key waste streams

The bleed off of the HTF needs to be assessed in terms of its waste potential. The re-use of the bulk of the HTF is positive in terms of the waste management hierarchy.

The high-pressure steam is directed to a conventional Rankine-cycle steam turbine/generator set where the steam provides the energy to rotate the steam turbine and drive the generator producing electricity. The remaining steam is then transported to a condenser which cools the steam back to a liquid state. The low-pressure (spent) steam from the turbine is condensed by a cooling system as it flows through the cooling loop. After being cooled and condensed, the condensed water – or condensate - is returned to the HTF heat exchangers by feedwater pumps to again be turned into steam.

Key waste streams

Closed loop system also minimises wastage of water and energy

3.3.1 Ancillary Facilities

Ancillary facilities will be constructed to, amongst other, support the water usage requirements of the CSTP facility. The facility's annual water consumption is estimated at 975 000 m^3 for a wet cooling system and 205 000 m^3 for a dry cooling system. Raw water will be supplied from the Orange River, approximately 11 km away from the plant site through an extraction point adjacent to the Sishen-Saldanha railway bridge. The preliminary design of the abstraction system includes an open-water extraction unit, raw water settling tanks, and pipelines running along the Transnet servitude to two on-site storage tanks.

An on-site water treatment system will be used to provide the necessary quality of water for the various CSTP requirements. Water uses at the facility can be divided into the following levels based on the quality required:

- Water for the cooling system (for the case of wet cooled condenser);
- Service water for the plant, which includes all other miscellaneous uses;
- Demineralised water for make-up to the steam Rankine cycle and mirror washing and
- Potable water. The potable system will supply water to sinks, toilets, showers, drinking fountains, and emergency eyewash/safety showers.

3.3.2 Streams and Rejections

Liquid wastes that will be produced by the Thermosolar Power Plant must be collected within a separate network, with different streams according to the origin of the liquids that produce them.

According above chapter, the blowdown for cooling tower will be the main effluent of the Plant under a Wet cooled condenser solution. In addition, other effluents will appear and can be classified within the following groups:

Key waste streams

- **Effluents of the process;**
- **Residual sanitary water;**
- **Effluents that may contain oily/greasy waste; and**
- **Reject from the wastewater treatment Plant.**
- **Residual solids from water treatment plant**

3.3.3 Drainage Network System

The drainage network will be designed to allow the separation of the effluents with the aim of applying the most appropriate treatment to each one.

The basic function of the BOP drainage system is to collect all water streams that are produced during the running of the Plant and to send them to the specific treatment process according to the nature of these ones before the neutralization and homogenization pond. The neutralized waste water will be delivered in the evaporation pond finally.

The Plant's drainage system is composed of:

- Collecting networks;
- Cooling Tank for potentially hot effluent;
- Storm water basin;
- Retention basin;
- Separator of light hydrocarbons coming from the Power Island;
- Separator of hydrocarbons coming from the area of HTF and Salts;
- Neutralization and homogenization pond;

- Waste network and evaporation pond;
- Wells, manholes, drains and other typical components of a drainage network; and
- Evaporation pond.

The drainage collection network is made up of the following lines that collect reject waters according to their nature, as indicated below:

- Process blowdown (potentially hot):
    - Auxiliary boiler blowdown;
    - Deareator drainage;
    - Intermittent blowdown tank overflow;
    - PSV discharge and deareator overflow;
    - Drainage of atmospheric drainage tank from ST and BOP; and
    - High and low pressure pre-heating drainage.
- Sanitary water network:
    - Generated within the administrative building, workshop and store room; and
    - Generated within the electrical building and control room.
- Oily water network 1: rainwater containing oil or hose water used for cleaning and washing:
    - Buildings containing turbines and drainage in the condenser area;
    - Compressed air unit slab;
    - Fire protection pump room;
    - Transformer area;
    - Drainage of pavement in supply water pump area;
    - Drainage of pavement in service water pump area;
    - Drainage of pavement in make-up pump
    - Drainage of pavement in demineralized water pump; and
    - Drainage of pavement in solar field pump.
- Oily water network 2: Rainwater carrying HTF or hose water for cleaning and washing in HTF area:
    - Filter area for thermal oil;
    - Boiler pumps area;
    - Steam generation area;
    - HTF heater area;
    - Main HTF pumps area;
    - Steam generation area;
    - Basin of expansion and overflow vessels; and
    - HTF-Salt exchanger area.
- Water network
    - Water flows from the oil-separating manhole in the Transformer area;
    - Water treatment area of the Plant;
    - Pre-water treatment area of the Plant;
    - Sampling area;

- Compressed air area drainage;
- Demineralised water tank drainage and overflow;
- Service water tank drainage and overflow;
- Eye-washing showers;
- Filter cleaning;
- Chemical dosification area drainage; and
- Cleaning water from chemical bunds (without chemical concentrates).

- Collecting concentrates
  - Reverse osmosis concentrate from the demineralization line; and
  - Blowdown of the cooling circuit.

Key waste streams from the drainage network

- **Effluents from the contaminated/oily water system;**
- **Clean storm water drainage;**
- **Waste accumulating in the evaporation ponds**

3.3.4 Solid and Non-Hazardous Waste

The CSTP plant will produce maintenance and plant wastes typical of power generation operations. Generation plant wastes include: oily rags, broken and rusted metal and machine parts, defective or broken electrical materials, empty containers, and other miscellaneous solid wastes including the typical refuse generated by workers. These materials will be collected by a local waste disposal company and disposed at a landfill permitted to receive these wastes. Waste collection and disposal will be in accordance with applicable regulatory requirements to minimise health and safety effects.

Key waste streams from non hazardous solid waste

- **Miscellaneous solid waste from process;**
- **General solid waste generated by employees;**

3.3.5 Hazardous Waste

A number of hazardous wastes may be generated during the operation of the facilities. These wastes include: spent HTF, used oil, spent oil filters, spent solvents, cleaning rags, old or out of date chemicals from the water treatment system, old paints, among others.

These wastes will be temporarily stored on-site in portable tanks and disposed of in permitted hazardous landfill sites. Sites under consideration are located in Johannesburg, Port Elizabeth, and Cape Town. The disposal of hazardous materials will be carried out by a chemical cleaning contractor in accordance with applicable regulatory requirements. Workers will be trained to handle all hazardous wastes generated at the site.

Key waste streams from hazardous waste stream

- **spent HTF, used oil, spent oil filters, spent solvents, cleaning rags, old or out of date chemicals from the water treatment system, old paints**

4 LEGISLATION, STANDARDS, GUIDELINES AND CRITERIA

The waste assessment will be undertaken in terms a legal review in terms of the latest legislation as well as to achieve compliance with the requirements of the DEA. This review gives a brief overview of the pertinent sections of the respective legislation.

A. National Legislation

- Constitution of the Republic of South Africa Act 108 of 1996
- National Environmental Management Act 107 of 1998
- National Environmental Management: Waste Act 59 of 2008
- National Water Act 36 of 1998
- National Health Act 61 of 2003
- National Roads Traffic Act 93 of 1996
- Hazardous Substances Act 15 of 1973
- Occupational Health and Safety Act 85 of 1993
- National Road Traffic Act 93 of 1996

B. Other Policies, Regulations and Standards

- White Paper on Integrated Pollution and Waste Management for South Africa May, 2000

- Minimum Requirements for waste disposal by landfill, 2nd Edition DWAF, 1998
- Minimum Requirements for handling, classification and disposal of hazardous waste, 3rd Edition DWAF, 2005
- South African National Standards 10228
- National Waste Management Strategy, 2011
- SANS 10234:2007 Global Harmonised System (GHS) classification and labelling of chemicals
- NEM:WA Draft national standard for disposal of waste to landfill: Government Notice (GN) 636, Gazette No. 36784 of 23 Aug 2013
- NEM:WA Draft standard for assessment of waste for landfill disposal: GN 635, Gazette No. 36784 of 23 Aug 2013
- NEM:WA Draft waste classification and management regulations: GN 634, Gazette No. 36784 of 23 Aug 2013
- NEM:WA Draft National Norms and Standards for the Storage of Waste : GN 926, Gazette No. 37088 of 29 Nov 2013

5 OVERVIEW OF WASTE ASSESSMENT STREAMS

5.1 Process related waste streams

The key process related emissions for the central receiver and parabolic trough based systems is shown in **Figure 2** and **Figure 3** respectively.

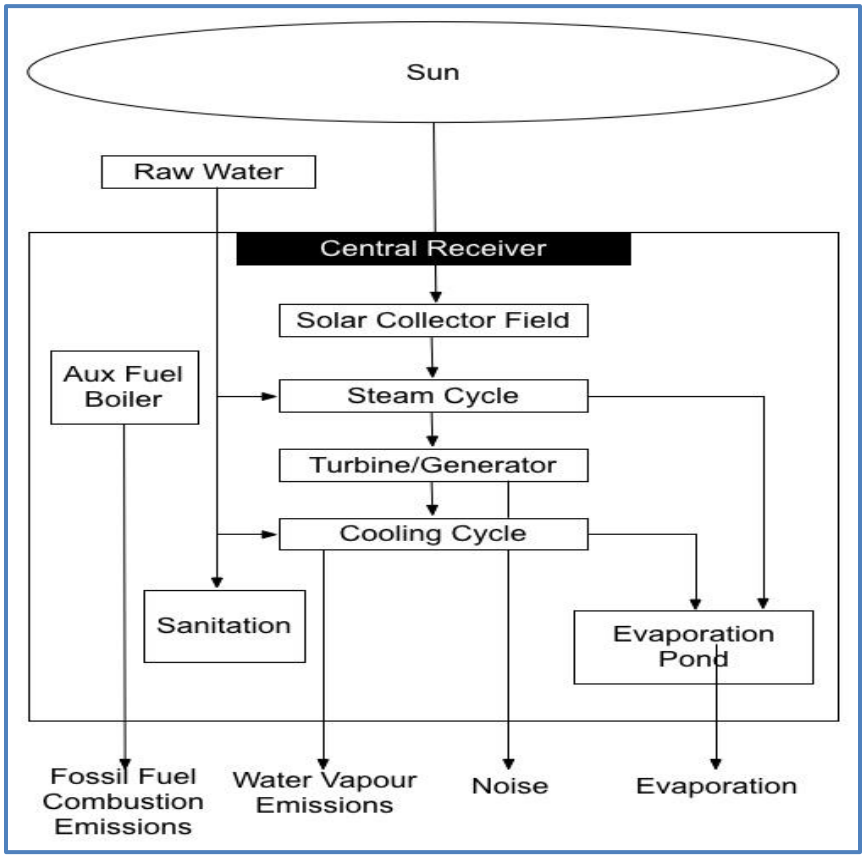

Figure 2: Key emissions Central Receiver Plant

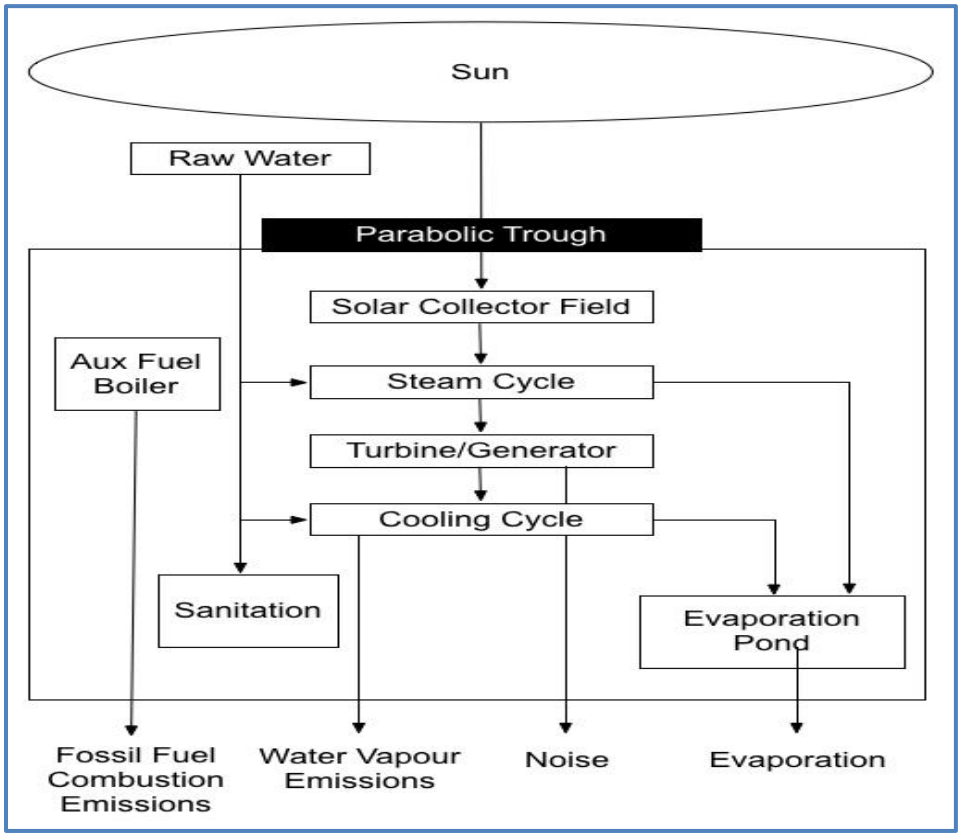

Figure 3: Key emissions from Parabolic Trough Plant

In both plants, the emissions are similar in terms of sanitation effluent, treatment plant effluent. Ultimately all solids will be classified in terms of their type for landfill disposal. The accumulation of all effluent streams will end up in the evaporation ponds. In the evaporation ponds, the pure water will be evaporated to atmosphere. The dissolved salts in the evaporation pond will increase in concentration over time. Based on the input concentrations, a proper waste assessment will be undertaken of this stream inline with legislative requirement.

Auxiliary fuel in the form of coal, oil or gas will be used. If coal is used, the ash will constitute the solid waste stream.

5.2 Summary of waste streams identified

A summary of waste streams identified is shown in Table 1.

Table 1: Summary of waste streams

Waste Streams	Source	Waste Generated
General Office Waste	Office materials / supplies	Paper Packaging
		Plastic
General Food Waste	Canteen / eating area	All food waste
Hazardous Office Waste	Office equipment	Fluorescent tubes
		Printed cartridges
		Batteries
General Site Waste	Construction materials and components	Packaging
Hazardous Site Waste	Construction and operations machinery / equipment / maintenance	Used oils / grease
		Oily rags
		Used chemicals
		Used spill clean–up kit
Other	Wastewater treatment facility	Water treatment solid waste
Evaporation ponds	Leachate	Dissolved salts and heavy metals

For each of the waste streams identified, it will be assessed in terms of its risk level and management protocol.