HESSEQUA MUNICIPALITY

RIVERSDALE ERF RE/2018

PROPOSED SOLAR PHOTOVOLTAIC PLANT WITH BATTERY ENERGY STORAGE

ELECTRICAL ENGINEERING REPORT

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Compiled for:

SILENT CHIKAMHI: MANAGER
TECHNICAL SERVICES
HESSEQUA MUNICIPALITY
1 HOSPITAL STREET
RIVERDSALE
6670

TEL: **(028) 713 8000**

Compiled by:

NEIL LYNERS AND ASSOCIATES (PTY) LTD
P O BOX 4901
TYGERVALLEY
7536

CONTACT PERSON: **Lukas van Eck**
TEL: **(021) 914 0300**
FAX: **(021) 914 0437**
Email: **lukas@lyners.co.za**

EXECUTIVE SUMMARY

This document describes the technical activities that will be necessary to establish a 10MW Solar PV with 10MWh BESS plant on ERF RE/2018 outside Riverdsale.

All the activities that are envisaged to take place on the site will be listed as well as a breakdown of how the required space will be used.

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1. INTRODUCTION

Neil Lyners and Associates (Pty) Ltd, from here on referred to as Lyners, were appointed were appointed to provide technical assistance with the Environmental Approval process for the establishment of a ground mounted Photovoltaic (PV) facility with a battery energy storage system (BESS). The PV plant requirements as set out by Hessequa Municipality is for approximately 10MW PV generation with additional BESS with a capacity of 10MWh to be added to the existing distribution network.

This PV plant will be built on an existing ERF and this report will detail the technical requirements for the project to assist the appointed EAP in determining the listed activities required to successfully construct and operate the PV plant in the most feasible way to provide energy directly into the existing distribution network that is operated by Hessequa Municipality.

It is the intention of Hessequa Municipality to appoint an engineering, procurement and construction (EPC) contractor to do the detailed design of the plant, procure materials, construct the plant and be responsible for the operation and maintenance of the plant for a multi-year period after commissioning.

2. PRELIMINARY PLANT LOCATION

The preferred site under consideration as proposed by the Municipality is erf RE/2018 adjacent to the **Eskom Intake substation for Riversdale at approximate coordinates 34.126498°S 21.241505°E.** The erf spans over an area of approximately 420ha. A proposed layout of approximately **18.5ha** was used across the gravel road from the main Eskom intake. This is ample space for the establishment of a solar plant of up to 10MW with additional 10MWh of BESS as well as the required MV Switchgear and cabling as required to facilitate the grid connection of the PV plant onto the municipal grid.

The proposed PV facility will trigger a listed activity and thus a Basic Assessment (BAR) Process because more than 1 hectare of land will be cleared.

3. SCOPE OF WORK

The full development to be constructed will consist of the following:

- A 10MW (up to 11MWp) Solar PV Plant.
- A Battery Energy Storage System with a usable (at least 4000 cycles) capacity of 10MWh consisting of containerised Lithium Ion or Redox Flow type batteries.
- LV/MV Transformer stations
- An access road and internal roads that will have a width of up to 8m including drainage on both sides of the road.
- MV cabling operating at 11kV between Substation tie-in point and plant as well as internal cabling.
- Indoor and Outdoor MV switchgear for grid tie-in point
- Fencing and Security

3.1 Solar PV Plant

The solar PV plant will consist mainly of the following components:

3.1.1 Solar PV Panels and Structures

Solar PV panels consist of several photovoltaic cells that generate a DC electrical current from the photons in light.

The panels to be used shall be reliable modules from a Tier 1 manufacturer with a proven track record in performance. All modules supplied shall be of the same type and from a single manufacturer.

The photovoltaic module technologies to be utilized can be either Monocrystalline Silicon, or Bifacial/Graphene types. The solar PV panel shall be selected to withstand the anticipated climatic conditions based on meteorological data over the past 10 years at the minimum, as well as consideration for changing climatic conditions forecasted for next 20 years.

This solar PV plant will consist mostly of solar PV panels mounted on either fixed axis structures or single axis tracking structures.

Fixed axis structures can be installed directly into the ground or using a small concrete base.

Single axis tracking structures will require additional equipment mounted on the structure to enable movement of the panels along a single axis and may require more robust structures for the additional load on the structures.

Dual axis tracking require the most complex support structures and generally have a higher levelized cost of energy value and will not be preferred for this project since preference will be given to the contractor with the best levelized cost of energy proposal.

3.2 Grid-tied and Hybrid Inverters

Inverters are power electronic devices required to convert DC electrical power to AC electrical power.

Grid-tied inverters are proposed for the PV plant section of this project. The Inverters act as a current source and follow the reference voltage of the distribution network it is connected to.

The grid-tied inverters can be mounted separately on the PV panel structures or grouped together at the MV/LV step-up transformer.

The BESS plant will however utilize hybrid inverters, which can create their own reference voltage and will be used to charge and discharge the BESS units in the plant. The hybrid inverters used for the BESS plant may be installed separately form the BESS units or as part of the BESS units.

3.3 LV cabling

DC LV cabling will be installed between the solar PV panels and grid-tied inverters using 6mm2 or larger DC cables that are fully separated (i.e. positive and negative phase separated and protected independently) The DC cables will be strung between panels on the structures and then reticulated underground through PVC sleeves where necessary. DC cabling should be rated for the conditions it will be installed in, i.e. UV rated, underground rated or both and should be rated to have a suitable insulation level for the PV strings proposed up to 1500V DC.

DC cabling can be combined using DC combiner boxes or wired directly to the inverters with DC fuses and disconnectors installed as necessary.

LV AC Cabling will be required between the inverter outputs and the transformer stations. LV AC cabling will be installed underground at depths of roughly 800mm and should be rated for the application it will be used for.

3.4 Battery Energy Storage System Plant

The BESS Plant will consist mainly of containerized Battery energy storage units. These units will store DC electrical power using electrolytic cells that can be recharged and discharged using DC electrical power.

The BESS plant will require hybrid inverters as mentioned above to facilitate the management of the charging and discharging of the BESS units. Should the inverters be installed separately from the containers, DC cabling will need to be installed between the containers and inverter stations and this will be done underground.

Two battery technologies are proposed for this project, depending on which option is the most feasible, Lithium Iron Phosphate (LiFePO4 or similar) batteries or flow type batteries (vanadium flow or similar).

Lithium batteries will be installed in pre-assembled sealed units with no on-site electrolytic installations allowed due to the high risk of fire posed by the materials. Flow batteries can be installed and filled with their respective electrolytical solutions on site due to the lower fire risk posed. No electrolytical solutions may be stored on site after assembly of the BESS units.

Should it be required fire breaks and possible fire walls may be installed between BESS units to decrease the risks of fire and to contain fires, should they occur. In addition to this all containers must be fitted with fire detection and fire suppression measures.

It is proposed that all the BESS units be installed to the South of the PV plant, to ensure that there is no shading from the BESS units on the PV plant, should it be possible to install the BESS to the Southern Side of the MV Eskom line that is crossing the site, this will be preferred.

3.5 LV/MV Transformer Stations

All the generation and energy storage inverters will output an LV Voltage. This output voltage will vary from 400Vac to 800Vac and will need to be stepped up to 11kV to tie into the existing Hessequa distribution network.

Purpose built solar transformers can be built into minusubstations or transformer stations with all the required LV and MV Switchgear necessary.

Various sizes of transformers are available, and it is proposed that sizes between 3 and 9 MVA are used and placed according to the EPC contractors suggestion.

The BESS and PV plants can share transformers if similar inverter technologies are used, but this should be part of the EPC design. Should this be implemented, less transformers and possibly cables can be installed.

3.6 Access and internal Roads

Access roads will be up to 8m in width with wide bellmouths for vehicles to turn onto the various access and service roads. Although service roads are indicated on the drawings, the final position will be determined by the EPC contractor.

Part of the 8m road width will be stormwater drainage on each side of the road that will tie into the EPC contractor's stormwater management plan.

3.7 MV Cabling

To tie into the existing MV network, MV cables and switchgear must be installed between the MV side of the Transformer stations and the existing MV distribution network of Hessequa Municipality.

These cables will be installed underground at a depth of approximately 1000mm. The final cable and routing will be done by the EPC contractor. All the internal cabling will be connected to MV switchgear to connect to combine onto larger cables capable of carrying the full 10MVA capacity of the plant to the Municipal distribution network, these larger cables may be installed deeper than 1000mm since they will be crossing a road. It is recommended that two separate cable be installed with a 10MVA capacity each to have an N-1 redundant supply to the plant.

The contractor will have the option of using PILC or XLPE type single or three core cables for the MV cables.

3.8 MV Switchgear

In addition to the MV Switchgear at each transformer station, MV Ring Main units will be required to connect combine the entire plants MV cable onto cables that will cross the public road and tie-into the municipal network.

Currently there are 3 indoor MV switchgear panels in a nearby switching station that are supplying two overhead lines that are supplying the town of Riversdale.

The contractor will have to option to tie into one of the existing overhead lines using outdoor MV RMUs similar to those proposed for the PV and BESS plant or to install 2 or more MV panels in the switchgear onto the existing 11kV switchgear board.

The overhead lines will also be upgraded by Hessequa Municipality at a later stage and this may negatively affect the outdoor switchgear option.

The Indoor switchgear option will increase redundancy and simplify control and metering of the plant compared to tying into the existing overhead lines and will be easier to configure for Eskom integration if permission for this is granted to Hessequa Municipality.

3.9 Fencing and security

Although the municipality has indicated that a fence should be installed around a large portion of the erf. It is recommended that the PV plant and BESS facility be fenced off separately for safety reasons as there are numerous types of electrical infrastructure, that should not be accessible to the general public.

A Clearvu or similar approved or steel palisade fence with a minimum height of 2.4m is proposed for this facility, with additional electric fencing, barbed wires or spikes if necessary.

The EPC contractor will have to operate and maintain the PV and BESS plant for a fixed period after construction and hence they will be responsible to install security measures or appoint a full-time service provider during this time to ensure the safety of the asset.

Should a full-time guard be present on site, small guard house with a working toilet and water source will need to be provided. Should there not be any existing water or sewerage services on site for this purpose, the EPC contractor should provide an alternative water source and a septic tank.

Any lighting that would be required must be determined by the EPC contractor.

3.10 Stormwater Management Plan

The EPC contractor will ensure stormwater is managed across the site. Natural vegetation shall be kept in place as far as possible to aid with this and all roads shall have a suitable stormwater runoff.

All roads and open spaces shall be designed in such a way that stormwater runoff is managed and if necessary, berms shall be installed to manage stormwater runoff without causing stormwater to accumulate on site or to cause erosion especially between and around all structures on site.

4. PLANNED ACTIVITES AND REQUIREMENTS

4.1 Engineering Phase

During the engineering phase of the project the appointed EPC contractor shall design the PV plant within the limits of the environmental authorization provided and will maintain a minimal presence on site.

After the engineering phase the final position of all the equipment as described above and access roads will be determined. Along with all the required designs of the plant including but not limited to the stormwater management plan, lighting risk assessment, PV plant Desing, BESS plant design, control system design, MV reticulation and grid tie-in designs.

All activities shall be done within the proposed footprint of the site, but the final positions will vary from the current layout.

4.2 Construction Phase

During construction phase all electricity and water access will be negotiated with the municipality if available.

A temporary electrical connection can be constructed from the Municipal substation or from the MV integration point, should that be implemented first.

Should a municipal water connection not be present on site, the EPC contractor should arrange for construction water as well as potable water for all staff.

Portable toilets will be acceptable on site during construction and this shall be removed after construction.

No stay-in labour camps will be established and the EPC contractor will have to appoint local labour where possible for unskilled labour and provide lodging in the nearby town of Riverdale for specialized staff, if necessary.

A portion of the site can be used for a laydown area and site office if necessary, this can also be accommodated on portions of the access road reserves, which are 15m in the preliminary layout.

4.3 Operation and Maintenance Phase

During the operations and maintenance phase the EPC contractor will be responsible for security on site as well as potable water and sanitation facilities for maintenance staff, should portable toilets be provided, they must be removed in periods that no maintenance occurs.

No staff shall stay permanently on-site for the maintenance and operation period.

5. PV PLANT FOOTRPINT CONSIDERATIONS.

It is estimated that to accommodate PV panels with a total DC power rating of up to 11MWp approximately 11 ha of space is required.

There should be additional space for the BESS plant, additional switchgear, optimal panel spacing; additional equipment; maintenance roads; spacing between any fencing and the panels and to maintain clearances from the Eskom line crossing the site hence the full 18.5ha can possibly be utilized.

Annexure A

Site A Proposed Layout