Eskom Park PV Scope of Work

1. Background

The Eskom Integrated Long Term Plan and the Eskom Corporate Plan sets up the organisation for growth and maps out a low carbon future in a post-coal environment. The plan describes Eskom's participation in renewable energy and other technologies to deliver on opportunities that will add generating capacity and in turn aid in alleviating system constraints, while also pursuing a low carbon future.

The installation of Solar Photovoltaic (PV) at the Eskom Park Offices in eMalahleni was identified as a project that could achieve these objectives. The Eskom Park complex in eMalahleni provides office space to several Eskom Divisions including Distribution, Generation and the National Transmission Company of South Africa. The impact of power outages to the complex has a detrimental impact on productivity. The entire complex has a total maximum demand of approximately 850kVA. It is intended to add one AC and one DC Electric Vehicle charging station in the near future as well as the Network Management Centre load.

It is proposed to install a grid tied hybrid Solar Photovoltaic and Battery Energy Storage system at Eskom Park, hereafter referred to as the Plant. The system will integrate into the Eskom owned electrical infrastructure supplying the complex at present.

The following approach has been proposed:

A Photovoltaic plant of 1500kW nominal capacity, occupying less than 1 ha land area. A Battery Energy Storage System (BESS) which can supply 100% of the load for up to 4 hours supported by the PV plant.

Due to the urgent need for additional generation capacity and the tight time constraints, the project must be prioritised for completion within the next 12 months.

The Plant will connect to the existing grid through MV cables that will terminate at Witbank DS substation between the Witbank DS and Eskom Park 22kV busbars through two 22kV feeder bays.

Grid connection at the PV/BESS plant will be through 4x1000kVA, 22kV/400V minisubs or 8x500kVA, 22kV/400V transformers. The scope of work for the grid connection will be to establish 2 x 22kV feeder bays at Witbank DS (one as grid feed from Witbank DS and one as load to Eskom Park). Install 2x300m 22kV cables from the Plant transformers to Witbank DS.

Two alternatives must be explored for the installation of the PV panels. The preferred solution would be to convert the existing carports to PV panel mounted structures. The alternative to consider would be to establish ground mounted frames in the open area adjacent to the substation.

2. PV/BESS Plant Description

2.1. The works comprise of the design for a PV plant of 1500kWac capacity at the Eskom Park Complex in eMalahleni, Mpumalanga.

2.2. BESS system of 7200kWh that will provide energy storage for a minimum of 4 hours for the Eskom Park complex.

2.3. The power produced by the PV and BESS plant will be stepped up to 22kV through suitable BESS compliant transformers at the generation site. The Maximum export capacity shall not exceed 75% of the rating of the minisubs / transformers.

2.4. The Grid side of the Plant will be connected to the Witbank DS substation 22kV busbar, through 1 x dedicated 22kV feeder bay. The feeder bay shall be equipped with a line VT. A suitably sized cable shall connect the 2000kVA MV/LV transformers to the feeder bay

2.5. The Load side of the Plant will be connected to the Eskom Park (Witbank DS) substation 22kV busbar, through 1 x dedicated 22kV feeder bay. A suitably sized cable shall connect the 2000kVA MV/LV transformers to the feeder bay.

2.6. The PV plant will comprise of carport mounted solar photovoltaic (PV) modules and associated infrastructure. The EPC contractor shall do an optimal design for the PV installation, including the structures to fit the panels on.

2.6.1. Option A

The exiting carport structures shall be assessed to determine the feasibility of hosting the PV panels on the existing structures.

2.6.2. Option B

Should the existing structures found to be inadequate, the proposal should include the works to replace the existing carport structures with a suitable design to serve as carports and hosting the PV panels.

2.6.3. Option C

In order to find an optimal solution, options a and b above shall be compared to a third alternative of a ground mounted solution on the vacant land adjacent to the substation.

2.7. System shall be modular to allow for future expansion should it be needed.

2.8. The Civil works shall be designed for a fully functional PV plant and to withstand the site conditions.

2.9. The Contractor provides a Plant with a minimum design life of 25 years, with minimum annual average plant guaranteed availability of 98%.

2.10. The Plant operates in an automatic mode producing electrical power for evacuation into the electrical grid/network whenever sufficient sunlight is available and is monitored and operated as per the requirements in this document. Whenever the combined generation output of the Eskom Park Plant exceeds the MV/LV transformer capacity, the plant is required to curtail automatically in accordance with the conditions set out in this document, ensuring that the combined generation output does not exceed the imposed limitation.

3. Contractor's Scope of Work

3.1. PV and BESS facility: The Contractor is responsible for surveying, studies, permitting, design, engineering, manufacture, procurement and supply of all materials and labour, delivery to site, offloading, construction, erection, installation, off-site testing, on-site testing, commissioning, performance testing, provision of samples, preparation of all detail design drawings, as-built record drawings, maintenance manuals and instructions

for the works, in accordance with the general requirements and performance requirements as detailed in this document.

3.2. The scope of work also includes the Operation and Maintenance (O&M) activities during the first two (2) years of operation. The O&M scope of work is attached in **Error! Reference source not found.** of this document.

3.3. The Contractor provides training to Eskom staff including design, construction and maintenance activities.

3.4. Medium Voltage Connection: The PV Plant will be connected to the Witbank DS substation 22kV busbar, through 2 x dedicated 22kV feeder bays (one as grid feed from Witbank DS and one as load to Eskom Park). Suitably sized cables shall connect the 2000kVA MV/LV transformers to the feeder bays.

3.4.1. Install 4x1000kVA, 22kV/400V minisubs or 8x500kVA, 22kV/400V transformers at the Plant.

3.4.2. Install suitably sized 22kV cables from the transformer to Witbank DS substation.

3.4.3. Extend Witbank DS substation.

3.4.4. Install a 22kV feeder bay at the Witbank DS 22kV busbar, including a 22kV line VT.

3.4.5. Install a second 22kV feeder bay at Witbank DS substation on the Eskom Park 22kV busbar.

3.4.6. Install a NEC on the 22kV side of the MV/LV substation to create a return path for phase to earth faults on the MV network.

4. Eskom Scope of Work

Monitor and review the project detail from Engineering, Procurement and Execution in line with Eskom’s self-build standards.

Appendix A: Concept solution

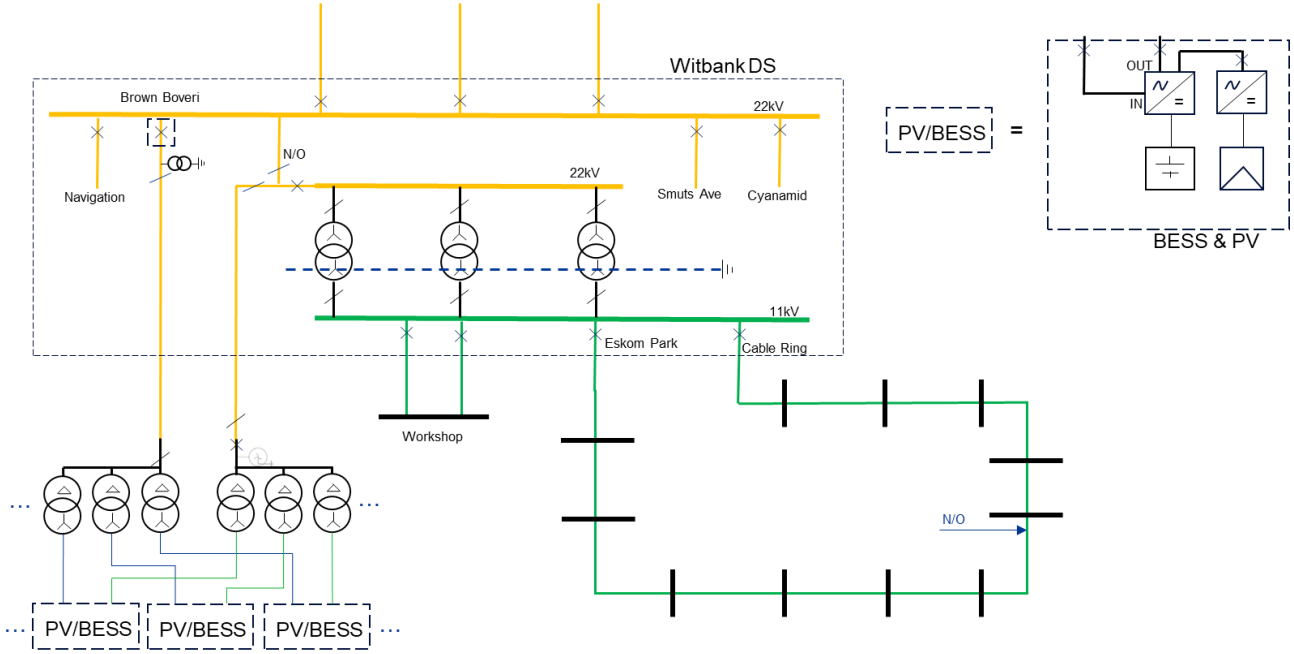

Figure 1 – Schematic diagram of concept solution

1. **Planned Operations:**
   1.1. PV/BESS will feed from 22kV busbar at Witbank DS.
   1.2. Eskom Park 22kV will feed permanently from the BESS.
   1.3. Connecting the load on the LV side of the BESS allows for rapid switch over, which will eliminate the dead start and associated inrush current.
2. **Problem Statement:**
   2.1. Utilise the existing Brown Boveri feeder bay (to be equipped/reconstructed with all primary and control plant equipment) including line VT.
   2.2. Install cable from feeder bay to PV/BESS.
   2.3. Install a second cable and minisub/transformers with recloser and NEC/R.
   2.4. Install new feeder bay at Eskom Park 22kV busbar with bypass to Witbank DS busbar.
   2.5. Remove/dismantle feeder bay between Witbank DS and Eskom Park 22kV busbars.
   2.6. Space (substation extension required) and amount of work to be done.
   2.7. Minisub/transformers not to be loaded above 75% MEC.
3. **Risk:**
   3.1. If load increases and throughput power demand exceeds rating of the MV/LV transformers and/or BESS, the entire system will trip out.