iLinge Energy Automation (Pty) Ltd

ENGINEERING DESIGN & FEASIBILITY REPORT

Grootfontein Agrovoltaic Solar Energy Facility (SEF)

11.85 MWdc / 10 MWac | Macangceni, Eastern Cape, South Africa

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Prepared for: Abantu Environmental Services (Pty) Ltd – EIA Information Request dated 03 June 2026

Submitted by: iLinge Energy Automation (Pty) Ltd | 2059 NU 9 Mdantsane, East London, 5219

1. PROJECT OVERVIEW

The Grootfontein Agrovoltaic Solar Energy Facility (SEF) is a grid-connected photovoltaic (PV) power plant designed to generate up to 10 MWac of clean electricity at the point of injection into the Eskom distribution network. The project incorporates an agrovoltaic design philosophy, allowing for compatible agricultural activities beneath and between the PV array rows.

Parameter	Detail
Project Name	Grootfontein Agrovoltaic Solar Energy Facility (SEF)
Project Location	Macangceni, Eastern Cape, South Africa
Coordinates (approx.)	Latitude: 31.4474°S | Longitude: 27.7331°E
Altitude	1,429 m above mean sea level
Installed DC Capacity	11.85 MWdc (11,832 kWp nominal STC)
Grid Connection Capacity	10 MWac
DC:AC Ratio	1.18
Project Type	Grid-Connected, Agrovoltaic PV Plant
Grid Connection	Eskom Macangceni Switching Station via IPP Switching Station at 22 kV
Simulation Tool	PVsyst V8.1.2 | Simulation date: 05 June 2026
Prepared by	iLinge Energy Automation (Pty) Ltd
Document Status	Rev 00 – For EIA Submission

2. SITE DESCRIPTION & LAYOUT

2.1 Site Location

The project site is located at Macangceni in the Eastern Cape Province of South Africa, within the jurisdiction of the Enoch Mgijima Local Municipality. The site is predominantly open agricultural land, consistent with the agrovoltaic project concept. The terrain is gently undulating at an altitude of approximately 1,429 m AMSL.

2.2 Site Layout

The site layout diagram below shows the principal infrastructure components of the SEF, including the PV array field boundary (11.85 MWdc), the O&M building, the IPP Switching Station, the interface with the existing Eskom Macangceni Switching Station, and the 22 kV MV cable route from the array to the switching station.



Figure 1: Grootfontein SEF Site Layout – 11.85 MWdc / 10 MWac (Source: iLinge Energy Automation, 2026)

2.3 Key Site Infrastructure

Infrastructure Element	Description
PV Array Field	11.85 MWdc enclosed within the blue boundary polygon. Single-axis horizontal E-W tracker configuration.
O&M Building	Located at the southern edge of the array field, adjacent to the IPP Switching Station. Houses inverter control, SCADA, and maintenance facilities.
IPP Switching Station	On-site IPP-owned 22 kV switching station providing grid isolation, protection and metering for the SEF.
Eskom Macangceni SS	Eskom 22 kV switching station located at the site access road. Point of Common Coupling (PCC) for the project.
22 kV MV Cable	Underground 22 kV MV cable (shown in red) connecting the PV array output to the IPP Switching Station, then to the Macangceni SS.
Eskom 22 kV OHL	Eskom 22 kV overhead line (OHL) connecting the Macangceni SS to the Cala Substation – grid export route.
Internal Access Road	Gravel internal access road circling the site for maintenance vehicle access and security patrol.
Agrovoltaic Buffer Zone	Clearance maintained between rows to allow compatible agricultural activities (grazing, low crops).

3. PV SYSTEM TECHNICAL DESIGN

3.1 PV Array Configuration

Parameter	Value
PV Module	Generic TSM-DE21-665 (Original PVsyst database)
Module Nominal Power (STC)	665 Wp
Total Number of Modules	17,793 units
String Configuration	659 strings x 27 modules in series
Total PV Nominal Power	11,832 kWp (11.83 MWp) at STC
Tracker Type	Single-axis, horizontal East-West axis tracking
Tracker Tilt Range	-/+ 55° from horizontal
Tracker Algorithm	Astronomic calculation (sun-position based)
Diffuse Shading Treatment	Automatic (diffuse shading included)
Total Module Area	55,271 m²
Total Cell Area	51,788 m²
Module Efficiency at STC	21.42%

3.2 Inverter Configuration

Parameter	Value
Inverter Model	Generic SG250-HX (Original PVsyst database)
Inverter Unit Power	250 kWac per unit
Number of Inverters	40 units
Total Inverter AC Power	10,000 kWac (10 MWac)
Operating DC Voltage Range	500 – 1,450 V
DC:AC Pnom Ratio	1.18
Inverter Configuration	Group 1: 21 inverters (5,250 kVA) | Group 2: 19 inverters (4,750 kVA)
Power Sharing	Shared within inverter groups

3.3 Grid Connection Design

Parameter	Value
Grid Voltage	22 kV (Eskom MV distribution network)
Connection Point	Eskom Macangceni Switching Station
IPP Interface	IPP-owned 22 kV switching station on-site
MV Cable	22 kV underground MV cable from array to switching station
Overhead Line	Eskom 22 kV OHL: Macangceni SS to Cala Substation
Protection Philosophy	MV overcurrent, earth fault, and loss-of-mains protection per NRS 097 / NRS 048
Metering	Revenue-grade metering at point of common coupling (PCC)

SCADA / Telemetry	Remote monitoring and control via SCADA connected to ESKOM SCADA system

4. ENERGY YIELD ASSESSMENT

4.1 Simulation Parameters

Parameter	Value
Simulation Software	PVsyst V8.1.2
Simulation Mode	Grid-Connected, Hourly simulation step
Weather Data Source	Meteonorm 9.0 dll, Sat=100% – Synthetic data
Weather Data Type	Monthly averages, Synthetic multi-year average
Albedo	0.20 (standard for natural grass/agricultural land)
Global Horizontal Irradiation (GHI)	1,808.3 kWh/m²/year
Global Incident (Collector Plane)	2,243.1 kWh/m²/year
Annual Average Ambient Temp	14.20 °C

4.2 Annual Energy Production Summary

Parameter	Value
P50 Annual Production	21,955,968 kWh/year (21.96 GWh/year)
P90 Annual Production	21,128,109 kWh/year (21.13 GWh/year)
P95 Annual Production	20,895,182 kWh/year (20.90 GWh/year)
Specific Production (P50)	1,856 kWh/kWp/year
Specific Production (P90)	1,786 kWh/kWp/year
Specific Production (P95)	1,766 kWh/kWp/year
Performance Ratio (PR)	82.72%
Global Variability (P50–P90)	2.9% (weather data + system uncertainty)

4.3 Monthly Energy Production

Month	GlobHor (kWh/m²)	DiffHor (kWh/m²)	T_Amb (°C)	GlobInc (kWh/m²)	EArray (kWh)	E_Grid (kWh)	PR (ratio)
January	190.8	76.92	18.37	197.6	1,932,226	1,902,978	0.814
February	157.4	68.50	18.35	164.2	1,614,491	1,588,967	0.818
March	156.1	63.10	17.24	175.1	1,711,820	1,684,914	0.813
April	123.7	44.81	14.23	165.1	1,641,680	1,617,578	0.828
May	110.5	32.47	12.03	182.3	1,836,581	1,813,514	0.841
June	97.2	22.38	9.41	182.2	1,853,596	1,830,907	0.849
July	108.7	26.93	8.72	190.4	1,926,379	1,902,650	0.845
August	133.4	34.97	10.84	195.2	1,949,365	1,924,320	0.833
September	162.6	45.88	13.25	197.1	1,916,386	1,890,008	0.811
October	184.9	69.21	14.76	196.3	1,940,309	1,912,420	0.823
November	187.1	75.68	15.96	193.6	1,928,794	1,899,590	0.829

Month	GlobHor (kWh/m²)	DiffHor (kWh/m²)	T_Amb (°C)	GlobInc (kWh/m²)	EArray (kWh)	E_Grid (kWh)	PR (ratio)
December	195.7	83.99	17.47	204.1	2,018,038	1,988,121	0.823
YEAR	**1,808.3**	**644.84**	**14.20**	**2,243.1**	**22,269,665**	**21,955,968**	**0.827**

4.4 System Losses Analysis

The following losses were identified in the PVsyst simulation loss diagram:

Loss Component	Value / Notes
Global Horizontal → Collector Plane gain	+24.0% (tracker benefit – E-W axis tracking)
IAM Factor Loss	-1.83%
PV Loss due to Irradiance Level	-0.46%
PV Loss due to Temperature	-6.86% (operating at 50°C NOCT conditions)
Module Quality Loss	+0.37% (positive module tolerance)
Module Array Mismatch Loss	-2.00%
Ohmic Wiring Loss	-1.20% (DC wiring at 1.5% STC)
Inverter Loss – Efficiency	-1.33%
Inverter Loss – Over Nominal Power	-3.79% (due to DC:AC ratio of 1.18)
Inverter Loss – Max. Input Current	-1.52%
Night Consumption	0.00%

5. CIVIL & STRUCTURAL DESIGN

5.1 General Civil Scope

The following civil and structural works are associated with the Grootfontein SEF:

- Site clearing and grading limited to access roads and building pads to minimise land disturbance
- Driven or screw-pile foundations for single-axis tracker structures (no concrete excavations required for array structure)
- Concrete strip or pad foundations for the O&M building and IPP Switching Station
- Gravel internal access road (5 m wide) encircling the site perimeter for maintenance and security access
- Cable trench excavation for underground 22 kV MV cable route from array to IPP SS
- Stormwater drainage channels at site perimeter and access road interfaces
- Security perimeter fencing (2.4 m palisade or electrified game fence) with access control gate

5.2 Tracker Foundation Design

Parameter	Detail
Foundation Type	Driven steel H-pile or screw pile
Pile Material	Galvanised steel, minimum 40 micron hot-dip galvanising
Pile Embedment Depth	1.5 – 2.0 m depending on local soil bearing capacity
Row Spacing (North-South)	As per shadow analysis – minimum row pitch determined by tracker geometry and ±55° rotation

Post Spacing (E-W)	Approx. 5.0 – 8.0 m on-centre (structural span dependent on module layout)
Wind Design	Design wind speed per SANS 10160-3 for Eastern Cape coastal escarpment zone. Stow position at >12 m/s wind speed.
Geotechnical Survey	Geotechnical investigation to be conducted prior to detailed design to confirm pile type and embedment depth

5.3 O&M Building

Parameter	Detail
Building Type	Prefabricated steel or masonry construction
Floor Area	Approximately 120 – 180 m² (to be confirmed at detailed design)
Contents	Control room, SCADA workstation, inverter monitoring, LV distribution, battery room (UPS), ablution facilities, tool store, first aid room
Construction Standard	SANS 10400 compliant, OHS Act compliant

6. ELECTRICAL INFRASTRUCTURE

6.1 DC Side

Parameter	Detail
String Configuration	17,793 modules in 659 strings of 27 modules in series
DC String Voltage at MPP	934 V (at 50°C operating conditions)
DC String Current at MPP	11,598 A (total array)
String Combiners (SCBs)	String combiner boxes per sub-array, with fuse protection and monitoring per string
DC Cabling	DC string cables: 6 mm² or 10 mm² PV cable (TÜV-certified, UV-resistant, per IEC 62930)
DC Surge Protection	Type II SPD at SCB level, Type II at inverter DC input per IEC 61643
Earthing (DC)	Floating DC system with insulation monitoring device (IMD) per IEC 62109

6.2 AC Side (LV – Inverter Output to MV Transformer)

Parameter	Detail
Inverter Output Voltage	400 V / 3-phase (to be confirmed per SG250-HX datasheet)
AC Cabling	3-core XLPE armoured cable per inverter to AC collection board
AC Distribution Board	MV/LV transformer input board with protection per NRS 097
Step-Up Transformer	400 V / 22 kV pad-mounted or containerised transformer(s)
Transformer Rating	Sized for 10,000 kVA total capacity, split across inverter groups
Transformer Type	Oil-immersed ONAN or ONAF; SANS 780 compliant
AC Surge Protection	Type II SPD at inverter AC output, Type I at MV transformer LV terminals

6.3 MV Grid Connection (22 kV)

Parameter	Detail
MV Voltage	22 kV (Eskom distribution network)
MV Cable	Underground 3-core 22 kV XLPE cable (Eskom-approved type) from IPP SS to Macangceni SS
Cable Route	As shown in Figure 1 – follows internal road corridor to minimise land disturbance
IPP Switching Station	22 kV switchgear bay including: main incoming breaker, protection relays (overcurrent, earth fault, ROCOF, vector shift), metering CT/VT, isolation, earthing switch
Protection Relays	Per NRS 097-2-1 and Eskom distribution code. Minimum: IDMT overcurrent, directional earth fault, loss-of-mains (ROCOF/vector shift)
Revenue Metering	Class 0.5 revenue meter at PCC (Macangceni SS), compliant with NRS 057
SCADA Telemetry	IEC 61850 or DNP3 communication to Eskom distribution SCADA

7. AFFECTED PROPERTY INFORMATION

The following property information is provided to the extent available at this stage of the EIA process. Detailed cadastral verification, 21-digit SG codes, and title deed copies are to be obtained from the Deeds Office / Surveyor-General as part of the EIA process. iLinge Energy Automation will submit these upon receipt.

Item	Detail
Farm / Erf Name	Grootfontein (and associated farm portions)
Municipality	Enoch Mgijima Local Municipality, Chris Hani District Municipality, Eastern Cape Province
Magisterial District	Queenstown (Komani)
Approximate Farm Locality	Macangceni, Eastern Cape | ~31.45°S, 27.73°E
Land Use (Current)	Agricultural / Grazing land
Proposed Land Use	Agrovoltaic Solar Energy Facility (compatible with existing agricultural use)
SG Code (21-Digit)	To be confirmed – Surveyor-General records to be provided under separate cover
Title Deed	To be provided under separate cover upon receipt from Deeds Office (Registrar: King William's Town)
Erf / Farm Portion Numbers	To be confirmed and submitted as supplementary information to this EIA submission

NOTE: iLinge Energy Automation (Pty) Ltd undertakes to provide certified copies of all relevant title deeds, surveyor-general diagrams, and 21-digit SG codes as a supplementary submission to Abantu Environmental Services within 10 (ten) working days of this report.

8. ENVIRONMENTAL & AGROVOLTAIC CONSIDERATIONS

8.1 Agrovoltaic Design Principles

The Grootfontein SEF is designed as an agrovoltaic facility, integrating solar energy generation with continued agricultural use of the land. The following design principles apply:

- Tracker row spacing is designed to allow sufficient light penetration and equipment access for low-intensity grazing or compatible crop cultivation between rows
- No permanent structures are installed outside the O&M building and switching station pads — tracker foundations are driven piles with minimal land disturbance
- Stormwater management design ensures no increased runoff to adjacent land
- No indigenous vegetation clearing is anticipated — site is established agricultural land
- Fencing and access control maintains site security while allowing wildlife movement through appropriately designed fence sections if required by EIA/EMP conditions

8.2 Construction Environmental Management

- Construction Environmental Management Plan (CEMP) to be developed prior to construction commencement
- Dust suppression on access roads and construction areas
- Topsoil stockpiling and rehabilitation of any disturbed areas
- Waste management plan for construction waste (cables, packaging, concrete off cuts)
- No hazardous substance storage on-site during construction except as per OHSA regulations

8.3 Operational Environmental Management

- Vegetation management (mowing/grazing) to maintain ground cover and prevent shading
- PV module cleaning using approved cleaning agents, collected wastewater disposed of per EMP requirements
- Transformer oil secondary containment bunding per SANS 10108 and NRS 048
- Emergency Response Plan (ERP) addressing fire, oil spill, and electrical emergency scenarios

9. DOCUMENT LIST – EIA SUBMISSION PACKAGE

The following documents are submitted or will be submitted to Abantu Environmental Services in response to the EIA Information Request dated 03 June 2026:

No.	Document Title	Reference / Source	Status
1	Engineering Design & Feasibility Report (this document)	iLEA-GRT-ENG-RPT-001	Submitted
2	PVsyst Simulation Report – Grootfontein 10 MWac	PVsyst V8.1.2, 05/06/2026	Submitted
3	Site Layout Drawing – 11.85 MWdc / 10 MWac	iLEA-GRT-DWG-001	Submitted
4	Single-Line Diagram – PV System	PVsyst SLD (PVsyst V8.1.2)	Submitted
5	Affected Farm / Erf Cadastral Information & 21-Digit SG Codes	Surveyor-General / Deeds Office	Pending – within 10 days
6	Title Deeds of Affected Properties	Deeds Office – King William's Town	Pending – within 10 days
7	Geotechnical Investigation Report	Third-party geotechnical consultant	Pending – to be commissioned

No.	Document Title	Reference / Source	Status
8	Environmental Impact Assessment Specialist Studies	Abantu Environmental Services	In progress
9	Heritage Impact Assessment	To be appointed	To be commissioned
10	Visual Impact Assessment	To be appointed	To be commissioned

10. DECLARATION & SIGN-OFF

This Engineering Design and Feasibility Report has been prepared in good faith by iLinge Energy Automation (Pty) Ltd and represents, to the best of the preparer's knowledge, an accurate technical description of the Grootfontein Agrovoltaic Solar Energy Facility as currently designed. The information contained herein is based on the PVsyst simulation model and conceptual design drawings and is subject to revision as detailed design progresses.

Submitted by: iLinge Energy Automation (Pty) Ltd

2059 NU 9 Mdantsane | East London, 5219 | Eastern Cape, South Africa

Signature: _____ Date: _____

Name: _____ Designation: _____

Prepared for: Abantu Environmental Services (Pty) Ltd | 41 Avon Place, Overbaakens, Gqeberha, 6070

EIA Information Request dated: 03 June 2026 | Re: Grootfontein Agrovoltaic 10 MWac SEF EIA (including Macangceni Switching Station and Overhead Power Line to Cala Substation)