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HOLLAND AND ASSOCIATES ENVIRONMENTAL CONSULTANTS
ATTENTION: Ms Anja Albertyn
Environmental Assessment Practitioner

20 June 2022

Dear Madam,

CONFIRMATION OF PAARDE VALLEY PV2'S INTENT TO COMMISSION THE COMPILATION OF A GEOTECHNICAL STUDY FOR THE PROPOSED GRIDLINE CONNECTION AND ASSOCIATED INFRASTRUCTURE IN DE AAR, NORTHERN CAPE.

We refer to the aforementioned and advise as follows:

A Screening tool report was generated for the proposed gridline which will connect the authorised Paarde Valley PV2 Solar Energy Facility to the proposed Vetlaagte Main Transmission Substation. In response to the required Geotechnical study identified by the Screening tool report, a Site Sensitivity Verification report was compiled and stated that a geotechnical study will be commissioned once the Applicant is awarded Preferred Bidder status.

Paarde Valley PV2 is in the process of finalising the required scope in order for a Geotechnical Scope and Requests for Proposals to be circulated to qualified service providers. In addition, the Project is engaging with Eskom to ensure the design and data of the study is correctly captured in order to meet Eskom's Self Build design standards as the substations and powerline design and underlying studies will be handed back to Eskom once commissioned.

We trust the aforementioned provides you with clarity. If you have any questions or require further clarification, please do not hesitate to contact our offices.

Kind regards

Warren Morse
Authorised Representative
Paarde Valley PV2 (PTY) LTD



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**Proposal for Geotechnical Technical Advisory
– Geotechnical Investigation**

CE2022-090

Rev0 7 June 2022

**Understanding the
Project Requirements**



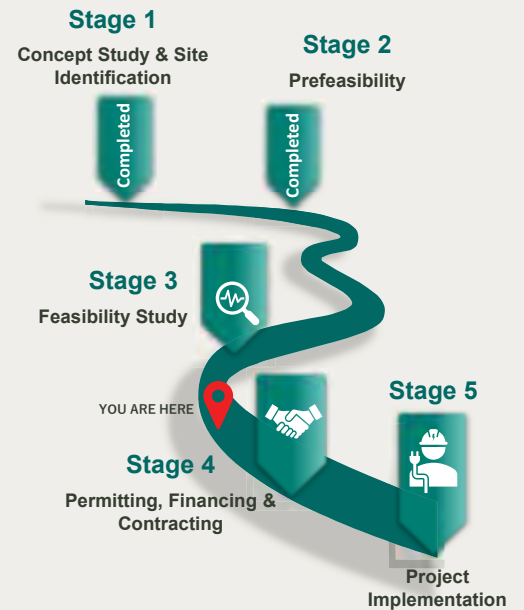
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► Understanding the Project Requirements

Thank you for the meeting held on Monday 6th June via Teams.

Paarde Valley PV2 has requested Zutari to provide geotechnical technical advisory services. It is understood that the developer typically in the past has procured geotechnical investigations for preliminary project stages. The need is for geotechnical advice related to geotechnical investigations (GI) for detailed design for Solar PV projects.

1. The Developer has identified an opportunity for developing a generic type Geotechnical Investigation Specification document which will form a base document for Geotechnical Investigations. The scoping for a Geotechnical Investigation is site specific driven by available information, past investigations and the ground conditions expected at the site and associated ground risks. This document will include all aspects that could potentially be included in a GI for solar PV outlining project specific details for inclusion and to be scoped by a geotechnical professional for each site. This document will standardize the approach to GI and mitigate rework for each project in relation to creation of GI specifications and BoQ's.
2. The second component of the scope is to provide a scope, specification and BoQ for the geotechnical investigation for the Paarde Valley PV2 site. It is understood that Zutari may undertake the Detailed Design and the scoping of the GI will mitigate risk to the design in ensuring the correct information is acquired and received from the GI works for detailed design and construction.



► Understanding the Project Requirements

Understanding of site for Scope 2

Paarde Valley PV 2 Solar project

The proposed development for the solar project is Paarde Valley PV 2 solar facility located north of De Aar adjacent to the existing Mulilo De Aar 10MW Solar Plant. Zutari was appointed for the Hydra Solar Project to the west of De Aar.

Paarde Valley Solar PV2 project

De Aar MW Solar plant



Hydra Solar project



Approach and Methodology

Geotechnical

ZUTARI

Our value add to the project

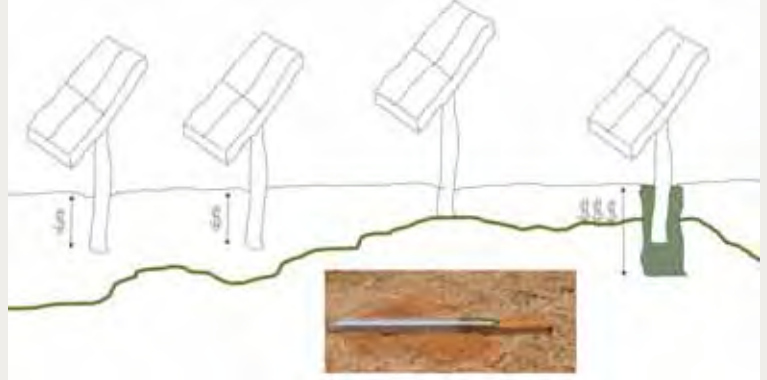
The Zutari team possess the following key strengths and will provide the best value for this project:

- Zutari has an extensive track record with solar farm projects.
- Our geotechnical service offering covers the entire life cycle of a solar project from initial remote studies, field investigation, preliminary and detailed design, specialist site supervision and monitoring and design review. We have worked on over 28 No. solar farm projects totalling over 2.5 GW.
- We have extensive experience working in complex environments and designing the best solutions for our clients for the complex ground conditions anticipated at the site.
- Zutari brings value to the project through our balance of engineering geologists and geotechnical engineers. The interlinked working of the two disciplines brings immense value in the interpretation of ground conditions, drivers for design and the development of the best solutions.
- We bring eminent extensive geotechnical expertise to the project with our Senior Geotechnical Engineer having developed a guideline on derisking solar PV projects from a ground perspective.
- Zutari utilises advanced numerical modelling capability to understand complex environments and ground conditions and develop ground solutions that best manage our client's ground risk.
- Zutari will utilise digital capture of all geotechnical data, this will include capture of the existing geotechnical information and create a geological model of the site using LeapFrog software. This will give the client a 3D view and understanding of the geology of the project site. This allows informed design and construction decisions to be made.
- We have a experience with the local ground conditions.
- We have extensive experience in managing geotechnical investigations and interfacing with many stakeholders.

Approach and Methodology

Economy of scale drives foundations for PV structures where ease and time of installation and foundation pile length are important in ensuring a commercially viable project. Ground conditions and the associated risks to foundation design and installation for solar PV power plant projects continue to pose a large cost risk to developers and contractors.

A change in foundation installation type is often required due to refusal of driven piles, shallow bedrock or soft conditions. This change impacts construction cost where for instance a change from driven to predrilled pile foundations can be in the order of 3x the cost of the originally intended driven pile solution. This has not only cost but programme implications to the project.



Approach and Methodology

A high level of uncertainty exists at the beginning stages of the project and the developer incurs cost to address the relevant uncertainties at each stage. The incurred cost in the early stages is often incurred at risk. Ground investigations undertaken in the early stages of the project are required to inform preliminary foundation design which is used for tender.

A founding solution best suited for the perceived ground conditions is designed for and the potential variability assessed to determine the percentage allowance to be made for any alternative founding solutions due to a change in ground conditions. The ground information available at tender influences the level of ground risk the EPC Contractor is required to carry into construction. This can result in elevated construction prices and potential claims. Detailed Design is undertaken after tender where an optimisation in founding solution and pile length is strived for. The ground risk also relates to the cable design and sizing.

The approach to when the ground investigation is undertaken and what this comprises of is very important to ensure its value to understanding potential ground risks at critical stages of the project.



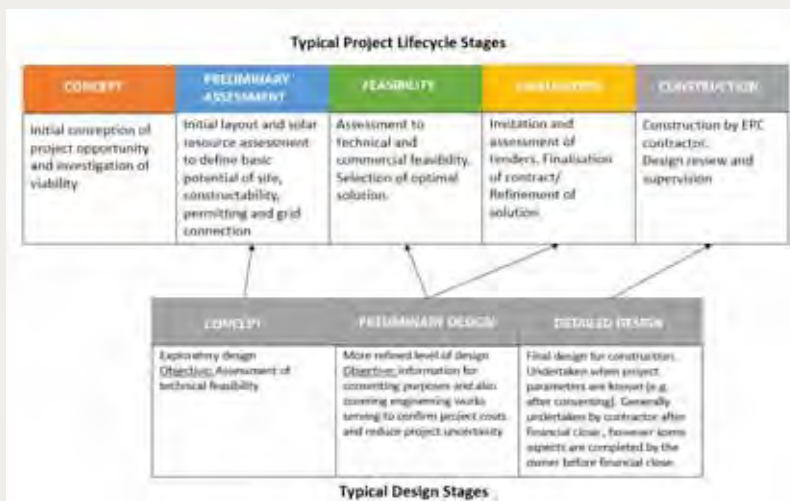
Approach and Methodology

The key to managing ground and foundation risk is:

1. Understanding of what ground risks could occur
2. Apply a structured targeted approach throughout project lifecycle to address ground risks and allow an optimised foundation design to be developed

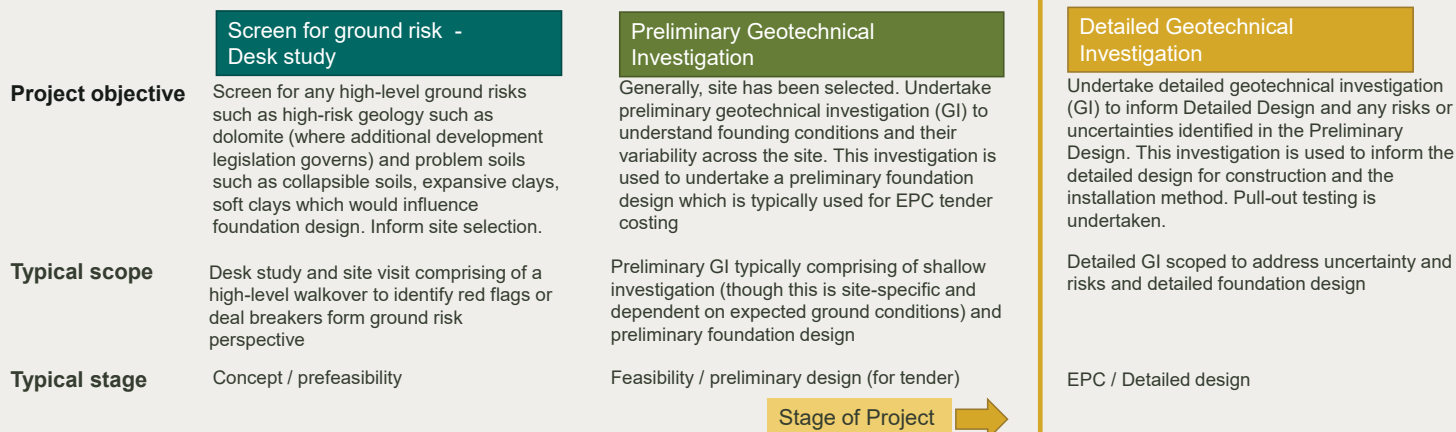
This is applied through the methodology developed by Zutari Ground Engineering. The method and approach has been based on extensive experience on many solar PV projects. The methodology is to map out ground risks and guide the approach throughout the project cycle.

The project lifecycle stages and design stages are summarised alongside. In general, the design stages will typically be undertaken in the project development lifecycle stages as shown alongside however this is project dependent.



Approach and Methodology

- The assessment required to understand ground risks at each stage of the project is tailored to balance technical risk to cost to allow a decision to be made on feasibility and viability of the site from a foundation solution and ground risk perspective.
- The following are typically the stages for geotechnical studies required along the project cycle to understand ground risk and inform preliminary and detailed foundation design. These descriptions are general and could change with project-specific requirements and development stages. The requirements at each stage are to reduce uncertainty balanced by spend at each project stage.



Drivers for foundation design and ground risk



- Depending on the MW of the plant, solar PV plants comprise of some 40,000 to 80,000 No. foundations.
- Solar PV structures are lightly loaded compared with more conventional structures and result in shallow foundations (dependent on the geology of the underlying area).
- However because of economy of scale this results in every 0.1m of length of foundation adding cost to the project.
- Solar PV foundations are driven by the shallow ground profile, and uplift and lateral loads due to wind are generally the driving design case.
- The foundation design and understanding of ground risks is thus driven by:
 - Nature of the material
 - Ground water level
 - Potential corrosivity of the material
 - Stiffness and material consistency with depth
 - Shallow rock and rock outcrops
 - Areas subject to flooding
 - Erodibility of material,
 - The stiffness and variability of the material with depth and spatially, and the
 - Occurrence of problems soils such as highly expansive, soft clays, collapsible soil, dolomite etc.
- These factors all influence the type of foundation and installation required for each project site as well as the risk of a number of foundation types and installation methods being required due to variability in ground conditions across the site. In addition, they influence electrical design such as cable sizing, trenching etc. This all influences the construction cost.

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Geotechnical Investigation scope

A Geotechnical Investigation is scoped to assess:

- Ground water level
- Potential corrosivity of the material
- Stiffness and material consistency with depth
- Shallow rock and rock outcrops
- Erodibility of material
- The stiffness and variability of the material with depth and spatially, and the
- Occurrence of problems soils such as highly expansive, soft clays, collapsible soil, dolomite etc.

Each scope is different for each site as the ground conditions and ground risks differ. In addition, the GI scope is different for each stage of the project as it is scoped and structured to address risk reduction and value creation aligned with the project stage.

For Detailed Design stage, the GI aims to provide a deeper understanding of the site-specific ground conditions required to determine the most appropriate and suitable foundation design for the site and build in allowance for any potential variability to occur in construction. An understanding of the ground risks and potential variability on the site is important at this stage.

The scope also considers available information and previous investigations on a site and aims to use this information to optimize testing and test locations.

A poorly scope geotechnical investigation at any stage of a project will ultimately result in greater costs incurred later in the project either through elevated tender costing to account for uncertainty and risk or costly foundation changes during construction due to change in ground conditions to those assumed during tender which impact programme.

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► Scope 1 – Generic-type Geotechnical Investigation Specification

Zutari will create a generic type Geotechnical investigation Specification.

This will detail methods and tests typically applied for solar PV projects, highlighting where site-specific criteria need to be “inputted”.

It will provide one concise document that forms a template for specification for geotechnical investigations for Solar PV developments. A generic BoQ will be provided to be populated per project.

Scoping of a GI per site will need to be undertaken by a professional Geotechnical practitioner (Geotechnical engineer / engineering geologist) and quantities and scope applied to this generic specification per site.

The generic specification will assist to streamline process and efficiency negating the need to create a new GI specification per project as the template is used as a base standardising process. It also ensures methods and tests related to best practise are included. This will include requirements for ESKOM overhead lines, substations etc.

Deliverable: Geotechnical Investigation Specification and BoQ

► Scope 2 – Geotechnical Investigation Scope and Specification for Paarde Valley PV 2 solar project

It is understood that no intrusive geotechnical investigation works have been undertaken on the site.

The available information for the neighbouring site will be reviewed to understand expected ground conditions and a desk study will be undertaken for the site considering expected geology.

The following information is available for De Aar 10MW Solar Plant adjacent to the site.

- Geotechnical Report for design De Aar Solar Park, Report prepared by ABB South Africa by GCS Consulting, February 2013, Report No. GCS-RP/0010/2013.
- Gestamp Solar, De Aar Site – Preliminary Report on Geotechnical Investigation, Report prepared for Gestamp Solar South Africa, Report No. 447966/1, SRK Consulting, May 2012.
- Test Report, Prieska 20MW ABB & De Aar 10MW ABB, Ground Screw Pull Out Test, Powerway Renewable Energy Co. Ltd, 31/05/2013
- TE REN OPS, Appendix E1, Grid Interconnection Philosophy, Paarde Valley PV2 Solar Energy Facility, 30/05/2022
- Powerway Renewable Energy South Africa, Foundation Design and Calculation Report for ABB South Africa, Mulilo Renewable Energy Solar PV De Aar Park Project, Version V1.4
- Powerway Renewable Energy South Africa, Powerway Ground Screw Pull Out Test Report, ABB De Aar 10 MW Solar Project, 03/08/2013
- Rocklab Report, 24 April 2013, for SRK Consulting



De Aar 10MW solar plant

► Scope 2 – Geotechnical Investigation Scope and Specification for Paarde Valley PV 2 solar project

The scope for the GI will comprise the PV array and all associated infrastructure as well as the electrical infrastructure (substations, switching stations, overhead lines etc).

Thermal and electrical resistivity testing shall be included.

The scope does not include a Pile testing specification.

Deliverable:

- Geotechnical Investigation Specification
- Drawing showing test locations and co-ordinates
- BoQ



De Aar 10MW
solar plant

Who are we



Geotechnical

Zutari have a strong cohort of engineering geologists and geotechnical engineers who support our solar energy projects through development and execution. We assist our clients to understand ground risk and how this impacts the different stages of the project cycle. Our services to clients include:

- Geotechnical mapping
- Desktop studies for pre-feasibility
- Preliminary and detailed geotechnical investigations
- Site suitability from geotechnical perspective
- Factual and interpretive reporting
- Aggregate sourcing studies
- Foundation design incorporating soil-structure interaction
- Slope stability
- Verification of founding conditions during construction
- Pile testing to inform design

KEY CONTACTS



Salona Naidoo
Technical Director,
Geotechnical



Dr. Gabi Wojtowicz
Associate,
Geotechnical Engineer



Trevor Pape
Engineering
Geologist

Through the development of our digital database, it provides business intelligence for optioneering studies and project shaping, giving a higher confidence in concept design development and a more efficient scoping for ground investigations.

Why us?

We are lean, agile and adapting to a changing project landscape through the application of design-led thinking, lean methodologies and value co-creation on our projects. Working with our clients to develop the best solutions for complex problems based on a creative approach.

- We assist our clients in understanding and managing ground risk.
- In the project shaping stage, we identify potential geohazards early in the project life-cycle and through a value co-creation framework assist our clients in assessing technical feasibility, business viability, human desirability, system sustainability and project constructability.
- We advise and undertake third-party asset protection assessments through ground movement and building damage assessments utilising soil-structure analyses
- We provide specialist design services for a wide range of geotechnical applications.
- Our detailed, advanced numerical modelling capability allows us to determine driving mechanisms to inform better, design solutions. It also assists the structural engineer to verify superstructure design through provision of optimised springs, foundation forces and moments and post construction effects.



Our Services

Desktop and feasibility studies
Ground investigations and interpretation
Geotechnical risk assessment
Earthworks design
Ground treatment / improvement methods
Slope stability and seismic assessments
Karst and undermining assessments
Shallow and deep foundation design
Tailings

Excavation support and retaining system
Advanced numerical modelling
Geological modelling
Construction impact assessment
Instrumentation planning, implementation and monitoring
Specialist construction supervision
Design verification
Specialist dam engineering geology
Rock engineering

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Key Personnel

ZUTARI



Dr Gabi Wojtowicz
Geotechnical Engineer

Gabi is a senior geotechnical engineer and Associate Design Director at Zutari with more than 15 years' experience. She has worked on a variety of projects throughout the United Arab Emirates, Qatar, Saudi Arabia, Africa, South Africa, United Kingdom and Australia. Her experience includes a wide range of civil infrastructure projects, including tall and super-tall buildings, bridges, sport stadia, large commercial developments, wind and solar farms, railways, large metro projects, harbours and mining infrastructure. Gabi has been responsible for geotechnical analysis, design and design review for a number of Zutari's solar energy projects across sub-Saharan Africa.

Most recent PV project experience include the 20MW Golomoti PV plant (JCM Power) in Malawi, Anglo Solar PV projects across the development portfolio at a number of mines, Total-Mullio Hydra Solar Project and a number of REIPPP and RMIPPP projects. Gabi was the Geotechnical Design Lead responsible for geotechnical investigation, pile testing, prelim foundation design, specifications, review of contractor's detail foundation design and construction support.

Gabi holds a PhD in Geotechnical Engineering from the University of Southampton in the United Kingdom and BEng (Hons) Geotechnical Engineering and BEng Civil Engineering from the University of Pretoria (UP), South Africa. She is also a registered professional engineer with the Engineering Council of South Africa (ECSA) and a member of the South African Institute for Civil Engineering (SAICE). Gabi is the winner of both the Consulting Engineers South Africa (CESA) Aon Excellence in Engineering 'Young Engineer of the Year' award and the SAICE 'Young Engineer of the Year' award in the same year (2016) as well as the South African Professional Services Awards - Built Environment Category - Young Professional of the Year 2018.

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Project Experience

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Project experience Geotechnical Service Offering

Our geotechnical service offering covers the entire life cycle of a solar project from initial remote studies, field investigation, preliminary and detailed design, specialist site supervision and monitoring and design review. **We have worked on 28 No. solar farm projects totalling over 2.5GW.** Balance of Plant is defined as Development (concept & preliminary design, sub-contractor procurement) and Execution (detailed design / design review, quality assurance)

ZUTARI

Capability	Country	Role	Stage	Desk study	Geotechnical Investigation	Reporting	Analysis and Design	Review	Construction, pile testing, site design verification and monitoring
				Overview of topographical, geological and soil maps as well as available information including satellite imagery from Zutari's vast database	The geotechnical investigation is scoped to suit the project stage balancing ground risk with cost. This can comprise of test pitting, rotary core, percussion or sonic drilling, resistivity testing, Continuous Surface Wave (CSW) testing and laboratory testing; Field management and supervision; Geological mapping and zoning	Reports include: Progress reports; Monitoring reports; Factual reports; Geotechnical Interpretative Reports; Final Design Reports (Preliminary and Detailed); Construction and site investigation specifications; Bills of Quantities (BoQs)	Solar PV / CSP foundations; Earthworks; Ground improvement; Construction material identification; Advanced 2D and 3D numerical modelling; back-analysis of pile testing for foundation optimisation	Acting as Owner's Engineer, review of geotechnical and foundation design and geotechnical reports.	Scoping and execution of pile testing; On site design verification of foundation installations; Instrumentation and Monitoring; Site supervision; Inspection and Test Plan (ITPS) and check sheets for construction
7 MW & 75 MW power stations Renova Solar Project	South Africa	BoP	Development	X	X	X			
125MW Solis CSP Solar Farm	South Africa	BoP	Development	X	X	X	X		X
1GW Upington Solar Farm	South Africa	BoP	Development	X	X	X			
100MW Ilanga Solar Substation	South Africa	BoP	Development	X	X	X			
60MW Mogalakwena Solar PV	South Africa	Engineer	Site Selection	X					
Metehara Solar Project	Ethiopia	BoP	Development	X	X	X			
30MWp Redsol Solar PV	Malaysia	BoP	Detailed Design		X	X	X		X
100MW LSS3 Solar PV	Malaysia	BoP	Development	X		X	X		
60MW Salima Solar PV	Malawi	Owner's Engineer	Development					X	X
20MW Golomoti Solar PV Farm	Malawi	BoP	Development	X	X	X	X	X	X
Mocuba Solar Mozambique	Mozambique	BoP	Development						
Sibanye Gold pv solar plant	South Africa			X	X	X			
Leopards Hill Solar Development	Zambia	BoP	Development	X					
A Proposed New 54 MW 'Scaling Solar' PV Power	Zambia	BoP	Development	X	X	X			
Kronos Solar PV facility	South Africa	BoP	Development	X	X	X			
80MW Lephalele solar PV	South Africa	BoP	Development	X	X	X			
216 MW Muilo-Total Solar PV farms (Hydra & Coega)	South Africa	EPC Engineering Consultant	Construction			X	X		X
100MW Avondale-1 Solar Farm	South Africa	BoP	Development	X	X	X	X		
9 No solar Farms for REIPPP Round 5	South Africa	BoP	Development	X		X	X		
Kumba Iron Ore 2 No. solar Farm	South Africa	BoP	Development	X	X	X	X		

Project Experience

Solar PV

Zutari has an established track record in solar energy, with a selection of our recent roles listed below. A full list of project experience can be provided upon request. We have undertaken a wide variety of roles including development and bid support, Owner's Engineer, Lender's Technical Advisor, detailed design and detailed grid code compliance support.

Owner's Engineer Roles

- Successful projects in South Africa REIPPPP:
 - 75 MW Waterloo Solar PV
 - 68 MW Bokamoso Solar PV
 - 75 MW Prieska PV4 Solar PV
 - 75 MW REISA Kathu PV
 - 75 MW Letsatsi PV
 - 75 MW Lesedi Solar PV
 - 60 MW Boshof Solar PV (Post commercial-ops only)
 - 30 MW Witkop Solar (Post commercial-ops only)
 - 28 MW Soutpan Solar PV (Post commercial-ops only)
- 60 MW Salima Solar PV (Malawi)
- 10 MW Mariental and 10 MW Kokerboom Solar PV (Namibia)

Detailed Design for Solar PV

- 28 MW Golomoti Solar PV/BESS (Malawi)
- 30 MW Redsol Solar PV (Malaysia)
- 220 MW Bungela 1 and 2 Solar Farm (Australia)
- 123 MW Sun Metals Solar Farm (Australia)
- 25 MW Barcaldine Solar Farm (Australia)

Grid Connection Design

- 75 MW Droogfontein II Solar PV
- 75 MW Prieska PV3
- 75 MW Prieska PV4
- 75 MW Zeerust PV
- 50 MW De Wildt PV



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Project experience

Solar PV



Prieska PV4 Facility - 81MW_{DC} - Single-Axis Tracking PV

South Africa
Total Energies Nouvelles & Mullio

Zutari acted as the Owner's Engineer for the utility-scale Prieska PV4 Facility, providing detailed design review, construction monitoring and commissioning verification services, while also supporting the Owner with ad-hoc queries and issues as construction progresses. At the Owner's Engineer Zutari advised the client on Contractual matters including certifying payment milestones and contractor claims.



Salima Solar

Malawi
JCM and InfraCo Africa

Zutari initially supported JCM as Owner's Engineer for this pioneering 60MW project in Malawi and was extensively involved throughout site identification, concept development, feasibility and the early stage of project execution. Zutari's role subsequently shifted to an Engineering Service provider role with JCM taking on a self execution role.



Terraform Portfolio OE - 110MW_{AC} Portfolio of 3 projects, Boshof, Witkop and Soutpan

South Africa
Terraform

Zutari has supported Terraform with operational Owner's Engineer services for these three utility plants in South Africa. Services include end of warranty inspection, revised energy production assessment, incident investigations and procurement support for O&M services.



Lesedi PV Installation

South Africa
Lonjas Tecnologia

Lesedi Solar PV installation has an installed capacity of 64MW and is located at Humansrus, near Kimberley in the Northern Cape. It is being developed by SolarReserve, the Kensani Group and Intikon Energy, with Lonjas Tecnologia the appointed Owner's Engineer. Zutari were in turn appointed to provide in-country support to Lonjas, by undertaking technical design review to ensure compliance with local regulations, construction monitoring and environmental monitoring.

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Project experience

Solar PV



Bui solar photovoltaic (PV) feasibility study

Ghana
Strategic Security Systems Ghana

Feasibility study for integrating a solar photovoltaic (PV) facility to the existing hydro power plant in Bui

July 2019 – May 2020



Structural, civil and electrical design review and site supervision on behalf of the owner's engineer for the Lesedi photovoltaic (PV) plant

South Africa
Lonjas Technologia S.A.

Zutari has been appointed by Lonjas Technologia of Spain to assist with the role as owner's engineer during the construction phase of the Lesedi photovoltaic (PV) plant. Zutari contributed to the project through provision of structural, civil and electrical design review and site supervision expertise. Zutari's knowledge of local regulations and standards assisted Lonjas to correctly advise the client on relevant matters. Zutari has also been able to assist the project in the complex technicalities of preparing the facility for connection to the Eskom grid.

January 2013 – May 2014



New 132kV Impala Switching Station and 132/11kV, 1x 80MVA Sishen Solar Facility Substation

South Africa
E+PC Engineering & Project Company

Aveng E+PC approached Zutari to provide them with engineering design services for the grid connection of their Sishen Solar Facility to the national Eskom grid. The solution comprised of the complete design service to ensure compliance to the Eskom Procedure for high voltage (HV) Self-Build Projects (Eskom document 240-43874056).

July 2012 – July 2014



Design, review and site supervision for the Kathu solar photovoltaic (PV) plant

South Africa
Renewable Energy Investments of South Africa (Pty) Ltd (REISA)

The project consisted of the design, procurement construction, operation and maintenance of a photovoltaic (PV) solar plant with 75 MW (AC) capacity located in Kathu, Northern Cape region. Zutari was appointed as the Owner's Engineer by Renewable Energy Investments South Africa (REISA) for the construction and commissioning of the 75 MW single axis tracking solar PV plant.

December 2012 – June 2017

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