Mediclinic Rooftop PV Projects: Performance Report January 2023

Prepared for:

Moshesh Partners

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Abbreviations

|  |  |
| --- | --- |
| COD | Commercial Operating Date |
| HSE | Health and Safety and Environment |
| kWh | Kilo Watt Hour |
| OPEX | Operating expenses |
| PPA | Power Purchase Agreement |
| PR | Performance ratio |
| SCADA | Supervisory control and data acquisition |
| YTD | Year-to-date |

Glossary of Terms

|  |  |
| --- | --- |
| Actual Production | Production produced in kWh |
| Predicted Production | The forecasted P50 production in kWh |
| PR | Actual production divided by weather adjusted production in % |
| Weather Adjusted Predicted | Predicted production adjusted for actual weather in kWh |

# Introduction

Harmattan Renewables (“Harmattan”) has been appointed by Moshesh Partners (the “Client”) to provide asset management support for its rooftop PV assets at six Mediclinic sites across South Africa (each a “Project,” together the “Portfolio”). The Projects were installed by ACES Africa (“ACES”) who are now acting as the O&M contractor (the “Operator”).

## Scope of Work

The scope of work is fully described in Harmattan proposal “*HAR\_P215\_MOSHESH\_MediclinicAssetManagement \_v2”*, dated 15 July 2022”.

## Site Visits

No site visits were performed in January 2023. We are planning a site visit to Tzaneen on 30 March 2023.

## Report Layout and Risk Assessment Scale

Key findings and recommendations to the Client are highlighted in section 2. Risks are colour coded and include a narrative of the overall findings. A detailed summary of the documents reviewed is included in section 9. Where possible, Harmattan has confirmed if review items are consistent with market norms / standards and across all Project documentation. Where Harmattan identified an omission, error, inconsistency, or deviation from our expectations, the issue is flagged, analysed, and assigned a risk rating as outlined in Table 1‑1.

For all items, where an issue is identified, a risk category and colour code are allocated. Categorisation is achieved by making a qualitative assessment of the probability of the occurrence of the issue and the severity of the impact of the issue and allocating a tag Critical (C) / High (H) / Medium (M) / Low (L) / Negligible (N) and associated colour code to each issue (together with a brief explanation of why the tags were chosen). These tags are then multiplied in a range of combinations to yield a qualitative risk categorisation (see graphic below). This categorisation of risk allows for the prioritisation of the issues originally identified and brings a degree of focus to the subsequent mitigation process. If no risk is present / relevant, then the categorisation is summarised as 'Not Applicable' (N/A). Harmattan highlights that a simple, non-numerical, approach has been adopted to maintain the simplicity and functionality of the method and to avoid unproductive debates around the calibration of the categorisation components.

|  |  |  |
| --- | --- | --- |
| Key | Definition | Description |
| C | Critical | Risk of critical negative influence on project/investment outcome |
| H | High | Risk of high negative influence on project/investment outcome |
| M | Medium | Risk of medium negative influence on project/investment outcome. |
| L | Low | Risk of low negative influence on project/investment outcome. |
| N | Negligible | Risk of negligible negative influence on project/investment outcome. |
| N/A | Not Applicable | No risk present/relevant. |
| TBC | Awaiting  Information | Additional information required to enable Harmattan to opine on the risk. |

Table 1‑1: Risk Definitions Key

# Executive Summary

## Portfolio Overview

The following map shows the location of Moshesh Rooftop PV Portfolio operating sites. The sites are in the Gauteng and Western Cape Provinces of South Africa.

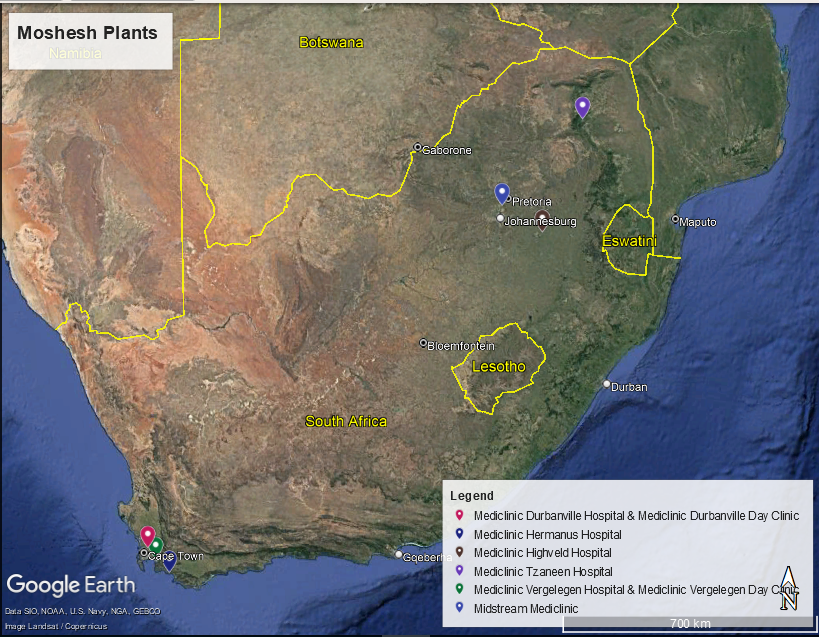


Figure 2‑1: Project Locations

|  |  |  |  |
| --- | --- | --- | --- |
| Name | COD (Commercial Operation Date) | Design Capacity DC/AC (kW) | Installed  Capacity DC/AC (kW) |
| Moshesh Mediclinic Durbanville Solar PV (“Durbanville”) | 11 November 2021 | 704.6 / 650 | 705.7 / 650 |
| Moshesh Mediclinic Hermanus Solar PV (“Hermanus”) | 10 March 2022 | 211.7 / 200 | 211.7 / 220 |
| Moshesh Mediclinic Highveld Solar PV (“Highveld”) | 30 March 2022 | 263 / 250 | 258.9 / 250 |
| Moshesh Mediclinic Midstream Solar PV (“Midstream”) | 27 October 2021 | 227.9 / 200 | 227.9 / 220 |
| Moshesh Mediclinic Vergelegen Solar PV (“Vergelegen”) | 28 October 2021 | 697.1 / 650 | 689.6 / 650 |
| Moshesh Mediclinic Tzaneen Solar PV (“Tzaneen”) | 11 October 2022 | 405/400 | 405/350 |

Table 2‑1: Project Overview

## Performance Summary

The following section summarises the performance of the sites in January 2023.

* + - 1. Moshesh Mediclinic Vergelegen Solar PV
* Production 358,125 kWh with a variance of 6.89 % below the P50 forecast.
* Irradiation is 603 kWh/m2 with a variance of -5.65 % below P50 forecast.
* Availability is 73% with a variance of -22.49 % above the warranted availability.
* PR is 90 % with a variance of 19.11 % below warranted availability.
* Revenue is R0 with a variance of nan % below forecast.
  + 1. Moshesh Mediclinic Durbanville Solar PV
* Production is 0 KWh with a variance of nan % below the P50 forecast.
* Irradiation is 636 kWh/m2 with a variance of -5.42 % below P50 forecast.
* Availability is 75 % with a variance of -21.22 % above the warranted availability.
* PR is 67 % with a variance of 67 % below warranted availability.
* Revenue is R0 with a variance of nan % below forecast.
  + 1. Moshesh Mediclinic Midstream Solar PV
* Production is 0 kWh with a variance of nan % below the P50 forecast.
* Irradiation is 566 kWh/m2 with a variance of -0.06 % below P50 forecast.
* Availability is 81 % with a variance of -14.43 % above the warranted availability.
* PR is 81 % with a variance of 7.45 % below warranted availability.
* Revenue is R0 with a variance of nan % below forecast.
  + 1. Moshesh Mediclinic Hermanus Solar PV
* Production is 0 kWh with a variance of nan % below the P50 forecast.
* Irradiation is 549 kWh/m2 with a variance of -8.54 % below P50 forecast.
* Availability is 73 % with a variance of -23.41 % above the warranted availability.
* PR is 61 % with a variance of -26.67 % below warranted availability.
* Revenue is R0 with a variance of nan % below forecast.
  + 1. Moshesh Mediclinic Highveld Solar PV
* Production is 0 kWh with a variance of nan % below the P50 forecast.
* Irradiation is 563 kWh/m2 with a variance of 1.5 % below P50 forecast.
* Availability is 76 % with a variance of -20.11 % above the warranted availability.
* PR is 44 % with a variance of -42.41 % below warranted availability.
* Revenue is R0 with a variance of nan % below forecast.
  + 1. Moshesh Mediclinic Tzaneen Solar PV
* Production is 80,549 kWh with a variance of -49.81% below the P50 forecast.
* Irradiation is 497 kWh/m2 with a variance of 2.85 % below P50 forecast.
* Availability is 0 % with a variance of -100.0 % above the warranted availability.
* PR is 49 % with a variance of -40.95 % below warranted availability.
* Revenue is R0 with a variance of nan % below forecast.

## Key Risks, Recommendations & Actions

The following table describe the risk identified in January 2023.

|  |  |  |  |
| --- | --- | --- | --- |
| Key Risks | Description | Risk Rating | Recommendations |
| Portfolio Key risk | Harmattan has identified the following portfolio risks:   * All the plants, except for Vergelegen, have performed below forecast due to loadshedding. The plants have experienced low availability because the inverters are grid tied, which results in loss of production during grid outages. We note that due to the increase in load shedding the plants will continue to underperform going forward. * We have reviewed the SCADA systems and noted that the irradiation data was not recorded due to logging errors, resulting in large data gaps. The Operator has opted to use google studio to record the data rather than the use of specialist software. * No annual plan was provided by the Operator with Scheduled maintenance activities. | H | We recommend that the Client identify any financial risk and adjust their financial model to account for the load shedding in 2023 as load shedding will persist.  Harmattan further also recommends that the Operator resolve the SCADA data handling issue and use a central monitoring system for all the plants.  We also recommend that the Operator install UPS systems in each plant control system to enable plant data to continue to be supplied to the central SCADA during grid outages.    We recommend that the Operator provide an annual maintenance plan with specific dates. |
| EPC Contract | Harmattan has performed LD calculations for the Midstream, Vergelegen, and Durbanville plants. We were provided with Solcast irradiation data in the form of an Excel spread sheet for the 12-months of production. This approach was taken as the irradiation data extracted from the SCADA contained gaps due to network communication errors during load shedding events.  Harmattan performed the initial calculation based on Annexures 5 and 7 of the EPC contracts and we included the deemed energy provided by the Operator.  The calculation resulted in LD of **R 193,134.16** for the three projects assessed.  The Operator then performed a review of the calculation and then included some additional losses based on a load shedding schedule for the 2022 years of production.  The calculation with the additional losses resulted in reduction of the LDs payable to **R 183,271.44**  Harmattan reviewed the Operator’s calculation note their load shedding losses cannot be verified on the SCADA system as the SCADA does not distinguish between grid fault and normal system faults. | H | While the extent of losses due to load shedding claimed by ACES appear reasonable given knowledge of the loadshedding taking place over the past year, Harmattan cannot unfortunately verify the reduction in LDs claimed.  Harmattan recommends:   * The SCADA systems installed are upgraded to the following.   + Add a module to the SCADA that can allow load shedding downtime to be logged or replace the system with the SCADA that would allow losses due to load shedding to be verified.   + Irradiation measurement and recording to be improved. We have moted that the irradiation measured by the onsite pyranometer at Hermanus had fewer data gaps which suggested that a UPS was installed We recommend installing UPS on all site to reduce data loss recorded from either satellite or onsite pyranometer.   + Include an automated calculation and recording of P/R. * On the LD calculation the Operator:   + Use Load Shedding Schedule Data: Instead of relying solely on nationwide load shedding days, it may be helpful to obtain load shedding schedules for the specific areas where the sites are located. This can provide more accurate information about when load shedding is expected to occur and help to better estimate the impact on the sites.   + Consider Inverter Start-up Time: To account for the time, it takes for the inverters to start up, it may be helpful to add a buffer period before and after the estimated load shedding time. This can ensure that the estimated impact on the sites is more accurate.   + Improve Automation as the process is currently very manual. Implementing more automation can help to streamline the process and reduce errors. This could include talking to the SCADA manufacture on improving the system. |
| Tzaneen technical | The SCADA system is not recording any availability data. | H | We recommend that the Operator check the availability module on the SCADA for this project for correct functionality. |
| Midstream technical | We have noted inconsistencies between the actual Performance Ratio (PR) and the forecast production values. This suggests that there may be an issue with the calculation of the PR, as it is not producing accurate results. | H | We recommend that the Operator clarify the formula they are using to calculate the PR as the formula is not defined under the contract, especially if it is being done manually rather than through the SCADA system. They should also ensure that the calculation method is accurate and up to date with the current industry standards. |

Table 2‑2: Key Risk Contracts

## O&M Contract

The O&M contract between Moshesh and ACES Africa (Operator) was executed in December 2022.

## EPC Contract

Harmattan has calculated the LDs under the EPC contract for Durbanville, Vergelegen and Midstream. Harmattan was provided with 12-months of satellite data in Excel format, as the SCADA data contained gaps. The results of the calculation are stated in Table 2‑2.

|  |  |  |
| --- | --- | --- |
| Plant | Harmattan Liquidated Damages Payable | ACES Liquidated Damages Payable |
| Durbanville | R 89,358.91 | R 84,541.93 |
| Midstream | R 16,052.49 | R 14,162.61 |
| Vergelegen | R 87,722.76 | R 84,566.89 |
| Total | R 193,134.16 | R 183,271.44 |

Table 2‑2: Liquidated damages

Table 2‑2. shows that the Operator has included additional deemed losses which Harmattan cannot verify as the SCADA is unable to distinguish grid maintenance works, Mediclinic interference, load shedding and normal faults. This reduces their LD total to R183,271.44 compared to the Harmattan total of R193,134.16.

The additional Deemed losses by the Operator were estimated by calculating the average kW during the time of load shedding and multiplying it by the amount of time the site was down for (adjusted for weather data).

However, as noted by the Operator, load shedding schedules can vary, and the inverters may take some time to start up. This could affect the accuracy of the estimates. Additionally, the Operator mentioned that they are "blind" to whether the site had load shedding or not and that the process is currently very manual.

Harmattan is unable to verify the Operator’s losses from the SCADA system as it does not distinguish normal fault, grid fault and load shedding. Additionally, the SCADA system has not being used to store irradiation data or PR calculation. We understand this is because data is lost during load shedding due to network connectivity issues.

Harmattan considers the SCADA systems not suitable for correctly monitoring the Projects. We recommend they be upgraded to include:

* Add a module to the SCADA that can allow load shedding downtime to be logged or replace the system with the SCADA that would allow losses due to load shedding to be verified.
* Irradiation measurement and recording to be improved. We have moted that the irradiation measured by the onsite pyranometer at Hermanus had fewer data gaps which suggested that a UPS was installed We recommend installing UPS on all site to reduce data loss recorded from either satellite or onsite pyranometer.
* Include an automated calculation and recording of P/R.

On the LD calculation we recommend that the Operator:

* Use Load Shedding Schedule Data: Instead of relying solely on nationwide load shedding days, it may be helpful to obtain load shedding schedules for the specific areas where the sites are located. This can provide more accurate information about when load shedding is expected to occur and help to better estimate the impact on the sites.
* Consider Inverter Start-up Time: To account for the time, it takes for the inverters to start up, it may be helpful to add a buffer period before and after the estimated load shedding time. This can ensure that the estimated impact on the sites is more accurate.
* Improve Automation: As noted by the Operator, the process is currently very manual. Implementing more automation can help to streamline the process and reduce errors. This could include talking to the SCADA manufacture on improving the system.

# Portfolio Revenue

## PPA Rates

Revenues are based on actual production and the rate agreed upon between each Mediclinic site and Moshesh under the Power Purchase Agreements (PPA) as described in Table 3-1 below.

|  |  |  |
| --- | --- | --- |
| Plant | PPA Rate (ZAR/kWh) | Applicable Year |
| Durbanville | 0.6423 | 11 November 2021 - 10 November 2022 |
| Vergelegen | 0.6517 | 28 October 2021 - 27 October 2022 |
| Highveld | 0.6589 | 30 March 2022 -29 March 2023 |
| Midstream | 0.7145 | 27 October 2021 - 26 October 2022 |
| Hermanus | 0.7944 | 10 March 2022 - 9 March 2023 |
| Tzaneen | 0.7934 | 11 October 2023 - 10 October2023 |

Table 3‑1: PPA Rates

The PPA rates increase by 6% every 12 months from COD. Vergelegen, Midstream and Durbanville have increased by 6% from October 2022. Hermanus and Highveld will increase in April 2023 and Tzaneen in October 2023.

Forecast revenues are based on the P50 Helioscope simulation, which is loaded into the SCADA and allows calculation of degradation. The simulations were performed during pre-construction and have not been adjusted to reflect actual irradiation or the installed capacity.

Actual revenue is based upon production as recorded by the SCADA and the PPA rates.

## Revenue Year to Date

The following graph shows the year-to-date Project’s energy sales in South African Rand (ZAR).

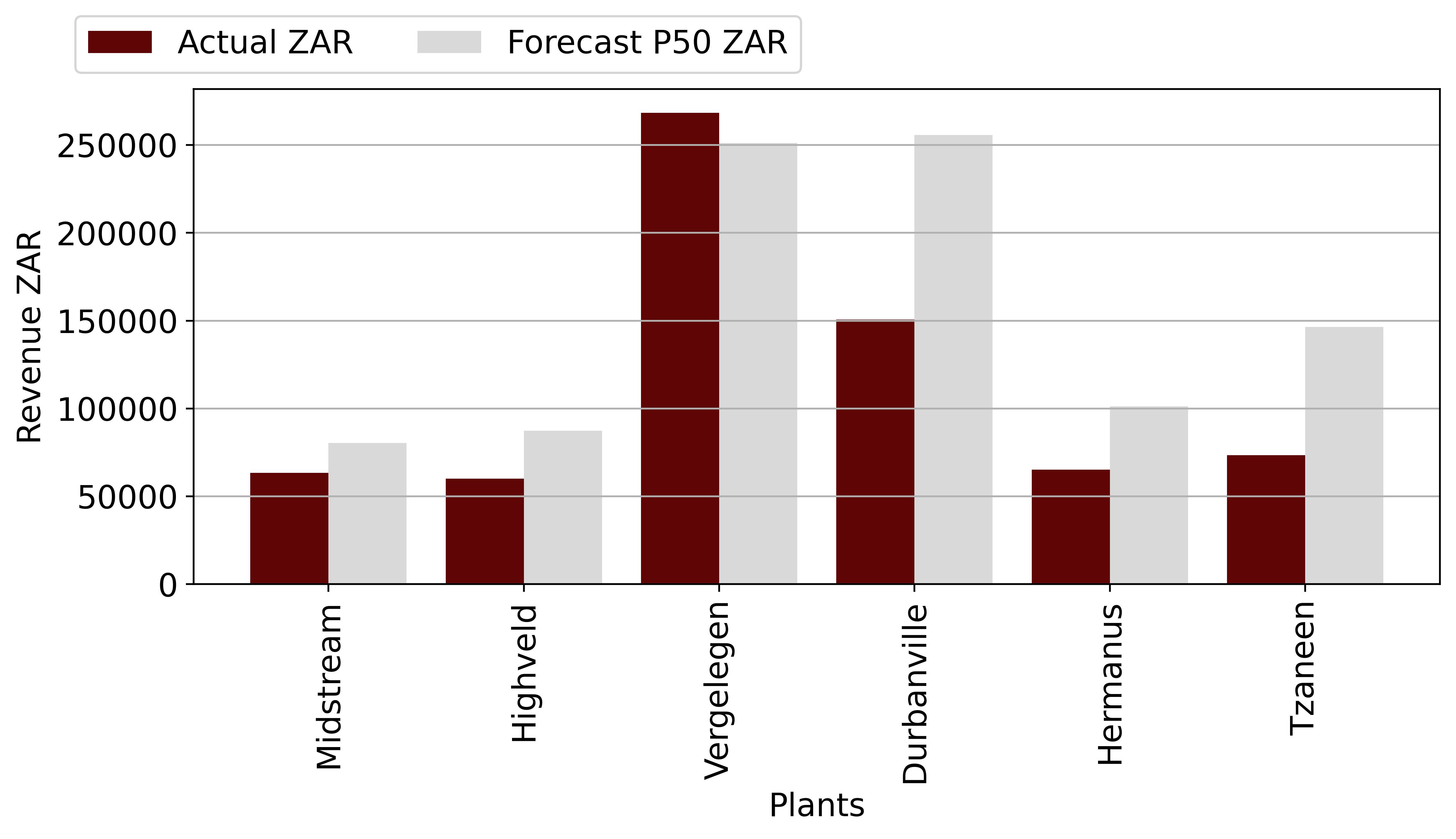


Figure 3‑1: Revenue to Date Year to Date

|  |  |  |  |
| --- | --- | --- | --- |
| **Revenue (ZAR)** | | | |
| **Plants** | **Actual** | **Forecast** | **Delta (%)** |
| Durbanville | 150,671 | 255,744 | -41.09 |
| Vergelegen | 268,393 | 251,093 | 6.89 |
| Highveld | 60,072 | 87,248 | -31.15 |
| Midstream | 63,348 | 80,346 | -21.16 |
| Hermanus | 65,162 | 101,193 | -35.61 |
| Tzaneen | 73,494 | 146,441 | -49.81 |

Table 3‑2: Project Revenue Year to Date Overview

All plants have performed below forecasted revenue, with Durbanville and Hermanus showing the most significant deviation from forecast. Vergelegen has a misleading result due to the reconciliation of December 2022 production into January 2023 figures.

# Technical Portfolio Overview

We have investigated the performance of the Projects by comparing irradiance, availability, performance ratio, and production against forecasts. All sites have underperformed against the forecast. The underperformance of each site was dominated by frequent load shedding which results in curtailment. This curtailment occurs as the installed, grid-tied inverters have anti-islanding protection.

Anti-islanding protection is a necessary safety feature to protect grid workers by disabling the PV inverters when the grid experiences an outage – either planned or unplanned. In an islanded condition, the project could operate, generating power and supplying it to systems it is connected to and spilling excess back into the grid. Anti-islanding prevents this by disabling the inverters to prevent generation. In this way, anti-islanding ensures the safety of any person working on the disabled grid. Unfortunately, this system also means that the inverter will not operate during Eskom load shedding.

## Data Analysed

Harmattan compiled SCADA data and reviewed the January 2023 production reports for each site. Harmattan was provided with Operator data and note that no scheduled or unscheduled maintenance were reported in January 2023.

The performance data was directly downloaded from the Higeco SCADA System and processed using Microsoft Excel. However, the Operator stopped reporting irradiation to the SCADA system which had the effect of preventing PR calculation. As a result, Harmattan requested access to the irradiation data, which was available on Google Studio and used the PR from the Operator Production report. With this data, Harmattan calculated the weather-adjusted forecast for the plants.

# Highveld Technical Performance

The following chapter assesses the Project technical performance compared to forecast. We have evaluated irradiation, availability, performance ratio and production.

## System Design

The plant is a 258.9kWp system using 540 Wp JA Solar PV modules connected to 100 kW and 50 kW Huawei inverters with key details noted in Table 5‑1. The system uses PV modules to generate DC electricity that is converted to AC electricity by the inverters and used in the buildings. This offsets the grid supply during the times when solar electricity is available. The inverters installed by Mediclinic are grid tied with anti-islanding protection as explained in Chapter 5.

|  |  |
| --- | --- |
| Project Overview | |
| Design Capacity DC/AC (kW) | 263 / 250 |
| Installed Capacity DC/AC (kW) | 258.9 / 250 |
| Technology | Solar |
| Project Company | Moshesh Solar PV 1 (Pty) Ltd |
| Address | 46 Barney Molokwane, Trichardt South Africa |
| Commercial Operation Date | 30 March 2022 |

Table 5‑1: Highveld Project Overview

## Irradiation vs Forecast

Table 5‑2 shows the Project irradiance for January 2023 and compare to the pre-construction Helioscope P50 prediction. Harmattan notes that the irradiance data is satellite-based.

|  |  |  |  |
| --- | --- | --- | --- |
| **Irradiation (kWh/m2)** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 231 | 205 | 12.64 |
| Feb 23 | 160 | 174 | -8.11 |
| Mar 23 | 172 | 176 | -1.94 |
| Apr 23 | 563 | 555 | 1.5 |

Table 5‑2: Highveld Irradiation and Forecast

The actual irradiation was 231 kWh/m2, 14.77% higher than the forecast 201 kWh/m2. Ideally, this should have resulted in higher production. Other factors such as equipment issues or shading can still reduce the overall performance of the solar panel system.

## Availability vs Forecast

The Operator has a minimum guaranteed availability of 95 %. Harmattan has compared this with the actual availability recorded by the SCADA for January 2023 in Table 5‑3.

|  |  |  |  |
| --- | --- | --- | --- |
| **Availability (%)** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 74 | 95 | -21.95 |
| Feb 23 | 70 | 95 | -26.06 |
| Mar 23 | 83 | 95 | -12.31 |
| Apr 23 | 76 | 95 | -20.11 |

Table 5‑3: Highveld Availability and Forecast

Achieved availability was 74%, while the forecast availability was 95%, resulting in a variance of -21.95%.

Availability is reduced by risks for which the Operator is not responsible. As an example, equipment failures affect availability, but Project switch offs due to force majeure would not. The full calculation methodology can be found in Appendix A1.

Possible factors that could have contributed to the low availability include unexpected downtime such as the high levels of load shedding, experienced by the Project. grid maintenance works, and normal faults. Load shedding is employer risk, but the Operator SCADA cannot distinguish between normal system loss, grid maintenance loss and loadshedding losses, the risk is on the Operator as they must prove that the system was down due to loadshedding. The availability does not reconcile load shedding and thus the Operator must manually record loadshedding. Furthermore, the Operator has stated that sometimes the power only goes off a little bit later and other times it's like clockwork. Additionally, the inverters take some time to start up, which also needs to be accounted for.

We recommend that the Operator improve data logging on the system as it is not clear from the SCADA when load shedding took place due to the unpredictability of loadshedding.

## Performance Ratio vs Forecast

Table 5‑4 shows the measured and forecast performance ratio (PR) of the Project.

|  |  |  |  |
| --- | --- | --- | --- |
| **Performance Ratio (%)** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 72 | 76 | -5.18 |
| Feb 23 | 59 | 76 | -21.87 |
| Mar 23 | 0 | 76 | -100.0 |
| Apr 23 | 44 | 76 | -42.41 |

Table 5‑4: Highveld PR and Forecast

In January 2023, the Performance Ratio was 72%, 5.18%. lower than the forecasted value of 76%. PR is likely below forecast due to frequent load shedding events occurring across South Africa. Load shedding affects the Project for 2-4 hours a day depending on the stage of load shedding.

## Production vs Forecast

Table 5‑5 shows the January 2023 actual production and comparisons to the original and weather adjusted forecasts.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Month** | **Production (kWh)** | | | **Actual vs Original Forecast (%)** | **Actual vs Weather Adjusted Forecast (%)** |
|  | **Original Forecast** | **Weather Adjusted Forecast** | **Actual Production** |
| Jan 23 | 40,997 | 46,179 | 32,109 | -21.68 | -30.47 |
| Feb 23 | 36,012 | 33,090 | 19,390 | -46.16 | -41.4 |
| Mar 23 | 38,134 | 37,394 | 27,780 | -27.15 | -25.71 |
| Apr 23 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **115,143** | **116,663** | **79,279** | **-31.15** | **-32.04** |

Table 5‑5: Hermanus Production and Forecast

Production of 32,109 kWh was 19.54% below the original forecast of 39,908 kWh, and 29.9% below the weather-adjusted forecast. The low production in a period of high irradiance, likely reflects the curtailment due to load shedding.

# Durbanville Technical Performance

The following tables and figures describe the technical performance of the plant compared with the forecast. We have evaluated irradiation, availability, performance ratio and production.

## System Design

The plant is a 705.7kWp system consisting of 535Wp JA Solar PV modules connected to 13 Huawei 50 kW inverters with key details noted in Table 6 1. The inverters installed by Mediclinic are grid tied with anti-islanding protection as explained in Chapter 5

|  |  |
| --- | --- |
| Project Overview | |
| Design Capacity DC/AC (kW) | 704.6 / 650 |
| Achieved Capacity DC/AC (kW) | 705.7 / 650 |
| Technology | Solar |
| Project Company: | Moshesh Solar PV 1 (Pty) Ltd |
| Address: | Wellington Road Durbanville South Africa |
| Commercial Operation Date | 11 November 2022 |

Table 6‑1: Highveld Project Overview

## Irradiation vs Forecast

Table 6 2 shows the Project irradiance for January 2023 and compare to the pre-construction Helioscope P50 prediction. Harmattan notes that the irradiance data is satellite-based.

|  |  |  |  |
| --- | --- | --- | --- |
| **Irradiation kWh/m2** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 260 | 255 | 1.98 |
| Feb 23 | 213 | 209 | 2.0 |
| Mar 23 | 163 | 209 | -21.88 |
| Apr 23 | 636 | 673 | -5.42 |

Table 6‑2: Durbanville Irradiation and Forecast

The actual irradiation was 260 kWh/m2, 5.93% higher than the forecasted irradiation of 246 kWh/m2. This should have resulted in higher production. Other factors such as equipment issues or shading can still reduce the overall performance of the solar panel system.

## Availability vs Forecast

The Operator has stated a minimum guaranteed availability of 95 % in their monthly reports. Harmattan has used this guaranteed availability to compare with the actual availability from the SCADA.

|  |  |  |  |
| --- | --- | --- | --- |
| **Availability (%)** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 77 | 95 | -19.06 |
| Feb 23 | 63 | 95 | -33.59 |
| Mar 23 | 85 | 95 | -11.02 |
| Apr 23 | 75 | 95 | -21.22 |

Table 6‑3: Durbanville Availability and Guaranteed

Achieved availability was 77%, while the forecast availability was 95%, resulting in a variance of -19.06%.

Availability is reduced by risks for which the Operator is not responsible. As an example, equipment failures affect availability, but Project switch offs due to force majeure would not. The full calculation methodology can be found in Appendix A1.

Possible factors that could have contributed to the low availability include unexpected downtime such as the high levels of load shedding, experienced by the Project. grid maintenance works, and normal faults. Load shedding is employer risk, but the Operator SCADA cannot distinguish between normal system loss, grid maintenance loss and loadshedding losses, the risk is on the Operator as they must prove that the system was down due to loadshedding. The availability does not reconcile load shedding and thus the Operator must manually record loadshedding. Furthermore, the Operator has stated that sometimes the power only goes off a little bit later and other times it's like clockwork. Additionally, the inverters take some time to start up, for which also needs to be accounted.

We recommend that the Operator improve data logging on the system as it is not clear from the SCADA when load shedding took place due to the unpredictability of loadshedding.

## Performance Ratio vs Forecast

Table 6‑4 shows the measured and forecast performance ratio (PR) of the Project.

|  |  |  |  |
| --- | --- | --- | --- |
| **Performance Ratio (%)** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 60 | 74 | -18.37 |
| Feb 23 | 66 | 74 | -10.3 |
| Mar 23 | 74 | 74 | 0.32 |
| Apr 23 | 67 | 74 | -9.43 |

Table 6‑4: Durbanville PR and Forecast

In January 2023, the Performance Ratio was 60%, -18.37%. lower than the forecasted value of 74%. PR is likely below forecast due to frequent load shedding events occurring across South Africa. Load shedding affects the Project for 2-4 hours a day depending on the stage of load shedding.

A negative variance shows that the actual performance was significantly lower than expected or planned. This is likely to be due to frequent load shedding events as the plant had low availability that contributed to production losses, although the precise number of hours of loadshedding was not recorded by the SCADA system.

## Production vs Forecast

Table 6‑5 shows the January 2023 actual production and comparison to the original forecast and the weather adjusted forecasts.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Month** | **Production (kWh)** | | | **Actual vs Original Forecast (%)** | **Actual vs Weather Adjusted Forecast (%)** |
|  | **Original Forecast** | **Weather Adjusted Forecast** | **Actual Production** |
| Jan 23 | 127,670 | 130,197 | 79,512 | -37.72 | -38.93 |
| Feb 23 | 109,018 | 111,199 | 62,421 | -42.74 | -43.87 |
| Mar 23 | 109,170 | 85,284 | 61,829 | -43.36 | -27.5 |
| **Total** | **345,859** | **326,680** | **203,762** | **-41.09** | **-37.63** |

Table 6‑5: Durbanville Production and Forecast

Production of 79,512 kWh was 37.72% below the original forecast of 79,512 kWh, and 41.21% below the weather-adjusted forecast. The low production in a period of high irradiance, likely reflects the curtailment due to load shedding.

# Midstream Technical Performance

The following tables and figures describe the technical performance of the plant compared with the forecast. We have evaluated irradiation, availability, performance ratio and production.

## System Design

The plant is a 227.9kWp system with 535Wp JA Solar PV module connected to 2 Huawei 100 kW inverters. with key details noted in Table 7‑1. The inverters installed by Mediclinic are grid tied with anti-islanding protection as explained in Chapter 5.

|  |  |
| --- | --- |
| Project Overview | |
| Design Capacity kW DC/AC (kW) | 227.9 / 200 |
| Achieved Capacity DC/AC (kW) | 227.9 / 220 |
| Technology | Solar |
| Project Company: | Moshesh Solar PV 1 (Pty) Ltd |
| Address: | Midstream Drive, Hill Boulevard Midstream Estate, Olifantsfontein. - South Africa |
| Commercial Operation Date | 27 October 2021 |

Table 7‑1:Midstream Project Overview

## Irradiation vs Forecast

Table 7‑2 shows the Project irradiance for January 2023 and compare to the pre-construction Helioscope P50 prediction. Harmattan notes that the irradiance data is satellite-based.

|  |  |  |  |
| --- | --- | --- | --- |
| **Irradiation (kWh/m2)** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 231 | 208 | 10.64 |
| Feb 23 | 155 | 177 | -12.31 |
| Mar 23 | 180 | 181 | -0.38 |
| Q1 | 566 | 567 | -0.06 |

Table 7‑2: Midstream Irradiation and Forecast

The actual irradiation was 231 kWh/m2, 7.35% higher than the forecasted irradiation of 215 kWh/m2. This should have resulted in higher production. Other factors such as equipment issues or shading can still reduce the overall performance of the solar panel system.

## Availability Vs Forecast

The Operator has stated a minimum guaranteed availability of 95 % in their monthly reports. Harmattan has used this guaranteed availability to compare with the actual availability from the SCADA system.

|  |  |  |  |
| --- | --- | --- | --- |
| **Availability (%)** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 83 | 95 | -12.62 |
| Feb 23 | 76 | 95 | -20.31 |
| Mar 23 | 85 | 95 | -10.36 |
| Apr 23 | 81 | 95 | -14.43 |

Table 7‑3: Midstream Availability and Guaranteed

Achieved availability was 83%, while the forecast availability was 95%, resulting in a variance of -12.62%.

Availability is reduced by risks for which the Operator is not responsible. As an example, equipment failures affect availability, but Project switch offs due to force majeure would not. The full calculation methodology can be found in Appendix A1.

Possible factors that could have contributed to the low availability include unexpected downtime such as the high levels of load shedding, experienced by the Project. grid maintenance works, and normal faults. Load shedding is employer risk, but the Operator SCADA cannot distinguish between normal system loss, grid maintenance loss and loadshedding losses, the risk is on the Operator as they must prove that the system was down due to loadshedding. The availability does not reconcile load shedding and thus the Operator must manually record loadshedding. Furthermore, the Operator has stated that sometimes the power only goes off a little bit later and other times it's like clockwork. Additionally, the inverters take some time to start up, for which also needs to be accounted.

We recommend that the Operator improve data logging on the system as it is not clear from the SCADA when load shedding took place due to the unpredictability of loadshedding.

## Performance Ratio Vs Forecast

Table 7‑4 shows the measured and forecast performance ratio (PR) of the Project.

|  |  |  |  |
| --- | --- | --- | --- |
| **Performance Ratio (%)** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 78 | 75 | 4.16 |
| Feb 23 | 73 | 76 | -4.46 |
| Mar 23 | 94 | 77 | 22.44 |
| Apr 23 | 81 | 76 | 7.45 |

Table 7‑4: Midstream PR and Forecast

The actual (78%) and forecast (77%) Performance Ratio (PR) for the month of January 2023 were very close with a difference of 0.57%. We note that this is inconsistent with the actual production values, which are very low compared to the forecast. This suggests that there may be an issue with the calculation of the PR.

It is important for the Operator to clarify the formula they are using to calculate the PR, especially if it is being done manually rather than through the SCADA system. They should also ensure that the calculation method is accurate and up to date with the current industry standards.

## Production vs Forecast

Table 7‑5 shows the January 2023 actual production and comparisons to the original and weather adjusted forecasts.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Month** | **Production (kWh)** | | | **Actual vs Original Forecast (%)** | **Actual vs Weather Adjusted Forecast (%)** |
| **Month** | **Original Forecast** | **Weather Adjusted Forecast** | **Actual Production** |
| Jan 23 | 35,448 | 39,221 | 30,813 | -13.07 | -21.44 |
| Feb 23 | 30,703 | 26,924 | 20,108 | -34.51 | -25.31 |
| Mar 23 | 31,625 | 31,504 | 26,169 | -17.25 | -16.94 |
| Apr 23 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **97,777** | **97,649** | **77,091** | **-21.16** | **-21.05** |

Table 7‑5: Midstream Production and Forecast

Production of 30,813 kWh was 13.07% below the original forecast of 35,448 kWh, and 19.03% below the weather-adjusted forecast. The low production in a period of high irradiance, likely reflects the curtailment due to load shedding.

# Hermanus Technical Performance

The following tables and figures describe the technical performance of the plant compared with the forecast. We have evaluated irradiation, availability, performance ratio and production.

## System Design

The plant is a 211.7kWp system with 540Wp JA Solar PV modules connected to two Huawei 100 kW with key details noted in Table 8‑1. The inverters installed by Mediclinic are grid tied with anti-islanding protection as explained in Chapter 5.

|  |  |
| --- | --- |
| Project Overview | |
| Design Capacity (kW) DC/AC: | 211.7 / 200 |
| Achieved Capacity (kW) DC/AC | 211.7 / 220 |
| Technology | Solar |
| Project Company: | Moshesh Solar PV 1 (Pty) Ltd |
| Address: | Ravenscroft Rd Hermanus – 7,200 – South Africa |
| Commercial Operation Date | 10 March 2022 |

Table 8‑1: Hermanus Project Overview

## Irradiation Vs Forecast

Table 8‑3 shows the Project irradiance for January 2023 and compare to the pre-construction Helioscope P50 prediction.

|  |  |  |  |
| --- | --- | --- | --- |
| **Irradiation (kWh/m2)** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 223 | 238 | -6.32 |
| Feb 23 | 169 | 176 | -3.93 |
| Mar 23 | 157 | 186 | -15.75 |
| Apr 23 | 549 | 600 | -8.54 |

Table 8‑2: Hermanus Irradiation and Forecast.

The actual irradiation was 223 kWh/m2, 6.21% lower than the forecasted irradiation of 238 kWh/m2. This should result in lower production as confirmed later.

## Availability Vs Forecast

The Operator has stated a minimum guaranteed availability of 95 % in their monthly reports. Harmattan has used this guaranteed availability to compare with the actual availability from the SCADA.

|  |  |  |  |
| --- | --- | --- | --- |
| **Availability (%)** | | | |
| Month | Actual | Forecast | Delta (%) |
| Jan 23 | 73 | 95 | -23.17 |
| Feb 23 | 70 | 95 | -26.22 |
| Mar 23 | 75 | 95 | -20.84 |
| Apr 23 | 73 | 95 | -23.41 |

Table 8‑3: Hermanus Availability and Forecast

Achieved availability was 73%, while the forecast availability was 95%, resulting in a variance of -23.17%.

Availability is reduced by risks for which the Operator is not responsible. As an example, equipment failures affect availability, but Project switch offs due to force majeure would not. The full calculation methodology can be found in Appendix A1.

Possible factors that could have contributed to the low availability include unexpected downtime such as the high levels of load shedding, experienced by the Project. grid maintenance works, and normal faults. Load shedding is employer risk, but the Operator SCADA cannot distinguish between normal system loss, grid maintenance loss and loadshedding losses, the risk is on the Operator as they must prove that the system was down due to loadshedding. The availability does not reconcile load shedding and thus the Operator must manually record loadshedding. Furthermore, the Operator has stated that sometimes the power only goes off a little bit later and other times it's like clockwork. Additionally, the inverters take some time to start up, which also needs to be accounted for.

We recommend that the Operator improve data logging on the system as it is not clear from the SCADA when load shedding took place due to the unpredictability of loadshedding.

## Performance Ratio vs Forecast

Table 8‑4 shows the measured and forecast performance ratio (PR) of the Project.

|  |  |  |  |
| --- | --- | --- | --- |
| **Performance Ratio (%)** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 64 | 83 | -22.1 |
| Feb 23 | 56 | 83 | -32.05 |
| Mar 23 | 61 | 83 | -25.85 |
| Apr 23 | 61 | 83 | -26.67 |

Table 8‑4: Hermanus PR and Forecast

In January 2023, the Performance Ratio was 64%, 22.1%. lower than the forecasted value of 83%. PR is likely below forecast due to frequent load shedding events occurring across South Africa. Load shedding affects the Project for 2-4 hours a day depending on the stage of load shedding.

## Production Vs Forecast

Table 8‑5 shows the January 2023 actual production and comparisons to the original and weather adjusted forecasts.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Month** | **Production (kWh)** | | | **Actual vs Original Forecast (%)** | **Actual vs Weather Adjusted Forecast (%)** |
|  | **Original Forecast** | **Weather Adjusted Forecast** | **Actual Production** |
| Jan 23 | 42,604 | 39,909 | 30,525 | -28.35 | -23.52 |
| Feb 23 | 35,031 | 33,654 | 20,372 | -41.85 | -39.47 |
| Mar 23 | 33,134 | 27,916 | 20,431 | -38.34 | -26.81 |
| Apr 23 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **110,768** | **101,480** | **71,328** | **-****35.61** | **-29.71** |

Table 8‑5: Hermanus Production and Forecast

Production of 32,109 kWh was 19.54% below the original forecast of 39,908 kWh, and 29.9% below the weather-adjusted forecast. The low production in a period of low irradiance and low availability, likely reflects the curtailment due to load shedding and poor weather conditions.

# Vergelegen Technical Performance

The following tables and figures describe the technical performance of the plant compared with the forecast. We have evaluated irradiation, availability, performance ratio and production.

## System Design

The system is a 689.6kWp project with 535Wp JA Solar PV modules connected to six Huawei 100 kW inverters and one Huawei 50 kW inverter with key details noted in Table 9‑1. The inverters installed by Mediclinic are grid tied with anti-islanding protection as explained in Chapter 5.

|  |  |
| --- | --- |
| Project Overview | |
| Design Capacity DC/AC (kW) | 697.1 / 650 |
| Achieved Capacity DC/AC (kW) | 689.6 / 650 |
| Technology | Solar |
| Project Company: | Moshesh Solar PV 1 (Pty) Ltd |
| Address: | Vergelegen, Main Road Somerset West South Africa |
| Commercial Operation Date | 28 Oct 2022 |

Table 9‑1: Vergelegen Project Overview

## Irradiation Vs Forecast

Table 9‑2 shows the Project irradiance for January 2023 compared to the pre-construction Helioscope P50 prediction. Harmattan notes that the irradiance data is satellite-based.

|  |  |  |  |
| --- | --- | --- | --- |
| **Irradiation (kWh/m2)** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 247 | 252 | -1.77 |
| Feb 23 | 204 | 202 | 1.46 |
| Mar 23 | 151 | 185 | -18.66 |
| Apr 23 | 603 | 639 | -5.65 |

Table 9‑2: Vergelegen Irradiation and forecast.

The actual irradiation was 247 kWh/m2, 1.26 % lower than the forecasted irradiation of 251kWh/m2. This should have resulted in lower production. This suggests that the solar panels received less sunlight than expected during the month of January. The possible reason would be poor weather conditions with cloud cover.

## Availability Vs Forecast

The Operator has stated a minimum guaranteed availability of 95 % in their monthly reports. Harmattan has used this guaranteed availability to compare with the actual availability from the SCADA.

|  |  |  |  |
| --- | --- | --- | --- |
| **Availability (%)** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 85 | 95 | -10.71 |
| Feb 23 | 54 | 95 | -43.13 |
| Mar 23 | 82 | 95 | -13.65 |
| Apr 23 | 74 | 95 | -22.49 |

Table 9‑3: Vergelegen Availability and Guaranteed

Achieved availability was 85%, while the forecast availability was 95%, resulting in a variance of -10.71%.

Availability is reduced by risks for which the Operator is not responsible. As an example, equipment failures affect availability, but Project switch offs due to force majeure would not. The full calculation methodology can be found in Appendix A1.

Possible factors that could have contributed to the low availability include unexpected downtime such as the high levels of load shedding, experienced by the Project. grid maintenance works, and normal faults. Load shedding is employer risk, but the Operator SCADA cannot distinguish between normal system loss, grid maintenance loss and loadshedding losses, the risk is on the Operator as they must prove that the system was down due to loadshedding. The availability does not reconcile load shedding and thus the Operator must manually record loadshedding. Furthermore, the Operator has stated that sometimes the power only goes off a little bit later and other times it's like clockwork. Additionally, the inverters take some time to start up, which also needs to be accounted for.

We recommend that the Operator improve data logging on the system as it is not clear from the SCADA when load shedding took place due to the unpredictability of loadshedding.

## Performance Ratio Vs Forecast

Table 9‑4 shows the measured and forecast performance ratio (PR) of the Project.

|  |  |  |  |
| --- | --- | --- | --- |
| **Performance Ratio (%)** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 94 | 75 | 25.78 |
| Feb 23 | 77 | 75 | 2.57 |
| Mar 23 | 98 | 76 | 28.92 |
| Apr 23 | 90 | 75 | 19.11 |

Table 9‑4: Vergelegen PR and Forecast

In January 2023, the Performance Ratio was 94%, 25.78%. higher than the forecasted value of 75%. PR The higher-than-expected performance ratio is due to the inclusion of December 2023 production into January 2023 data. This reconciliation was due to the meter connection error in December 2023.

## Production Vs Forecast

Table 9‑5 shows the January 2023 actual production and comparisons to the original and weather adjusted forecasts.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Month** | **Production (kWh)** | | | **Actual vs Original Forecast (%)** | **Actual vs Weather Adjusted Forecast (%)** |
|  | **Original Forecast** | **Weather Adjusted Forecast** | **Actual Production** |
| Jan 23 | 130,973 | 128,654 | 203,236 | 55.17 | 57.97 |
| Feb 23 | 105,857 | 107,399 | 82,384 | -22.17 | -23.29 |
| Mar 23 | 98,211 | 79,882 | 72,504 | -26.18 | -9.24 |
| Apr 23 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **335,041** | **315,935** | **358,125** | **6.89** | **13.35** |

Table 9‑5: Vergelegen Production and Forecast

The original forecast for the month was 130,973 kWh, while the weather-adjusted forecast was slightly lower at 129,327 kWh. However, the actual production for the month greatly exceeded both forecasts, reaching 203,236 kWh. This was due to the reconciliation of January 2023 production with December 2022 due to the meter communication errors mentioned above.

The percentage differences between the actual production and the original and weather-adjusted forecasts are 55.17% and 57.15%, Harmattan cannot verify if the plant underperformed as the January production data was affected by the December reconciliation. Based upon the plant availability data we can deduce that the plant did experience down time due to load shedding in January.

# Tzaneen Technical Performance

The following tables and figures describe the technical performance of the plant compared with the forecast. We have evaluated irradiation, availability, performance ratio and production.

## System Design

The project is a 405kWp system with 540Wp JA Solar PV modules connected to four Huawei 100 kW inverters with key details noted in Table 10‑1. The inverters installed by Mediclinic are grid tied with anti-islanding protection as explained in Chapter 5.

|  |  |
| --- | --- |
| Project Overview | |
| Design Capacity DC/AC (kW) | 405 / 400 |
| Achieved Capacity DC/AC (kW) | 405 / 350 |
| Technology | Solar |
| Project Company: | Moshesh Solar PV 1 (Pty) Ltd |
| Address: | Tzaneen, Main Road Somerset West South Africa |
| Commercial Operation Date | 11 Oct 2022 |

Table 10‑1: Tzaneen Project Overview

## Irradiation Vs Forecast

The following table and graph below describe the irradiance in January 2023 compared to the Helioscope P50 prediction. Harmattan notes that the irradiance measurement is satellite-based.

|  |  |  |  |
| --- | --- | --- | --- |
| **Irradiation (kWh/m2)** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 197 | 174 | 13.57 |
| Feb 23 | 134 | 148 | -9.85 |
| Mar 23 | 166 | 161 | 2.98 |
| Apr 23 | 497 | 483 | 2.85 |

Table 10‑2: Tzaneen Irradiation and Forecast.

The actual irradiation was 197 kWh/m2, 13.57% higher than the forecasted irradiation of 174 kWh/m2. This should have resulted in higher production, but it did not, as seen later in the other factors such as equipment issues or shading can still reduce the overall performance of the solar panel system.

## Availability vs Forecast

The Operator has stated a minimum guaranteed availability of 95 % in their monthly reports. Harmattan has used this guaranteed availability to compare with the actual availability from the SCADA.

|  |  |  |  |
| --- | --- | --- | --- |
| **Availability (%)** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 0 | 95 | -100.0 |
| Feb 23 | 0 | 95 | -100.0 |
| Mar 23 | 0 | 95 | -100.0 |
| Apr 23 | 0 | 95 | -100.0 |

Table 10‑3:Tzaneen Availability and Guaranteed

The SCADA did not measure plant availability for the month of January, Harmattan cannot verify if the plant has met the forecast availability of 95%. We recommend that the Operator add a module to measure availability on the SCADA system.

## Performance Ratio Vs Forecast

Table 10‑4 shows the measured and forecast performance ratio (PR) of the Project.

|  |  |  |  |
| --- | --- | --- | --- |
| **Performance Ratio (%)** | | | |
| **Month** | **Actual** | **Forecast** | **Delta (%)** |
| Jan 23 | 70 | 83 | -15.86 |
| Feb 23 | 34 | 83 | -58.23 |
| Mar 23 | 42 | 83 | -48.77 |
| Apr 23 | 49 | 83 | -40.95 |

Table 10‑4: Tzaneen PR and Forecast

The table above shows the actual and forecasted Performance Ratio (PR) for the month of January 2023. The actual PR for the month was 70%, while the forecasted PR was 83%.

The percentage difference between the actual and forecasted PR is -15.86%, indicating that the actual PR was lower than anticipated. Low plant availability had an impact on PR resulting in loss of production. We note that the low availability was due to frequent load shedding. In addition to load shedding, other factors, shading, module soiling, and other issues could also contribute to lower-than-expected PR.

## Production Vs Forecast

Table 6 5 shows the January 2023 actual production and comparisons to the original and weather adjusted forecasts.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Month** | **Production (kWh)** | | | **Actual vs Original Forecast (%)** | **Actual vs Weather Adjusted Forecast (%)** |
|  | **Original Forecast** | **Weather Adjusted Forecast** | **Actual Production** |
| Jan 23 | 56,838 | 64,553 | 44,182 | -22.27 | -31.56 |
| Feb 23 | 49,359 | 44,500 | 14,829 | -69.96 | -66.68 |
| Mar 23 | 54,302 | 55,920 | 21,538 | -60.34 | -61.48 |
| Apr 23 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **160,499** | **164,973** | **80,549** | **-49.81** | **-51.17** |

Table 10‑5: Tzaneen Production and Forecast

Production of 80,549 kWh was 49.81% below the original forecast of 56,377kWh, and --31.0% below the weather-adjusted forecast. The low production in a period of high irradiance, likely reflects the curtailment due to load shedding.

# Events

## Health and Safety

No health and safety incidences were reported by the Operator based on the information provided by the Operator.

## Scheduled Maintenance

No other maintenance activities except for monitoring (SCADA) and documentation were performed in Q1 based on the information provided by the Operator. We note that no annual plan was provided by the Operator for each plant. Harmattan recommends that the Operator provides an annual operational plan to verify if tasks are on performed on specific dates.

## Unscheduled Maintenance

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Date** | **Plant** | **Event** | **Description** | **Resolution** |
| 22 February 2023 | Tzaneen | Burnt cables in manhole | The incident involved burned DC cables in a manhole and black smoke residue in sleeves. It occurred during a period of heavy rain in Tzaneen. The cause of the incident was likely a damaged cable that got wet during the rainfall, leading to an electrical arc and subsequent burning of the cables in the manhole. The incident was isolated to the manhole and did not spread further. | Cables was disconnected from modules to disconnect any live voltages. Burnt cables between manhole and inverters was removed.  Harmattan conducted a site visit to Tzaneen on the 31 March 2022 and noted that the cables were replaced, and the plant was running at full capacity.  Detail of the incident will be reported in the site visit report. |

Table 36:Unscheduled Maintenance

## Spare Parts

Harmattan notes that no spare parts are kept parts on site by ACES. The Operator has stated that minor spare parts are in stock in Cape Town and Johannesburg. Major spares will be kept in Cape Town by the Operator. We note that only keeping the major spare parts in Cape Town may present a problem for plants outside of Cape Town given the longer lead times to deliver the spare to site, resulting in higher production losses.

# Documents Reviewed

|  |  |
| --- | --- |
| Project Name | Documents Reviewed |
| Vergelegen | * Vergelegen DS Jan 2023 * Mediclinic DS January 2023 All Sites |
| Durbanville | * Durbanville DS Jan 2023 * Mediclinic DS January 2023 All Sites |
| Midstream | * Midstream DS Jan 2023 * Mediclinic DS January 2023 All Sites |
| Hermanus | * Hermanus DS Jan 2023 * Mediclinic DS January 2023 All Sites |
| Highveld | * Highveld DS Jan 2023 * Mediclinic DS January 2023 All Sites |

Table 12‑1: Document Reviewed

A1. Appendix Availability Guaranteed

