Mediclinic Rooftop PV Projects: Monthly Report

Prepared for:

Moshesh Partners

Reference No:

HAR\_215\_Moshesh Mediclinic Monthly Report

{{day}} {{month}} {{year}}

Document Control

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Abbreviations

|  |  |
| --- | --- |
| A | Actual |
| B | Budget |
| F | Forecast |
|  |  |
| HSE | Health and Safety and Environment |
| kWh |  |
| OPEX | Operating expenses |
| PR | Performance ratio |
| SCADA | Supervisory control and data acquisition |
| YTD | Year-to-date |
| Δ | Variance |

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 |

# Executive Summary

## Performance Summary {{month}} 2022

#### Moshesh Mediclinic Vergelegen Solar PV

* Production is {{VERP}} KWh with a variance of {{VERPV}}% below the P50 Forecast.
* Irradiation is {{VERI}} kWh/m2 with a variance of {{VERIV}} % below P50 Forecast.
* Availability is {{VERA}} % with a variance of {{VERAV}} % above the warranted availability.
* PR is {{VERPR}} % with a variance of {{VERPRV}} % below warranted availability.

### Moshesh Mediclinic Durbanville Solar PV

* Production is {{DURP}} KWh with a variance of {{DURPV}}% below the P50 Forecast..
* Irradiation is {{DURI}} kWh/m2 with a variance of {{DURIV}} % below P50 Forecast.
* Availability is {{DURA}} % with a variance of {{DURAV}} % above the warranted availability.
* PR is {{DURPR}} % with a variance of {{DURPR}} % below warranted availability.

### Moshesh Mediclinic Midstream Solar PV

* Production is {{MIDP}} KWh with a variance of {{MIDPV}}% below the P50 forecast..
* Irradiation is {{MIDI}} kWh/m2 with a variance of {{MIDIV}} % below P50 Forecast.
* Availability is {{MIDA}} % with a variance of {{MIDAV}} % above the warranted availability.
* PR is {{MIDPR}} % with a variance of {{MIDPRV}} % below warranted availability.

### Moshesh Mediclinic Hermanus Solar PV

* Production is {{HERP}} KWh with a variance of {{HERPV}}% below the P50 Forecast.
* Irradiation is {{HERI}} kWh/m2 with a variance of {{HERIV}} % below P50 Forecast.
* Availability is {{HERA}} % with a variance of {{HERAV}} % above the warranted availability.
* PR is {{HERPR}} % with a variance of {{HERPRV}} % below warranted availability.

### Moshesh Mediclinic Highveld Solar PV

* Production is {{HIGP}} KWh with a variance of {{HIGPV}}% below the P50 Forecast.
* Irradiation is {{HIGI}} kWh/m2 with a variance of {{HIGIV}} % below P50 Forecast..
* Availability is {{HIGA}} % with a variance of {{HIGAV}} % above the warranted availability.
* PR is {{HIGPR}} % with a variance of {{HIGPRV}} % below warranted availability.

## Key Risks, Recommendations & Actions

The following key risk were identiﬁed in report month.

|  |  |  |  |
| --- | --- | --- | --- |
| **Key Risks** | **Descriptions** | **Actions** | **Recommendation** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Table ‑: Key Risk

# Portfolio Overview

Harmattan Renewables (Harmattan) has been appointed by Moshesh Partners (the Client) to provide asset management support for its rooftop assets at the various Mediclinic sites.

This document is intended to assist the Client in understanding the operational status of its active installations. The document provides details of energy production at Vergelegen, Midstream, Hermanus, Highveld, and Durbanville Mediclinics. The following table provides an overview of Commercial Operation Dates (COD). Harmattan will conduct a detailed review of plants performance in the asset management report to determine any factors that have affected plants performance.

|  |  |  |
| --- | --- | --- |
| **Name** | **COD (Commercial Operation Date)** | **Capacity DC (kW)** |
| Moshesh Mediclinic Durbanville Solar PV | 11 Nov 2021 | 705.7 |
| Moshesh Mediclinic Hermanus Solar PV | 10 Mar 2022 | 219.4 |
| Moshesh Mediclinic Highveld Solar PV | 30 Mar 2022 | 262.7 |
| Moshesh Mediclinic Midstream Solar PV | 27 Oct 2021 | 227.9 |
| Moshesh Mediclinic Vergelegen Solar PV | 28 Oct 2021 | 689.6 |

Table ‑: Project Overview

## Scope of Work

The scope of work is fully described in Harmattan proposal “*HAR\_P215\_MOSHESH\_MediclinicAssetManagement \_v2”*, dated 15 July 2021”.

## Site Visits

Harmattan has not yet conducted operational monitoring site visits to any of the Project, however site visits are planned to Durbanville, Midstream and Vergelegen operational sites for July 2022.

# Revenue

## Revenues Year to Date

The following graph shows the YTD revenue against the budgeted revenue.

{{Revenue}}

Figure ‑: Revenue Year to Date

|  |  |  |  |
| --- | --- | --- | --- |
| **Revenue (ZAR)** | | | |
| **Plants** | **A** | **F** | **Δ (%)** |
| Mediclinic Durbanville | 506061.85 | 642983.19 | -21% |
| Mediclinic Vergelegen | 594582.4 | 627296.02 | -5% |
| Mediclinic Highveld | 90797.14 | 123041.36 | -26% |
| Mediclinic Midstream | 222184.45 | 241974.4 | -8% |
| Mediclinic Hermanus | 102448.17 | 109552.03 | -6% |

Table ‑: Project Revenue Overview

# Vergelegen Technical Performance

Technical performance tables and Forecastigures below give details on plant Gross Generation, Irradiation, Availability and Performance Ratio compared against the F/warranted values, then analyse the results and give recommendations.

|  |  |
| --- | --- |
| **Project Overview** | |
| Capacity (kW DC): | 689.6 |
| Resource | Solar |
| Project Company: | Moshesh Solar PV 1 (Pty) Ltd |
| Address: | Vergelegen, Main Road Somerset West South Africa |

Table ‑: Vergelegen Project Overview

## Vergelegen Production Vs Forecast

The following table describes the production of the Vergelegen Mediclinic site. Production was measured from COD through August 2022 and compared to the P50 and production forecast.

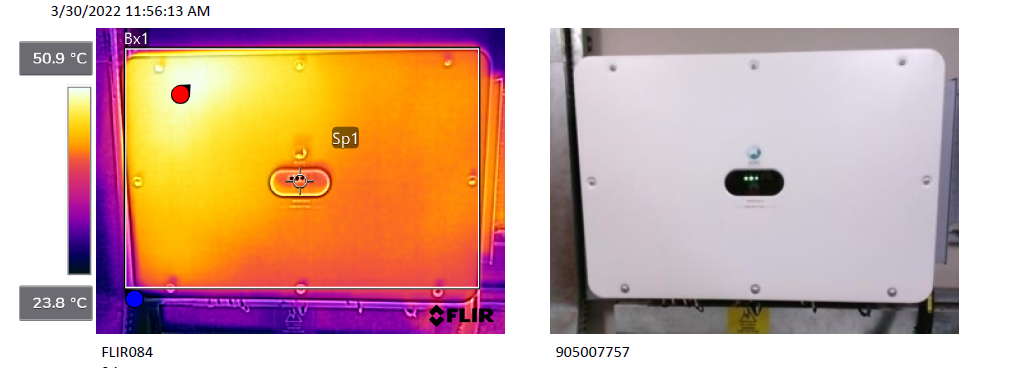
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Production (kWh)** | | | | | | | Date | **A** | **F** | **Δ (%)** | **W** | **Δ (%)** | | {%tr for item in VERPtable\_contents%} | | | | | | | {{item.Date}} | {{ item.VERPA }} | {{item.VERPF}} | {{item.VERPV}} | {{item.VERPW}} | {{item.VERPWV}} | | {%tr endfor%} | | | | | | | **Total** | **{{VERPATOT}}** | **{{VERPFTOT}}** | **{{VERPVTOT}}** | **{{VERPWTOT}}** | **{{VERPWVTOT}}** | |
| Table ‑: Vergelegen Production and Forecast |
| {{VERPImage}}  Figure ‑: Vergelegen Production Vs Forecast |

The total production since COD is 838139 with a deviation of -5.53% from the predicted production. With the exception of October when only 4 days were produced, production since cod has been below average. We found that the production is below the P50 forecast because the bad weather resulted in less sunshine than expected. This is confirmed by the weather-adjusted forecast, which shows lower production than the P50 forecast. Another reason for the lower-than-forecast generation is load shedding, which causes power plants to shut down, resulting in production losses.

Grid-connected PV plants are usually programmed to shut down during load shedding. This is due to international safety standards. Solar modules generate DC electricity, but this must be converted to AC in order to be used in buildings. For this purpose, solar inverters are used to convert the electricity.

In the event of a grid outage (e.g., Eskom load shedding), the solar inverters are designed to shut down. This is to protect the grid personnel working on the transmission lines during the outage. If the buildings continue to generate power during a grid outage and potentially feed power to the national grid, this could be fatal to maintenance personnel who are unaware that power is flowing in the lines when the grid is down.

The following figure describes the inverter temperature at Vergelegen, the thermal image was taken on 30 March 2022, this shows

inverter operating at 50 ˚C which is close to the maximum operating temperature of 60 ˚C. The high operating temperature of the inverter has impact on the production. Harmattan notes that the inverter has not exceeded the maximum temperature of 60 degree but notes that this will change during the summer seasons.  Figure ‑: Vergelegen Production Vs Forecast

Harmattan notes that Operator(Aces) has suggested that Mediclinic add ventilation to the room housing the inverter, but this has not been done since the winter season provide extra cooling for the inverter.

## Vergelegen Irradiation Vs Forecast

The following table and graph describe the irradiance of the site compared to the Helioscope P50 prediction. Harmattan notes that the irradiance measurement is satellite-based. The irradiance measurement is online from April until today.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | **Irradiation (kWh/m2)** | | | | | **Date** | **A** | **F** | **Δ %** | | {%tr for item in VERItable\_contents%} | | | | | {{item.Date}} | {{ item. VERIA}} | {{ item. VERIF }} | {{item. VERIV}} | | {%tr endfor %} | | | | | {{VERIImage}} |
| Table ‑: Vergelegen irradiation and Forecast | Figure ‑: Vergelegen Irradiation Vs Forecast |

The irradiation is 166.76 kWh/m2 with a deviation of 11.78% from the F. This is consistent with the low gross generation for this month noted above. (See Appendix G for more details). The month of March recorded low irradiation on 05, 09, 16, 17, and 21 March 2022 due to heavy cloud cover.

## Vergelegen Availability Vs Forecast

The following table and chart describe the availability of the plant since COD, comparing the availability of the plant with the guaranteed minimum availability of 95%.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | **Availability (%)** | | | | | **Date** | **A** | **F** | **Δ %** | | {%tr for item in VERAtable\_contents%} | | | | | {{item.Date}} | {{ item. VERAA}} | {{ item. VERAF }} | {{item. VERAV}} | | {%tr endfor %} | | | | | {{VERAImage}} |
| Table ‑: Vergelegen Availability and Guaranteed | Figure ‑: Vergelegen Availability Vs Forecast |

From the above table and chart, it appears that the power plant has not met the minimum availability of 95% since COD. Harmattan cannot confirm if the unavailability of the power plant is due to unscheduled maintenance as no report has been submitted. The operator has indicated that the availability of the power plant was mainly affected by load shedding. Harmattan recommends that the operator submit the unscheduled maintenance reports for the site to confirm this..

## Vergelegen Performance Ratio Vs Forecast

The following table and chart compare the Scada Performance Ratio with the monthly forecast P50 PR of the Helioscope Forecast report.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | **Performance Ratio (%)** | | | | | **Date** | **A** | **F** | **Δ %** | | {%tr for item in VERPRtable\_contents%} | | | | | {{item.Date}} | {{ item. VERPRA}} | {{item. VERPRF }} | {{item. VERPRV}} | | {%tr endfor %} | | | | | {{VERPRImage}} |
| Table ‑: Vergelegen PR and Forecast | Figure ‑: Vergelegen PR Vs Forecast |

Harmattan notes that the plant's performance was below the expected forecast, with a maximum deviation of -21.43% in July and a minimum deviation of -11.56% in April. Harmattan notes that the plant's performance has not improved since COD until today. The operator has stated that the inadequate performance of the power plant is due to the bad weather conditions, which have resulted in lower irradiation than expected, as well as load shedding, which leads to production losses because the inverter cannot be put into operation for safety reasons.

# Durbanville Technical Performance

Technical performance tables and forecast figures below give details on plant Gross Generation, Irradiation, Availability and Performance Ratio compared against the F/warranted values, then analyse the results and give recommendations.

|  |  |
| --- | --- |
| **Project Overview** | |
| Capacity (kW DC): | 705.7 |
| Resource | Solar |
| Project Company: | Moshesh Solar PV 1 (Pty) Ltd |
| Address: | Wellington Road Durbanville South Africa |

Table ‑:Durbanville Project Overview

## Durbanville Production Vs Forecast

The following tables describe the production of the plant since COD. Production is compared to the P50 Helioscope forecast and the weather-adjusted forecast.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Production (kWh)** | | | | | | | **Date** | **A** | **F** | **Δ (%)** | **W** | **Δ (%)** | | {%tr for item in DURPtable\_contents%} | | | | | | | {{item.Date}} | {{ item.DURPA }} | {{item.DURPF}} | {{item.DURPV}} | {{item.DURPW}} | {{item.DURPWV}} | | {%tr endfor%} | | | | | | | **Total** | **{{DURPATOT}}** | **{{DURPFTOT}}** | **{{DURPVTOT}}** | **{{DURPWTOT}}** | **{{DURPWVTOT}}** | |
| Table ‑: Durbanville Production and Forecast |
| {{DURPImage}}  Figure ‑: Durbanville Production Vs Forecast |

The total production since COD is 838139 with a deviation of -5.53% from the predicted production. With the exception of October when only 4 days were produced, production since cod has been below average. We found that the production is below the P50 forecast because the bad weather resulted in less sunshine than expected. This is confirmed by the weather-adjusted forecast, which shows lower production than the P50 forecast. Another reason for the lower-than-forecast generation is load shedding, which causes power plants to shut down, resulting in production losses. The plant is also experiencing shading due to nearby tree that have resulted in some loss of production This was noted During the inspection of the site in March 2022 as illustrated by the following image.



Figure ‑: Durbanville Production Vs Forecast

## Durbanville Irradiation Vs Forecast

The following table and graph describe the irradiance of the site compared to the Helioscope P50 prediction. Harmattan notes that the irradiance measurement is satellite-based. The irradiance measurement is online from April until today.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | **Irradiation kWh/m2** | | | | | **Date** | **A** | **F** | **Δ (%)** | | {%tr for item in DURItable\_contents%} | | | | | {{item.Date}} | {{ item. DURIA}} | {{ item. DURIF }} | {{item. DURIV}} | | {%tr endfor %} | | | | | {{DURIImage}} |
| Table ‑: Durbanville irradiation and Forecast | Figure ‑: Durbanville Irradiation Vs Forecast |

The irradiation is 166.76 kWh/m2 with a deviation of 11.78% from the F. This is consistent with the low gross generation for this month noted above. (See Appendix G for more details). The month of March recorded low irradiation on 05, 09, 16, 17, and 21 March 2022 due to heavy cloud cover.

## Durbanville Availability Vs Forecast

The following table and chart describe the availability of the plant since COD, comparing the availability of the plant with the guaranteed minimum availability of 95%.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | **Availability (%)** | | | | | **Date** | **A** | **F** | **Δ (%)** | | {%tr for item in DURAtable\_contents%} | | | | | {{item.Date}} | {{ item. DURAA}} | {{ item. DURAF }} | {{item. DURAV}} | | {%tr endfor %} | | | | | {{DURAImage}} |
| Table ‑: Durbanville Availability and Guaranteed | Figure ‑: Durbanville Availability Vs Forecast |

From the above table and chart, it appears that the power plant has not met the minimum availability of 95% since COD. Harmattan cannot confirm if the unavailability of the power plant is due to unscheduled maintenance as no report has been submitted. The operator has indicated that the availability of the power plant was mainly affected by load shedding. Harmattan recommends that the operator submit the unscheduled maintenance reports for the site to confirm this.

## Durbanville Performance Ratio Vs Forecast

The following table and chart compare the Scada Performance Ratio with the monthly forecast P50 PR of the Helioscope Forecast report.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | **Performance Ratio (%)** | | | | | **Date** | **A** | **F** | **Δ (%)** | | {%tr for item in DURPRtable\_contents%} | | | | | {{item.Date}} | {{ item. DURPRA}} | {{item. DURPRF }} | {{item. DURPRV}} | | {%tr endfor %} | | | | | {{DURPRImage}} |
| Table ‑: Durbanville PR and Forecast | Figure ‑: Durbanville PR Vs Forecast |

Harmattan notes that the plant's performance was below the expected forecast, with a maximum deviation of -21.43% in July and a minimum deviation of -11.56% in April. Harmattan notes that the plant's performance has not improved since COD until today. The operator has stated that the inadequate performance of the power plant is due to the bad weather conditions, which have resulted in lower irradiation than expected, as well as load shedding, which leads to production losses because the inverter cannot be put into operation for safety reasons.

# Midstream Technical Performance

Technical performance tables and forecast figures below give details on plant Gross Generation, Irradiation, Availability and Performance Ratio compared against the F/warranted values, then analyse the results and give recommendations.

|  |  |
| --- | --- |
| **Project Overview** | |
| Capacity (kW DC): | 227.9 |
| Resource | Solar |
| Project Company: | Moshesh Solar PV 1 (Pty) Ltd |
| Address: | Midstream Drive, Hill Boulevard Midstream Estate, Olifantsfontein. - South Africa |

Table ‑: Midstream Project Overview

## Midstream Production Vs Forecast

The following tables describe the production of the plant since COD. Production is compared to the P50 Helioscope forecast and the weather-adjusted forecast.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Production (kWh)** | | | | | | | **Date** | **A** | **F** | **Δ (%)** | **W** | **Δ (%)** | | {%tr for item in MIDPtable\_contents%} | | | | | | | {{item.Date}} | {{ item.MIDPA }} | {{item.MIDPF}} | {{item.MIDPV}} | {{item.MIDPW}} | {{item.MIDPWV}} | | {%tr endfor%} | | | | | | | **Total** | **{{MIDPATOT}}** | **{{MIDPFTOT}}** | **{{MIDPVTOT}}** | **{{MIDPWTOT}}** | **{{MIDPWVTOT}}** | |
| Table ‑: Midstream Production and Forecast |
| {{MIDPImage}}  Figure ‑: Midstream Production Vs Forecast |

The total production since COD is 838139 with a deviation of -5.53% from the predicted production. With the exception of October when only 4 days were produced, production since cod has been below average. We found that the production is below the P50 forecast because the bad weather resulted in less sunshine than expected. This is confirmed by the weather-adjusted forecast, which shows lower production than the P50 forecast. Another reason for the lower-than-forecast generation is load shedding, which causes power plants to shut down, resulting in production losses.

## Midstream Irradiation Vs Forecast

The following table and graph describe the irradiance of the site compared to the Helioscope P50 prediction. Harmattan notes that the irradiance measurement is satellite-based. The irradiance measurement is online from April until today

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | **Irradiation (kWh/m2)** | | | | | **Date** | **A** | **F** | **Δ (%)** | | {%tr for item in MIDItable\_contents%} | | | | | {{item.Date}} | {{ item. MIDIA}} | {{ item. MIDIF }} | {{item. MIDIV}} | | {%tr endfor %} | | | | | {{MIDIImage}} |
| Table ‑: Midstream irradiation and Forecast | Figure ‑: Midstream Irradiation Vs Forecast |

The irradiation is 166.76 kWh/m2 with a deviation of 11.78% from the F. This is consistent with the low gross generation for this month noted above. (See Appendix G for more details). The month of March recorded low irradiation on 05, 09, 16, 17, and 21 March 2022 due to heavy cloud cover.

## Midstream Availability Vs Forecast

The following table and chart describe the availability of the plant since COD, comparing the availability of the plant with the guaranteed minimum availability of 95%.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | **Availability (%)** | | | | | **Date** | **A** | **F** | **Δ (%)** | | {%tr for item in MIDAtable\_contents%} | | | | | {{item.Date}} | {{ item. MIDAA}} | {{ item. MIDAF }} | {{item. MIDAV}} | | {%tr endfor %} | | | | | {{MIDAImage}} |
| Table ‑: Midstream Availability and Guaranteed | Figure ‑: Midstream Availability Vs Forecast |

From the above table and chart, it appears that the power plant has not met the minimum availability of 95% since COD. Harmattan cannot confirm if the unavailability of the power plant is due to unscheduled maintenance as no report has been submitted. The operator has indicated that the availability of the power plant was mainly affected by load shedding. Harmattan recommends that the operator submit the unscheduled maintenance reports for the site to confirm this.

## Midstream Performance Ratio Vs Forecast

The following table and chart compare the Scada Performance Ratio with the monthly forecast P50 PR of the Helioscope Forecast report

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | **Performance Ratio (%)** | | | | | **Date** | **A** | **F** | **Δ (%)** | | {%tr for item in MIDPRtable\_contents%} | | | | | {{item.Date}} | {{ item. MIDPRA}} | {{item. MIDPRF }} | {{item. MIDPRV}} | | {%tr endfor %} | | | | | {{MIDPRImage}} |
| Table ‑: Midstream PR and Forecast | Figure ‑: Midstream PR Vs Forecast |

Harmattan notes that the plant's performance was below the expected forecast, with a maximum deviation of -21.43% in July and a minimum deviation of -11.56% in April. Harmattan notes that the plant's performance has not improved since COD until today. The operator has stated that the inadequate performance of the power plant is due to the bad weather conditions, which have resulted in lower irradiation than expected, as well as load shedding, which leads to production losses because the inverter cannot be put into operation for safety reasons.

# Hermanus Technical Performance

Technical performance tables and forecast figures below give details on plant Gross Generation, Irradiation, Availability and Performance Ratio compared against the F/warranted values, then analyse the results and give recommendations.

|  |  |
| --- | --- |
| **Project Overview** | |
| Capacity (kW DC): | 219.4 |
| Resource | Solar |
| Project Company: | Moshesh Solar PV 1 (Pty) Ltd |
| Address: | Ravenscroft Rd Hermanus – 7200 – South Africa |

*Table 7‑1: Hermanus Project Overview*

## Hermanus Production Vs Forecast

The following tables describe the production of the plant since COD. Production is compared to the P50 Helioscope forecast and the weather-adjusted forecast.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Production (kWh)** | | | | | | | **Date** | **A** | **F** | **Δ (%)** | **W** | **Δ (%)** | | {%tr for item in HERPtable\_contents%} | | | | | | | {{item.Date}} | {{ item.HERPA }} | {{item.HERPF}} | {{item.HERPV}} | {{item.HERPW}} | {{item.HERPW}} | | {%tr endfor%} | | | | | | | **Total** | **{{HERPATOT}}** | **{{HERPFTOT}}** | **{{HERPVTOT}}** | **{{HERPWTOT}}** | **{{HERPWVTOT}}** | |
| Table ‑: Hermanus Production and Forecast |
| {{HERPImage}}  Figure ‑: Hermanus Production Vs Forecast |

The total production since COD is 838139 with a deviation of -5.53% from the predicted production. With the exception of October when only 4 days were produced, production since cod has been below average. We found that the production is below the P50 forecast because the bad weather resulted in less sunshine than expected. This is confirmed by the weather-adjusted forecast, which shows lower production than the P50 forecast. Another reason for the lower-than-forecast generation is load shedding, which causes power plants to shut down, resulting in production losses.

## Hermanus Irradiation Vs Forecast

The following table and graph describe the irradiance of the site compared to the Helioscope P50 prediction. Harmattan notes that the irradiance measurement is satellite-based. The irradiance measurement is online from April until today.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | **Irradiation (kWh/m2)** | | | | | **Date** | **A** | **F** | **Δ (%)** | | {%tr for item in HERItable\_contents%} | | | | | {{item.Date}} | {{ item. HERIA}} | {{ item. HERIF }} | {{item. HERIV}} | | {%tr endfor %} | | | | | {{HERIImage}} |
| Table ‑: Hermanus irradiation and Forecast | Figure ‑ Hermanus Irradiation Vs Forecast |

## Hermanus Availability Vs Forecast

The following table and chart describe the availability of the plant since COD, comparing the availability of the plant with the guaranteed minimum availability of 95%.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | **Availability (%)** | | | | | **Date** | **A** | **F** | **Δ (%)** | | {%tr for item in HERAtable\_contents%} | | | | | {{item.Date}} | {{ item. HERAA}} | {{ item. HERAF }} | {{item. HERAV}} | | {%tr endfor %} | | | | | {{HERAImage}} |
| Table ‑: Hermanus Availability and Forecast | Figure ‑:Hermanus Availability Vs Forecast |

From the above table and chart, it appears that the power plant has not met the minimum availability of 95% since COD. Harmattan cannot confirm if the unavailability of the power plant is due to unscheduled maintenance as no report has been submitted. The operator has indicated that the availability of the power plant was mainly affected by load shedding. Harmattan recommends that the operator submit the unscheduled maintenance reports for the site to confirm this.

## Hermanus Performance Ratio Vs Forecast

The following table and chart compare the Scada Performance Ratio with the monthly forecast P50 PR of the Helioscope Forecast report.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | **Performance Ratio (%)** | | | | | **Date** | **A** | **F** | **Δ (%)** | | {%tr for item in HERPRtable\_contents%} | | | | | {{item.Date}} | {{ item. HERPRA}} | {{item. HERPRF }} | {{item. HERPRV}} | | {%tr endfor %} | | | | | {{HERPRImage}} |
| Table ‑: Hermanus PR and Forecast | Figure ‑: Hermanus PR Vs Forecast |

Harmattan notes that the plant's performance was below the expected forecast, with a maximum deviation of -21.43% in July and a minimum deviation of -11.56% in April. Harmattan notes that the plant's performance has not improved since COD until today. The operator has stated that the inadequate performance of the power plant is due to the bad weather conditions, which have resulted in lower irradiation than expected, as well as load shedding, which leads to production losses because the inverter cannot be put into operation for safety reasons..

# Highveld Technical Performance

Technical performance tables and forecast figures below give details on plant Gross Generation, Irradiation, Availability and Performance Ratio compared against the F/warranted values, then analyse the results and give recommendations

|  |  |
| --- | --- |
| **Project Overview** | |
| Capacity (kW DC): | 262.7 |
| Resource | Solar |
| Project Company: | Moshesh Solar PV 1 (Pty) Ltd |
| Address: | 46 Barney Molokwane, Trichardt South Africa |

Table ‑: Highveld Project Overview

## Highveld Production Vs Forecast

The following tables describe the production of the plant since COD. Production is compared to the P50 Helioscope forecast and the weather-adjusted forecast.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Production (kWh)** | | | | | | | **Date** | **A** | **F** | **Δ (%)** | **W** | **Δ (%)** | | {%tr for item in HIGPtable\_contents%} | | | | | | | {{item.Date}} | {{ item.HIGPA }} | {{item.HIGPF}} | {{item.HIGPV}} | {{item.HIGPW}} | {{item.HIGPW}} | | {%tr endfor%} | | | | | | | **Total** | **{{HIGPATOT}}** | **{{HIGPFTOT}}** | **{{HIGPVTOT}}** | **{{HIGPWTOT}}** | **{{HIGPWVTOT}}** | |
| Table ‑: Highveld Production and Forecast |
| {{HIGPImage}}  Figure ‑: Highveld Production Vs Forecast |

The total production since COD is 838139 with a deviation of -5.53% from the predicted production. With the exception of October when only 4 days were produced, production since cod has been below average. We found that the production is below the P50 forecast because the bad weather resulted in less sunshine than expected. This is confirmed by the weather-adjusted forecast, which shows lower production than the P50 forecast. Another reason for the lower-than-forecast generation is load shedding, which causes power plants to shut down, resulting in production losses.

## Highveld Irradiation Vs Forecast

The following table and figure describe the irradiation of the site compared with the p50 helioscope forecast. Harmattan notes that the irradiation measurement is based on satellite. The irradiation measurement came online from April to date.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | **Irradiation (kWh/m2)** | | | | | **Date** | **A** | **F** | **Δ (%)** | | {%tr for item in HIGItable\_contents%} | | | | | {{item.Date}} | {{ item. HIGIA}} | {{ item. HIGIF }} | {{item. HIGIV}} | | {%tr endfor %} | | | | | {{HIGIImage}} |
| Table ‑: Highveld irradiation and Forecast | Figure ‑ Highveld Irradiation Vs Forecast |

## Highveld Availability Vs Forecast

The following table and chart describe the availability of the plant since COD, comparing the availability of the plant with the guaranteed minimum availability of 95%.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | **Availability (%)** | | | | | Date | **A** | **F** | **Δ (%)** | | {%tr for item in HIGAtable\_contents%} | | | | | {{item.Date}} | {{ item. HIGAA}} | {{ item. HIGAF }} | {{item. HIGAV}} | | {%tr endfor %} | | | | | {{HIGAImage}} |
| Table ‑: Highveld Availability and Forecast | Figure ‑:Highveld Availability Vs Forecast |

From the above table and chart, it appears that the power plant has not met the minimum availability of 95% since COD. Harmattan cannot confirm if the unavailability of the power plant is due to unscheduled maintenance as no report has been submitted. The operator has indicated that the availability of the power plant was mainly affected by load shedding. Harmattan recommends that the operator submit the unscheduled maintenance reports for the site to confirm this.

## Highveld Performance Ratio Vs Forecast

The following table and chart describe the availability of the plant since COD, comparing the availability of the plant with the guaranteed minimum availability of 95%.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | **Performance Ratio (%)** | | | | | **Date** | **A** | **F** | **Δ (%)** | | {%tr for item in HIGPRtable\_contents%} | | | | | {{item.Date}} | {{ item. HIGPRA}} | {{item. HIGPRF }} | {{item. HIGPRV}} | | {%tr endfor %} | | | | | {{HIGPRImage}} |
| Table ‑: Highveld PR and Forecast | Figure ‑: Highveld PR Vs Forecast |

Harmattan notes that the plant has performed below the expected forecast with a maximum deviation of -21.43 % in July and a minimum deviation of -11.56% in April. Harmattan notes that the plant performance has not improved since COD to date. The Operator has stated that the underperformance of the plant is due to the bad weather condition resulting in a lower irradiance than expected and the loadshedding event that results in production loss since the inverter cannot be operational for safety reason.

# Events

## Scheduled Maintenance

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Monitoring Intervals** | **Interval** | **Durbanville** | **Vergelegen** | **Midstream** | **Hermanus** | **Highveld** |
| Continuously monitor the performance of the plant, considering Irradiance. | Daily |  |  |  | Completed/ Overdue |  |
| Check that all inverters perform as they should | Daily |  |  |  |  |  |
| Keep track of the long-term performance of the plant | Monthly |  |  |  |  |  |
| Thermal image report of PV modules and Electrical (AC and DC) connections. | Annually |  |  |  |  |  |
| Ensure that the router and sim card is loaded with enough data to ensure uninterrupted remote monitoring and data acquisition for the next two to three months | Monthly |  |  |  |  |  |
| License fees are paid up to ensure the continued monitoring of the Energy Project | Monthly |  |  |  |  |  |
| Maintain a log of cumulative power delivery (kWh to date) and chart this value against date and reference yield. Explain variation by season, weather, or site-based activities. | Monthly |  |  |  |  |  |
| Maintain a log of lost energy generation and motivate when deemed energy can be claimed | Daily |  |  |  |  |  |

Table ‑: Scheduled Maintenance

## Unscheduled Maintenance

The following table describes the unscheduled maintenance activities that have occurred since COD.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Date Occurred | Plant | Events | Description | Resolution |
| 9/5/2022 | Durbanville | The communication is down in, and the inverters are not producing. | Communication between inverters and logger is interrupted and inverters show no production - idle status.  It has been determined that UPS has failed for communication on block 3, causing communication to be interrupted. The UPS has failed without external causes. | The UPS was repaired on 10 May 2022. The estimated production downtime is 8 hours. |
| 9/5/2022 | Durbanville | Inverter 5 - no production - string fault. | The inverter went into fault mode because one string had an abnormal voltage reading to earth.  String 5.4.1 had an insulation fault and there was a voltage leakage into the earth system.  The fault could not be corrected within 24 hours because no team was available at that time to lift the equipment and find the fault. | On 27 May 2022, the faulty string was disconnected from the inverter to resume production, and a new connector was attached to the undamaged piece of cable.  The fault resulted in a production loss of 175 kWh. |
| 3/7/2022 | Durbanville | Inverters 4 to 7 no production | No link between the logger and inverters 4 to 7.  The UPS for the PA link has failed | On 4 July 2022,  a new part (UPS) was installed  The production loss hour is 5.5 hours |
| 21/04/2022 | Durbanville | Module shading |  | No reports were provided to confirm if the issue was resolved... |
| 22/02/2022 | Vergelegen | Block 1, inverter 2, large DC of output current | Inverter 2 had a string fault that caused a high output DCcurrent.  It was determined on site that inverter 2, string 2.2.1, had an open circuit voltage reading. The MC4 connection on the module array of string 2.2.1 failed due to a hot connection and melted, causing an open circuit connection. | On 23 February 2022, the MC4 was removed, the cables were reconnected, and a new MC4 was installed and properly connected to ensure continuity. The string was retested and found to be functional.  The estimated production loss is 68.85 kWp. |
| 25/05/2022 | Hermanus | Main circuit breakers not switching on | The main circuit breakers at the feeder and PVDB do not want to turn on automatically.  It was determined on site that the UFD, which automatically turns the circuit breakers on and off, has failed. | 0n 26 May 2022, the UFD was replaced by another UFD.  The production downtime is 9 hours. |
|  |  |  |  |  |

## Spare Parts

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Major Parts List – 2022 | Maximum QTY | Durbanville QTY | Vergelegen QTY | Midstream QTY | Hermanus QTY | Highveld QTY |
| SUN2000 100KTL Inverter | 1 |  |  |  |  |  |
| SUN2000 50KTL Inverter | 1 |  |  |  |  |  |
| 630A CB | 1 |  |  |  |  |  |
| 200A CB | 1 |  |  |  |  |  |
| 100A CB | 1 |  |  |  |  |  |
| Motorised Breaker Mechanism | 1 |  |  |  |  |  |
| JA Solar 540 W modules | 10 |  |  |  |  |  |

Table ‑: Major Spare parts

# Project Budget

The table below lists the monthly scheduled maintenance that has been performed from COD to present. Harmattan has reviewed the scheduled maintenance for each facility.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Project Budget | | | | | | | |
| Site | | Monitoring | **Satellite Data** | **Site Maintenance & Cleaning** | **Administration** | **Spare Parts** | **Total Cost** |
| Durbanville | F | R7'785.83 | R9'673.89 | R37'191.36 | R15'000.00 |  | R69'651.08 |
| A |  |  |  |  |  |  |
| Δ (%) |  |  |  |  |  |  |
| Vergelegen | F | R7'702.96 | R9'673.89 | R36'879.36 | R15'000.00 |  | R69'256.21 |
| A |  |  |  |  |  |  |
| Δ (%) |  |  |  |  |  |  |
| Midstream | F | R2'518.30 | R9'673.89 | R17'360.64 | R15'000.00 |  | R44'552.83 |
| A |  |  |  |  |  |  |
| Δ (%) |  |  |  |  |  |  |
| Tzaneen | F | R4'492.93 | R9'673.89 | R24'794.56 | R15'000.00 |  | R53'961.38 |
| A |  |  |  |  |  |  |
| Δ (%) |  |  |  |  |  |  |
| Highveld | F | R2'906.15 | R9'673.89 | R18'820.80 | R15'000.00 |  | R46'400.84 |
| A |  |  |  |  |  |  |
| Δ (%) |  |  |  |  |  |  |
| Hermanus | F | R2'339.29 | R9'673.89 | R16'686.72 | R15'000.00 |  | R43'699.90 |
| A |  |  |  |  |  |  |
| Δ (%) |  |  |  |  |  |  |
| **Totals** |  |  |  |  |  |  |  |

Table ‑: Operating Budget