Mediclin`ic Rooftop PV Projects: Monthly report

Prepared for:

Moshesh Partners

Reference No:

HAR\_215\_Moshesh Mediclinic Monthly Report

01 Sep 2022

Document Control

|  |  |  |  |
| --- | --- | --- | --- |
| Responsible for | Name | Date | Signature |
| Content | Mutali Nepfumbada | 26 May 2022 |  |
| Checked | René Stewart | 30 May2022 |  |
| Approved | Adam Terry | 30 May 2022 |  |
| Copyright: | Commercial in Confidence | Document Reference: | HAR\_215\_Moshesh Mediclinic Monthly Report |
| Signatures in this approval box have checked this document in line with quality procedures requirements  This document has been prepared by Harmattan with all reasonable skill and care. The document contains information from sources and data which we believe to be reliable, but we have not confirmed that reliability and make no representation as to their accuracy or completeness.  The document is confidential to the Client and Harmattan accepts no responsibility to any third party to whom information in this proposal may be disclosed. No part of this document may be reproduced without the prior written approval of Harmattan. | | | |

Table of Contents

[1. Executive Summary 4](#_Toc112872268)

[1.1. Sep Performance Summary 4](#_Toc112872269)

[1.1.1. Moshesh Mediclinic Durbanville Solar PV 4](#_Toc112872270)

[1.1.2. Moshesh Mediclinic Hermanus Solar PV 4](#_Toc112872271)

[1.1.3. Moshesh Mediclinic Highveld Solar PV 4](#_Toc112872272)

[1.1.4. Moshesh Mediclinic Midstream Solar PV 4](#_Toc112872273)

[1.1.5. Moshesh Mediclinic Vergelegen Solar PV 4](#_Toc112872274)

[1.2. Key Risks, Recommendations & Actions 5](#_Toc112872275)

[2. Portfolio Overview 6](#_Toc112872276)

[2.1. Scope of Work 6](#_Toc112872277)

[2.2. Site Visits 6](#_Toc112872278)

[3. Revenue 7](#_Toc112872279)

[3.1. Revenues This month 7](#_Toc112872280)

[4. Vergelegen Technical Performance 8](#_Toc112872281)

[4.1. Vergelegen Production vs Forecast 8](#_Toc112872282)

[4.2. Vergelegen Irradiation vs Forecast 8](#_Toc112872283)

[4.3. Vergelegen Availability vs Forecast 8](#_Toc112872284)

[4.1. Vergelegen Performance Ratio Vs Forecast 9](#_Toc112872285)

[5. Durbanville Technical Performance 10](#_Toc112872286)

[5.1. Durbanville Production vs Forecast 10](#_Toc112872287)

[5.2. Durbanville Irradiation vs Forecast 10](#_Toc112872288)

[5.3. Durbanville Availability vs Forecast 10](#_Toc112872289)

[5.4. Durbanville Performance Ratio Vs Forecast 11](#_Toc112872290)

[6. Midstream Technical Performance 12](#_Toc112872291)

[6.1. Midstream Production vs Forecast 12](#_Toc112872292)

[6.2. Midstream Irradiation vs Forecast 12](#_Toc112872293)

[6.3. Midstream Availability vs Forecast 12](#_Toc112872294)

[6.4. Midstream Performance Ratio Vs Forecast 13](#_Toc112872295)

[1.1. Hermanus Production vs Forecast 14](#_Toc112872296)

[1.4. Hermanus Performance Ratio Vs Forecast 15](#_Toc112872297)

[2.1. Highveld Production vs Forecast 16](#_Toc112872298)

[2.4. Highveld Performance Ratio Vs Forecast 17](#_Toc112872299)

[3. Events 18](#_Toc112872300)

[3.1. Scheduled Maintenance 18](#_Toc112872301)

[3.2. Unscheduled Maintenance 18](#_Toc112872302)

[3.3. Spare Parts 18](#_Toc112872303)

[4. Project Budget 19](#_Toc112872304)

List of Figures

[Figure 1: Revenue Year to Date 7](#_Toc112872305)

[Figure 3: Vergelegen Irradiation Vs Forecast 8](#_Toc112872306)

[Figure 4: Vergelegen Availability Vs Forecast 9](#_Toc112872307)

[Figure 5: Vergelegen PR Vs Forecast 9](#_Toc112872308)

[Figure 3: Durbanville Irradiation Vs Forecast 10](#_Toc112872309)

[Figure 4: Durbanville Availability Vs Forecast 11](#_Toc112872310)

[Figure 5: Durbanville PR Vs Forecast 11](#_Toc112872311)

[Figure 3: Midstream Irradiation Vs Forecast 12](#_Toc112872312)

[Figure 4: Midstream Availability Vs Forecast 13](#_Toc112872313)

[Figure 5: Midstream PR Vs Forecast 13](#_Toc112872314)

[Figure 2: Hermanus Production Vs Forecast 14](#_Toc112872315)

[Figure 3 Hermanus Irradiation Vs Forecast 14](#_Toc112872316)

[Figure 4:Hermanus Availability Vs Forecast 15](#_Toc112872317)

[Figure 5: Hermanus PR Vs Forecast 15](#_Toc112872318)

[Figure 2: Highveld Production Vs Forecast 16](#_Toc112872319)

[Figure 3 Highveld Irradiation Vs Forecast 16](#_Toc112872320)

[Figure 4:Highveld Availability Vs Forecast 17](#_Toc112872321)

[Figure 5: Highveld PR Vs Forecast 17](#_Toc112872322)

List of Tables

[Table 1: Project Overview 6](#_Toc112872323)

[Table 2: Project Revenue Overview 7](#_Toc112872324)

[*Table 13: Vergelegen Project Overview* 8](#_Toc112872325)

[Table 4: Vergelegen Production and Forecast 8](#_Toc112872326)

[Table 5: Vergelegen irradiation and Forecast 8](#_Toc112872327)

[Table 6: Vergelegen Availability and Guaranteeed 9](#_Toc112872328)

[Table 7: Vergelegen PR and Forecast 9](#_Toc112872329)

[*Table 8:Durbanville Project Overview* 10](#_Toc112872330)

[Table 4: Durbanville Production and Forecast 10](#_Toc112872331)

[Table 5: Durbanville irradiation and Forecast 10](#_Toc112872332)

[Table 6: Durbanville Availability and Guaranteeed 11](#_Toc112872333)

[Table 7: Durbanville PR and Forecast 11](#_Toc112872334)

[*Table 23: Midstream Project Overview* 12](#_Toc112872335)

[Table 4: Midstream Production and Forecast 12](#_Toc112872336)

[Table 5: Midstream irradiation and Forecast 12](#_Toc112872337)

[Table 6: Midstream Availability and Guaranteeed 13](#_Toc112872338)

[Table 7: Midstream PR and Forecast 13](#_Toc112872339)

[*Table 3: Hermanus Project Overview* 14](#_Toc112872340)

[Table 4: Hermanus Production and Forecast 14](#_Toc112872341)

[Table 5: Hermanus irradiation and Forecast 14](#_Toc112872342)

[Table 6: Hermanus Availability and Forecast 15](#_Toc112872343)

[Table 7: Hermanus PR and Forecast 15](#_Toc112872344)

[*Table 18: Highveld Project Overview* 16](#_Toc112872345)

[Table 4: Highveld Production and Forecast 16](#_Toc112872346)

[Table 5: Highveld irradiation and Forecast 16](#_Toc112872347)

[Table 6: Highveld Availability and Forecast 17](#_Toc112872348)

[Table 7: Highveld PR and Forecast 17](#_Toc112872349)

[Table 28: Scheduled Maintenace 18](#_Toc112872350)

[Table 29: Major Spare parts 18](#_Toc112872351)

[Table 30: Operating Budget 19](#_Toc112872352)

Abbreviations

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

Glossary of Terms

|  |  |
| --- | --- |
| Outages | Carrying out preventive maintenance work can mean the implicit disconnection of:  The whole plant: This will only happen when working on the whole substation.  Grouping of blocks: This situation will arise when working on equipment that connects various blocks at the same time (transformers, MV cabling, etc.…)  Whole blocks: This situation will arise when working on the transformer or inverter of a block.  Parts of a block: This will occur when we are working on PV module junction boxes or DC combiner boxes.  No disconnection: When working on auxiliary equipment (security system, SCADA, fire fighting equipment, etc.…), or when working on the PV installation, the work does not involve an electrical risk (cleaning the modules, visual inspection, etc.…) Frequency: Is the frequency with which each of the jobs is carried out. |
| Communication systems | Are those systems that are common to all the blocks that make up the plant, for example, the security system, SCADA, perimeter fence, fire equipment, etc. |
| DC Combiner Boxes | The boxes where all the DC strings are combined. AC cabling: Comprises all AC cabling on the entire plant including the MV cabling between the 22kV transformers and the IPP substation. |
| DC Cabling | Comprises the cabling between the modules, as well as the cabling between the combiner boxes and the inverters. |

# Executive Summary

## Sep Performance Summary

### Moshesh Mediclinic Durbanville Solar PV

* Production is 43182.7 KWh with a variance of -33.37% below the forecast.
* Irradiation is 105.7 kWh/m2 with a variance of -7.52 % below forecast.
* Availability is 89.31 % with a variance of -8.87 % above the warranted availability.
* PR is 57.9 % with a variance of 57.9 % below warranted availability.

### Moshesh Mediclinic Hermanus Solar PV

* Production is 15231.91 KWh with a variance of -13.84% below the forecast.
* Irradiation is 94.09 kWh/m2 with a variance of -1.79 % below forecast.
* Availability is 88.05 % with a variance of -10.15 % above the warranted availability.
* PR is 76.4 % with a variance of -12.35 % below warranted availability.

### Moshesh Mediclinic Highveld Solar PV

* Production is 42440.4 KWh with a variance of -32.55% below the forecast.
* Irradiation is 82.51 kWh/m2 with a variance of -60.58 % below forecast.
* Availability is 91.65 % with a variance of -10.15 % above the warranted availability.
* PR is 71.95 % with a variance of -19.59 % below warranted availability.

### Moshesh Mediclinic Midstream Solar PV

* Production is 20957.11 KWh with a variance of -20.18% below the forecast.
* Irradiation is 95.74 kWh/m2 with a variance of -31.76 % below forecast.
* Availability is 93.77 % with a variance of -4.32 % above the warranted availability.
* PR is 73.19 % with a variance of -10.86 % below warranted availability.

### Moshesh Mediclinic Vergelegen Solar PV

* Production is 42440.4 KWh with a variance of -10.65% below the forecast.
* Irradiation is 82.51 kWh/m2 with a variance of -0.1 % below forecast.
* Availability is 91.65 % with a variance of -6.48 % above the warranted availability.
* PR is 71.95 % with a variance of -12.78 % below warranted availability.

## Key Risks, Recommendations & Actions

The following key risk were identiﬁed in report month.

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

# 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 1: 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 This month

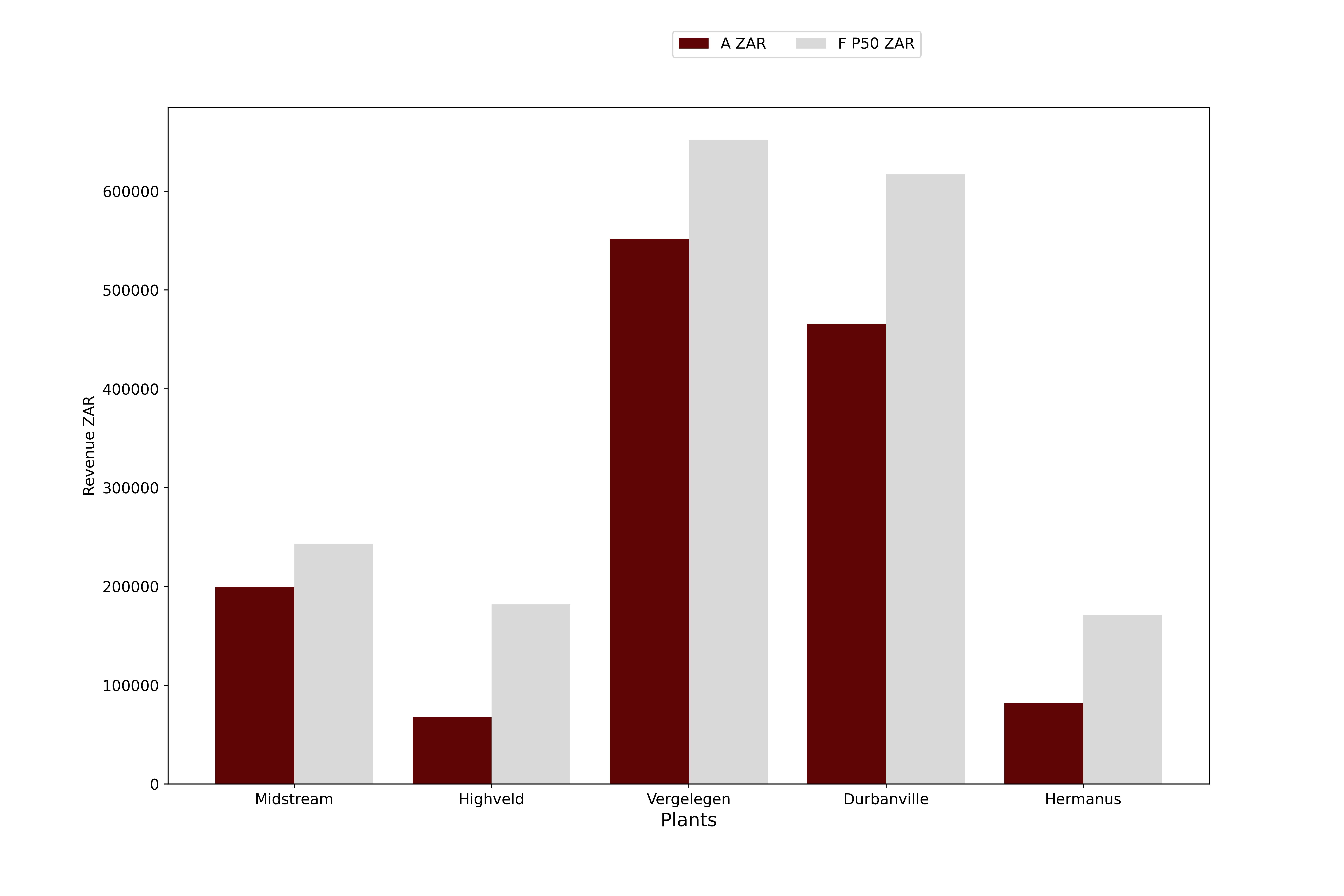


Figure 1: Revenue Year to Date

|  |  |  |  |
| --- | --- | --- | --- |
| Plants | Actual ZAR | Forecast ZAR | Var % |
| Mediclinic Durbanville | 42149.02 | 47715.92 | -12% |
| Mediclinic Vergelegen | 37110.00 | 36465.55 | 2% |
| Mediclinic Highveld | 21364.50 | 24253.22 | -12% |
| Mediclinic Midstream | 18145.07 | 20377.57 | -11% |
| Mediclinic Hermanus | 17771.48 | 17225.23 | 3% |

Table 2: Project Revenue Overview

# Vergelegen Technical Performance

Technical performance tables and figures below give details on plant Gross Generation, Irradiation, Availability and Performance Ratio compared against the forecast/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 13: Vergelegen Project Overview

## Vergelegen Production vs Forecast

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Date | Actual  kWh | Forecast  kWh | Δ % | W% | Δ | | Oct | 15875.7 | 106909.0 | -85.15 |  |  | | Nov | 114666.8 | 124191.3 | -7.67 |  |  | | Dec | 126249.6 | 135649.0 | -6.93 |  |  | | Jan | 127624.6 | 134331.04 | -4.99 |  |  | | Feb | 96946.4 | 108571.18 | -10.71 |  |  | | Mar | 94648.1 | 100729.11 | -6.04 |  |  | | Apr | 70139.1 | 70910.55 | -1.09 |  |  | | May | 52487.9 | 51576.41 | 1.77 |  |  | | Jun | 39237.9 | 41981.69 | -6.54 |  |  | | Jul | 42440.4 | 47500.46 | -10.65 |  |  | |
| Table 4: Vergelegen Production and Forecast |
| Figure 2: Vergelegen Production Vs Forecast |

Gross energy generated is 881,659.00 kWh with a deviation of 12.07% from forecast and 0.33% from weather-adjusted expected energy. The low generation is due to  inverter 2EO2 buffer module failing during  start-up. The buffer module was replaced on 22 March 2022, resulting in a production loss of 15015.00 kWh. The weather-adjusted expectation shows that the energy was also affected by the low irradiance, as there was little difference between the weather-adjusted expected energy and the actual generation. See Appendix G for daily generation versus Irradiation. The total gross generation YTD is still below the forecast with a variance of 3.36%. .

## Vergelegen Irradiation vs Forecast

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | Date | Actual  % | Guaranteed  % | Δ % | | Oct | 0.0 | 192.8 | -100.0 | | Nov | 0.0 | 227.7 | -100.0 | | Dec | 0.0 | 252.1 | -100.0 | | Jan | 0.0 | 250.6 | -100.0 | | Feb | 0.0 | 201.5 | -100.0 | | Mar | 38.21 | 185.2 | -79.37 | | Apr | 121.69 | 127.1 | -4.25 | | May | 92.27 | 90.9 | 1.51 | | Jun | 82.07 | 73.4 | 11.81 | | Jul | 82.51 | 82.6 | -0.1 | |  |
| Table 5: Vergelegen irradiation and Forecast | Figure 3: Vergelegen Irradiation Vs Forecast |

The irradiation is 166.76 kWh/m2 with a deviation of 11.78% from the forecast. 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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | Date | Actual  % | Guaranteed  % | Δ % | | Oct | 15.83 | 98 | -83.85 | | Nov | 92.2 | 98 | -5.92 | | Dec | 100.0 | 98 | 2.04 | | Jan | 98.83 | 98 | 0.85 | | Feb | 99.29 | 98 | 1.32 | | Mar | 100.0 | 98 | 2.04 | | Apr | 96.83 | 98 | -1.19 | | May | 99.26 | 98 | 1.29 | | Jun | 92.02 | 98 | -6.1 | | Jul | 91.65 | 98 | -6.48 | |  |
| Table 6: Vergelegen Availability and Guaranteeed | Figure 4: Vergelegen Availability Vs Forecast |

The plant achieved an availability of 97.67% with a deviation of 2.81% above the guaranteed availability of 95%. This availability does not correspond to the 98% availability stated in the juwi O&M report. The small deviation was caused by a communication failure on 01 March 2022 which affected the SCADA data. This caused the SCADA to report an incorrect value of 87.81%, which was corrected in the O&M report. The primary cause of the loss of plant availability was the inverter buffer module failure during startup from 17 March 2022 to 22 March 2022.

## Vergelegen Performance Ratio Vs Forecast

The following table and graph compare the Scada performance ratio against the monthly guaranteed PR.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | Date | Actual  % | Guaranteed  % | Δ % | | Oct | 0.0 | 0.0 | 0 | | Nov | 0.0 | 0.0 | 0 | | Dec | 0.0 | 0.0 | 0 | | Jan | nan | 76.9 | nan | | Feb | 0.0 | 77.29 | -100.0 | | Mar | 82.45 | 78.02 | 5.68 | | Apr | 73.31 | 80.03 | -8.4 | | May | 77.96 | 81.39 | -4.21 | | Jun | 68.44 | 82.05 | -16.58 | | Jul | 71.95 | 82.49 | -12.78 | |  |
| Table 7: Vergelegen PR and Forecast | Figure 5: Vergelegen PR Vs Forecast |

The above analysis calculates the performance ratio with the degradation factor Dn for the 9th year of operation with a degradation factor of 0.9646.

The PR evaluated by Harmattan is 75.47% without degradation factor and 77.93% with degradation. This does not match the PR given in the SCADA, Juwi and Management report for the month of March. The following table compares the Harmattan PR with the SCADA, Management and Juwi reports..

# Durbanville Technical Performance

Technical performance tables and figures below give details on plant Gross Generation, Irradiation, Availability and Performance Ratio compared against the forecast/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 8:Durbanville Project Overview*

## Durbanville Production vs Forecast

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Date | Actual  kWh | Forecast  kWh | Δ % | W% | Δ | | Oct | 0.0 | 0.0 | 0 |  |  | | Nov | 67694.7 | 122450.0 | -44.72 |  |  | | Dec | 94632.7 | 130720.8 | -27.61 |  |  | | Jan | 100806.4 | 130944.06 | -23.02 |  |  | | Feb | 91369.8 | 111813.67 | -18.28 |  |  | | Mar | 89806.3 | 111969.25 | -19.79 |  |  | | Apr | 70141.5 | 85867.72 | -18.31 |  |  | | May | 60420.9 | 68401.09 | -11.67 |  |  | | Jun | 49555.8 | 58421.74 | -15.18 |  |  | | Jul | 43182.7 | 64810.21 | -33.37 |  |  | |
| Table 4: Durbanville Production and Forecast |
| Figure 2: Durbanville Production Vs Forecast |

Gross energy generated is 881,659.00 kWh with a deviation of 12.07% from forecast and 0.33% from weather-adjusted expected energy. The low generation is due to  inverter 2EO2 buffer module failing during  start-up. The buffer module was replaced on 22 March 2022, resulting in a production loss of 15015.00 kWh. The weather-adjusted expectation shows that the energy was also affected by the low irradiance, as there was little difference between the weather-adjusted expected energy and the actual generation. See Appendix G for daily generation versus Irradiation. The total gross generation YTD is still below the forecast with a variance of 3.36%.

## Durbanville Irradiation vs Forecast

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | Date | Actual  % | Guaranteed  % | Δ % | | Oct | 0.0 | 0.0 | 0 | | Nov | 0.0 | 226.4 | -100.0 | | Dec | 0.0 | 243.9 | -100.0 | | Jan | 0.0 | 245.7 | -100.0 | | Feb | 0.0 | 208.7 | -100.0 | | Mar | 35.13 | 208.7 | -83.17 | | Apr | 126.11 | 156.9 | -19.62 | | May | 118.87 | 122.1 | -2.65 | | Jun | 103.47 | 103.1 | 0.36 | | Jul | 105.7 | 114.3 | -7.52 | |  |
| Table 5: Durbanville irradiation and Forecast | Figure 3: Durbanville Irradiation Vs Forecast |

The irradiation is 166.76 kWh/m2 with a deviation of 11.78% from the forecast. 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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | Date | Actual  % | Guaranteed  % | Δ % | | Oct | -0.01 | 98 | -100.01 | | Nov | 68.81 | 98 | -29.79 | | Dec | 100.0 | 98 | 2.04 | | Jan | 88.6 | 98 | -9.59 | | Feb | 99.05 | 98 | 1.07 | | Mar | 100.0 | 98 | 2.04 | | Apr | 96.77 | 98 | -1.26 | | May | 90.56 | 98 | -7.59 | | Jun | 95.26 | 98 | -2.8 | | Jul | 89.31 | 98 | -8.87 | |  |
| Table 6: Durbanville Availability and Guaranteeed | Figure 4: Durbanville Availability Vs Forecast |

The plant achieved an availability of 97.67% with a deviation of 2.81% above the guaranteed availability of 95%. This availability does not correspond to the 98% availability stated in the juwi O&M report. The small deviation was caused by a communication failure on 01 March 2022 which affected the SCADA data. This caused the SCADA to report an incorrect value of 87.81%, which was corrected in the O&M report. The primary cause of the loss of plant availability was the inverter buffer module failure during startup from 17 March 2022 to 22 March 2022.

## Durbanville Performance Ratio Vs Forecast

The following table and graph compare the Scada performance ratio against the monthly guaranteed PR.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | Date | Actual  % | Guaranteed  % | Δ % | | Oct | 0.0 | 0.0 | 0 | | Nov | 0.0 | 0.0 | 0 | | Dec | 0.0 | 0.0 | 0 | | Jan | 0.0 | 75.64 | -100.0 | | Feb | 0.0 | 76.04 | -100.0 | | Mar | 86.14 | 76.14 | 13.13 | | Apr | 59.89 | 77.67 | -22.89 | | May | 71.88 | 79.51 | -9.59 | | Jun | 67.48 | 80.42 | -16.1 | | Jul | 57.9 | 80.47 | -28.05 | |  |
| Table 7: Durbanville PR and Forecast | Figure 5: Durbanville PR Vs Forecast |

The above analysis calculates the performance ratio with the degradation factor Dn for the 9th year of operation with a degradation factor of 0.9646.

The PR evaluated by Harmattan is 75.47% without degradation factor and 77.93% with degradation. This does not match the PR given in the SCADA, Juwi and Management report for the month of March. The following table compares the Harmattan PR with the SCADA, Management and Juwi reports.

# Midstream Technical Performance

Technical performance tables and figures below give details on plant Gross Generation, Irradiation, Availability and Performance Ratio compared against the forecast/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 23: Midstream Project Overview*

## Midstream Production vs Forecast

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Date | Actual  kWh | Forecast  kWh | Δ % | W% | Δ | | Oct | 4349.6 | 35710.0 | -87.82 |  |  | | Nov | 18453.8 | 35427.2 | -47.91 |  |  | | Dec | 48330.8 | 37840.0 | 27.72 |  |  | | Jan | 34169.2 | 36357.19 | -6.02 |  |  | | Feb | 32936.6 | 31490.67 | 4.59 |  |  | | Mar | 29032.3 | 32436.4 | -10.49 |  |  | | Apr | 23635.8 | 27151.55 | -12.95 |  |  | | May | 23406.5 | 26286.34 | -10.96 |  |  | | Jun | 21763.2 | 23827.62 | -8.66 |  |  | | Jul | 20957.11 | 26254.38 | -20.18 |  |  | |
| Table 4: Midstream Production and Forecast |
| Figure 2: Midstream Production Vs Forecast |

Gross energy generated is 881,659.00 kWh with a deviation of 12.07% from forecast and 0.33% from weather-adjusted expected energy. The low generation is due to  inverter 2EO2 buffer module failing during  start-up. The buffer module was replaced on 22 March 2022, resulting in a production loss of 15015.00 kWh. The weather-adjusted expectation shows that the energy was also affected by the low irradiance, as there was little difference between the weather-adjusted expected energy and the actual generation. See Appendix G for daily generation versus Irradiation. The total gross generation YTD is still below the forecast with a variance of 3.36%. .

## Midstream Irradiation vs Forecast

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | Date | Actual  % | Guaranteed  % | Δ % | | Oct | 0.0 | 201.1 | -100.0 | | Nov | 0.0 | 199.6 | -100.0 | | Dec | 0.0 | 214.9 | -100.0 | | Jan | 0.0 | 208.5 | -100.0 | | Feb | 0.0 | 177.3 | -100.0 | | Mar | 43.04 | 180.8 | -76.19 | | Apr | 116.89 | 149.1 | -21.6 | | May | 137.18 | 141.7 | -3.19 | | Jun | 92.15 | 127.2 | -27.55 | | Jul | 95.74 | 140.3 | -31.76 | |  |
| Table 5: Midstream irradiation and Forecast | Figure 3: Midstream Irradiation Vs Forecast |

The irradiation is 166.76 kWh/m2 with a deviation of 11.78% from the forecast. 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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | Date | Actual  % | Guaranteed  % | Δ % | | Oct | 100.0 | 98 | 2.04 | | Nov | 100.0 | 98 | 2.04 | | Dec | 100.0 | 98 | 2.04 | | Jan | 0.0 | 98 | -100.0 | | Feb | 64.27 | 98 | -34.42 | | Mar | 100.0 | 98 | 2.04 | | Apr | 96.69 | 98 | -1.34 | | May | 95.94 | 98 | -2.1 | | Jun | 100.0 | 98 | 2.04 | | Jul | 93.77 | 98 | -4.32 | |  |
| Table 6: Midstream Availability and Guaranteeed | Figure 4: Midstream Availability Vs Forecast |

The plant achieved an availability of 97.67% with a deviation of 2.81% above the guaranteed availability of 95%. This availability does not correspond to the 98% availability stated in the juwi O&M report. The small deviation was caused by a communication failure on 01 March 2022 which affected the SCADA data. This caused the SCADA to report an incorrect value of 87.81%, which was corrected in the O&M report. The primary cause of the loss of plant availability was the inverter buffer module failure during startup from 17 March 2022 to 22 March 2022.

## Midstream Performance Ratio Vs Forecast

The following table and graph compare the Scada performance ratio against the monthly guaranteed PR.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | Date | Actual  % | Guaranteed  % | Δ % | | Oct | 0.0 | 0.0 | 0 | | Nov | 0.0 | 0.0 | 0 | | Dec | 0.0 | 0.0 | 0 | | Jan | 0.0 | 76.51 | -100.0 | | Feb | 0.0 | 77.93 | -100.0 | | Mar | 86.96 | 78.72 | 10.46 | | Apr | 81.26 | 79.9 | 1.71 | | May | 74.75 | 81.4 | -8.17 | | Jun | 77.95 | 82.2 | -5.17 | | Jul | 73.19 | 82.11 | -10.86 | |  |
| Table 7: Midstream PR and Forecast | Figure 5: Midstream PR Vs Forecast |

The above analysis calculates the performance ratio with the degradation factor Dn for the 9th year of operation with a degradation factor of 0.9646.

The PR evaluated by Harmattan is 75.47% without degradation factor and 77.93% with degradation. This does not match the PR given in the SCADA, Juwi and Management report for the month of March. The following table compares the Harmattan PR with the SCADA, Management and Juwi reports.

1. Hermanus Technical Performance

Technical performance tables and figures below give details on plant Gross Generation, Irradiation, Availability and Performance Ratio compared against the forecast/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 3: Hermanus Project Overview*

## Hermanus Production vs Forecast

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Date | Actual  kWh | Forecast  kWh | Δ % | W% | Δ | | Oct | 0.0 | 0.0 | 0 |  |  | | Nov | 0.0 | 0.0 | 0 |  |  | | Dec | 0.0 | 0.0 | 0 |  |  | | Jan | 0.0 | 42603.49 | -100.0 |  |  | | Feb | 0.0 | 35030.76 | -100.0 |  |  | | Mar | 17949.2 | 33133.54 | -45.83 |  |  | | Apr | 21947.0 | 24642.89 | -10.94 |  |  | | May | 19453.0 | 18855.06 | 3.17 |  |  | | Jun | 15026.09 | 15568.68 | -3.49 |  |  | | Jul | 15231.91 | 17678.79 | -13.84 |  |  | |
| Table 4: Hermanus Production and Forecast |
| Figure 2: Hermanus Production Vs Forecast |

Gross energy generated is 881,659.00 kWh with a deviation of 12.07% from forecast and 0.33% from weather-adjusted expected energy. The low generation is due to  inverter 2EO2 buffer module failing during  start-up. The buffer module was replaced on 22 March 2022, resulting in a production loss of 15015.00 kWh. The weather-adjusted expectation shows that the energy was also affected by the low irradiance, as there was little difference between the weather-adjusted expected energy and the actual generation. See Appendix G for daily generation versus Irradiation. The total gross generation YTD is still below the forecast with a variance of 3.36%.

* 1. Hermanus Irradiation vs Forecast

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | Date | Actual  % | Guaranteed  % | Δ % | | Oct | 0.0 | 0.0 | 0 | | Nov | 0.0 | 0.0 | 0 | | Dec | 0.0 | 0.0 | 0 | | Jan | 0.0 | 200.9 | -100.0 | | Feb | 0.0 | 176.0 | -100.0 | | Mar | 0.0 | 186.0 | -100.0 | | Apr | 51.63 | 156.2 | -66.95 | | May | 138.66 | 155.2 | -10.66 | | Jun | 19.35 | 141.3 | -86.31 | | Jul | 60.82 | 154.3 | -60.58 | |  |
| Table 5: Hermanus irradiation and Forecast | Figure 3 Hermanus Irradiation Vs Forecast |

The irradiation is 166.76 kWh/m2 with a deviation of 11.78% from the forecast. 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.

* 1. Hermanus Availability vs Forecast

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | Date | Actual  % | Guaranteed  % | Δ % | | Oct | 0.0 | 98 | -100.0 | | Nov | 0.0 | 98 | -100.0 | | Dec | 0.0 | 98 | -100.0 | | Jan | 0.0 | 98 | -100.0 | | Feb | 0.0 | 98 | -100.0 | | Mar | 100.0 | 98 | 2.04 | | Apr | 93.46 | 98 | -4.63 | | May | 95.92 | 98 | -2.12 | | Jun | 91.82 | 98 | -6.31 | | Jul | 88.05 | 98 | -10.15 | |  |
| Table 6: Hermanus Availability and Forecast | Figure 4:Hermanus Availability Vs Forecast |

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Aenean ac ligula consectetur velit dignissim aliquam in vel est. Morbi quis lorem metus. Etiam sed erat sed sapien rhoncus fringilla. Etiam luctus, tellus nec porttitor placerat, quam sem dignissim tortor, ac aliquam eros justo ac arcu. Vivamus justo ante, sollicitudin eget posuere vitae, ultrices et quam. Donec sed sodales felis. Praesent gravida orci nec orci faucibus, eu tincidunt elit vestibulum.

## Hermanus Performance Ratio Vs Forecast

The following table and graph compare the Scada performance ratio against the monthly guaranteed PR.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | Date | Actual  % | Guaranteed  % | Δ % | | Oct | 0.0 | 0.0 | 0 | | Nov | 0.0 | 0.0 | 0 | | Dec | 0.0 | 0.0 | 0 | | Jan | 0.0 | 84.7 | -100.0 | | Feb | 0.0 | 84.9 | -100.0 | | Mar | 100.41 | 85.06 | 18.04 | | Apr | 78.08 | 86.03 | -9.24 | | May | 81.53 | 86.55 | -5.8 | | Jun | 78.95 | 86.62 | -8.85 | | Jul | 76.4 | 87.17 | -12.35 | |  |
| Table 7: Hermanus PR and Forecast | Figure 5: Hermanus PR Vs Forecast |

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Aenean ac ligula consectetur velit dignissim aliquam in vel est. Morbi quis lorem metus. Etiam sed erat sed sapien rhoncus fringilla. Etiam luctus, tellus nec porttitor placerat, quam sem dignissim tortor, ac aliquam eros justo ac arcu. Vivamus justo ante, sollicitu

1. Highveld Technical Performance

Technical performance tables and figures below give details on plant Gross Generation, Irradiation, Availability and Performance Ratio compared against the forecast/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 18: Highveld Project Overview*

## Highveld Production vs Forecast

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Date | Actual  kWh | Forecast  kWh | Δ % | W% | Δ | | Oct | 0.0 | 0.0 | 0 |  |  | | Nov | 0.0 | 0.0 | 0 |  |  | | Dec | 0.0 | 0.0 | 0 |  |  | | Jan | 0.0 | 40931.67 | -100.0 |  |  | | Feb | 0.0 | 35932.82 | -100.0 |  |  | | Mar | 0.0 | 38047.27 | -100.0 |  |  | | Apr | 21643.97 | 32408.21 | -33.21 |  |  | | May | 28195.21 | 32007.52 | -11.91 |  |  | | Jun | 17909.61 | 29209.23 | -38.69 |  |  | | Jul | 21623.06 | 32059.25 | -32.55 |  |  | |
| Table 4: Highveld Production and Forecast |
| Figure 2: Highveld Production Vs Forecast |

Gross energy generated is 881,659.00 kWh with a deviation of 12.07% from forecast and 0.33% from weather-adjusted expected energy. The low generation is due to inverter 2EO2 buffer module failing during start-up. The buffer module was replaced on 22 March 2022, resulting in a production loss of 15015.00 kWh. The weather-adjusted expectation shows that the energy was also affected by the low irradiance, as there was little difference between the weather-adjusted expected energy and the actual generation. See Appendix G for daily generation versus Irradiation. The total gross generation YTD is still below the forecast with a variance of 3.36%.

* 1. Highveld Irradiation vs Forecast

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | Date | Actual  % | Guaranteed  % | Δ % | | Oct | 0.0 | 0.0 | 0 | | Nov | 0.0 | 0.0 | 0 | | Dec | 0.0 | 0.0 | 0 | | Jan | 0.0 | 200.9 | -100.0 | | Feb | 0.0 | 176.0 | -100.0 | | Mar | 0.0 | 186.0 | -100.0 | | Apr | 51.63 | 156.2 | -66.95 | | May | 138.66 | 155.2 | -10.66 | | Jun | 19.35 | 141.3 | -86.31 | | Jul | 60.82 | 154.3 | -60.58 | |  |
| Table 5: Highveld irradiation and Forecast | Figure 3 Highveld Irradiation Vs Forecast |

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Aenean ac ligula consectetur velit dignissim aliquam in vel est. Morbi quis lorem metus. Etiam sed erat sed sapien rhoncus fringilla. Etiam luctus, tellus nec porttitor placerat, quam sem dignissim tortor, ac aliquam eros justo ac arcu. Vivamus justo ante, sollicitudin eget posuere vitae, ultrices et quam. Donec sed sodales felis. Praesent gravida orci nec orci faucibus, eu tincidunt elit vestibulum.

* 1. Highveld Availability vs Forecast

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | Date | Actual  % | Guaranteed  % | Δ % | | Oct | 0.0 | 98 | -100.0 | | Nov | 0.0 | 98 | -100.0 | | Dec | 0.0 | 98 | -100.0 | | Jan | 0.0 | 98 | -100.0 | | Feb | 0.0 | 98 | -100.0 | | Mar | 100.0 | 98 | 2.04 | | Apr | 95.0 | 98 | -3.06 | | May | 97.61 | 98 | -0.4 | | Jun | 94.65 | 98 | -3.42 | | Jul | 94.95 | 98 | -3.11 | |  |
| Table 6: Highveld Availability and Forecast | Figure 4:Highveld Availability Vs Forecast |

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Aenean ac ligula consectetur velit dignissim aliquam in vel est. Morbi quis lorem metus. Etiam sed erat sed sapien rhoncus fringilla. Etiam luctus, tellus nec porttitor placerat, quam sem dignissim tortor, ac aliquam eros justo ac arcu. Vivamus justo ante, sollicitudin eget posuere vitae, ultrices et quam. Donec sed sodales felis. Praesent gravida orci nec orci faucibus, eu tincidunt elit vestibulum.

## Highveld Performance Ratio Vs Forecast

The following table and graph compare the Scada performance ratio against the monthly guaranteed PR.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | Date | Actual  % | Guaranteed  % | Δ % | | Oct | 0.0 | 0.0 | 0 | | Nov | 0.0 | 0.0 | 0 | | Dec | 0.0 | 0.0 | 0 | | Jan | 0.0 | 77.56 | -100.0 | | Feb | 0.0 | 77.72 | -100.0 | | Mar | 0.0 | 77.87 | -100.0 | | Apr | 69.85 | 78.98 | -11.56 | | May | 66.9 | 78.51 | -14.79 | | Jun | 61.82 | 78.69 | -21.43 | | Jul | 63.6 | 79.09 | -19.59 | |  |
| Table 7: Highveld PR and Forecast | Figure 5: Highveld PR Vs Forecast |

The above analysis calculates the performance ratio with the degradation factor Dn for the 9th year of operation with a degradation factor of 0.9646.

The PR evaluated by Harmattan is 75.47% without degradation factor and 77.93% with degradation. This does not match the PR given in the SCADA, Juwi and Management report for the month of March. The following table compares the Harmattan PR with the SCADA, Management and Juwi reports.

# 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 28: Scheduled Maintenance

## Unscheduled Maintenance

Corrective maintenance was performed on the 2EO1 inverter. The inverter's fan failed on 05 March 2022 and was replaced by SMA on 22 March 2022. The other corrective maintenance was performed on the buffer module of inverter 2EO2. The inverter failed during startup. The buffer module was also replaced on 22 March 2022. inverter 2EO1 fan failure did not affect the production, while the inverter buffer module resulted in a total loss of 15015.00 kWh.

Harmattan recommends negotiating with SMA to increase response time as the inverter fan was replaced 17 days after the incident and SMA took 5 days to replace the buffer module of the 2EO2 inverter.

## 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 29: Major Spare parts

# Project Budget

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

Table 30: Operating Budget