



Hornbill Drones

## Solar Inspection

Analysis report

13 Mar 2023

# Megawatts Solar Farm Aerial PV Inspection Report



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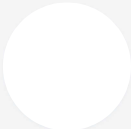
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Example of Anomalies

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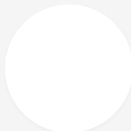
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# Site Summary

Site Name	Ramkrishna Industries
Location	17.3N   78.1E
Address	Shadnagar, Telengana
Inspected On	Sun, March 5, 2023
time of Day	01:46 PM IST

Results have been quality checked and reviewed for accuracy. Hornbill Drones software analysis checks for all of the following anomalies: Cell, Cell Multi, Combiner, Cracking, Delamination, Diode, Diode Multi, Hot Spot, Hot Spot Multi, Inverter, Junction Box, Module, Missing Modules, Shadowing, String, Tracker, Reverse Polarity, Vegetation, and Suspected PID. All RGB (color) and IR (thermal) imagery has been cross checked to tag the source of the anomaly



# Site Overview

## Company

NAME

Hornbill Drones

PHONE

+91-9742568404

EMAIL

contact@hornbilldrones.com

ADDRESS

WeWork Rajapushpa Summit |  
Nanakramguda Financial  
District | Hyderabad-500032 |  
India

## Site

POWER

1 MWdc

INVERTERS

SMA Sunny Highpower Peak1  
SHP75-10 75kW, SMA SMA SC  
500HE-US 500kW

MOUNT

Ground Mount

MODULE NAME

Jinko JKM240M 240W, Sunshine  
Sunny 240W

MODULE LAYOUT

14 modules per string

MODULE TECH

Multi Crystalline Technology

## Data Capture

UAS

M200

IMAGING  
SYSTEM

XT2

## Weather

HUMIDITY

55%

TEMPERATURE

27.49° C

CLOUD COVER

Clear

WIND SPEED

10.55 km/h

SOLAR RADIATION

720 W/m^2

## Findings

Anomaly	Anomalies *(1)	Modules *(2)	Est. Affected DC *(3)	Est. Affected DC *(4)	Est. Annual Impact (kWh) * (5)	Est. Annual Impact (\$) *(6)
Cell High	1	1	0.08 kW	0.00%	95.19 kWh	\$9.52
Cell Low	22	22	1.76 kW	0.03%	2094.19 kWh	\$209.42
Cell Medium	2	2	0.16 kW	0.00%	190.38 kWh	\$19.04
Cell Multi High	1	1	0.12 kW	0.00%	142.80 kWh	\$14.28
Cell Multi Low	53	53	6.36 kW	0.10%	7568.40 kWh	\$756.84
Cell Multi Medium	9	9	1.08 kW	0.02%	1285.20 kWh	\$128.52
Cracking	73	73	17.52 kW	0.27%	20848.80 kWh	\$2084.88
Damaged	2	2	0.48 kW	0.01%	571.20 kWh	\$57.12
Diode	192	192	15.36 kW	0.24%	18276.57 kWh	\$1827.66
Diode Multi	14	14	2.24 kW	0.04%	2665.61 kWh	\$266.56
Internal Short Circuit Low	9	9	2.16 kW	0.03%	2570.40 kWh	\$257.04

## Findings

Anomaly	Anomalies *(1)	Modules *(2)	Est. Affected DC *(3)	Est. Affected DC *(4)	Est. Annual Impact (kWh) *(5)	Est. Annual Impact (\$)* (6)
Diode Multi	14	14	2.24 kW	0.04%	2665.61 kWh	\$266.56
Internal Short Circuit Low	9	9	2.16 kW	0.03%	2570.40 kWh	\$257.04
Internal Short Circuit Medium	3	3	0.72 kW	0.01%	856.80 kWh	\$85.68
Junction Box High	1	1	0.24 kW	0.00%	285.60 kWh	\$28.56
Junction Box Low	1	1	0.24 kW	0.00%	285.60 kWh	\$28.56
Junction Box Medium	1	1	0.24 kW	0.00%	285.60 kWh	\$28.56
Missing	1	1	0.24 kW	0.00%	285.60 kWh	\$28.56
Module	4	4	0.96 kW	0.02%	1142.40 kWh	\$114.24
String	3	42	10.08 kW	0.16%	11995.20 kWh	\$1199.52
Underperforming String	9	126	30.24 kW	0.47%	35985.60 kWh	\$3598.56
Vegetation	39	39	3.12 kW	0.05%	3712.43 kWh	\$371.24

## Findings

Anomaly	Anomalies *(1)	Modules *(2)	Est. Affected DC *(3)	Est. Affected DC *(4)	Est. Annual Impact (kWh) *(5)	Est. Annual Impact (\$) *(6)
Totals	440	596	93.41 Kw	1.46%	111143.57Kwh	\$11114.36

\*(1) Anomalies: The number of instances of a specific anomaly.

\*(2) Modules: The number of modules affected by a specific anomaly.

\*(3) Est. Affected DC (kW): The estimated affected power is determined by multiplying the number of modules affected, the peak power of the solar module at STC, and a power factor ranging from 0 to 1 specific to the anomaly.

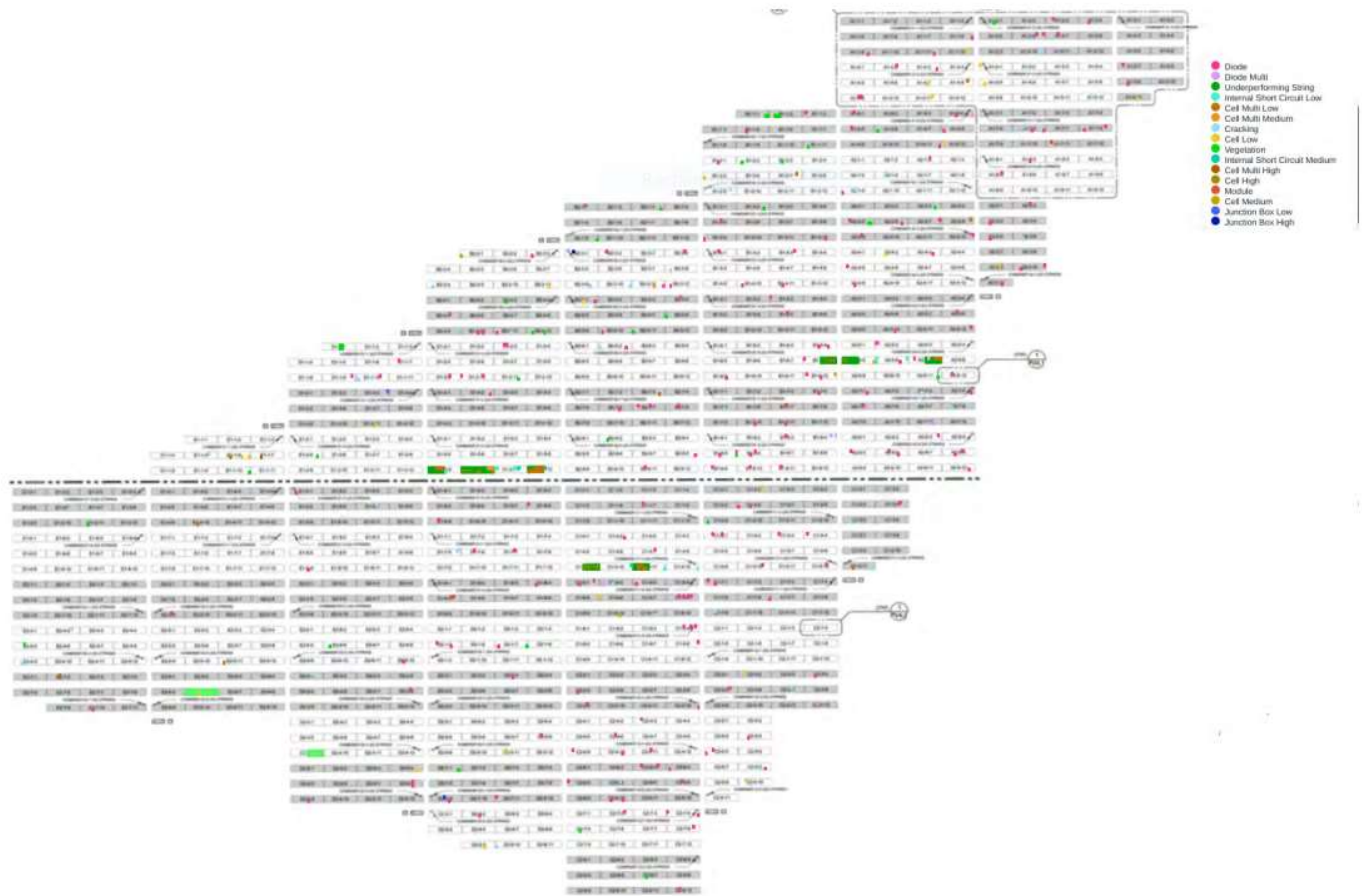
\*(4) Est. Affected DC (%): The estimated affected power of the anomaly is divided by the total site's power and represented as a percent.

\*(5) Est. Annual Impact (kWh): The estimated annual impact in kilowatt-hours is the estimated affected power multiplied by the site's peak sunlight hours. The peak sunlight hours can be changed by selecting the "\$ PPA Values" button in the left navigation menu.

\*(6) Est. Annual Impact (\$): The estimated annual impact in money is the estimated annual impact in kilowatt-hours multiplied by the money per kilowatt-hour i.e. power purchase agreement (PPA) rate. The PPA rate can be changed by selecting the "\$ PPA Values" button in the left navigation menu.


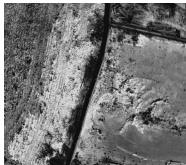

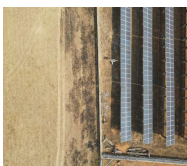
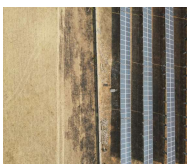
For more information on each class of anomaly please continue to the appendix to learn more.

# Anomaly Map


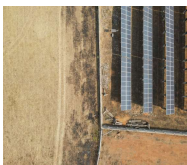
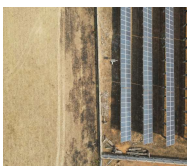
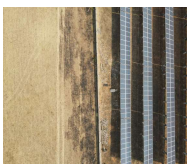




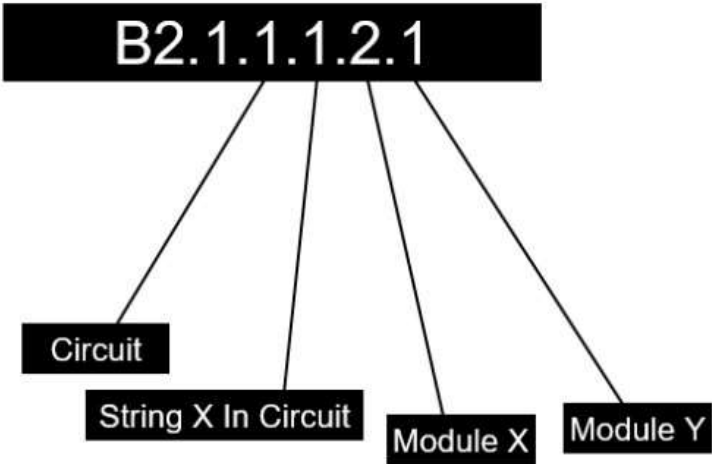
Anomaly Location

Primary Image	Secondary Image	Tag Name	Locator	Priority	Norm. Delta T	Irradiance W/m^2
 DJI_0139_W.jpg	 DJI_0140_T.JPG	Cell Low	A2.4.2.1.5.2	Low	5.8	864.9
 DJI_0141_W.JPG	 DJI_0142_T.JPG	Diode	A2.4.2.1.3.1	Medium	4.4	864.9
 DJI_0143_W.JPG	 DJI_0144_T.JPG	Diode	B1.4.3.2.4.1	Medium	4	864.9
 DJI_0145_W.JPG	 DJI_0146_T.JPG	Diode	B1.4.1.1.7.1	Medium	2.3	864.9
 DJI_0147_W.JPG	 DJI_0148_T.JPG	Diode	B2.3.4.2.2.1	Medium	3.6	864.9
 DJI_0149_W.JPG	 DJI_0150_T.JPG	Cracking	B2.3.3.2.3.1	High	3.1	864.9

Anomaly Location

Primary Image	Secondary Image	Tag Name	Locator	Priority	Norm. Delta T	Irradiance W/m^2
 DJI_0139_W.jpg	 DJI_0140_T.JPG	Cell Low	A2.4.2.1.5.2	Low	5.8	864.9
 DJI_0141_W.JPG	 DJI_0142_T.JPG	Diode	A2.4.2.1.3.1	Medium	4.4	864.9
 DJI_0143_W.JPG	 DJI_0144_T.JPG	Diode	B1.4.3.2.4.1	Medium	4	864.9
 DJI_0145_W.JPG	 DJI_0146_T.JPG	Diode	B1.4.1.1.7.1	Medium	2.3	864.9
 DJI_0147_W.JPG	 DJI_0148_T.JPG	Diode	B2.3.4.2.2.1	Medium	3.6	864.9
 DJI_0149_W.JPG	 DJI_0150_T.JPG	Cracking	B2.3.3.2.3.1	High	3.1	864.9

# Localizing Anomalies



Module X

String X

Module Y

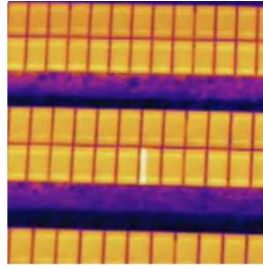
1,1	2,1	3,1	4,1	5,1	6,1	7,1	8,1	9,1	10,1	2,1	2,1	3,1	4,1	5,1	6,1	7,1	8,1	9,1	10,1
1,2	2,2	3,2	4,2	5,2	6,2	7,2	8,2	9,2	10,2	1,2	2,2	3,2	4,2	5,2	6,2	7,2	8,2	9,2	10,2

## Example of Anomalies



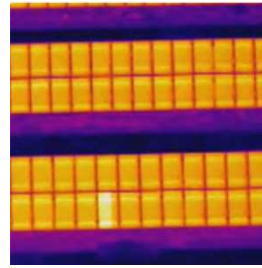
### Cracking

Module anomaly caused by cracking on module surface



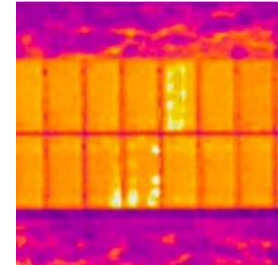
### Diode

A bypass diode provides a current path around a faulty cell or module. A diode anomaly indicates as activated bypass diode, typically 1/3 of module.



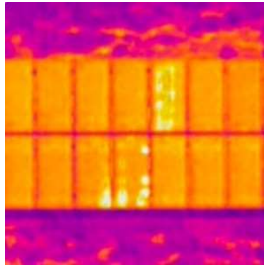
### Diode Multi

Multiple activated bypass diodes, typically affecting 2/3 of module



### Internal Short Circuit Low

Multiple cell anomalies occurring within the boundaries of a diode(s), where the temperature of an anomalous area is less than 10°C higher than adjacent areas.



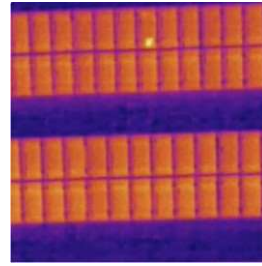
### Internal Short Circuit Medium

Multiple cell anomalies occurring within the boundaries of a diode(s), where the temperature of an anomalous area is 10-20°C higher than adjacent areas.



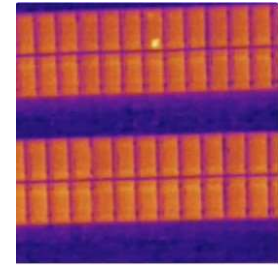
### Missing

Module is present on as-built but missing from PV system



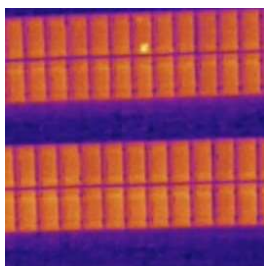
### Cell High

Cell anomaly, where the temperature of an anomalous area is 20°C higher than adjacent areas



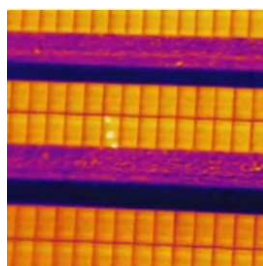
### Cell Low

Cell anomaly, where the temperature of an anomalous area is less than 10°C higher than adjacent areas



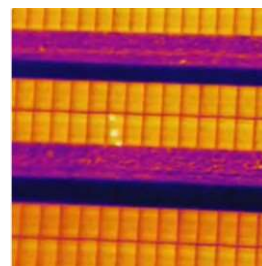
### Cell Medium

Cell anomaly, where the temperature of an anomalous area is 10-20°C higher than adjacent areas



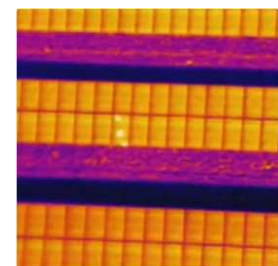
### Cell Multi High

Cell multi anomaly, where the temperature of an anomalous area is 20°C higher than adjacent areas



### Cell Multi Low

Cell multi anomaly, where the temperature of an anomalous area is less than 10°C higher than adjacent areas



### Cell Multi Medium

Cell multi anomaly, where the temperature of an anomalous area is 10-20°C higher than adjacent areas