DNV·GL

FIELD EVALUATION

Engineering Report
Tigo

March 15, 2016 – April 14, 2016

Report No.: R86530135A-1
Date: 21 April 2016

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Project name:	Engineering Report	DNV GL - Energy
Report title:	Performance Testing	Advisory Americas
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Project No.:	Q86530135	Enterprise No.: 27-0489579
Report No.:	R86530135A-1	

Task and objective:
Perform Performance Testing for Trina/Tigo.

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Abbreviation	Meaning
DNV GL	DNV GL PVEL, LLC
POA	Plane of Array
PV	Photovoltaic

1 INTRODUCTION

Tigo has retained DNV GL to perform energy harvest assessments on two (2) side-by-side systems. Each system leverages quantity fifteen (15) PV modules for an approximate 4 kW system comparison. The systems are left to accumulate energy and the results of the systems performance are highlighted in this report.

1.1 System Configuration

There exist 2 systems as a part of this energy harvest assessment. A table highlighting the systems is shown below detailing system configuration, approximate rated output, and PV module type.

Table 1-1 System Summary

System	PV Module	Inverter	System Size
Tigo DC Optimizers	Trina TSM-260PD05.18	5kW SMA Inverter	3921 Watts
SolarEdge	Trina TSM-260PD05.18	3.8kW SolarEdge Inverter	3919 Watts

An image of the final installation is shown as Figure 1 below. Each of the systems are mounted to simulated rooftop structures and oriented South facing for the energy harvest analysis.

Figure 1-1 Energy Harvest System Installation

1.2 System Maintenance

DNV GL performs routine system cleaning and maintenance at PV USA on a system need basis. With local construction activities resulting in higher soiling content than normal, DNV GL performs monthly module washing on these systems through the summer months, and quarterly cleaning from October through March.

2 PROJECT RESULTS

This report covers the testing and evaluation period starting March 15, 2016 and ending April 14, 2016 the below are the raw and normalized data results from this four system energy yield analysis.

2.1 Test Region

PVUSA is located at 24662 Country Road 102 in Davis, California. The Davis facility includes a number of desirable measurement and environmental conditions for this type of analysis, including custom built rooftops for this set of experiments to better reflect real world installation conditions.

2.2 Test Period

This testing period covers a one-month span of time over the spring months at Davis, California. The monitoring period started on March 15, 2016 and ended on April 14, 2016. The data for this period is shown below.

2.3 Weather Information

Table 2-1 Weather Data

Date	POA Insolation	Wind Direction	Wind Speed	Air Temperature	Humidity	Barometric Pressure
	Total [kWh/m^2]	Avg. [°]	Avg. [m/s]	Avg. [°C]	Avg. [%]	Avg. [mBar]
March 15, 2016	6.892	267.0	1.8	15.1	52.0	1022.6
March 16, 2016	6.805	162.6	1.9	16.9	56.3	1017.4
March 17, 2016	6.993	145.7	1.4	18.7	57.5	1012.9
March 18, 2016	6.768	165.6	1.2	18.2	63.5	1013.4
March 19, 2016	6.440	190.3	1.4	18.0	65.8	1014.9
March 20, 2016	2.836	199.9	2.4	16.4	73.4	1016.0
March 21, 2016	2.159	203.1	3.1	14.2	71.1	1015.9
March 22, 2016	7.236	144.0	1.4	14.3	51.2	1022.2
March 23, 2016	6.983	236.3	2.1	16.4	49.6	1024.6
March 24, 2016	6.696	145.0	1.0	17.5	56.3	1021.6
March 25, 2016	7.191	293.5	1.8	19.2	47.0	1015.3
March 26, 2016	6.941	276.2	2.6	20.4	34.9	1013.1
March 27, 2016	5.768	223.0	1.5	17.4	64.5	1015.3
March 28, 2016	5.811	262.8	3.2	13.5	42.0	1010.8
March 29, 2016	7.409	258.9	2.2	15.9	34.7	1010.0
March 30, 2016	7.344	208.0	1.3	16.4	47.6	1013.9
March 31, 2016	5.410	211.8	1.1	17.2	59.7	1017.0
April 1, 2016	6.799	180.3	1.5	18.6	54.6	1019.3
April 2, 2016	7.198	173.9	1.1	18.8	58.6	1019.6
April 3, 2016	6.989	211.1	1.3	20.3	53.6	1016.8
April 4, 2016	7.405	195.7	1.4	20.1	52.2	1020.9
April 5, 2016	7.619	322.2	3.4	22.7	28.4	1020.6
April 6, 2016	7.521	225.6	1.6	24.7	36.8	1017.7
April 7, 2016	5.500	239.9	1.8	22.1	47.4	1010.4
April 8, 2016	5.224	261.0	1.7	20.0	58.1	1009.4
April 9, 2016	1.054	215.0	1.7	15.0	84.1	1010.9
April 10, 2016	2.588	150.4	2.0	15.6	78.0	1010.9
April 11, 2016	5.962	205.4	1.4	18.4	63.0	1017.6
April 12, 2016	4.537	206.6	1.8	18.2	63.5	1019.8
April 13, 2016	6.977	174.1	1.6	18.1	50.7	1018.7
April 14, 2016	7.381	285.5	2.6	16.7	45.8	1018.0
Total	188.437	214.2	1.8	17.9	54.9	1016.4

2.4 Summary of Raw Data Results

Table 2-2 Summary of Raw Data Results

Model	Number of Modules	Rated Wattage [W]	System Capacity [kW]	Inverter Model	Results	
Tigo Optimizers	15	260	3.921	5kW SMA	Production Power [kWh]	667.328
					Yield [kWh/kWp]	170.19
					Performance Ratio [%]	90.3
SolarEdge Optimizers	15	260	3.919	3.8kW SolarEdge	Production Power [kWh]	656.394
					Yield [kWh/kWp]	167.49
					Performance Ratio [%]	88.9

2.5 Normalized System Data

Table 2-3 Normalized System Data

System	Raw Data (kWh)	Scaling Factor	Normalized Data (kWh)
Tigo Optimizers	667.328	0.9995	666.988
SolarEdge Optimizers	656.394	1	656.394

2.6 System Ranking for Period of Study

The systems are evaluated based on the Energy Yield, Performance ratio (%), and normalized production data (performance ratio) will be the basis for determining ranking. The performance ratio is a measure of PV energy converted by PV system that is normalized to system nameplate on the PV side by results from the flash testing of the PV modules.

$$AC\ Performance\ Ratio = \frac{AC\ Energy\ Converted\ (kWh)}{Solar\ Insolation\ (\frac{kWh}{m^2})} \times \frac{1000\ (\frac{W}{m^2})}{Nameplate\ Power\ Rating\ (W)}$$

1. Tigo Optimizers
2. SolarEdge Optimizers

3 SUMMARY

For this period of study (March 15, 2016 to April 14, 2016) the Tigo system outperformed all other systems in the study. The normalized results show the Tigo Optimizers as the highest performer, followed by the SolarEdge system.

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