Off-grid lighting testing and certification processes

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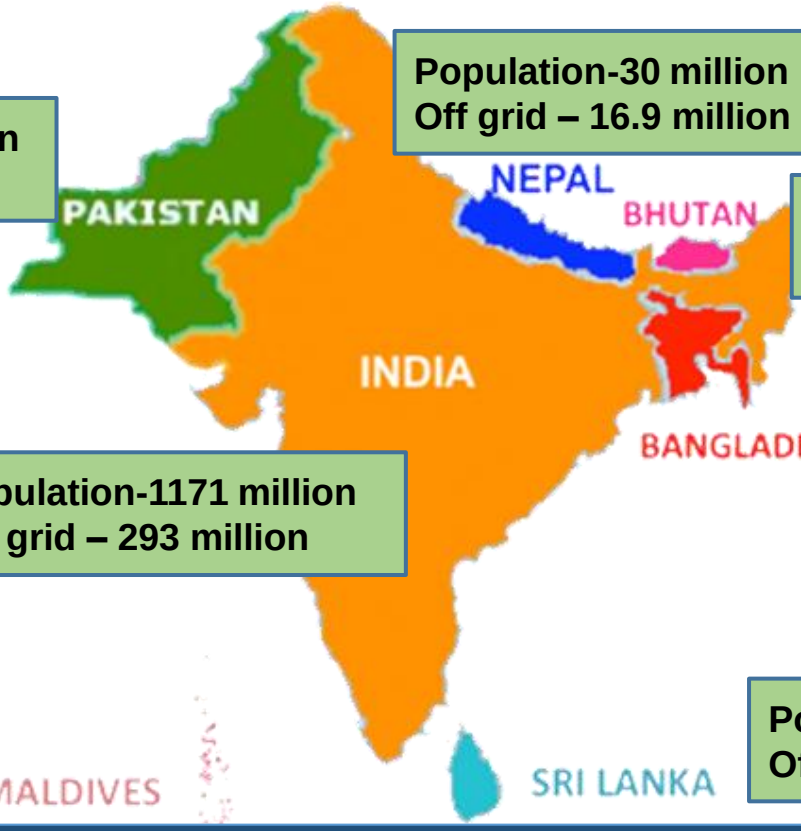
Off grid population in South Asia



Population-173.6 million
Off grid – 76.3 million

Population-30 million
Off grid – 16.9 million

Population-0.7 million
Off grid – 0.3 million

Population-148.7 million
Off grid – 87.7 million

Population-1171 million
Off grid – 293 million

Population-20.9 million
Off grid – 4.9 million

Almost 30% of total population in South Asian countries are without any grid

Common off grid sources of illumination in India

Kerosene lamp with glass
113.9 million

Kerosene lamp with wick
51 million

Candles
8.5 million

On an average Indian government is spending 2 billion USD on subsidy in kerosene

Torch
0.7 million

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Benefits of solar off grid lighting in India

6.7 billion litres of kerosene

0.89 billion batteries

3.7 billions candles

18.1 million tonnes of CO2 reduction

On an average 2.8 billion USD could be saved with a payback period of 22 months

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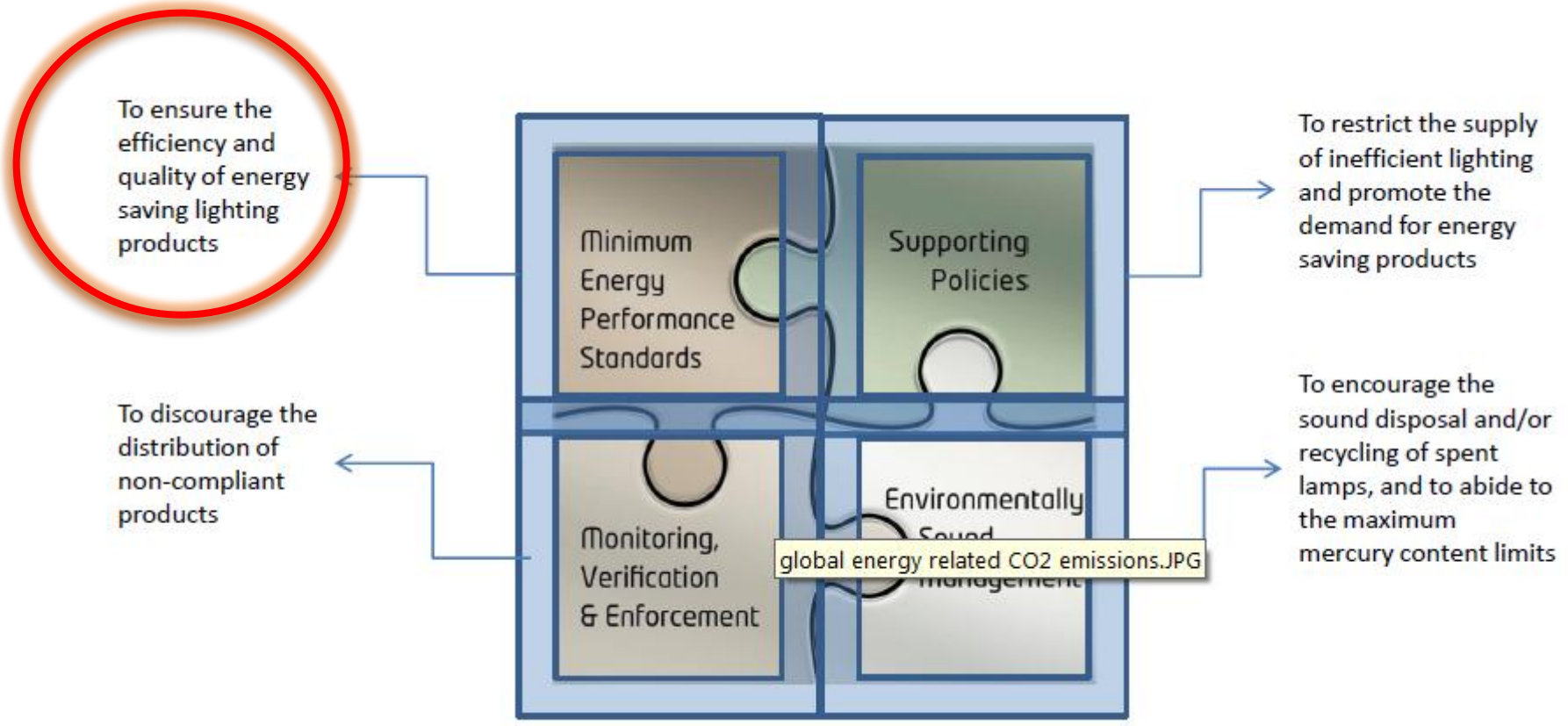
UNEP En.lighten Initiative Integrated Policy approach (IPA)



Lighting a billion lives (LaBL)-A TERI Initiative

- LaBL a TERI initiatives, is a fee- for service model where solar charging stations are set up in villages and solar lanterns are provided to villagers on rental bases.
- The campaign was started in 2008, with illuminating more than 200 households in a small village in southern West Bengal.
- Presently about 200 villages are covered, helping about 10000 households

TERI LaBL Initiative.mp4

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Phase 1- Year 2008-2010 *(TERI Initiatives)*

- Ministry of New and Renewable sources of Energy (MNRE) specifications were available for Solar lantern, Street lighting and Solar home system.
- MNRE specification were reviewed by TERI and was observed that mainly electrical specifications were mentioned. Information related to photometry were not mentioned.
- No test methods/procedures to check the quality and performance of off grid lighting system were available
- Literature survey for all the available international standards on testing methods for off grid lighting system was done by TERI. It was observed that existing specifications need revision and was discussed with MNRE

Phase 2-Year 2010-2012 *(TERI and MNRE Initiatives)*

- MNRE agreed to revise their existing specification .
- MNRE provided initial funding to TERI for setting up the laboratory at TERI premises.
- TERI in consultation with MNRE revised the specification by including information on photometry of lamps (LEDs and CFLs).
- TERI also developed test methods for testing solar Lanterns using several internationally available test methods

Phase 3- Year 2012-2014 *(TERI, MNRE and IFC Initiatives)*

- International Financial Corporation (IFC) Lighting Africa came to Asia.
- IFC interacted with TERI and MNRE and visited first MNRE lab and then TERI lab.
- IFC reviewed the testing procedures and methods developed by TERI.
- IFC provided technical support to TERI to modify the existing methods and develop the testing methods using the IEC 62257 9-5 standard .
- TERI with support from IFC expert reviewed the IEC 62257 9-5 standard and customized the standard(mainly sample size, weather parameters for SPV testing) as per Indian requirements.
- IFC provided support to TERI for expanding the existing infrastructure of laboratory.
- TERI lab is now testing the solar lighting system and certification is provided by IFC.

TERI Solar Lighting Laboratory

- TERI SLL.VOB

SPV test bed

To evaluate the electrical characteristics and performance of solar modules and arrays of various SPV technologies

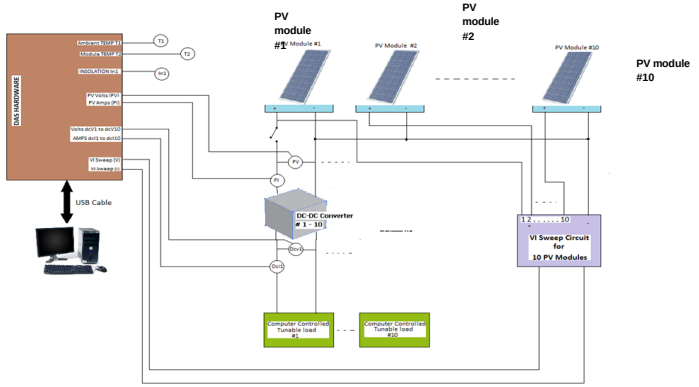
To evaluate the performance of Solar Charging Stations with various configurations and combinations of components to develop the most appropriate design.

FEATURES

Up-to 10 SPV modules (each of up-to 150W) can be tested simultaneously

with voltage up-to 200V and current up-to 25A can be connected

Tunable voltage up to 20V and current up-to 2A at each port of the DC-DC converter cum Junction Box



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Battery test bed

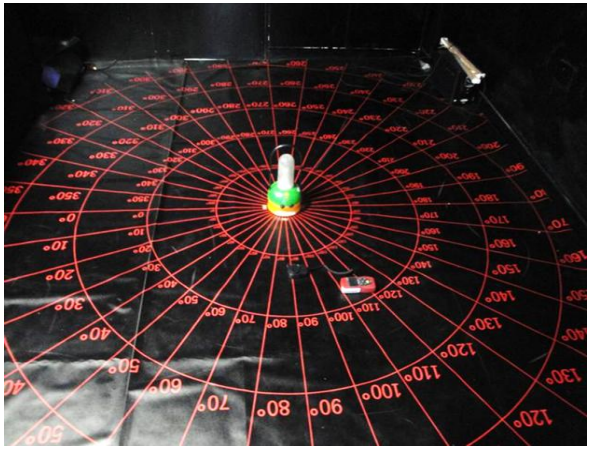
The purpose of the Battery Test bed is to test charging and discharging cycles of various types of batteries

FEATURES

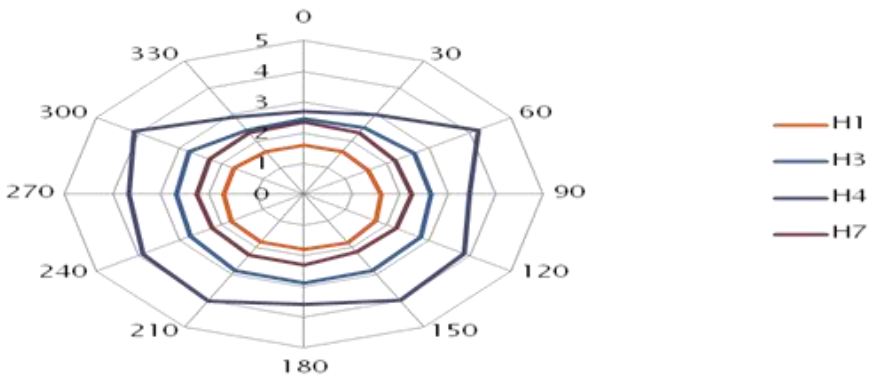
- **Test performed at different temperatures and humidity conditions**
- **Testing capacity for Lead-acid, Li-ion/Lithium Polymer and NiMH**
- **User defined charging and discharging cycles**
- **Charging current upto 20 amperes**

Light distribution test

Measure the light distribution characteristics of Solar Lighting Systems on a 360 degree horizontal plane



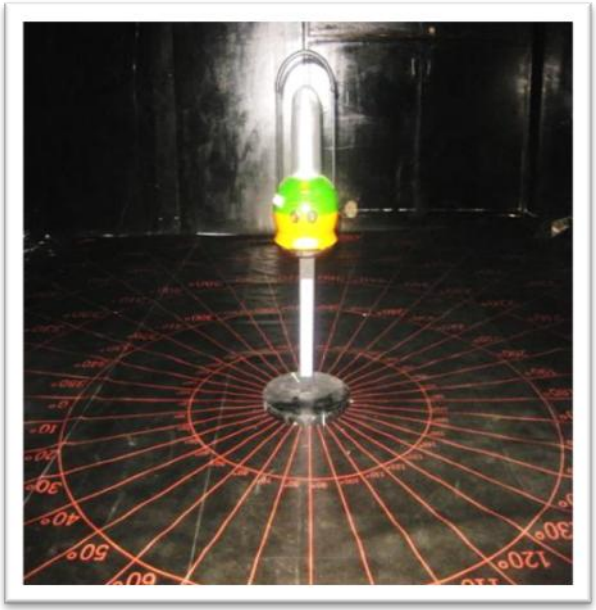
Test set up for light distribution test



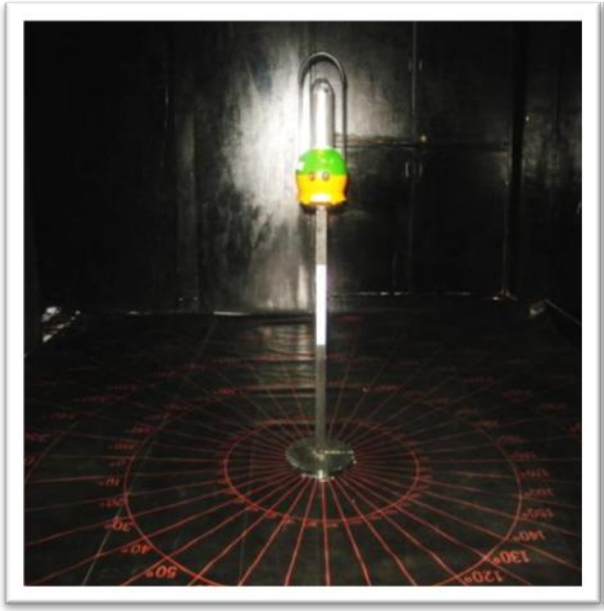
Test set up for light distribution characteristics of SLS

Light test at different height

Measure the Illuminance of Solar Lighting Systems at various height .



Arrangement for 1 ft. height

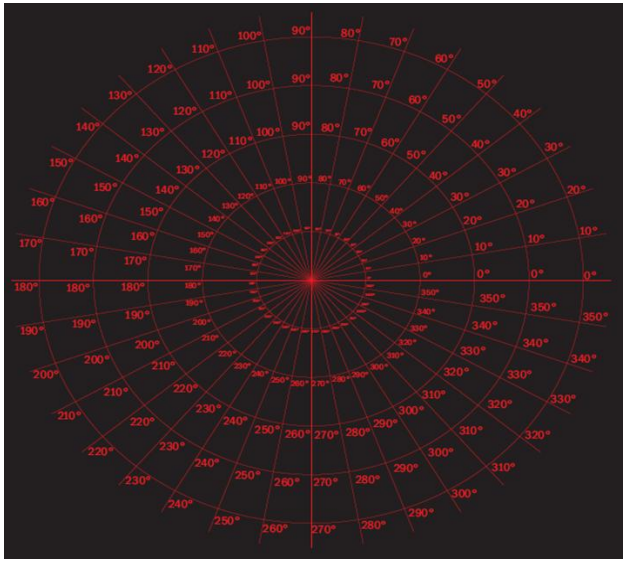


Arrangement for 2 ft. height

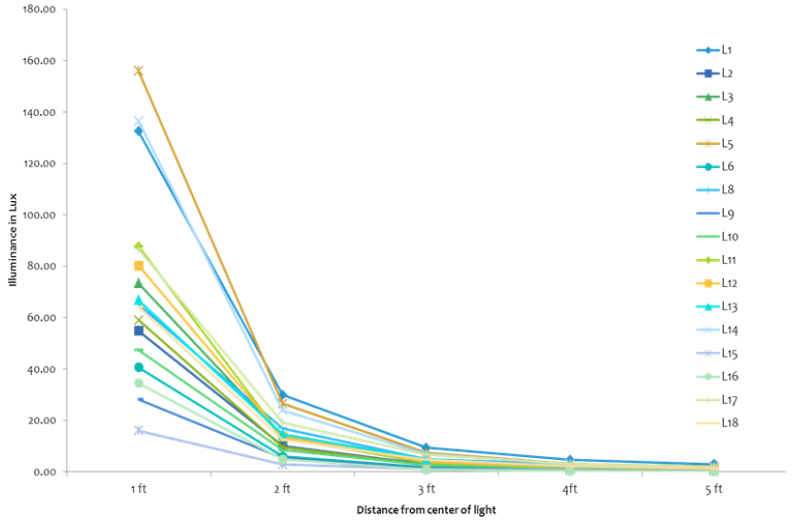
Arrangement for 3 ft. height

Light test at various distance

Measure the Illuminance of Solar Lighting Systems at various distances



Arrangement for Illuminance at various distance



Illuminance of lanterns with distance

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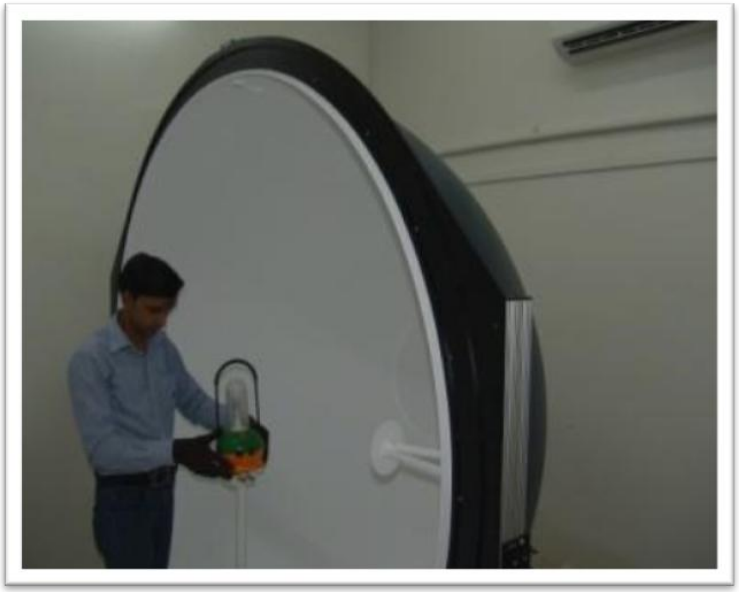
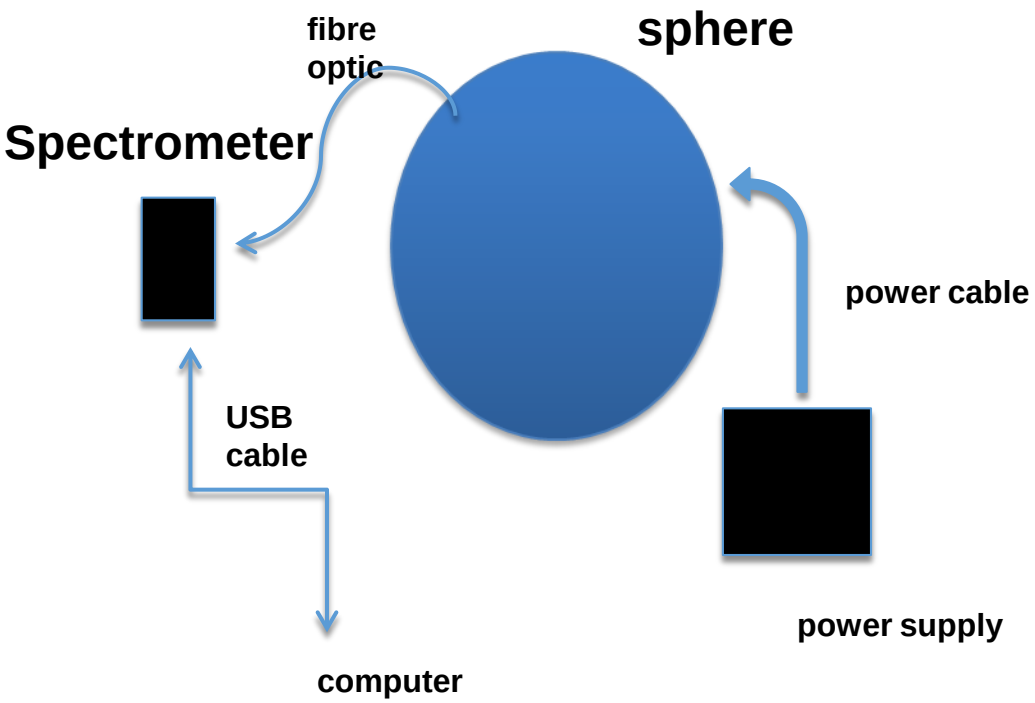
Light Output Test



Integrating sphere



Long Term Lumen Degradation Facility

Estimate if the product's light output excessively degrades prematurely prior to the end of its usable lifetime

Typical reasons for failure

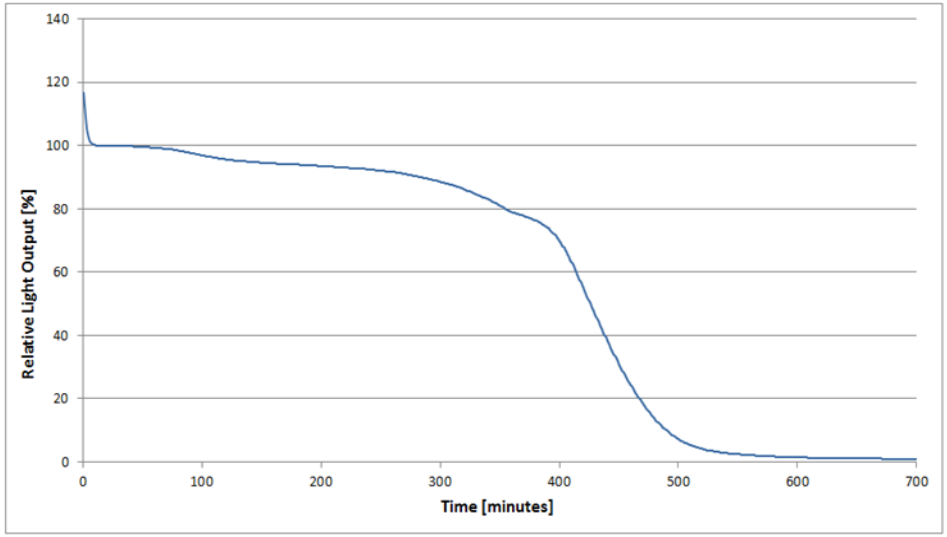
- Thermal management
- Electrical operation

The lumen maintenance test measures how much light output the product maintains as it runs continually for 2,000 hours

L70≥ light output after 2000hrs.

Full Battery Run Time Test

Determines the maximum useful duration of the product's service



Test and test standards at TERI SLL

Sl no	Specific tests or types of tests performed	Specification, standard (method) or technique used	Range of testing/ Limit of detection
1	**(a) Battery capacity** **(b) Battery efficiency**	IEC 62257-9-5 :2013 Annexure K, L & N	Battery Voltage: 1.2 - 36 V Battery Capacity: 500 mAh - 24 Ah
2	**Full-battery Runtime Test**	IEC 62257-9-5 :2013 Annexure M	Illuminance: up to 400,000 lux Battery Voltage: 1.2 - 15 V Battery Current: 10 mA - 2 A
3	**Grid Charge Runtime Test**	IEC 62257-9-5 :2013 Annexure O	Illuminance: up to 400,000 lux Battery Voltage: 1.2 - 15 V Battery Current: 10 mA - 2 A
4	**Electro-mechanical Charge Test**	IEC 62257-9-5 :2013 Annexure P	Battery Voltage: 1.2 - 15 V Battery Current: 10 mA - 2 A

Continued….

Sl no	Specific tests or types of tests performed	Specification, standard (method) or technique used	Range of testing/ Limit of detection
5	**I-V Characteristics Test** (a) Short circuit current at STC (b) Open circuit voltage at STC (c) Maximum power point power at STC (d) Maximum power point current at STC (e) Maximum power point voltage at STC (f) Short circuit current at TMOT (g) Open circuit voltage at TMOT (h) Maximum power point power at TMOT (i) Maximum power point current at TMOT (j) Maximum power point voltage at TMOT (k) STC I-V curve data set	IEC 62257-9-5 :2013 Annexure Q IEC 60904-1 IEC 60891	SPV Module Voltage: 0.2 - 28 V SPV Module Current: 20 mA - 2 A
6	**Solar Charge Test** (a) Solar operation efficiency (b) Battery charging circuit efficiency (c) Solar runtime (d) Solar charging system characteristics	IEC 62257-9-5 :2013 Annexure R	Illuminance: up to 400,000 lux Battery Voltage: 1.2 - 15 V Battery Current: 10 mA - 2 A

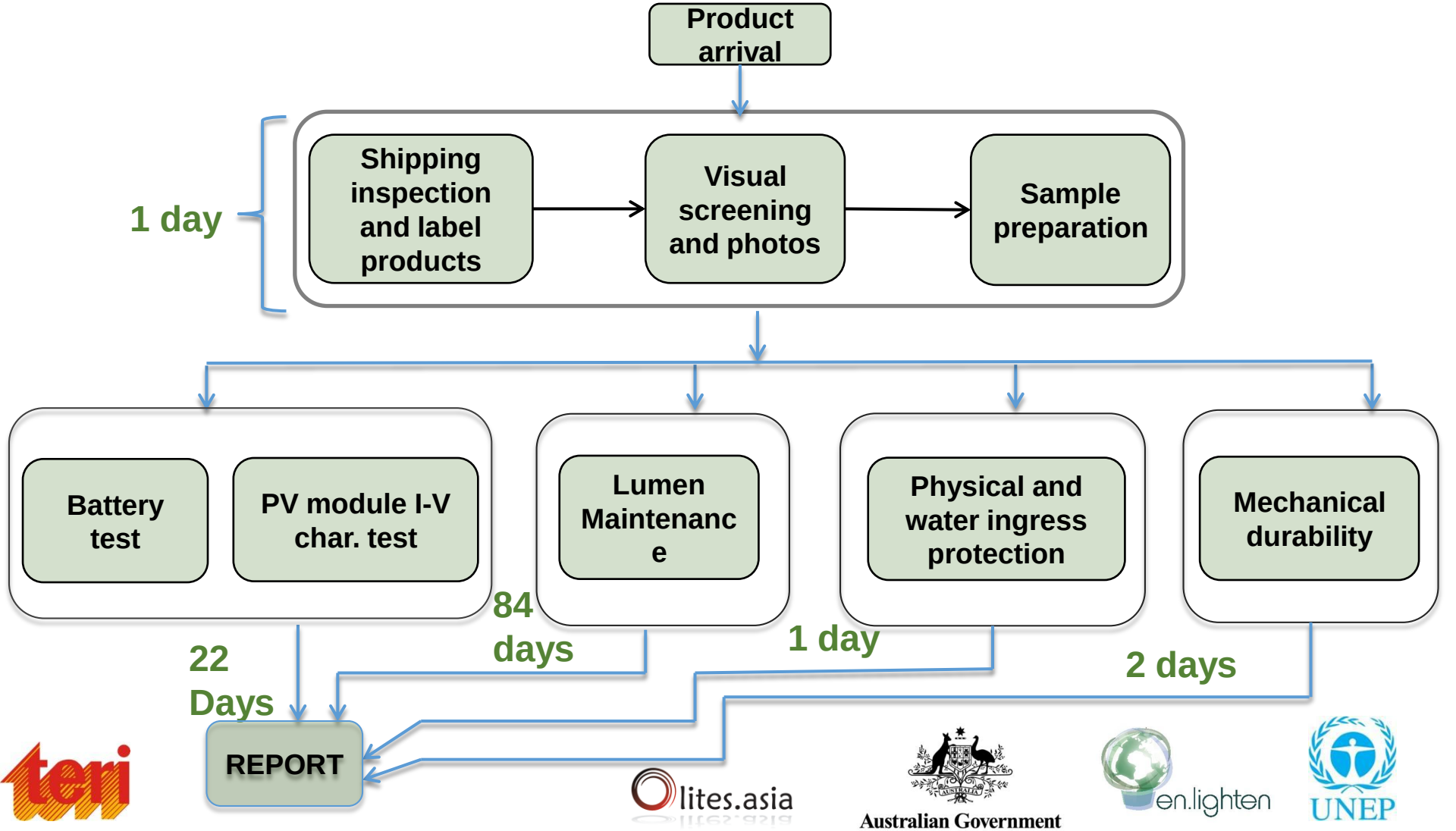
Continued….

Sl no	Specific tests or types of tests performed	Specification, standard (method) technique used	Range of testing/ Limit of detection
7	**Charge Controller Behavior Test** (a) Active deep discharge protection test (b) Active overcharge protection test (c) Passive deep discharge protection test (d) Passive overcharge protection test (e) Standby loss measurement	IEC 62257-9-5 :2013 Annexure S	Battery Voltage: 1.2 - 15 V Battery Current: 10 mA - 2 A
8	**Mechanical durability test** (a) Drop test (b) Switch and connector test (c) Gooseneck test (d) Strain relief test	IEC 62257-9-5 :2013 Annexure W	SPV Module Voltage: 0.2 to 28 V SPV Module Current: 20 mA - 2 A Battery Voltage: 1.2 - 15 V Battery Current: 10 mA - 2 A

Continued….

Sl no	Specific tests or types of tests performed	Specification, standard (method) technique used	Range of testing/ Limit of detection
9	**Light Output Test** (a) Luminous Flux measurement (b) Correlated colour temperature (CCT) measurement (c) Colour Rendering Index measurement	IEC 62257-9-5 :2013 Annexure I	Photometric range: 0.08 - 260,000 lm Red LED Range: 1.7 - 93,000 lm Green LED Range: 2.0 - 10,000 lm Blue LED Range: 0.70 - 32,000 lm Max Lamp Dimension: 21 x 21 cm2 Maximum Tubular Lamp Length: 1.3 m
10	**Lumen Maintenance Test**	IEC 62257-9-5 :2013 Annexure J	Illuminance: up to 400,000 lux System Voltage: 1 - 64 V System Current: 0.1 - 10 A
11	**Light Distribution Test** (a) Illuminance on a plane (b) Rotary disk (c) Illuminance on a desktop	IEC 62257-9-5 :2013 Annexure T	Illuminance: up to 400,000 lux System Voltage: 1 - 64 V System Current: 0.1 - 10 A

Testing time



Test results (IEC 62257 – Test Criteria)

General Information

Manufacturer :
Product Name :
Model # :
Report Date: January 31, 2014
Test Start Date : December 16, 2013
Test End Date : January 31, 2014

Sample #	Sample ID Code
1	SLL/SKP/161213/T/21
2	SLL/SKP/161213/T/22
3	SLL/SKP/161213/T/23

Setting #	Setting Description
1	TURBO
2	NORMAL
3	BED-TIME

Product Photo(s):

Results Summary

Parameter Tested	Setting	Rating	Measured Value	Average Percent Deviation	Comments
Component Measurements					
Battery Capacity [mAh]	--	*1450*	1564	7.9	--
PV Power [W]	--	*2.5*	2.6	5.1	Measurement made at SERC 3 W is reported in the product's Lighting Global Standardized Specifications Sheet; 2.5 W is specified on the product's packaging.
Run Time					
Full-Battery Run Time at L70 [h]	TURBO	*6*	7.3	21.7	--
	NORMAL	*15*	17.4	16.0	--
Solar Run Time at L70 [h]	TURBO	*6*	7.3	21.7	--
Lighting Service					
Luminous Flux [lm] (Average over L70)	TURBO	*100*	119	19.3	110 lm is reported in the product's Lighting Global Standardized Specifications Sheet; 100 lm is specified on the product's packaging.
Correlated Color Temperature [K]	TURBO	--	3901	--	--
Color Rendering Index	TURBO	--	70	--	--
Useable working surface through L70 (≥ 25 lx) [m²]	TURBO	--	1.2	--	Measured at 0.75 m distance from a surface
Horizontal Full-Width Half-Max Angle [degrees]	TURBO	--	126	--	
Vertical Full-Width Half-Max Angle [degrees]	TURBO	--	125	--	
Useable working surface through L70 (≥ 25 lx) [m²]	TURBO	--	1.2	--	Measured at the distance the lamp sits away from a surface when used as a desk lamp
500 hour Lumen Degredation [% of initial]	TURBO	--	100	--	--

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Certification

SCOPE : TERI LAB

SCOPE: IFC

Step 1

Tests are performed on the procured sample.

Step 2

Result summary is generated and is submitted to IFC

Step : 3

IFC provides the manufacturer with justified certificate based on the result summary

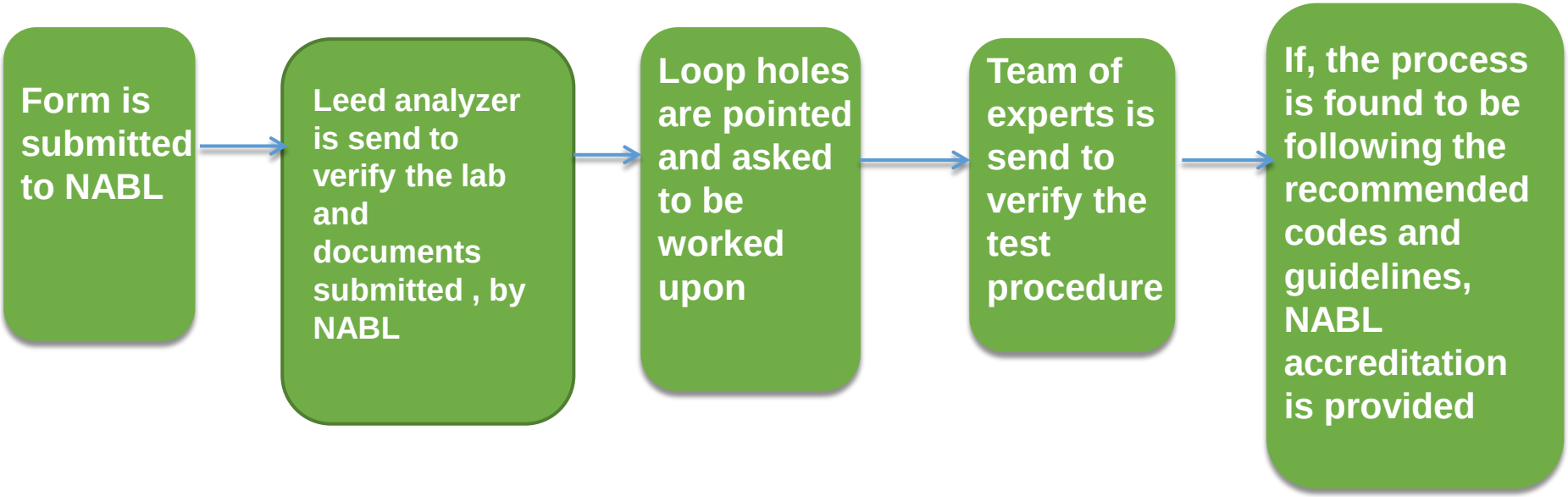
TERI lighting laboratory: Equipment cost

	USD
Cost of Instruments	**130000**
Spare cost	**10000**
Calibration cost	**20000**
Total	**160000**

List of affiliated labs under lighting global programme

- ISE fraunhofer Germany
- Schatz Energy Research Institute USA
- Lighting Research Centre USA
- Solar Lighting Lab Nairobi
- TERI's Solar Lighting Lab New Delhi India

NABL Accreditation (ISO/IEC 17025)



Thank you!

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