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**□** ARM **🗹** ENG **□** PAP **□** Input

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Technical Domain / Task Number 2 …………………………………

Author(s) / Submitter(s) …Jörg Unterderweide…………

Comparison of Solar Model Performance

# Summary

This paper presents information from the IALA Solar Sizing Excel Sheet for comparison with other calculation software during EEP2 WG2. Given the reference load information given in appendix 1, the indication is that 1 battery bank and 12 solar modules are required.

## Purpose of the document

Forward to WG2 for information to their on-going work.

## Related documents

ENG1 Working Paper 11.2.3

Guideline 1039

# Background

During EEP1, Task Group 2 identified that a review and combining of a number of guidelines on power systems is needed. This was to start with a comparison of solar sizing techniques to be able to update the IALA calculator. Members were requested to use their own calculators and submit the results for comparisons and discussion. Trinity House was to provide the load, location, battery and solar module data.

# Discussion

## Parameter

### Radiation (assumption)

* Average Radiation data is available for example in the [Internet](https://eosweb.larc.nasa.gov/cgi-bin/sse/grid.cgi?&num=177142&lat=51.567&hgt=100&submit=Submit&veg=17&sitelev=20&email=skip@larc.nasa.gov&p=grid_id&p=swvdwncook&p=avg_dnr&p=ret_tlt0&step=2&lon=-3.971)  
  (https://eosweb.larc.nasa.gov/cgi-bin/sse/grid.cgi?&num=177142&lat=51.567&hgt=100&submit=Submit&veg=17&sitelev=20&email=skip@larc.nasa.gov&p=grid\_id&p=swvdwncook&p=avg\_dnr&p=ret\_tlt0&step=2&lon=-3.971)
* 66° tilt angle
* South-orientation of PV Modules

### Latitude / Station (provided by Trinity House)

* 51.567N
* Duration of the night is calculated according to latitude.

### Deduction for ageing of solar panels (assumption)

* 20%

### Voltage (provided by Trinity House)

* 24 Volts

### Voltage in the Maximum Power Point (provided by Trinity House, datasheet)

* 35,2 Volts (17,6 Volts \* 2)

### Power (provided by Trinity House, datasheet)

* 58 Watts peak per module

### Orientation (assumption)

* 1 = all modules looking in south direction

### Lantern load (provided by Trinity House)

* 17,77 Watts
* Only Main Light
* Because the Main Light has a power consumption during eclipse the effective power needs to be calculated

### Duty cycle (provided by Trinity House)

* 100%
* Duty cycle was already included in the calculation of the Main Light load (see 3.1.8)

### Switch-level (assumption)

* 1 hour

### Continues load (provided by Trinity House)

* Navigation Light Control 1,81 W
* Charge Regulator 2,7 W
* Fog Signal System 7,35 W  
  probability of fog during winter 7 h/d  
  (periode of low radiation = critical time)
* Visibility Detector 1,185 W
* Cyclic Control 1,725 W
* Racon 1,4 W
* AIS 1,2 W
* Total continues load 12,16 W

### Battery capacity (provided by Trinity House, datasheet)

* 1363 Ah C100

### Max. usable Capacity (assumption)

* 100%

### Battery efficiency

* 80%

## Procedure

* Increasing the number of modules until 21 days without gain are reached
* Increasing the number of battery banks to check if the number of modules could be reduced significantly (which is not the case)
* Checking the Simulation for the 2. year (separate sheet)

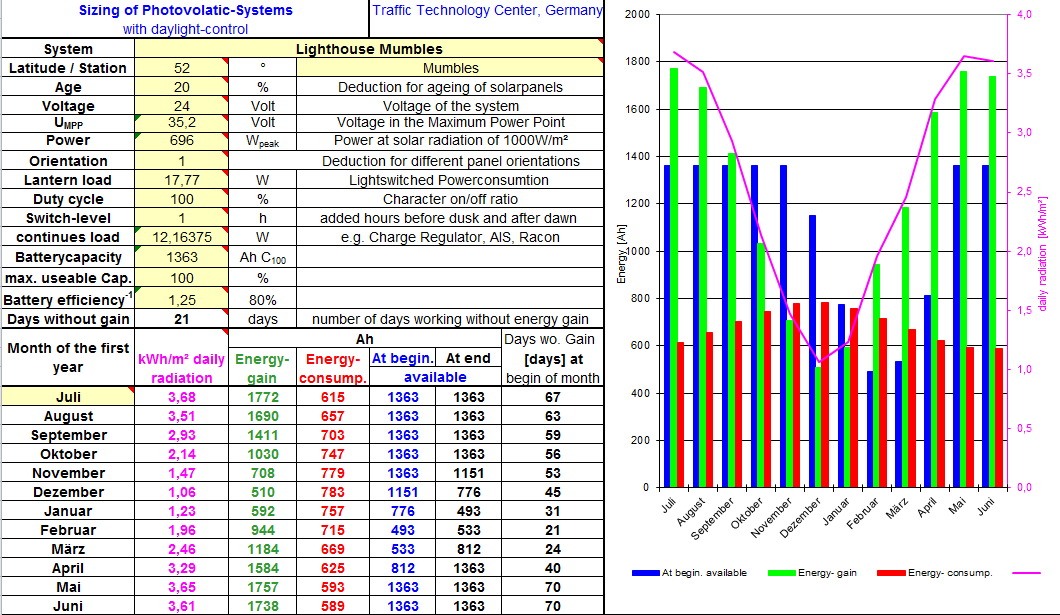
## Results

By using 1 battery bank and 12 modules 21 days without energy gain are calculated.

## Remarks

* For comparing of results assumptions need to be checked
* Some data needs to be combined for using the Excel-sheet (e.g. calculation of continuous load)
* Integration of various trigger criteria could be difficult (e.g. Night-time, seasonal fog)
* Assumptions for data which is not provided by manufacturers are difficult (e.g. deduction for aging of solar panels, max. usable capacity of batteries, battery efficiency) and have a significant influence on the results
  + Varying “Age” by 5% causes a difference of 4 days without gain
  + Varying “max. usable capacity” by 5% causes a difference of 3 days without gain
  + Varying “max. usable capacity” by 10% causes a difference of 6 days without gain
  + Varying “Battery efficiency” by 5% causes a difference of 4 days without gain

## Excel Sheet





1. Solar Model Data
2. Back Ground Information
3. Mumbles Lighthouse



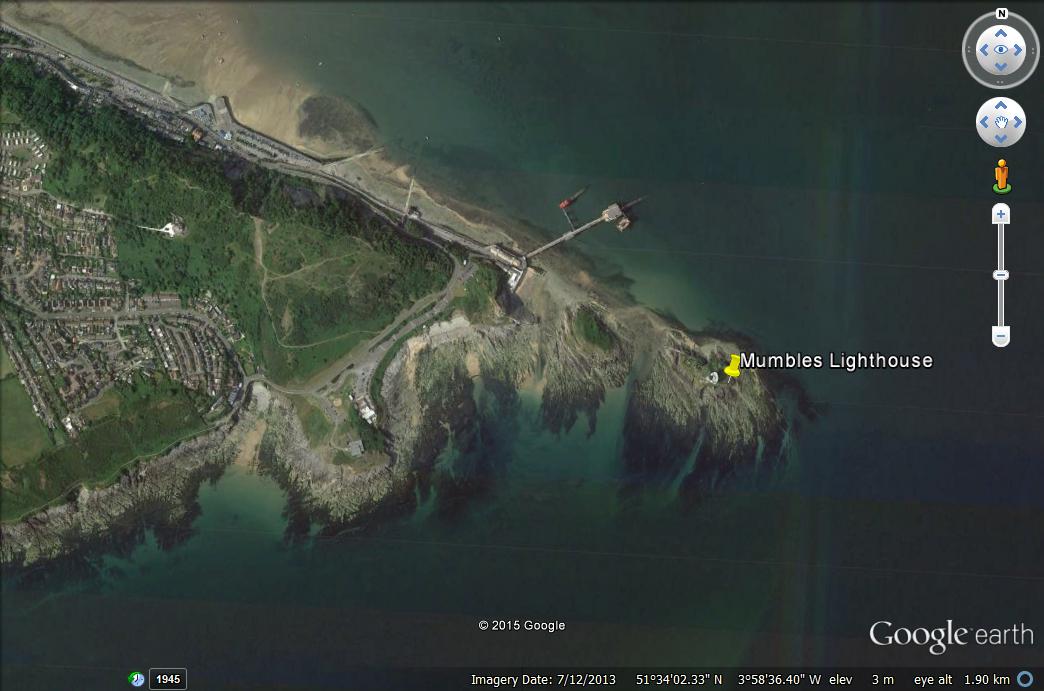
This is a new AtoN system to be installed at a historic lighthouse known as Mumbles.

Location - Mumbles Head, West side of Swansea Bay, SA3 4JT

Lat: 51º 34.009 N

Lon: 003º 58.268 W

Solar Panel Type: Solanova SOL 58D - 58W panel – See data sheet



1. Google View

Solar Panel orientation: South facing inclined at latitude +15° = 67°

Battery type: Sonnenschein A602/1250 Gel battery type 10 OPzV 1000 = 1248Ah @C20 to 1.80v @ 20°C = 1363Ah @ C100 to 1.80v @ 20°C – See data sheet

1. Data Sheets

|  |  |
| --- | --- |
| Solar Panel Data Sheet |  |
| Battery Data Sheet |  |

1. System Concept
2. Effective Loads

Main Light

Navigation Light Control System

Distribution

Solar Modules

Charge regulator

Cyclic control cubicle

Visibility detector

Fog Signal Emitters

Fog Signal Driver

Racon

Battery

AIS

1. System Block Diagram
   1. Main Light

LED Lantern, 15nm white light with Flash Character of Group Flash 4 every 20s (0.3s flash length).

Power during a flash = 290W

Power during the eclipse = 0.4W

Effective power = 290 x (4 x 0.3/20) + 0.4 x (20 - (4 x 0.3))/20 = **17.77W (Night time & Fog)**

* 1. Navigation Light Control

Continuous load, day and night = 1**.81W**

* 1. Charge Regulator

Continuous load = **2.7W**

* 1. Fog Signal System

The Fog Character for Mumbles is 3 x 1s blast ev 60s, giving a Duty Cycle of 5.0%.

Fog Signal & Driver during the blast = 141.6W

Fog Signal & Driver during the eclipse = 0.29W

Effective power = 141.6 x (3 x 1/60) + 0.29 x (60 - (3 x 1))/60 = **7.35W (During Fog)**

* 1. Visibility Detector

On for 3 minutes every 20 minutes

Power when on = 7.9W

Power when off = 0W

Effective power = 7.9 x (3/20) = **1.185W continuous**

* 1. Cyclic Control

Continuous load = **1.725W**

* 1. Racon

Continuous load = **1.4W**

* 1. AIS

Continuous load = **1.2W**

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