

Small Scale Irradiance Measuring Device

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Needs Identification

Document

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1.0 Introduction

The small-scale solar irradiance project aims to implement a device which may accurately model the irregularities of solar irradiance on COBar Ranch. The Institute for Sustainable Energy Solutions (ISES) and Dr. Tom Acker at NAU are working with WindLogics to evaluate the reliability of the solar resource on a square mile monitoring station. This is in order to determine the viability of a large scale energy generation project at COBar Ranch. The current evaluation method uses a large land area and many data collection devices to determine the reliability of irradiance. The project is to streamline data collection while minimizing cost, land area usage, and system assembly time.

2.0 Need Identification

The current solar irradiance variance measuring system is large and semi-permanent. This is a problem because the large size increases the cost of the system, requires many man-hours to maintain and collect data, and puts stress on the land owner. For instance, the existing system requires a large number of pyranometers to measure the irradiance as well as individual data acquisition centers for each of the devices. Setting up the pyranometers requires t-stakes to be installed in the ground and in some cases buckets of concrete with t-stakes in them had to be transported to locations where bedrock prevented direct installation. The current method is costly, inefficient, and too permanent for its desired purpose. In addition, having individual data acquisition centers has proven to produce inconsistent time readings which reduces the quality and reliability of the data. Multiple sensors causes the data collected to be poorly time stamped and hard to read in MATLAB due to improperly placed headers. Finally, convincing landowners to grant access to an area as large as the current site is difficult.

Need Statement:

The current system is inefficient with its use of land, man hours, and produces poor data.

3.0 Problem Statement

Goal:

Design a relatively small, portable solar irradiance measuring system that can accurately quantify variance in solar irradiance over a larger area.

Objectives:

The following list describes the pertinent objectives as seen in Table 3.1 required to achieve this goal.

- Scales down site- Minimizes required surface area for data collection.
- Location- Each of the sensor locations needs to be known for representative data.
- Easy set up/operation- Minimal set up time and error propagation.
- Longevity- The device needs to operate in an outside environment for the duration of the study.
- Transportable- The device should be deployed easily to the study site.
- Inexpensive- Device should cost effective.

Table 3.1 basis of measurement for objectives

Objectives	Basis for Measurement	Units
Scales Down Site	Surface Area	Ft ²
Location of Sensor	GPS	Lat./Long.
Easy Set-up/Operation	Set Up Time	S
Longevity	Durability	Months
Transportable	Packed Volume	Ft ³
Transportable	Weight	Lbs
Inexpensive	Cost	\$

Constraints:

Appendix A shows how the customer’s requirements relate to the constraints in the list below.

- Does the data collected correlate with the larger site?
- The surface area must not exceed that of a 100 ft diameter circle.
- Does the system store data safely?
- The system must be properly set up in 16 man hours.
- Does the system autonomously function between data collection visits?
- Does the system measure an accurate location for each sensor?
- Are the sensors taking readings in synchronization?
- Is the system inexpensive?
- The system must be able to withstand ‘typical’ environment conditions for approximately 14 months.

Test environment:

Preliminary testing of systems and subsystems will occur in the lab. Final testing for all constraints and objectives will be at the CO Bar Ranch study site except for cost, portability, and surface area which will be accounted for in the design process.

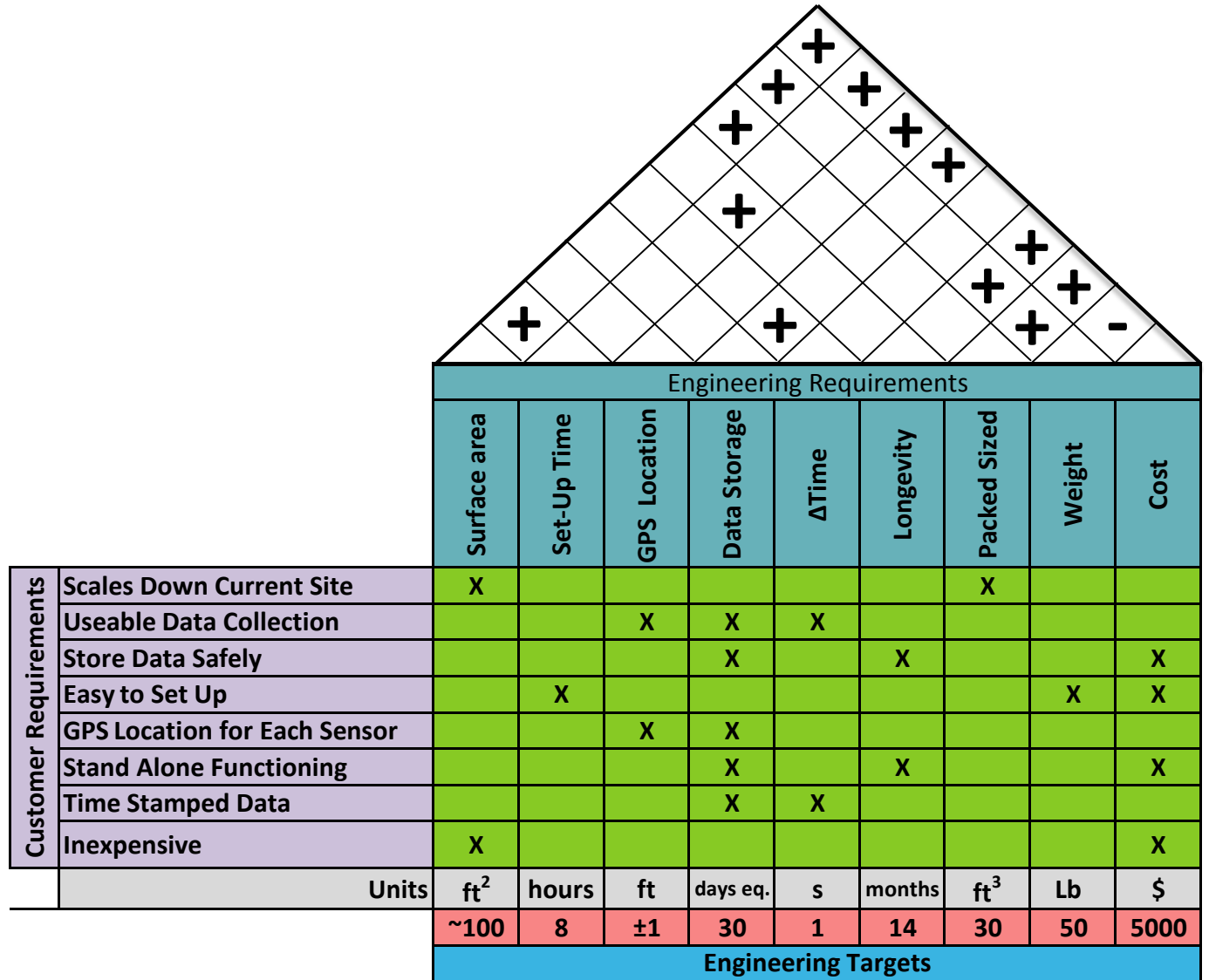
4.0 Conclusion

In summary, the goal of this project is to determine whether or not a similar irradiance variability measuring device is possible in a smaller scale while still being compatible with the current system. With few proposed constraints, our solution will be found over a period of testing and analysis. This process will follow the Gantt chart shown in Appendix B.

References

- Twidell, John, and Weir, Tony. *Renewable Energy Resources*. New York: Taylor and Francis Group, 2006.

Appendix A: Quality Function Deployment



Quality Function Deployment

Appendix B: Gantt chart

