SPEC-14-230

PROJECT SPECIFICATION

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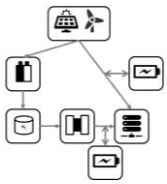

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Fuel Cell

Revision History

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-	Initial Release	2/1/15	Blake Lane

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1 PROJECT SPECIFICATION OVERVIEW

1.1 Executive Summary

This project aims to design a 100 MW data center that runs entirely on clean, renewable energy. We will determine which renewable energies to use; possibilities include solar, wind, hydro, and other energy sources. The data center will ideally be powered by these energy sources when possible, to decrease potential areas for power loss. Due to the varying nature of most renewable energy sources, we will design an energy storage system that will take electricity from times of excess and store it as hydrogen using an electrolyzer. The hydrogen will then be used in a fuel cell at times when the data center is not receiving enough power from the other sources. Because fuel cells do not respond quick enough to the demands of servers, batteries will also store energy to be used on transient responses of the servers.

After research, we have found that solar and wind power will be the best renewable sources of energy for this project. Therefore, we will direct our study on a system with solar panels, wind turbines, an electrolyzer, fuel cells, and batteries.

To determine the specifications for the data center, we will be conducting small scale experiments on the individual sections. We will measure the wind speed using an anemometer. Through the use of a computer model, we will determine an appropriate power output from the wind speed. We will use the solar panels to determine how much power we can generate from the sun. We will also connect a server to the solar panels to see how directly using solar power will affect the server. We will take data from an electrolyzer to determine how quickly we can make hydrogen and other relevant specifications. We will use the hydrogen to fuel the fuel cell which will power the servers. Batteries will provide power at times when the fuel cell cannot meet the demand fast enough.

When we have gathered the relevant data, we will extrapolate to design a full scale 100 MW data center.

See project definition sheet for further details.

2 Product Description

2.1 *Product Context*

This product is a design that requires the user to purchase equipment that deliver the desired amount of power. Once the user has the required components, which we will recommend, they will set up their power system as we describe. In doing so, the user will have a clean, renewably-powered energy system that works completely independently from the electrical grid.

2.2 *User Characteristics*

Users of our design are companies that need to power large facilities. Our target user is a company that is planning to create a large data center, but our design can be adapted to power other facilities with a variety of energy needs.

2.3 *Assumptions*

We assume that the location we are placing the data center will have enough sun and wind to power the center. If those two power sources are not available in the required amounts, the end user can add other sources of alternative energy such as hydro and geothermal.

2.4 *Constraints*

We will be considering only solar and wind power for our alternative energy sources due to the wide availability of the sun and wind. However, other sources could easily be added to our design if they are available in a prospective data center location.

2.5 *Dependencies*

For our design to reasonable in terms of cost, the price of fuel cells must drastically be reduced. Proton exchange membrane fuel cells now are very expensive, in large part due to their expensive platinum catalyst. Many fuel cells will be needed for our 100 MW design, so the overall cost would be prohibitive now, even for large companies.

3 Requirements

3.1 *Functional and Performance Requirements*

The system will be independent of any external power source and continue to power the server. There will be an energy storage system to prevent adverse weather from stopping the system.

3.2 *User Requirements*

The user will have power generating equipment such as solar panels, wind turbines, and hydropower.

3.3 *Maintenance Requirements*

The solar panels and wind turbines will have general upkeep requirements. The panels need to be cleaned about four times a year, and the turbines should be lubricated and serviced annually. The fuel cells and batteries will need replacement after several years of use.

3.4 *Standards Compliance*

The required building standards for the location chosen by the user must be followed. Also, electrical safety requirements for high power must be followed.

3.5 *Deleted or Deferred Requirements*

We will not be creating a complete, small-scale model of our system as we originally intended. The loss of five members' manpower and student fees necessitated this change. Instead, we will collect data and simulate a model on the computer, likely with Matlab.

4 Appendix

4.1 Definitions, Acronyms, and Abbreviations

N/A

4.2 References

N/A