FSU/FAMU College of Engineering

Department of Electrical and Computer Engineering

Energy Manager (FSU Utilities)

Team 12

Team Members

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David Gonsoulin

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# Overview of the Design Team

The design team consists of 4 students. The team member names are: Dallas Perkins, Patrick Dawson, Matt Streich, and David Gonsoulin.

**Patrick Dawson (Team Leader)**

Patrick has experience through both classes and through internships that relate well with this project. He has excelled in courses that will help design this project, such as electronics. Also, he has leadership experience through clubs such as Engineers without Borders and attending the World Energy Engineering Congress. He has three internships and his last was with a large utility. He will be able to bring this knowledge into the group and help realize concepts such as rate tariffs and the economics behind a public utility. His role as group leader will be managing the team with a sense of responsibility and respect. He must be able to see long-term goals and set up a plan in order to develop ideas. He needs to promote cooperation through the group and hold team members accountable for meetings.

**Dallas Perkins (Chief Research Officer)**

Responsibilities shall include analyzing the current building conditions and possible implementations available for demand side management. This will include examining the blueprints and specifications for each building to determine which areas the energy reduction techniques can be applied in. He is expected to contribute an understanding of the design of commercial buildings and the interpretation of plans due to his background working for a construction design engineering firm.

Technical Area: his study in the field of power and energy will provide a knowledge base for the power distribution and three-phase analysis needs of the project. He is expected to contribute to the analysis of the power supply network for each of the buildings and in the process of designing a new, more efficient system.

**Matthew Streich (Communication Liaison and Verification Officer)**

The communication liaison will be responsible for arranging meetings, and will serve as the buffer between the group and the advisor/sponsor. The liaison also keeps records of all group meetings, posting results to bb. The verification officer takes theory calculated and simulates this data in MATLAB, verifying the correctness of the design calculations performed. Matt has programming experience in both hardware and software in a variety of languages, from high-level OOP to assembly in two internships at a fortune 500 company as well as work at CAPS

**David Gonsoulin (Financial Advisor)**

The responsibilities of the Financial Advisor includes, but is not limited to, the following: managing the project budget, keeping records of purchases and other expenses, and coordinating the purchasing of any needed equipment or items. The areas of contribution for David include: microcontroller programming, network programming, three-phase analysis, and power electronic design. The programming background could be useful for implementing a complete system in the building of choice. The system may include a central processing unit that takes in data from the rest of the building. Based on the input data, the central processing unit must instruct different microcontrollers as to what to do. Three-phase analysis will prove useful when looking at the building plans; this will facilitate a better understanding of the entire building electrical system.

# Needs Assessment

## Project Overview

The project is to design a Demand Side Management Program that will allow the university to save money on energy costs.

### Problem Statement

This project is to design, implement, and evaluate a demand side management program for a large building on the Florida State main campus. This project will collaborate directly with the FSU Utility department in order to implement a solution that will be able mitigate the demand of power for the building. The main goal of this project will be to create an individual design of a management program that will be able to substantially lower energy use during peak demand as well as be able to capture relevant data pertaining to energy usage, demand response and cost savings.

#### Background Context

The concept of demand side management arose in the early 1980’s with the goal of managing customer demand in both residential and commercial sectors. The main method of achieving this goal is to use less energy during peak hours (peak clipping) when the prices for each kilowatt-hour are higher, and moving more load to off-peak times (load shifting). This allows for a steadier load for the power companies and reduced costs for the consumer due to using a higher percentage of their energy when the prices were lower in off-peak times. Additionally, energy can be stored during off-peak hours to supplement the power supply when prices are higher. Demand response is a large part of this process, and incorporates methods of remotely controlling equipment such as air conditioners, water pumps and water heaters. These devices can be equipped to monitor the energy usage of each piece of equipment and to cycle them during peak demand hours or turn them off in case of a demand spike. Doing this allows for a lower demand during times when it is more expensive for the power companies to produce the energy, and shift demand to cheaper time periods when the overall demand of the grid is low.

#### Statement of Needs

The goal of this project is to save money for the University by implementing a Demand Side Management system in two of the buildings on the FSU Main Campus. The buildings are the Dirac and Shores buildings. The group will analyze the economics behind the tariff rates that apply to these buildings and decide on the hardware and software needed to mitigate energy usage and in turn reduce the cost of operation. Additionally, the system needs to be implemented while maintaining the quality of life in the buildings. Another consideration is to ensure critical loads in these buildings do not exceed their tolerances.

#### Supporting Information

The quality of life has an array of different items that must be considered. The ventilation and temperature in the buildings must be maintained. There is a requirement for the minimum air flow that every building on campus must meet. The temperature and relative humidity for the rooms in the buildings must be maintained within a certain range. Another load that must be considered is the lighting inside the building. The lighting must be maintained according to the standards set out by governing bodies.

##### Ranking of Needs

1. Safety
2. Reliability
3. Critical Loads
4. Building Comfort
5. Economics

#### Statement of Objectives

The final objective of this project is to save the university energy usage, thus money. This will have to be done while maintaining a level of comfort and reliability in order to control a steady quality of life.

##### Preliminary Design Objectives

The design goal of this project is to develop a theoretical model and system for demand side management that could potentially be implemented in the two buildings chosen. The goal of the design is to produce a system that would cost less to implement than the potential savings created by reducing the power consumption of the buildings.

##### Preliminary Solution Concepts

One possible approach could be to slightly increase temperature in buildings. Another possible solution would be to slow down fans that push air into buildings. A third possible solution would be peak clipping and load shifting in order to create a more consistent load, thus lowering load variance and cost due to utility pricing plan.

# Requirements Specification

## List of Engineering Requirements

#### Functional Requirements

REQF-01 System should save University money

REQF-02 System should perform real-time analysis of data points and respond to data accordingly

REQF-03 System should track data in a database for future economic analysis

#### Constraints

REQC-01 System should be able to interface with current existing Siemens Controls system operating at main utility plant

REQC-02 System should maintain a steady temperature, ventilation and critical loads as proscribed by administration

REQC-03 System should connect with other legacy hardware such as non-variable motors and thermostats

#### Standards Compliance

All electrical systems should comply with the National Electric Code (NEC) 70

#### Operating Environment

RECO-01 Equipment should weather and tamper-resistant – air handlers are often placed outside where they could possibly be accessed by intruders

RECO-02 As mentioned previously, ambient air, humidity, and ventilation levels must be maintained.

#### Usability Requirements

Design must be able to be altered/replicated by FSU control engineers.

## Assumptions and Limitations

#### Assumptions

* Current Siemens sensor systems are accurate
* Utility rate plan will stay the same or similar
* Data points will provide enough information to forecast potential economic benefits

#### Limitations

* Not promising a design that can be easily ported to other buildings

#### Prioritization Analysis of Requirements

1. Maintain standards outlined by NEC
2. Maintain Quality-of-life standards outlined by FSU administration
3. Maintain Critical loads
4. Reduce money spent by university on electricity
5. Maintain interface with current Siemens system
6. Portability

# Preliminary Testing Plan

1. Research demand-side management technologies and techniques
2. Use drawings and information provided by primary sponsor to evaluate potential power savings in Shores and Dirac
3. Develop a theoretical model of design for power management
4. Implement simulation of theoretical design
5. Review simulations with our sponsors and faculty advisor to determine potential energy savings and risks associated with implementing our changes
6. Implement changes, monitor impact
7. Make changes where necessary, repeat steps C-F as needed.

# Budget

The budget for this project will be determined by the potential savings proposed by the theoretical model of the system. Therefore, if it can be proven that the system will save more money than it will cost to implement the design in a relatively short time span, the necessary funds will be appropriated. This allows for a varying budget that depends on the efficiency of the design produced.

# Conclusion

In conclusion, this project must maintain current standards while saving money and energy. The project is still open-ended in that there is a variety of technologies that may be implemented based on economic feasibility. This will allow a great degree of flexibility when it comes to possible methods for design realizations. Therefore, there will be a multitude of design paths that can be investigated when looking for a solution to the proposed problem. David Gonsoulin promises a 50% energy reduction or he will fail.