Alternative Power Source to Draw Underground Water

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Team 01

Needs Identification, Product Specification and Project Plan

Report 1

Submitted towards partial fulfillment of the requirements for
Mechanical Engineering Design – Fall 2012

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Contents

1. Introduction

Babbitt Ranches is the producer of AQHA quarter horses and is home to the Coconino Plateau Natural Reserve Lands. Babbitt Ranches, located between Flagstaff Arizona and the Grand Canyon, was established in 1886 and has 730000 acres of land, with an additional 300000 acres deeded. In addition to raising livestock, Babbitt Ranches hosts a mining operation run by Cemex. Cemex, a global building materials company that distributes and sells cement, currently mines aggregate on Babbitt Ranches' property.

2. Needs Identification

On October 11, 2012 the team met with the client Billy Cardasco, President of Babbitt Ranches. Mr. Cardasco identified the combined need of Cemex and Babbitt Ranches for a new means of drawing water from wells with depths beyond 800 feet. The first priority for both Babbitt Ranches and Cemex is to lower the operating costs of their water pumping systems. In addition, they have also expressed interest in mitigating their carbon emissions. Considering all wells on Babbitt Ranches' property, the well that is utilized by Cemex is the most demanding design challenge. The well is required to pump 75 gallons/minute from a depth of 1700 feet. Therefore, Mr. Cardasco would like a solution to be found for the Cemex dedicated well, which then can be applied to other wells that are found throughout the ranch property.

Need Statement: The client is unsatisfied with the cost of fuel as well as the emission penalties required to draw 75 gallons of water per minute from 1700 feet below the surface.

3. Goal

The team will identify the obstacles associated with drawing water from the prescribed depth. This would improve the team's understanding of the problem as well as put the team in a better position to think of innovative ideas to solve the problem. The long term goal would be to design an alternative energy source for the pump used by Cemex. This new design would improve on the existing pump system and its power supply as well as draw the energy from an

alternative source. If the design is shown to improve the current pump system, the solution would able to be incorporated into similar designs for all of Babbitt Ranches' pumps.

Goal Statement: The team will design an alternative energy source that can be utilized to draw water from wells at 1700 feet that can reduce the client's current operating expenses.

Scope of the Goal Statement: The team plans to analyze the problems that Babbitt Ranches and Cemex are experiencing, and through the analysis, create a design that meets the objectives set forth for this project. A working prototype is not in the scope for the time of this class.

4. Objectives

The defined objectives for this design project are seen in Table 1 below.

Table 1: Objectives

Objective	Basis of Measurement	Units
Depth	How deep water is being pumped from	feet
Reduce Costs	Operating/Maintenance costs of diesel engines	$
Maintain Flow Rates	Flow rates of current system	gallons/min
Maximize Alternative Energy	Amount of energy from alternative sources	lbf-hr
Decrease CO_2	Carbon emissions of diesel engines	lb CO_2/year

5. Constraints

The following is a list of constraints:

1. The pump is required to pump water from 1700 feet.
2. The pump must operate at a flow rate of 75 gallons per minute.

6. Testing Environment

All of the testing for this project will be done from analysis. No physical testing of the current system or a working prototype is expected to occur. If the team is able to find a solution to the problem, it will be provided to Cemex and Babbitt Ranches with detailed design plans to install such a system on their premises.

7. Recapitulation

Need: The client is unsatisfied with the cost of fuel as well as the emission penalties required to draw 75 gallons of water per minute from 1700 feet below the surface.

Goal: The team will design an alternative energy source that can be utilized to draw water from wells at 1700 feet that can reduce the client's current operating expenses.

Objectives:

1. Create a power supply system capable of drawing water from depths of 1700 feet.
2. Reduce annual operating, fuel, and maintenance costs of the current system.
3. Maintain flow rates of the current pumping system with the new design.
4. Produce a maximum amount of energy from alternative sources versus conventional sources.
5. Decrease pounds of CO_2 per year.

Constraints:

1. The pump is required to pump water from 1700 feet.
2. The pump must operate at a flow rate of 75 gallons per minute.

8. Criteria Tree

The criteria tree for this design project can be seen in Figure 1 below.

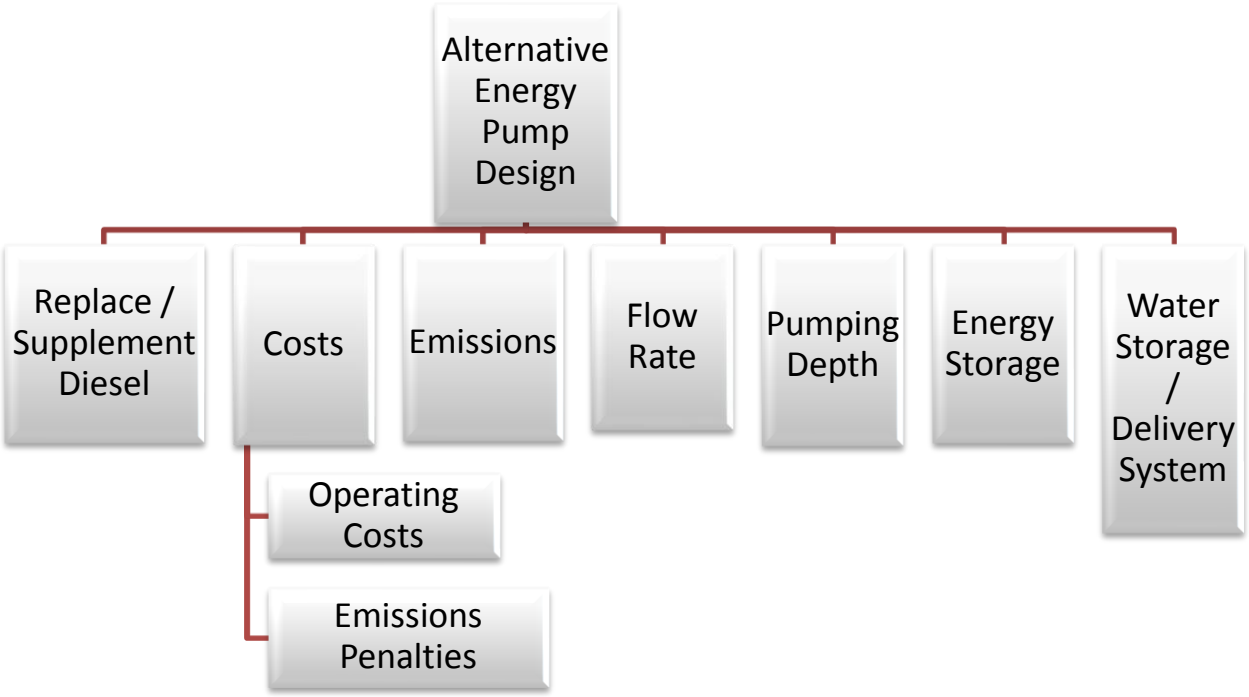

Figure 1: Criteria Tree

9. Quality Function Deployment

The Quality Function Deployment table for this design project can be seen in Table 2 below. Note that an "X" indicates a correlation between the customer requirements and the engineering requirements while an "O" indicates that the bench mark currently meets the customer requirements.

Table 2: Quality Function Deployment

		Engineering Requirements							Bench Mark
		Conversion Technology Efficiency	Generator Power Output	Generator Efficiency	Pump Power Requirements	Pump Efficiency	Pump output capacity	Cost	Diesel Generator
Customer Requirements	Reliable							X	O
	Sufficient gal/min				X	X	X		O
	Pump water from1700 ft.		X	X	X				O
	Utilizes alternative energy source	X							
	Emission Reduction							X	
	Low running cost	X						X	
	Units	%	hp	%	hp	%	gal/min	$	

10. House of Quality

The House of Quality for this design project can be seen in Figure 2 below. Note that a "+" indicates a proportional relationship between the engineering requirements.

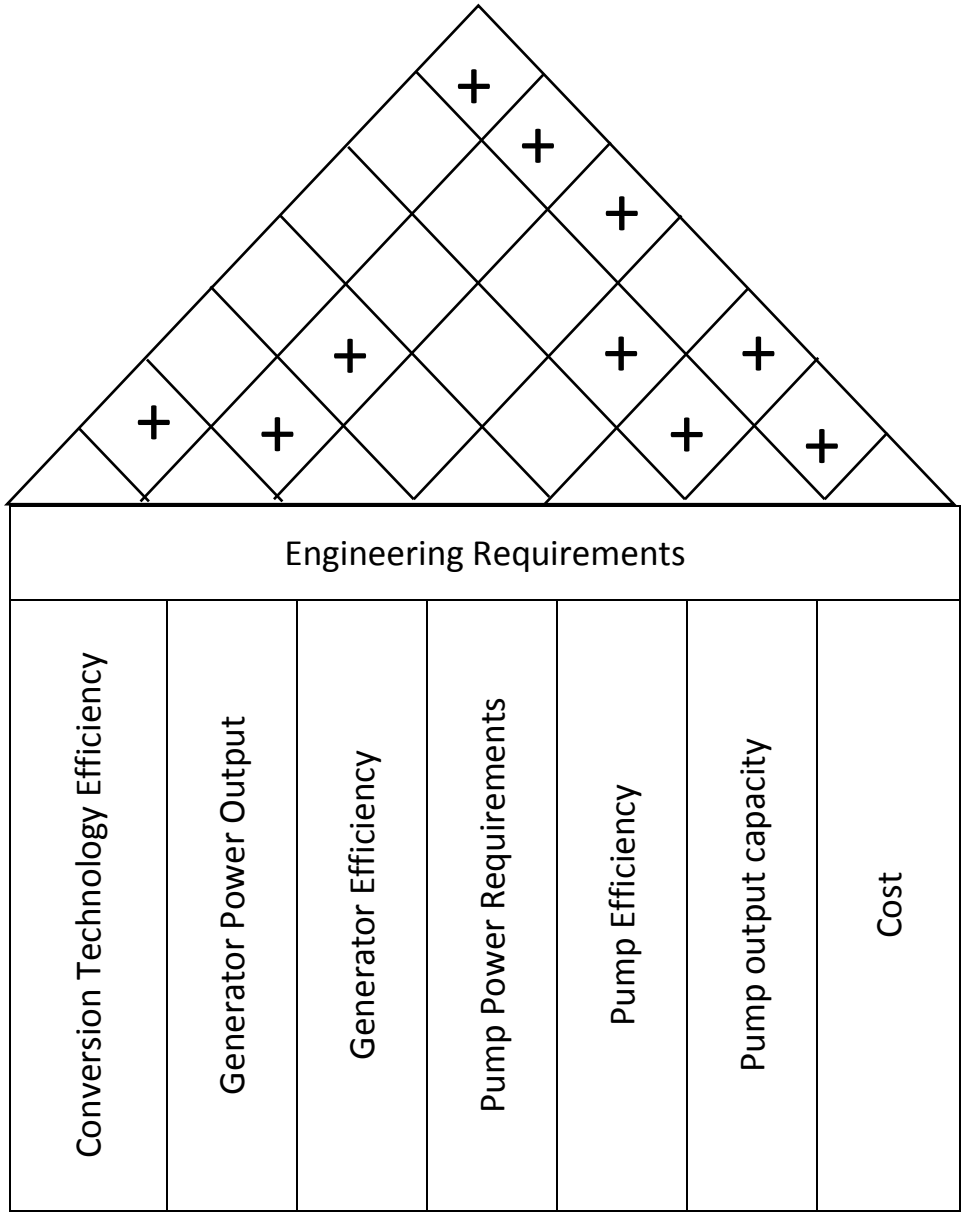

Figure 2: House of Quality

11. Gantt Chart

The Gantt Chart detailing the project schedule can be seen in Figure 3 below.

Task Name	Duration	Start	Finish
Develop Initial Project Strate	11 days	Sun 9/30/12	Wed 10/10/12
Meet with Contact	1 day?	Thu 10/11/12	Thu 10/11/12
Report/Presentation 1	12 days	Thu 10/4/12	Mon 10/15/12
Report 1 Due	0 days	Mon 10/15/12	Mon 10/15/12
Presentation 1 Due	0 days	Mon 10/15/12	Mon 10/15/12
Prepare Secondary Questior	2 days	Fri 10/12/12	Sat 10/13/12
Meet Doug Stevens CEMEX	3 days?	Wed 10/17/12	Fri 10/19/12
Meet Professor Acker	1 day?	Fri 10/12/12	Fri 10/12/12
Concept Generation	15 days?	Fri 10/12/12	Fri 10/26/12
Research	40 days?	Mon 10/1/12	Fri 11/9/12
Report/Presentation 2	12 days	Mon 10/15/12	Fri 10/26/12
Report 2	0 days	Fri 10/26/12	Fri 10/26/12
Presentation 2	0 days	Mon 10/22/12	Mon 10/22/12
Meet Bill Meyers	5 days?	Mon 10/29/12	Fri 11/2/12
Meet Bill Cardasco	5 days?	Mon 10/29/12	Fri 11/2/12
Meet Doug Stevens	5 days?	Mon 10/29/12	Fri 11/2/12
Meet Shaum Electric	5 days?	Mon 10/29/12	Fri 11/2/12
Site Visit	5 days?	Mon 10/29/12	Fri 11/2/12
Engineering Analysis	19 days?	Mon 10/22/12	Fri 11/9/12
Report/Presentation 3	15 days?	Fri 10/26/12	Fri 11/9/12
Report 3 Due	0 days	Fri 11/9/12	Fri 11/9/12
Presentation 3 Due	0 days	Mon 11/5/12	Mon 11/5/12
Meet with Clients	5 days?	Mon 11/12/12	Fri 11/16/12
Final Design Review	22 days?	Fri 11/9/12	Fri 11/30/12
Report/Presentation 4	19 days?	Mon 11/12/12	Fri 11/30/12
Report 4 Due	0 days	Fri 11/30/12	Fri 11/30/12
Presentation 4 Due	0 days	Mon 11/26/12	Mon 11/26/12
Meet with Clients	5 days?	Mon 12/3/12	Fri 12/7/12

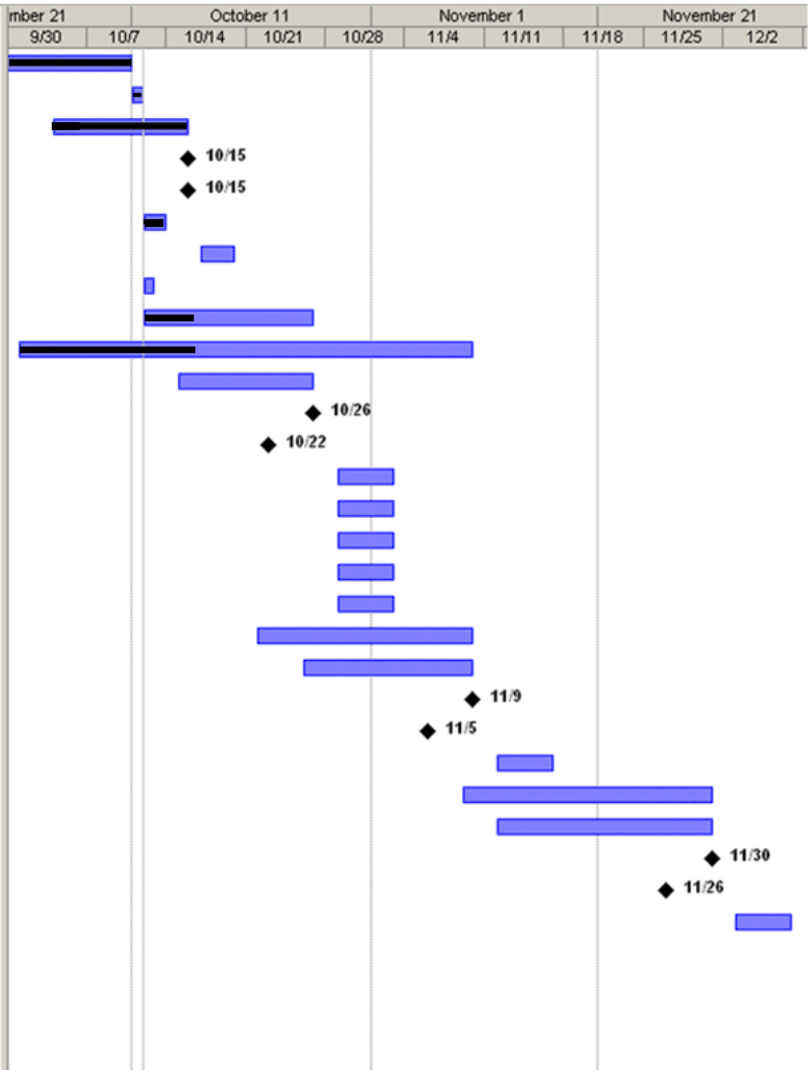

Figure 3: Gantt Chart

12. References

1. Doug Stevens – Cemex
2. Bill Cardasco – Babbitt Ranches
3. www.nrel.gov