Alternative Power Source To Draw Underground Water

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Team 01

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Overview

Problem Statement

Current Diesel Generator

Wind Power

Solar Power with Battery Array

Solar Power with Diesel Generator

Solitary Diesel Generator

Proposal

Gantt Chart

References

Problem Statement

- The Client requests a solution that will draw water from 520 meters while maintaining the current flow rate of 0.3 m^3/min and reducing overall cost.


DANGER
NON-POTABLE
WATER
DO NOT DRINK

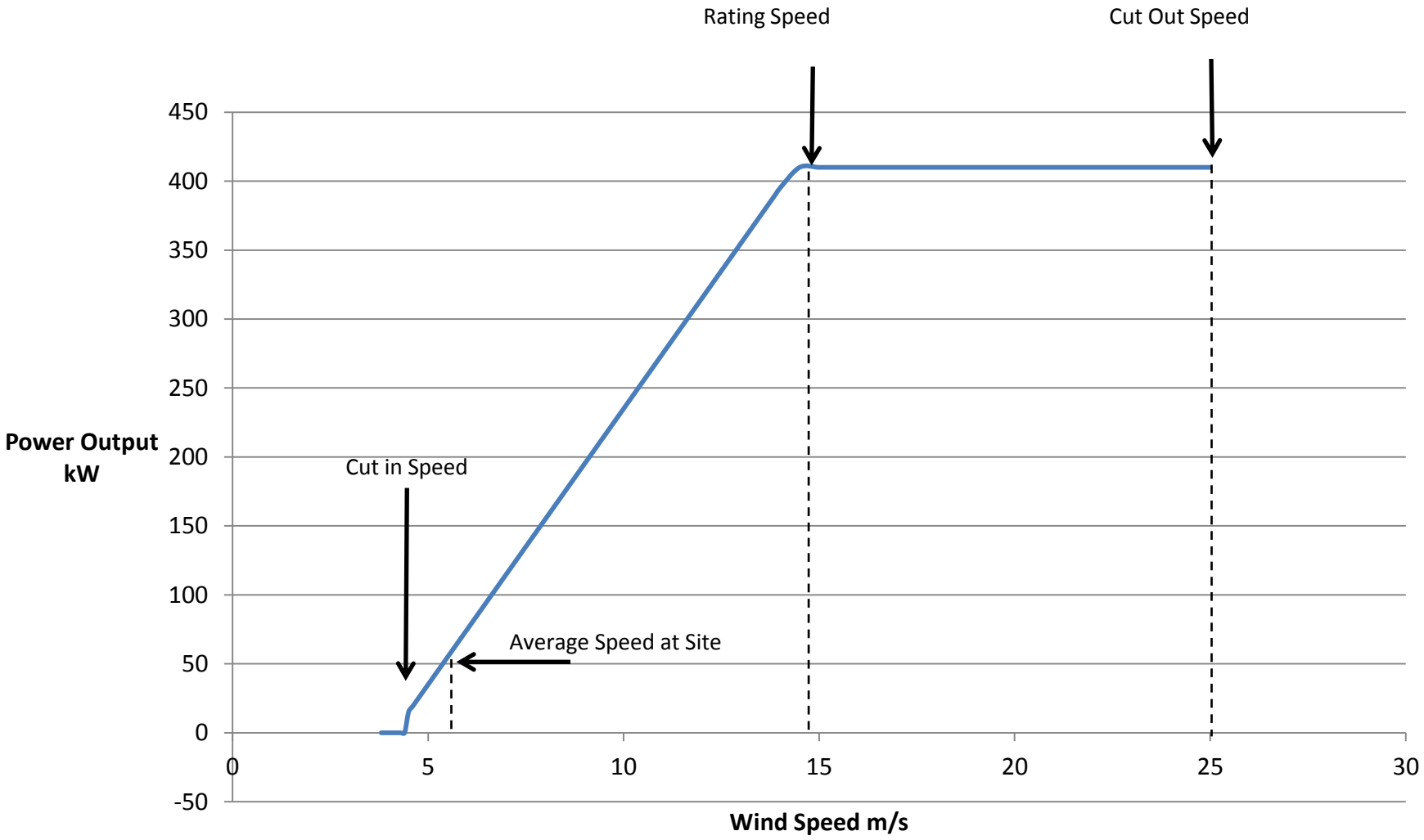
Current Diesel Generator Costs

- Cost of fuel - $3.50 per gallon
- Fuel Consumption - 27 gallons per day
- Operation - Running 6 days per week
- Yearly cost - $29,000 per year

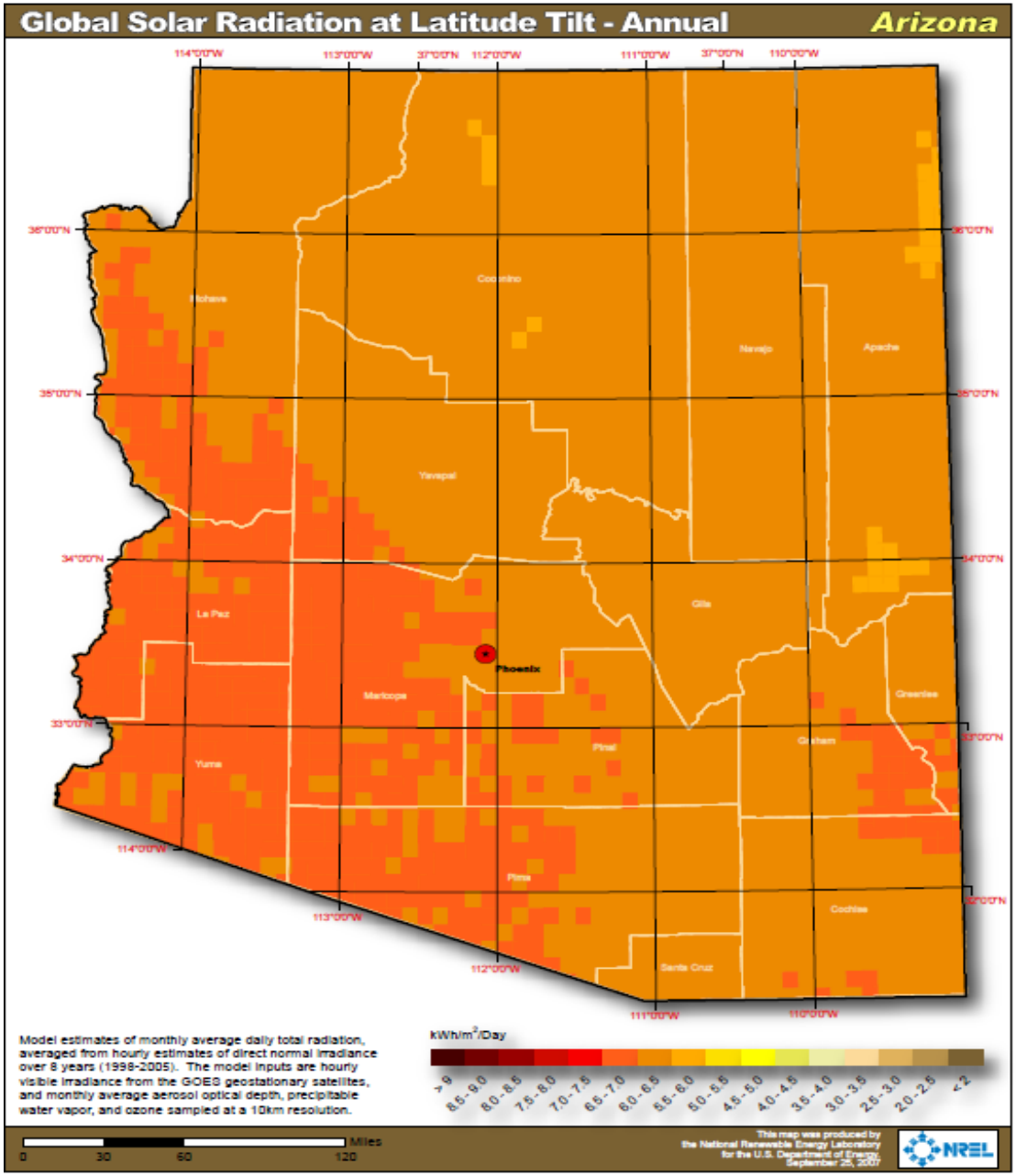
Wind Power

- Average wind speed - 5.5 m/s
- Minimum cut in speed - 4.5 m/s
- Rayleigh distribution
  - Expected usable average 7 m/s wind speed
  - 60% availability factor

Idealized Power Curve - 30m Rotor Diameter



Solar Resource



Solar Power with Batteries

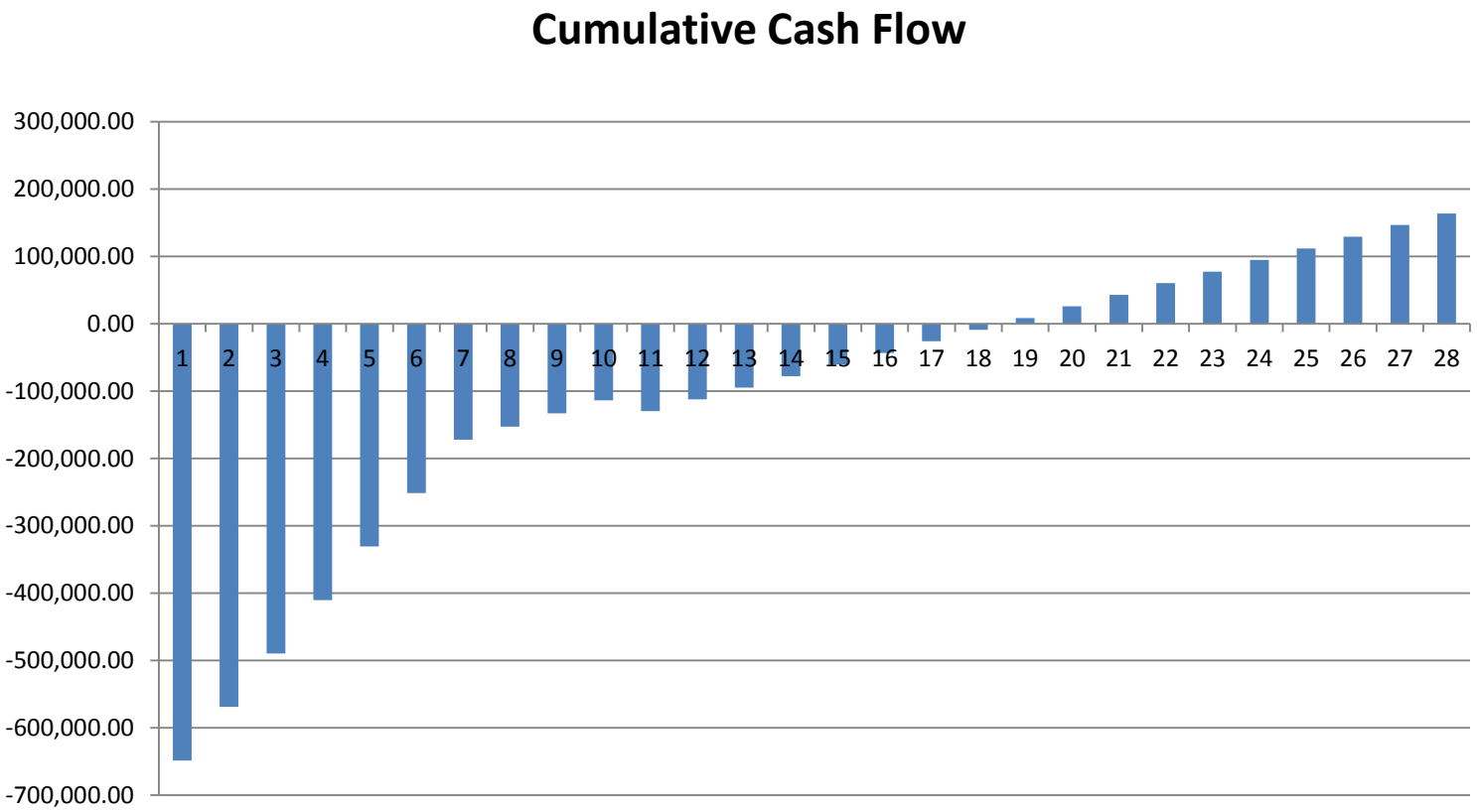
- 6 days of autonomous function
  - Recommended for systems with no backup
- 11 year maximum life
- 18 year payoff to offset diesel costs
  - Using diesel generator at maximum
- Battery array is not feasible

Solar Power with Diesel Generator

- Average cost per watt (DC) installed - $10.00

Year Of Operation	At Installation	1	2	3	4	5
Gross Installation Cost	-$1,000,620.00					
Federal Tax Credit	$300,186.00					
Annual System Maintenance		-$10,006.20	-$10,006.20	-$10,006.20	-$10,006.20	-$10,006.20
AZ Solar Energy Production Tax Credit	$2,103.70	$2,103.70	$2,103.70	$2,103.70	$2,103.70	$2,103.70
State Credits Corporate Rate	$50,000.00					
APS Utility Rebate	$60,037.20					
Inverter Cost	-$60,000.00					
Tax Savings from MACRS Depreciation (5yr)		$60,037.20	$60,037.20	$60,037.20	$60,037.20	$60,037.20
Diesel Fuel Savings /year		$30,660.00	$30,660.00	$30,660.00	$30,660.00	$30,660.00
Generator Fuel Cost		-$3,406.67	-$3,406.67	-$3,406.67	-$3,406.67	-$3,406.67
Generator Purchase	-$35,000.00					
Generator Tier 4 Maintenance Program	-$5,000.00					
Annual Cash Flow	-$648,293.10	$44,388.04	$79,388.04	$79,388.04	$79,388.04	$79,388.04
Cumulative Cash Flow	-$648,293.10	-$603,905.06	-$524,517.02	-$445,128.99	-$365,740.95	-$286,352.91

Solar Power with Diesel Generator

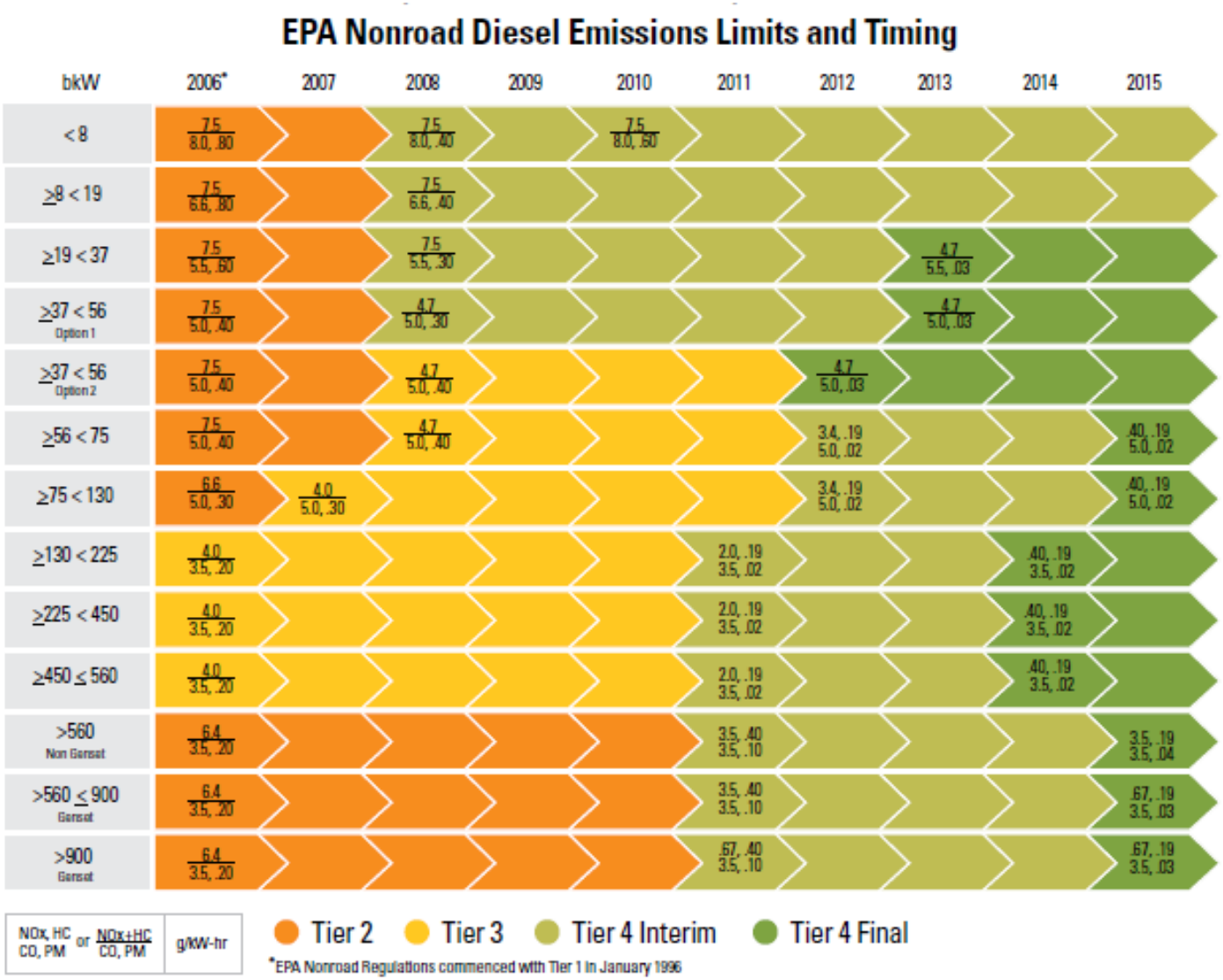


Solitary Diesel Generator

Design Constraints:

- Must Meet Current Needs
- Must Conform to New Emissions Standards
  - Required by 2015

Tier 4 Emissions Standards



Source: http://emissions.michigancat.com

Generator: Cummings QSB 3.3

- 60 kW
- Conforms to Tier 4
- MSRP ≈ $35,000
- T-Tip ≈ $5,000

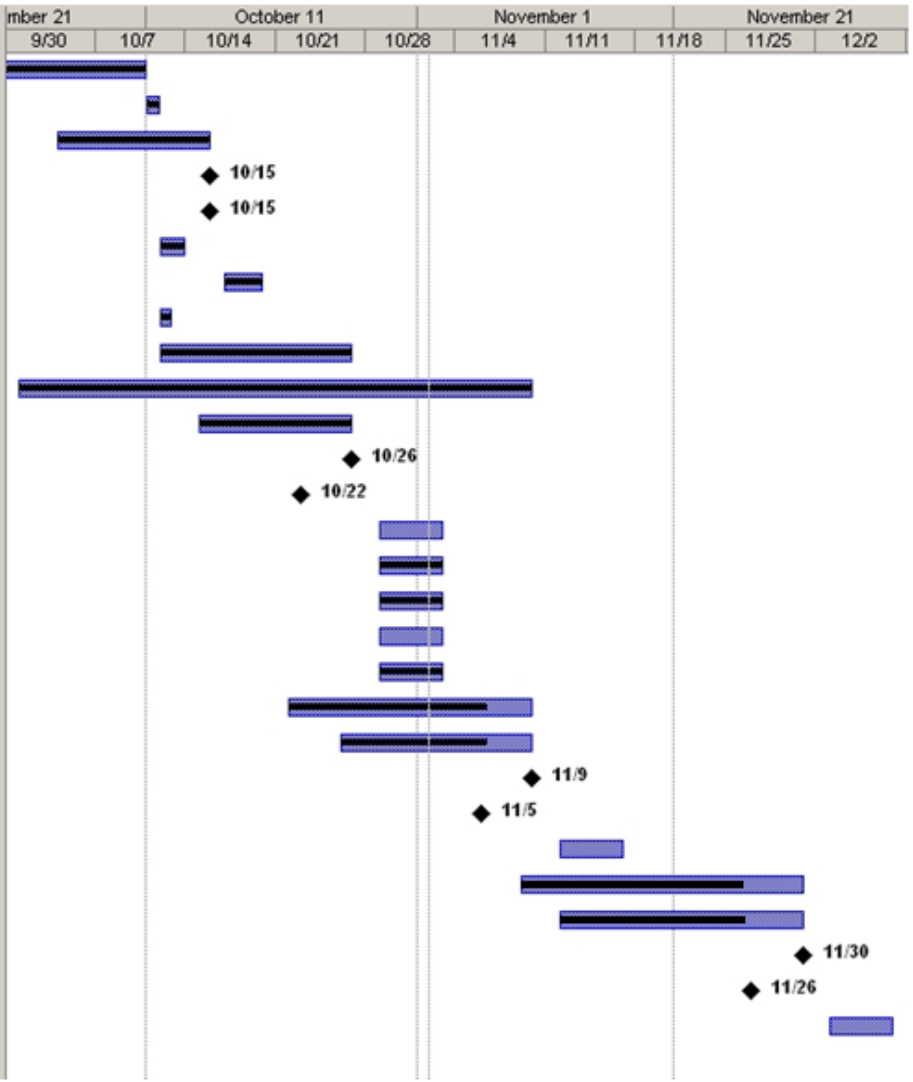
Source: http://cumminsengines.com

Proposal

- Solar Panels with Diesel Generator
  - $1,000,000
  - Payoff time of 19 years
- Diesel Generator
  - Cummings QSB 3.3
  - $40,000 with maintenance program

Gantt Chart

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



References

Doug Stevens – Cemex

Bill Cardasco – Babbitt Ranches

www.energy.ca.gov

www.lipower.org

www.usasolarwind.com

www.azgs.az.gov/geothermal

nau.edu

www.zbbenergy.com/

www.windustry.org/

www.wind-estimate.org

solarenergy.advanced-energy.com

www.wind-sun.com

www.solarworld-usa.com

www.generac.com/en082011

Questions?