Blackstone Valley Regional Vocational Technical High School
Student Portfolio- Project Reflection

Date	**10-28-22**
Student Name	**Om Patel**
Subject	**Power Grid Project: POE (10th)**
Instructor's Name	**Mr. Oliveira**
Instructor's Signature	**Mr. Oliveira**

With the first part of the project, I calculated the maximum amount of LEDs that I would need in a specified series, parallel and series-parallel circuit and tested them using a circuit simulation application called Multisim. For the first question I calculated the maximum LEDs for a series circuit which consisted of an unknown resistor and a 12 volt, 1 amp power supply. Then I calculated the maximum LEDs for a parallel circuit in which I had to find the amount of branches this circuit could have. With these two circuits I could then find the maximum LEDs passible from a 12 volt, 1 amp power supply in the last question asking me to use a series-parallel circuit. This taught me that to maximize the use of a power supply it is best use a series-parallel circuit. This also taught me how to calculate and find the maximum amount of LEDs can be used in a specified circuit.

In the second part of this project, I design a power supply and grid using a steam engine and five generators. With these parts, my group and I are supposed to design and create a way to connect the steam engine to the generators and try to get as many LEDs powered as possible. Some information we were given was that the generator was rated to generate 1.8 volts and .87 amps, each LED is paired with a 330-ohm resistor, and it takes 3.5 volts and .008 amps to power one LED. With this information, I created a series-parallel circuit, which consisted of two branches with two generators in each branch, giving me a total of 3.6 volts and 1.74 amps. With my power supply created, I could then find the maximum amount of LEDs that the power supply could power and create a power grid. Using the minimum power input for an LED to power and the maximum power output from the generators, I create a power grid, which was made up of a series-parallel circuit with 217 branches and 1 LED in each branch, giving me a total of 217 LEDs. Knowing that I used the maximum output of the generator I knew I was not going to get 217 LEDS but, it allows me and my group to have another variable that we could easily compare to find the best design for our power grid.

The next step was to design a way in which we could connect the generators and the steam engine. With my group, we brainstormed and try to make the most efficient method of connecting the steam engine to the generators. Some considerations we had to make were how we would clamp or attach it to the table, how to make the least amount of friction, make a design that's simple enough that we can print it in a short time, and a system that won't make our job of connecting the generators harder. With this in mind, we came to a design that had five holes in a rectangular prism, for the generators, a clip, to attach to the steam engine, a clamp tab, to allow us to clamp the holder to the table, 5 wheels, one to attach to each generator, and rubber bands to connect the wheels and steam engine, creating a pulley system. With our prototype we found that we did not space the generators far enough to have tension on the rubber bands, the generators easily fell out, and the clip was unnecessary. With this, we created our final design that separated the generators' holes, didn't have a clamp tab, and was able to tighten the holes. This was done by separating the top and bottom halves to allow us to screw them together creating a tighter fit for them. With our design printed, we tested it and found it worked, allowing the generators to spin and create power.

Using a multimeter the team found out that the steam engine generates 4 volts and 190 milliamps, which is not as near to what we calculated, as we expected. We also found that the steam engine could power two LEDs in series but not three. With that information, the team individually calculated what they think is the maximum amount of LEDs our power supply can power. Knowing that we can output .19 amps and it takes .006 amps to power one branch, I calculated there could be 31 branches. Knowing that two LEDs in series are a possibility, from our experiments, I created a series-parallel circuit that consisted of 62 LEDs. With the goal being to get the maximum amount of LEDs we all compared the numbers we had gotten for that variable and all found that 62 was the maximum, and the series-parallel circuit was the best design. The next step was to create the circuit in real life which my group members and I did using breadboards, LEDs, and 330-ohm resistors. While we built the breadboards we tested our work by using a power source, set to 4 volts, as we didn't want to start the steam engine up every time. At every interval of ten, we tested our circuit to ensure that the LEDs would turn on and that we were not using too much current. When testing our final breadboard we were able to light up all the LEDs and were ready to do the final test on our steam engine.

With the breadboards finish and hooked up, I started up the steam engine and watched as all 62 LEDs lit up. However, the light was very dim, and to see them lit to their brightest we removed one branch. With that, we know that 62 LEDs is the maximum amount of LEDs that can be powered by our power supply but if you want to see the LEDs brighter, the best amount would be 60. With our final design built I calculated the efficiency of the generators which ended up being 9.7% due to the generators outputting .76 watts whereas they should be able to output 7.83 watts. Ultimately, this project tested my ability to use the engineering design process, work in teams, build off others' ideas, and use my knowledge of electricity in a somewhat real-life scenario.

Technical competencies and academic skills demonstrated by completing this assignment.

Framework Standard	**Description**
2.B.01.02	**Brainstorm ideas; develop and evaluate solutions; create documentation; build and test prototype; and present design.**
2.C.01.02	**Calibrate and use test devices accurately**
2.C.02.08	**Calculate voltage, current and resistance in circuits using Ohm's law.**
2.C.03.02	**Construct a circuit.**
Embedded Academics	**Description**
2.C.02.08.4	**Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.**
2.B.01.02.8.d	**Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented**
2.C.20.9-10	**Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text**
2.C.06.1.5	**Interpret plans, diagrams, and working drawings in the construction of prototypes or models.**