**INTEGRATED POWER SOLUTIONS**

**Solar Powered Generator**

**By:** Daniele Weisberg

Macarous Ansah

Heejin Cho

Tiffany Anson

Syed Ibrahim

**TABLE OF CONTENTS**

1. INTRODUCTION\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_2

1.1 Background\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_2

1.2 Problem Statement\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_3

1.3 Needs Statement\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_3

1.4 Objective\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_3

2. PROPOSED TECHNICAL APPROACH\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_3

2.1 Requirements\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_4

2.2 Architecture Design\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_5

2.3 Technical Description\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_5

2.4 Quality Assurance Plan\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_6

2.5 Generator Pricing\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_6

3. EXPECTED PROJECT RESULTS\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_7

3.1 Measures of Success\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_8

4. SCHEDULE\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_8

5. REFERENCES\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_9

**1. Introduction**

In 2017, one of the most destructive categories to hit Puerto Rico in nearly a century, made landfall on 20 September. More than 44% of the population of Puerto Rico lives in poverty (Amnesty International, n.d). On 28 August 2018, Puerto Rico’s Governor revised the official death count from 64 to 2,975, which went higher as time progressed. This hurricane also knocked out 80% of Puerto Rico’s electrical grid and plummeted the island into total darkness. It was the largest blackout in US history and the second largest in the world (Amnesty International, n.d). For hospitals, loss of power can be the difference between life and death. If power is interrupted or down for a prolonged period, critical operations and data are compromised (Vox, 2020). If power is lost and a sufficient backup power supply is not in place, critical life saving devices and technologies could become compromised and the health of patients could be at risk. This engineering proposal is focused on the development of solar-powered generators that will allow the hospitals to run independently from municipal or private electricity in the event of an emergency. This generator will initially be tested and distributed to the Hospital Metropolitano San Francisco which was one of the hospitals hit the hardest, and the hospital is a nice fit to install the solar panels because of their flat roof top. Having a generator can be a great way of saving lives for those critical in the hospital.

**1.1 Background**

Hospitals are one of the largest commercial building electricity consumers (CBECS, 2012). Thousands of patients, doctors, nurses, and visitors occupy the buildings daily. Their sophisticated heating, air conditioning systems, and ventilations run 24 hours a day. Many energy-intensive medical and lab equipment, sterilization, food services, and refrigeration require a substantial amount of electricity. These all make hospitals the most vulnerable to blackouts. If their backup generators do not work properly, minutes can mean life or death.

Unfortunately, most hospitals in Puerto Rico, including Hospital Metropolitano San Francisco were not prepared for Hurricane Maria when it landed and left every Puerto Rican without electricity. Hurricane Maria destroyed 80 percent of Puerto Rico’s power lines and its generators, it took months to restore them (Goodkind, 2018).

Hospital Metropolitano San Francisco became a nightmare as soon as the light went out. The lives of the patients relying on dialysis machines and oxygen tanks were immediately put in jeopardy. Diabetes patients lost their insulin injections as the refrigerator went out and it no longer kept the injections cool. These patients could become severely ill in just a few hours without their life-saving machine and medications. But transferring them to the other hospitals where the machines and medications were available was not easy because the communication with other hospitals was not possible without electricity. Also, their electrical medical records including the list of their current medications and diagnosis could not be obtained and refill orders for medications and medical supplies could not be placed without power.

**1.2 Problem Statement**

One of the largest problems with the fuel backup generators is that these generators are typically installed outdoors or in the basement due to the safety and environmental issues, which is prone to flooding. Another problem is the fact that the fuel backup generators require a constant and steady supply of fuels, which is almost impossible during the natural disaster as the demand for fuels would be overwhelming.

**1.3 Needs Statement**

We are seeking permission and funding for the development of our solar power generator.

The current backup generators in most hospitals run on fossil fuels that produce greenhouse gases, which pollutes the environment. and in case of a natural disaster the supply of these fuels becomes difficult to remote regions in Puerto Rico, as it happened when hurricane Maria hit the island. In addition, the generators cost money at the time of refilling them when the power outage lasts a long time. The backup generators in hospitals also produce a lot of noise because of the combustion design for producing electricity. Our design runs on solar energy that is free, environmentally friendly, and it does not produce any noise pollution. The solar powered generator is also cost friendly in the long term because it will only require yearly maintenance compared to a regular backup generator that costs fuel, and more money for maintenance.

**1.4 Objective**

Our goal is to develop an isolated solar backup generator for the hospitals affected by Hurricane Maria. It will be installed under the roof to prevent flooding. By maintaining a steady electricity supply during natural disasters, it will keep every life-saving machine running and allow the hospital to accept injured patients and save more lives.

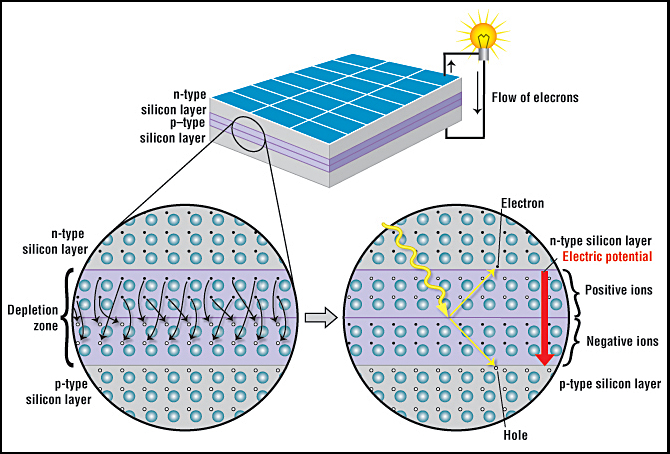
**2. Proposed Technical Approach**

The proposed solution to disaster-based blackouts in hospitals is to equip them with specially designed solar-powered generators. Solar panels will be securely mounted to the roofs of the buildings, able to withstand the brunt of weather-related disturbances. Connected generators will be positioned directly below the roofs (instead of on lower floors) in order to protect them from damage due to flooding. Gearing hospitals with these independent generators will allow them to be self-sufficient in cases where municipal or private electricity are not available. To test the functionality of these machines, we intend to install the generators into Catano, Puerto Rico's largest hospital, Hospital Metropolitano San Francisco. Instead of initially wiring them to power the entire building, they will first be connected to specific wings. By doing this, we can monitor their performance and reliability on a smaller scale before increasing the demand load. In the case of successful results, we will expand the solar-powered generators’ supply, slowly scaling towards the goal of powering the entire hospital during the case of a blackout. Our biomedical and electrical engineers will work closely together to select specific branches of the hospitals suitable for testing, as well as ensuring all power needs are met. The electrical engineers will constantly monitor the data from the generators and an emergency back-up will be available in the case of any machine failures. Our mechanical engineer will work with the team to design the layouts necessary to fit the equipment securely among the various hospital architecture.

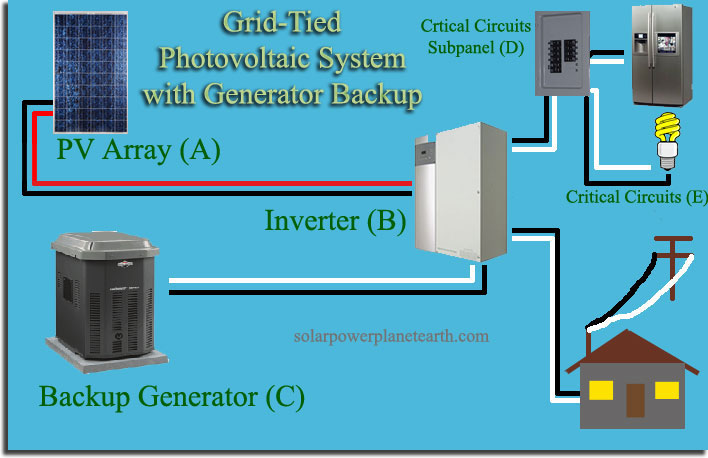
**2.1 Requirements**

After the solar-powered generators are installed into the hospital, electrical engineers will monitor the results of the machines’ two-battery design. They will look for results based upon the biomedical engineer’s recommendations for the specific wings being tested. Data will be recorded daily over the scheduled period of tests. It is important to test the solar panels energy generation throughout all times of the year to ensure there are no lapses during a shift in seasons or weather. Outside of the solar-powered generators, requirements for the project include the materials that will be used for production, permit and inspections, a production facility to produce the machines, and transportation to move the parts to the designated hospitals.

**2.2 Architecture Design**

Most solar powered generator systems only supply a building for 1 day at most but our design is capable to supplying Hospital Metropolitano San Francisco for weeks because we have designed solar panels with a new silicon isotope and a glass coating on top that would allow for more absorption of sunlight and our system generators come with 2 separate back up batteries. The generator system is unique because it would allow for non-stop power supply for weeks while others only last a few days and usually in widespread power outages specially ones that occur as a result of Hurricanes last for weeks. Overall, it takes 2 - 3 days for the system to recharge after the batteries are completely used up (n.d, 2020). However, our new efficient design contains 2 separate battery systems that would be connected with an inverter that would shut down one of the systems and let it charge while the other one operates, this process occurs in microseconds, so the devices connected to the generator will not be affected. In addition, our enhanced solar panels can recharge the system within 1 day so the system will stay charged for no matter how long the power outage lasts. The enhanced solar panels require less energy from sunlight to go into an excited state and leave the atom. As a result, more energy is produced as more silicon atoms are in an excited state. As the molecular diagram depicts the zone in between where negatively and positively charged atoms are parallel to each other but they are designed not to meet. This design enables the solar panels to generate the flow of negatively charged ions, which produce electricity. 

**2.3 Technical Description**

The generator we have designed gets the energy from solar panels and it also comes with a battery system that stores the energy. The solar panels are made of 2 parallel semi conducting-photovoltaic silicon plates. On the atomic level we use the semiconducting plates because as the energy from sunlight (photon) hits these atoms, their valence electron is released. This occurs with billions of atoms in the silicon plates. On the other hand, the placement of these plates creates a magnetic field when these electrons are released, which generates electricity. These solar panels are connected in series placement with other solar panels. The next part of our design is an inverter charger that connects the solar panels to the, letter A to letter B on figure 1, since the electricity generated by the solar panels is in direct current and all the power outlets require alternating current, which is why an inverter is needed. However, this inverter is unique because it can switch the current from AC to DC and from DC to AC the switch from AC to DC is also necessary because as the system charge gets low, this inverter would start the recharging remotely (Altstore, 2015). The next part of the generator are lithium ion batteries that would store the electricity that was generated by the solar panels, this part of the design is connected to the inverter charger. The inverter is also connected to the power panel. When the hospital loses electricity, the inverter would get a 0 voltage reading from the power panel and it would automatically connect the power panel to the backup generator and when the electricity comes back the inverter would detect a non-zero voltage reading and connect the powerpanel to the power supply. This process would also take place in microseconds, so any important equipment will not be affected. In essence, an inverter is the main component of our system because it is programmed to control all generators and the power supply sources and manage the system, the inverter also comes with a charge controller that manages the amount of current that comes in from the solar panel.

**2.4 Quality Assurance Plan**

Integrated Power Solutions is committed to providing the best quality products to our customers. As a result, our products undergo rigorous testing that checks every component of the backup generators. We take the safety of our customers very seriously, which is why we will install these generators at the hospital and monitor them for 6 months to make sure our systems do not have any problems. On the other hand, our product will come with 10 years limited warranty, where the customer can call us for any problem with our system and we will replace any part in the system. In case of generator failure, our design comes with automatic shut off and a relay that would directly supply the electricity from the solar panels in our system. At integrated power solutions we are committed to our customers' expectations. So, our engineering team will do final inspections and install the system and complete regular maintenance every year.

**2.5 Generator Pricing**

According to energy usage the amount of 15 kW system consists of 69 solar panels, which produces 21,234 kilowatt hours annually (EnergySage, 2020). We should divide system capacity by the system capacity needed which is 9292 kilowatts, which equals 550 (15 KW systems) X 69 (solar panels per system.) This gives the total number of average sized panels needed, which is 37,950 solar panels and the area needed on the rooftop is 400,000 square feet. So, 5% of the solar panels are needed to recharge the solar generator system, which means 1898 standard solar panels are needed and 20,000 square feet of area of full sunlight is needed

Solar Generator cost - $300 - $5000 per generator est.

Solar Panel installation cost.

* National Average Cost $32,000 est
* 15KW - 69 panels
* Cost per watt $1.83 Before tax
* Average cost of electricity per KW for hospitals is approximately 2 dollars per KW per hour.
* Labor Cost $0.27 per watt about 15% of the total budget.
* Panel mounts
  + Fix- mount $15 each
  + Adjustable Mount- $50 each
* Permits & Inspection Fees- $0.06 per watt or $50 - $200 per permit

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| --- | --- |
| **Requirements** | **Costs** |
| Solar panels | $68,000 |
| Solar Generator | $300 - $5000 per set |
| Solar panel installation | $32,000.00 |
| Panel mount | $15 X 28 (15 KW systems) = $420 |
| Permit & Inspection fees | $50 - $200 per permit |
| Testing (every 3 years) | $75,000.00 |
| Labor cost | $50,000.00 |
| Total budget (upper bound) | $380,650.00 |

Note: The total budget is for 3 years, which can be paid in 3 installments.

**3. EXPECTED PROJECT RESULTS**

* Our company expects to do weekly updates to fix any problems on the solar panels and to check the progress of the generator.
* After a natural disaster strikes and the damages are done, we expect to push an update to fix as many issues as we can encounter while the hospital turns to the backup generator.
* Our company expects the number of blackouts to decrease overtime as many hospitals in that area turn to use the generator.
* After the completion of the project, which includes the installation of a solar panel and generator system, our company expects the hospital to operate for more than 8 weeks without power supply, where the backup power will run the hospital for a trial of 8 weeks.
* Our company expects that during the 8-weeks trial, the electricity bill from the utility company will also be 0 dollars for Hospital Metropolitano San Francisco.
* On the other hand, we anticipate that during the hurricane season our system will sustain any damage from wind and keep supplying the electricity without any issues, while the hurricane ravages the area.
* Our company also expects the solar panels installed on the rooftop of the hospital to withstand any damages after the natural disaster.
* Our company expects to change the solar panels after every 10 years from the date of the installation.

**3.1 Measures of Success**

We will evaluate the results of yearly testing that our engineers will conduct for 3 years. In addition, we will assess the amount of times blackouts occurred and the amount of damages that was caused to the systems by the wind. If there are no blackouts, no damage, and our system cleared all the tests, then we have been successful and we have accomplished our goal for installing the solar powered generators.

**4. SCHEDULE**

**Task Schedule**

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| --- | --- |
| **Task** | **Date** |
| **Meetings:** meeting up with the director of the hospital, Yelitza Lucena Quilesdue and the Governor, Wanda Vazquez Garced, to discuss the application and advantages of installing the backup generator. During this meeting, we will ask the governor and the hospital management to grant initial approval for initiation of the project. | December 18, 2020 - December 25, 2020 |
| **Development:** After the initial approval is granted on December 18, 2020, we will inspect the Hospital Metropolitano San Francisco and provide a complete summary of the exact number of parts needed in the solar powered generator system and provide the exact amount of funding needed for the project. Then we will send the request for final approval to initiate the work and buy the materials needed. | December 25, 2020 - April 30, 2021 |
| **Testing:** After the approval process is completed we will begin installation of solar panels on the roof, installation of custom inverter, and custom built generator. Then our engineers will test the system to spot any glitches and fix them. | April 30, 2021 - June 20, 2021 |
| **Trial period:** After installation of solar powered generators, we will closely monitor the system and run it for 8 consecutive weeks and see for any glitches. | June 20, 2021 - August 20, 2020 |
| **Implementation:** After the trial period is over we will submit a complete report to the director of the hospital, Yelitza Lucena Quilesdue and the Governor, Wanda Vazquez Garced, as requested initially. | August 20, 2021 |
| **Long term support:** This process will last for 3 years where we will test the system yearly. In addition, if any problem occurs 10 year after installation, we will replace the generators without any additional costs. | August 20, 2021 |

**5. References**

1. Alexia Fernández Campbell. (2018, August 15). Puerto Rico power restored 11 months after Hurricane Maria. Retrieved from Vox website: <https://www.vox.com/identities/2018/8/15/17692414/puerto-rico-power-electricity-restored-hurricane-maria>
2. Beaudet, A. (2015, September 10). What is an Inverter/Charger? Retrieved November 20, 2020, from Solar Power News & DIY Solar Tips <https://www.altestore.com/blog/2015/09/what-is-an-invertercharger/#.X6teCmhKjIU>
3. Goodkind, N. (2018, April 12). Six months after Hurricane Maria, Puerto Rico's power outage is the world's second largest blackout ever. <https://www.newsweek.com/puerto-rico-power-hurricane-maria-blackout-882549>
4. How a Solar Cell Works - American Chemical Society. (2013). Retrieved from American Chemical Society website: <https://www.acs.org/content/acs/en/education/resources/highschool/chemmatters/past-issues/archive-2013-2014/how-a-solar-cell-works.html>
5. How Does A Solar Generator Work? - Can it Last Through a Power Outage. (2019, January 15). Retrieved November 20, 2020, from Powered Portable Solar Generator <https://poweredportablesolar.com/how-does-a-solar-generator-work/#:~:text=In%20short%2C%20a%20solar%20generator>
6. Marsters, P., & Houser, T. (2019, February 25). America's Biggest Blackout. Retrieved from <https://rhg.com/research/americas-biggest-blackout-2/>
7. Puerto Rico a year after Hurricane Maria. (n.d.). Retrieved November 30, 2020, from www.amnesty.org website: <https://www.amnesty.org/en/latest/research/2018/09/puerto-rico-a-year-after-hurricane-maria/#:~:text=Hurricane%20Maria%2C%20the%20strongest%20hurricane>
8. Rodriguez, J., (2017, November 15). How a small hospital in rural Puerto Rico survived Hurricane Maria. Retrieved from <https://www.statnews.com/2017/11/15/puerto-rico-hurricane-maria-hospital/>
9. Solar Power System with Generator Backup. (n.d.). Retrieved November 29, 2020, from solarpowerplanetearth.com website: <http://solarpowerplanetearth.com/solarwithgeneratorbackup.html>
10. U.S. Energy Information Administration - EIA - Independent Statistics and Analysis.<https://www.eia.gov/consumption/commercial/reports/2007/large-hospital.php>

**REFLECTION PAPER**

**Macarous Ansah**

When I saw the assignment, I had so many ideas on what I wanted to research and work on, since only for the past 20 years, we have experienced multiple natural disasters from all over the world. My group and I joined ideas together, debated on them and also with the help of the professor (Professor Carr), we arrived at the same idea of building solar powered generators to supply power or electricity to hospitals when blackout occurs due to natural disaster. My team and I have different concentrations; Daniele, Syed, Tiffany and I, are majoring in Electrical Engineering, while Heejin is majoring in Biomedical Engineering and she always has great and amazing ideas that she brings to the table whenever we have a project. With this proposal, we had to concentrate on how to create a solar powered generator which consists of mostly electrical components, but we were able to join ideas together and incorporate biomedical ideas by researching how the generator can benefit the healthcare department. I learned through this assignment that teamwork and collaborating is a necessity in engineering because engineers come from different backgrounds with different sets of knowledge.

With this proposal, I learned how to incorporate rhetorical situations in a non-narrative project, I also gained insight into all the different aspects that it takes to approve a proposal. In all the projects we have done during the entire semester, I notice that the previous projects had a different layout, structure, and way in which the composition was made compared to this proposal.

My role in this project was writing the introduction, helping with the cost for the project, expected project results and the schedule on the start to the finish of the project. Our company’s name is Integrated Power Solutions, and our primary objective is developing an isolated solar powered backup generator for the hospitals affected by Hurricane Maria. This will be installed under the roof to supply a steady electricity during the natural disaster. We were inspired to develop this project due to the aftermath of the Hurricane. Based on the news, articles and reports, most people lost their lives and others did not get the right medical care because their proper medical reports could not be retrieved because the entire hospital and clinics in the area were out of power. Some patients had to be treated in the open because the hospital rooms were out of air condition which operated on electricity.

The genre of this project is an engineering proposal. This proposal is a document that is used to persuade or seek permission from the audience, in this case the director of the health care department, the governor of Puerto Rico and the secretary of the healthcare department, to give us the funds or support to pursue our project. This proposal will help save many lives destroyed by the natural disaster, making it very valuable and relevant to develop this project.

The media of this proposal is live online oral presentation through Zoom with the use of PowerPoint. The proposal will be submitted digitally, this was good because my group and I made use of Google docs to gather our ideas together and work simultaneously while commenting on each other’s works along the way.

The stance is to push the director of the hospital, Yelitza Lucena Quilesdue and the Governor, Wanda Vazquez Garced, to discuss the application and advantages of installing the backup generator. During this meeting, we will ask the governor and the hospital management to grant initial approval for initiation of the project. This will help the hospital to run with electricity in the event of a Hurricane, more patients can be treated properly. The exigence of this proposal is the lack of communication that can be caused by natural disasters. When Hurricane Maria hit Puerto Rico, 80% of the island lost power and where left in total darkness, most of the electrical grids were destroyed and communication was down (Amnesty International, n.d). With the development of this generator, first responders can have access to communicate between victims affected and the hospital.

The primary audience of the proposal is the Governor of Puerto Rico, Wanda Vazquez Garced, she is the one who approves the funds distributed to the development of the aftermath of the hurricane. She can accomplish this because in 2017, she released a statement that the FEMA package is $12.8 billion, with $10.5 billion for power (Vox, 2020). So, she can give us some of the funds reserved for power to build our project. The secondary audience is Yelitza Lucena Quiles, the director of the Hospital Metropolitano San Francisco, she is the associate administrator of the hospital and can give us her approval to use the hospital to test our project. The third audience for the proposal is the Secretary of the healthcare department of Puerto Rico, Lorenzo González Feliciano, who devoted most of his time in making sure the healthcare facility improves.

Based on this proposal, I feel like we have achieved the Course learning outcomes from 1 to 7. For the first outcome, the project is a group effort, we collaborate with each other to develop the generator. We did the draft work, revisions, edits, and went over it as a group and also in the class among other groups. We tried to follow all the requirements needed for a proposal which checks out the learning outcome 2. For the learning outcome 3, we considered different rhetorical situations which will help us better persuade our audience to approve the project. We also used appropriate citations and information in all the sections of the proposal, following the APA guidelines, satisfying the Learning Outcome 4. The learning outcome 5 is also satisfied because we used the stance to further develop the need of the generator to be funded and installed. The learning outcome 6 was accomplished by completing the peer review of each other on this proposal. 7 - My group members were very helpful in pointing out things to change and improve throughout the proposal.

**Syed Ibrahim**

My part in the proposal document and the PowerPoint section of this assignment was to provide details on the technical aspects of the project and how the solar panel works. In addition, on the PowerPoint section of the document, I completed the reference section and the technical aspects of the project by providing visuals. I liked working in teams to complete this assignment because working in teams brought ideas from multiple people and enhanced my ability to coordinate with others and make less mistakes in the project. In addition, having more team members allowed for more checks on the project where we corrected each other when we thought something needed to change.

Throughout the proposal our audience was the governor of Puerto Rico and the executives of Hospital Metropolitan San Francisco in San Juan. The major component of our audience is that they are Hispanic, and their language of preference was Spanish. As a result, we used visuals and graphics throughout the document section of the proposal so that the audience could better understand the technical aspects of the project, we also used a lot of bullet points compared to paragraphs, throughout the proposal document to help the audience understand the purpose of our proposal. I also knew that the audience is mature and skilled, which is why I provided high level analysis, the scope of work, and details about the project in the document and slides.

The purpose of the assignment was to get funding and permission to start work on the solar powered generator and its installation on Hospital Metropolitano San Francisco. This was accomplished by providing all the details about the current problem the hospitals are facing, such as blackouts during hurricanes and additional fuel costs when the backup generator runs. By providing the details of the current situation, we were able to persuade the audience that some things need to change in the current system. Then we introduced the audience about our plans and how it will solve all the problems that were mentioned in the beginning. This technique persuaded the audience to provide us the funding and permission to start our project. In addition, we also provided a schedule and the estimated costs of the project and a complete reference section, which showed our credibility and helped in persuading the audience for funding and permission.

Throughout our presentation our stance was to save as many lives as possible during and after hurricanes by reducing the number of blackouts in hospitals. We provided this information during the objective section of the proposal document. In addition, we also provided details on how we plan to accomplish this goal throughout the proposal document.

The genre that we used for this assignment was an engineering group proposal project. Where we provided the audience with our goals to get funding and permission for a new technology. In this genre, we provided the audience with our objective, background for the technology, technical description, and the cost analysis of the project. In addition, we also provided the schedule for the completion of the project and expected results, if the project is completed.

The media that we used for this assignment was an oral presentation and digital document because we presented the PowerPoint section of our proposal project to the audience. Afterwards, we would provide the proposal document to the same audience for evaluation. This would allow the audience to ask any question during the oral presentation section and receive a detailed proposal for further use or investigation.

The exigence for this assignment was the number of blackouts that we saw in hospitals after hurricane Maria in Puerto Rico and the number of people who had to be airlifted to the mainland US hospitals. These problems caused deaths of many patients who needed urgent care after the storm. In addition, many areas of Puerto Rico did not get the power back days after the storm, even the hospitals, which also caused the deaths of many patients.

By completing this assignment I achieved course learning outcome number 1 where our audience was fluent in Spanish and we had to use different methods to communicate our points and we used more graphics, visuals, tables and bullet points throughout the proposal document to help the audience recognize our purpose. I also accomplished course learning outcome number 2 because I used the comments from other groups to improve our proposal document. We also achieved course learning outcome number 7 because we used several sources from the internet to expand on the project ideas and provided a complete reference section in the proposal document and the PowerPoint section of the assignment. I also achieved course learning outcome number 8 because I was able to cite all the resources throughout the proposal document and the PowerPoint section using APA guidelines. In addition, I used credible sources for both parts of the project.

**Tiffany Anson**

It is great to be able to work with a group. This is not my first group assignment, but having class online during this pandemic and not being able to see each other face to face was very challenging. My group and I decide to create a solar generator to help assist the power outage in Puerto Rico, when there is a natural disaster such as a hurricane. With this generator you would be able to keep the most vital equipment online during the loss of electricity. With this generator you’ll also be able to keep electricity constant for a long period of time without any interruption. This generator will have two batteries, once one battery is used the second one will come online and the used battery will recharge from the solar panels located on the roof. With this assignment we had to do a lot of research on which hospital to test the generators, also how big is the hospital and where it is located for the panels to be installed and get enough solar energy. The challenge we had in this group was finding information about the hospital. Since Puerto Rico is a Spanish speaking territory, the majority of the information was in Spanish. Each of us chose a section to research and to work on because once again we are working virtually during a pandemic, so this should be easier to get the project done. Without the plan we wouldn’t have gotten the project to complete, this is what teamwork is all about. My part in this assignment was the budgeting for the proposal. This was challenging for me because without physically seeing the hospital and knowing where everything is located I wasn’t sure if I was going to provide all the necessary information needed. In the end with lots of research and a little help from my group I was able to complete my section.

The Genre for this is an engineering proposal. The proposal is to create a solar generator to assist hospitals when they lose power during a hurricane. The media for this assignment is through media and PowerPoint presentation. We have to upload our proposal through blackboard and also attach a PowerPoint which we will do a presentation for our instructor and classmates through zoom.

My stance for this proposal is that there are always going to be natural disasters, these ore out of our hands so the best thing we can do is after a natural disaster such as hurricane Maria, we provide aid to the local hospitals. The aid my group will provide is by creating a solar panel generator to assist the hospital vital equipment when there is a power loss. At any moment in and hospital there are patients on life support and also on vital equipment that are keeping them alive. Without power this equipment will not work and people will eventually die.

The purpose for this proposal is that my group and I need to get permission from Hospital Metropolitano San Francisco president and CEO, to install and test these solar panel generators in their hospital. The audience for this assignment is Yelitza Lucena Quiles, Executive Director of Hospital Metropolitano San Francisco, and Lorenzo Gonzalez Feliciano, Secretary of Health of Puerto Rico.

This proposal met all the course learning outcomes number 1,2, 5,6 and 7 that was presented in the chapter. In the end my group and I work really hard with the limited time and resources we had available. We came together, worked hard and the outcome of this proposal is great.

**Daniele Weisberg**

The engineering proposal was the most collaborative and intensive group project I have been a part of. It has been very interesting to brainstorm ideas with my fellow engineering classmates and finally see a cohesive design come together. My role for the proposal was explaining the team’s technical approach and requirements, illustrating the team’s solution in tackling the problem we identified in Puerto Rico and we would go about it.

The purpose of the project was to design a solution to protect Puerto Rico's hospitals from future environmentally-based disasters. Subsequently, our presentation and report's goal was to receive funding from and be granted access by Hospital Metropolitano San Francisco and the local government to develop, test, and produce Integrated Power Solution's solar-powered generators. The proposal illustrated what caused territory's problems in the past and how our design would solve it. However, it also demonstrated how the generators would be saving hospitals money in the long term compared to how much they currently spend.

The primary audience for the proposal, specifically the governor of Puerto Rico, the Secretary of Health, and the executive director of the Hospital Metropolitano San Francisco, would have varying perspectives and knowledge about the technology in the report. While they are all of high levels of education and experience, they may not be familiar with the scientific aspects of solar technology. Our technical description's goal is to give them a basis of understanding how it works first before elaborating on the description of the generator itself. The secondary audience would be financial board members for the hospital and advisers to the Secretary of Health and governor.

The exigence of this proposal was from witnessing the lack of appropriate response and assistance after the destruction Puerto Rico suffered from Hurricane Maria. From someone living far away, but following it in the news, it was difficult to watch the uncoordinated actions to provide them the necessary emergency relief. Using our engineering experience to target hospitals, the most important industry during a disaster, seemed like the most effective change we could make in a narrow scope. It was important to design something that would not be a continuous large expense for the hospitals, so we were satisfied with the solar technology, which would save them money long term.

The stance of the proposal is that saving as many lives as possible during an emergency is of the utmost importance. I think we illustrated that with the design for the project as well as the advantages we listed. It was created around saving patients lives and helping hospitals perform at full capacity at all times. There is even the added benefit of saving hospitals money through solar power. Assisting Puerto Rico was the main priority.

The genre was an engineering proposal. It is a persuasive, multi sectioned report that is designed to convince an audience into pursuing the engineer's idea or product. There were many aspects to its completion including a memo and job posting, as well as a brief technical description within the proposal. It was accompanied by a powerpoint presentation that will eventually be demonstrated in a group call environment. Since the proposal was created both digitally and presented "in person," the engineering proposal was multimodal. If it were a real proposal, a print version of the report would most likely have been submitted to the primary audience as well.

Many of the learning outcomes were met when writing this proposal. The first and second were accomplished when composing the initial outline, drafts, and final report as the entire group had to review each other's work constantly to make sure we were all on the same page. Some parts of the assignment, such as the memo was written collaboratively. The fourth learning outcome was met as the group held multiple meetings in and out of class to brainstorm and work together. The sixth learning outcome was met through the introduction to our proposal illustrating the disaster Puerto Rico had to experience and then explaining why we made our design. The seventh and eight were met as we had to supply references to back up the statements made in the proposal, as well as for researching the people for the audience.

**Heejin Cho**

For us, choosing a topic was already a challenge. Unlike most other groups, I was the only biomedical engineering major while everyone else in my group was an electrical engineering major. I thought I would end up going independent for the project. Fortunately, the professor helped us find the topic that focuses on both electrical and biomedical engineering concentrations and we came up with the idea of building solar backup generators for hospitals affected by Hurricane Maria. The fact that we were able to find the topic for all of us was the greatest part of doing this project because it made me realize there is always a solution to anything just like we are trying to find a solution to hospitals without fuel-free backup generators.

I wrote the background where I talked about how hospitals in Puerto Rico are vulnerable. In the problem statement, I wrote about how their fuel generators are not appropriate during unexpected blackouts because it requires a constant supply of fuel and is usually prone to flooding. In the need statement, I specifically mention we are seeking permission and funding for our project to achieve our objective, which is to develop solar backup generators.

I met class learning outcome 1: “acknowledges your and others’ range of linguistic differences as resources and draw on these resources to develop rhetorical sensibility,” when I realized our audience might not be alert if I do not provide them with specific details. Addressing what exactly would happen with kidney failure patients and oxygen deficiency patients may give them a better idea and how urgent it is. I met outcome 2: “enhance strategies for reading, drafting, revising, editing, and self-assessment,” because the assignment required different genres of writing such resume, memo, and peer-review and we gave each other feedback. It helped me to figure out what part of the proposal lacks information or needs improvement.

I met outcome 3: “negotiate your own writing goals and audience expectations regarding conventions of genre, medium, and rhetorical situation” as the paper included both a proposal and presentation aspect of the project. I had to consider what specific components of the proposal can be included in my presentation and what needs to be revised. I met outcome 4: “develop and engage in the collaborative and social aspects of writing processes.” The project requires everyone to participate and to work together. We communicated via WhatsApp to discuss the topic, what needs to be addressed in each session and how we take it into the presentation. I met outcome 5: “engage in genre analysis and multimodal composing to explore effective writing across disciplinary contexts and beyond,” as I did genre analysis for four different samples. Analyzing how people wrote their proposals helps me write my own proposal because I was able to explore and compare their samples and see which writing is more effective. I met outcome 6: “formulate and articulate a stance through and in your writing” in which I had to describe why I was writing the proposal and what I can do. I am a pre-med student who cares about patients and their health and safety in the hospital. Hospitals must remain safe during natural disasters and my background allows me to develop the solution to this problem. I met outcome 7: “practice using various library resources, online databases, and the Internet to locate sources appropriate to your writing projects,” because the project requires a lot of research on how people in hospital were affected by Hurricane Maria, I used search engine and library resources to look up articles, reports, and statistics from government website. Lastly, I met outcome 8: “strengthens your source use practices (including evaluating, integrating, quoting, paraphrasing, summarizing, synthesizing, analyzing, and citing sources),” as I utilized different sources in my proposal and presentation from images to paraphrasing how hospitals are vulnerable to natural disaster.

The purpose of this assignment is to persuade my audience to give us permission and funding for our project. I have realized that most hospitals are vulnerable to blackouts for many reasons. They use fuel generators that are installed in the basement, which is prone to flooding and they require a constant and steady supply of fuel to function. Because these hospitals were severely affected by Hurricane Maria, these problems needed to be addressed and something must be done to prevent blackouts.

The primary audience of the proposal is the Governor of Puerto Rico, Wanda Vazquez, who has authority to approve the funds to the development of our project. The secondary audience is Yelitza Lucena Quiles, the director of Hospital Metropolitano San Francisco, who can approve the permission for our project. The third audience is the secretary of the healthcare department of Puerto Rico, Lorenzo González Feliciano, who can influence the other audiences and possibly have them give funding or permission for our project.

The genre of this assignment is both a proposal and presentation. The proposal describes the problems that most hospitals in Puerto Rico have and how they can be more prepared for the next natural disasters or blackouts by installing fuel-free solar backup generators. The proposal also includes how the installation will be done

The media of this assignment is digital. The digital component comes from collaborating with my teammates via google docs and slides to draft up the proposal and powerpoint. We gave each other feedback for the proposal and power point through the group chat we created at the beginning of the semester.

The exigence of this paper is the fact that I am a pre-med student and care about people’s health and their safety in hospital specifically during natural disasters. It was important for me to learn about what situations patients would be in without electricity, how blackouts would affect these patients, and what options are available to keep hospitals from blackouts.

My stance on this assignment is that hospitals must be always available to patients and protect their patients and patients’ health even during natural disasters and blackouts. If hospitals are not prepared enough for unexpected blackouts, a lot of patients in hospitals will not be protected and their lives will be put in jeopardy. The solar backup generators will allow them to remain safe and protected.

**Audience Analysis:**

**Governor of Puerto Rico**

1. Reader's Name: Wanda Vazquez Garced

Job Title: Governor of Puerto Rico

Name Job Title Organization: Government Official

2. Kind of Reader:. Primary

3. Reader's Educational Background: Formal Education. Training Courses & Workshops: A lawyer with more than 20 years of experience in politics.

4. Reader's Professional Background: (previous or work experience.) Lawyer

5. Reader's Chief Job Responsibilities: Manages the Island of Puerto Rico and Signs the bills into laws

6. Reader's Personal Characteristics: Affiliated with Demorat Party

7. Reader's Likes and Dislikes: N/A

8. Reader's attitude toward you and the subject of the document. Positive Neutral Negative Why? In what ways? The reader’s attitude is positive because the governor is a part of the democrat party that stands on the platform of Environmental Protection and Climate Change Reforms.

9. Reader's Cultural Characteristics: Hispanic

10. How the reader will use the document: Skim it Read it Read a portion of it. Which Portion? Modify it and submit to another reader? Yes No Attempt to implement recommendations? Yes No Use it to perform a task or procedure? Yes No Use it to create another document? Yes No Other? Yes No Explain. The reader will read the document thoroughly without skipping any section.

11. Reader's Physical Environment: Office Desk

**Executive Director of Hospital Metropolitano San Francisco**

1. Reader’s Name: Yelitza Lucena Quiles

Job Title: Director of Hospital Metropolitano San Francisco

Name of Organization: Hospital Metropolitano San Francisco

2. Kind of Reader:. Primary

3. Reader's Educational Background: Formal Education. Training Courses & Workshops: Actuary and Accountant.

4. Reader's Professional Background: (previous or work experience): 20 years of experience in accounting and Management combined

5. Reader's Chief Job Responsibilities: Hospital Management

6. Reader's Personal Characteristics: N/A

7. Reader's Likes and Dislikes: N/A

8. Reader's attitude toward you and the subject of the document. Positive Neutral Negative Why? In what ways? The reader is positive towards the subject because the solar generators will help reduce the reliance of the hospital on utility companies, which would reduce the chances of a blackout.

9. Reader's Cultural Characteristics: Hispanic

10. How the reader will use the document: Skim it Read it Read a portion of it. Which Portion? Modify it and submit to another reader? Yes No Attempt to implement recommendations? Yes No Use it to perform a task or procedure? Yes No Use it to create another document? Yes No Other? Yes No Explain. The reader will read the whole document because the document suggests major changes to the electrical system of the hospital and the reader needs to read it carefully.

11. Reader's Physical Environment: Office desk

**Secretary of Health of Puerto Rico**

1. Reader's Name: Lorenzo González Feliciano

Job Title: Secretary of Health of Puerto Rico

Name Job Title Organization: Government Official

2. Kind of Reader: Primary

3. Reader's Educational Background: Doctorate of medicine from University of Puerto Rico School of Medicine, Doctorate in Health Systems Administration (DHA) from Central Michigan University, Master of Business Administration from the University of Pittsburgh

4. Reader's Professional Background: Psychiatrist, Secretary of Health (2009-2013), Medical Director of Physician Correctional

5. Reader's Chief Job Responsibilities: Advises the governor on Puerto Rico’s health, welfare, and income security issues. Overseas and carries out approved programs for the government’s health department.

6. Reader's Personal Characteristics: Affiliated with Demorat Party

7. Reader's Likes and Dislikes: N/A

8. Reader's attitude toward you and the subject of the document. Positive Neutral Negative Why? In what ways? The reader’s attitude is most likely positive because the governor’s party supports environmental reform, however, they may be cautious regarding issues surrounding Hurricane Maria.

9. Reader's Cultural Characteristics: Hispanic

10. How the reader will use the document: Skim it **Read it** Read a portion of it. Which Portion? Modify it and submit to another reader? Yes **No** Attempt to implement recommendations? **Yes** No Use it to perform a task or procedure? Yes **No** Use it to create another document? Yes **No** Explain. The reader will read the document thoroughly without skipping any sections. He may hand it over afterwards to other related officials in order to get second opinions.

11. Reader's Physical Environment: private office or home office.