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Respondent

1

Thomas McManamen

12:04

Time to complete

Final Project Report

1. Date of this final project report submission *

June 1, 2025

2. Name of project exactly as it was listed in your award letter *

Power Station

3. Date (or semester/year) of original award letter *

November 9, 2023

4. Expiration date of award as listed on original award letter or approved scope change letter - whichever is more recent *

November 2, 2025

5. Enter the amount of the award, including any budget increases as a result of a previous scope change. *

\$3,950.00

6. What is your project's 6 digit fund account number created for this project and to which the SSC allocation was transferred?

Please ask your project's financial contact for this information if unknown.

303692

7. How much (in dollars) of your award (including previous approved budget increases) is remaining? *

\$0.00

8. Briefly describe the goals of your project. *

The core of the power station project is the development of a sustainable and versatile source of energy to keep people running off the grid. Often, the go-to solution in these environments is to use a gas generator or otherwise dirty option, but battery powered solar stations such as the one we sought to create are ultimately cleaner, quieter, easier to use, and more efficient. Through our research, development, and testing process, we believe we have demonstrated the viability of these systems to be easily assembled and customized for use in various applications. We are excited to continue sharing our design with the greater community to encourage wider adoption of these systems and promote cleaner technologies to help the environment. The second part of the project is the reuse of 18650 battery cells to save both materials and cost. Both components are intended to be used by our team of over 50 students during rocketry launches—the 18650s as a part of our avionics bays and the power station itself for our telemetry ground station and overall team support.

9. Did you complete your project as it was outlined in the original award letter or in a subsequent approved scope change? *

- ☒ Yes, the project was completed as originally outlined.
- ☐ No, the project was not completed as originally outlined.

10. On what date did you consider the project finished or that you stopped working on it? *

The vast majority of direct assembly work on the project was completed by the end of the Spring 2024 semester (5/10/2024), with most of the 24-25 school year dedicated to testing and research of minor improvements, most of which were unable to be completed due to budgetary constraints. While further restoration of 18650 cells using our existing procedures will continue and Power Station will be used for years to come, we are happy to call the project complete as of the conclusion of our most recent test on 5/16/2024.

11. Describe, in detail, the challenges / obstacles your project faced. *

Throughout the past year of major successes in the testing and use of Power Station, the team has come to realize that its greatest strength is also its greatest weakness. Spec'ed to last when it matters, Power Station uses very large equipment to support long-term usage and high power draws, causing it to completely fill the 40-inch long case in which it is housed. This massive size and weight made the system very difficult to transport, thereby restricting its use. While a team like ours has the people to carry Power Station, operation for a single individual is difficult. The solar panels are also quite bulky and are a separate unit from the main case, making them far less convenient than if they were completely integrated. This overbuilt nature also manifests itself in the cost of the project, where single components, namely the battery and solar panels, cost several hundred dollars and ate up much of the budget. This prevented us from dedicating substantial funding to improving organization and ease of use for the system and would make it impractical for the average person to source and assemble themselves. Due to these concerns, we intend to pursue development of a smaller and more affordable system in the near future.

12. Describe, in detail, the successes your project experienced. *

Power Station has delivered a string of real-world success stories throughout the launches during which it was available:

Kairos I: Taking place in March 2024, Kairos I was the first flight of restored 18650 battery cells, and saw them successfully power the vehicle's video system. It was also an opportunity to test our prototype power station unit and validate many of our design ideas before finalizing component selection for the main unit.

Kairos II: During the first launch with the fully assembled unit, Power Station provided our telemetry team with the necessary backup power to be able to effectively set up our system, monitor the rocket's telemetry and health, and comfortably perform the necessary data analysis to pinpoint the rocket's location after launch, all while losing less than 10% of its total battery capacity. Restored 18650s once again formed a key part of our avionics bay.

Stargazer 1.3: Both Power Station and our 18650s yet again proved to be launch critical, powering key flight electronics and equipment on the ground for last-minute repairs before launch.

Stargazer 1.4: During one of our most crucial test launches, the integration of Stargazer 1.4 was placed on a particularly cold morning, which affected the fine motor skills of our members during the integration process. Not only did Power Station once again provide more than enough power for our telemetry systems to track and pinpoint the rocket, but the entire system was also able to sustain 1.8kW of load in order to create a warmer environment for our launch operations members, increasing the speed at which the vehicle was able to be integrated.

Aether I: Perhaps the greatest challenge for Power Station yet, the launch of Aether I had a single, extremely difficult logistical challenge – we would have to be completely off the grid during our long, night integration process (lasting over 8 hours), as well as power the most advanced telemetry system to date. Power Station powered work lights, a Starlink terminal, and many other auxiliary systems throughout the night, allowing for integration to move smoothly and efficiently. Then, it once again flawlessly contributed to the successful tracking of the vehicle during the launch, all while using less than 30% of the overall capacity.

Aether II: Though this launch is in the future, it's important to note that we once again rely on this system for all of our off-the-grid field launches, and this one will be no different. We have very high confidence in the Power Station system, and as such believe it will once again be the cornerstone of a successful launch campaign.

Overall, Power Station's high capacity and versatile nature has allowed the team to keep running through long hours at remote launch sites, powering equipment from work lights to soldering irons and WiFi routers. Our restored 18650 batteries have saved resources and maintained performance just as well as brand new, commercial cells. This repeated success, from both portions of the project, in high-stress situations has proved their viability and guaranteed continued use by the team in the long-term.

13. Describe, in detail, how your implemented project addressed sustainability. *

The average gas generator emits approximately 4 lbs of carbon dioxide per hour of continuous use. With the growing dependence of the team on power off the grid, this would, across 4-5 launch days throughout the year, produce almost 250 pounds of atmospheric carbon dioxide pollution per year. We believed that we could do better. Through this project, our team has selected durable, long-lasting components that would allow us to rely purely on our own power systems, from charging telemetry laptops to powering student work lights well throughout the night for launch integration.

Our design allowed for a fully hybrid approach to bringing power anywhere. Our 400W foldable solar panel is able to maintain much of our power usage and recharge the internal battery during downtime, eliminating the need for supplemental power from the grid during optimal operating conditions. Additionally, the ability to plug into the grid when needed lets us ensure the batteries are topped up before heading out to the field, allowing us to avoid any last minute generator usage or any need to bring fuel to the field.

This system was designed for long-term reusability and scalability. The launch of Aether I is testament to the versatility of Power Station in the field for meeting our power needs, allowing us to power all necessary integration equipment throughout the night (Midnight - 8AM), as well as our entire telemetry system for launch without dropping below 70% capacity.

Additionally, work on this project provides many of our members with the education to make efficient, modular, repairable designs. We built this system with the goal of having it be extremely serviceable and usable in a wide range of applications, thus allowing us to cultivate the next generation of engineers well versed in sustainability and sustainable design practices.

14. Describe, in detail, how your project integrated student involvement and community outreach. *

From the start, Power Station has been an interdisciplinary project focused around a variety of electrical concepts and has involved students from many majors and backgrounds. For the dozens of students who have contributed to and interacted with the project, it has been a great experience to learn about solar power, battery management, electrical wiring, and sustainable design practices. Power Station has also been a great support to the team at many events, from our launches to university functions such as quad day, which are great opportunities to share our design and educate the broader student and rocketry communities about how it works. We hope to continue incorporating Power Station into our team's educational outreach events and sharing what we have learned about developing systems with a focus on sustainability, clean energy, and reusability.

15. Describe how the project engaged individuals from underrepresented groups and/or how it promoted diversity, equity, and inclusion. *

The Illinois Space Society has historically been systematically structured to welcome and uplift students from any background – including those from underrepresented groups – and to foster the importance of inclusive culture across many of our different projects.

Power Station, like all of our projects, is open for anyone to contribute to. We believe that the best way to learn a skill is to be hands-on with the hardware, and we provide the necessary resources and mentoring to our members to go from complete newbie, to mastering the basics (such as wire stripping, harnessing, and safety), to becoming leaders in their own respective fields. Almost all component selection and assembly for Power Station was done by freshmen across different disciplines, and the result speaks for itself – the project has been a central pillar in our launch operations throughout the last year.

Projects like Power Station in ISS offer members something that isn't easy to come by in many other projects around campus – the ability to take full ownership of a system and participate in the entire design process, no matter what their skill level or background is. We believe that one part of a sustainable team and project doesn't just come from the ability for it to sustainably affect the environment, but the ability to sustain the members that work with the team. As such, we are very proud of our equitable initiatives and RSO's focus on the inclusion of members of all backgrounds in our technical teams and work.

16. What key takeaways should the campus community know about your project? *

We believe the biggest takeaways from this project are from the goals we set out to achieve in the beginning:

- We eliminated the necessity of being connected to the power grid or using noisy, polluting gas generators by deploying our own power solution, able to rely purely on reusable power.
- We incited hands-on, collaborative learning and design of a large, central project to the team, and taught many of our members extremely valuable sustainable design skills.
- Showcased our system to the greater community, allowing others to see not only the incredible work our members have put into the project, but also the lasting benefits of sustainable designs.
- And we've given other teams a blueprint for their own sustainable designs, by creating a replicable model for any team to use within their field operations.

17. Describe the marketing material developed for promotion of your project, including but not limited to advertising (including digital) and/or signage related to this project. All marketing must include SSC's logo and/or a statement of which fee funded the project. Projects must coordinate with SSC to ensure the promotion appropriately highlights the SSC's contributions to the project. *

Our Spaceshot team has included Power Station in several social media posts, such as a May 22 Instagram post (https://www.instagram.com/illinoisspacesociety/p/DJ-1AQMMzli/?img_index=7).

18. Upload project marketing and/or media not previously submitted in semester progress reports. *

-  [Aether I Ground Station_Thomas McManamen.JPG](#)
-  [Aether I Integration \[1\]_Thomas McManamen.jpg](#)
-  [Aether I Integration \[2\]_Thomas McManamen.jpg](#)
-  [Custom Voltage Regulator Test_Thomas McManamen.JPG](#)
-  [Solar Test \[1\]_Thomas McManamen.JPG](#)
-  [Solar Test \[2\]_Thomas McManamen.JPG](#)
-  [Solar Test \[3\]_Thomas McManamen.JPG](#)
-  [Stargazer 1.4 Ground Station \[1\]_Thomas McManamen.jpg](#)
-  [Stargazer 1.4 Ground Station \[2\]_Thomas McManamen.jpg](#)

19. Complete and upload the semester financial documentation for your project. You should reflect all expenditures since your last semester project report. **We strongly suggest that you also upload supporting financial transaction reports from Banner for your award's CFOP. Talk to your project's financial advisor for more information on generating this report.**

<https://studentengagement.illinois.edu/sites/default/files/2024-09/SSC-Budget-Timeline-SEMESTER-PROGRESS-REPORT-template.xlsx>

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NOTE: Any unused project funds remain the property of SSC and will be transferred back to SSC when the project has finished or when the award expires, whichever comes first.

-  [Power-Station-Final-Budget-Timeline_Thomas McManamen.xlsx](#)