Project SHARP — Power Generation and Delivery System

Project Plan

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Change record

Issue	Date	Total pages	Page(s) affected	Description of change
1.0	2/2/2026	5	0–5	Adapt Initial Template
2.0	3/2/2026	14	0–14	Create chapters and fill in rough required elements
2.1	6/2/2026	15	4–14	Refine outline for all sections and work out chapters 1–4

Table of Contents:

1 Background

Stellar Space Industries

Stellar Space Industries (SSI) is a Dutch aerospace company located in Noordwijk near ESA's ESTEC facility. SSI specialises in high precision manufacturing capabilities and covers the entire product development cycle including design, machining, assembly, integration and testing. Their production facility is equipped with high-precision machining and testing equipment.

In collaboration with ESA, SSI is developing a novel electrodeless electric propulsion system for small satellites. This propulsion system aims to increase efficiency, lifespan and reliability compared to current state-of-the-art electric propulsion systems. SSI is currently in their second phase of development where they aim to design build and test the entire system in-house.

Presently, several subsystems of the propulsion system are being developed and tested concurrently. During the development of these subsystems, SSI is also looking for opportunities to apply the technology of each component in other applications. One of the subsystems that is currently ready for testing and application is SSI's flow control unit (FCU) which is a high-precision valve that can control the mass flow of gaseous propellants.

Project SHARP

In order to find a relevant application for their FCU, SSI has initiated the Solid Hydrogen Aircraft Regulated Propulsion (SHARP) project. SHARP is a joint investigation between SSI and Solid Flow, a Dutch company specialising in the development of solid hydrogen storage systems. The goal of SHARP is to investigate the feasibility of hydrogen-fuelled drones that utilise solid-state hydrogen storage. In this collaboration, Solid Flow B.V. provides the cool gas generator (CGG), a system capable of producing gaseous hydrogen on demand from solid hydrogen storage. Stellar Space Industries B.V. contributes its expertise in flow control systems for electric propulsion, which may be adapted for hydrogen-based applications.

SHARP is conducted under the Luchtvaart in Transitie (LIT) program of the RVO of the Dutch government, which aims to advance sustainable aviation technologies. SHARP aims to contribute to the aviation energy transition by providing a scalable, weight and volume efficient energy source that is CO_2 and NO_x neutral. SHARP first aims to demonstrate the feasibility of the technology in drone applications, allowing future projects to scale the technology to larger aircraft and replace traditional jet fuel-based propulsion systems.

SHARP — Power Generation and Delivery System

This document considers the project plan for a subsystem of the SHARP project, specifically the development of the power generation and delivery system. This part of the SHARP project is conducted as a graduation internship. Throughout this document the part of SHARP that falls under the graduation internship will be referenced as SHARP — Power System (SHARP-PS).

2 Project Results

For Stellar Space Industries, the primary goal for SHARP is to test and apply their FCU in a real world scenario and thus advance the FCU's technology readiness level (TRL) from 4 to 6. In addition to this, they aim to find a secondary market for their FCU in hydrogen based aviation compared to electric propulsion for satellites. Solid Flow has the same goals for their hydrogen CGG. The goal of SHARP-PS is to integrate the FCU and CGG and demonstrate the technologies and their compatibility in a relevant environment.

The relevant environment for the SHARP-PS project will be a fuel cell that delivers power to a motor and propeller system. Results of tests performed in this environment will be directly applicable to hydrogen based aviation projects. The result of the SHARP-PS project will be a test bench setup that includes this fuel cell and motor-propeller system and the integrated FCU and CGG hydrogen supply. This test bench setup shall be easily adaptable to be integrated into an unmanned areal vehicle (UAV). The project result of SHARP-PS shall meet the following requirements:

- Stellar Space Industries' FCU shall be included in the system.
- Solid Flow's hydrogen CGG shall be included in the system.
- A fuel cell shall be used to generate electricity from hydrogen.
- The system shall function without external power supply.
- The power density (power output over system weight) of the system must be the same or higher than that of state-off-the-art UAV power systems.
- Test results will be recorded and presented in a research report that is in accordance with 'Report writing for readers with little time' (Elling & Andeweg, 2012)
- The research report shall answer the following question: 'To what extent is a hydrogen fuel cell based power generation and delivery system that integrates a Solid Flow's cool gas generator and Stellar Space Industries' flow control unit feasible for extending the mission time for UAV's'

3 Project Activities

The project is divided into multiple activities. The activities are organized into categories, so that each category is of a similar level of complexity. Note that some activities are dependent on other activities. This, along with the time constraints of each activity, is discussed in section 8 Planning.

1. Orientation
   - 1.1 Literature study on hydrogen storage, fuel cells, electric propulsion for drones
   - 1.2 Create requirements for power system from mission scenario
   - 1.3 Write Project Plan
2. Design of test bench setup
   - 2.1 Conceptual design of test bench setup
   - 2.2 Trade-off and select best concept
   - 2.3 Detailed design of test bench setup
3. Building of test bench setup
   - 3.1 Procurement of parts
   - 3.2 Manufacturing and assembly of test bench setup
   - 3.3 Integration of subsystems
4. Testing of test bench setup
   - 4.1 Test planning
   - 4.2 Execution of tests
   - 4.3 Analysis of test results
5. Documentation and reporting of outcomes
   - 5.1 Writing of research report
   - 5.2 Preparation of presentations
   - 5.3 Final review and submission

If time allows, the scope of the SHARP-PS project can be extended, this will be discussed in more detail in section 4 Scope. Should this scope extension indeed be the case, this will lead to the following additional activities.

6. Design of drone prototype
   - 6.1 Conceptual design of drone prototype
   - 6.2 Trade-off and select best concept
   - 6.3 Detailed design of drone prototype
7. Building of drone prototype
   - 7.1 Procurement of parts
   - 7.2 Manufacturing and assembly of drone prototype
   - 7.3 Integration of power system into drone
8. Testing of drone prototype
   - 8.1 Test planning
   - 8.2 Execution of tests
   - 8.3 Analysis of test results

4 Scope

As SHARP-PS is conducted as an internship, the start and end dates are fixed. The internship runs from 2 February 2026 to 14 June 2026, and as such SHARP-PS will follow those dates as well. At this time, the exact time requirement for the SHARP-PS project can not yet be accurately determined, only estimated. Therefore, the scope of the project is made slightly flexible to satisfy the exact time requirement of the internship.

This chapter defines a minimum scope which concerns the development and testing of an independent power generation and feed system that is not yet integrated in a UAV, this setup is also referred to as a test bench setup. If time allows, integrating this power system into a commercial off-the-shelf (COTS) or custom built UAV may be included in the scope of SHARP-PS as well.

The following lists describe the scope of the SHARP-PS project and exactly which activities are part of it. This is done by listing certain activities that fall particularly at the border of the project, and clarifying whether or not they are part of SHARP-PS, the SHARP-PS extended scope, SHARP as a whole or not part of SHARP at all.

Activities that **are** included in SHARP-PS:

- Designing a system overview of the complete power generation and feed system.
- Selecting components for the hydrogen fuel cell and intermediate electrical storage
- Developing the electrical design of the power generation and feed system.
- Performing assembly and integration of the power generation and feed system.
- Conducting ground testing of the power generation and feed system using a gaseous hydrogen source.
- Compiling a comprehensive report of all findings and results.

Activities that initially **are not** included in SHARP-PS, but **may** be included in SHARP-PS if allowed by time:

- Selecting a suitable COTS or custom built UAV.
- Selecting components for the UAV interfaces.
- Implementing mechanical modifications to the UAV to ensure system compatibility.
- Integrating the power system developed as part of the test bench setup with the selected UAV.
- Conducting flight testing of the integrated power system and UAV using a CGG hydrogen source.

Activities that have already been completed by SSI (**not** part of SHARP-PS):

- Developing the flow control unit.
- Testing the FCU in lab conditions.
- Adapting the FCU for hydrogen purposes.

Activities that **are not** included in SHARP-PS but are part of the larger SHARP project:

- Designing a mission scenario for solid hydrogen based UAV's.
- Setting requirements for the hydrogen CGG.
- Producing a hydrogen CGG.

5 Deliverables

Each deliverable is a result of one of the activities, can just be the same list In the planning chapter each deliverable will get a due date which makes the project trackable

- Literature report on hydrogen fuel cells and storage vs batteries
- List of requirements for power system
- Detailed design of test bench setup
- Assembled test bench setup
- Test plan for test bench setup
- Test results from test bench setup
- Final research report
- Project Plan

These might also be workpackages. There are some defined already (in gantt chart on onedrive) Are these applicable to internship or is that a different scope?

6 Quality Control

How do we assure the quality of each deliverable. Take the list of deliverables and describe what the quality demands are for each of them. Describe how each deliverable will be checked for quality. Describe standards that will be used. Describe software that will be used.

- Literature report on hydrogen fuel cells and storage vs batteries
- List of requirements for power system
- Project Plan
- Detailed design of test bench setup
- Assembled test bench setup
- Test plan for test bench setup
- Test results from test bench setup
- Final research report

Deliverable	Review Method	Software used
Documents	Company Supervisor review, University Supervisor review	LaTeX, Word
Designs	Company Supervisor review	Autodesk Inventor
Hardware	Company Supervisor review, Performance testing	—
Test results	Company Supervisor review, Comparison to expected results	??

7 Project Organisation

This chapter should contain a description of the project organisation. Who are the team members and what are their roles and responsibilities. Contact details of team members and other stakeholders can also be given here. The meeting frequency and dates can also be mentioned as well as the digital workspace that will be used.

- email, phone of me and Imre (and others?)
- Contact details of Solidflow? (outside of scope maybe)
- Weekly progress meetings on Thursdays
- The onedrive space for files
- Decide on a place for CAD files?

Name	**Role**	**Email Address**
Imre Bakker	Project Manager, Company Supervisor	imre.bakker@stellarspaceindustries.com
Philip Weersma	University Supervisor?	philip.weersma@inholland.nl
Emil Boot	Project Intern	661522@student.inholland.nl
	...	

8 Planning

Put the activities in an activity table (basically gantt chart but in table form). Assign required time of each activity. Describe dependencies between activities.
Is the gantt chart in onedrive applicable and/or up to date?

- Orientation
  - Literature study on hydrogen storage, fuel cells, electric propulsion for drones
  - Create requirements for power system from mission scenario
  - Write Project Plan
- Design of test bench setup
  - Conceptual design of test bench setup
  - Trade-off and select best concept
  - Detailed design of test bench setup
- Building of test bench setup
  - Procurement of parts
  - Manufacturing and assembly of test bench setup
  - Integration of subsystems
- Testing of test bench setup
  - Test planning
  - Execution of tests
  - Analysis of test results
- Documentation and reporting of outcomes
  - Writing of research report
  - Preparation of presentations
  - Final review and submission

Additional activities (if time and budget allow)

- Design of drone prototype
  - Conceptual design of drone prototype
  - Trade-off and select best concept
  - Detailed design of drone prototype
- Building of drone prototype
  - Procurement of parts
  - Manufacturing and assembly of drone prototype
  - Integration of power system into drone
- Testing of drone prototype
  - Test planning
  - Execution of tests
  - Analysis of test results

9 Costs and Benefits

Costs

- Labour hours
- Test bench materials
- Fuel cell system
- Hydrogen fuel
- Safety equipment/education
- Drone prototype manufacturing and testing (if applicable)

Benefits

- Practical testing environment for SSI valve
- Sellable research results
- Practical approach to electric flight using hydrogen CGG

—	**Small**	**Medium**	**Large**
Model	DJI air	DJI Inspire	DJI Matrice 400
Power	100 W	230 W	1.2 kW
Drone Weight	0.7 kg	4 kg	15 kg
Fuel Cell Weight	0.6 kg	1 kg	2–6 kg
Drone Cost	€1,000	€15,000	quote
Fuel Cell Cost	€1,500	€3,000	€12,000
Total Cost	€2,500	€18,000	$>$ €30,000

10 Risks

Points of failure for the project should be identified here. Internal and external risks should be separated. Grit has a whole system on doing this, assigning a value for likelihood and impact to each risk.

Internal Risks

- Running out of time
- Running out of budget
- Underestimation of technical complexity
- Safety issues related to hydrogen handling

Risk	**Likelihood**	**Impact**	**Mitigation Strategy**
Running out of time	Low	High	Regular progress reviews, buffer time in schedule
Running out of budget	Low	High	Cost monitoring
Underestimation of technical complexity	Medium	High	Early prototyping, expert consultation
Safety issues related to hydrogen handling	Low	High	Safety training, proper equipment, adherence to regulations

External Risks

- Solid Flow backing out of collaboration
- Delays in hardware acquisition/manufacturing
- Dependence on external parties for critical components?

Risk	**Likelihood**	**Impact**	**Mitigation Strategy**
Solid Flow backing out of collaboration	Low	High	Early agreement on deliverables, regular communication
Delays in hardware acquisition/manufacturing	Medium	Medium	Early ordering, multiple suppliers

References

Elling, S., & Andeweg, B. (2012). *Report writing for readers with little time*. Wolters-Noordhoff bv.