Hydrogen Production at Very High Current Densities in Flow-Engineered Alkaline Electrolyser Stack

Quality Assurance Plan

HyFlow Deliverable 6.3 (M4)

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Notices

For information, please contact the project coordinator, Micah Asistores, e-mail: micah.asistores@stargatehydrogen.com. This document is intended to fulfil the contractual obligations of the HyFlow project, which has received funding through the Clean Energy Partnership from each consortium member's national funding agency, concerning deliverable D6.3.

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Table of revisions

Version	Date	Description and reason	Author	Affected sections
V0.1	02.03.2026	First draft created	Micah Asistores, Stargate	all
V0.2	05.03.2026	1st internal review	Elo Meier, Stargate	all
V0.3	12.03.2026	Input from partners integrated	n/a	4.3, 7.1
V1.0	20.03.2026	Final review	Clemens Kubeil, Fraunhofer IFAM	all

List of Partners

Stargate Hydrogen Solutions OÜ (Stargate)
Université Catholique de Louvain (UCLouvain)
JEMA Belgium (JEMA)
JENTEC GmbH (JENTEC)
Fraunhofer IFAM (IFAM)

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List of Abbreviations

BoP – Balance of Plant

CETP – Clean Energy Transition Partnership

CVI – Canvas Image (file)

DMP – Data Management Plan

QAP – Quality Assurance Plan

EU – European Union

GA – General Assembly

WP – Work Package

WPL – Work Package Leader

H_2 – Hydrogen

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1 Objectives

The purpose of the Quality Assurance Plan is to establish a clear leadership framework ensuring effective communication and efficient project operations. It defines responsibilities for both scientific and exploitation activities, establishes clear decision-making and governance structures, and promotes transparent collaboration among all partners.

2 Management Structure

The HyFlow consortium comprises five partners and is coordinated by Stargate. Work Package Leaders (WPLs) are firmly supported by the rest of the consortium members. The main tasks of management are:

- Coordination of general administrative, financial, legal, scientific, and technology activities
- Establishment and operation of HyFlow decision-making bodies and procedures
- Monitoring and supervision of project procedures, timelines, and risk management
- Establishment of efficient communication among partners, towards the Clean Energy Transition Partnership (CETP)
- Knowledge, intellectual property, innovation and sustainability management during and after the project lifecycle

The HyFlow management structure comprises of the following:

- The Project Coordinator
  - Leading the scientific and executive management of the project
- The General Assembly
  - Consists of partner delegates from each partner organisation
- Work Package Leaders
  - Coordinating work package implementation via the WP team and task leads

2.1 Project Coordinator

The Project Coordinator (Stargate) has primary responsibility for decision-making to guide the success of the project. The Coordinator is responsible for monitoring the scientific achievements, ensuring the accomplishment of the technical objectives, and promoting project visibility. The Coordinator works in close cooperation with the Work Package Leaders.

The Project Coordinator's tasks include:

- Provision of the project's communication backbone (CETP, project partners)
- Supporting administrative requests by the partners
- Maintenance of the consortium- and other agreements
- Coordination and preparation of project meetings (incl. distribution of meeting minutes)
- Integration of documents, maintaining data and document repositories, version management
- Lead reporting activities to CETP (deliverables, periodic reports)
- Monitor monthly project progress for continuous rating of the achievements, objectives, tasks, work packages with a comprehensive overview of the project
- Take actions to avoid or minimize any technical risk and resolve any conflict

2.2. The General Assembly

The General Assembly (GA) consists of representatives of all partners, chaired by the Project Coordinator. The GA is the main body that discusses and decides on all managerial and technical aspects of the project. GA decisions are based on a voting procedure and quorum defined in the Consortium Agreement.

GAs are planned to occur every six months. The GA is to convene either in-person, hosted by one of the partners, or online via a secure and reliable teleconference channel. In-person GAs are considered highly important to be held at least once a year. In addition, regular monthly teleconferences are scheduled to support the project monitoring and progress within the consortium. The responsibilities of the General Assembly are:

- Progress monitoring and technical quality control
- Innovation and knowledge management and other related activities
- Risk assessment
- Deciding on disputes concerning technical matters between WPs
- Re-arranging work distribution within WPs if necessary
- Mediating and resolving inter-partner conflicts
- Review and amendment of the Grant- or Consortium Agreement, if needed

2.3 Work Package Leaders

The Work Package Leaders (WPLs) ensure the delivery of their WP results and report on progress to the whole consortium. WPLs are responsible for planning, progress control, quality management, and successful completion of their WP and the interactions with other WPs according to the work plan. WPLs are also responsible to schedule update meetings and discussions with the partners relevant for the delivery of the tasks within the WP.

The WPLs together with the Project Coordinator will be responsible for maintaining an overall view of progress and direction as well as ensure that the technical contributions within related WPs are coherent and complementary in achieving a complete system. They are expected to spot potential problems in connecting different elements of the work and to suggest countermeasures, which will enable the project to deliver the maximum possible benefit.

HyFlow WP Leaders

WP	WP Title	Lead	Start	End
1	Cell Component Development	Stargate	M1	M32
2	Forced Flow Concept Development	UCLouvain	M2	M24
3	Power Electronics Development	JEMA	M4	M26
4	Adjustments of the Pilot	JenTec	M3	M30
5	Forced Flow Technology Validation on stack-level	IFAM	M2	M36
6	Reporting and Knowledge Community	Stargate	M1	M36

3 Communication

The primary tools for communication are email and Microsoft Teams. For file storage and management, a SharePoint cloud service is being used. Public documents will be uploaded to the HyFlow website (https://www.hyflowh2.com/).

Regular updates about the project-related topics (meeting organisation, requirements from CETP, upcoming events, etc.) are communicated via e-mail and during the regular consortium meetings. The Project Coordinator is responsible for keeping an updated list of contacts to ensure the smooth exchange of information.

3.1 Project meetings

Regular consortium meetings are held every month. Regular face-to-face (or virtual) GA meetings with all partners are held at least twice a year or every six months.

An agenda of the meeting is put together and distributed by the Project Coordinator before the meeting. The project meetings include progress reports by all WPLs and discussions regarding upcoming tasks, deliverables, milestones, and any deviations from the original plan as well as any other topics related to the project. Minutes of all meetings will be taken and distributed within a week after the event. All minutes are stored in the shared project folder “HyFlow Meetings”.

In case of outside restrictions that will not permit some members to take part in the GA meeting, concessions will be made to either have a virtual meeting instead or broadcast the meeting through a secure channel so that all members of the consortium will be able to attend.

3.2 Work Package meetings

Regular WP-specific technical meetings will be held for specific WPs as appropriate. WPLs are responsible for regular communication between their WP members. They will ensure that everyone is aware of their assignments, sub-tasks have been completed in a timely manner, and if needed, escalate risks and problems to the Project Coordinator level.

Many tasks in WPs depend on previous deliverables of the project. The Project Coordinator will share any official documentation available to the new task leader, but the leaders themselves are responsible for communicating the details of their findings among themselves.

4 Reporting

4.1 Reporting to CETP

The Project Coordinator is responsible for the communication between the consortium and the CETP representative. Project updates are communicated regularly directly via email.

The Project Coordinator will collect input from all partners and provide overall progress reports to CETP. Also, any possible problems concerning the entire project such as serious delays, financial matters, contract matters, or necessary changes of partners will be communicated to the CETP and the national funding body of the partner (if applicable) immediately.

In addition, a regular status overview will be shared with the consortium and the CETP, where the following information will be included:

- Progress toward the scientific and technological objectives
- Overall status of WPs, deliverables, and milestones
- Open issues and risks
- Deviations and corrective actions

4.2 Reporting of deliverables and periodic reports

A project logo, CVI and templates for deliverable reports and PowerPoint presentations have been created and distributed. These will be used in any external and official internal communications, providing a design standard for the whole project.

Despite all upcoming deliverables being discussed during the project meetings, the Project Coordinator reminds each partner well ahead of the deadline to start preparing the deliverable. The reports must be reviewed by at least one other partner before final submission to CETP. The European Commission directives will be used in the submission of each deliverable.

Before the end of each reporting period, templates and direction will be sent out to each partner on how to submit annual reports.

4.3 Reporting to each partner's local funding agency

Each partner in the consortium has a financial liability to report the spending relating to the HyFlow project based on the agreement with the agency. It is the responsibility of each partner to adhere to the local or national funding authorities' requirements and submit it in a timely manner. The Project Coordinator is not responsible for any financial obligations of each partner to their own local funding agency. If any issues arise regarding this, each partner shall communicate any issue regarding this matter if it affects the execution of WPs, Tasks, or Deliverables.

Below is the reporting period requirement for each partner's local funding agency

Partner Name	Technical Reporting	*Frequency*	Financial Reporting	*Frequency*
Stargate	Required	End of Project	Required	Quarterly
UCLouvain	Required	Yearly	Required	Half-yearly
Fraunhofer IFAM	Required	Mid-term + End of Project	Required	Mid-term + End of Project
JEMA	Required	Yearly	Required	Half-yearly
JenTec	Required	Mid-term + End of Project	Required	Mid-term + End of Project

5 Knowledge Management

All information that is needed to perform work and results will be made available for all partners via:

- Internal Document Management System, a shared versioned repository accessible to all partners
- Security mechanisms will be implemented, assessed monthly, and appropriate measures taken
- The project webpage (https://www.hyflowh2.com/) contains general information open to the public based on the knowledge accessibility parameter of each deliverable.

6 Risk Analysis

Risk management is an integral component of quality assurance, ensuring that potential deviations from project objectives are identified and mitigated in a timely manner. Each partner has defined health and safety procedures, which can be provided upon request.

The overall approach for risk management within the project is presented below.

6.1 Risk identification process

For a successful risk management, potential risks must be systematically identified. The following issues shall be considered as tools and techniques for risk assessment and identification:

- Analysis of deliverable status
- Analysis of WP schedules and scopes
- Regular communication between the Project Coordinator and the WPLs.

6.2 Risk analysis

Risk analysis foresees assessing the probability and impact of the potential project risk on a scale: low, medium, and high. For example, a risk with a high probability and high impact will be considered a critical risk. A risk matrix, shown in Figure 1, will be utilized to plot and prioritize risks based on these criteria. Additional factors such as detectability and proximity could also be considered during the risk analysis.

The Project Coordinator, in collaboration with the WPLs, will estimate the probability of the risks at different times during the project lifetime.

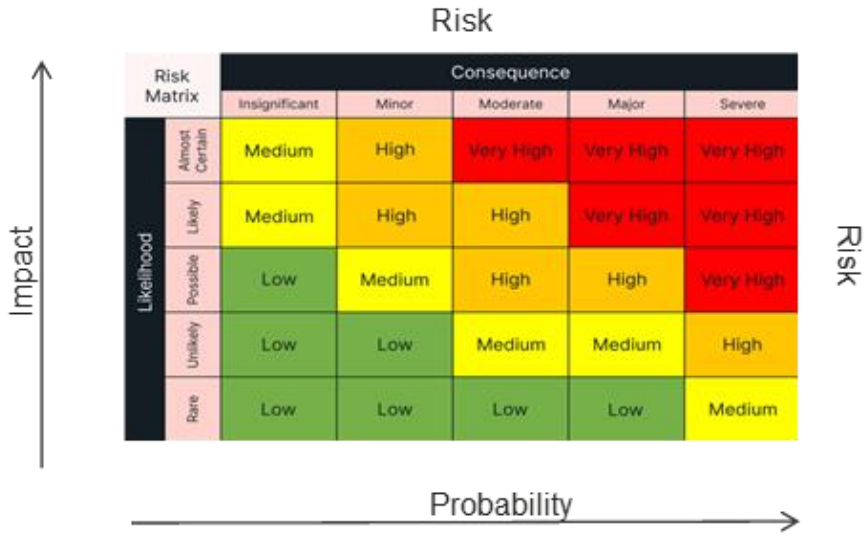

Figure 1: Risk matrix

6.3 Risk evaluation

It is the responsibility of all partners to openly communicate to the WP leaders or Project Coordinator about the status and effectiveness of potential risks and respective mitigation measures. Risk exposure will be continuously re-evaluated and modified accordingly. If any new risks are identified by a partner, they will be analysed as those on the original risk list and then added in the register.

The WP leaders and the Project Coordinator regularly review the list of risks and during the face-to-face meetings, the list will be reviewed by the entire consortium.

6.4 Risk treatment

Risks will be prioritized based on their combined probability and impact scores. A scoring system will be used for ranking risks from highest to lowest priority. Critical risks requiring immediate attention will be highlighted and escalated to the project management team for prompt action. All identified risks will be documented in a risk register, which includes the following details:

Risk description	WP	Likelihood / Probability (low/medium/high)	Severity/Impact (low/medium/high)	Mitigation	Month risk detected	Status update

The risk register will be reviewed and updated regularly as needed, but no less than once a year.

Each party is responsible for executing the risk mitigation activities which relate to the task or WP they lead. If a mitigation action cannot be effectively carried out or does not solve the risk, the risk exposure is likely to become more important. In this case, visibility of the risk must be highlighted by the Project Coordinator and the mitigation measure reviewed. An item can be considered closed when it is no more likely to occur. In this case it is ranked as low and reported respectively in the register.

7 Identified critical risks for implementation

7.1 Risks identified prior to the project start

Prior the project start, a risk assessment was conducted for the HyFlow project about the potential critical implementation risks that may occur during the project lifetime. To date, none of these risks have materialised.

Risk description	WP	Likelihood (low/medium/high)	Severity/ Impact (low/medium/high)	Mitigation	Month (risk detected)	Status update
MANAGEMENT RISKS						
Partner withdrawal from the consortium	All	Low	High	The partners have complementary tasks and skills. However, there is a chance of finding substitute partners with relevant expertise in case of withdrawal. The Coordinator will try to shift resources released by a substitution partner capable of fulfilling the abandoned tasks. Partners have previous experience working together which helps to mitigate this risk.		
Communication breakdown between consortium partners	All	Low	Medium	The Coordinator is responsible for organising sufficient and efficient communication within the consortium. The communication channels and regularity will be agreed at the Kickoff meeting and managed by the Coordinator. Regular calls will		

				be organised to track the progress of the project and keep partners up to date.		
Change in key staffing	All	Medium	Medium	In all partner organisations more than one person has information about the project, its objectives, activities, and tasks for the respective partner.		
IMPLEMENTATION RISKS						
Electrode fabrication methodology that is optimised for 2D electrodes is not suitable for 3D electrodes	1,2,4	Low	High	T1.1 starts early to identify potential issues. The coating method is flexible and can be modified by changing process parameters		
Electrode scale-up from 100 cm2 to 2400 and 3800 cm2 is more challenging than expected	1,2,4	Medium	Low	Several process optimisation iterations are included in project plan, employing people with previous experience in similar scale-up activities		
In-line diagnostic tool for electroplating will not be able to detect critical quality issues	1	Medium	Low	The electrodes will be produced and characterised using traditional (offline) diagnostic tools, like cross-sectional electron microscopy		
Scaling from laboratory to pilot plant: a high electrolyte rate in the stack can lead to the catalyst being washed out → High efficiency degradation rates	4,5	Medium	Medium	Adaptation of the catalysts to materials with no brittle phases and a strong bond between the catalyst and substrate. Adaptation of the PTE: application of		

				a thicker, front-most graded layer on which the catalyst is placed		
Scaling from laboratory to pilot plant: high electrolyte rate in the stack requires large electrolyte inlets, which lead to high shunt currents → System efficiency decreases	4,5	Low	High	Adjustment of the electrolyte distributor to increase the line resistance between the cells		
Scaling from laboratory to pilot plant: adjusting the BoP for high electrolyte flows can lead to insufficient separation efficiency, especially in the gas-electrolyte separator → resulting in poor gas quality	4,5	High	Low	The residence time of the electrolyte gas mixture should be greater than 5 minutes. The process can be accelerated by introducing porous layers. Increasing the size of the separator unit will also increase the time		
New power electronic units from JEMA (rectifier with pulsed power and health monitoring system) not compatible with BoP of existing pilot-scale systems	3,4	Medium	Low	For UCLouvain pilot, part of the budget has been allocated to subcontracting to the same power electronics company that designed the current BoP, to allow for optimal interaction from the very start of WP3.		
Health monitoring of the galvanic bath power supply from JEMA, including control system, not at the level of performance required for the Stargate process	3	Medium	Low	Galvanic process could work with the main goal of manufacturing electrodes, even without the health monitoring system, that can be updated / improved in		

				parallel to the main target of production.		
Several prototype stack designs are needed before being able to demonstrate a 6.5-fold process intensification factor	2,5	Medium	Medium	Although this is the very objective of the project itself, the fact that 2 distinct pilot-scale units are already available within the consortium as a starting point significantly increases the chances for success		

8 Conclusions

As the project progresses, consistent communication within the consortium is essential to effectively track deliverables and milestones and to remain alert to potential emerging risks. Regular interaction among partners allows the consortium to identify and address issues early, ensuring that any challenges that could affect the project's objectives or delivery are managed in a timely manner.

In conclusion, the Quality Assurance Plan provides a structured framework for managing, monitoring, assessing, and mitigating risks throughout the project lifecycle. By implementing the recommended strategies and maintaining a flexible and adaptive approach to quality management, the consortium can strengthen project coordination, enhance the likelihood of successful outcomes, and achieve its overall objectives.