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HySelect

Efficient water splitting via a flexible solar-powered Hybrid thermochemical-Sulphur dioxide depolarized Electrolysis Cycle

www.hyselect.eu

D1.2 Quality management plan - Public

30.06.2023

WP1 - Project coordination and management

Clean Hydrogen Partnership

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Disclaimer

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Preface

HySelect will demonstrate the production of hydrogen (H_2) by splitting water via concentrated solar technologies (CST) with an attractive efficiency and cost, through the Hybrid Sulphur cycle (HyS). The HyS consists of two central steps: the high temperature -yet below-900 C -decomposition of sulphuric acid forming Sulphur dioxide (SO_2) and the subsequent low temperature (50-80 °C) SO_2 depolarized electrolysis (SDE) of water to produce H_2. HySelect will introduce, develop and operate under real conditions a complete H_2 production chain focusing on two innovative, full scale plant prototype core devices for both steps of the HyS cycle: an allothermally heated, spatially decoupled from a centrifugal particle solar receiver, sulphuric acid decomposition-Sulphur trioxide splitting (SAD-STS) reactor and a Sulphur dioxide depolarized electrolyzer (SDE) without expensive Platinum Group Metals (PGMs). Furthermore, a heat recovery system will be integrated to exploit the temperature difference within the cycle and boost the overall process efficiency. In the course of the work, non-critical materials and catalysts will be developed, qualified and integrated into the plant scale prototype units for both the acid splitting reactor and the SDE unit. Experimental work will be accompanied by component modelling and overall process simulation and culminate with a demonstration of the complete process integrating its key units of a 750 kW_{th} centrifugal particle receiver, a hot particles storage system, a 250 kW_{th} SAD-STS and a 100 kW_e SDE into a pilot plant. Testing for a period of at least 6 months in a large-scale solar tower, driven with smart operation and control strategies, will establish the HySelect targeted efficiency and costs. Finally, an overall process evaluation will be carried out in order to assess the technical and economic prospects of the HySelect technology, directly linked to the know-how and developments of the sulphuric acid and water electrolyzers industries.

DLR	German Aerospace Center	DE	
CERTH	Centre for Research and Technology Hellas	GR	
AALTO	Aalto University	FI	
ENEA	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	IT	
FENR	FEN Research GmbH	AT	
GRILLO	Grillo Werke AG	DE	

Summary

This document is Deliverable D1.2 Quality management plan, developed within WP1 of the Clean Hydrogen JU HySelect project. It contains the necessary planning provisions and guidelines to be adopted by the partners to ensure that the HySelect project is implemented smoothly and that all deliverables are of high quality and submitted to the EU services in a timely manner.

A thorough quality procedure for project deliverables and reports has been established: Each project deliverable is reviewed by at least one internal reviewer (member of the consortium) as well as by the project coordinator before it is submitted to the EU's funding agency. The procedure is designed to ensure that the submitted deliverables adequately meet the quality criteria of clarity, completeness, accuracy, relevance, and technical compliance. Similar quality assurance (QA) procedures will also be followed for project reports and dissemination materials.

Finally, a risk management plan is established, including the identification of technical (research-oriented) and management risks (related to project implementation), as well as the mitigation measures to be taken on a case-by-case basis.

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1. Introduction

Deliverable *1.2 The Quality Management Plan (QMP)* is prepared as part of the Management and Coordination (WP1) work package. It presents the project's approach to ensure that tasks are completed on time and to ensure high performance/quality of project deliverables. It closely follows Deliverable 1.1. Project Management Plan (PMP), which defines the project management bodies and their roles and responsibilities and analytically describes the internal communication plan, deliverables and work plan.
In this context, the specific objectives of this document are:

- Define the processes to ensure the quality of the deliverables and reports;
- Analyse the potential risks to the project that could jeopardize quality and assess their impact;
- Proactively define planned mitigation measures to ensure proper execution of project tasks.

To ensure its relevance throughout the life of the project, the QMP will be regularly reviewed and updated as needed.

2. Quality Assurance of Project Reports

As described in D1.1, the project is divided into three reporting periods (RPs):

- RP1: from Month 1 to Month 18 (January 1st, 2023 – June 30th, 2024)
- RP2: from Month 19 to Month 36 (July 1st, 2024 – December 31st, 2025)
- RP3: from Month 37 to Month 48 (January 1st, 2026 – December 31st, 2026)

Within 60 days from the end of each RP, a Report must be submitted to the granting authority by the PC, i.e. two Periodic Reports and one Final Report are due in total. The Reports are mandatory and linked to interim and final payments by the granting authority.
The periodic and the final reports contain
(a) a "periodic technical report";
(b) a "periodic financial report".
The requirements and contents for each one are described in the Grant Agreement (see section 4.2, periodic reporting and payments). It is important to stress that whereas the Project Coordinator (PC) is responsible for uploading the "periodic technical report", the "periodic financial report" and the relevant cost statements of the partners and their uploading remain a sole responsibility of each beneficiary.
The continuous reporting module in the European Commission (EC) participant portal was activated at the date the project started and is continuously open to submit deliverables and report on milestones etc. Following the end of each reporting period the functionality of periodic reporting in the Participant Portal will be activated. The latter will allow each participant to complete on-line their own Financial Statement and allow the PC to upload the respective period's technical report. Final versions of Periodic Reports will also be uploaded and saved to the team site. The procedure and timing for the preparation and review to ensure high quality of the reports consists of the steps outlined in Table 1.

3. Quality Assurance of Project Deliverables

As a part of the Quality Management Plan, the consortium will apply an internal reviewing procedure to guarantee the quality of its results. Each WP leader will be responsible for the quality of the results, especially of the deliverables, which will be subjected to a peer review by another member of the project team. Before its submission, each project deliverable will be quality-reviewed by at least one internal reviewer (member of the consortium partners). In general, the PC will invite all consortium partners to declare their interest in reviewing the upcoming deliverables for the next six months, and then will allocate the reviewers based on the declared interest, the partners technical expertise and overall availability.

Table 1: Process for the delivery of project's official periodic reports.

When*	Who	What	Recipient
1 day	Project Coordinator	Asks the task leaders to provide all relevant technical data, information and input to the respective WP leaders within two weeks.	Task Leaders all partners
15 days	Task Leaders	WP leaders have all necessary technical data, information and input from their WP tasks.	WP leaders
25 days	WP leaders	WP leaders consolidate their WP tasks data, articulate their WP report into the relevant periodic report template and send it to the PC. PC asks all partners to start preparing the financial report.	Project Coordinator
40 days	Project Coordinator	PC synthesizes draft periodic report from relevant WP leaders' data and sends it to the partners for reviewing.	All partners
45 days	All partners	Reviewers (all partners) send comments to the PC as a Track Changed document. The Reviewers are responsible for performing Quality Assurance whereby the document will be assessed according to specific quality criteria.	Project Coordinator
50 days	Project Coordinator	The PC sends the revised document to all partners for final review. If in the case the document fails to match the QA criteria, the GA will be notified and will set out steps to be taken to improve the report's quality.	All partners, General Assembly (GA)
40-55 days	All partners	Provide their own financial statements and upload it in the participants portal	EC
55-59 days	All partners, Project Coordinator	Reviewers confirm document is accepted. PC puts together the Final version of Part B of the report and submits it to the participant portal.	EC

*after the end of the reporting period

However, the general idea is that, if possible, the reviewer should not be involved at all with the WP that the specific deliverable is associated with, so that can provide a "sort-of-third-party" assessment and criticism. On the other hand, naturally, the reviewer should have a relevant technical expertise on the topic under review. Therefore, in cases where it would be not possible to identify a suitable reviewer outside the Deliverable's WP, i.e. in Deliverables or WPs where most or all partners are participating, the Deliverable draft will be forwarded to all parties. With the rationale above, the following, tentative list of allocation of reviewers per Deliverable as per Table 3 has been assembled. Naturally, the list can be subjected to change in the course of the project, depending on partners' involvement, technical expertise, availability etc. In any case, the steps above should take place early enough before the deliverables submission due date to secure its timely submission.

The quality of the deliverables will be assessed against specific quality criteria in order to ensure uniformity and consistency in the review process of all deliverables and to ensure the reviewers' clear understanding of and compliance with the process. Given that many of the Deliverables are Public, attention should be paid by both the primary authors as well as the reviewers (criteria for evaluation) of the Deliverables to the following points:

- the language of the text is clear, unambiguous and useful to the targeted audience (e.g. scientists, policymakers, etc.) and there are no spelling errors;
- the terminology, including acronyms is explained;
- any potentially sensitive information is appropriately worded to safeguard the interest of the involved consortium partners;
- credit to all prior work cited is acknowledged with respective references;
- the content is relevant to the scope of the deliverable and all aspects of the deliverable as described in GA-A1 are fully addressed.

In case where the EC would request a revision of a submitted Deliverable, the internal review process will be repeated.

4. Quality Assurance of Dissemination Materials

Other scientific and policy-related outputs of the project, i.e. the project commentaries, newsletters, briefs and working documents, will also be reviewed before they are published, mainly for compliance with the respective templates. As there are no deadlines and no formal submission for these materials, the process only includes delivery of the draft document by the dissemination leader, based on the inputs of the authors, and a technical check by the Project Coordinator.

Templates will also be developed for other, communication-related, project material (e.g. newsletters and press releases). For this type of resources, the *WP9 Knowledge and innovation management, dissemination and communication* Leader together with the Project Coordinator, will be reviewing the content of every produced resource for completeness and its format for compliance with the respective template.

The quality assessment of these materials will be performed against the performance indicators set under the expected policy, societal, and research/scientific impacts reflected in Annex I (Part B) of the Grant Agreement and Listed in Table 2.

Table 2: Key Performance Indicators (KPIs) targeted for Dissemination and Communication material.

Activity/Deliverable	**Target / KPIs**
Open access Publications in scientific journals	at least 20
Presentations at international conferences	at least 20
Project website	over 3000 visits over 200 downloads of public deliverables
Flyers distributed at events	over 1000
Workshops	at least 2
Twitter	at least 200 followers
LinkedIn	at least 70 followers
Videos	at least 1

5. Risk Analysis

Considering the project's timeframe and milestones, the consortium has analysed and identified the risks and conceived respective mitigation actions as summarized in Table 4. Naturally, the assessment of those or any other upcoming risks and the decision on mitigation measures will constantly take place during the project. As already mentioned, the challenges and associated risks can be categorized to the materials development ones and to those relevant to the device level and its operation.

Table 3: First tentative allocation of internal reviewers to project deliverables.

No	Deliverable name	Responsible	Reviewer
D1.1	Project management plan	DLR	FENR
D1.2	Quality management plan	DLR	FENR
D1.3	First annual data JU report 15M	DLR	FENR
D1.4	Second annual data JU report 27M	DLR	FENR
D1.5	Third annual data JU report 38M	DLR	FENR
D2.1	Subsystems requirements for solar platform testing	ENEA	AALTO
D2.2	Final plant layout and control strategy	ENEA	AALTO
D2.3(i)	Complete flowsheet and P&ID (internal)	DLR	CERTH
D2.3	Complete flowsheet and P&ID	DLR	CERTH
D2.4(i)	Scale-up design of the optimized plant & techno-economic analysis (internal)	ENEA	CERTH
D2.4	Sustainable business case research	FENR	CERTH
D3.1	SO_3 splitting catalysts shortlisting	CERTH	GRILLO
D3.2	Selected catalytic formulations	CERTH	GRILLO
D3.3	Structured SO_3 splitting catalytic systems	CERTH	GRILLO
D3.4	Long-term stable structured SO_3 splitting catalysts	DLR	GRILLO
D3.5	SDE membrane materials	AALTO	GRILLO
D3.6	Au-coated SDE bipolar plates	AALTO	GRILLO
D3.7	Tested short SDE stack	AALTO	GRILLO
D4.1	Solar-driven H_2 production concept	DLR	ENEA
D4.2	Solar receiver-heated particles of sufficiently high temperature	DLR	ENEA
D4.3	Stored particles of sufficiently high temperature	DLR	ENEA
D5.1	Qualified and optimized SDE stack	AALTO	ENEA
D5.2	Pilot SDE design	AALTO	ENEA
D5.3	Pilot SDE prototype	GRILLO	ENEA
D6.1	$2kW_{th}$ prototype SAD-STS reactor	DLR	GRILLO
D6.2	$250kW_{th}$ SAD-STS reactor design	DLR	GRILLO
D6.2	$250kW_{th}$ SAD-STS reactor	DLR	GRILLO
D7.1	High-temperature heat recovery system	GRILLO	CERTH
D7.2	SO_2 separation system	GRILLO	AALTO
D8.1	HySelect PMS model	ENEA	CERTH
D8.2	HySelect PMS validation	DLR	CERTH
D8.3	Fully automated operation	DLR	GRILLO
D8.4	Completion of solar HyS plant campaign	DLR	GRILLO
D9.1	Project's website	FENR	DLR
D9.2	Data Management Plan	DLR	FENR
D9.3	Dissemination, exploitation and communication plan	FENR	DLR
D9.4	Preliminary market study	FENR	DLR
D9.5	Final Workshop	DLR	ENEA
D9.6	Dissemination/exploitation activities	FENR	DLR
D9.7	Virtual Reality tool	DLR	CERTH

Table 4: HySelect risk analysis

Description	WP	Likelihood start	Impact	Mitigation	Likelihood end
Inability to define a convincing version of the integrated solar-chemical plant layout	2	Low	High	Partners already possess substantial experience in the successful definition of solar thermochemical plant layouts, as demonstrated in relevant past projects	Low-to-Medium
Insufficient catalytic activity and/or inability to demonstrate the efficacy of the cascaded (high-to-medium temperature) catalytic approach	3	Low-to-Medium	High	Relevant partners have already defined high temperature catalytic formulations with proven high activity and e.g. Fe_2O_3 based approaches can always be a safe fall-back option. In case the cascaded catalytic concept cannot be materialized, a conventional high temperature catalyst can cover for this w/o detrimental effect on process efficiency	Medium
Not adequate efficiency of the main proposed SDE concept	3	Low-to-Medium	High	There is already one solid fall-back option (i.e. thicker Au films in foil form, a simpler manufacturing method) described in the workplan	Medium
Insufficient performance of the particle receiver based overall setup (temperature achieved, losses in storage tanks etc.)	4	Low-to-Medium	High	There is already a solid starting point in terms of achievable temperatures created by the campaigns in PEGASUS (https://www.pegasus-project.eu/) project. Specific design improvements already proposed in the workplan. Available technologies for high temperature vessels insulation sufficient to achieve targeted low heat losses; back-up Joule heating of vessel to ensure target temperature, foreseen to be implemented.	Medium
Inability to scale up SO_3 splitting catalytic formulations	3	Low	High	The envisaged fall-back option of catalyst coating on suitable porous structures has already been implemented successfully in the past by relevant partner	Low-to-Medium
Insufficient time for pilot scale experimental demonstration in the platform due to delays and failures of critical components at the target scale	5,6,7,8	Medium	High	Relevant partners have proven experience in developing similar/relevant critical sub-systems and components at scales targeted by HySelect. The scale of the overall system has been selected with a priori technical feasibility as main criterion. If necessary, scaling down of selected components to 50 kW will be pursued (still within call topic requirements). An adequate time of 9 months of demo testing is already foreseen and delays of up to 3 months can be absorbed. Project duration is realistically set at 48 months.	Medium
Partner leaving the consortium or systematically underperforming	all	Low	Medium	Existing consortium already has partners to compensate for such issues to a certain extent. If a leaving partner's contribution/expertise cannot be covered internally, a partner with similar expertise will be sought within the partners' existing substantial networks of collaborators	Low

6. Conclusions

Following the project kick-off meeting, a Quality Management Plan (QMP) for the project has been drafted, in close conjunction with the Project Management Plan (PMP). The QMP describes the approaches to be adopted by the partners in order to ensure that the project is implemented smoothly and all its deliverables are of high quality and submitted to the EC on time.

The approach involves timely internal reviewing of the project's deliverables and reports by at least one internal reviewer as well as by the suitable project's management bodies before being submitted to the EU's funding agency.

This work breakdown structure and the global timeline of the project allow to identify some initial risk issues in its course which is particularly important at this early stage in order to consider and prepare mitigation strategies and fall-back options to ensure timely completion of all deliverable and milestones. Hence, a risk management plan is put into place, consisting of the identification risks and the mitigation actions to be employed.