ID-FAST - Investigations on degradation mechanisms and Definition of protocols for PEM Fuel cells Accelerated Stress Testing

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D.7.2 Quality assurance plan

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Summary

This document is describing the assurance quality plan applied for ID-FAST, reminding the aspects that will be managing the quality of the project process, such as the way to handle the deliverables for the quality of the activities and results, the milestones as control points and the risk analysis.

Revisions

Version	Date	Author(s)	Commments *(inputs added, revision, approval…)*
	15.11.2018	S. Escribano (CEA coord)	initial draft
Final	17.05.2019	S. Escribano (CEA coord)	for submission

Contents

1. Introduction of the quality assurance approach

For this research project, the quality assurance plan is mainly based on the management of the technical progress and how the development plan is properly defined first and properly followed then.

The report reminds first the deliverables that are mainly acting as the evidence of an actual technical progress, including the confirmation of the human and equipments ressources involvement for the achievement of the expected outcomes.

Then, in addition to the evidence of scientific and technical achievements, control points and risk analysis have been defined to complete the quality management. Those are reminded in the second part of this report.

In paralle, for the coordinator, the CEA quality process will be followed as for all the projects involving CEA, including particularly a project review to check the correct availability of ressources in agreement to the work plan.

2. Deliverables

Project progress will be first assessed through the deliverables. The quality will be ensured by the following submission procedure.

- The deliverables must use the as defined template (Cf. D7.1)
- The authors are responsible for the quality of the reported results. The deliverable is not only a list of results, those results must be discussed and explained.
    - Regarding the testing and characterisations of materials, components, MEA and stacks, an experimental description of the equipment and of the method is included in the reporting of results in order to insure the possibility to reproduce the results. Experience and know-how of the partners involved will help ensuring application of best practice, quality of investigations and thus relevance of results.
    - Regarding the modelling and the simulation, details will be given to explain the physical mechanisms involved, validation methods applied will be described, simulation and experimental results obtained will be compared, allowing to assess relevance of the degradation models and performance models developped.
- The WP leader check and validate both the quality of the results and the consistency of the deliverable according to the Description of Action (technical part of the Grant Agreement). If needed to adapt the content of the deliverable, this will be explained in the introduction.
- Then, the project coordinator may also check the deliverable and takes in charge the submission to ECAS.

As this is a research project, most deliverables are reports about scientific and technical activities and results. Some of them more critical for the project success are related to milestones presented later.

In addition, there are some non-technical deliverables, thus not on the critical for the project but helpful as related to the management aspects of the technical progress, which concern mainly the exchange of information within or outside the consortium, including frameworks, quality assurance

aspect, plans for dissemibnationn, communication or exploitation and also the minutes of consortium meetings. The consortium meetings will play a key role for the quality assurance plan since they will be systematic points where all aspects of the project are assessed and discussed for the definition of next steps.

3. Milestones and Risk control

3.1 Milestones

Important milestones have been identified for the project implementation and will be carefully monitored by the corresponding WP leaders, and the project manager. When a milestone is delayed or is not achieved, the impact on project course and WP will be assessed and a back-up plan will be proposed by the concerned WP leaders. Such issues will be reviewed during the consortium meetings.

Control points have thus been defined all along the project to help controlling the overall progress in addition to the deliverables. Milestones and their means of verification are reported in the table below.

Milestone nb	**Milestone name**	**Related WP(s)**	**Due date (month)**	**Means of verification**
MS1	First aged samples from real systems defined and delivery plan clarified	1	M4	Confirmation letters by the providers
MS2	Agreement on real ageing test protocols	1	M6	Deliverable D1.1 available
MS3	New reference single cell hardware	4	M8	Decision on the reference single cell to be applied for ageing test
MS4	Progress on characterisation data on GDLs and BPP	2 & 3	M9	Sufficient information (characterisation data and analysis) to launch developments of new ASTs (particularly on GDL, BPP)
MS5	Control point on analysis of coupling to launch the validation of combined AST	2&3&4	M15	Kick-off meeting of WP5

MS6	Availability of performance degradation models	3	M18	Availability of first simulation results on coupled degradation phenomena to be used as a tool for combined AST and transfer functions developments
MS7	Project mid-term review	6	M20	Mid-term review report delivered
MS8	Control point on AST & transfer function definition and validation	4 & 5	M24	Workshop including Advisory group

Most of the milestones are related to technical aspects, availability of objects and data, or expected quality of available results.

However, MS7 which will act as a major control point including all the previous technical items and also the financial reporting thus allowing a control point for the allocation of ressources.

Finally, the dissemination and exchanges about project achievements towards and with stakeholders, particularly from the advisory group, is also identified as an important control point to ensure optimal significance of the actions planned for the last period of the project.

3.2 Risks

Managing risks is also part of the quality assurance plan since occurrence of the risks identified will prevent deliverables production or delays.

Most important will be to consider the possible risks as already identified in the proposal and to apply the mitigation proposed or other solutions if needed and defined along the project.

Description of risk (indicate level of likelihood: Low/ Medium/ High)	**WP(s) involved**	**Likeli hood (1-5)**	**Impact (1-5)**	**Level (likely hood x impact)**	**Proposed risk-mitigation measures**
Lack of available and consolidated information on real aged data / Difficulty to identify and localise the degradations and linked mechanisms	WP1	4	3	12	Mitigation: Continuous real database resourcing / Specific real aging tests carried out in the project (test benches, system benches and vehicles) on selected objects / Multiple sources of aged samples available Contingency: Planning of additional tests

Ageing results in real life ageing are significantly different from bench testing.	WP1	2	2	4	Redefinition of bench test protocols / representative load cycles and / or operating conditions will be required.
Delay in sample supply	WP2	2	2	4	Mitigation: Since samples from different stack/single cells test are available, a delay of a specific test would have only minor impact Contingency: Rearrangement of the planning to optimise sample supply management and tests
Delay in sample analysis	WP2	2	3	6	Mitigation: A delay in sample analysis would postpone understanding of AST and input to modelling. To ensure that minimum input to other WP can be provided, D2.3 with preliminary results was defined at M24. Contingency: Rearrangement of the planning to optimise sample analysis
Difficulty in developing and validating degradation laws of main observed degradation mechanisms with required accuracy and low computational cost	WP3	2	4	8	Mitigation: continuous monitoring of validation activity results Contingency: Revise priorities on models development depending on difficulties and project objectives
Delay in development of new reference single cell Delay in development of AST because of inconsistency with real ageing degradation mechanisms	WP4	2	3	6	Mitigation: survey of task progress during the most critical period Contingency: 1. Selection of the best suitable design among existing and available single cells, in particular JRC design normally available from end 2017 2. Study of other protocols and stressing factors in conjunction with WP3 heuristic approach

Difficulty to validate the methodology between ASTs and real world / Difficulty to find the best compromise between test acceleration and stack degradation in order to be representative of reality	WP5	3	4	12	Mitigation: Ageing tests performed on same objects (components and stacks) ensure the validity of comparison and ranking / Revision of the validity criteria with consortium's expertise and OEMs support Contingency: Planning of additional tests with deep involvement of end-users

In addition to the research/technical risks, two other categories are identified: organisational and economical/market risks. Risk ownership has been considered so as to assign risks to the most appropriate organisation to ensure a tight monitoring, assessment and update of the risk management plan as detailed in the table below.

Risks categories	Risk Ownership	Resources
Research & Technology	WP leaders (ZSW, DLR, CEA, POLIMI)	• Technology watch • Technical implementation monitoring (milestones & planning)
Business	Industrial Partners (BMW, FPM, Symbio)	• Market intelligence, • Business/account planning, • Cost assessment
Intellectual property rights	Exploitation manager (BMW) with support of involved partners and coordinator (CEA)	• IP landscape analysis, • Competitors' analysis, • Strategy for IP protection • Collaborative and commercial agreements (NDA, MoU, licensing…)

The milestones and risks tables will be considered during the plenary consortium meetings involving all partners to check their status, allowing to validate the progress or to adapt the project process and/or to launch mitigation actions as needed.