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Plan for the integrating analysis by experts and selection of experts (Task 6.1):

Pilot EE consensus memorandum for D3.25 POPLU test plan

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PP	Restricted to other project participants (including the Commission Services)	PP
RE	Restricted to a group specified by the partners of the DOPAS project	
CO	Confidential, only for partners of the DOPAS project	

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Version 1.0	Issued on 5 Dec. 2013 at dissemination level RE as an additional deliverable of the project	
Version 2.0	Issued on 24 April 2014 with dissemination level PP, by removing the person name information with respect to privacy concerns	new dissemination level PP

ABSTRACT:

A pilot expert elicitation was carried out on the test plan of the POPLU experiment (D3.25) with the purpose of assisting the planning of the integrating expert analysis (Task 6.1 of the WP6) using the EE process for the quality assurance of the project deliverables. This deliverable describes briefly the pilot EE process, the tools used in it and the outcome of the process in the form of a consensus memorandum. The input of the EE process was used in the finalisation of the POPLU test plan.

RESPONSIBLE:

Posiva Oy, Marjatta Palmu

REVIEW/OTHER COMMENTS:

The consensus memorandum version 1.0 was reviewed and approved by all participants to the pilot EE process during the period November 11 to December 4, 2013 via e-mail.

APPROVED FOR SUBMISSION:

Posiva Oy, Johanna Hansen, December 5, 2013 (version 1.0), April 24, 2014 (version 2.0)

DOPAS WP6 TASK 6.1 CONSENSUS MEMORANDUM OF PILOT EE FOR POPLU TEST PLAN

1 Introduction

The DOPAS project (EC-GA no 323273), which is co-funded under the Euratom FP7 programme aims at demonstrating the construction feasibility and performance of several full-scale plug and seal experiments. Under the DOPAS project, four experiments will be carried out by 2016 and their monitoring will be most likely continued after the end of the project, too.

The original memorandum was modified due to change of dissemination level and the names of the pilot participants are removed from this revised v.2 on April 24, 2014.

The DOPAS project itself is divided into seven work packages. The project results are targeted besides the internal quality assurance procedures also for independent reviews by experts. The approach taken to expert reviews includes the use of the Expert Elicitation (EE) process. The final Work Package results from four RTD and DEMO work packages *WP2: Definition of requirements and design basis of the plugs and seals to be demonstrated*; *WP3: Design and technical construction feasibility of the plugs and seals; WP4: Appraisal of plug and seals system's function* and *WP5: Performance assessment of plugs and seals system*, are to be subjected to the EE process.

The EE process has been used within the context of the Safety Cases by Posiva Oy[1] and within the Euratom FP6 PAMINA project[2]. The desire in DOPAS was to extend its application from the Safety Analysis context to a more technical context.

In the DOPAS work plan (Task 6.1), it was decided that prior rolling out the full scale EE process, the process would be tested within the POPLU experiment's test plan review. POPLU is one of the five experiments and is currently on-going in Finland at Posiva's URCF ONKALO. It includes the full scale construction of a wedge-type deposition tunnel end plug consisting of a cast concrete plug made of low pH cement, the related

[1] Hukki K. (2008). A Formal Process for Elicitation and Validation of Expert Judgments for Safety Case in the Context of Spent Nuclear Fuel Management, Working Report WR 2008-60, Posiva Oy, Olkiluoto, Finland

[2] Bolado R. & al. (2009). Expert judgement review and exercise (estimation of the solubility limit distributions for five elements in the near field in a repository in granite). Milestone report of the PAMINA Performance Assessment Methodologies in Application to Guide the Development of the Safety Case.

grouting of the concrete to the tunnel profile rock, some bentonite tape and a potential filter element made of bentonite and concrete.

This memorandum describes briefly the process and the consensus outcome of the Experts concerning the target of the review or the "issue under elicitation". A more detailed account of the process is given in a separate document.

2 Scope the pilot elicitation of the test plan

The target for the elicitation was chosen to be the test plan of the POPLU plug experiment. At the time the target was selected, some design options related to the complementary structures of the full-scale plug were still worked. This led to the choice of looking at the instrumentation plan of the plug. This plan was prepared by VTT and was based on predictive modelling of the plugs mechanical behaviour and laboratory tests related to the concrete component recipe alternatives developed. Also the water tightness of the plug is of interest in the performance monitoring of the plug.

The EE process participants agreed at the induction meeting that the issue under elicitation for the pilot was:

The completeness and its "suitability for purpose" of the instrumentation planned for the monitoring and measurement data collection of the performance of the concrete component of the Posiva deposition tunnel end-plug POPLU.

The elicitation should also focus on identifying potential uncertainties in the instrumentation design (plan) and potential controversies in the plan and in the related documentation.

3 Materials and working methods used in the pilot EE process

The pilot EE included the preparation of the elicitation forms for the domain experts and for the performance assessors. The Elicitation Experts consisted of one external domain expert and of one external performance assessor and of 4 other domain experts (VTT and Posiva) and of 3 other performance assessors (Posiva) and of the facilitator from Posiva.

Expert area	Organisation	Role
Domain	SKB	External technical domain expert to POPLU; DOMPLU experiment leader
Domain	VTT	Main instrumentation designer
Domain	VTT	Instrumentation designer
Domain	Posiva Oy	Posiva's monitoring specialist, external to POPLU
Domain	Posiva Oy	Posiva's research manager in charge of the practical implementation of R&D demonstrations and activities in ONKALO
Performance analyst	VTT	External performance assessment specialist to POPLU. Former member of Posiva's safety group and specialist e.g. in the requirements and design basis for a disposal facility
Performance analyst	Posiva Oy	Performance assessment specialist in charge of the modelling work for POPLU experiment
Performance analyst	Posiva Oy	Performance assessment/safety case specialist of Posiva in the DOPAS project
Performance analyst	Posiva Oy	Performance assessment specialist on bentonite related studies in Posiva and Posiva's requirement specialist in the DOPAS project
Facilitor	Posiva Oy	DOPAS WP6 leader, EE process specialist at Posiva.
Observer in the consensus meeting	Posiva Oy	POPLU experiment leader

The experts were invited to an induction session that was carried out on two locations connected via videoconferencing. After the induction, the experts were mailed the related material for elicitation. The forms were completed by the experts, a preliminary summary was prepared for the instrumentation plan designers, structural and contextual description drafts were produced and a consensus meeting held. After the consensus meeting the experts were also asked to provide their assessment of the Technology readiness level (TRL) of the instrumentation for the experiment. The elicitation also produced input for other parts of the POPLU experiment, but this memorandum focuses only on the consensus results regarding the issue under elicitation.

4 Consensus meeting outcomes regarding the instrumentation of the concrete plug

4.1 Input by experts

Three domain experts and four performance assessment experts completed the predesigned questionnaire tools (Appendices 1 and 2) in June 2013. A preliminary summary of the replies was compiled and forwarded to the main instrumentation designer in July 2013. Based on the replies, the facilitator drafted the two conceptual descriptions that were used together with the summarized inputs by the experts. Part of the materials was sent to the group a day before the meeting. However, the actual work to reach the consensus was carried out in the meeting itself by following the themes listed on the elicitation material list and contrasted with the experts potentially controversial feedback.

The EE frozen instrumentation plan version used in the elicitation by the experts was the *POSIVA'S DEPOSITION TUNNEL END PLUG (POPLU): P5. Instrumentation v.1.1, dated 7 June 2013*. The outcomes of the elicitation have been included into the subsequent *P5. Instrumentation* plan documentation.

4.2 Handling of expert inputs

The expert feedback included in total 25 discussion items, which were split between the different areas related to the POPLU experiment as is explained in Table 1:

Table 1: EE pilot discussion item summary based on meeting notes 5 September 2013

Area of POPLU test	Total discussion items (no)	Uncertainties identified (no)
Instrumentation	7	4
Predictions / Modelling	8	6
Design and Construction (incl. Materials)	2	6
Expected Outcomes of POPLU test	8	8
Total	25	22

4.3 Outcomes of the consensus meeting

The consensus meeting outcomes included improvements to the instrumentation, to the modelling, to the design and some additional considerations. The outcomes were documented in an action list. During the elicitation, five related improvements were agreed upon and these were then further extended to the list presented in this section in the following.

The focus of the pilot EE was to address the selected issue under elicitation, thus only the following improvement proposals that were made to the instrumentation plan are recorded in this memorandum.

Improvement or alternative actions related to the instrumentation plan:

At the cast contact of the two parts: displacement or strain sensors recommended to be added into the instrumentation plan. Their purpose is to verify the assumption that the plug behaves as a one solid piece.

Explanation to be added on what are the uncertainties in the instrumentation plan and in the function of sensors.
This should include discussion about uncertainties in both the outcomes and the instrumentation in the modelling and instrumentation parts of the project plan.

Also to be included into the plan a discussion about the strategy related to selection the number and types of sensors planned to be used. I.e. that the intention in choosing the number and type of sensors is not to add redundancy by increasing the number of the same type of sensors in the instrumentation since the failure behaviour is more likely to be similar, but rather to increase redundancy of the measured outcomes by installing sensors of different types but measuring the same parameter or expected outcome result.

Instead of adding pH detectors as suggested in the elicitation, the pH monitoring can be carried out as part of the ONKALO monitoring and specifically by monitoring leaking fractures. Posiva's monitoring contact person to discuss about ground water flow monitoring near POPLU to include these aspects into the ONKALO monitoring programme (a plan to be made for this additional monitoring).

Make an action to plan for water chemistry monitoring/sampling that could help to locate possible leaking points, including also regular visual monitoring focussing on the changes in the colour of leaking water (white water indicates that bentonite present is in the water and thus the water is very likely coming through the plug).

Study the feasibility of measuring the pressure/load against form work during casting. Ambient Temperature (T) measurement has been already included into the instrumentation plan of plug (also in the extensometers), since this would help optimise the form work design. The design is currently planned to be very robust due to unknown loads to which the form work is subjected.

SKB's written material from the DOMPLU plug experiment to be send to the instrument designer and ONKALO staff (Ilkka and Kimmo) as there is **an interest in the durability of the sensors, reliability of output from sensors especially strain gauges, and other implementation experiences**. Also include SKB's experiences on the lead-through for the instrumentation

Suggestion based on SKB's calibration experiences to also **have same parallel sensors for calibration to be cast in same concrete cast blocks during the experiment** and e.g. to place them into the adjacent instrumentation tunnel for the duration of the experiment in similar ambient conditions. Take this into the instrumentation plan.

In addition some recommendations were made to cover instrumentation outside the concrete component:

Study the feasibility of increasing the number of potential extensometers into the surrounding rock. Now two units are included in the plan.

The structural and contextual descriptions were finalised with only small modification (see Appendix 3).

In addition to the improvements, the following uncertainties related to the instrumentation were identified during the elicitation. These uncertainties are also a part of risk identification of the POPLU test.

The **expected life time of the sensors is five years**. This has been set as the minimum duration and an indicator for discontinuing the measurements at latest. The actual life time is uncertain in the POPLU environment.

The **potential breakage of individual or specific type of sensors or their connecting cables / wiring** is unknown. Potential sources of damage can be the high humidity of the environment (up to 100%) and the impact of the concrete cast shrinkage on the cables during curing.

Uncertainty was also identified related to **the actual vs. planned location** of the sensors in the concrete and to **the stability of the locations of the sensors** during the test. The attachment of the sensors to the reinforcement steel bars reduces the location uncertainty.

Insufficient or incorrect type of sensors installed. This uncertainty is reduced by the production of the requirement documentation for main parameters to be measured and the environmental conditions of the test.

Seven participants to the meeting also produced their assessment of the Technology Readiness Level of the instrumentation (and design, and modelling) at the moment and as it is expected to be at the end of the project. For the Technology Readiness Level definitions the scale presented by DOE[3] from the United States was applied.

The TRL level in September 2013 for the instrumentation was rated to be on average TRL 5[4] (n= 7) and the expectation for the TRL level at the end of the DOPAS project and the POPLU experiment was TRL 7[5] (n= 8).

5 Actions taken resulting from the consensus

The instrumentation plan was modified according to the outcomes of the consensus meeting and the procurement of the sensors for the plan is under way.

APPENDICES

1. Domain Expert's Elicitation Form v.1
2. Performance Assessor's Elicitation Form v.1
3. Contextual and Structural Descriptions (8 Nov. 2013)

[3] U.S. Department of Energy, Office of Environmental Management. 2008. Technology Readiness Assessment (TRA) / Technology Maturation Plan (TMP) Process Guide. March 2008.
[4] TRL5 = The basic technological components are integrated so that the system configuration is similar to the final application in almost all respects. The system tested is almost prototypical.
[5] TRL7 = Demonstration of an actual system prototype in a relevant environment. Includes results from full-scale testing and analysis of the differences between the test environment, and analysis of what the experimental results mean for the eventual operating system/environment. Final design is virtually complete.

DOMAIN EXPERT'S ELICITATION FORM (Pilot version)

Issue under elicitation (in the pilot)

Name of respondent

Expertise in regard to the issue under elicitation (personal involvement in the input data production or as external reviewer), relevant experience in the area in general including previous engagement in similar activities:

Role of the expert input[1] data in the formulation of input data for the test plan production

- For what purpose[2] are the input data and the test plan produced and by whom; and who is the customer using the input data and/or the test plan and the potential outputs if not the domain expert?

Rationale underlying the definition and production of the expert input data (see above) and definition and production of the test plan

- How are the input data for the plan defined and the test plan produced?

    a) On which basis have the methods and tools used been chosen for acquiring the input data for the plan?

    b) What is the reasoning underlying 1) the input data and 2) the plan e.g. modelling, design of experiments, measurements or observations?

    c) How are the measured or observed input data parameters for the plan chosen, on which grounds?

[1] expert input data refers to input that requires making a selection for data that is not clearly defined (e.g. from a range of values)
[2] e.g., input data, model, prediction, safety margin, technical plan, requirements,
The issue needs to be defined in clear terms so that its scope can be understood. Like "The concept, instrumentation plan and its implementation and monitoring of results in the concrete component part of the Posiva Wedge Plug POPLU in ONKALO"

d) How is the dimensioning of the test plan, its components (instruments, sensors, other items requiring dimensioning) done? and on which grounds?

e) What kind of data interpretations (abstractions, inferences, upscalings) have been used for the input data or for the test plan?

f) On which kind of theories and models or abstractions from previous experiments are they based on?

g) What are the assumptions and grounds underlying the interpretations?

h) What kind of simplifications (e.g. linearizations, omissions) were made related to the input data or test plan formulation and on which grounds?

i) What type of other constraining factors have been taken into account and which approaches or methods have been used to tackle with them?

Adequacy of the expert input data for producing the plan including its input data and foreseen outcomes?

- Do you feel any doubt concerning the adequacy of the produced and used input data, the plan itself or its outcomes? If so, about what and why, what are the reasons?

- Could the possible inadequacies influence the desired performance assessment results and meeting the initial state (as defined in the safety case) of the plug? If so, in which ways?

- What type of uncertainties do you see remaining related to the data input, the test plan and its potential outcomes? How has this been tackle in the plan?

Challenges in producing the expert input data and the plan

- Has there been difficulties / what are the difficulties possibly encountered in producing the input data and in preparing the plan and what are / might be the reasons for the difficulties?

- How have these problems been solved / how could this kind of problems be solved?

Feedback on the EE process and the form:

Is there need for enhancing possibilities to discuss the areas covered above or similar topics like these at POPLU project group or the DOPAS consortium? If so, who should participate in the discussions?

This is a pilot form. What are your proposals for changes or additions concerning the questions and visual appearance of this form, needed for improving the usability of the form as a tool in the formal expert elicitation process at later stages of the DOPAS project.

PERFORMANCE ASSESSOR'S (/SAFETY ANALYST'S) ELICITATION FORM
(DOPAS EE pilot version)

Issue under elicitation

Elicitation task[1]

Name of respondent

Expertise in regard to issue under elicitation (relevant experience in either performance assessment or safety analysis/safety cases)

Appropriateness and completeness of the conceptual model/models used for the test plan for the assessment of performance and/or compliance of the plug

1. How comprehensive is the conceptual model/s used for the issue under elicitation from the performance or compliance assessment point of view? What are the main uncertainties related to the conceptual model/s used?

Role of the expert input data for the related test plan in the assessment of the component (or plug) performance and in the assessment of compliance with the requirements

2. Are the input data used directly in performance or safety assessment or are they an intermediate result in the data production chain for coming up with the test plan?

Preliminary assessment of the adequacy of the expert input data, of other models, methods and tools used for coming up with the plug component test plan

3. What is your opinion on the adequacy and suitability of the input data or models used as input? Do you foresee any inadequacies[2] in the way the input data or the models have been produced?

[1] describe how you understand this elicitation task for the issue under elicitations, what are your objectives for the elicitation from quality assurance point of view

4. In which ways can the foreseen inadequacies cause uncertainty and reduce the quality of the produced input data or models used in coming up with the test plan?

5. What is your opinion on the adequacy and suitability of the methodology and tools used in the test plan? Do you foresee any inadequacies[3] in the way they are planned to be used or have been used?

6. In which ways can the foreseen inadequacies cause uncertainty and reduce the quality of the produced performance data from the test?

Definition and the origins of the requirements and the expert input data for the performance assessment

7. How are the expert input data and the requirements produced and used in the assessment of the component / plug performance and how are they used in the definition of the initial state of the plug or plug component?

8. If you foresee uncertainty caused by the way the requirements or input data have been produced, how is this kind of uncertainty handled in the test plan and further in performance assessment?

9. Are there difficulties in handling this kind of uncertainty in performance assessment or in the assessment of other compliance with the requirements? If so, why? What are the reasons?

10. What is the possible or predicted influence of this kind of uncertainty on the performance assessment results and on the understanding of the initial state[4] of the plug or the plug component?

Rationale and way of thinking underlying your preliminary assessment (above)

11. What are the assumptions and grounds[5] underlying your assessment?

12. Did you experience difficulties in making your assessment? If so, what kind of difficulties and for why? What were the reasons?

13. Do you feel any doubt concerning the adequacy of your assessment? If so, about what and for what reasons?

[2] e.g., ungrounded or undocumented choices, omissions, generalizations etc.
[3] e.g., ungrounded or undocumented choices, omissions, generalizations etc.
[4] the state in which the plug (or its component) is after the last man-made action targeted to the plug and its near-field
[5] e.g., literature, pilot modelling results, sensitivity analysis, use of conservatism, authorities' requirements

Feedback on the process and form:

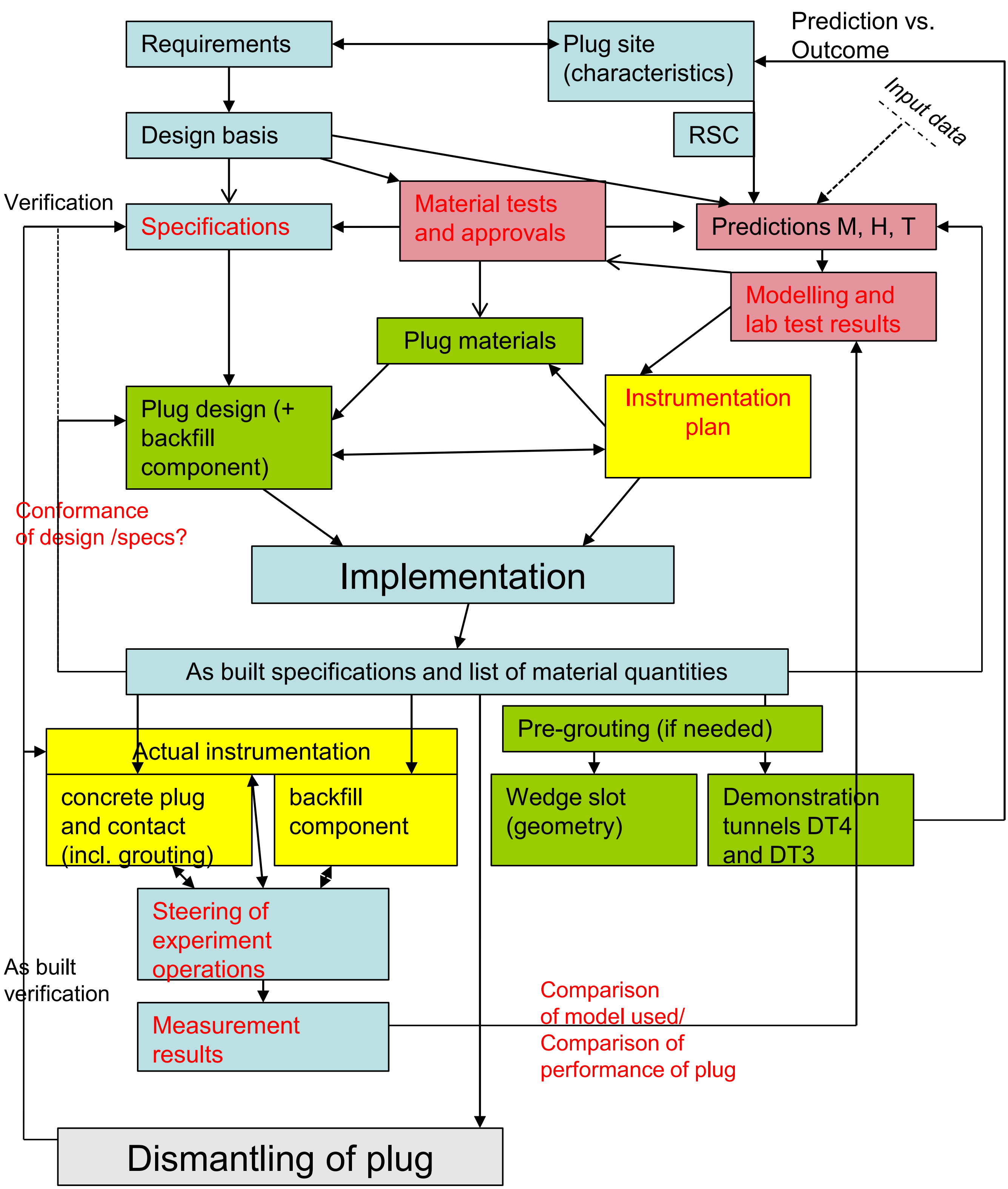
Is there a need for enhancing possibilities to discuss difficulties encountered in your assessment (e.g. identification and treatment of uncertainty in the test plan or the performance assessment) at POPLU project group or the DOPAS consortium? If so, who should participate in the discussions?

This is a pilot form. What are your proposals for changes or additions concerning the questions and visual appearance of this form, needed for improving the usability of the form as a tool in the formal expert elicitation process at later stages of the DOPAS project.

Appendix 3

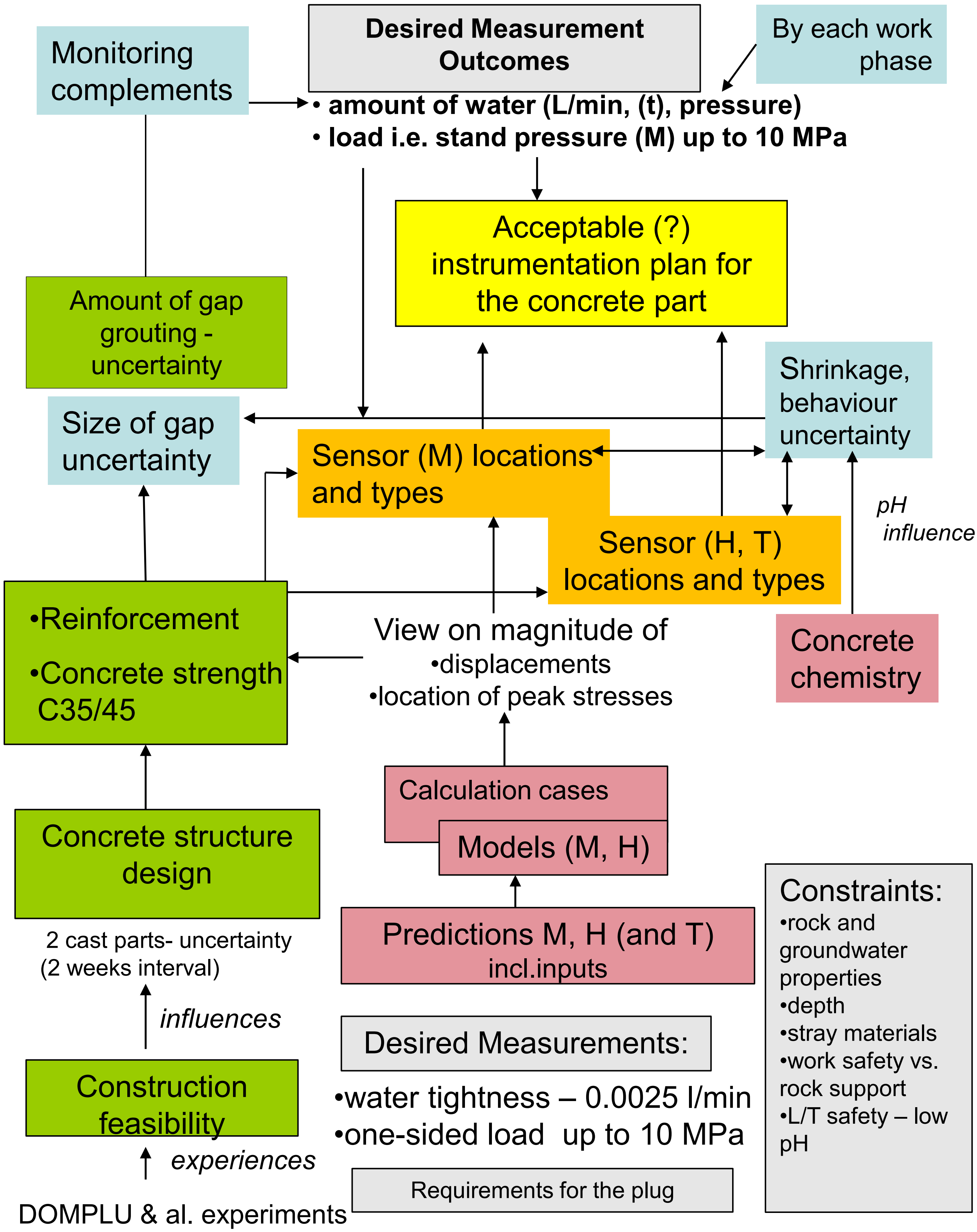
EE 8.11.13

POPLU Experiment (General Contextual Description) v.5



EE 8.11.13

Instrumentation Plan – Structural description v. 3



Legend for the descriptions

(yellow box)	Instrumentation
(pink box)	Predictions/modelling
(green box)	Design
work within DOPAS	Work included in DOPAS project
POPLU only	Work included in POPLU experiment, but not in DOPAS project
DOPAS (PA) results	Information of DOPAS activities
Other results	Other activities information

For clarification: ”Input data” means all the parameters required or used to make the predictions, including assumptions (and related justifications) and existing process understanding of the relevant processes (M, H, T)