QA in SKB's Corrosion Experiments: Issues for a Review Meeting

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1. Introduction

SSM has completed the initial phase of its review of the SR-Site safety assessment produced by SKB. The review subsequently entered its main phase, with assignments targeted on prioritised tasks and issues and aimed at supporting SSM's compliance judgments. As part of the main review, SSM tasked Galson Sciences Limited to undertake an assessment of SKB's documentation and quality assurance (QA) of selected copper corrosion experiments. The overall aim of the assignment is not necessarily to check specific values or decisions that have been highlighted in other reviews of corrosion processes, but to check the existence and application of appropriate procedures during all stages of the corrosion experiments, including analysis of the experiments and use of results.

The assignment has two main components:

- A QA review meeting with SKB staff (and SKB's consultants if needed) who have been involved in the copper corrosion experiments.

- An assessment of the documentation and QA of the copper corrosion experiments.

This document relates to the QA review meeting with SKB. The aim of the meeting is to review project documentation, including both the procedures themselves and evidence of their application. In the absence of specific procedures, the process followed will be reviewed by asking to see a full documentation trail for decisions relating to the experiments. The review will ask for a demonstration of the links between the assumptions about corrosion rates made in the SR-Site licence application and the experiments that support those assumptions. In order to facilitate this review process, a list of QA issues relating to the design, running, analysis and use of results of the corrosion experiments is presented in this document. The meeting findings will be used in the second component of the work to assess the documentation and QA of the corrosion experiments.

The QA review is focusing on SKB's Miniature Canister (MiniCan) corrosion experiment, the Long Term Test of Buffer Material (LOT) project and the aqueous corrosion tests at the Äspö hardrock facility in Sweden. The LOT and MiniCan experiments were the subject of a previous QA review reported in 2010:

- Baldwin T.D., Hicks T.W. (2010). Quality Assurance Review of SKB's Copper Corrosion Experiments, Strålsäkerhetsmyndigheten, Research Report 2010:17.

The current review will consider the viewpoints expressed in the above report, as discussed in Section 2, and will evaluate the work presented by SKB in recent reports, with focus on the following:

- Smart N., Rance A., Reddy B., Fennell P., Winsley R. (2012). Analysis of SKB MiniCan. Experiment 3, Svensk Kärnbränslehantering AB, SKB TR-12-09.

- Smart N., Reddy B., Rance A. (2012). Miniature Canister (MiniCan). Corrosion experiment progress report 4 for 2008-2011, Svensk Kärnbränslehantering AB, SKB P-12-13.

- Smart N., Rose S., Nixon D., Rance A. (2013). Metallographic Analysis of SKB MiniCan Experiment 3, Svensk Kärnbränslehantering AB, SKB R-13-35.

- Hallbeck L., Edlund J., Eriksson L. (2012). Microbial analyses of groundwater and surfaces during the retrieval of experiment 3, A04, in MINICAN, Svensk Kärnbränslehantering AB, SKB P-12-01.

- Karnland O., Olsson S., Sandén T., Fälth B., Jansson M., Eriksen T., Svärdström K., Rosborg B., Muurinen A. (2011). Long term test of buffer material at the Äspö HRL, LOT project. Final report on the A0 test parcel, Svensk Kärnbränslehantering AB, SKB TR-09-31

- Wersin P. (2013). LOT A2 test parcel, Compilation of copper data in the LOT A2 test parcel, Svensk Kärnbränslehantering AB, SKB TR-13-17.

- Boman M., Ottosson M., Berger R., Andersson Y., Hahlin M., Björefors F., Gustafsson T. (2013). Koppars korrosion i ultrarent vatten, Svensk Kärnbränslehantering AB, SKB R-13-31.

- "Aqueous corrosion tests" from WM'02 Conference, February 24-28, 2002, Tucson, AZ "L. O. Werme, B. Rosborg, C. Taxén, O. Karnland, G. Quirk, title: In Situ Copper Corrosion Experiments In Äspö Hard Rock Laboratory."

The list of issues and questions to be discussed at the QA review meeting in relation to the copper corrosion experiments undertaken as part of the MiniCan and LOT experiments and the aqueous copper corrosion tests is presented in Section 3. It is intended that the list of issues is addressed for each experiment in turn:

- MiniCan Experiment 3, focusing on the corrosion analysis of the copper coupons and canister.

- LOT project, the A0 parcel tests, focusing on the analysis of the copper coupons.

- The LOT A2 test parcel tests, focusing on the analysis of the copper tube.

- The copper corrosion tests in oxygen-free pure water.

- Atmospheric and aqueous copper corrosion tests at Äspö HRL.

2. Follow-up of Viewpoints Expressed in the QA Review from 2010

In the previous QA review reported in 2010 (Baldwin and Hicks, 2010) two of SKB's copper corrosion experiments were reviewed: the LOT project and the MiniCan experiment. Questions that were answered during this earlier review will not be repeated. The focus of the present QA review will be the results obtained after the 2010 QA review was completed and the new experiments designed and conducted by SKB concerning copper corrosion. However, during the previous QA review a number of important issues were highlighted and the present QA review will start by re-examining these issues and investigating the measures/changes implemented by SKB to address them.

3. QA Review Issues List

3.1. Procedures for experiment design and management

- How was the requirement for the experiment identified and how does it support the repository development programme?
- Is there a QA plan for the experiment? Does the QA plan cover planning, design, running, analysis and reporting of the experiment?
- What constraints or requirements are there on the location, scale and schedule for the experiment?
- How are organisation(s)/expert teams selected to undertake the experiments and analyse the results? How is it ensured that appropriate QA/Quality Control (QC) procedures are followed by the contractors and that the necessary expertise is available for the work?
- What QA procedures are in place for management of contractors' work and ensuring that the objectives of the experiment and analysis are met?

3.2. Procedures for quality control of materials and use of instrumentation

- What quality controls are there on the materials used and the installation of the experiment?
- What procedures are used for instrumentation calibration and reliability testing for the experiment, instrumentation checking and maintenance during the experiment, instrumentation backup/duplication, and instrumentation checking at the end of the experiment?
- How are measurement uncertainties and instrument detection limits reported and accounted for?
- What controls are there on material recovery for analysis at the end of the experiment?

3.3. Procedures for running the experiments

- What procedures are used for ensuring that the conditions of the experiment (e.g. chemical and hydraulic) are controlled as planned and monitored and recorded during the experiment? How are uncertainties in conditions identified and recorded?

- What procedures are there for recording any ongoing corrosion results and the conditions of the experiment at the time of measurements?

- What procedures are used for checking records of ongoing results?

- What procedures are used if the on-going corrosion tests show unreliable measurements or if the test conditions are changing unexpectedly and are not representative for the designed aim of the experiments?

3.4. Procedures for material analysis

- What procedures are used for calibration and testing of instrumentation used in the material analysis?

- What procedures are there for recording the results of the analysis, including uncertainties?

- What procedures are used to identify, evaluate and report outliers?

- How are measurement uncertainties and instrument detection limits recorded and taken into account?

- Are there procedures for checking that the range of possible corrosion mechanisms has been considered when interpreting the results of the experiments and analysis?

- What procedures are used for checking the results of the analysis?

- What procedures are used for selection of the data that are implemented further for modelling studies of long-term corrosion behaviour of copper canisters? Which experimental data are used for validation of modelling results?

3.5. Procedures for data management and control

- How are data from the experiments stored, backed-up, accessed and controlled?

- What procedures are used for ensuring that the data are used appropriately and uncertainties taken into account (i.e. ensuring that the experimental conditions under which the data were acquired are recorded and understood)?

3.6. Procedures for reporting the results of the experiments

- What procedures are used for reporting the experiments, analysis and results?
- What procedures are used for review and checking of reports?
- Are there procedures to ensure that the documentation provides enough detail for the experiment to be repeated?
- Are there procedures for ensuring that results presented in the licence application can be traced back to particular experiments, and sets of data?
- How is it ensured that the reported results are used appropriately and uncertainties are taken into account?
- How is it ensured that experimental results are not omitted from being reported?