

**Från:** Strömberg, Bo  
**Skickat:** den 12 januari 2021 15:24  
**Till:** 'Lotta Rubio Lind'  
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**Ämne:** Kommentarer på minnesanteckningar LOT

God fortsättning!

Tack för den reviderade versionen av mötesanteckningar från möte 1. Det blev ett lite längre uppehåll än jag tänkt mig.

Jag fick in ytterligare ett par mindre synpunkter kring dessa anteckningar (se nedan). Bör dock vara en liten insats att tillföra dessa. Nedan följer synpunkter på samtliga tre minnesanteckningar. Efter detta mail kommer inga fler synpunkter från SSM på några av dem inför upprättande av slutliga versioner. Överlag är vår bedömning att anteckningarna på ett bra sätt speglar presentationer och diskussioner under de tre mötena. Punkterna nedan är förslag på ändringar i syfte att förtydliga och komplettera anteckningarna, och förbättra läsbarheten.

Det kan tänkas att vi återkommer med några få kompletterande skriftliga frågor om LOT inför att vi tar fram våra slutrapporter/PM som i så fall hanteras separat från dessa möten (från Galson och SSM). Första utkast rapport från Galson väntas slutet januari. Denna kommer sedan revideras efter synpunkter från SSM. Rapport/PM från SSM planeras bli klar slutet av februari

Bästa hälsn

Bo

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Comments on meeting notes nr 2:

Topic 1, last sentence: "It was concluded that SKB handles pitting in a conservative way". This sentence should be more specific, e.g. handles assessment of pit depth on the LOT specimens conservatively by assuming that all pits are due to pitting corrosion. It cannot be a general conclusions since for instance pitting due to sulphide corrosion could not even be assessed by the LOT samples. The reference to the ABM 45, package 5 results could be made a bit clearer by adding e.g. similar results have been obtained from ABM 45 by examination of exposed copper samples in another experiment similar to LOT.

Topic 2, last sentence referring to corrosion during initially oxygenated conditions as a "limited" process. This is of course true but the same could be said about e.g. sulphide corrosion (limited by slow mass transfer of sulphides) although it is expected that this process will go on at a slow rate indefinitely in the repository environment. A more specific conclusion for corrosion in the presence

of initially available oxygen is for instance that the total extent of this corrosion process will approach an upper limit value.

Topic 3: Could a comment be added on whether there were any deviations from the activity plan for the corrosion analysis?

Topic 4, discussion point. SKB did use previous experiences when extracting copper coupons..... Could previous experiences be a little more specific for readability purposes?? What were those?

Topic 5, discussion point. Just for clarification: What is the material laboratory in question? KIMAB?

Topic 6, last sentence: The sentence just say that P has an influence not which one it is. A clarification is recommended, e.g. preliminary experimental results based on electrochemical potentiodynamic measurements suggest that pure copper is more prone to passivation as compared with OFP-copper.

Topic 8, under SKB's reply, point b, last sentence, since use of "another contractor" is a bit cryptical a name is better. Other is presumably other than Clay Technology.  
Under discussion, rather than "it is not obvious 8 m pilots were used, it is perhaps better to write that the reason has not been documented.

Topic 11. It was said that pipe sections in blocks 21-23 were selected for practical reasons. That is, they were in the same bentonite blocks as the coupons. It was also said that the hottest parts of the pipes could still be analysed. Could these points be added?

In the last paragraph it is stated "without a thermal gradient". This is a bit misleading since there will always be a radial thermal gradient in the whole package (i.e. mainly from the copper surface and in the bentonite extending into the rock). So it should be "without an axial thermal gradient along the copper surfaces", and maybe "such as in a real repository situation where the temperature increase is caused by spent fuel residual heat rather than an electric heater."

Comments on meeting notes nr 3:

Topic 1: discussion section. Is it not a requirement that SKB will have to approve a replacement consultant? (not merely be informed as is indicated by the present formulation). Also it may be clarified that "who" (in the first sentence) presumably refer to a list of approved staff members at the supplier company.

Topic 3: It could be clarified that the TEM analyses appendix in TR-20-14 was included more-or-less in the form it was provided by Swerim, and that this section was subject to peer review with the rest of TR-20-14. Also it should be clarified if there are specific requirements for external reviewers of SKB reports, e.g. if specific scientific qualifications are needed? Since TR-, R- and P- reports are mentioned, do requirements differ in between the different series?

Topic 4. A point which was made during the meeting is that to access data in SICADA, contractors need to make a request to SKB. Can that be added?

Topic 5. Bullet point nr 1 and 2: Could "other factors" be elaborated? E.g. does heterogeneous refer to oxygen availability/resaturation within each experiment or in between the different experiments, and what in turn could be primary causes for heterogeneity?

Topic 7. Last sentence: The copper adsorption on ion-exchange site in bentonite is clear but could the possible complexation referred to be clarified and made more specific?

Topic 8. SKB's new experimental studies on early stage corrosion and oxygen consumption are noted briefly. These were discussed more in the meeting in terms of there being small (a UK lab) and medium-scale (Äspö) experiments. Could SKB add information about these experiments, including their schedules and aims?

Topic 10. Discussion section, last sentence. The first part is OK, but the last part is not so clear. The topic brought up refer to a situation in which the potential consumption rate of oxygen is more rapid than oxygen supply by mass transfer. Under such conditions oxygen concentration could in principle not only be low but be close to zero in spite of a slow oxygen consumption still taking place. Such slow mass transfer could still have some relevance in time scales of several years.

Topic 11. A way to determine if Fe(II) have been oxidised during the course of the experiments would be to look for ferric precipitates since Fe(III) would be very insoluble in the prevailing conditions. Other reducing agents mentioned and deemed to be less important were dissolved manganese and hydrogensulphide.

Topic 12. A point was made that there could be residual oxygen in bentonite and sand even after saturation that could diffuse to the copper surface.

Topic 13. Two effects were discussed, and the final sentence of the discussion section seems to imply that that these two effects are opposing each other. The two effects (effects of temperature differences, and different resaturation rates) and their implications need to be explained more carefully and clarified for readability purposes.

Topic 14. When it is said that kinetic control phase was much shorter for coupons, one might add that diffusion control is more likely to be rate limiting for a comparatively longer duration, which may also explain the smaller accumulated amount of corrosion.

Topic 15. In the discussion part papers in the general scientific literature are available related to reaction rates between copper and oxygen. Could one or two references be added?

Topic 16. The point was made that there is a great deal of uncertainty about the saturation process but the sand beneath the bottom plates would have saturated quickly. Could SKB say more about how corrosion of the bottom plate is expected to have progressed in the presence of oxygen and Cu(II)?

Topic 18. Regarding the definition issue, would the redox conditions of a relevant typical deep groundwater with redox potential of  $-0.2$  V better be described as chemically reducing or anoxic or would both be equally applicable? Is it not possible that the prolonged presence of solid phases normally associated with oxidising conditions (such as atacamite) is due to slow dissolution kinetics in combination with slow mass transfer rather than kinetic stability for conditions and time scale of these experiments. In this context there was also a discussion about thermodynamic stability of cuprite together with copper both in the presence and absence of other redox affecting species such as dissolve hydrogensulphide. Also, an SKB reference for the synthesis and thermodynamic stability of CuOH was mentioned and discussed during the meeting. Could that one be added?

Summery bullet points. Second from last bullet. Just for readability purposes could references to SKB experiments and what-if calculations related to the proposed chemical reaction be added.

Concluding remarks. Could SKB add a concluding point about the different observations and processes that occurred in the vicinity of the bottom plates, and whether there would be any benefit in analysing the bottom plates further given that their appearance has drawn attention?

Comments on meeting notes nr 1.

Topic 2. It was noted that S2 and A3 were allowed to run for longer in response to changes in the schedule for constructing the repository - this point could be added.

Topic 4. It was noted that daily logs also provide a good record of when work is done, which can be important information if there are any interactions between neighbouring experiments (e.g. water pressure effects). There was also discussion about lab protocols that allow comment on any deviation from a procedure. Would such information will be used in production of the experience report?

Topic 5. In the meeting it was stated that safety issues in the tunnel were a factor when deciding not to include impartial observers. Could this point be added?

Topic 12. It was noted that it was considered cost-effective to go directly to suppliers rather than to go through public procurement. Could this be added?

Topic 13. The first word is presumably How

Topic 14. It was noted that images are stored in disks separately for SICADA. Could this be added?