Strålsäkerhetsmyndigheten
Swedish Radiation Safety Authority

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Review comments Galson Report

Dear Tim, and Tamara

Many thanks for your efforts with the report. I congratulate you on the flawless writing. I tried hard to find typos, but did not succeed well. I have not checked the reference list so it you have an opportunity it would be a good thing to go through that once.
In the SSM perspective we need a short section summery by the authors. The long summery can stay as an extended summery, but you need to complement with a shorter one for the perspective.

On page 1, first para, understanding how buffer will behave is a bit vague, I think you could add thermal bentonite alteration as one primary objective (illitisation, salt enrichment, etc.)

On page 3, I think you should mention MKG as the lead environmental organisation in the LOT review context. Also Peter Szakalos and Christofer Leygraf are not from environmental organisations, rather corrosion scientists at the Royal Institute of Technology (KTH).

Also on page 3, One major point raised during the meeting was the idea many large repository experiments have shown development of anoxic conditions in a few months period, such as REX, Minican, FEBEX, FE etc. I think that should be reflected in the bullet list.

On page 6, maybe it should be clarified if the wording of the figure captions comes from you or the referenced SKB report.

On page 8, last sentence of the first paragraph, the meaning of this sentence needs to be clarified, is it that the sensors are not reliable at all, or that they are only unreliable after full saturation because of contact with saline water (which is at least the way I interpreted the SKB report).

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On page 8, if you compare the description in the SKB report (4.4.3) I got the feeling that they relied on a combination of the pressure measurements and the relative humidity measurements to arrive at approximate resaturation times. Your text on the other hand suggests that the times are only derived from the relative humidity measurements.

On page 11, under 3.1.1. first para, which are the other three owners?

On page 11, last para, you can maybe say “on the then planned schedule for repository construction”

On page 12, first para, I don’t think they could get more data on system behaviour. The size of the data set would be the same depending on the examination strategy of samples not monitoring data, but the exposure time would be longer. Two slightly different things.

On page 13, last sentence, in IPR 99-01 cement smectite alteration is actually mentioned as an objective of the LOT work, is it stated anywhere that SKB has abandoned this objective, in the way that they made explicit for the microbes study?

On page 15, the second bullet, it might be worth pointing out that the Mössbauer spectroscopy has as far as I understand nothing to do with the corrosion analysis

On page 15, under 3.1.3 second para, I am not sure what is meant by “including a potential collaboration with POSIVA” is it that POSIVA would be regarded as an external stakeholder, or that they would actively collaborate with SKB??

On page 17, WP1 and WP2, Isn´t it so that the XRF analysis belongs to WP1, and if so that could be stated.

On page 20, third para, it is here stated that film technicians were called in at key points, if you compare that with the first sentence in the second paragraph page 16 it is here stated that SKB did film the entire parcel retrieval process, the two do not seem to go together, so some revision is needed here.

On page 26, first para, last sentence, is it clear that the work RISE did for SKB is regarded as research or maybe they regarded it as an assignment from industry. It is not really important for anything but if there is a lack of certainty maybe the last sentence could be rephrased slightly.

On page 28, first para after bullet list, last sentence, I interpret this sentence in the way that you (i.e. Galson) did these spot checks as part of the review. But since the sentence is passive this is not so clear.

On page 32, second para, last two sentences, just for clarification of the idea with corrosion products in pits as an indication of local corrosion. Is this an outcome of this review or is it also a conclusion that can be found in the SKB report?

On page 33, first para, on the gypsum issue a little more text could be added. I recall that SKB suggested that the clear correlation between sulphur and calcium complicates interpretation related to sulphides (due to the expected presence of gypsum), but that there were spots with clear accumulation of sulphur without a corresponding accumulation of calcium.

On page 37, first para, the judgement that the corrosion product layer was very thin is presumably based on the later specified thickness of 1 µm. Did SKB anywhere calculate how much such a layer compares to the accumulated amounts of copper in bentonite?

On page 37, second para, could "good agreement" be made a bit more specific?

On page 37, third para, I think you could add anhydrite to gypsum. The two different phases are hard to distinguish and are formed at only slightly different environmental conditions.

Page 38, section 4.6, in the review by Torbjörn Sanden, the identity of the "bacterial" coupons were explicitly mentioned.

Page 38, section 4.6, I think this section is a bit confusing because of the various contexts that microbial process has been mentioned in LOT. From the beginning SKB were likely only concerned with impacts of SRB's on copper corrosion, i.e. sulphide attack. The idea of microbes being important for oxygen consumption and therefore need to be understood to interpret LOT came in much later. I seem to recall that SRBs (Sulphate Reducing Bacteria) are obligate anaerobes rather than facultative anaerobes (i.e. they cannot use oxygen as an electron acceptor) so these added microbes would in that case not be related to oxygen consumption, but of course others could. I think it would help the readers with a little bit of basic info on these two forms of microbial activity.

Page 39, first para, the last three sentences, the first talk about sulphide formation, then the second presence of cuprite and the third accumulated amount of corrosion. This is a bit confusing, some readers not familiar with the different forms of corrosion would draw the conclusion that the three sentences are related, when in fact only the two latter are related.

Page 40, second para, last sentence, if the CuS-phase would not be associated with corrosion how would it form?

Page 42, first bullet. "SKB cited studies.." do you have any reference here?

Page 42, second bullet. I think also SKB mentioned that bentonite often contain small amounts of gypsum which would render sulphate measurements to trace pyrite oxidation essentially meaningless.

Page 42, under 4.7.4, third paragraph, if you go to Nagra NAB 16-16, section 5.1.1. The authors argue that based on the amount of ferric iron corrosion products, the amount of oxygen needed for this reaction is about 10 times larger than the oxygen available.

Page 46, 5.1 first para, should it not be: project have changed is not surprising, **and** the changes do not appear to have any significant impact etc. Is there a contradiction?

Page 46, 5.1 second para, same as earlier not a greater quantity of data (since there were essentially no meaningful time dependence beyond the resaturation phase), but data corresponding to a longer exposure time.

Page 47, second para, are images also included in Sicada?

Page 48, first para, maybe you can say cumulative amount of corrosion just to clarify

Just one comment on the summery. Pressure conditions are mentioned. Would they be much different from a real repository since there would be a slow gradual build-up to eventually equate surrounding groundwater pressure also there?