Errata 2012-12

SKB TR-11-01

Long-term safety for the final repository for spent nuclear fuel at Forsmark

Main report of the SR-Site project

Volume II

In the earlier distributed report, there are errors that have now been corrected. The corrected page 383 is enclosed. The changed text is marked with a vertical line in the page margin. An updated pdf version of the report, dated 2012-12, can be found at www.skb.se/publications.

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Movement of the canister in the deposition hole

One of the safety functions for the buffer is that it should prevent the canister from sinking in the deposition hole since this would render the canister in direct contact with the rock thus short-circuiting the buffer.

Canister settlement consists mainly of four different processes:

1. Consolidation/swelling caused by the canister weight.
2. Volumetric creep caused by the canister weight.
3. Deviatoric creep caused by the canister weight.
4. Stress changes caused by upwards swelling of the buffer/backfill interface
   a) Consolidation/swelling.
   b) Volumetric creep.
   c) Deviatoric creep.

The fourth process can thus be divided into the same processes as the first three processes but the consolidation and creep is caused by the swelling pressure from the buffer on the backfill instead of the weight of the canister.

The settlement of the canister has been modelled in /Åkesson et al. 2010a/. The calculations include two stages, where the first stage models the swelling and consolidation that takes place in order for the buffer to reach force equilibrium. This stage takes place during the saturation phase and the subsequent consolidation/swelling phase. The second stage models the deviatoric creep in the buffer over 100,000 years. The modeling takes into account all processes except volumetric creep, which thus may cause a slight underestimation of the canister displacement. The motive for excluding volumetric creep is that canister settlement caused by volumetric creep will not change the total mass of bentonite under the canister but will only increase the density and is thus not judged to be a problem.

The base cases in the calculations correspond to the final average density at saturation of 2,000 kg/m³ with the expected swelling pressure 7 MPa in a buffer. In order to study the sensitivity of the system to loss in bentonite mass and swelling pressure seven additional calculations were done with reduced swelling pressure down to 80 kPa corresponding to a density at water saturation of about 1,500 kg/m³. The results of the calculations with fixed backfill boundary and the corresponding friction angle at retained initial swelling pressure are summarized in Table 10-4. The canister settlement shown in

Table 10-4. Summary of results from the calculations with fixed buffer/backfill boundary /Åkesson et al. 2010a/.

Calculation No	Density at saturation ρ_m (kg/m³)	Swelling pressure p (kPa)	von Mises stress at failure q_f (kPa)	Canister settlement (mm)	Friction angle at retained swelling pressure ϕ (°)[1]	Canister settlement at corresponding friction angle and retained swelling pressure (mm)[2)3)]
1 (base case)	2,010	7,000	2,238	0.35	8.8	0.35
2	1,950	3,500	1,312	0.67	5.2	0.47
3	1,890	1,750	770	1.26	3.1	0.67
4	1,840	875	451	2.42	1.8	1.04
5	1,780	438	265	4.63	1.1	1.67
6	1,720	219	155	8.89	0.63	2.78
7	1,690 (1,640)[1)]	160	122	12.0	0.50	3.51
8	1,620 (1,470)[1)]	80	72	22.5	0.29	5.54

1) For the actual values of void ratio and density at saturation since the void ratio, e > 1.5 and Equation

$$\phi = \frac{3}{6\,p/q_f + 1}$$

2) Derived from the consolidation in the base case (0.20 mm) + the creep from respective creep calculation.

3) The total bottom buffer thickness is 500 mm.