

Document ID 1343309	Version 1.0	Status Approved	Reg no	Page 1 (3)
Author Allan Hedin			Date 2012-05-03	
Reviewed by Olle Olsson			Reviewed date 2012-05-04	
Approved by Helene Åhsberg			Approved date 2012-05-07	

## Additional hydrogeological model realisations

### Introduction

At the hearings with SKB in December 2011, the NEA IRT brought up the issue of the sufficiency of the number of realisations of the hydrogeological models used in SR-Site. SKB responded during the hearings and also provided additional statistical analyses in a Memo dated 2011-12-22. In the Memo, SKB's intention to carry out additional realisations to further increase the confidence in the calculated mean values was also mentioned.

This Memo reports on the results of such additional realisations. The fully correlated hydrogeological model variant was run since this model variant yielded the highest calculated risk in the compliance demonstration in SR-Site. The context of the analyses is explained in the earlier Memo. The present document presents the additional data, the statistical analysis of these and the conclusions that can be drawn based on this additional information.

### Statistics from additional realisations

Fifteen realisations of the fully correlated hydrogeological model variant have been run, in addition to the five realisations that were run within the SR-Site assessment. Table 1 shows, for each realisation, the number of deposition positions that have sufficiently high flow rates to cause canister failure due to corrosion, i.e. the same type of information as in Table 1 of the earlier Memo, but now only for the fully correlated variant.

*Table 1. The number of deposition positions with sufficiently high flow rates to cause failure within 10<sup>6</sup> years in the corrosion scenario. The results of both the original 5 realisation and the additional 15 realisations (green cells) of the fully correlated hydrogeological model variant are shown in the table. (For technical reasons, the first realisation has ID number 2.)*

Realisation ID number	Number of high-flow positions	Realisation ID number	Number of high-flow positions
2	15	12	44
3	17	13	41
4	60	14	47
5	33	15	25
6	33	16	27
7	52	17	20
8	28	18	30
9	52	19	23
10	25	20	16
11	31	21	26

### Svensk Kärnbränslehantering AB

Swedish Nuclear Fuel and Waste Management Co  
 PO Box 250, SE-101 24 Stockholm  
 Visiting address Blekholmstorget 30  
 Phone +46-8-459 84 00 Fax +46-8-579 386 10  
 www.skb.se  
 556175-2014 Seat Stockholm

The results of the statistical analyses of these data are shown in Table 2, assuming an underlying normal distribution and in Table 3 assuming an underlying log-normal distribution, in analogy with the corresponding tables in the earlier Memo. Simple chi-squared tests of fittings to normal and log-normal distributions were also performed, yielding a somewhat better agreement with a log-normal distribution, whereas a normal distribution could not be excluded.

**Table 2 Statistical analysis of the data in Table 1, assuming a normal distribution. Statistics based on the 5 original realisations (middle column) and on all 20 realisations (right column) are shown.**

Number of realisations, $N$	5	20
Student's $t$ distribution, $t_{0.025, (N-1)}$	2.78	2.09
Mean value, $m$	31.6	32.3
Standard deviation, $s$	18.0	13.0
Lower 95% confidence limit*	9.2	26.2
Upper 95% confidence limit*	54.0	38.3

\*The lower and upper confidence limits are obtained as  $m \pm t_{0.025, (N-1)} \cdot s / \sqrt{N}$

**Table 3 Statistical analysis of the data in Table 1, assuming a log-normal distribution. Statistics based on the 5 original realisations (middle column) and on all 20 realisations (right column) are shown.**

Number of realisations, $N$	5	20
Student's $t$ distribution, $t_{0.025, (N-1)}$	2.78	2.09
Mean value ( $^{10}\log$ data), $m_{\log}$	1.44	1.48
Standard deviation ( $^{10}\log$ data), $s_{\log}$	0.245	0.175
Lower 95% confidence limit ( $^{10}\log$ )*	1.14	1.39
Upper 95% confidence limit ( $^{10}\log$ )*	1.75	1.56
Mean value (lin), i.e. $10^{m_{\log}}$	27.8	29.9
Lower 95% confidence limit (lin)	13.8	24.7
Upper 95% confidence limit (lin)	56.1	36.1

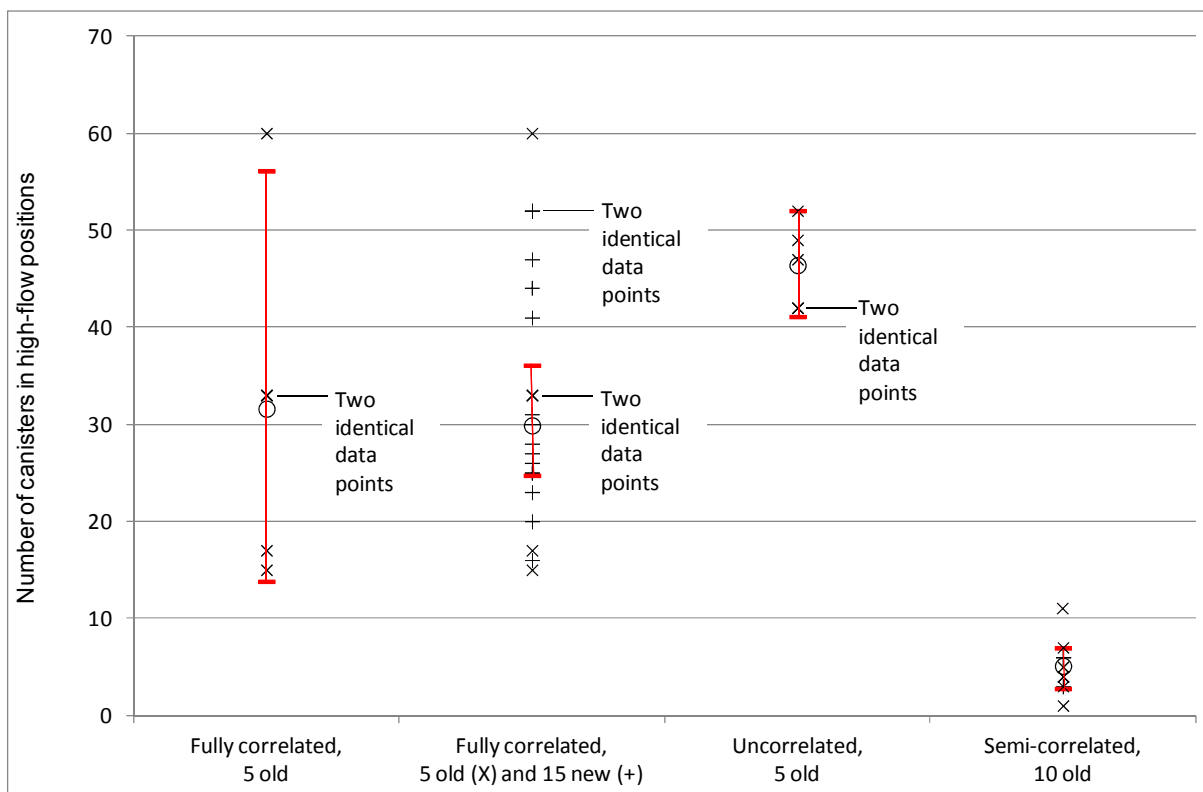
\*The lower and upper confidence limits in  $^{10}\log$  space are obtained as  $m_{\log} \pm t_{0.025, (N-1)} \cdot s_{\log} / \sqrt{N}$

The results are illustrated in Figure 1, which is identical to Figure 1 in the earlier Memo, except that a data series showing the pooled result of the 20 realisations of the fully correlated model has been added.

## Conclusions

Both Tables 2 and 3 and Figure 1 demonstrate *i*) that the mean values are relatively unaffected and *ii*) that the 95 percent confidence interval for the mean value has been substantially reduced by the additional realisations.

It is, therefore, concluded that the additional data enhance the confidence in the calculated risk and hence in the compliance demonstration in the safety assessment SR-Site.



**Figure 1.** The data points in Table 1 (x = old data; + = new data), the mean values of the data (black circles) and the 95% confidence limits of the mean value assuming log-normal distributions (red intervals). Earlier results for the uncorrelated and the semi-correlated model variants are also shown.