Appendix 2

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Objet: Projet minier Niocan - miscalculations and other errors in DA21

I have just reviewed exhibit DA21, "Caractérisation des matériaux du site minier St-Lawrence Columbium", a report dated May 2002 prepared by Roche for Niocan.

I am writing to inform you of some miscalculations and incorrect inferences in the document.

Background

Earlier this year (February 2002) I pointed out in testimony before the TAQ that Roche had seriously miscalculated all the radioactivity coefficients for the samples cited in the Niocan Environmental Assessment document of 2001. These calculations were carried out for samples of slag [scories], tailings [sandy residues], and barren rocks [stériles].

The miscalculations occurred because Roche simply neglected to include in the calculation the majority of the radioactive isotopes present in the samples, in violation of the procedure that is quite clearly described in the Règlement sur les matières dangereuses.

As a result, all of the reported radioactivity coefficients in the Environmental Assessment Report were too low by a factor of ten or more. In the case of one sample of stérile, for example, Roche had calculated a coefficient of 0,4 when the actual coefficient was more than 4,0 . Roche then used this miscalculation to reach the incorrect conclusion that that particular sample of stérile was below the regulatory limit and should therefore not be classified as a dangerous radioactive material (defined as a material for which the radioactivity coefficient exceeds 1).

ATTACHMENT 2: CALCULATION OF RADIOACTIVE COEFFICIENT
SAMPLE OF SLC STERILES 2002 - CORRECTION (2) TO DA21

MINIMUM ESTIMATES FOR U-238, Th-234, Pa-234m, U-234
BASED ON MEASURED ACTIVITY OF Pa-234m - LESS 10 percent
(all activity is measured in Bq/kg)

THORIUM SERIES	C	A	C/A
Th-232	Inferred	Reg. Limit	Ratio
thorium-232	112	4,000	0.028
radium-228	112	40,000	0.0028
actinium-228	110	40,000	0.00275
thorium-228	112	4,000	0.028
radium-224	112	40,000	0.0028
radon-220	112	40,000	0.0028
polonium-216	112	40,000	0.0028
lead-212	125	40,000	0.00313
bismuth-212	110	40,000	0.00275
[2/3] polonium-212	80	40,000	0.002
[1/3] thallium-208	40	40,000	0.001
lead-208	inactive	stable	0
URANIUM SERIES	**C**	**A**	**C/A**
U-238	Inferred	Reg. Limit	Ratio
uranium-238	460	4,000	0.115
thorium-234	460	4,000	0.115
protactinium-234	460	4,000	0.115
uranium-234	460	4,000	0.115
thorium-230	393	4,000	0.09825
radium-226	393	4,000	0.09825
radon-222	380	40,000	0.0095
polonium-218	380	40,000	0.0095
lead-214	390	40,000	0.00975
bismuth-214	370	40,000	0.00925
polonium-214	380	40,000	0.0095
lead-210	380	4,000	0.095
bismuth-210	380	40,000	0.0095
polonium-210	380	4,000	0.095
lead-206	inactive	stable	0
ACTINIDE SERIES	**C**	**A**	**C/A**
U-235	Inferred	Reg. Limit	Ratio
uranium-235	19.7	4,000	0.00493
thorium-231	19.7	4,000	0.00493
protactinium-231	19.7	4,000	0.00493
actinium-227	19.7	4,000	0.00493
thorium-227	19.7	4,000	0.00493
radium-223	19.7	40,000	0.00049
radon-219	19.7	40,000	0.00049
polonium-215	19.7	40,000	0.00049
lead-211	19.7	40,000	0.00049
bismuth-211	19.7	40,000	0.00049
thallium-207	19.7	40,000	0.00049
lead-207	inactive	stable	0
OTHER Primordial	**C**	**A**	**C/A**
K-40	Inferred	Reg. Limit	Ratio
potassium-40	640	400,000	0.0016
SUM OF ALL C/A's	COEFFICIENT	=	1.01151

Additional Errors: Incorrect Inferences

The largest contributor to my 0,974 figure comes from Pa-234m, whose activity was measured as 512 becquerels per kilogram (± 10 %). For some unexplained reason, the actual measurement was disregarded by Roche in favour of the fictitious estimated value of 393 Bq/kg. Any well-trained scientist or mathematician would ask why this should be considered a reasonable thing to do. (Especially since it is not in accordance with the procedure laid down in the Règlement.) I have chosen to use the measured values wherever they exist, because that is the correct procedure.

If the 512 Bq/kg of Pa-234m is correct, or even approximately correct (in the range 460 to 563, using the ± 10 % specified in the table), then there must also be 460 to 563 Bq/kg EACH of U-238, Th-234, and U-234. Why? Because the stérile is 20 years old, while Th-234 and Pa-234m have half-lives of less than a month. Unless there is 460 to 563 Bq/kg of U-238 to replenish the supply of Th-234 and Pa-234m, these short-lived isotopes could not possibly exist at such activity levels in the sample.

Uranium-238 --> Thorium-234 --> Protactinium-234m --> Uranium-234

Moreover, U-234 is chemically inseparable from U-238 under natural conditions: the ratio between their masses is immutable, and since they belong to the same decay chain, they must maintain the same activity level.

Given the half-lives of the three isotopes U-238, Th-234, Pa-234m , it is clear that even if the radioactive equilibrium were broken at some point in time due to weathering or leaching, it wouldn't matter much -- because that equilibrium would be re-established again within 5 or 6 months. Meanwhile the U-234 activity will always match the U-238 activity for reasons stated in the previous paragraph.

Thus there is every reason to believe that U-238, Th-234, Pa-234m, and U-234 all have equal levels of activity in this sample, and those levels are at least 460 Bq/kg.

Using the lowest value of 460 Bq/kg for all four, we get a radioactivity coefficient of 1,01 [attachment 2]. If we use the measured value of 512 for Pa-234m -- as required by the Règlement -- and use 460 for the others, we get a coefficient of 1,025. [attachment 3] Thus the radioactivity coefficient for this sample of stérile, using the procedure required by the Règlement, is at least 2 $^1/_2$ percent higher than the regulatory limit used to define a hazardous radioactive material.

If we use the higher value of 563 Bq/kg for U-238, Th-234, and U-234, and the measured value of 512 for Pa-234m, we get a coefficient of 1,10 -- ten percent over the regulatory limit. [attachment 4]

The possibility that such a release into the environment can occur in only two or three decades underscores the necessity of treating the stériles as potentially hazardous materials and protecting the environment from them.

Third, it appears desirable for the Ministry of Environment to maintain an independent expertise in the field of low-level radioactivity to ensure that regulations are properly followed.

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