Consequences in Norway after Hypothetical Accidents at Sellafield and the Leningrad NPP

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1. Introduction

To assess potential consequences in Norway after hypothetical accidents, two worst case scenarios were considered: accident at the Sellafield complex in UK and accident at the Leningrad Nuclear Power Plant (LNPP) in Russia.

2. Background

Scenario I. This scenario involves an explosion and fire at the B215 facility at Sellafield resulting in a 1 % release of the total HAL (Highly Active Liquors) inventory of radioactive waste with a subsequent air transport and deposition in Norway. Air transport modelling was based on real meteorological data with wind direction towards Norway and heavy precipitation.

Scenario II. This scenario considered a Chernobyl type accident at the Leningrad Nuclear Power Plant. Air transport modelling was based on meteorological data with wind direction towards Norway and an average precipitation of 8.8 mm on the way to Norway.

3. Methods

To simulate atmospheric transport of radionuclides to Norway for different combinations of accident/weather scenarios, the Severe Nuclear Accident Program (SNAP) dispersion model developed by the Norwegian Meteorological Institute was used.

To assess consequences for foodstuff in Norway, the modelled radioactive contamination data was coupled with data concerning transfer in the food chain and statistics on production and hunting. The assessment has been limited to the terrestrial environment with a focus on sheep, goats, wild berries, fungi, game and reindeer.

4. Results and discussion

Scenario I. The modelling of an accident at Sellafield showed that highest deposition levels would be observed at the west coast of Norway and the largest consequences would be there (Fig. 1 I).

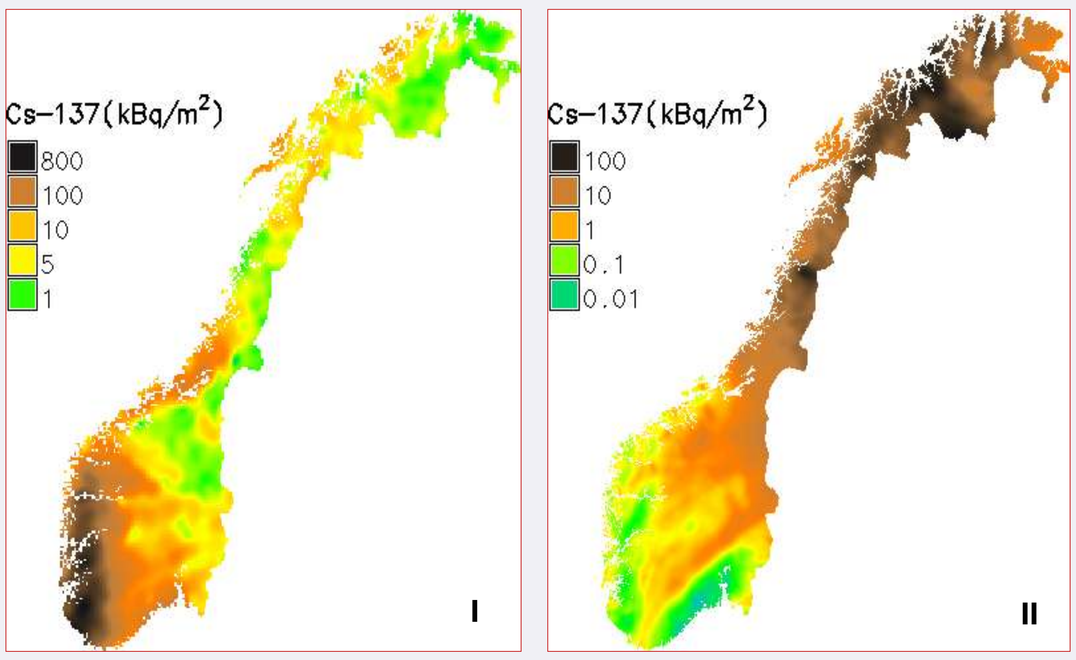

Fig. 1. Deposition of Cs-137 in Norway after an accident at Sellafield, UK (I) and the Leningrad NPP, Russia (II).

Scenario II. The highest deposition levels after an accident at Leningrad NPP would be observed in the northern part of Norway and thus the largest consequences would be found there (Fig. 1 II).

4.1 Comparison of the scenarios from Sellafield and LNPP with the Chernobyl fallout in Norway.

Scenario I. For the Sellafield-scenario the estimated fallout in Norway would be ~17 PBq of Cs-137 which is 7 times higher than the fallout from the Chernobyl accident.

Scenario II. For the LNPP-scenario the total deposition of Cs-137 and Cs-134 would be ~ 4.3 PBq and 2.8 PBq respectively, which is about twice as large as the total deposition after the Chernobyl accident. In contrast with this scenario, only small amounts of the Chernobyl caesium reached northernmost Norway.

4.2 Radiocaesium transfer to animals in Norway after hypothetical accidents at Sellafield and the Leningrad NPP.

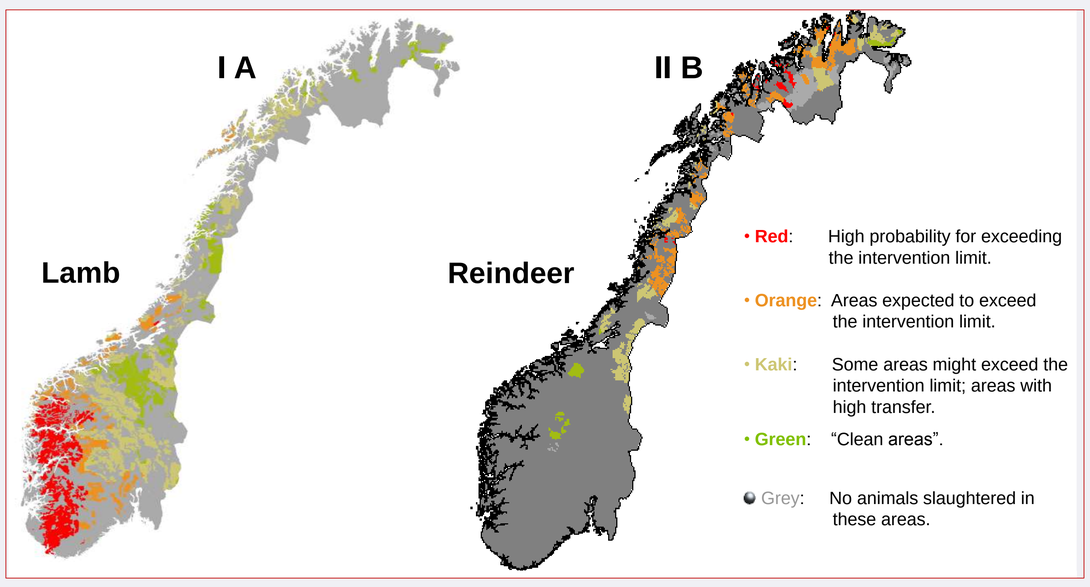

Fig. 2. Predicted contamination of animals in Norway after hypothetical accidents at Sellafield (I A: lamb) and the Leningrad NPP (II B: reindeer).

Scenario I. In the Sellafield scenario, up to 80 % of all lambs could be exceeding the food intervention level for radiocaesium the first few years after the fallout, with 30-40 % likely to be above for years or even decades (Fig. 2 I A). There will be a need for extensive countermeasures in large areas for many years involving several hundred thousand animals each year. Large consequences are also expected for reindeer husbandry – the first year in particular. The consequences for game will mostly depend on the regional distribution of different species.

Scenario II. For the LNPP scenario, the largest consequences are predicted for semi-domestic reindeer, sheep and goat cheese production. Up to 90 % of all semi-domestic reindeer could be exceeding the food intervention level of 3000 Bq/kg for radioactive caesium the first couple of years after the fallout, and 20-60 % likely to be above for years or even decades to come. (Fig. 2 II B). For lamb the number of affected animals in the first years could reach 300 000 (35 % of the country total production), and as many as 100 000 animals could be above the intervention level in the following years (Table 1).

Table 1. Animals affected in Norway per year according to the worst case scenarios from Sellafield (I) and the Leningrad NPP (II).

I

Type	Number of animals affected Expected (min-max)	Total animals	% of total Expected (min-max)
Lamb	380 000 (250 000-720 000)	890 000	43 (28-81)
Goats (whey cheese production)	22 000 (9 500-33 000)	35 000	62 (27-92)
Red deer	11 000 (430-26 000)	33 000	32 (1-78)
Goats (milk production)	9 300 (1 900-15 000)	35 000	26 (5-42)
Wild reindeer	1 100 (660-2 000)	5 200	21 (13-38)
Roe deer	6 100 (700-13 000)	30 000	20 (2-43)
Semi-domesticated reindeer	4 100 (140-43 000)	73 000	6 (<1-58)
Moose	1 200 (<100-11 000)	36 000	3 (<1-30)

II

Type	Number of animals affected Expected (min-max)	Total animals	% of total Expected (min-max)
Semi-domesticated reindeer	40000 (14000-62000)	70000	57 (20-89)
Lamb	110000 (17000-310000)	890000	12 (2-35)
Goats (whey cheese) production)	12000 (3900-16000)	35000	34 (11-45)
Goats (milk production)	3400 (0-12000)	35000	10 (0-33)
Moose	1 (0-7300)	36000	0 (0-21)
Roe deer	0 (0-1800)	30000	0 (0-6)
Red deer	0 (0-240)	33000	0 (0-0.7)
Wild reindeer	0 (0-880)	5200	0 (0-17)

5. Conclusions

The modelling of hypothetical accidents at Sellafield and Leningrad NPP showed that in case of worst case scenarios, both for release and weather conditions, the radioactive fallout could reach Norway and bring serious consequences for the Norwegian society. The environment and foodstuff would be contaminated for several decades.