Is spent nuclear fuel at the Kola Coast and dumped in waters a real danger?

by

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Norwegian concerns regarding nuclear activities at the Kola Peninsula.

Norwegian concerns regarding nuclear activities at the Kola Peninsula is foremost related to risk for a major nuclear accident with release of large quantities of radioactive substances. Examples of such accidents are:

- Loss of coolant accident (LOCA) in a nuclear power plant.
- Large criticality accident in a nuclear power plant.
- Accidental explosion of a nuclear weapon.
- Major accident with spent nuclear fuel for ship reactors, i.e. criticality accident or core melt down in a ship reactor, in spent fuel storage or during spent fuel handling or transport.

This paper discusses the last item presented above.

Radioactivity content of spent fuel from a ship reactor.

A typical modern russian ship reactor has a power of little less than 200 MW (megawatt). A fresh core contain 150-200 kg Uranium-235. To calculate the radioactivity content of the fission products in a reactor with high degree of accuracy, it is necessary to know the exact operation history (power history) of the reactor core. However, a rough estimate of the content of long lived fission product nuclides in spent fuel can be made very easy.

Cesium-137 is for many reasons suitable to be used as an indicator for the radioactivity content of spent nuclear fuel. When the Cs-137 content is assessed, the content of other fission products can be estimated by comparison and adjustment for difference in physical properties as fission yield and half life.

If we assume that half of the U-235 content in a ship reactor core is burned (is fissioned), say 85 kg, 10 000 TBq (terabequerel) Cs-137 is created. This quantity is the maximum content of Cs-137 in a fully utilized russian ship reactor core.

The first generation of submarine reactors were most likely smaller with respect to both power and maximum burn up of fuel. I will assume 5 000 TBq Cs-137 for the maximum content in a first and second generation russian ship reactor core.

Along the Kola Coast, in land storages, floating storages, and in submarines taken out of service, the total number of spent fuel reactor cores amount to two hundred. If we take 3 000 TBq Cs-137 as a mean value to indicate the radioactivity content of all spent fuel reactor cores at the Kola Peninsula, this figure is most probably correct within a factor of 2.

Thus the total Cs-137 radioactivity in spent ship reactor fuel at the Kola Peninsula can be assessed to 600 000 TBq, more than 10 million Ci Cs-137 alone.

The sunken Russian submarine "Komsomolets" contains 2 000 TBq Cs-137, according to information given by USSR officials a few weeks after the accident in 1989. Later this figure has been changed to 3 000 TBq.

Spent nuclear fuel and other high level radioactive waste at the Kola Peninsula and in Arctic Waters.

It is sometimes argud that spent nuclear fuel is not the same as nuclear waste. I consider this as an academic question. The fission products in the spent fuel is no doubt radioactive waste. Besides, a fraction of the spent fuel, perhaps as much as 20 reactor cores, is damaged.

Some information on spent nuclear fuel and high level nuclear waste has been given by Russian sources. However, more complete and detailed information is necessary to evaluate the risk - and the safety.

More than half of the total quantity, in terms of bequerel Cs-137, seems to be at the Litsafjord, approximately 50 km from border to Norway. At the Andrejeva Bay, at the west side of the fjord, the 1993 "White Book" (Jablokov) indicates that fuel from approximately 100 reactor cores is stored here.

Russian and Norwegian media have reported that the spent fuel interim storage at Andrejeva Bay is in bad condition. Russian authorities have detailed plans for construction of new interim storage at the site, most likely with a capasity to store spent fuel from some 60 reactor cores. Interim storage of spent fuel in such quantities close to the border to Norway is a serious concern for Norwegian nuclear safety authorities. It is difficult to understand why it is necessary to keep spent nuclear fuel containing 200 000 TBq Cs-137 at this place in the future.

Spent nuclear submarine fuel is also said to be stored on land in the following nuclear support yards for the North Fleet: Olenya Fjord yard and Pala Fjord yards near Polyarny north of Murmansk, in the Gremika yard and at Severodvinsk near Arkhangelsk.

At the maintenance yard for the nuclear ice breaker fleet in Murmansk spent fuel from some 20 reactor cores is stored on the ships Lepse, Lotta and Imandra. The fuel in Lotta, corresponding to 3 reactor cores, is badly damaged and difficult to remove.

Storage of spent nuclear fuel at ships, and moreover in a big city harbour with heavy traffic, is an obvious danger for the population of the city and for the environment. The construction of a land storage which started 10 years ago has been extremely slow.

To what extent the Russian Navy has interim storage of spent fuel on ships is not known for Norwegian authorities.

In naval bases at the Kola Peninsula about 70 nuclear submarines have been taken out of service to be decommissioned. The nuclear fuel remains in at least 50 of them. This means that another 100 reactor cores are in interim storage along the Kola Coast. Russian media claim that there is little money for attention and maintenance.

Risk for release of radioactivity from spent fuel.

Accidents with spent nuclear fuel can not be excluded. A fire in a submarine or in a nuclear spent fuel storage, on land or onboard a ship, is obvious a real risk. An accidental nuclear chain reaction, a criticality accident is a possibility. Such accidents have occured during handling spent nuclear fuel, both in USSR and in United States.

At the Kola Peninsula nuclear fuel storages in a ship can contain more than ten reactor cores, and a storage on land can contain larger quantities. Under these circumstanses, it seems realistic to base accidental release analysis on the assemption that at least volatile nuclides from spent fuel from one reactor core may be released. If we assume that half of the max core inventory of Cs-137 is released, this amounts to 5 000 TBq.
In the Chernobyl disaster, UNSCEAR 1988 reports a release of 30 000 TBq Cs-137.

Quite obvious a release of 5 000 TBq Cs-137 may cause a serious contamination in the immediate vicinity of the accident. Preliminary studies indicate that also in Norway, more than 50 km from the spent fuel storage at the Litsa Fjord, it could be heavy contamination of raindeer meet, mutton and fresh water fish after such release.

Norwegian authorities are also concerned for long term leakage of radioactivity from nuclear spent fuel at the Kola Peninsula. However, this is more due to possible influence to fish export than immediate radiological effects to people. The seven dumped ship reactors with fuel at Novaya Zemlya cause similar concerns both with respect to accidental and long term release.

Conclusions.

- Spent nuclear ship reactor fuel in interim storage at the Kola Peninsula amounts to 200 reactor cores.
- The total inventory of Cs-137 alone is estimated to 600 000 TBq.
- Accidental release to air caused by criticality or core melt is considered a real radiological hazard by Norwegian radiation protection and nuclear safety authorities.
- A worst case release may amount to more than 5 000 TBq Cs-137, a quantity which under unfavourable conditions might cause serious contamination locally and even across the border to Norway, which is 50 km from the 100 reactor cores stored at the Litsa Fjord.