GREENPEACE Briefing

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KURSK NUCLEAR SUBMARINE ACCIDENT IN THE BARENTS SEA: POSSIBLE ENVIRONMENTAL IMPACTS

Greenpeace is opposed to nuclear submarines because of the threats that the technology poses to human health, the environment and for nuclear proliferation. Greenpeace has consistently called on Russia, the US, the UK, China and France to stop the research, development, construction and use of nuclear powered submarines and nuclear surface vessels immediately.

Potential environmental impacts if there were a radioactive leak from the Kursk into the Barents Sea

Given the lack of information at the present time, Greenpeace cannot say with any degree of accuracy what the potential environmental impacts of the Russian submarine accident will be. If the two nuclear reactors on board the Kursk release radioactivity into the marine environment there will undoubtedly be an impact because there is no safe level of radioactivity. It is, however, impossible to make any exact predictions because there are so many variables, such as when, in what manner and in what quantity radioactivity is released and the form in which it is released. Other considerations include what the currents are doing and how the circumpolar currents could move radioactivity around the arctic and possibly further afield. The Barents Sea accounts for a substantial proportion of the total biological production in the Arctic Region and is one of five of the most important fishing grounds in the world. For example, it is the main source for cod.

What does Greenpeace think should happen to the submarine?

Clearly, the international community must work with the Russian government in order to take all possible steps to prevent any discharge of radioactive material into the marine environment. The primary objective must be to fully assess whether or not the Kursk and its nuclear reactors can be retrieved from the seabed stored where they can be properly managed and monitored on land. Surveys may show that the structural integrity of the submarine or its reactor compartments is so badly damaged this option is not possible. If it transpires that it would be environmentally unsafe to move the Kursk then some form of containment or encasement must occur to ensure the submarines nuclear materials are contained as far as possible. To do nothing is not an option.

The Marine Environment of the Barents Sea

The Barents Sea is a shallow sea with an average depth of 230 m. With an area of 1,4 million km2, the Barents Sea represents only about 7% of the total areas of the Arctic ocean, but accounts for a substantial proportion of total biological production in the Arctic Region. As much as 75% of the surface can be covered by ice during winter and spring. Annual variations in both sea temperature and ice cover are, however, considerable.

The inflow of warm and nutrient rich Atlantic water to the Barents Sea is an essential factor influencing the conditions for biological production in the area. The Barents Sea is, however, characterised by large fluctuations in the inflow as well as large seasonal and inter-annual variability in the ice cover. Overall, current flows in the region are complex, though predominant flow is from the west in the Southern Barents and from the North and Northeast in the Northern Barents.

The Barents Sea ecosystem naturally supports some of the world's richest stocks of fish such as cod, haddock, capelin and Norwegian spawning herring. In addition to the direct harvest of the area, the Barents Sea is important as feeding grounds for fish populations harvested further south on the Norwegian shelf. Fish-eggs and larvae are transported via the Norwegian Coastal Current into the Barents Sea, where the fish fry may have the benefit of abundant food.

The annual catches of fish from the Barents Sea have, during the last forty years, been in the order of 1.5 – 3.5 million tonnes, with catches at the lower end of this range in the last decade resulting from stock depletion and, in some cases, consequent closure of fisheries. There have been considerable variations in catches over the years due to both overfishing and changing environmental conditions. Data from 1994 indicate that cod, herring and haddock still account for the bulk of total catches.

For Norway and Russia the fisheries in the Barents Sea are of great importance, not only because the harvest is considerable in magnitude, but because the Barents Sea fisheries are, especially for Norway, the basis for the coastal settlements of the area. Most of the fish caught in the Barents Sea is exported to a third country. Fish from the Barents Sea is popular on the international market as it is still relatively less contaminated than fish from other areas, such as the North Sea.

Worst Case Accident Scenario

Regardless of what caused the accident onboard the Kursk it is now clear that:

- the submarine hull is breached at the bow;

- one or more compartments are flooded up to, and perhaps including, the submarine’s conning tower;
- there is little or no electrical supplies, and that;
- the submarine is on the seabed lying at an estimated sixty-degree angle.

Even though the two 190 megawatt pressurised water reactors have been shut down, the reactor fuel rods will remain hot for some considerable amount of time. How long will depend upon how long the reactors were in operation prior to the accident occurring. Like the element in a kettle, after the water boils, the kettle shuts off but the element inside takes time to cool down. Therefore the estimated one and a half tonnes of highly enriched uranium fuel in each of the reactors will require continuous cooling to dissipate the naturally occurring radioactive decay heat.

If this does not occur the coolant inside the reactor will dry out, the fuel will start to break down and eventually melt. This could lead to the fuel burning a hole in the reactor containment vessel leading to a release to the marine environment.

There are several emergency cooling systems believed to be onboard the Kursk. The first reacts when there is a build up of pressure in the reactor - vents remove the steam through a tank of water sitting next door, the steam is turned back into water, which is then vented back into the reactor. The second requires electricity, which drive pumps to transfer water from reserve tanks into the reactor - electricity that the Kursk does not have. Another works through natural convection. There is also an emergency reactor flooding mechanism.

John Large, the nuclear engineer commissioned by Greenpeace, questions whether any of the above did function or are currently functioning adequately to provide sufficient coolant to stop a fuel core meltdown occurring because of the suddenness of the accident and the angle at which the vessel is currently sitting.

John Large has identified one study of a flooded reactor tilted on its side to an 80-degree angle, which took less than 20 days for sixty percent of the reactor core to melt. The Greenpeace consulting engineer also speculates that steam building up from the water as the hot fuel heats it could be being automatically dumped to the sea as the pressure increases and an automatic pressure relief safety valve kicks in. This could be occurring intermittently, a bit like a pressure cooker, but this valve does provide a direct pathway to the marine environment of particulates of radioactive material from the reactor fuel. Steam venting to the marine environment will also increase the risk of a fuel meltdown.

As previously mentioned, if none of these reactor coolant systems are functioning properly and if venting is occurring, the reactors will eventually boil themselves dry, the remaining steam will superheat and the submarine fuel will breakdown and melt.

Slow Leak Scenario

If the reactor is not currently leaking and the worst case scenario is avoided, this does not mean there will be no environmental impact. As the submarine rusts over many years, radioactivity will be slowly into the environment. This radioactivity will spread through ocean currents and build up in the food chain. In this scenario, there are still likely to be cancers and other adverse health effects caused by the leaking radiation but it will be future generations that are affected.

Conclusion

The international community must work with the Russian Government in order to take all possible steps to prevent any discharge of radioactive material to the marine environment. There are three basic options: complete or partial recovery of the vessel or in situ management of the sunken submarine. Which of these options is the most appropriate depends on the state of the submarine and of the reactors and the technical feasibility of the intervention. It is essential that a detailed assessment of the current state of the vessel be made at the earliest opportunity in order to determine the best course of action and that this conducted in as open a manner as possible.

A failure to act at all would mean that it would become simply a matter of WHEN not IF the submarines radioactive materials (and other toxic substances on board) would be released to the marine environment. Therefore, from an environmental point of view, the most urgent priority is to prevent or minimise the release of radioactive materials.

For further information contact:
William Peden, Greenpeace Disarmament campaigner in Washington + 44 7801 212 992 or +1 202 285 9130
Tobias Muenchmeyer, Greenpeace Nuclear Campaigner + 49 30 440 589 60

RADIOACTIVE WASTE IN THE BARENTS SEA

The Soviet nuclear submarine program, started by Josef Stalin in 1952, has turned Russia's North into an environmental disaster zone:

Dumped nuclear reactors:

Between 1965 and 1988 17 nuclear reactors have been dumped into the Kara Sea, the total radioactive inventory was at the time of dumping 37 PBq.

Dumped nuclear waste:

More than 11,000 m3 of solid radioactive waste and 16,000 tonnes of low-level liquid radioactive waste have also been dumped in the Barents- and Kara Seas.

Improperly stored wastes:

The Kola peninsula stores more nuclear wastes than all the western waste repositories put together. All in all, more than 45,000 spent nuclear fuel elements are stored in the region, in temporary on-shore storage tanks, on board run-down service vessels and in the reactors on decommissioned submarines.

Currently there is approximately 8.000 m^3 of solid nuclear waste of low to medium activity in storage at Northern Fleet bases and yards. Total activity for the waste is about 37 TBq (1000 Curies). It is stored at 11 different places along the coast of the Kola Peninsula. All of the facilities are full, and at a number of them, solid radioactive waste is also stored outside of storage buildings in the open without any kind of protection.

Liquid radioactive waste is stored at almost all of the naval bases, either in land-based tanks, or on board service ships or floating tankers. Most of the storage tanks for liquid radioactive waste are full, and a number of them are in very poor condition.

Rusting decommissioned submarines:

According to US and Russian nuclear arms reduction treaties, over 120 nuclear powered submarines should be scrapped by 2007, but instead of 10 per year needed to meet this target date the Russians are currently dismantling half that. Because of this delay the number of nuclear submarines of the Northern Fleet waiting to be dismantled has grown steadily to 90 and will continue to rise. These submarines have been laid up at 10 different shipyards on the Kola Peninsula. The 52 submarines that have not yet been defueled represent the greatest safety risk. The submarines are not stored in dry docks, and are in very poor condition. They must be kept afloat by constantly pumping compressed air into the hulls. This helps to minimise the risk of spontaneous chain reactions in the nuclear fuel through contact with seawater. Nevertheless, there remains a significant risk of leaks of radioactivity should the submarine sink. The reactors of vessels that have not been defueled must be cooled continuously by circulating coolant through the primary circuit from a land-based electrical power source. A breakdown in either of these two safety systems could lead to a serious nuclear reactor accident

Accidents

From 1961 until present, a number of accidents involving nuclear submarines of the Northern Fleet have occurred. Most of these happened whilst the submarines were on patrol, although some occurred during refuelling or repair operations. Prior to the Kursk three Northern Fleet nuclear submarines have sunk. Loss of coolant accidents have occurred on 10 boats, and four serious fires leading to loss of human life have also occurred on Russian submarines.