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Joint Norwegian–Russian expedition to investigate the sunken nuclear submarine K-159 in the Barents Sea

Of all the dumped and sunken objects containing nuclear waste in arctic waters, the sunken nuclear submarine K-159 in the Barents Sea represents the single largest potential source of radioactive contamination. This autumn, Norwegian and Russian scientists joined forces to assess the current status of the submarine.

THROUGH THE NORWEGIAN-RUSSIAN expert group for investigation of Radioactive Contamination in the Northern Areas, a joint Norwegian-Russian expedition to the Barents Sea was carried out in the autumn of 2014 to investigate the sunken nuclear submarine K-159. The purpose of the mission was to obtain up-to-date information about the physical condition of the wreck and investigate the levels of radioactive pollution in the surrounding marine environment. The last joint international expedition to the site of K-159 took place in 2007.

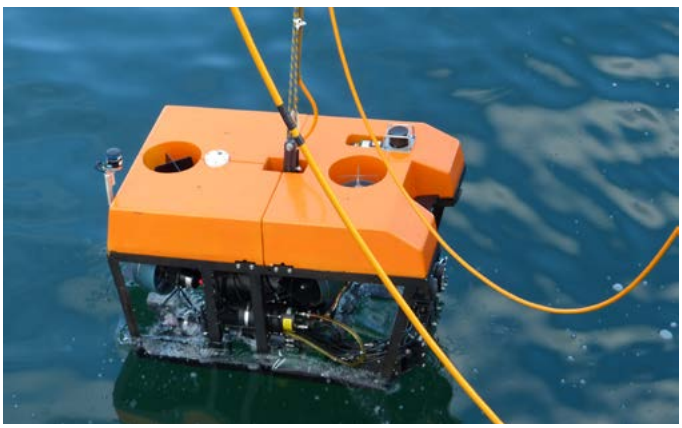
On the 30th of August 2003, the decommissioned nuclear submarine K-159 foundered and sank in heavy seas whilst under tow northwest of Kildin Island in the Barents Sea. K-159 was a November class attack submarine and belonged to the former Soviet Union's first generation of nuclear submarines. K-159 was being towed with the aid of flotation pontoons from a base in northwestern Russia to a shipyard for final dismantling. The loss of one or more of the flotation pontoons was determined to be the cause of the eventual sinking. Nine members of the towing crew were lost with the submarine.

K-159's two 70 MWt nuclear reactors had been shut down since 1989 but still contained around 800 kg of spent nuclear fuel. It has been estimated that the reactors on board K-159 contained a total radioactive inventory of some 7.4 PBq at the time of sinking. K-159 lies at a depth of 246 m in the Barents Sea in Russian territorial waters near important fishing grounds and at a distance of less than 130 km from the Norwegian border.

A previous modelling study by the Institute of Marine Research had showed that a pulse discharge of the entire Caesium-137 inventory from K-159 could result in increases of activity concentrations in muscle of cod in the eastern part of the Barents Sea up to 100 times

The author collecting water samples from around the sunken nuclear submarine K-159 for subsequent analysis of radionuclides.

Photo: NRPA

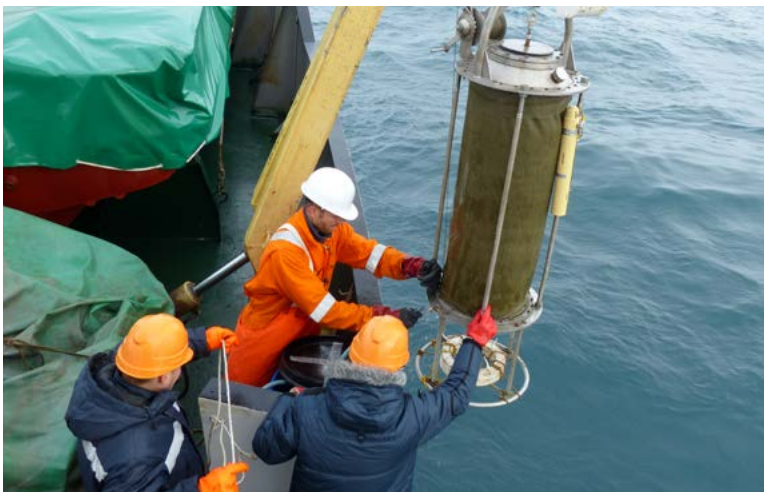


Deployment of the ROV used to investigate the status of the sunken nuclear submarine K-159.

Photo: NRPA

The Norwegian participants on the expedition (left to right) Hans Christian Teien (Norwegian University of Life Sciences–Centre for Environmental Radioactivity), Hilde Elise Heldal (Institute of Marine Research) and Justin Gwynn (Norwegian Radiation Protection Authority).

Photo NRPA



Norwegian and Russian scientists collecting bottom water samples from around the sunken nuclear submarine K-159. *Photo: NRPA*

Underwater photo of the conning tower of the sunken nuclear submarine K159. *Photo: NRPA*

current levels for approximately two years after the discharge. However, even in such a scenario the resulting activity concentrations in fish would likely be below national guidelines. Despite this, any radioactive leakage from the reactors of K-159 may have important economic consequences for Norwegian and Russian fisheries in the northern areas due to the general public's heightened sense of concern with regard to radioactive pollution.

The expedition lasted for three weeks and was carried out on the Russian research vessel *Ivan Petrov*. From Norway, there were participants from the Norwegian Radiation Protection Authority, the Institute of Marine Research and the University of Life Sciences. From Russia, there were participants from the Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet), the Kurchatov Institute and the Yuzhmorgeologiya research centre. The International Atomic Energy Agency (IAEA) was also represented on the expedition.

The expedition carried out video surveillance of K-159 with a remotely operated submersible (ROV) and conducted in situ radiation measurements at critical locations around the submarine such as above the reactor compartment. The ROV recovered sediment samples close to the bow, stern and on either side of the reactor compartment. Seawater, sediment and biota were also collected in the area around K-159; these will be analysed to determine the exact radiological status of the marine environment.

Video pictures showed that K-159 is lying upright on the seabed with the deck of the submarine covered in a layer of sediment. Several different fish species and other biota were observed around the submarine. The inspection of the outer hull showed a number of missing hatches and some damage to the deck and stern. The measurements conducted during the expedition showed that radiation levels around K-159 were low and typical for the Barents Sea. A similar picture for the radiological situation around K-159 was observed in 2007. Based on the results obtained so far, the conclusion of the Norwegian-Russian expedition is that no leakage has occurred from the reactors of the submarine to the marine environment.

"It's reassuring that the preliminary results show that there has been no leakage from this submarine. It will now be important to study the information collected from this expedition and discuss any plans for future action," said Per Strand, director of the Department for Nuclear Safety, Emergency Preparedness and Environmental Radioactivity at the Norwegian Radiation Protection Authority.

Russia and Norway will now cooperate on further detailed laboratory analyses of the collected samples and on drawing conclusions from this additional work. A final report based on the findings of the 2014 joint Norwegian-Russian expedition will be published by the end of 2015.