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The radiological risk related to new nuclear propulsion systems resulting in challenges to monitoring systems

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The nuclear propulsion in application for space probes is developing constantly during last sixty years. At the beginning of those times the world superpowers were working also on nuclear jet propulsion for airplanes, where the heat from combustion of chemical fuel was substituted by the heat generated by nuclear reactors. Since the risk related with crash of airplane having nuclear reactor onboard was found too high those works were stopped in early sixties of XX Century together with atmospheric nuclear ban treaty. However, in March 2018 president of Russia Federation made a public announcement about successful test of nuclear jet propulsion applied to the unmanned cruise class missile. The lack of pilot removes the necessity of biological shielding and reduces the weight of the machine. A bit later, in August 2019 a mysterious radiation accident apparently related to nuclear propulsion happened in the Nyonoksa Bay killing seven person. All technical details remains disclosed, moreover, no evidence for nuclides released in this accident exists in open literature. Earlier, in October 2017, in air over vast European locations the traces of Ru-106 was found. Despite many efforts undertaken by researchers worldwide it remains unclear what was the site of release and its circumstances. The only sure fact is that the release point was in Russia. The temporary adopted explanation on release from Mayak is doubtful, since there was no high Ru-106 found on site. It can be noticed, that Ru-106 is a useful nuclide for heat generation due to high energy emitted in beta decay ($E_{max}=3.6$ MeV) of his short lived daughter Rh-106. On the other hand the practical usefulness is limited due to one year half time of Ru-106. Very similar energetic properties can be found in the system of Ar-42 decaying to K-42. This was proposed (but still not confirmed) as the possible nuclide system related to Nyonoksa accident [1]. Traces of those nuclides are very difficult to detect in remote sites. The another possible use of nuclear energy in propulsion of modern flying objects is the replacement of the classical chemical batteries used in so called "kamikaze drones" by the Radio-Thermo Generators (RTG). The advantage of such replacement is in invincible extension of range of such weapon. During attack the RTG battery will be destroyed causing local high radioactive contamination. The contemporary existing monitoring systems in many countries, based mostly on scenario of Chernobyl or Fukushima accidents or nuclear bomb fallout are blind for many variants of possible radioactive releases of nuclides suitable for RTG like Sr-90, Pu-238 and especially the Ar-42/K-42 system. All this suggests that currently the strategies related to monitoring of radioactivity in air should be revised and adopted to new threads [1].

Reference:

1. J.W. Mietelski & P. Povinec, Journal of Environmental Radioactivity vol. 214-215 (2020) p. 106151

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