RADIONUCLIDE BACKGROUND ACTIVITY CONCENTRATIONS IN EASTERN LITHUANIA – PREPAREDNESS STUDY'S EXCERPTS TO ASSESS THE START OF A NEW NUCLEAR POWER PLANT

Arūnas Gudelis, Lina Gaigalaitė, Gintautas Kandrotas

Department of Metrology, Center for Physical Sciences and Technology
e-mail: arunas.gudelis@ftmc.lt

Two units of the water-water power reactor (WWER), which is a series of pressurized water reactor (PWR) designs developed in Russia, are currently planned at the Astravets site in Belarus (Fig. 1). They are the III generation VVER-1200 type reactors (AES-2006 model). Fuel loading for the first unit started on 7 August 2020, and Unit 1 achieved the first criticality on 11 October 2020. The reactor started supplying electricity on 3 November 2020, and it was officially connected to the grid on 7 November 2020. It is also possible that two additional reactors will be built by 2025. The estimation of a tritium (^{3}H) amount per year produced by a single VVER-1200 reactor gives around 6.7×10^5 GBq [1]. The Neris River (510 km long, 228 km in Lithuanian territory) hydrographically belongs to the Neris drainage subbasin, and it is the second largest river in Lithuania. The water of this river may be used for technological needs (the primary coolant and secondary cooling of the reactor core) of the Astravets NPP. The Neris River comes from Belarus and flows through Vilnius – the capital city of Lithuania located 45 km from the Astravets NPP site. Eventually, it connects the Nemunas River – the largest river in the country, which then flows westward across Lithuania and into the Curonian Lagoon that is connected to the Baltic Sea. As the primary coolant contains high concentrations of tritium this radionuclide is a suitable radioisotopic tracer for both the leak detection and an impact on environment studies. The environmental tritium concentrations in surface waters in the Northern hemisphere may vary from 1 Bq L^{-1} to 9 Bq L^{-1}, thus they can be measured by the direct method with an ultra low-level liquid scintillation counting spectrometer. To assess the background activity of tritium in the Neris River in a prestarting period of a new nuclear power plant at the Astravets site the measurement campaign was organized in 2018 – 2020. The main research area in Eastern Lithuania is shown in Fig. 1. Here, we can also see two sites where aerosol samples from the near-ground level atmosphere are collected in Vilnius and Vosyliškės. The mean tritium activity concentration value of 1.5 Bq·L^{-1} shows no current influence of any technogenic nuclear activity. However, after the start of a new nuclear power plant the higher tritium activity levels might be anticipated in the future. The radionuclide activity measurements are traceable to the national standard that is maintained by the Center for Physical Sciences and Technology (FTMC) – that is the Lithuanian National metrology institute [2]. The main objective of this work is to demonstrate the preparedness to make assessments of the radiological impact of the Astravets NPP on the environment in the future. In this regard, the more comprehensive radiological research programme should be expanded by adding at least the determination of the gamma-ray emitting radionuclide content in the ground-level air, the total beta-activity measurements in the river water and the research into biota, fallout, and soil.

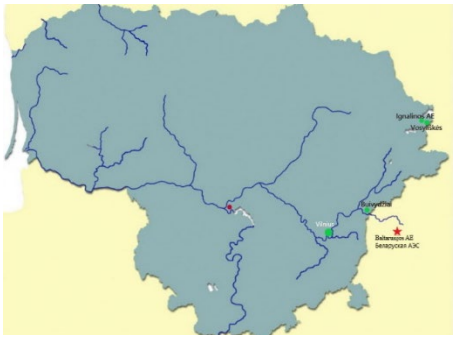

Fig. 1. The main research points in Eastern Lithuania. A red star depicts the Astravets NPP location.

References

1. International Atomic Energy Agency (2004) Management of waste containing tritium and carbon-14. IAEA Technical Reports Series No. 421.
2. A. Gudelis, L. Gaigalaitė, I. Gorina, P. Butkus, ICRM technical series on radionuclide metrology. https://physics.nist.gov/ICRM/ICRM_technicalseries_1.pdf (2017).