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Enhancing CTBT verification through a global radioxenon emission inventory for nuclear power plants

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For the verification of the Comprehensive Nuclear-Test-Ban Treaty, atmospheric concentrations of noble gases, and of radioxenon isotopes in particular, are continuously monitored. At the corresponding monitoring stations, the civil background of the four isotopes Xe-135, Xe-133m, Xe-133 and Xe-131m is inevitably sensed along with possible evidence of treaty violations. One class of these civil emitters are nuclear power plant (NPP) reactors.

To facilitate the interpretation of observed atmospheric concentrations, generic annual radioxenon emission strengths for all operable NPPs were estimated in this project. The compiled inventory is based on 4637 quarterly and annual emission reports for North American and European NPPs issued between 1995 and 2005. Generic annual source terms were calculated for each site and used in turn to estimate the average releases of NPPs for which no effluent data are available. According to this inventory, a total of 1.3 PBq of radioxenon isotopes are released per annum as continuous or pulsed emissions by all 439 operable NPP reactors. However, regional differences in the release behavior are observable. Some reports allowed for further characterizing pulsed releases and for extracting typical ratios between different effluent modes or different isotopes. Effects of alternative averaging processes are discussed as well as correlations to observational studies and the significance of medical isotope production facilities for the inventory.