DEVELOPMENT OF DOSE ASSESSMENT CODE FOR RELEASES OF TRITIUM DURING NORMAL OPERATION OF NUCLEAR POWER PLANTS

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Abstract: A computer code PTM_HTO has been developed to assess tritium doses to the general public. The code enables to simulate the behaviour of tritium in the environment released into the atmosphere under normal operation of nuclear power plants. Code can calculate the doses for the two chemical forms: tritium gas (HT) and tritiated water (HTO). The models in this code consist of the tritium transfer model including oxidation of HT to HTO and reemission of HTO from soil to the atmosphere, and the dose calculation model.

The code enables to model the diffusion of tritium releases from wet cooling towers and ventilation stacks. Cooling towers are emitting water drops with HTO content and tritiated water vapour. Experimentally acquired data from Czech and Slovak cooling towers regarding drop size distribution were used for calculation of drops terminal speed. Ventilation stacks release tritiated water and gas. There is permanent lack of information about ratio HTO/HT for releases from ventilation stack, therefore releases of HT was modelled using the Monte Carlo and uncertainty analyses methods.

Releases from cooling towers and ventilation stacks are modelled as 1-hour puffs. Vertical diffusion of puffs is modelled using the numerical solution of partial differential equation. Trajectories of puffs and drops, dry and wet deposition of HT and HTO and oxidation of HT to HTO are modelled as well. Reemission of HTO from soil to atmosphere is simulated using the Lagrange trajectory model for diffusion of gases from area sources.

Uncertainty and sensitivity analyses enabled to estimate the influence on the accuracy of concentration and dose calculation of such uncertainty parameters as meteorological input data, reemission rate, oxidation rate, dry deposition velocity, etc.

The results of concentrations and individual equivalent doses calculations:
- confirmed the importance of modelling of HTO reemission from soil to atmosphere,
- confirmed the urgent need of modelling of both types of chemical forms of tritium,
- confirmed the need of acquisition of value for release rate of HTO/HT from ventilation stacks, and
- enabled to estimate the workers doses from drift of water drops from cooling towers.