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Prediction of irradiation doses for population under implementation of Russian Federal Program: "Development of Russian atomic energy industrial complex (ARFP) on 2007-2020 years".

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Today in the whole world the intense growth of electric energy at nuclear power plants (NPP) is observed According to IAEA prediction to 2030 year its generation will be about 700 Gig watt. NPP production results to generation of radionuclide's gas-aerosol atmospheric discharges (RGAD) and liquid radioactive discharges (LRD) into NPP surface heat sinks with the additional pollution of environment. It is necessary to provide the exclusive safety measures, in particularly provide the levels of irradiation doses for population (PID) will be not exceeded the 10 Micro Sievert. 17 new atomic power units on the base of will be put in exploration at 7 homeland now operated NPP. Motivation this work is the PID and risk assessments. We have collected and analyzed RGAD and LRD for all 10 Russian NPP during 1995 -2007. The observed stable annual tendency of RGAD and LRD decreasing has created the well ground scientific base for prediction of their levels of each NPP according to our own special developed methodology. Then these levels will be used for PID calculations on the special certified model "Kassandra" and "Nostradamus' information-simulation systems, developed in our Nuclear Safety Institute for assessment of irradiation dose of human organism through all possible ways and chains: water, breath, food (meat, milk, fish, vegetables, fruits) and others under the response of the following varied natural climate temporal space random factors: wind, its velocity and directions, snow, rains, temperature and humanity, really registered at each NPP region. For most critical population group "fishers" we used such assumptions and predictions that PID obtained assessments were the maximum (conservative) ones. The stochastic compartmental "Kassandra" [1] is successfully used for radionuclide's transport and assessment of their concentrations in water, bottom sediments and flood plains of rivers and heat sinks, connected with real NPP. System of the special diffusion equations describing the transfer have been resolved for concrete conditions. Simulation of radionuclide's migration was used with taking into account of mass their exchange between main stream and underflow for river contamination model under the persistent radioactive discharges during long time. The integral computer NOSTRADAMUS system was developed for the effective forecasts of radioactive situation with atmospheric radionuclide's emission and it is based on 3-D Lagrangian trajectory stochastic (Monte-Carlo) model [2]. The impurity plume (or cloud) is presented as large amount of test particles. Every particle moves according to wind velocity and undergoes to random displacement that simulates turbulent scattering. A certain activity is assigned to every particle so that total activity of all particles is equal to activity released from the source. Impurity volume concentration is associated with particles concentration (number of particles in certain control volume divided by this volume). Results of PID assessment is presented in Table 1.

Table 1. ***Predicted of irradiation doses for population in zone of Russian reconstructed NPP observation***

Nuclear power plant (NPP)	Effective dose of irradiation for water consumption, Micro Sievert	Effective dose of irradiation for water consumption, Micro Sievert	Effective dose for all possible ways of irradiation, Micro Sievert
Kursk NPP	6,69	0.19	6.86
Kola NPP	7,8	0.014	7.814
Kalinin NPP	3,4	0.012	3.412
Volgodonsk NPP	3,99	0.0026	3.9926
Leningrad NPP	0,62	0.24	0.86
Novovoronezh NPP	0,828	0.023	0.851
Smolensk NPP	5,14	0.1	5.24

These PID values provide the permitted risk level lees than 10^{-6} in year. Our proposed method and methodology have the universal character and may be used for decision of some thematic problem of atomic energy.

1.A. Krylov et. al. “Importance of the process of mass-exchange between main stream of a river and underflow for modelling of concentration of radioactive substances in river water and bed sediments.” in Proc. Fourth Intern. Conf. –River Basin Management, 21-23 May 2007,Kos Island, Greece,v. IV, pp. 493-504. WIT press.
2. R.V.Arutunjan, V.N.Semenov et.al. “Computer System "NOSTRADAMUS" for Decision-Making Support at Emergency Discharges at Radiation Hazardous Objects.” Applied Energy: Russian Journal of Fuel, Power and Heat Systems, 1995, V.33, N4, pp.14-21.