Comprehensive Research Monitoring of Environment and Public Health in Regions of the Russian NPP

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INTRODUCTION

The analysis of medical effects of the Chernobyl accident has obviously demonstrated the high importance of the establishing so-called “zero” baseline of the population health. Such information is necessary to evaluate possible medical effects of many year operation of atomic facilities and to clarify the scale of the health impact. Such assessments require vast comprehensive hygienic studies within the long period of time. Thus, the necessity to organize the rigorous social hygienic monitoring in the NPP vicinity is occurred, which is the system of state surveillance, analysis, assessment, and prognosis of the population health and habituated environment as well as the correlation of the population health versus the habituated environment factor exposure.

MATERIALS AND METHODS

Research social hygienic monitoring in NPP locations includes environmental radiation-hygienic monitoring and monitoring of the public health. The main stages of social hygienic monitoring in the NPP vicinity are as follows:

- Conducting of background “zero” examination of public health and radiation hygienic situation before the NPP start-up;
- Dynamic monitoring of important parameters of public health and hygienic parameters (including radiation factor) during the whole NPP operation period;
- Comparison of observed changes of public health and environment against “background” values;
- Observation of changes of public health within 5-10 years after decommissioning NPP or reactor units.

The scientific sound selection of radiation characteristics of the habitat conditions and criteria of the public health assessment has principal importance during research monitoring. In order to evaluate the environmental radioactivity (in the reference points of the NPP surveillance area and in the comparison area), the specialized rules are elaborated. These rules include the types of environmental media, scope and periodicity of sampling, methodological and technical requirements, etc.

Two approaches are used for population health assessment: epidemiological approach based upon the health evaluation via medical statistics data and cohort clinical approach to include health assessments via detailed examination of critical population groups and critical body systems. Medical demography characteristics are based upon indices of the birth rate, general malignant neoplasm mortality, infant and childhood mortality. Morbidity is used as quantitative and qualitative index of the population health to assess the dissemination and structure of major diseases in the population of the NPP vicinity. To evaluate health status, medical statistics data are applied and dynamic indices within many years are analyzed.
RESULTS AND CONCLUSIONS

During last decade, SRC-Institute of Biophysics has performed investigations at some Russian NPPs, when two tasks were solved as follows: the collection of baseline health and environment assessment and the comparison to the control.

Environmental monitoring

During radiation environmental examinations the following tasks found their solutions:
- Sufficient and valid dynamic information accessing on controlled environmental radiation parameters, radionuclide composition of local foods and water. Disclosing current changes of radiation parameters.
- External and internal public dose assessment due to all radiation sources, specifying NPP contribution.
- Providing the information for local authorities and public on radiation situation in the supervised territory.

The environmental radiation situation in NPP surveillance areas is generally satisfactory and stable. It is characterized by following basic parameters:
- Background dose rate of gamma radiation is within the limits of fluctuations for similar territories, making from 8 till 15 µR·h⁻¹;
- Specific activity of ⁹⁰Sr in water of open basins varies from 0.005 up to 0.04 Bq·l⁻¹, the specific activity of ¹³⁷Cs – from 0.002 up to 0.02 Bq·l⁻¹ within the limits of changes for radionuclide content in ponds of Russian central region;
- Content of ⁹⁰Sr and ¹³⁷Cs in drinking water is less than 0.03 - 0.04 Bq·l⁻¹, that is much less than intervention level. The level of summary α- and β- activity also is less than permissible levels established by the hygiene standards;
- Content of ⁹⁰Sr and ¹³⁷Cs in foodstuffs is in 100 - 1000 times lower in comparison with permissible levels; content of ⁹⁰Sr and ¹³⁷Cs in foodstuffs and drinking water is same, as well as in similar foodstuffs received from other regions of Russia.

The individual population risk due to all radiation sources is 2.5·10⁻⁴ - 3.1·10⁻⁴ cases/year. The individual risk related to the NPP operation is 0.4·10⁻¹² - 3.2·10⁻⁸ cases/year. That is, NPP-induced risk is hundreds and even millions times lower than unconditionally acceptable risk – 1·10⁻⁶.

Monitoring of the public health

Assessment of background health state in NPP regions and in comparison areas was made using the state medical statistic data over more than decade. All population morbidity rate averaged for many years was not confidently exceed averaged statistical nationwide indices.

The child organism at growth and development phase is specific to the peculiar sensitivity, so the children under the radiation risk compose the population critical group. In the framework of the elaborated children health monitoring, statistical data on pediatric assistance are used as well as the detailed clinical examination results in some groups of children together with functional techniques of pre-nosological diagnosis.

The baseline data on leukemia and thyroid morbidity are essential for the comprehensive assessment of NPP vicinity resident health to use these data as the reference for the following radiation exposure effects. Thyroid examinations presume endocrinologist evaluation and ultrasound imaging to obtain sizes and echo structure as well as the iodine deficiency assessment via urinalysis. Inherited developmental defects are radiation exposure markers used in radiobiology and the inherited pathology is considered to be the radiation effects in
human health as same as the oncological morbidity. The rate and structure of the inherited developmental defects of any kind should be analyzed.

The children morbidity rate in NPPs vicinity averaged for many years had not differed from averaged values in Russian Federation and in the comparison areas. Negative dynamics was not found within the researching period of time. The morbidity structure was dominated by diseases of pulmonary, digestive and nervous systems, which corresponds to the general population assessments. The pregnant women morbidity, the newborn morbidity, still birth rate, the rates of early neonatal mortality and inherited developmental defects were not exceed average nationwide indices and indices in comparison areas.

Special attention was paid to the frequency and dynamics of malignant neoplasm inducing. Specification of any pathology levels in the population appeared to be insufficient during health monitoring. In many cases, factors to be scrutinized, which could affect the registered morbidity increasing or reduction, including health protection state (preventive measure inefficiency, poor quality of medical care, impertinence, availability of every description specialists).

The challenge of the public radiation protection under conditions of the national Renaissance of the Russian nuclear power complex results in an urgent performance of the special comprehensive research monitoring in the regions of NPP. The methodology, approaches and evaluation criteria proposed permit not only to assess radiation situation, "background" environmental conditions and public health objectively, but also to control dynamic changes, i.e., to perform monitoring during the NPP operation and after commissioning of its new units. The obtained information is necessary for comprehensive assessment (social, medical etc.) and definition of possible impacts of many-year nuclear facilities operation on the environment and public health. The developed comprehensive investigation social hygienic monitoring in the NPP vicinity can be widespread to other radiation facilities in this country.