

## NIOSH Closeout Summary with Publications

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**Title:** Reconstruction of Doses for Chernobyl Liquidators  
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**Telephone:** (337) 273-8485  
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**Total Project Cost:** \$358,756  
**Program Area:** Exposure Assessment Methods  
**Key Words:** exposure, radiation, method development

### Final Report Abstract:

Case-control studies of leukaemia and non-Hodgkin lymphoma (NHL) and of thyroid cancer have been carried out, nested within the cohorts of Chernobyl liquidators, the persons who were involved in the clean-up of the Chernobyl accident in 1986 and 1987 in the area around the Chernobyl nuclear power plant, under a contract from the European Commission. The leukemia and NHL study included 70 cases and 304 matched controls, while the study of thyroid cancer included 73 cases and 309 matched controls.

The majority of liquidators in the studies were exposed predominantly to whole body radiation (from external sources and intake of  $^{137}\text{Cs}$ ), although substantial dose to the thyroid from iodine isotopes could be received by liquidators who worked in May-June 1986 and who resided in contaminated territories of Belarus.

The main objective of the current project was to develop, test and implement a detailed method for individual dose reconstruction for the subjects in these epidemiological studies. Two different approaches were considered and tested. The method adopted, RADRUE (Radiation Dose Estimation with Uncertainty Estimates), a variant of an analytical dose reconstruction method previously derived for professional radiation workers of the Chernobyl power plant, appears to work well. It is based on detailed time and motion studies, coupled with the use of very comprehensive databases of radiological data.

The development of this method has involved very extensive work to:

1. locate, collate and evaluate very large databases of gamma background measurements made by various organisations at different times on the industrial site and throughout the 30 and 70 km areas around the Chernobyl nuclear power plant;
2. bring together experts knowledgeable about working conditions in different groups of liquidators and formalise and compile their knowledge into an integrated database;
3. develop an integrated software program that allows the calculation of doses and associated uncertainties from a subject's work history;
4. carefully reconstruct itineraries of the study subjects using the information provided in the very detailed study questionnaires.

Extensive validation of the work has been carried out.

The contract also provided funds for the extension of the case-control study to further groups of liquidators in Baltic countries and Russia. This has allowed the evaluation of possible recall difficulties for a number of questions related to work as a liquidator, as the majority of Baltic liquidators had previously been included in a cohort study and had responded to a similar questionnaire. Data from this questionnaire was obtained. Overall, there was good agreement between the answers to the two questionnaires concerning dates and places of work and type of activity performed.

Doses and associated uncertainties were estimated for all of the subjects in the case-control study. Doses to the bone marrow range from close to 0 to over 1 Gy, with a median of 20 mGy. The average geometric standard deviation was of the order of 2. Doses to the bone marrow among Belarus liquidators tended to be much lower (8 mGy) than among Russia liquidators (55). Doses to the thyroid gland ranged from close to 0 to 2 Gy, with a median of about 70 mGy. The highest doses were found for Belarus liquidators who lived and worked in areas of high contamination and are related to ingestion of I-131. For Russian and Baltic country liquidators, doses from ingestion are thought to be close to zero. Doses from inhalation of I-131 were, however, received for liquidators who worked in the first weeks after the accident. In conclusion, this contract has permitted the development, testing and optimisation of a detailed analytic dose reconstruction method for the estimation of individual doses and related uncertainties for Chernobyl liquidators. The method has been successfully applied to the subjects included in case-control studies of leukaemia, NHL and thyroid cancer among Chernobyl liquidators from Belarus, Russia and Baltic countries. Analyses of these data are underway under a separate contract and results should be submitted for publication in late 2003.

The approach has implications for dose reconstruction in other situations, and may be adapted for populations of workers involved in clean-up of accidents in the future.

**Publications:**

No publications to date.