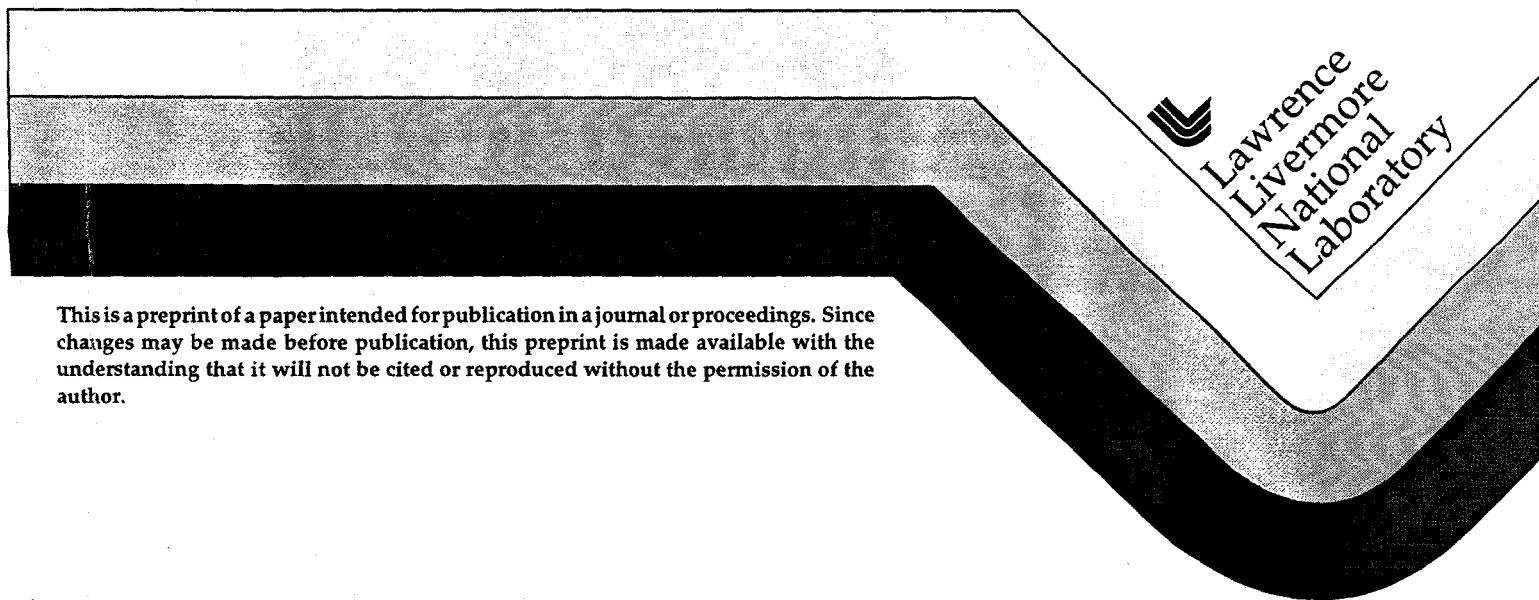# Reconstruction of Thyroid Doses for the Population of Belarus Following the Chernobyl Accident

Yuri I. Gavrilin, Valeri T. Khrouch, Victor F. Minenko,
Vladimir V. Drozdovich, Alexander V. Ulanovsky,
Sergei M. Shinkarev, Andre C. Bouville, Lynn R. Anspaugh and
Tore Straume

September 1995

Lawrence Livermore National Laboratory

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

Reconstruction of Thyroid Doses for the Population of

Belarus following the Chernobyl Accident*

Yuri I. Gavrilin,[a] Valeri T. Khrouch,[a] Victor F. Minenko,[b] Vladimir V. Drozdovich,[b]

Alexander V. Ulanovsky,[b] Sergei M. Shinkarev,[a] André C. Bouville,[c]

Lynn R. Anspaugh,[d,e] and Tore Straume[d]

Introduction

Following the large release of ^{131}I from the accident at the Chernobyl Nuclear Power Plant, an expected late effect is thyroid cancer, especially in children. In anticipation of this problem, hundreds of thousands of measurements of thyroid glands were made with survey meters. Much attention was also focused on measuring the deposition density of ^{137}Cs. The expectation was that the latter measurement could be a good surrogate for the deposition density of ^{131}I, so that ecological models could be used to reconstruct thyroid doses in locations where no direct measurements of thyroid activity were made. However, this assumption has been seriously questioned, and there is interest in a more suitable surrogate that can still be measured even nine years or more after the accident.

The purpose of this paper is threefold: to discuss the reconstruction of thyroid doses for a case-control study of childhood-thyroid cancer that has just been concluded, to discuss the reconstruction of thyroid doses for a current cohort study of childhood-thyroid cancer, and to discuss the use of ^{129}I as a surrogate for the deposition density of ^{131}I.

Dose reconstruction for a case-control study of childhood-thyroid cancer

A case-control study was planned in 1992 to include 119 cases of thyroid cancer among children under age 15 at the time of the accident and who were operated on by mid-August 1992. Two types of controls were selected for the study: Type I were drawn from the general population exposed to significant radioiodine fallout in Belarus. Controls were matched on the basis of age, sex, and urban/rural residence. Type II controls were chosen on the basis of diagnostic pathway and matched as for Type I controls. At the conclusion of the study, there were 107 cases, 104 Type I controls and 105 Type II controls. The results of the epidemiological analysis are discussed in a separate presentation at this Symposium.

Doses for all cases and controls were required to be assessed by a common method. This necessitated being "blinded" to information for 12 cases with direct measurements of thyroid. Calculations of dose were based upon a detailed analysis of the relationship between thyroid dose as calculated from direct measurements and the value of the deposition density of ^{137}Cs with a correction for the best estimate of the ratio of ^{131}I-to-^{137}Cs activity in the specific location at the time of most significant deposition.

Dose reconstruction for a cohort study of childhood-thyroid cancer

The ^{131}I content in the thyroids of more than 200,000 people in Belarus were measured in May–June 1986. It is planned to enroll approximately 15,000 children selected from those with direct thyroid measurements into the study cohort. Individual thyroid doses will be specified on the basis of results of direct thyroid

measurements, of information on the extent of radioactive contamination of the subjects' locations, and on knowledge of lifestyle habits. The latter will be gained from questionnaires.

Factors critical for success are an accurate calibration of the instruments used for the direct measurements and the development of an accurate model to translate such measurements into dose. In addition, major attention is being devoted to the calculation of the radiation doses due to (1) internal irradiation resulting from the intake of short-lived radioiodine isotopes and of ^{132}Te, (2) internal irradiation from the intake of long-lived ^{137}Cs, and (3) external irradiation from radionuclides deposited on the ground.

Reconstruction of ^{131}I-deposition density on the basis of measurements of ^{129}I

A general problem in the reconstruction of thyroid dose is to infer the deposition density of ^{131}I for those locations where residents were not measured for their thyroidal radioiodine content and where it is necessary to use a model of food-chain transport for dose reconstruction. Unfortunately, the deposition density of ^{137}Cs has not proven to be a reliable surrogate for the deposition density of ^{131}I.

In theory, a much better surrogate is the deposition density of ^{129}I, which is also produced in a fission reactor. We have designed and carried out a pilot study wherein soil samples were collected to a depth of 30 cm and then analyzed for their content of ^{129}I by the use of an accelerator mass spectrometer. The results of this pilot project will be presented.

[a]Institute of Biophsics, Ministry of Public Health and Medical Industry of the Russian Federation, Moscow, Russia

[b]Research Institute of Radiation Medicine, Ministry of Health, Minsk, Belarus

[c]Radiation Effects Branch, National Institutes of Health, Bethesda, Maryland

[d]Health and Ecological Assessment Division, Lawrence Livermore National Laboratory, Livermore, California

[e]Presenter