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NUCLEAR DIVISION



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February 12, 1981

**NRC Research and Technical  
Assistance Report**



Mr. Frank Swanberg, Jr.  
Chief, Branch of Health and  
Environmental Research  
Division of Safeguards, Fuel  
Cycle, and Environmental Research  
Nuclear Regulatory Commission  
Washington, D. C. 20555

Dear Frank:

Enclosed is the quarterly report for our project "Methods in  
Dosimetry for Nuclear Regulation," FIN/189 No. B0410.

If you have any questions or comments, please call me at  
FTS 624-6251.

Sincerely yours,

Keith F. Eckerman  
Health and Safety Research Division

KFE:bpw

Enclosure

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# NRC Research and Technical Assistance Report

## INTERIM REPORT QUARTERLY PROGRESS REPORT

ACCESSION NO. \_\_\_\_\_

ORNL/HASRD-111

Contract Program or Project Title: Methods in Dosimetry for Nuclear Regulation

Subject of this Document: Technical Progress

Type of Document: Quarterly Progress Report for October-December, 1980

Author(s), Affiliation and Address: K. F. Eckerman, S. R. Bernard, D. J. Crawford, and M. Cristy  
Health and Safety Research Division\*

Data of Document: February 9, 1981

NRC Individual and NRC Office or Division to Whom Inquiries Should be Addressed: Mr. Frank Swanberg, Jr.  
Chief, Branch of Health and Environmental Research  
Division of Safeguards, Fuel Cycle, and Environmental Research

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This document was prepared primarily for preliminary or internal use. It has not received full review and approval. Since there may be substantive changes, this document should not be considered final.

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Prepared for  
U.S. Nuclear Regulatory Commission  
Washington, D. C. 20555  
Under Interagency Agreement DOE #40-550-75  
NRC FIN No. B0410

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Oak Ridge, Tennessee 37830  
operated by  
Union Carbide Corporation  
for the  
Department of Energy



QUARTERLY PROGRESS REPORT

INTERIM REPORT **NRC Research and Technical Assistance Report**

QUARTERLY PROGRESS REPORT  
FOR OCTOBER-DECEMBER, 1980

METHODS IN DOSIMETRY FOR NUCLEAR REGULATION  
(FIN/189 No. B0410)

Health and Safety Research Division  
Oak Ridge National Laboratory



PRINCIPAL SCIENTISTS: S. R. Bernard, D. J. Crawford, and M. Cristy

OBJECTIVE:

To provide the NRC with additional methodologies and capabilities in dose and risk estimation for application to the general public in order to meet the particular needs of the Commission.

PROGRESS IN OCTOBER-DECEMBER, 1980:

Task 1: Test of Organ Cross-Irradiation

A draft of the report is undergoing internal review at ORNL. Further revision is expected as Task 3 proceeds. Additional information on this topic is being prepared from the extensive data computed during the course of computations for ICRP Publication 30.

Task 2: Design of Pediatric Phantoms

M. Cristy presented an invited paper entitled "Development of Mathematical Phantoms for Internal Dose Calculations: Design, Limitations, and Prospects" at the 3rd International Radiopharmaceutical Symposium held in Oak Ridge in October.

A paper entitled "Active Bone Marrow Distribution as a Function of Age in Humans," by M. Cristy has been accepted for publication in *Phys. Med. Biol.*

Task 3: Calculation of Photon Absorbed Fractions

Testing has been completed on the age-dependent Monte Carlo code with the exception of one item. The routine in the current code version for sampling the spatial location of a point in the total body has been written for sampling uniformly in the volume. As the lung and skeleton are not at the same density as other tissues, this routine has to be converted to mass sampling to achieve a uniform source in the total body. The new routine has been developed and will be "debugged" in January. Before production runs of the code are initiated we plan to revise the tissue composition and density data used in the code to that currently given in ICRP-23, Reference Man. A revision in the phosphorous value is to be issued by the ICRP and we will update our files.

**NRC Research and Technical  
Assistance Report**

#### Task 4: Absorbed Fractions for Alpha and Beta Emitters

A Monte Carlo code for calculation of the absorbed fractions for sources in the skeleton has been written. Further bone measurement data of the marrow cavity sizes in trabecular bone are being sought from Spier's group at Leed University, England. The absorbed fractions generated by this code will also be used to derive more realistic estimates of the photon energy deposition in the active marrow, particularly at low photon energy where the approach used in the photon transport code overestimates the active marrow dose by as much as a factor of four. In addition, the absorbed fractions will be applied to beta and alpha emitters on the surface or within the volume of the bone.

#### Task 6: Metabolic Data

A generalized approach to age-specific metabolic information has been formulated and is now under implementation. An age-specific lung model has been developed by D. J. Crawford. A report entitled "A Generalized Age-Dependent Lung Model with Application to Radiation Standards," ORNL/NUREG/TM-411 has been reviewed and will be published early in 1981.

An initial age-dependent gastrointestinal tract model has been formulated which includes modeling of the elevated transfer of material across the gut to blood. Testing of the model using both available human and animal data continues. Work on an age-dependent model for Sr-90 retention in the skeleton is underway. At this stage in the model development, it appears that generalization of the model to other alkaline earth elements will be possible. The model is being constructed largely from physiological and metabolic information on calcium such that the vast information on Sr-90 from weapon's testing can be used to validate the model.

#### Task 7: Computer Code for Age-dependent Calculation of Dose Factors

A new computer code is being developed from the earlier INREM II code. In addition to embodying the age-dependent information, the code will include (a) consideration of the blood/body fluids as a transfer compartment feeding the systematic organs, and (b) dose rate data will be calculated rather than dose commitment values. The latter item being included to provide the dosimetric needs for health effects assessment. The intent is to tabulate dose rate information at various times post intake of a unit activity. Convolution of these data with intake functions derived from environmental transport codes can then be used to evaluate risk.

BUDGET AND TECHNICAL MANPOWER EXPENDITURES (FY 1980):

<u>Reporting Period</u>	<u>Project Costs, \$</u>	<u>Technical Support, Man-Months</u>
FY 1981	51,426	3.0
Total to Date	51,426	3.0
Estimated Cost FY 1981	210,000	

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