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INTERIM REPORT

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Author(s): David C. Kocher

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Responsible NRC Individual and NRC Office or Division: Mr. Frank J. Arsenault, Division of Health, Siting, and Environment

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INTERIM REPORT

NRC Research and Technical  
Assistance Report


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NRC Research and Technical  
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ORNL

FOREIGN TRIP REPORT

ORNL/FTR-1093

DATE: June 25, 1981

SUBJECT: Report on Foreign Travel of David C. Kocher, Research Staff Member, Technology Assessments Section, Health and Safety Research Division

TO: Herman Postma

FROM: David C. Kocher

PURPOSE: (1) To represent the United States Government at an Advisory Group Meeting convened by the International Atomic Energy Agency (IAEA) for the purpose of reviewing a working document on the subject of pathways for radionuclide releases of regional and worldwide interest. (2) To consult with Dr. H. D. Brenk of the firm Ingenieurbüro für Wissenschaftlich Technischen Umweltschutz in Aachen, F.R.G. on problems of mutual interest in the field of external dosimetry.

SITES VISITED:

6/1-5/81 IAEA Headquarters, Vienna Austria  
R. J. Kirchmann, Scientific Secretary

6/6-9/81 Ingenieurbüro für Wissenschaftlich Technischen Umweltschutz, Aachen, Federal Republic of Germany  
H. D. Brenk, Head

ABSTRACT: Twenty-two participating scientists and observers representing eleven countries and three international organizations were convened by the IAEA to discuss, review, and revise a working document entitled "Regional and Global Environmental Behaviour of Radionuclides from the Nuclear Fuel Cycle." This document had been prepared at a previous consultants' meeting attended by the traveler and held in Vienna on November 3-7, 1980. The revised document prepared at the Advisory Group Meeting is concerned with radionuclides released from routine operations of the nuclear fuel cycle which are of potential importance on regional and worldwide scales. For each of the regional and global regimes, the revised document briefly discusses the particular radionuclides of potential importance due to their long half-lives and/or mobility in the environment, the pathways and processes which are relevant to the environmental transport of these radionuclides and subsequent exposures of affected populations,

and the models which have been developed to describe the environmental transport for the particular radionuclides. The second part of the trip involved consultations with Dr. H. D. Brenk, who is head of a private consulting firm concerned with environmental radiological assessments in Aachen, F.R.G. The discussions concerned problems of mutual interest in calculations of external dose from radionuclides dispersed in the environment.

## REPORT

### Advisory Group Meeting with IAEA

On June 2-5, 1981, the traveler represented the United States Government at an Advisory Group Meeting convened by the IAEA in Vienna, Austria, for the purpose of reviewing a working document on the subject of pathways for radionuclide releases of regional and global concern. The working document entitled "Regional and Global Environmental Behaviour of Radionuclides from the Nuclear Fuel Cycle" had been prepared by a previous consultants group which met in Vienna on November 3-7, 1980. The traveler also participated in the previous meeting, and this work was described in the interim report ORNL/FTR-983 dated November 17, 1980. All travel and living expenses during the Advisory Group Meeting were provided by the IAEA.

During routine operations of the nuclear fuel cycle, some of the released radionuclides may result in a potential radiological impact on regional and worldwide scales, due to their long half-lives and/or mobility in the environment. Because regional and global dispersion of released radionuclides usually involves transport of the activity from the country of origin across national boundaries, international cooperation is required if limits are to be placed on the quantities of such material that can be released to the environment. As an international organization, the IAEA has assumed the responsibility for developing and compiling the necessary technical information on which decisions regarding release limits could ultimately be based. The preparation of the original working document in November 1980 and its review at the Advisory Group Meeting in June 1981 constitute the first steps in the process of formulating the technical basis for any future decisions on release limits.

The Advisory Group Meeting was attended by twenty-two scientists and observers representing eleven countries and three international organizations in addition to the IAEA. As stated above, the purpose of this meeting was to review and amend the previous working document on radionuclides of regional and global concern. The document is divided into three parts. The first part involves establishing criteria for identifying radionuclides of potential importance on global and regional scales and listing those radionuclides which are believed to meet these criteria. The remaining two parts are concerned with the regional and global scales, respectively. For each of these two regimes, the document discusses the pathways and processes by which the relevant radionuclides are dispersed in the environment and eventually impact man and the models which have been

developed to describe environmental transport. In order to facilitate the review and revision of the working document, the Advisory Group was divided into three subgroups, each of which was responsible for one of the three parts of the document described above. The report of each subgroup was then discussed in detail by the Advisory Group as a whole.

It should be noted that the revised working document does not emphasize technical details concerning pathways and processes or environmental transport models for radionuclides of regional and global concern. That is, detailed equations, transfer coefficients, numerical results, etc., are not discussed. Rather, the purpose of the document is to outline in a qualitative fashion the relevant information to serve as a basis for more technically oriented and detailed reports to be prepared by future Advisory Groups. It should also be emphasized that the working document does not represent the consensus of all participants. It was more often the case that conflicting or dissenting opinions on relevant issues were expressed by one or more participants, and the different points of view were recorded in the working document. It is again the purpose of the IAEA to resolve those conflicts in future Advisory Group meetings.

The working group concerned with identification of radionuclides of importance on regional and global scales was chaired by Ms. H. Zindler from the German Democratic Republic. The group proposed four criteria for selecting radionuclides of regional or global concern — the amount of radionuclides released to the environment during normal operations of the nuclear fuel cycle, the radioactive half-life, the radionuclide residence time in the transporting medium (air or water), and the possibility of resuspension and subsequent enrichment of radionuclides in the environment. It was the opinion of this group that only  $^3\text{H}$ ,  $^{14}\text{C}$ ,  $^{85}\text{Kr}$ , and  $^{129}\text{I}$  are of importance on a global scale, and  $^{99}\text{Tc}$  may also prove to be important as the necessary information on environmental behavior is obtained. The group produced a list of about 75 radionuclides comprising fission and activation products and actinides, which the members felt could be important on a regional scale.

The second working group concerned with pathways, processes, and models on a regional scale was chaired by Mr. P. Cagnetti of Italy. The group was unable to arrive at a definition of regional scale which was satisfactory to all members but this point did not seriously affect the discussions of the relevant pathways and processes in this regime. This group considered pathways and processes and environmental transport models on a regional scale for both atmospheric and aquatic releases of radionuclides. For atmospheric releases, the important processes include atmospheric dispersion and transport, dry and wet deposition, and resuspension; the important pathways to man include external irradiation, inhalation, and ingestion of contaminated foodstuffs. Similar considerations also apply to aquatic releases. The report of this group summarized current knowledge concerning the pathways and processes and the currently available models for describing environmental transport on a regional scale.

The third working group, which was chaired by the traveler, was concerned with radionuclides of potential importance on a global scale. The report of this group was mainly concerned with a review of currently available compartment models to describe the global transport of  $^3\text{H}$ ,  $^{14}\text{C}$ ,  $^{85}\text{Kr}$ , and  $^{129}\text{I}$ . The group compared and contrasted the available models and provided recommendations for the models most appropriate for global population dose assessments. This group also considered the possibility that other radionuclides from the nuclear fuel cycle might be of importance on a global scale even though the environmental concentrations might vary considerably with location and depend upon the point of release. For atmospheric releases,  $^{129}\text{I}$  and  $^{133}\text{Xe}$  might be of importance because of the long residence time in the atmosphere. For radionuclides in particulate form in the atmosphere,  $^{137}\text{Cs}$ ,  $^{90}\text{Sr}$ , and to a lesser extent  $^{89}\text{Sr}$ ,  $^{134}\text{Cs}$  and  $^{140}\text{Ba}$  could also have global significance. For aquatic releases, preliminary studies indicate that  $^{99}\text{Tc}$ ,  $^{134}\text{Cs}$ ,  $^{137}\text{Cs}$ , and  $^{237}\text{Np}$  are of potential importance on a global scale.

The subject of pathways and processes for radionuclides on regional and global scales is important for the Department of Energy and Nuclear Regulatory Commission because any realistic assessment of the consequences of nuclear fuel cycle operations must consider potential radiological impacts on populations far from a release point for long-lived and/or mobile radionuclides. The technical reports to be prepared for the IAEA should provide a useful summary of methods which could be adopted by agencies in the U.S. for such assessments. The participation of the traveler in this working group will directly benefit the research programs of the Technology Assessments Section of the Health and Safety Research Division at ORNL. Further, this participation has brought to the attention of the IAEA and scientists in other countries some of the work that has been done at ORNL and other laboratories in this country.

#### Consultations with Dr. H. D. Brenk

On June 8-9, 1981, the traveler engaged in consultations with Dr. H. D. Brenk, who is head of a small consulting firm in Aachen, Federal Republic of Germany. All living expenses during this visit were provided by Dr. Brenk. Dr. Brenk is an internationally known expert in the field of atmospheric transport of radionuclides and estimation of external dose from radionuclides dispersed in the environment. The discussions concerned problems of mutual interest in external dosimetry, including calculations of external dose to skin from electron irradiation, methods for treating the buildup and decay of radioactive daughter products in external dose calculations, methods for estimating the spectra of electrons in beta decay from atmospheric clouds which have finite extent and nonuniform radionuclide concentrations. The subject of external dose from finite clouds is of particular interest to the traveler, who has had considerable responsibility for developing methods and data bases for estimation of external dose to be used in the dose assessment methodology of the Nuclear Regulatory Commission. In the process of revising NRC documents such as Regulatory Guide 1.109, the traveler believes that it could be worthwhile for the NRC to consider finite-cloud calculations such as those developed by Dr. Brenk to provide more realistic dose estimates from external exposure than are obtained using current methods.

## APPENDIX

## A. Itinerary

|                 |  |
|-----------------|--|
| May 30-31, 1981 | Travel from Oak Ridge, Tennessee, to Vienna, Austria   |
| June 1, 1981    | Preparation for Advisory Group Meeting   |
| June 2-5, 1981  | Advisory Group meeting on regional and global environmental behaviour of radionuclides from the nuclear fuel cycle |
| June 6-7, 1981  | Travel from Vienna, Austria, to Aachen, Federal Republic of Germany, and weekend                                   |
| June 8-9, 1981  | Consultations with Dr. H. D. Brenk on problems of mutual interest in external dosimetry                            |
| June 10, 1981   | Return to United States  |

## B. List of Contacts

IAEA Advisory Group Meeting

- R. J. Kirchmann, IAEA, Vienna, Austria
- J. Kretzschmar, CEN/SCK, Mol, Belgium
- J. Horyna, Nuclear Research Institute, Rez, Czechoslovakia
- A. Doury, CEN, Fontenay-aux-Roses, France
- H. Zindler, National Board of Nuclear Safety and Radiation Protection, Berlin, German Democratic Republic
- H. Bonka, Technische Hochschule Aachen, Aachen, Federal Republic of Germany
- V. Sitaraman, Bhabha Atomic Research Centre, Bombay, India
- P. Cagnetti, CNEN-CSN Casaccia, Rome, Italy
- Z. Jaworowski, Central Laboratory for Radiological Protection, Warsaw, Poland
- R. Bergman, National Defense Research Institute, Umea, Sweden
- G. S. Linsley, National Radiological Protection Board, Chilton, United Kingdom
- G. Fraser, Commission of European Communities, Kirchberg, Luxembourg
- P. Gaglione, Commission of European Communities, Ispra, Italy
- C. Myttenaere, Commission of European Communities, Brussels, Belgium
- B. Rügger, OECD/NEA, Paris, France
- G. Silini, UNSCEAR, Vienna, Austria
- A. Bouville, CEN, Fontenay-aux-Roses, France
- M. Gras, CEA, Paris, France
- V. Ferrara, CNEN-CSN Casaccia, Rome, Italy
- C. Gyllander, Studsvik Energiteknik AB, Nyköping, Sweden

## B. List of Contacts (continued)

IAEA Advisory Group Meeting (continued)

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Ingenieurbüro für Wissenschaftlich Technischen Umweltschutz,  
Aachen, F.R.G.

- H. D. Brenk  
G. Schwarz

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