UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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EPA-SAB-RAC-COM-92-001

OFFICE OF
THE ADMINISTRATOR

Honorable William K. Reilly
Administrator
401 M Street, S.W.
Washington, D.C. 20460

Subject: Status of EPA Radionuclide Models

Dear Mr. Reilly:

In recent years many Science Advisory Board reports have included constructive criticism of the models, databases, and uncertainty analyses used by the Agency. These criticisms have not been unique to the Office of Radiation Programs' radiation-related activities, but the criticisms are pertinent to those activities. Therefore, the Radiation Advisory Committee of the SAB would like to share with you its view of the limited progress it has seen in this area and the problems that remain. The Committee does so because outmoded or inappropriate models, supported by inadequate data and executed to produce conservative results, can lead to significant overestimates of impact for specific potential hazards.

In addition, selection of regulatory limits based on overestimates may lead to remedial actions unwarranted by actual risks and thus deprive other activities of the resources needed for protection of public health and the environment. The Committee strongly recomends that the EPA at this time assign a high priority to the development of comprehensive models and data sets for the transport of radionuclides in the environment.

This commentary focuses on three principal topics: (1) models used for predicting radionuclide transport, (2) data sets used as bases for prediction, and (3) lack of uncertainty analysis.

The Radionuclide Transport Models: The models employed by the Office of Radiation Programs to predict the transport of radionuclides in the environment are often inappropriate. Specific models are either outdated or are not the best choice for the specific task. During recent years, improvements in model platform, development, selection and peer review have been inadequate. Several examples follow.

In its 1988 review of the scientific documentation supporting the National Emission Standards for Hazardous Air Pollutants (NESHAP) [SAB-RAC-89-003], the reviewing Subcommittee stated:

a. The use of dynamic models is favored, rather than steady-state models such as AIRDOS-EPA, for use with seasonal or episodic releases.

b. Although the Gaussian dispersion portion of AIRDOS-EPA has been subjected to validation (comparison to actual data), a great deal of effort remains to validate as many steps in the subsequent risk-assessment process as possible.

In its 1989 review of the Radionuclides NESHAP Background Information Document (BID) [SAB-RAC-89-024], the Committee recommended that EPA should quickly update and complete the CRRIS model for calculating radiation dose and risk, and make the model and documentation available for technical review.

In its 1990 review of criteria documents supporting the proposed regulation of radionuclides in drinking water [EPA-SAB-RAC-92-009], the Committee concurred with a previous SAB Drinking Water Subcommittee that recommended against use of dose calculational risk estimates for radium based on models, and that, instead epidemiologic data should be used for radium.

Data Used for Prediction: The data sets used by the Office of Radiation Programs as the bases for prediction of the effect of proposed regulatory actions are not adequate. They often do not include the best and most complete information available within the time and budget constraints posed by specific problems, or by the general needs of the Agency. Sensitivity analysis should be used to determine the data sets most in need of supplementation. During recent years the Committee has found little Office of Radiation Programs support for collection of adequate data. Several examples follow.

In its 1988 review of the scientific documentation supporting the NESHAP [SAB-RAC-89-003], the reviewing Subcommittee observed,

> *Despite its appreciation of modeling, the Subcommittee believes that measured data best represent source strengths and environmental concentrations and also near-source atmospheric and environmental concentrations from sources subject to complex diffusion (such as near a building complex or large gypsum or uranium tailings pile). The use of measured source data for elemental phosphorus plants is a good example of a case in which EPA has successfully benefitted from this approach. Where such data are not available or cannot be obtained on the schedule required, it is appropriate to use assessment models.*

In its 1989 review of the Radionuclides NESHAP Background Information Document [SAB-RAC-89-024], the Committee recommended that:

a. The rule should permit the use of actual environmental measurements for demonstrating compliance with the individual dose limit.

b. EPA should use measured values of radon flux near facilities and near covered tailings piles to determine actual radon emissions, to calculate individual risk; and

c. actual, local-dispersion data, or best available data, should be used to reduce uncertainties in local-dispersion calculations.

In its 1990 review of draft criteria documents supporting the proposed regulation of radionuclides in drinking water [EPA-SAB-RAC-92-009], the Committee found that the choice of model parameters was not well justified; for example, the F_1 gut-to-blood absorption factor appeared to be arbitrary and in disagreement with recent publications and the risk factors used in the assessment of man-made alpha emitters were ad hoc.

Inadequate Uncertainty Analysis: Office of Radiation Programs documents using the results of modeling generally do not include detailed presentation of uncertainty analyses. The multiple levels of conservatism often built into a particular analysis are usually not apparent from the document. Specific results often reflect the high end of a range of possible modeling results. Rather a modeling result should in most cases be presented as an average (reflecting average input data) and a range (which may include a zero health risk at the low end). Presentation of the range of uncertainty is often helpful to the decision maker. The Committee has observed improvement in uncertainty analysis in specific cases in recent years; however, in general, few Office of Radiation Programs reports present their results properly bounded. Several examples follow.

In its 1988 review of the scientific documentation supporting the NESHAP [SAB-RAC-89-003], the reviewing Subcommittee noted that:

a. without rigorously derived uncertainty estimates, the credibility of dose and risk values cannot be judged;

b. sensitivity analyses should be used to guide the expenditure of resources and effort for the sake of model improvement and data development; and

c. the presentation of calculated risk data should be presented in a format similar to that in Administrator Lee M. Thomas' "Memorandum on 'Proposed benzene NESHAP decisions and limitation of issue to Section 112 of the Clean Air Act'" April 5, 1988.

In its 1989 review of the Radionuclides NESHAP Background Information Document [SAB-RAC-89-024], the Committee recommended that:

a. with respect to risk assessment methodology, a full description of the biases and uncertainties in the estimates used in the modeling was not provided;

b. uncertainty analysis may have little meaning if the model itself is incomplete and not intended to yield best estimates.

c. the Office of Radiation Program's commitment to develop state-of-the-art models, and to apply full uncertainty analysis to its modeling efforts (recommended in SAB reports dating back to 1984) has been deferred previously, due to urgent situations. It is past time for EPA to complete tasks so vital to providing a scientific basis for its action;

d. best (unbiased) estimates of dose and risk, with appropriate uncertainty statements and ranges, should be presented in all risk assessments and the shape of the uncertainty distribution should be presented;

e. the range of uncertainty should be expressed for the low-LET risk value applied here; and

f. EPA should calculate the total uncertainty from all parameter values, compare all models for completeness, compare measurements and model predictions (validate the models), and perform sensitivity analyses.

In its 1990 review of criteria documents supporting the proposed regulation of radionuclides in drinking water [EPA-SAB-RAC-92-009], the Committee found that:

a. one of the most important flaws in the criteria documents was the failure to address uncertainties in parameters and calculated risks and to present them so that decision makers are made fully aware of the quality of the estimates on which particular legal guideline values are based;

b. reported risks for man-made radionuclides do not include uncertainties in input parameters or in the results of the risk calculation;

c. uncertainties in model parameters used in estimating the risk from radon in water must be addressed and inconsistencies removed; and

d. the basis for and uncertainty associated with the assumed values for tap water consumption rate and 20% volatilization of Rn are not adequately addressed.

Finally, given the eventual selection of a suite of appropriate models, adequate supporting data sets, and development of a well-designed sensitivity and uncertainty analysis protocol, two more topics must be considered by the Office of Radiation Programs.

1. The selected models must be adequately validated, i.e., their ability to predict must be tested against actual environmental measurements.

2. An ordered approach to the selection, from the above suite, of specific models most appropriate to specific problems must be developed. For example, single, one-dimensional models are best suited for many screening tasks. Given a good understanding of input/output uncertainty ranges, a simple model may provide an adequate, cost-effective prediction for many cases. More complex models, with more complex data requirements, should logically be specified only when the increased accuracy of the resulting predictions is truly required to solve a problem, and when an adequate input data base is available to support the complex input requirements of the model.

In summary, many of the recommendations found in recent Radiation Advisory Committee reports echo those in the August 1984 report of the Science Advisory Board Subcommittee on Risk Assessment for Radionuclides and the SAB generic resolution on modeling (SAB-EEC-89-012). The Office of Radiation Programs has discussed these problems on numerous occasions in the interim, and has assured the SAB it will develop the techniques and data sets to allow state-of-the-art risk assessment as a basis for regulation, but much of the basic framework of problems remains.

The Committee hopes that by drawing this persistent problem to your attention, specific work, such as development of validated environmental assessment models with integral uncertainty analysis capability, will be emphasized. These models must be well-documented, peer-reviewed personal computer implementations, capable of producing uncertainty-bounded best estimates for a range of increasingly detailed input data. They must be made

generally available to other researchers, and should have associated generic and region-specific input data sets based on research programs. Development of this comprehensive and defensible model/data set will improve the scientific basis of impact assessments for the next round of radiation-related regulations. We look forward to your response.

Sincerely,

Raymond C. Loehr, Chairman
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