

Overview of INTERNAL DOSE RECONSTRUCTION IMPLEMENTATION GUIDELINE (OCAS-IG-002)

Due to the nature of work at Department of Energy (DOE) facilities, it is sometimes possible for workers to be exposed to radiation internally. Radioactive materials can enter the body through one of three pathways: inhalation, ingestion, and skin contact. Exposures can occur when small radioactive particles become airborne, are inhaled and deposited in the lungs; are present in contaminated food, drink, or other consumable items and are ingested; or are spilled onto the skin and are absorbed or enter through cuts or scratches. Internal exposures may result from the intake of a large amount of radioactive materials at one time (acute exposure) or chronic exposure from an accumulation of small amounts of radioactive materials over a long period of time.

Once in the body, the radionuclides (i.e., radioactive elements) will tend to migrate and accumulate in certain body organs, called target organs. For example, iodine will accumulate in the thyroid gland. Internal exposures arise when these radionuclides decay and give off energy, which is absorbed by surrounding tissues. The actual radiation dose delivered will depend on the radioactive nature of the material and its physical and chemical properties.

Under the Energy Employees Occupational Illness Compensation Program Act of 2000 (EEOICPA), an estimate must be made of the dose to a particular tissue or organ where the cancer is found. *Internal Dose Reconstruction Implementation Guideline* (OCAS-IG-002) provides guidance on the methods and approaches that can be used to determine annual occupational radiation doses to specific tissues or organs from internally deposited radionuclides. This guideline provides basic, rather than step-by-step, instruction for reconstructing internal doses. It is generally used in combination with technical basis documents that cover specific sites, more detailed technical information bulletins, and procedures.

SUMMARY OF FINDINGS RESULTING FROM THE TECHNICAL REVIEW

Review of the *Internal Dose Reconstruction Implementation Guideline* by Sanford Cohen and Associates (SC&A), the technical contractor for the Advisory Board on Radiation and Worker health, produced 10 findings:

Finding #1: The guidance is ambiguous and is not clear about how to proceed in circumstances that require professional judgment.

Finding #2: Guidance on how to treat radionuclides that result from natural radioactive decay of the elements present is incomplete. Also, the method used when working with the elements calcium and cadmium should be updated to follow directions given in the regulation titled *Age-Dependent Doses to Members of the Public from Intake of Radionuclides: Part 4, Inhalation Dose Coefficients*, International Commission on Radiological Protection Publication 71 (ICRP 71).

Finding #3: *Internal Dose Reconstruction Implementation Guideline* (OCAS-IG-002) does not mention how to treat gases and vapors in reconstructing internal doses.

Finding #4: Guidance in Sections 6 and 7 is not clear on how to determine preliminary internal dose estimates and the associated uncertainties.

Finding #5: Section 7.2 does not provide adequate guidance regarding the selection of limits necessary to calculate uncertainty.

Finding #6: Section 2.1, Figure 2, should include the mouth in the portion of the 'extra thoracic region' identified as ET2.

Finding #7: Section 4.1.2, *Ingestion*, inaccurately states that all soluble compounds are eliminated by the body fairly quickly.

Finding #8: Section 4.1.2, page 13, provides a technically flawed example when referring to "...an in vivo measurement [with] no detectable Thorium-232 in the lungs" as a "valid" sample.

Finding #9: Section 4.3, *Solubility Class*, page 15, states, "The most accurate means of evaluating the solubility class is by examining multiple bioassay samples after an intake." The fact that determining solubility type by multiple bioassays of urine samples is complex and may be misleading is not well explained in this section.

Finding #10: Guidance in Section 7.4, *Radon*, does not explain how to calculate doses from radon gas without including the additional radionuclides that are produced naturally as radon decays.

RESOLUTION OF FINDINGS

In response to the findings, NIOSH did the following:

- (1) Agreed to modify a future revision of *Internal Dose Reconstruction Implementation Guideline* (OCAS-IG-002) to accommodate Findings #1, #2, #3, #4, #5, #7, and #10.
- (2) Agreed to work with SC&A to consider a new gastrointestinal dose model developed by the International Commission on Radiological Protection (ICRP) in order to resolve Finding #6.
- (3) Although NIOSH agreed with Finding #8, it was decided that no revision to the guideline is in order, since the finding refers only to an example. NIOSH indicated that the quotation from the procedure assumes as established fact that Thorium-232 gamma-emitting decay products would naturally exist at all times in known quantities relative to the Thorium-232 present.
- (4) Although NIOSH agreed with Finding #9, no modification is needed to the guideline, as this particular document is not intended to include the level of detail described by the reviewer in the finding.

All issues were resolved to the satisfaction of the Advisory Board.