

Overview of

CALCULATION OF DOSE FROM INTAKES OF SPECIAL TRITIUM COMPOUNDS (ORAUT-OTIB-0066)

The procedure provides guidance to the Oak Ridge Associated University Team (ORAUT), a contractor to the National Institute for Occupational Safety and Health (NIOSH), on how to assign doses from intakes of special tritium compounds using worker urine bioassay results. Tritium is radioactive hydrogen and is usually taken into the body by inhalation or ingestion of tritiated water (i.e., “radioactive water”), which is water that contains a radioactive hydrogen atom. When inhaled, the tritium from such water vapor is distributed throughout the body, where it is gradually excreted through the urine at a well-known rate. The amount of tritium excreted each day permits a reliable estimation of the amount of tritium in the body, which, in turn, allows performance of an accurate reconstruction of the internal doses associated with the intake of tritiated water.

In addition to tritiated water, workers in some plants may also have been exposed to tritium existing in the work environment in more complex chemical forms, such as carbon compounds called organically bound tritium (OBT), and metal compounds called stable metal tritides (SMTs). These more complex tritium compounds can stay in the body longer than the water form and, therefore, may result in higher doses to workers. OBT and SMTs can enter the body through the inhalation or ingestion of such compounds. The length of time that these compounds stay in the body and the types of organs that they affect depend on the specific form of the compounds. For example, in the case of SMTs, the way in which the compound behaves in the body depends on the type of metal to which the tritium is bound. Titanium tritide, for instance, would behave differently than hafnium tritide. Therefore, the amount of radioactive dose that a worker experienced depends on the specific type of OBT and SMT compounds involved.

The guidance in ORAUT-OTIB-0066 explains how doses from intakes of OBTs and SMTs can be calculated using a worker’s urine bioassay data and a process described in another procedure, *Tritium Calculated and Missed Dose Estimates* (ORAUTOTIB-0011). The ORAUT-OTIB-0011 procedure describes three different methods for calculating tritium dose from bioassay data. The dose is dependent on the specific form of the compound being considered; therefore the procedures instruct the dose reconstructor to choose a method of calculation based on the types of compounds present at the employee’s work locations.

SUMMARY OF FINDINGS RESULTING FROM THE TECHNICAL REVIEW

SC&A’s review of the procedure produced four findings:

Finding #1: The ORAUT Technical Information Bulletin (OTIB) recommends the use of the methods given in ORAUT-OTIB-0011 to calculate doses from intakes of OBT to all organs and tissues. But this method does not meet the requirement that techniques should be claimant favorable. The dose coefficient, or multiplication factor, for organically bound tritium in International Commission on Radiological Protection publications is 1.4 times higher than the one resulting from using *Tritium Calculated and Missed Dose Estimates* (ORAUTOTIB-0011).

Finding #2: Techniques to calculate the largest feasible tritium dose as proposed in *Calculation of Dose From Intakes of Special Tritium Compounds* (ORAUT-OTIB-0066) cannot correctly characterize tritium exposure without knowing:

What special tritium compounds were handled (information is often inadequate or incomplete),

The quantity of material,

The locations and time periods of exposure, and

The physical behaviors of tritium compounds in the employee's environment.

Finding #3: ORAUT-OTIB-0066 does not ensure that the doses are based on adequate monitoring data.

Finding #4: The procedure does not provide guidance on how to distinguish between special tritium compounds, elemental tritium, and tritiated water, all of which could occur at the same time or overlap.

RESOLUTION OF FINDINGS

NIOSH agreed with all of the findings and indicated that they will make any necessary corrections and additions in the next revision of the procedure. SC&A and NIOSH both agreed that knowledge of the compounds and the amount of specific material at a given site is necessary and will be addressed in the site profile for each site. NIOSH committed to using claimant-favorable assumptions regarding the type of tritiated compound and the duration of exposure when applying this procedure to workers at a specific site. NIOSH also indicated that it will include a discussion in the next revision of the procedure giving an interpretation and potential shortfalls associated with using urine bioassay data to calculate dose from special tritium compounds.