

1.0 Introduction

The Hanford Internal Dosimetry Program (HIDP) provides internal dosimetry support services for operations at the Hanford Site. The HIDP is staffed and managed by the Radiation and Health Technology group, within the Pacific Northwest National Laboratory (PNNL). Operations supported by the HIDP include research and development, the decontamination and decommissioning of facilities formerly used to produce and purify plutonium, and waste management activities. Radioelements of particular interest are plutonium, uranium, americium, and tritium and the fission and activation product radionuclides ^{137}Cs , ^{90}Sr , and ^{60}Co .

This manual describes the technical basis for the design of the routine bioassay monitoring program and for assessment of internal dose. The purposes of the manual are to

- provide assurance that the HIDP derives from a sound technical base
- promote the consistency and continuity of routine program activities
- provide a historical record
- serve as a technical reference for radiation protection personnel
- aid in identifying and planning for future needs.

The internal dosimetry philosophy documented in this manual is based on the concepts of dose equivalent and effective dose equivalent described in publications 26 and 30 of the International Commission on Radiological Protection (ICRP 1977; 1979). The committed dose equivalents (doses integrated over a period of 50 years following intake) are the basis for evaluating compliance with regard to the 10 CFR 835.202 dose limits of 5 rem/y for effective dose equivalent and 50 rem/y for single organs and tissues.

1.1 Document Description

This manual establishes the science underlying internal dosimetry as practiced by the HIDP. The general methods chapter describes the fundamental principles used for internal dose calculations, and subsequent chapters deal with specific radioelements or a related group of radionuclides. The appendixes (beginning with a glossary

in Appendix A) provide information that is general to all of the chapters. Radionuclides not specifically mentioned are rarely encountered at levels of dosimetric concern at Hanford. The basis for dosimetry for additional radionuclides will be added to this manual as the need arises. A “special topics” chapter provides for a documented record of technical issues that do not fit under other specific chapters, or that will subsequently be incorporated into other chapters upon major revisions of chapters. The recommendations for specific bioassay programs and capabilities of such programs for demonstrating compliance with regulations are presented in the companion *Hanford Internal Dosimetry Project Manual* (PNL-MA-552).^(a)

The tables, figures, and appendixes included in this manual (PNNL-MA-860) reflect the most current information at the time of the revision of this manual; information may be changed without the change being reflected in this manual prior to the next scheduled revision.

1.2 Document History

The first version of this manual was the *Technical Basis for Internal Dosimetry at Hanford*, issued in April 1989 as a technical document (PNL-6866; Sula et al. 1989). During its first 2 years of publication, the document found a wide audience throughout the U.S. Department of Energy (DOE), its contractors, and other organizations involved in internal dosimetry. It not only served well as the intended reference for data, but also became a template for other sites in developing their own technical basis documents.

The “Technical Basis” was always intended to be a “living” document, responsive to the needs of the HIDP. The first revision of the document (Sula et al. 1991) was prompted by the desire to have additional information readily available for routine use in dose assessment and bioassay program design. Also, changes were made in the presentation of information to make the document easier to use. Throughout the next 8 years, no revisions were made to the document proper, although some updates and additions were made by supplemental letter reports addressing specific issues. The document itself remained unchanged due to program priorities and the fact that the essence of the material in the document was still current.

(a) Pacific Northwest National Laboratory. 1997. *Hanford Internal Dosimetry Project Manual*. PNNL-MA-552, Richland, Washington. (Internal manual.) Available URL: <http://www.pnl.gov/eshs/pub/pnnl552.html>

In January 2000, the Hanford technical basis changed its format from a document to a manual. Although the content and layout remained similar to previous versions, the manual format was adopted to allow future changes to be accomplished without republishing the entire document. The name change to *Methods and Models of the Hanford Internal Dosimetry Program* was made to more accurately reflect the manual's purpose and content, and avoid confusion that one document constitutes the entire "technical basis."

Shut down and cleanup of Hanford facilities have continued since the last revision. Plutonium production and fuel reprocessing have ceased, and facilities are in the midst of decontamination and decommissioning. Relatively short-lived fission and activation products have decayed to the point where the need for their dosimetry is substantially reduced, and the additional time since the end of reprocessing has changed the expected isotopic ratios in reference plutonium mixtures. As new missions are added or existing site programs modified, further modification of this manual may be required.

The HIDP seeks to implement technically appropriate and cost-effective methods and tools to carry out its functions. Recent recommendations from the ICRP include a new lung model, improved biokinetic models for radionuclides in the body, new recommendations for organs of concern and revised organ dose weighting factors. Many of those recommendations are gaining acceptance, however the tools to implement them are limited. The HIDP will continue to evaluate new models and tools for internal dosimetry, as they become available and incorporate cost-effective improvements that are consistent with regulatory and contractual requirements. This manual incorporates some of the newer biokinetic models. Regulatory requirements of 10 CFR 835 and contractual requirements for the Hanford Radiological Health and Safety Document (DOE 2001) preclude the adoption of recent ICRP recommendations for organ dose weighting factors (ICRP 1990) and effective dose coefficients based on those factors.

1.3 References

10 CFR 835. 1999. U.S. Department of Energy, "Occupational Radiation Protection." U.S. Code of Federal Regulations.

International Commission on Radiological Protection (ICRP). 1977. "Recommendations of the International Commission on Radiological Protection." (ICRP publication 26). *Annals of the ICRP*, 1:3, Pergamon Press, New York.

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