



**American National Standard**

# ANSI/HPS N13.22-2013

# Bioassay Programs for Uranium

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**American National Standards Institute, Inc.**


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**ANSI/HPS N13.22-2013**

## Foreword (This foreword is not part of American National Standard ANSI/HPS N13.22-2013.)

This version of the standard is identical to the previous version (HPS N13.22-1995) and is a re-affirmation of the earlier standard. The text of the standard is unchanged.

The 1995 standard was thoroughly reviewed and accepted in its existing form. It is the only standard specifically applicable to bioassay programs that monitor individuals for uranium intake. Recent toxicological information on uranium was evaluated as part of the review process, and the precision and quality of the existing standard are adequate and require no changes. Adherence to requirements of this standard helps assure programmatic compliance with existing radiation protection laws and directives of the United States.

The Working Group will initiate a revision to this standard when the latest International Commission on Radiological Protection (ICRP) recommendations on biokinetic models and the associated dose coefficients (i.e., ICRP Publication 103) are fully available.

The 2013 version of this standard is a re-affirmation of the 1995 version, performed under the authority of the Health Physics Society Accredited Standards Committee (ASC) N13, *Radiation Protection*. The Working Group responsible for this standard had the following members:

Allen Mabry, Chair
(GE-Hitachi Nuclear Energy)

James Bogard
(Dade Moeller & Associates, Inc.)

Richard Burklin
(AREVA)

Bruce Manninen
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(Y-12)

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John Takala
(Cameco Corporation)

Oversight for this action was provided by the N13 Administrative Committee, which had the following members:

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| Chairperson | Tracy A. Ikenberry |
| Vice Chairperson | Michelle L. Johnson |
| Secretary/Standards Coordinator | Nancy Johnson |
| Environmental Section Manager | J. Matthew Barnett |
| Medical and Operational Health Physics Section Manager | Glenn Sturchio |
| External Dosimetry Section Manager | Charles A. (Gus) Potter |
| Instrumentation Section Manager | Michelle Johnson (acting) |
| Internal Dosimetry Section Manager | Elizabeth Brackett |

This standard was consensus balloted and approved by members of the ANSI/HPS N13 Committee as a re-affirmation of the 1995 version on July 16, 2013. At the time of balloting, the committee had the following membership:

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|---|---|
| Chairperson | Tracy A. Ikenberry |
| Vice Chairperson | Michelle L. Johnson |
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| American Industrial Hygiene Association (AIHA) | Ray Johnson |
| American Iron and Steel Institute | Anthony La Mastra |
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| American Nuclear Insurers | Bob Oliveira<br>Marcia Anderson (alt.) |
| American Nuclear Society (ANS) | Ali Simpkins |
| Conference of Radiation Control Program Directors (CRCPD) | Earl Fordham |
| Council on Ionizing Radiation Measurements and Standards (CIRMS) | Chris Soares |
| Council on Radionuclides and Radiopharmaceuticals, Inc. (CORAR) | Leonard Smith |
| Health Physics Society (HPS) | Sandy Perle<br>Wayne Glines (alt.) |
| Institute of Electrical and Electronic Engineers (IEEE) | Mike Unterweger |
| Institute of Nuclear Materials Management | Harrison (Skip) Kerschner |
| National Council on Radiation Protection and Measurements (NCRP) | James Cassata |
| National Registry of Radiation Protection Technologists (NRRPT) | Dwaine Brown |
| Nuclear Energy Institute (NEI) | Ralph L. Andersen<br>Ellen Anderson (alt.) |
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| U.S. Department of Defense | Tim Mikulski<br>John Cuellar (alt.) |
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| U.S. Nuclear Regulatory Commission | Donald A. Cool |
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| Individual members | Eric Darois<br>Joseph P. Ring<br>L. Max Scott<br>Toshihide Ushino |

## Foreword (This foreword is not a part of American National Standard HPS N13.22-1995.)

The purpose of this document is to provide minimum program standards for monitoring the internal exposure of workers to the various forms of uranium encountered in the workplace, using bioassay methods. "Bioassay," as used in this standard, means the measurement and analysis of quantities of radioactive material in human body compartments through either: (1) the direct detection of gamma rays emitted from the radioactive material within body compartments, using gamma-ray detectors external to the body (in vivo bioassay); or (2) the determination of amounts of radioactive material in samples from the body (e.g., excreta, blood, hair) and the evaluation of internal deposits of radioactive materials using appropriate mathematical models relating excretion rates or sample contents to amounts within body compartments (in vitro bioassay). This standard does not address programs for measuring uranium in air (air monitoring), or programs for monitoring contamination on surfaces or in other materials that might be taken into the body.

The Working Group has intentionally included some definitions and specifications that differ from those in relevant international standards; common American practices and regulatory requirements have dictated these deviations, which are considered minor and on the side of increased protection. The standard provides: criteria and conditions under which workers are to be included in a bioassay program; the frequencies with which bioassay sampling are to be carried out for monitored workers; quantitative action levels and actions that will help to ensure that workers will be protected against unacceptable levels of internal exposure, and that appreciable internal exposures will be appropriately monitored and recorded; and other aspects of bioassay programs needed to meet acceptable standards of internal exposure monitoring for uranium. Tables that are part of the standard are referenced in the text of the standard with Arabic numerals; these tables are placed immediately after the text of the standard.

Five appendices, with tables, figures, and references, are included with this standard but are not considered part of the standard. The appendices are included to provide the rationale for the quantitative criteria in the standard, and to provide a collection of information that could meet only the specifications of this standard. Also included is information on analytical methods and procedures for interpreting bioassay data in terms of internal dose. Tables, figures, and references that are cited in the appendices, and which are part of the appendices, are numbered with Arabic numerals preceded by capital letters associated with the respective appendices. Tables and figures associated with each appendix are placed immediately after the respective appendix. All references in the appendices are placed in a single list at the end of the document. Table numbers referenced in the appendices that are not preceded by letters are tables in the standard.

Existing NRC guidance in this area (Regulatory Guide 8.22)(RG 8.22) applying to uranium mills has been provided as a reference in the appendices. Some of the provisions of RG 8.22 might apply to other facilities that process materials similar to yellowcake and ore handled in mills. However, the Working Group decided that it was not necessary to incorporate provisions of RG 8.22 into this standard. RG 8.22 was developed over many years as a consensus of knowledgeable persons in the uranium mill industry, government, and the health physics profession. Also, provisions of RG 8.22 have already been imposed on the uranium milling industry. Much information incorporated into RG 8.22 came from early drafts of this standard. Recent studies tend to support the action levels and actions in RG 8.22 for uranium mills. Therefore, provisions of RG 8.22 have been affirmed by this working group and are considered to be appropriate for uranium mill bioassay programs.

In 1987, the Canadian government published guidance for bioassay programs involving various nuclidic and chemical forms of uranium. This guidance included detailed information for estimating internal exposures from intakes. In 1990, the International Commission on Radiological Protection (ICRP) published a complete revision of its reports 10 and 10A, as ICRP Report 54, with recommendations on the bioassay of many nuclides under conditions of routine exposure and accidental, single intakes. Recent data consistent with the ICRP 30 models were used to estimate derived investigation levels (DILs), including DILs for the various important uranium nuclides in D, W, and Y forms, according to ICRP 30 lung

dissolution rate classifications. However, this guidance can not be used for in vivo monitoring of highly enriched uranium. Other available guidance is in some cases more complex than necessary for use in establishing programmatic aspects of industrial bioassay in the United States. In some cases, guidance on the most recent human data on chemical toxicity has not been utilized to establish DILs for uranium in D and W transportability classes, and there is no consideration of special Class Y compounds.

The standard has been prepared with appropriate attention to the content and rationale of other standards and guidance documents in order to avoid unnecessary confusion among users. The working group has independently examined the radiobiological and toxicological information available on uranium compounds, and has attempted to provide DILs or action levels consistent with those in the already-developed documents, where the precision of data did not warrant substantial changes.

The Health Physics Society Standards Committee Working Group responsible for this standard had the following members*:

Allen Brodsky, Chairperson
(Georgetown University)

Michael A. Austin*
(U.S. Department of Energy)

James S. Bogard
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Bruce Manninen
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The members acknowledge significant contributions by the following consultants:

Roscoe M. Hall, Jr., was an important contributor to this standard before his death in 1991.

Robert E. Alexander – The Alexander Corporation
S. Robert Bernard – Oak Ridge, Tennessee
Richard K. Burklin – Siemens Power Corporation
J.J. Davis – Advanced Sciences, Inc.
Darrell R. Fisher – Battelle - Pacific Northwest Laboratory
Gary H. Kramer – Bureau of Radiation and Medical Devices, Canada
Milton E. McLain, Jr. – Texas A & M University
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Bob Robinson – General Electric Company
Charles T. Schmidt – University of California
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Robert A. Wessman – Thermo Analytical, Inc.

* Michael A. Austin died after this standard was forwarded to HPS N13 for consensus balloting.

This standard was developed under the direction of the Health Physics Society Standards Committee and approved on 28 November 1994. At that time, the Standards Committee had the following membership:

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| Chairperson: | Harley Piltingsrud |
| Members: | John Buchanan<br>Nancy Daugherty<br>Jack Fix<br>Nolan Hertel<br>David Kocher<br>Perry Moskowitz<br>Richard Toohey |
| Internal Dosimetry Section Chairperson: | Gary Kramer |