Preface

In the first quarter of 2014, a proposal to write a National Council on Radiation Protection and Measurements (NCRP) report on Radiation Protection Guidance for the United States was approved by the Board of Directors. Council Committee 1 (CC 1) was formed in the second quarter of 2014. This Report updates and expands on Report No. 116, *Limitation of Exposure to Ionizing Radiation* (1993). The first meeting of CC 1 was held on September 3 and 4, 2014.

Since NCRP Report No. 116 was published in 1993, there have been advances in knowledge regarding the biological effects of ionizing radiation, particularly relating to cancer. In addition, health effects other than cancer such as cardiovascular disease and cataracts are emerging as potentially important concerns. Patient exposure to medical-imaging procedures and radiation therapy were not addressed in NCRP Report No. 116, nor was guidance for nonhuman biota (i.e., animal and plant life). Also, a discussion of established ethical principles and their application to radiation protection had not been introduced in NCRP Report No. 116. Furthermore, the Fukushima nuclear reactor accident and the potential for a nuclear or radiological incident in the United States, as well as the increase in population exposure to medical use of ionizing radiation (particularly computed tomography examinations, positron emission tomography scans, and nuclear medicine procedures) have increased the awareness of the importance of radiation protection guidance in the United States.

In 2007, the International Commission on Radiological Protection (ICRP) published revised recommendations for its system of radiological protection (ICRP Publication 103). Subsequently an important ICRP report on tissue reactions (also called deterministic effects), including early and late effects (ICRP Publication 118), was published in 2012. While the goals for radiation protection in the United States are the same as those for the international community, there are some differences in the specific approaches taken to achieve these goals [Kase, K.R. (2016). “Twelfth Annual Warren K. Sinclair Keynote Address — the influence of the NCRP on Radiation Protection in the United States: Guidance and regulation,” Health Phys. 110(2), 127–145]. NCRP radiation protection principles for exposure of humans are now expressed as: justification, optimization of protection, and numeric protection criteria (for management of dose to an individual). When there is a numeric protection criterion for a specific exposure situation, the first objective is to meet that protection criterion, then optimization of protection should be applied. These differences are discussed in this Report.
CC 1 considered numerous radiation protection issues that are discussed in the Report. There is overall consistency between the guidance for the United States in this Report and international radiation protection guidance. Where this guidance is unique or has adapted the international guidance for the United States, the rationale is given for the differences.

Notably, two scientific committees were formed to assist in the development of this Report, one on Guidance on Radiation Dose Limits for the Lens of the Eye and the other on Implications of Recent Epidemiologic Studies for the Linear-Nonthreshold Model and Radiation Protection.

Unique aspects of the manner in which CC 1 operated include:

- It was the first committee formed under the direct oversight of the Council as opposed to oversight by one of the NCRP Program Area Committees (PACs).
- All the PACs participated in the development and review of the recommendations.
- An effort was made to consult with and present to a number of national and international professional ionizing radiation groups during both the development and review phases of this work, including: the American Association of Physicists in Medicine, the American College of Radiology, the Health Physics Society, ICRP, the International Radiation Protection Association, and the Radiation Research Society.

This Report was prepared by CC 1 on Radiation Protection Guidance for the United States. Members of CC 1 and the PAC Advisors during development of the Report were:

**Co-Chairs**

**Kenneth R. Kase**  
NCRP Vice President Emeritus  
Stanford University (retired)  
Medford, Oregon

**Donald A. Cool**  
Electric Power Research Institute  
Charlotte, North Carolina
Members

Armin Ansari  
Centers for Disease Control and Prevention  
Atlanta, Georgia

John D. Boice, Jr.  
National Council on Radiation Protection and Measurements  
Bethesda, Maryland

Jerrold T. Bushberg  
University of California Davis  
School of Medicine  
Sacramento, California

Lawrence T. Dauer  
Memorial Sloan Kettering Cancer Center  
New York, New York

Darrell R. Fisher  
Versant Medical Physics and Radiation Safety  
Richland, Washington

Patricia A. Fleming  
Saint Mary’s College (retired)  
Notre Dame, Indiana

Kathryn A. Higley  
Oregon State University  
Corvallis, Oregon

Randall N. Hyer  
Center for Risk Communication  
New York, New York

William E. Irwin  
Vermont Department of Health  
Burlington, Vermont

Fred A. Mettler, Jr.  
University of New Mexico School of Medicine  
Albuquerque, New Mexico

Donald L. Miller  
Food and Drug Administration  
Silver Spring, Maryland

R. Julian Preston  
U.S. Environmental Protection Agency  
Chapel Hill, North Carolina

Gayle E. Woloschak  
Northwestern University  
Chicago, Illinois

Consultants | Liaison

S. James Adelstein  
NCRP Vice President Emeritus  
Harvard Medical School  
Boston, Massachusetts

Ralph L. Andersen  
Nuclear Energy Institute (retired)  
Burke, Virginia

Michael A. Boyd  
U.S. Environmental Protection Agency  
Washington, D.C.

John E. Till, PAC 7 Liaison  
Risk Assessment Corporation  
Neeses, South Carolina
PAC Advisors

<table>
<thead>
<tr>
<th>Name</th>
<th>PAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gayle E. Woloschak</td>
<td>PAC 1</td>
</tr>
<tr>
<td>Northwestern University</td>
<td></td>
</tr>
<tr>
<td>Chicago, Illinois</td>
<td></td>
</tr>
<tr>
<td>Kathryn H. Pryor</td>
<td>PAC 2</td>
</tr>
<tr>
<td>Pacific Northwest National</td>
<td></td>
</tr>
<tr>
<td>Laboratory (retired)</td>
<td></td>
</tr>
<tr>
<td>Richland, Washington</td>
<td></td>
</tr>
<tr>
<td>Tammy P. Taylor</td>
<td>PAC 3</td>
</tr>
<tr>
<td>Pacific Northwest National</td>
<td></td>
</tr>
<tr>
<td>Laboratory</td>
<td></td>
</tr>
<tr>
<td>Richland, Washington</td>
<td></td>
</tr>
<tr>
<td>James A. Brink</td>
<td>PAC 4</td>
</tr>
<tr>
<td>Massachusetts General Hospital</td>
<td></td>
</tr>
<tr>
<td>Boston, Massachusetts</td>
<td></td>
</tr>
<tr>
<td>S.Y. Chen</td>
<td>PAC 5</td>
</tr>
<tr>
<td>Illinois Institute of Technology</td>
<td></td>
</tr>
<tr>
<td>Chicago, Illinois</td>
<td></td>
</tr>
<tr>
<td>Steven L. Simon</td>
<td>PAC 6</td>
</tr>
<tr>
<td>National Cancer Institute</td>
<td></td>
</tr>
<tr>
<td>National Institutes of Health</td>
<td></td>
</tr>
<tr>
<td>Bethesda, Maryland</td>
<td></td>
</tr>
<tr>
<td>Randall N. Hyer</td>
<td>PAC 7</td>
</tr>
<tr>
<td>Center for Risk Communication</td>
<td></td>
</tr>
<tr>
<td>New York, New York</td>
<td></td>
</tr>
</tbody>
</table>

NCRP Secretariat

Marvin Rosenstein, Staff Consultant
Cindy L. O’Brien, Managing Editor
Laura J. Atwell, Office Manager
David A. Smith, Executive Director (2014–2016)
Kathryn D. Held, Executive Director (2016–)

NCRP expresses appreciation to the Committee members for the time and effort devoted to the preparation of this Report. NCRP would also like to thank the many colleagues not on the Committee, and some not on the Council, who provided critical reviews and guidance in specific areas of the Report. NCRP also gratefully acknowledges the financial support provided by NRC under Grant No. NRC-HQ-60-14-G-0012 and the Centers for Disease Control and Prevention (CDC) under Grant No. 5UE1EH000989. The contents of this Report are the sole responsibility of NCRP and do not necessarily represent the views of NRC or CDC.

John D. Boice, Jr.
President