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NCRP Commentary No. 20: Radiation Protection and Measurement Issues Related to Cargo Scanning with Accelerator-Produced High-Energy X-Rays, National Council on Radiation Protection and Measurements, 2007, 61 pp. (soft cover/downloadable PDF), $40.00/ $32.00, NCRP, 7910 Woodmont Avenue, Suite 400, Bethesda, MD 20814-3095; ISBN-13: 978 0 929600 95 6; http://www.ncrppublications.org.

NCRP Commentary No. 20 was prepared by the National Council on Radiation Protection and Measurements (NCRP) in response to a request for specific advice on the subject topic raised by the Domestic Nuclear Detection Office of the U.S. Department of Homeland Security (DHS). In response, this Commentary addresses the radiation protection issues related to the Cargo Advanced Automated Radiography System (CAARS) currently under development. The purpose of this system is to detect high atomic number ($Z > 72$) material that might be special nuclear material (SNM) or shielding designed to conceal SNM or other radioactive material. Furthermore, the system is being designed to include conventional radiographic imaging capable of finding other contraband such as narcotics, explosives, weapons, or currency. The goal is to be able to conduct routine radiographic inspections of 50% of all incoming cargo with such systems by 2012.

Specifically, NCRP was asked to evaluate potential health effects of inadvertent exposures of individuals as well as effective and reliable methods of measuring dose rates for these systems. As this is a relatively new use of ionizing radiation for the benefit and well being of the public, it is commendable that the DHS recognized the need for addressing the radiation protection concerns early in the development of the technology and consulted the appropriate institution chartered by the U.S. Congress to provide the necessary expertise. It is certainly far better to get the proper radiation protection criteria instituted at an early stage of the development of such a new technology rather than to have to require retrofits at a later date.

The Commentary gives a good, concise, and realistic description of modern cargo handling and the commensurate technical issues to be resolved. Due to this novel application of ionizing radiation, it correctly provides a rather comprehensive discussion of the ingredients of a complete radiation protection program. A clear, rather comprehensive, discussion of the constraints on the design particularly germane to radiation protection issues, both technical and programmatic, is provided.

The Commentary properly recognizes that perhaps some of the recipients of the information provided may be new to the radiation protection field in general or accelerator health physics in particular. The radiation physics of the envisioned 10 MV photon energy scale is presented. Also, considerable space is devoted to topics such as accelerator safety controls and warnings and safety interlocks. Guidance is given on the elements of the necessary radiation protection plan including provisions for personnel dosimetry, monitoring surveys, work controls, and environmental protection and monitoring. This is supported by a welcome summary review, about half of the page count, of supporting technical reference material fortified by a substantial bibliography. In particular, attention is given to the possibility of neutron exposure, a radiation field component usually found to be small at the presently ubiquitous medical accelerators of comparable energies but somewhat more plausible for accelerators as used in the CAARS application. A prudent quality assurance program is also described, a very useful feature in view of the anticipated large scale deployment of this system.

Extensive guidance is given on allowable exposures limits that is, as expected, consistent with that published in other NCRP documents. Risk estimates of repeated and "above-limit" events are also given. The dose limitation scheme recommended essentially eliminates the need for operators and support personnel including maintenance workers to be classified as "radiation workers" and restricts credible doses to people inadvertently exposed to "general public" limits. (The latter category is acknowledged to include "stowaways" in cargo containers.) While the ALARA principle is intrinsic to health physics practice, the application of the recommended dose limits challenges the designers to produce a system having the necessary sensitivity to achieve the desired goal, within these boundaries, of preventing tragic events perpetrated with malevolent intent. This reviewer fervently hopes that these potentially divergent goals can readily be met.

In general, the Commentary made an excellent effort to carefully define all terms. The lone major exceptions found by this reviewer are the references to the "radiation safety officer" (RSO) found on pages 12, 16, and 48. While the role of the RSO is well defined in other NCRP documents cited, a suitable definition of the qualifications and role of this official is given in neither the text nor the glossary, in contrast to the situation with the definition and usage of the term "qualified expert." Guidance could have been given to DHS to more clearly define the RSO function in the context of CAARS. For example, is an appointed RSO needed at each installation during routine operations? This and related questions are not clearly answered in the document.

The Commentary judiciously uses photographs and even some color figures with effectiveness—innovations only slowly but beneficially being embraced by the NCRP. In general, it is very well written and organized. It should serve DHS well for its intended purpose and provide other readers with a good review of the topic. Should related systems, perhaps using neutron or even particle beams, be devised for similar purposes, this Commentary will provide a sound basis for the appropriate guidance.

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