Published in final edited form as:

Health Phys. 2016 February ; 110(2): 98–100. doi:10.1097/HP.0000000000000402.

NCRP PROGRAM AREA COMMITTEE 1: BASIC CRITERIA, EPIDEMIOLOGY, RADIOBIOLOGY, AND RISK

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Abstract

This report is an update on Program Area Committee 1 (PAC 1) of National Council on Radiation Protection and Measurements activities during the past year. Highlights include an update on the reports on radiation dose limits for the lens of the eye and relative biological effectiveness on low linear energy transfer radiations as related to energies. In addition, ongoing reports on the relevance of the linear no-threshold model and a phase 2 study on space radiation effects on the central nervous system were discussed. New topics for future work of PAC 1 include considerations of cardiovascular effects, dose and dose-rate effectiveness factors, and tissue factors.

Keywords

National Council on Radiation Protection and Measurements; radiation epidemiology; radiation biology; risk assessment; space radiation

CURRENT PROJECTS

On 5 March 2017, Program Area Committee (PAC) 1 of the National Council on Radiation Protection and Measurements (NCRP) met to provide updates on NCRP projects that have been completed or are ongoing and also to discuss new projects for which there is a need in radiation protection. Dr. Eleanor Blakely provided an update on the commentary by Scientific Committee (SC) 1–23, “Guidance on Radiation Dose Limits for the Lens of the Eye” (co-chaired by Eleanor Blakely and Lawrence Dauer) (NCRP 2016a). Commentary No. 26 is important because for the first time in many years, it recommends that the occupational radiation dose limits be reduced from 150 mSv y⁻¹ to 50 mSv y⁻¹, although the committee recommended further research in the field since now technology permits new

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work on basic mechanisms that had not been accessible in the past. In considering dose limits, the committee noted that damage to the eye depends upon multiple factors (e.g., type of exposure, dose-rate of exposure, location of opacity). SC 1–23 also considered that several years ago the International Commission on Radiological Protection (ICRP) had lowered dose limits to the eye, and in response to this and to needs within the radiation protection community in the United States, NCRP tackled the question of eye dose limits and cataract induction. The commentary has been presented to the U.S. Nuclear Regulatory Commission (NRC) and others who are stakeholders and likely to be impacted by the work. In discussion, PAC 1 considered the recommended dose-limit changes particularly noting that while cataracts seem to be benign because surgery can easily repair the problem, for those doing close work, the surgery is often not optimal and sometimes surgery is not successful. Papers summarizing this work have recently been published (Dauer et al. 2016, 2017).

Dr. Polly Chang reported on the final stages of SC 1–20 “Biological Effectiveness of Low Linear-Energy Transfer Radiation as a Function of Energy” (chaired by Steven Simon). This report is now at Council review and should be completed in the coming months. One issue discussed by PAC 1 was that the document did not consider weighting factors; this omission was deliberate because CC 1 has taken on this task and there was no need for duplication of the effort. Another issue that led to considerable debate was the use of effectiveness ratio (ρ) in place of relative biological effectiveness (RBE) as a measure of radiation effectiveness. It was felt that this is a broad issue that needs to be addressed across NCRP as a whole.

A new committee, SC 1–25, “Recent Epidemiologic Studies and Implications for the Linear-Nonthreshold (LNT) Model” (co-chaired by Roy Shore and Lawrence Dauer) was formed because of the needs within the NRC for radiation protection guidance. SC 1–25 reviewed the epidemiology literature on LNT in terms of low-dose rate, heritable effects, in utero exposures, cardiovascular outcomes, and results of the Life Span Study. This Committee is working to complete a draft in the coming months for review by PAC 1 and Council.

SC 1–24 is now doing a Phase 2 study after Phase 1 (NCRP 2016b) was completed, “Radiation Exposures in Space and the Potential for Central Nervous System (CNS) Effects” (co-chaired by Leslie Braby and Jacob Raber). This study was contracted by the National Aeronautics and Space Administration to understand the effects of space radiation exposure to astronauts and potential effects on CNS that might lead to neurologic problems during a mission or upon return to Earth. Meetings for the remainder of the year have been established and it is hoped that this work will be completed by the following year. PAC 1 noted that data from individuals treated with radium or polonium isotopes could be relevant to these studies.

FUTURE PROJECTS

PAC 1 has proposed that NCRP consider exploring several areas of investigation that are emerging in the radiation protection field. A draft white paper proposal “Study of Cardiovascular and Cerebrovascular Risk from Radiation: Risk Assessments and Implications for Radiation Protection” (Roy Shore and Gayle Woloschak) was presented to

the group for their consideration. Dr. Shore summarized existing epidemiologic work that supports the need for such an assessment. PAC 1 members noted the need to include ongoing animal studies that have documented cardiovascular effects of radiation exposure. The PAC also discussed possible funding sources for this work, with all noting that this is an important area for investigation.

A white paper exploring dose and dose-rate effectiveness factor has been proposed for several years by Joel Bedford and Gayle Woloschak. It has been noted that ICRP has a committee exploring this and that NCRP should wait for that report to be completed. This proposal will be kept “on hold” until the ICRP report is completed, especially since several members of PAC 1 are involved in the ICRP efforts. Progress on the ICRP work was published last year (Ruhm et al. 2015).

A new white paper was proposed by Nobuyuki Hamada, Eleanor Blakely, and David Pawel) entitled “Guidance on Radiation Weighting Factors and Relative Biological Effectiveness (RBE) values for Dose Recommendations.” The overall background for this proposal was as follows: Biological effectiveness changes with ionizing radiations of varying quality, such as that described by linear energy transfer (LET), and, in general, RBE increases with decreasing dose, dose per fraction and dose rate to a presumed maximum value (called RBE_M for stochastic effects with no threshold and RBE_m for tissue reactions with threshold). Several additional approaches and terminologies describing the effectiveness across the field, and especially across NCRP reports and PACs, have led to confusion as to which terminology is appropriate for individual situations. Further complicating this is that risk depends on age at exposure, and thus there is an unmet need for age-adjusted tissue weighting factors covering all populations across all ages (including children) as well as occupational groups and pregnant women. It was considered that there is a need for simplifying the guidance for the use of different dose recommendations. PAC 1 affirmed the need for this report and charged the committee to write a white paper to be reviewed in a conference call. It was also considered that PAC 6, Radiation Measurements and Dosimetry, might have interest in this document.

Ken Kase, co-chair of CC 1 (along with Don Cool), made a presentation to PAC 1 about ongoing efforts to complete CC 1. PAC 1 had already submitted numerous comments to CC 1, and Dr. Kase reported to the group how their suggestions had been incorporated into the document. In particular, PAC 1 discussed problems that remained with aspects of wording to the “dose recommendations” since it appears that particular doses are being recommended (rather than recommended for radiation protection). In addition, there were comments about the fact that exposures at different ages come with different risks, and this is not well-reflected in the existing document. PAC 1 and the entire Council will have the opportunity to review another draft of CC 1.

Jacqueline Williams reported on progress with CC 2, which is a follow-up committee to the “Where are the radiation professionals? (WARP)” initiative. Several areas of focus for education and training are being considered: medicine, health and medical physics, radiation biology and chemistry, nuclear engineering and radiation epidemiology. The committee has

been meeting by conference call and will have a draft report prepared during the coming year.

The committee welcomed Kathryn Held, Chief Science Officer and Executive Director of NCRP (and former chair of PAC 1) and John Boice, President, to the meeting to discuss upcoming projects that relate to PAC 1. In particular, it was noted that SC 1–26 to be chaired by Julian Preston will examine “Integration of Radiation Biology and Epidemiology.” This committee will be formed soon, and PAC 1 membership will be considered. The need for training of radiation epidemiologists was also explicitly noted as being crucial since there had been no new graduates in the past 10 y.

The need to have inter-PAC collaborations was discussed by the group, particularly noting the need for strong collaborations of all PACs with PAC 7 (involved in public relations and outreach). PAC 1 prepared a report that was presented to the all-PAC meeting.

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