ABSTRACT BOOK

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Abstract Book

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ABSTRACTS

MAM-A.1
Follow the Yellow Brick Road – Radiation Protection and Nuclear Power

Cool DA
EPRI

Radiation Protection originated shortly after the discovery of the x-ray, as radiologists realized that the x-rays were causing burns of their hands. Initially, the concern was for the severe tissue reactions, and protection was to avoid those reactions. As time progressed, radiation protection's focus moved towards cancer and genetic effects, and now on to possible non-cancer effects. In parallel, the Atoms for Peace initiative moved the United States, and other countries into the use of power generation through nuclear fission. For nuclear power, the focus of radiation protection has also evolved, first looking at occupational protection, and then expanding to public protection and emergency response with significant events such as Chernobyl and Fukushima. In special NCRP sessions this afternoon and tomorrow we will be exploring further aspects of radiation protection in the nuclear power community by looking at the regulations, the science, effluents and decommissioning, and knowledge transfer and communication. Along this path, many opportunities have been found to improve protection. In fact, we have found that good radiation protection is also good business, and being a good neighbor. We have also found that good radiation protection hinges on a safety mindset, always being aware of the need for safety, while at the same time contributing reliable solutions to the ever increasing need for electrical energy in our daily lives.

MAM-A.2
Your NCRP: Current and Future Activities

Held K, Boice J
NCRP

The National Council on Radiation Protection and Measurements (NCRP) is a nonprofit organization chartered by Congress to provide independent scientific analysis, information and recommendations to the government, industry and the public on matters related to radiation health protection and measurements. Work is accomplished through two high-level Council Committees (CCs) and multiple Scientific Committees (SCs) under the purview of seven Program Area Committees (PACs). Following are examples of ongoing activities. In light of substantial advances in knowledge of radiation effects and understanding of radiation protection, CC-1 is updating NCRP Report No. 116 on "Radiation Protection Guidance for the United States". CC-2, "Meeting the Needs of the Nation for Radiation Protection" is revising and updating the comprehensive plan outlined by the "Where are the Radiation Professionals" (WARP) initiative to address the dwindling number of radiation professionals in many radiation sciences arenas. SC1-23 has just completed work evaluating studies on radiation-induced cataracts and recommended that the existing US occupational dose limit to the lens of the eye be decreased to 50 mGy/year. Other Scientific Committees are addressing: concerns that space radiation may cause acute or late central nervous system damage that could impair space missions or result in serious cognitive and mental dysfunction in exposed astronauts; implications of recent epidemiologic studies for the linear-nonthrehold model; radiation safety implications of nanotechnology; radiation safety "cradle to grave" of sealed radioactive sources; guidance and practical implementation recommendations for response to nuclear/radiological incidents; radiation protection in dentistry; radiation risks to human subjects; dose utilization in CT; radiation protection for NORM/TENORM; and dosimetry in epidemiologic studies. These and other highlights of current and planned NCRP work are discussed.

MAM-A.3
Commercial Nuclear Power – State of the Industry

Schlueter J
Nuclear Energy Institute (NEI)

Our nation's nuclear power plants are an important part of our infrastructure, providing clean, reliable always-on power while serving as economic engines for local communities. The industry is facing major economic challenges with several nuclear plants shot down prematurely and others at risk. The purpose of this presentation is to provide an overview of the status of the industry and how the industry is addressing challenges, including a discussion of the Delivering the Nuclear Promise initiative. The presentation will also discuss specific radiation protection related regulatory actions and their current status.

MAM-A.4
NRC's Re-Evaluation of Category 3 Source Security and Accountability Initiatives

White AD
U.S. Nuclear Regulatory Commission

The presentation will provide the current status of the U.S. Nuclear Regulatory Commission's (NRC) activities to re-evaluate Category 3 source security and accountability. In October 2016, the Commission directed staff to determine the necessity of revising NRC regulations and processes in light of the agency's operating experience with high-risk sources, the results of the assessment of the security requirements in 10 CFR Part 37 as required by the Energy and Water Development and Related Agencies Appropriations Bills for Fiscal Year 2015, and NRC's actions in response to the recommendations in the 2016 Government Accountability Office (GAO) audit report on the NRC and Agreement State materials licensing program. In 2009, NRC first implemented the National Source Tracking System (NSTS) for category 1 and 2 sources and later added Web-Based Licensing System (WBL) and the License Verification System to improve the overall control and management of radioactive sources in the United States. Staff recently completed a comprehensive program review and developed a number of recommendations based on the first two years of Part 37 implementation of physical security requirements for NRC licensees. In response to a 2015 GAO investigation in which GAO was able to obtain a radioactive material license for a Category 3 source using fictitious credentials, two NRC/Agreement State working groups recently completed their assessment of pre-licensing guidance and license verification and transfer of Category 3 sources that addressed GAO's recommendations. The Category 3 source re-evaluation will leverage the operational experience and recommendations from these assessments to look at options to revise NRC regulations and processes governing source protection and accountability. Staff's assessments and public input will form the basis of recommendations to the Commission in August 2017 that could impact over 5,000 licensees nationally.

MAM-A.5
GAO Report on NRC's Radiological Materials Licensing Program

Woodward N
US Government Accountability Office

In 2016, GAO issued a report on NRC's materials licensing program (GAO-16-330). GAO's report examined (1) the steps NRC and agreement states have taken since 2007 to ensure that radioactive materials licenses are granted only to legitimate organizations; and (2) the results of covert testing designed to test the effectiveness of these controls. GAO found that the NRC and agreements states have taken several steps since 2007 to help ensure that licenses are granted only to legitimate organizations. However, NRC and agreement states have not taken some measures to better control some dangerous quantities of radioactive materials. For example, NRC has not strengthened controls for all categories of radioactive material considered dangerous. Unlike its process for applicants for category 1 and 2 quantities of radioactive materials, for category 3 applicants NRC does not review specific security measures before a license is issued. NRC has also developed and deployed the various systems to better control some materials. However, these systems focus on more dangerous category 1 and 2 quantities but not category 3 quantities. Further, NRC does not specifically require that the validity of category 3 licenses be verified by the seller with NRC or the agreement states—creating risks that licenses could be counterfeited. GAO's covert testing of NRC requirements showed them to be effective in two out of our three cases; in a third case, GAO was able to obtain a license and secure commitments to purchase, by accumulating multiple category 3 quantities of materials, a category 2 quantity of a radioactive material considered attractive for use in a "dirty bomb." NRC is taking corrective actions to provide training to NRC and agreement state officials to emphasize greater scrutiny in conducting prelicensing site visits. NRC and agreement state working groups are currently evaluating licensing enhancements.

MPM-A.1
The U.S Environmental Protection Agency's Uranium Fuel Cycle Regulatory Actions

Peake T
US Environmental Protection Agency

Using authority from the Atomic Energy Act of 1954 (AEA) via the Reorganization Plan No. 3 of 1970, the EPA can establish generally applicable environmental standards for the protection of the general environment from radioactive material. The Agency used the AEA and amending statutes to promulgate regulations dealing with the uranium fuel cycle from milling to disposal. In the last several years, the EPA has undertaken a revision of 40 CFR part 192 (on milling) and an advance notice of proposed rulemaking (ANPR) for 40 CFR part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations," which was promulgated in 1977. The standards at 40 CFR part 190 contain two main provisions, a dose limit to members of the public, and a limit on cumulative releases to the environment for specific radionuclides from energy production activities of the fuel cycle. The ANPR for 40 CFR part 190 was published in 2014 and consisted of questions the Agency had as it contemplated making changes to the regulation. Six main questions were posed in the ANPR; the questions involved using a dose or risk option, addressing the release limits used in 190.10(b), water resource protection, storage of spent nuclear fuel and high-level radioactive wastes, and addressing new technologies. This presentation discusses the EPA's uranium fuel cycle regulations with a focus on the ANPR for 40 CFR part 190 and possible implications if the Agency were to revise the regulation.

MPM-A.2
NCRP CC-1 – Recommendations on Radiation Protection for the United States

Cool DA
EPRI

The National Council on Radiation Protection and Measurements (NCRP) last published recommendations for radiation protection as NCRP 116 in 1993. Council Committee 1 (CC-1) was established to review and update those recommendations in light of experience and the need to address areas that have not been previously addressed. During the 2016 HPS Annual Meeting, a special session was held which discussed some early thinking of CC-1. The committee is moving towards some agreements for the next version of the draft, and discussions will be held with the NCRP Program Area Committees during the NCRP Annual meeting in March. The recommendations will continue some previous recommendations of NCRP and ICRP, and evolve other aspects address implementation issues and needs. New areas that have not been previously covered include medical exposures, exposures within the environment, the relationship of decision-making and ethics in the formulation and implementation of protection, and the role of stakeholders in communications and decisions.

MPM-A.3

RP Implementation of the Prospective Assessment

Harris W
Exelon Nuclear

In the early 1990's, the Nuclear Regulatory Commission revised 10 CFR 20. A key aspect was the requirement to determine in monitoring was required per 10CFR20.1502. Specifically, a review was required to determine if an individual was likely to receive greater than 10 percent of the regulatory limit. This analysis was termed as the prospective analysis. This paper will discuss the current regulatory guidance and the implementation of this program at Exelon Nuclear.

MPM-A.4

Implications Of Recent Epidemiologic Studies for the LNT Model

Shore RE
Radiation Effects Research Foundation (Retired)

The LNT (linear no-threshold) hypothesis has been used as the fundamental model for radiological protection for four or more decades, but has come under attack by both those who believe it overestimates or underestimates risk. The NCRP Scientific Committee 1-25 has a charge to determine if recent reports of epidemiologic studies of low-dose and low-dose-rate exposure to low-LET radiation are consistent with the linear no-threshold model. The strengths and limitations of major recent studies are reviewed, and analyses pertinent to LNT are examined. The reviewed studies primarily focus on solid cancer outcomes, although studies of tissue reactions (deterministic effects) and special groups (childhood or in utero exposures, heritable effects) are also reviewed briefly. Evaluations are provided of the uncertainties in the dosimetry, the adequacy of the epidemiologic and statistical methods, and the conclusions drawn. The report will synthesize the results of the various studies to provide a "weight of evidence" summary regarding the LNT model. Preliminary results of this review will be presented.

MPM-A.5

Evaluating Cardiovascular Effects

Dauer L
Memorial Sloan Kettering Cancer Center

ICRP Publication 118 included a review of epidemiological evidence and provided updated estimates of practical threshold doses for tissue injury. Particular attention was paid to circulatory and cardiovascular diseases where they suggested an absorbed dose threshold for such outcomes at around 0.5 Gy. Several more-recent reviews have supported both causal associations and low (or no) thresholds for radiation exposure and cardiovascular diseases. This has potentially significant implications for occupational radiation protection, especially in nuclear power and medical applications where some higher-exposed job categories of individuals may receive lifetime doses nearing such a value. A decision still needs to be made on if or how to best incorporate circulatory and cardiovascular disease risks into stochastic protection approaches (e.g., effective dose concept).

Evaluating causal associations between radiation exposure (either high or low and acute or chronic) and various types of circulatory disease requires carefully combining the available data across a plethora of study populations, outcome identifications, and exposure situations. This involves identifying the available and applicable data in the literature, assessing the quality of the available epidemiological evidence, performing meta-analyses to evaluate statistical significance, understanding the biological mechanisms for cardiovascular disease outcomes from radiation exposures, and addressing the overall uncertainties associated with risk assessment.

MPM-A.6

The One-Million Persons Study of Low-Dose Radiation Effects (MPS): Dosimetry Aspects

Bouville AC
NCRP

The National Council on Radiation Protection and Measurements (NCRP) is coordinating an expansive epidemiologic effort entitled the One Million U.S. Persons Study of Low Dose Radiation Health Effects (Million Person Study) (MPS). The study populations include atomic veterans, U.S. Department of Energy (DOE) workers, nuclear power plant workers, medical radiation workers, and industrial radiographers. The primary aim of the MPS is to provide scientifically valid information on the level of radiation risk when exposures are received gradually over time, and not acutely as was the case for Japanese atomic-bomb survivors. The major health outcome of interest for the MPS is cancer mortality, but other causes of death such as cardiovascular disease and cerebrovascular disease will be evaluated. The validity of the MPS is tied to the validity of the dose reconstruction approaches to yield reliable estimates of individual doses. With that purpose in mind, NCRP instructed Scientific Committee 6-9 to prepare a Report that would provide guidance in the derivation of organ doses and their associated uncertainty for epidemiologic studies in general, but with a focus on the populations that make up the Million Person Study. That Report was prepared and is currently under peer review. For most of the MPS cohorts, external sources were found to be the predominant mode of exposure. However, for the DOE workers, preliminary estimates indicate that about half of the DOE workers also were exposed from intakes of radionuclides.

MPM-B.1

Superposition Analysis of Normalized Gaussians

Hayes R
North Carolina State University

This presentation describes a very simple technique to conduct quantitative analysis of data sets where each measurement of the same value has individual error. The method can be called a weighted histogram but is more properly classified as a kernal density estimator. Examples of its application will be given to include radiochemistry data sets and in the determination of an upper subcritical limit in nuclear criticality safety.

MPM-B.2

How Decisions for Radiation Safety are Governed by Habit

Johnson RH

Radiation Safety Counseling Institute

When adults make decisions today for radiation safety, they may believe that their decision is reasonable and prudent. They may believe that they have made their decision by a process that is rational and logical. This may not be the case. When health and safety are at risk, we may not have the time, or want to take the time for a careful detailed analysis before making a decision for safety. If a caveman took the time to carefully evaluate whether a sabre tooth tiger looked hungry, angry, or how far it could jump, he would likely become tiger food. Fortunately for survival, part of our brain is programmed for instant response to any signs of danger. For most people today, the word "radiation" is an indicator for danger based on typical news reports of "deadly radiation." Once a decision is made for radiation safety (perhaps in formative years) that decision is stored in memory for future reference. Since our rational "thinking" brain is programmed to conserve energy, people are not inclined to rethink a decision already made and stored in memory. Resorting to stored decisions is the basis of a habit. Habits describe all the functions of our lives that are routine and we no longer think about them in detail. For example, you always write with your dominant hand, sleep on the same side of the bed, get dressed in the same way, eat the same way, walk the same way, and communicate in the same way. We would not be able to function if we had to take the time to rethink all of the skills and practices we have ever learned at each moment of our lives. Instead we rely on the stored decisions made cumulatively over our lifetime to now function automatically as habits without requiring any new thinking. Decisions for radiation safety today may be based on decisions stored in memory (perhaps even decades ago) and are now automatic, ie a habit.

MPM-B.3

US EPA Superfund Radon Vapor Intrusion Preliminary Remediation Goal (RAD-VIPRG) Electronic Calculator

Dolislager FG, Walker SH, Bellamy MA, Galloway LD

The University of Tennessee, US Environmental Agency, Oak Ridge National Laboratory

Currently, there is no U.S. EPA guidance on correlating soil or groundwater levels of radon with indoor radon concentrations at Superfund sites. EPA is developing the Radon Vapor Intrusion Preliminary Remediation Goal (RAD-VIPRG) Calculator which is web-based calculator tool that (1) lists two radon isotopes (Rn-220 and Rn-222) known to pose a potential cancer risk through the inhalation pathway; (2) provides generally recommended risk and Applicable or Relevant and Appropriate Requirements (ARAR) based preliminary remediation goals (PRG) for groundwater, soil gas (exterior to buildings and sub-slab) and indoor air for default target risk and ARAR based levels and exposure scenarios; and (3) allows calculation of site-specific PRGs based on user-defined target risk and ARAR levels and exposure scenarios. EPA developed the RAD-VIPRG calculator to help risk assessors, remedial project managers, and others involved with risk assessment and decision making at radioactively contaminated sites. The RAD-VIPRG Calculator can assist Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) remedial project managers (RPMs) and on-scene coordinators (OSCs), as well as Resource Conservation and Recovery Act (RCRA) project managers in determining whether the vapor intrusion pathway has the potential to pose an unacceptable level of risk to human health or exceed ARARs by comparing subsurface or indoor data for radon against the PRGs provided in the Calculator. The PRGs in the Calculator are not intended to be used as cleanup levels, nor are they intended to supersede existing criteria of the lead regulatory authority.

MPM-B.4

U.S. EPA Superfund Counts Per Minute (CPM) Electronic Calculator

Dolislager FG, Walker SH, Bellamy MA, Bolus K

The University of Tennessee, US Environmental Agency, Oak Ridge National Laboratory

Currently, there is no U.S. Environmental Protection Agency (EPA) guidance on correlating CPM field survey readings back to risk, dose, or other applicable or relevant and appropriate requirements (ARAR)-based concentrations for Superfund remedial sites (sites regulated under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, or CERCLA). EPA developed the CPM calculator to help risk assessors, remedial project managers, and others involved with risk assessment and decision making at radioactively contaminated sites. The electronic calculator provides a method for correlating real-time survey results, often expressed as CPM, to contaminant concentrations used in risk assessments and cleanup levels at Superfund sites (typically provided in units of pCi/g or pCi/m2). The intent of the CPM calculator is to facilitate more real-time measurements within a Superfund response framework. It also may standardize the process of converting laboratory data to real-time measurements and thus lessen the amount of laboratory sampling needed for site characterization and confirmation surveys. However, it will not eliminate the need for sampling. The CPM calculator has two major sub-calculators based on the field survey scenario: (1) ground-based scanning of surface contamination; and (2) ground-based scanning of volumetric contamination. The CPM calculator includes 783 gamma emitting radionuclides that can be selected. Detector data is based on four sizes of gamma scintillation detectors by Ludlum Measurements Inc. When using the Volume calculator, there are six different options for source material, which are soil, concrete, plate glass, wood, steel, and drywall. The model for soil, concrete, plate glass, wood, and steel is based on a uniformly contaminated cylindrical slab source of varying thickness.

MPM-B.5

Why Telling the Truth About Radiation May Not Work

Johnson RH
Radiation Safety Counseling Institute

Which is likely to be more powerful, long-held views on the dangers of radiation (cancer and death) or the newly spoken words of truth presented by a specialist in radiation safety? When people hear views contrary to what they have always believed they may immediately question the truth of those views. We all know of the adage, "My mind is made up, do not bother me with facts!" This raises the question, "Why should someone change their prevailing view based on what an HP tells them?" What is the incentive or motivation to change? How readily are we willing to change our own minds about anything? If we are reluctant to change our minds, why should we expect others to change their minds, even when we are telling them the truth? If people hear the truth, will the truth really set them free? Of course the difficulty has to do with what is the "truth?" While specialists in radiation safety may believe they can defend their truths scientifically, for most of the world truth is based on their prevailing views or perceptions about radiation. Assuming we have been telling people the truth about radiation since the founding of the HPS, is public opinion about radiation any different today? If public opinion has not changed after hearing the truth for so many years, apparently telling the truth is not working. Does this mean we should forgo telling the truth? Most HPs will say no. Telling the truth is a high priority for our professionalism. However, getting people to change their minds about radiation will require not only continuing to tell the truth, but providing an incentive for change. This incentive may require an appeal to feelings and emotions to invite people to change the images they hold regarding radiation. Marketing people know how to do this as evidenced by the commercials on television. If we want to be more effective in radiation risk communication we may need to realize there is more to communication than simply telling the truth.

MPM-B.6

Acute Radiation Dermatitis

Kindrick S, Camphausen K, Ribaudo C
NIH

A common side effect of radiotherapy treatment is skin damage caused by the radiation beam as it enters the body in aim of a solid tumor. The skin injury is known as Acute Radiation Dermatitis. Acute Radiation Dermatitis usually occurs several days to weeks following external beam exposure but can occur as late as 90 days following radiation exposure to the skin. The severity of the injury varies from mild erythema to blistering and necrosis. The higher the radiation exposure the deeper into the dermis is the damage. Severity depends on radiation exposure with mild erythema at 2 Gy to loss of hair at 3 Gy to blistering and necrosis at 15 Gy to the dermis. Risk factors include poor nutrition, obesity, diabetes, systemic lupus, pre-existing skin disease and certain infections such as the human immunodeficiency virus. This presentation will review the clinical impact of Acute Radiation Dermatitis (long and short term) and provide awareness for oncology and general practitioner physicians. Patient care providers are advised that treatment is symptomatic including gently washing with non-soap cleansers and drying with a clean dry towel. For comfort, moisturizers and gels can be applied as well as dressings. For the first 1-2 weeks topical corticosteroids can sometimes be used for severe cases. Prevention includes avoidance of sun exposure, (or application of SPF50 cream) prior to radiotherapy. It also helps to not use perfumes, deodorants or alcohol based lotions. Skin injury during external beam radiotherapy is difficult to avoid; however this presentation will suggest radiation safety recommendations that oncology staff can use to minimize the condition.

MPM-B.7

Risks from Radon in Homes and Costs for its Control

Pawel DJ, Krop R
U.S. Environmental Protection Agency, The Cadmus Group

EPA is undergoing a review of its radon-in-home lung cancer risk projections and estimates of costs for its control. EPA currently estimates that about 21,000 people die from lung cancer each year from exposure to radon in homes. This estimate was based on models adapted from the 1999 National Academy of Sciences BEIR VI report and data on baseline lung cancer rates from 1989-1991. The BEIR VI models were based on pooled analyses of 11 cohorts of occupationally exposed underground miners, which provided sufficient evidence for the committee to conclude that "indoor radon [is] the second leading cause of lung cancer after smoking." Since the BEIR VI report was published, additional information from underground miner studies on risks from radon has become available — most notably results from the very large "WISMUT" cohort of East German uranium miners. There is now also direct evidence from pooled residential case-control studies that radon in homes causes cancer. Risk projections based on models developed from the WISMUT and pooled residential case-control studies tend to be within a factor of about 2 of projections based on the BEIR VI models. There are surprisingly few analyses of cost-effectiveness of efforts to control for the effects of radon. In 1992, EPA estimated that it costs about $1.2 million (adjusted for inflation) to save a life through radon testing and remediation. An oft-cited analysis published in 1999 indicated a far larger (inflation-adjusted) cost of about $5 million. The apparent discrepancy can largely be attributed to the use — for the latter analysis — of a 4% discount rate for quantifying the benefits of radon mitigation. Results based on updated risk models, mortality data, and the 3% discount rate recommended by the EPA's National Center for Environmental Economics, calculations will be presented. These results indicate that EPA's current efforts for controlling radon are cost-effective.

MPM-B.8

Comparing Radiological Risk and Dose Assessment Models of International and National Agencies

Shubayr N, Walker S
U.S. Environmental Protection Agency (EPA)

The U.S. Environmental Protection Agency (EPA) Superfund remedial program is conducting a comparative study between the risk and dose assessment models that are available nationally and internationally for risk assessment process at radioactively contaminated sites. The comparison includes the EPA models; Preliminary Remediation Goal (PRG) and Dose Compliance Concentration (DCC) internet based calculators for risk and dose assessment at Superfund sites, the U.S Department of Energy model; Residual Radioactive material guideline (RESRAD), the Bureau of Environmental Radiation of the State of New Jersey; Radioactive Soil Remediation Standards (RaSoRS), the U.K Government Department for Environmental, Food and Rural Affairs; The Radioactively Contaminated Land Exposure Assessment Methodology (RCLEA),

The French Nuclear Safety Authority (IRSN); SYMBIOSE Model, the Germany Department of Radiation Protection and Environment; WISMUT Model, the International Atomic Energy Agency (IAEA); NORMALYSA model; The Spain Environmental Impact of the Energy Department; Screening Model for Environmental Assessment (CHROM). Also the concentration tables in the NCRP (National Council on Radiation Protection and Measurements), Report No. 129, "Recommended Screening Limits for Contaminated Surface Soil and Review of Factors Relevant to Site Specific Studies", and the Nuclear Regulatory Commission (NRC), "Consolidated Decommissioning Guidance". The main focus of this comparative study is to analyse the different default input parameters and the maximum allowable concentrations provided by these models. This study aims to establish a common ground for cooperation between agencies by facilitating better understanding of each agency's modelling approach and identifying the similarities and differences between these agencies in the risk and dose assessment of the radioactively contaminated land.

MPM-B.9

Superfund Evolving Adjustments To External Slope Factors For Risk Assessments

Walker SA, Dolislager FG

U.S. Environmental Protection Agency, University of Tennessee, Oak Ridge National Laboratory

Prior to 2000, the U.S. EPA Superfund program assumed for purposes of estimating the external pathway for risk and dose assessment of radioactive contamination at Superfund sites, the contamination existed over an infinite distance and depth. Then EPA began to issue new guidance to more accurately reflect these gamma radiation. Most recently EPA has begun to make these adjustments using a software program Monte Carlo N-Particle (MCNP). In September 2014, EPA issued a revised PRG calculator with a new set of Area Correction Factors (ACFs) for soil in the report "Area Correction Factors for Contaminated Soil for Use in Risk and Dose Assessment Models". ACF values for all combinations of 19 source areas (ranging from 1 m2 to 1,000,000 m2) and 5 source thicknesses of 0, 1, 5, 15, and 200 cm are estimated. In this report are presented ACF values for the 1250 radioisotopes published in ICRP 107. In September 2014, when issuing the revised PRG calculator EPA also included new gamma shielding factors (GSF) from the report "Gamma Shielding Factors for Soil Covered Contamination for Use in Risk and Dose Assessment Models". In September 2015, EPA revised the BPRG and BDCC calculators with a new report "Room Radiation Dose Coefficients for External Exposure" that provided updated FSURF values which were added that account for multiple source depths (ground plane, 1cm, 5cm, 15cm and infinite depth) and multiple building materials (wood, glass, concrete, drywall and adobe mud brick were analyzed as well as 2 composite scenarios). An analysis is nearly complete to adjust external exposures for workers in trenches. These adjustment factors will be for the PRG and DCC construction worker scenarios when receptors are assumed to be in trenches for activities such as excavating soil for constructing buildings or laying down or repair utilities. Another analysis has begun of gamma shielding factors for several common building materials and thickness from contaminated soil.

MPM-B.10

Superfund Update: Revisions To Risk And Dose Assessment Tools

Walker SA, Dolislager FG

U.S. Environmental Protection Agency, University of Tennessee

The EPA Superfund remedial program's six Preliminary Remediation Goal (PRG) and Dose Compliance Concentration (DCC) internet based calculators for risk and dose assessment at Superfund sites are being revised to reflect better science. A comprehensive set of revisions to the PRG calculator was finished in November 2014. Additional revisions to the other 5 calculators were made in 2014 and 2015. A set of further revisions are expected to be finalized prior to end of 2016 and will be discussed in this abstract. There are several additional revisions that may be finished prior to HPS 2017 and will be presented if finished or discussed in more general terms if still underway. The current PRG and DCC calculators include exposures from fruits and vegetables in both the farmer and residential scenarios. This will be revised to now include 24 specific subcategories of produce. The produce intake rates are derived from 24 individual produce items, found in the 2011 Exposure Factors Handbook, that contribute to the overall produce ingestion PRG. Mass loading factors (MLFs) were also improved, from a single MLF that was applied to all produce, to 24 individual MLFs that correspond with the 24 individual produce items that make up the new produce intake rates. The user will be able to select climate zones and soil types to use a more appropriate soil to plant transfer factor from IAEA when available. In the farmer scenario for the PRG and DCC calculators, the previous 5 animal products will have an additional 4 animal products (Goat Milk, Mutton Milk, Goat Meat, and Mutton) that users may select as appropriate for their site-specific risk/dose assessment. In the resident, farmer, and indoor worker soil external exposure equations, a new variable has will be added (GSFb) to account for the gamma shielding provided by a clean soil beneath a building between the contaminated soil.

MPM-B.11

Assessment of Radium-226 Level on Some Water Samples Collected at Giri and Kuje Area of Abuja, North Central Nigeria

Maxwell O, Wagiran H, Saeed A, Sunday JE, Adewoyin O

Covenant University, Universiti Teknologi Malaysia

The EPA Superfund remedial program's six Preliminary Remediation Goal (PRG) and Dose Compliance Concentration (DCC) internet based calculators for risk and dose assessment at Superfund sites are being revised to reflect better science. A comprehensive set of revisions to the PRG calculator was finished in November 2014. Additional revisions to the other 5 calculators were made in 2014 and 2015. A set of further revisions are expected to be finalized prior to end of 2016 and will be discussed in this abstract. There are several additional revisions that may be finished prior to HPS 2017 and will be presented if finished or discussed in more general terms if still underway. The current PRG and DCC calculators include exposures from fruits and vegetables in both the farmer and residential scenarios. This will be revised to now include 24 specific subcategories of produce. The produce intake rates are derived from 24 individual produce items, found in the 2011 Exposure Factors Handbook, that contribute to the overall produce ingestion PRG. Mass loading factors (MLFs) were also improved, from a single MLF that was applied to all produce, to 24 individual MLFs that correspond with the 24 individual produce items that make up the new produce intake rates. The user will be able to select climate zones and soil types to use a more appropriate soil to plant transfer factor from IAEA when available. In the farmer scenario for the PRG and DCC calculators, the previous 5 animal products will have an additional 4 animal products (Goat Milk, Mutton Milk, Goat Meat, and Mutton) that users may select as appropriate for their site-specific risk/dose assessment. In the resident, farmer, and indoor worker soil external exposure equations, a new variable has will be added (GSFb) to account for the gamma shielding provided by a clean soil beneath a building between the contaminated soil.

MPM-B.12
Assessment of Natural Radioactivity Levels in the Coal Formation, Enugu, South Eastern Nigeria

Maxwell O, Saeed A, Sunday JE, Adewoyin O, Embong Z
Covenant University, Universiti Teknologi Malaysia, Universiti Tun Hussein Onn Malaysia (UTHM)

The activity concentrations of 238U, 232Th and 40K from lithological sequence of a borehole along Ninth Mile area were analysed due to interbedded coal formation which underlies the main Ajali sandstone (groundwater bearing formation) as a major concern for its radiological risks. Four different lithological rock samples at varying depths between 15 m - 250 m below ground level were collected for this study. Activity concentrations of the radionuclides were analyzed using high resolution co-axial HPGe gamma ray spectrometer system. The activity concentration of 238U ranges from 37 ± 4 to 74 ± 6 Bq kg-1 with the highest value of 74 ± 6 Bq kg-1 noted in the thin coal sample. The 232Th activity level in the rock samples ranges from 58 ± 5 to 85 ± 7 Bq kg-1 with the higher value of 89 ± 7 Bq kg-1 reported in the coal sample. For 40K, the activity concentration varies from 140 ± 19 to 293 ± 25 Bq kg-1 with the highest value of 293 ± 25 Bq kg-1 reported in coal samples whereas lowest value of 140 ± 19 Bq kg-1 was noted in Ajali sandstone. The higher activity levels of 238U, 232Th and 40K reported in coal samples may be due to the closer clusters of weathered surface of Ajali sandstone that overlays the thin coal layer with an escarpment being spread out, implying higher permeability towards deeper direction. In addition, the escarpment spread may be due to the ferruginasation and lateritsation of weak sheared zones, with a progressive increase in permeability as the sand becomes less cemented. All the values are within the recommended level when compared with UNSCEAR,2000. Further research on groundwater activity concentration and rock geochemistry is required.

P.1
Ships and Submarines — A Philatelic Look at Health Physics History

Johnston TP
NIST

The author's story of US nuclear powered vessels: ships and submarines. The story begins by way of fascination with science and adventure and enjoyment gained through reading. Introduction to this topic came via discovery of Jules Verne's Twenty Thousand Leagues Under the Seas. This classic described Captain Nemo's wonderful existence aboard the Nautilus and the undersea adventures capable with an electric powered submarine. The youngster next experienced a close encounter with Nemo's Nautilus on 7 December 1972 during a visit to Disneyworld and a ride on Walt Disney's version. This date is memorable since that evening our family witnessed firsthand the night launch of Apollo 17 at Cape Canaveral. Apollo 17 was also the last Apollo mission to land men on the moon. An interesting note: NASA was concerned about and protection measures were initiated with respect to radiation dose. Not only the cosmic radiation, but also exposure to the 147Pm used to illuminate switches and control panels, and from the 3H (tritium) used for radioluminescent lighting.

P.2
Pitchblende — A Philatelic Look at Health Physics History

Johnston TP
NIST

Pitchblende is also known as uraninite. The word comes from pitch or pech, meaning black or bad luck because of its black color, and blende. As health physicists we know about pitchblende and the work of Marie Skłodowska Curie and Pierre Curie in 1903. This poster will review the known uses of Uranium over time and the story is told with a graphical accompaniment of philatelic material (postage stamps). The story featuring Uranium begins with: the work of the Curie's, highlights the natural reactor in Gabon, a discovery of the first use of Uranium in Rome, miner's lung disease in the 1500's, a tie-in with President Herbert Hoover, a coloring agent for the ceramic and glass industries, silver mines and the U.S. dollar, more connections to the Curies and Becquerel, revelation of where those Coleman lantern mantles came from, a link to respiratory protection, spas in Jáchymov and the finish courtesy of Fiestaware.

P.3
Physicians and Radiologists, and Other Contributors to the Health Sciences — A Philatelic Look at Health Physics History

Johnston TP
NIST

With almost immediate certainty and in all likelihood, these physicians, radiologists, and other contributors to the health sciences depicted here were unknown to most people today. Yet these individuals were selected by the particular country's postal authority to be commemorated on a postage stamp.

An objective to strive for when writing about people from the past who have had an influence or impact on medical science, society and our lives is to bring to the forefront, perhaps remove from obscurity those individuals that until now have been unheralded. Let us begin with a brief introduction on the format for this month's column. This author thought a good and equitable approach would be simple: alphabetical order by country of notoriety and perhaps birthplace. For oftentimes, the country of birth does not always depict the accomplishments of the people that achieve fame or recognition. Sometimes the country that realizes and benefits from the individual's success or achievements will highlight and recognize this by the issuance of a commemorative postage stamp.

P.4

An Assessment of the Potential Association Between in Utero Exposure to Ionizing Medical Radiation and Childhood Leukemia: A Meta-Analysis of Literature, 2001-2015

Ioannidou SP, Smith DA

Georgetown University

The possible effect on childhood leukemia due to in utero radiation exposure has been investigated in many case-control studies since the 1950s with conflicting results. The review included nine case-control studies published between 2001 and 2015. Forest plots were generated to examine the potential association of childhood leukemia with in utero radiation exposure for diagnostic purposes. Crude and adjusted odds ratios (ORs) were reported and assessed. The pooled crude OR was found to be 0.99 (95%CI: 0.88;1.12), and the adjusted OR 1.06 (95% CI: 0.93; 1.21), indicating results weren't statistically significant. A subgroup analysis based on the method for exposure assessment (questionnaires v. medical records reviews) also indicated results weren't statistically significant (questionnaires: 0.88 (95% CI: 0.75; 1.03); medical records: 1.19 (95% CI: 0.98; 1.45). However, based on the central estimate we may conclude that results from questionnaires tend to underestimate the risk compared to the results from medical records. A statistically significant association between in utero radiation exposure and childhood leukemia was found when the target organ of examination was the abdomen [OR: 1.41 (95% CI: 1.10; 1.80)]. Acute lymphoblastic leukemia was not statistically associated with prenatal radiation exposure in x-rays [OR: 0.99 (95% CI: 0.87; 1.12)], while a statistically significant association was found for acute myeloid leukemia [OR: 2.01 (95% CI: 1.29-3.13]. Results should be interpreted with caution due to the potential of bias in the included studies and the small sample size in the exposed population. Exposure to ionizing radiation from diagnostic medical procedures during pregnancy does not appear to substantially increase the chance for childhood leukemia.

P.5

Space Radiation Exposure Simulation During Different Phases Of Solar Activity

*Paschalis P, Tezari A, Gerontidou M, Mavromichalaki H, Ioannidou SP**

National and Kapodistrian University of Athens, Georgetown University

Space radiation consists of galactic cosmic rays (GCR), solar energetic particles (SPE), and non-ionizing (UV-radiation), with a variety of health effects. The effects can be acute (radiation syndrome) or chronic (stochastic and/or non-stochastic). The occurrence of acute effects is mostly related to the high intensity SPEs, while chronic effects are due to long term exposure to GCRs. Therefore, exposure to space radiation may place astronauts and aviation crews under radiological risk. A variety of models has been developed to assess the tissue absorbed doses during SPEs. A new application, DYASTIMA-R, which constitutes a successor of the Dynamic Atmospheric Shower Tracking Interactive Model Application (DYASTIMA), based on GEANT-4 toolkit, has been developed in the frame of this work. This new Monte Carlo simulation tool can be used for the calculation of the equivalent dose during various flight scenarios. A cylindrical water phantom was used for the measurements. The dose levels were found to be directly related to the 11-years and the 22-years solar cycles of the GCR particle intensity. The GCR exposure peaks are anti-correlated to the solar activity being higher in solar minimum and lowest at solar maximum conditions. Moreover, the massive contribution of neutrons and other particles to the total equivalent dose rate is evident. This application can be used in the future to air-craft and spacecraft crews, passengers, airlines and tour operators, air-craft manufacturers, legislators and Civil Aviation.

P.6

Impact of Space Weather on Human Heart Rate During Solar Cycle 24

Ioannidou SP, Galata E, Mavromichalaki H, Gerontidou M, Ntakos G, Paravolidakis K, Benevides L

Georgetown University, National and Kapodistrian University of Athens, Nikaia General Hospital

Accumulating evidence suggests an association between space weather and parameters of human physiology. In this study, the focus is on the potential association between human heart rate (HR) and variations in cosmic ray intensity and geomagnetic activity. A total of 900 individuals were assessed during the time period from 2011 to 2015, corresponding to solar cycle 24. The study group was composed of 57% men, 41% women and 2% not provided. The heart rate of the subjects was monitored hourly using a Holter monitor device. The hourly variations of cosmic ray intensity (CRI) and the Disturbance storm time (Dst) were taken from the Neutron Monitor Station of the University of Athens and the Kyoto Observatory, respectively. The data was analyzed using Analysis of Variance (ANOVA) and Multiple Linear Regression analysis (MLR) to take into account the day time and adjust for inter-patient variability. In the ANOVA analysis, five levels were created for both CRI and Dst based on the respective normalized values showing statistically significant results. Results indicated that as the level of

CRI increases (less disturbed periods) the HR decreases. Similarly, as Dst index level increases (more disturbed periods), the HR increases. The MLR analysis showed the CRI was negatively associated with HR with a regression coefficient: -0.025 (95% CI: -0.179, -0.025) and p-value 0.009, and the Dst index was negatively associated with HR with a coefficient: -0.022 (95% CI:-0.035,-0.003) and p-value 0.023. The findings of this study appear to show a potential association between human heart rate and geomagnetic activity. However, our results should be interpreted with caution due to potential numerous confounders. Further studies with larger samples sizes which adjust for confounding parameters are imperative to support the association of our findings.

TAM-A1.1
Experiences Developing a Radiation Response Volunteer Medical Reserve Corps Unit

Elder D
University of Colorado Hospital

The Colorado Radiation Response Volunteer Medical Reserve Corps Unit is housed by the Central Rocky Mountain Chapter of the Health Physics Society with assistance from the Colorado Department of Public Health and Environment Office of Emergency Preparedness and Response. Since 2013, the unit has been training and developing procedures for operating a Community Reception Center to respond to a radiological incident. The more than fifty members come from many backgrounds, including nursing, health physics and emergency preparedness. They share a desire to help our communities react and recover from disasters involving radiation or radioactive materials by providing information, screening, decontamination and other support. Challenges have included minimal funding and an all-volunteer program. However, through training at local meetings and at the Center for Radiological/Nuclear Training for FEMA and tabletop exercises, a core group has developed the skill needed to respond if needed. Goals include drills to practice the skills for the various stations within a Community Reception Center and partnering with a hospital or other agency for a full scale exercise.

TAM-A1.2
The Use of Radioactive Sources for Local Law Enforcement Agency Training

Rubin WM
National Institutes of Health

The Montgomery County Police Department (MCPD) reached out to the National Institutes of Health (NIH) and inquired if NIH had radioactive sources available for the MCPD to use during their training exercises. For authorization to perform this type of work, the NIH amended its NRC license, procured sealed sources, obtained reciprocal recognition from the State of Maryland, and received approval by the NIH Radiation Safety Committee. Each of these entities had their own list of requirements that NIH had to commit to. Under these controls, NIH and Local Law Enforcement Agencies (LLEA) worked together to set up scenarios using multiple sources. The scenarios revolved around searching for hidden or unknown gamma-emitting sources using personal reading dosimeters and hand-held spectroscopy equipment. The training scenarios occurred in vacant office buildings, warehouses, parking lots, county fairgrounds, and police training facilities. These exercises empowered LLEA to become more familiar with using radiation detection equipment during these simulated response activities.

TAM-A1.3
An Overview of the Health and Safety Planning Guide for Planners, Safety Officers and Supervisors for Protecting Responders Following a Nuclear Detonation

Scott AL, VanHorne-Sealy JD
DHS, OHA, DOD

As the Interagency Policy Coordination Subcommittee for Preparedness and Response to Radiological and Nuclear Threats, led by the National Security Staff, was completing the Planning Guidance for Response to a Nuclear Detonation (2nd Ed, Jun 2010), it became evident that additional guidance for protecting responders following a nuclear detonation was necessary. This guide is that supplement to the aforementioned Planning Guidance for Response to a Nuclear Detonation, and is intended for response planners, safety officers and supervisors of responders to assist in the preparation for health and safety management in the initial 72 hours following an improvised nuclear device (IND) event and prior to the arrival of most federal response assets. This guidance broadly focuses on all potential response personnel and defines 'responders' as a diverse set of individuals who are critical to mitigating the potential catastrophic effects of an IND. This definition includes professional and traditional first responders; public health and medical professionals; skilled support personnel; emergency service and critical infrastructure personnel; volunteers; private sector personnel; and many more. The guide also emphasizes a holistic approach to risk management, making the point that there are many other risks in the emergency response environment, in addition to radiation, that must be taken into account. The recommended dose exposure guidance is in line with other published federal documents. The "Quick Reference Guide" included in Appendix A, and published separately, focuses on understanding the radiation hazards in a post detonation environment and the potential short and long term health effects. It is intended to be used by responders as part of an overall training and preparedness program, as well as a reference at the scene of an event.

TAM-A1.4
Permanently Reducing Risk Through Cesium-137 Irradiator Replacement

Garrison LM
National Nuclear Security Administration

Radioactive materials play a critical role in medical, industrial, and commercial applications. However, there are individuals who seek these materials for use in a "dirty bomb". The National Nuclear Security Administration's Office of Radiological Security (ORS) works to enhance global security by preventing the use of high activity radioactive materials in acts of terrorism. ORS accomplishes this mission through three strategies: Protect, Reduce, and Remove. ORS's Reduce program, the newest of the three, recognizes that there are some cases where it may be possible to utilize a non-radioisotope-based device in order to maintain or improve technical capability, while achieving permanent reduction in the risks associated with the malevolent use of radioactive materials. Within the Reduce program ORS established the Cs-137 Irradiator Replacement Project (CIRP), which provides an incentive for licensees to voluntarily convert from a Cs-137 irradiator to a non-radioisotopic device (e.g., X-ray irradiator). Through CIRP, ORS provides a limited financial incentive towards the purchase price of the replacement device. ORS also funds the recovery of the Cs-137 irradiator through the Offsite Source Recovery Project (OSRP). CIRP terms and conditions are subject to specific site details and availability of funding. By facilitating the adoption of viable non-radioisotopic alternative technologies, ORS complements its security mission by permanently reducing the threat and further preventing high activity radioactive materials from use in acts of terrorism.

TAM-A1.5
Communicating Between the Lines: The Need to Effectively Communicating Between Regulatory Limits and Emergency Threshold Model Guidance

VanHorne-Sealy JD
US Army Nuclear and Countering WMD Agency

Our profession has evolved to utilize one model for regulatory standards and others for actual risk. The Linear Non-Threshold Model (LNT) was created based on limited data in the 1970s and was recommended by Biological Effects of Ionizing Radiation (BEIR) VII report and that of the International Commission on Radiological Protection (ICRP). Over the last 40+ years additional data has suggested that actual risk is considerably different. Deterministic effects have been shown to manifest around 50 cGy. Stochastic effects data is inconsistent, with some areas of high background having lower probability of cancer. HPS advises against estimating health risk to people from exposure to near or less than natural background, yet background varies dramatically. Is a risk of cancer in 20+ years worth immediately risking lives and, if so, how do you justify it? NCRP emergency guidance is 50 cGy for lifesaving, federal guidance is 25 cGy and DoD guidance is 75 cGy in non-combat operations. So the challenge comes to us, how do we communicate why we have different standards? How do we answer the question, is it dangerous? Failing to effectively explain this, results in mistrust, poor decision making by leaders, unnecessary evacuations, anxiety, and all of the secondary and tertiary effects from each of those.

TAM-A2.1
The HPS Government Relations Program and Why It's Good For Society Members

Little CA
HPS Federal Agency Liaison

Among other things, the Health Physics Society (HPS) Government Relations Program (GRP) is designed to provide comments on proposed legislative and regulatory actions that have an effect on the mission of the Society and to allow HPS to be involved in the legislative and regulatory process for issues that affect the profession of health physics and the practice of radiation safety. The GRP features a federal agency liaison, a congressional liaison and a Government Relations Committee who work with society leadership to put forward the interests of the HPS with federal agencies, Senators, Representatives, their staffs and congressional committees. The GRP monitors potential agency rulemaking activities as well as legislation of interest to the society. The GRP works to be seen as an objective source of scientific information, the positions of which are valued for their content. The presentation describes the goals, organization and focus of the GRP and its value to society members.

TAM-A2.2
NRC/HPS: A Relationship that Informs Radiation Protection

Flannery C
U.S. NRC

With radiation protection as a common goal, the Nuclear Regulatory Commission (NRC) works closely with the Health Physics Society (HPS) on matters related to radiological protection and regulatory issues. The NRC and HPS keep each other informed about their activities and exchange information on current topics that are of common interest. NRC is working to ensure that open communication continues in order to fulfill its safety and security mission and leverage the work of the HPS. The purpose of this presentation is to introduce some regulatory matters that are of interest to the HPS and describe the collaborative efforts between the NRC and HPS. Regulatory issues that are in progress or are under consideration will be discussed as well as the process by which NRC engages the HPS and other stakeholders on current topics. NRC values recommendations and informed opinions and often base its regulations and guidance, at least in part, on the thoughtful input and feedback of the HPS.

TAM-A2.3
HPS Interaction with Congress

Connolly DA
HPS

The legislative program of the Health Physics Society is designed to allow Society representatives the opportunity to interact with Senators, Representatives, their staffs and those of the Committees of each body on matters of mutual interest to the Society and the Congress relating to radiation safety. After a brief overview of the structure of the two chambers of the Congress: the Senate and the House of Representatives, a description will be given as to the means and techniques that the Society utilizes to communicate with them. The presentation will focus on the semi-annual meetings of the Society's leadership team on Capitol Hill, and the day-to-day activities of the Congressional Liaison in maintain open lines of communication with the Congress.Finally, a number of the present issue areas of importance to the Society will examined along with a prediction about the future of science policy in the Trump Administration and the new Congress.

TAM-A2.4

Congressional Perspective on Budget and Science Priorities in the 115th Congress and New Administration

Cogliani L
Lewis Burke Associates

A presentation focused on budget and appropriations issues facing the 115th Congress and the new Trump Administration and how it impacts science priorities and health physics in particular. Mandatory spending cuts, known as sequester, will be back in force in FY 2018. Under current law, discretionary funding in FY 2018 would be $5 billion below FY 2017 enacted funding levels, which would result in cuts to existing programs and constraining new initiatives. However, pressure to increase defense spending and a recognition that discretionary spending is not a major contributing factor to the debt compared to mandatory funding programs like Social Security, increase the likelihood of at least another two-year budget deal, if not repeal of the sequester. The outcome of a budget deal will have significant impact on programs that support health physics. The presentation will also focus on examples of successful advocacy strategies and congressional engagement to help influence policy and budget decisions. Congress will continue to be a major driver of policy and budget decisions and it is critically important to engage with Members of Congress and their staff and have a clear, concise message on the importance of health physics.

TAM-A2.5

The HPS as a Welcome Stakeholder in EPA's Radiation Protection Program

Nesky AB, Boyd MA
U.S. EPA

In the United States, our citizens are given an opportunity to influence public policy in all three branches of government. They exert control over the legislative branch of government through the election process and they may bring suit in the courts when they believe the government has overstepped its legal authority. A more direct route exists for interacting with agencies of the Executive Branch through the many opportunities provided to the public for exchanging information and offering comments on proposed rules and guidance. Some of the more formal opportunities for collecting public opinion are required by the Administrative Procedures Act (APA). An easy way for anyone to offer comments on rules and certain guidance documents is through the federal website, regulations.gov. In addition, there are less formal means by which federal agencies can exchange information with interested stakeholders. At the U.S. Environmental Protection Agency (EPA), we frequently meet with environmental groups, representatives from industry, national and international advisory organizations, states, tribes and others to exchange information, hear differing viewpoints, and collect opinions on pending policy and regulatory initiatives. Managers and staff from EPA's Office of Radiation and Indoor Air usually meet with the leadership of the Health Physics Society (HPS) at least once per year. These meetings are mostly focused on information exchange. Although differing views may be offered on pending actions, the HPS visits are not lobbying opportunities. These visits provide an opportunity for the current HPS leadership to get to know the radiation program managers at EPA. They also provide HPS with a better understanding of EPA's ongoing projects and near term regulatory agenda, and strengthen professional ties between EPA and HPS.

TAM-B.1

Parametric Study on the Irradiation Field of a High Dose Rate Research Irradiator Design Baseline

Mickum S, Rushton R, Hope Z
Hopewell Designs

The present work explores the irradiation field parameters of a high dose rate research irradiator concept in comparison to the performance of a legacy irradiation system. A mainstay legacy irradiation system used internationally is the Gammacell 220 which is a self-contained, dry storage research irradiator developed in the late 1950s by Atomic Energy of Canada Limited and later Nordion. This system is capable of irradiating samples within a 20.47 cm tall by 15.49 cm diameter cylindrical chamber at Co-60 activities approaching 24kCi (nominally, 1.75 Mrad/hr). As a technical starting point, estimates of Gammacell 220 irradiation field parameters were modeled to determine dose uniformity ratios and absolute exposure rates achieved by the system. Several high-fidelity monte-carlo models utilizing the Los Alamos National Laboratory MCNP N-particle transport code (MCNP6) were developed for this investigation. A series of design perturbations were introduced to the model to limit operator exposure and maximize irradiation chamber volume for research irradiator systems while maintaining optimal dose uniformity ratios and absolute exposure rates. This talk includes an overview of the overall modeling effort, Gammacell 220 irradiation field performance, estimates of an improved irradiation design baseline and expected irradiation chamber dose uniformity ratio and absolute exposure rates for the new design baseline.

TAM-B.2

Engineering Heat Rejection in an Extreme Gamma Environment

Olszewska-Wasiolek MA, Prevost D, Hanson DJ
Sandia National Laboratories

A cobalt-60 source-holding fixture at the Gamma Irradiation Facility, called the "Shutter Array", has been built to create extreme gamma radiation environments, for applications in special materials and component testing. The Shutter Array is designed to change its "aperture", to adjust the strength of the radiation field experienced by the test object. In a small volume, test samples can be bombarded with up to 10E19 gamma particles per hour. Due to high energy deposition in the test object and the array itself, thermal environment within the array is a concern. This work describes the evaluation of radiation environments and the associated cooling methods that must be engineered to preserve the integrity of the test objects during irradiation.

TAM-B.3
Unique Shielding Considerations for a Newly Installed Hot Cell at the National Institutes of Health
Guarino SN
National Institutes of Health

In this presentation we review shielding design considerations for a hot cell using Curie quantities of C-11. A set of hot cells has been installed at the National Institutes of Health (NIH). Initial shielding design prints indicated that the shielding for the hot cells would be two inches on every side. After installation it was noticed that there were several large shielding penetrations in the roof. Additionally, the hot cells were constructed in a slightly different location than indicated on the drawings and the area above them had been converted from a storage room to an office that was to be occupied full time. When activity was introduced into the hot cell during testing, dose rates in the above office space were measured to be above acceptable levels. Following several attempts by the users to position lead bricks to reduce the dose rate, a unique shielding solution was developed and installed.

TAM-B.4
Radiological Toolbox 3.0.0
Dewji S, Hiller M, Hertel N, Eckerman K*
Oak Ridge National Laboratory, Georgia Institute of Technology, Easterly Scientific

The Radiological Toolbox software developed by Oak Ridge National Laboratory (ORNL) for U. S. Nuclear Regulatory Commission (NRC) is designed to provide electronic access to a vast and varied array of data needed in the field of radiation protection and shielding. Such data consolidates physical, chemical, anatomical, physiological, and mathematical parameters, which would otherwise require consulting multiple sources to retrieve this information. The software, although initially designed to serve the needs of the radiation protection specialist in the field, provides invaluable information to radiation protection and shielding specialists in electronic format. The latest release updated the software to accommodate changes in Windows operating systems. The features and functions will be explored. The Radiological Toolbox software is available from https://www.usnrc-ramp.com

TAM-B.5
How to Communicate Radiation Risks by Asking Questions
Johnson RH
Radiation Safety Counseling Institute

People have a vested interest in the answers they derive for themselves. They may not readily accept the answers provided by HPs, especially when those answers appear to contradict all that they have come to believe. While they may be interested in information, they may not want to be told what they should believe. Much of the public seems to readily accept and believe what they have always heard, namely that radiation is deadly. With that notion firmly entrenched at a subconscious level, and continually reinforced by media stories of “deadly radiation,” why would anyone spend energy re-evaluating their long-held views. Perhaps the best option for inviting people to explore other views is to begin by asking questions. This approach has to be done gently without implying that the other person’s current views are wrong. Asking questions that begin with, “Why. . . ?” may not be helpful. Such questions are associated with upset parents. More helpful questions could include: “What have you heard or come to believe about radiation?” Where or when did you learn that?” “What is the source of your information?” “What have you done to better understand radiation?” “Whom would you consider a credible resource about radiation?” “Have you ever talked with a specialist in radiation safety?” “Would you like to know how a radiation professional would answer a question about radiation safety?” “Have you gone through the steps from cause-to-effect for evaluating the risk from radiation?” “Would you be willing to go through these steps together?” HPs may have difficulties in this approach for asking questions (rather than giving answers) especially when confronting a person whose views on radiation are very different. The challenge is how to respond in a helpful way and avoid making others wrong or wanting to correct their technical misunderstandings.

TAM-B.6
Can We Change Our Habits to Improve Radiation Risk Communications?
Johnson RH
Radiation Safety Counseling Institute

Most people do not realize that their normal communication style is a habit developed from lifelong experience and choices. We began to develop our communication habits as infants when we began to learn how to get our needs met. Whatever approaches we found seem to work best we have continued to refine over our lifetimes. After practicing our preferred communication styles for decades, our approach to communication is now ingrained in our subconscious mind as a habit. This means that we do not consciously think about our preferred communication style, any more than we would take time to think about using our dominant hand for signing our name. Of course we are also generally not aware that our preferred communication style or habit may be different than that of others. We do know that we have trouble communicating with some people, especially about matters involving feelings and risks. HPs have long lamented the challenges of communicating radiation risks to frightened people or the media. We wish there was a magic formula that would allow us to be successful in risk communications. We wish someone would just tell us the steps to follow to assure success. In fact, numerous risk communication specialists have been telling us the steps for years. However, we may have learned from experience that knowing the steps does not guarantee success. Why not? The answer to the title of this talk is “Yes” with a major qualifier. To communicate in a different way requires that we change our normal communication habit. How hard is it to change a habit? All of you know, it is very hard to change habits, including our natural communication habit. We can change how we communicate, but it may be very difficult and require great energy to do so. If we want to be more effective radiation risk communicators we have to decide to commit the energy and the time to change our communication habits.

TAM-B.7
Conducting Radiological Surveys Using The Division Of Radiation Safety Electronic Survey System

Voegtli VL
National Institutes of Health

This presentation highlights the capabilities of the Division of Radiation Safety (DRS) to conduct comprehensive radiological surveys using a custom built mobile application at the National Institutes of Health (NIH). The DRS Electronic Survey System (DRESS) is a secure Java application that runs on an encrypted tablet PC in which surveyors use to verify laboratory information, radioactive material usage, survey meter calibration and other compliance items. The application also allows the surveyor to input data such as smear locations and areas of contamination found during survey on a detailed map of the laboratory. After surveys are completed data are transferred through secure connection from the device to the Radiation Safety Comprehensive Database (RSCD) where it is filed into a queue to await review. An overview of the electronic review and follow up procedures of completed surveys are detailed in the discussion. Conclusion of the presentation includes an examination of the successes and specific challenges in adopting this system and a discussion on its future developments and expansion of the DRESS system.

TAM-B.8
Enhanced Radiation Protection Measures Against Severe Accidents Based on Lessons Learned from the Fukushima Accident

Jeon IY
Korea Institute of Nuclear Safety

The Fukushima nuclear power plant accident served as a momentum to raise awareness of a likelihood that severe accidents can occur and how we are underprepared for such accidents in every aspect of safety. Without exception, the accident raised questions concerning radiation protection whether we are ready to take another challenge for radiological safety of workers and public. Based on the lessons learned from the Fukushima Accident, this study intended to reveal what factors should be addressed in radiation protection against severe accidents, and what aspects should be improved for occupational and public radiation safety. The study findings indicate that a combination of factors related to the accident condition such as earthquake, loss of power, and night may require introduction of more enhanced accident countermeasures with software and hardware improvement in radiation protection. In addition, this study discusses an on-going improvement in radiation protection against severe accidents in Korean nuclear power plants including within-building, on-site, and off-site radiation monitoring, protective measures to emergency workers, radioactive waste management, and CFVS (Containment Filtered Ventilation System).

TAM-C.1
Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards

Borras C
Consultant

Intergovernmental organizations involved in radiation protection and safety such as the World Health Organization and the International Labour Office, collaborate periodically with the International Atomic Energy Agency to elaborate -following primarily recommendations of the International Commission on Radiological Protection- what is colloquially known as the Basic Safety Standards, the BSS, a set of requirements adopted/adapted world-wide as national radiation protection legislation/regulations. Traditionally, patient exposure, the consequence of a medical act, was outside regulatory control. However, strong medical exposure requirements appeared in the 1996 BSS and were expanded in the 2014 edition. The 2014 BSS assigns responsibilities specific to medical exposures to the government, the regulatory body, principal and other parties and ethics committees. While the radiation safety officer was always a prominent figure in the BSS, the 2014 version makes explicit the roles of relevant health professionals: the "radiological medical practitioner", the "referring medical practitioner", the "medical radiation technologist", and the medical physicist. The government, "as a result of consultation between the health authority, relevant professional bodies and the regulatory body", ensures that the parties involved are authorized to assume their roles and responsibilities and are notified of their duties. The 2014 BSS sets standards for justification of the practices, specifying the interaction of the radiological medical practitioner and the referring medical practitioner, and for the optimization of protection, including design and operational considerations as well as source calibration, clinical dosimetry and quality assurance. Additional requirements address pregnant or breast-feeding women, release of patients after radionuclide therapy and unintended and accidental medical exposures. The section ends with standards on radiological reviews and records.

TAM-C.2
Why Is Epidemiology an Important Component of Radiation Protection Standards?

Shore RE
Formerly, Radiation Effects Research Foundation and New York University School of Medicine

Experimental radiobiological data are limited for quantifying radiation risk and setting radiation protection standards because such studies fail to mimic the heterogeneous genetic and exposure (e.g., diet, lifestyle) characteristics of human populations. Hence, we need epidemiologic studies of human health effects, informed by the radiobiological data. For decades, radiation protection standards were based on the Japanese A-bomb survivors who had relatively high, acute exposures, but most exposures today are low and at low dose rates. Therefore risks need to be assessed from high-quality studies of well-characterized cohorts of persons exposed at low doses and/or low dose rates. This presentation will review the available epidemiologic evidence based on occupational, environmental and diagnostic medical exposures, as they apply to risk assessment and radiation protection standards.

TAM-C.3
NRC Patient Safety Culture

Howe D
USNRC

The US Nuclear Regulatory Commission's (NRC's) Medical Policy Statement affirms that in addition to the physician's primary responsibility for the protection of their patients, NRC has a necessary role with respect to the radiation protection of patients. NRC's general medical regulations protect patients by ensuring instruments are calibrated, spills are cleaned up, and authorized individuals and Radiation Safety Officers are trained in radiation safety. NRC's specific written directive, procedures for administrations requiring a written directive, and medical event reporting requirements address the direct regulation of patient radiation safety when justified by the risk to patients. The licensees' implementation of general and specific patient radiation safety requirements is the core of patient safety culture. Some of the positive safety culture traits leading to good patient safety culture are personal accountability, continuous learning, environment to raising concerns, effective safety communication and questioning attitude.

TAM-C.4
How Have Federal Agencies Used Federal Guidance Report No. 14 to Enhance Their Medical X-ray Programs in Medicine, Dentistry, and Veterinary Practice

Keith S, Boyd M, Leidholdt E, Bower M
CDC, EPA, VA, ARMY

On January 15, 2015, U.S. Environmental Protection Agency Administrator Gina McCarthy signed Federal Guidance Report No. 14: Radiation Protection Guidance for Diagnostic and Interventional X-Ray Procedures (FGR-14), finalizing a multiyear, interagency effort to update federal x-ray guidance. FGR-14 is a toolkit that provides guidance to agencies and facilities on equipment, quality assurance, personnel and procedures for radiography, CT, fluoroscopy, interventional fluoroscopy, and bone densitometry. The guidance also covers radiation shielding, training and credentialing, requesting, performing and supervising imaging studies, and managing imaging informatics. Many of the recommendations in FGR-14 have been identified as best practices by international and U.S. radiation protection organizations and professional medical organizations. Others are free-standing guidance that is not codified in other places. Readers tell us that FGR 14 is "state of the art" and the most comprehensive document of its type available. It puts topics of x-ray safety interest in one neat location and fills gaps where other documents have become less current. It often informs the reader about aspects of the field of which they were not aware, so it is a teaching aid. While not binding on any agency or facility, incorporating the recommendations defined in this guidance will improve the safety of diagnostic and interventional imaging. Chiefs of different specialties and radiation safety officers use the guidance in developing cohesive and cogent policies.

TAM-C.5
Organ Doses From Diagnostic Medical Radiography — Trends Over Eight Decades (1930 to 2010)

Melo DR, Miller DL, Chang L, Moroz B, Linet MS, Simon SL
Melohill Technology LLC, Food and Drug Administration, National Cancer Institute - NIH

This study provides a retrospective assessment of doses to 13 organs for the most common radiographic examinations conducted between the 1930s and 2010, taking into account typical technical parameters used for radiography during those years. This study is intended to be a resource for documenting changes in medical radiation exposure over time and to support retrospective epidemiological studies of radiation health risks. We summarize from the literature and derive from our own assessment estimated doses to the brain, esophagus, thyroid, red bone marrow, lungs, breast, heart, stomach, liver, colon, urinary bladder, ovaries and testes based on 14 common radiographic procedures. The dose estimates were based on radiographic exposure parameters described in textbooks widely used by radiologic technologists from 1939 to 2010. The derived estimated doses presented here are believed to be representative of typical organ for an average size adult who might be considered to be similar to the reference person. There were large variations in organ doses among the different types of radiographic examinations. Doses were highest in organs within the area imaged and next highest in organs in close proximity to the area imaged. Estimated organ doses have declined substantially (overall 22-fold (+38)) over time as a consequence of changes in technology, imaging protocols and protective measures. For some examinations, we observed only slight differences in doses for the decades of the 1960s, 1970s and 1980s due to minor changes technical parameters. Substantial dose reductions were observed in the 1990s and 2000s.

TAM-C.6
Tracking and Estimating Organ Doses in Radionuclide Imaging

Thomas J
Via Christi Health

TJC standards in diagnostic imaging which became effective 01 July 2015 include requirements for dose tracking in CT examinations and verification of administered activity in Nuclear Imaging. During implementation of these revised TJC standards our health care system decided to extend the dose tracking to Nuclear Imaging. We have developed software to validate the radionuclide dose given for each examination. Tracking now includes statistics for the total activity handled, administered activity for each imaging procedure, range of administered activity and calculated organ doses for each administered radionuclide and chemical form. This presentation will share the rationale for extending dose tracking from CT to Nuclear Imaging and will show how this is a tool for improved management of Nuclear Medical Imaging.

TAM-C.7
FDA Efforts to Improve the Safety of Radiological Medical Imaging Devices and Radiation Emitting Electronic Products

Ochs RA
FDA/CDRH

The U.S. Food and Drug Administration (FDA), Center for Devices and Radiological Health (CDRH) regulates radiological medical devices and radiation emitting medical and non-medical electronic products. FDA's regulatory authority includes the premarket review of medical devices, post-market surveillance, and coordination with FDA district offices for inspections, imports, and lab sampling of regulated products. FDA also partners with key professional organizations, industry, other governmental agencies, other regulators, standards developing organizations, and the public. This talk will summarize FDA's regulatory authorities to protect and promote public health as well as ongoing areas of safety concerns and challenges, such as unnecessary radiation exposure from diagnostic imaging equipment and imports of noncompliant products. Initiatives to address these challenges and enhance the safety of regulated products will be discussed, including revisions to international safety standards, nationwide diagnostic x-ray surveys, safety communications for medical and non-medical equipment, updated regulations, and coordination to improve inspections and lab sampling. The intended outcome of the talk is to provide the audience with a better understanding of FDA's regulatory authority and efforts to improve product safety.

TAM-D.1
Electric Power Research Institute Research Related to Radiological Environmental Protection at Nuclear Power Plants

Kim K
Electric Power Research Institute

Nuclear power plants implement groundwater protection programs and controls to ensure effluents to the environment are As Low As Reasonably Achievable (ALARA.) In the United States all nuclear power plants have voluntarily committed to implementing groundwater protection programs at their sites during operations through the industry "Groundwater Protection Initiative." The United States Nuclear Regulatory Commissioning (US NRC) provides regulations and guidance associated to limiting and calculating doses to the members of the public due to effluents. Nuclear power plants implement effluents controls programs to comply to these regulations. Plants apply the principals of ALARA and generally use conservative calculations to demonstrate compliance with the regulatory limits. More accurate dose estimates may be useful for stakeholder communications and to inform research related to the estimated doses to the public. EPRI conducts research and provides further technical guidance to support the nuclear power plants implementation of robust groundwater protection programs and accurate accounting of nuclear power plant effluent doses to the members of the public. This presentation discusses nuclear power plant groundwater protection, off-site dose calculations, and EPRI research that supports these functions.

TAM-D.2
Lens of the Eye Dose Considerations for Nuclear Power Plants

Quinn D
DAQ, Inc.

Nuclear power plants in the U.S. do not currently have a major concern with lens of the eye dose. The USNRC limits for the lens are 150 mSv per year compared with 50 mSv per year for total effective dose equivalent (TEDE). There are certain conditions at nuclear power plants that will cause the lens dose to exceed the whole body dose. These include exposure to high energy beta and exposure to non-uniform radiation fields such that the eye receives a higher dose than the whole body. However, with the current lens dose being three times the whole body dose, it is a very rare situation where the lens dose will reach 15 mSv before TEDE reaches 50 mSv. Because of this large dose limit difference, there is little need to closely monitor and limit the lens dose. If the USNRC reduces the lens limit to the same as the whole body TEDE limit, then even small increases of lens dose over whole body dose must be considered. If or when that limit change occurs, several things will become much more important. These include the capability of the dosimeters to accurately measure high energy beta, the ability to place dosimeters near the lens, the ability to measure lens dose rate with a field instrument, knowledge of the protection factors (from beta) of safety glasses and other equipment, and methods of effective dose equivalent calculations.

TAM-D.3
Overview of Connecticut Yankee Decommissioning

Tarzia J
Radiation Safety and Control Services, Inc.

The Connecticut Yankee (CY) Haddam Neck Plant was a 600 MWe commercial pressurized water reactor plant that operated from 1968 to 1997. A decision to cease power operation was announced on December 4, 1996 based on an economic analysis of the facility. During its successful 29 year history, the plant achieved many national and international operating records and its total electrical output exceeded 110 Billion KW-Hrs.

CY was one of the first sites to decommission under the new decommissioning rules enacted in the 1990s. The CY decommissioning encountered a number of unique political, regulatory, and physical challenges including a significant transuranic source term and challenging groundwater issues.

This presentation discusses Connecticut Yankee's (CY's) decommissioning strategy and highlights the challenges and successes encountered to achieve final unrestricted release.

TAM-D.4
Preparing for the SAFSTOR Method of Decommissioning at the Kewaunee Power Station
Shannon DJ
Dominion

This presentation provides a summary of the challenges associated with preparing a nuclear power plant for the SAFSTOR method of decommissioning. The Kewaunee Power Station (KPS), located in the town of Carlton, WI permanently ceased operation on May 7th, 2013, and was permanently defueled on May 14th, 2013. The plant is being decommissioned using the SAFSTOR method. In 2013, there were only a few nuclear plants in the United States that had utilized SAFSTOR for decommissioning, and none that had recently used this method. The challenges associated with preparing a plant to enter SAFSTOR are summarized into three main areas: Plant, Programs, and Personnel. Plant considerations include chemistry controls, venting and draining systems, radiological effluent discharge controls, and system reclassification and abandonment. Program considerations include regulatory, licensing, design basis, and radiation protection process/procedure changes. Personnel considerations include creation of a decommissioning planning team, development of a SAFSTOR organization, selection and retention of key personnel, and reduction of plant staffing levels while continuing to maintain nuclear, radiological and industrial safety. With several more nuclear plants planning to enter decommissioning using the SAFSTOR method, this presentation provides recent operating experience and actions needed to address the challenges.

TAM-D.5
What is KT and R? Evolution of People Programs and Policies
Benevides E
NEI

The U.S. nuclear industry's workforce is no longer ageing, but getting younger. During the transition of the industry's workforce, the industry addressed knowledge transfer and retention by implementing a variety of programs, policies and people. The presentation will share industry best practices and lessons-learned as the industry addressed the ageing nuclear workforce reality.

TAM-D.6
Communicating Radiation Protection Issues with the Public
Mayer D
xxx

Communicating with external stakeholders is undeniably an important day-to-day business function. When potentially contentious and/or news worthy events occur external communications can rapidly become a "business critical" activity. A key-overriding tenet especially during times of stress is open and honest communication. Trust is an earned commodity that is extremely difficult to regain once lost or weakened. Radiation risk related communications, while offering their own unique jargon are not substantially different from that of other industrial communications when it comes to the need for stakeholder trust and clarity. There are actions that can and should be taken in preparation for the almost inevitable issue requiring an "off site" communication. Public relations and government affairs personnel can provide important insight and leveraging relationships of internal employees with offsite counterparts can have benefits in sustaining or building credibility. The importance of having your internal approval and messaging process well understood to minimize delays will also be reviewed. During initial notification, having a clearly defined message is an obvious requirement and one that will often necessitate internal review and vetting. Working out the vetting process upfront is key. As issues develop ongoing "update" communications may be necessary and can be burdensome however do not underestimate their importance in fostering and/or maintaining credibility and ensuring the facts are spoken by your organization rather than mouthed by others. These ongoing discussions must be carefully strategized so that you ensure the messages stay focused and clear. Some of the key attributes of an early and ongoing communication plan will be discussed based on over 10 years of experience (what worked and what did not). Examples include: importance of a bounding dose assessment, jargon, projections of potential outcomes, establishing a routine update process based on issue significance and level of community concern.

TAM-D.7
Delivering the Nuclear Promise: Advancing Safety, Reliability, Economic Performance and Radiation Protection Efficiencies
Anderson E
NEI

Companies that operate America's nuclear energy facilities are partnering on a multiyear strategy to transform the industry and ensure its viability for consumers as well as its essential role in protecting the environment.

This strategic plan, called Delivering the Nuclear Promise: Advancing Safety, Reliability and Economic Performance, will strengthen the industry's commitment to excellence in safety and reliability, assure future viability through efficiency improvements, and drive regulatory and market changes so that nuclear energy facilities are fully recognized for their value.

The industry has set an intrepid goal of defining opportunities to achieve 30 percent reduction in costs, in aggregate, across the industry by 2018. Pursuit of this broad industry goal will generate innovative thinking and new solutions in making an efficient industry even leaner. Teams of industry experts, including a team from Radiation Protection, have identified initial areas where cost efficiencies or process improvements may be gained.

This presentation provides an overview and status of the Delivering the Nuclear Promise initiative, including those efficiencies targeted for radiation protection.

TPM-A1.1

Room Submersion Calculations of Noble Gas Dose Rate Coefficients

Veinot K, Dewji S, Hiller M, Eckerman K, Easterly C, Hertel N*
Y-12 National Security Complex, Oak Ridge National Laboratory, Easterly Scientific, Georgia Institute of Technology

The International Commission on Radiological Protection (ICRP) Publication 116 reports external dose coefficients for the ICRP 110 male and female voxel phantoms, in six standard irradiation geometries while dose coefficients for environmental exposures, such as immersion in a cloud of radioactive gas, have been reported broadly in the literature. For environmental exposure scenarios, dose coefficients are typically calculated for persons immersed in a semi-infinite cloud, submersed in water or standing on contaminated ground. In ICRP Publication 30, dose coefficients were tabulated for workers exposed to airborne noble gas radionuclides in various workplaces. In this work, such coefficients have been derived using the ICRP reference voxel phantoms positioned in rooms representing an office, laboratory, and warehouse. The coefficients address photons, electrons, and positrons emitted uniformly in the air of the rooms. This work was supported by the U.S. Nuclear Regulatory Commission under Interagency Agreement number DOE 1886-T249-06/1886-T233-06 and was prepared by Oak Ridge National Laboratory, managed by UT-Battelle, LLC, for the U.S. Department of Energy under contract DEAC05-00OR22725.

TPM-A1.2

DoD Biodosimetry Network: Gap Identified and Justification for Proposed Network

Reyes RA
DHS

A joint biodosimetry effort that can provide the best possible result of dose continues to be a capability gap in the DoD. This was identified: (1) at a post-Fukushima reactor accident medical response briefing with all of the Services' Surgeons in June of 2011; (2) in a Capability Gap study by Nuclear Matters in 2012-13; (3) at a Joint Requirement Office led, multi-DoD Service, multi-DoD Components, and Combat Commands exercise in Spring 2014; and (4) in a letter from the NCRP to the Defense Health Agency in September of 2014. In an attempt to fill this gap, DoD sponsored a three-phase project for establishing a Biodosimetry Network. The first two phases of the project were: I. CONOPS Development; and II. Development of Courses of Action for Biodosimetry Network. They were completed under a Battelle contract. The third phase, Operational Network, has not been completed due to funding and certification challenges..

TPM-A1.3

Comparison of Organ Doses for PIMAL Stylized Phantoms in Upright and Bent Positions for Various Irradiation Geometries

Reed L, Dewji S, Hiller M*
Georgia Institute of Technology, Oak Ridge National Laboratory

A joint biodosimetry effort that can provide the best possible result of dose continues to be a capability gap in the DoD. This was identified: (1) at a post-Fukushima reactor accident medical response briefing with all of the Services' Surgeons in June of 2011; (2) in a Capability Gap study by Nuclear Matters in 2012-13; (3) at a Joint Requirement Office led, multi-DoD Service, multi-DoD Components, and Combat Commands exercise in Spring 2014; and (4) in a letter from the NCRP to the Defense Health Agency in September of 2014. In an attempt to fill this gap, DoD sponsored a three-phase project for establishing a Biodosimetry Network. The first two phases of the project were: I. CONOPS Development; and II. Development of Courses of Action for Biodosimetry Network. They were completed under a Battelle contract. The third phase, Operational Network, has not been completed due to funding and certification challenges.

TPM-A1.4

Declared Breastfeeding Worker Program

Fisher TE
National Institutes of Health

The Nuclear Regulatory Commission offers clear regulations and guidance regarding declared pregnant workers. While there is guidance addressing breastfeeding recommendations for mothers who have been administered a medical radionuclide, there is little to no breastfeeding guidance for working with open forms of radioactivity. Due to an incident involving a nursing worker experiencing an uptake of a radionuclide, a need to address the potential for radiation exposure to a nursing infant was realized. As a corrective action to this incident, the National Institutes of Health introduced a Declared Breastfeeding Worker program to complement the Declared Pregnant Worker program. The program is designed to prevent a dose to a nursing infant from exceeding 1 mSv by employing a bioassay scheme appropriate for the radionuclide(s) encountered in the mother's work. This presentation reviews the aforementioned incident, discusses the thought process that went into developing the program, and describes the program as it is today, a decade after its inception.

TPM-A1.5

Methodology to Compare the Relative Protection of Total Body and Effective Dose Limits

Littleton B, Marschke S
US Environmental Protection Agency, S. Cohen & Associates

The current 40 CFR Part 190 "Environmental Radiation Protection Standards for Nuclear Power Operations" is based on ICRP Publication 2 methodology, i.e., total body dose and organ dose limits. The US EPA is considering revising and updating Part 190 to utilize more recent ICRP recommendations, i.e., effective dose.

However, if updated, the US EPA would want to provide a level of protection under any revised regulation that is at least as stringent as what is allowed by the current Part 190. Comparing dose conversion factors, is one method to determine the relative protectiveness of different methodologies. However, when multiple exposure pathways are involved (i.e., inhalation, ingestion, and external for airborne releases), comparing dose conversion factors will not work. Therefore, a methodology was devised to compare the relative protection of total body/organ dose based regulations to effective dose based regulations. In this methodology for the different fuel cycle facilities releases that result in meeting each type of dose limit were determined, using typical, representative parameters to describe each facility and the surrounding environment. The dose limit (total body/organ or effective) that has the smallest release is the most protective. This paper describes the details of this methodology, its results, as well as a comparison to EPA's lifetime risk goal of less than about 1 x 10^{-4} and EPA's 2011 Blue Book dose-to-risk relationship.

TPM-A1.6

A 3D-Printing Method for the On-Demand Fabrication of Patient-Specific Anthropomorphic Phantoms with Multiple Tissues Represented

Mille MM, Kuzmin GA, Zimmerman BE, Lee C
National Institutes of Health, National Institute of Standards and Technology

Three-dimensional (3D) printing holds great promise to allow the on-demand fabrication of dosimetry phantoms from patient-specific anatomical images. However, previous efforts have consistently identified two barriers to progress: (1) The limited variety of 3D-printing materials for simulating tissues with mass densities ranging from 0.25 g/cm^3 (lung) to 1.85 g/cm^3 (bone); and (2) The inability to print parts from multiple materials simultaneously. To our knowledge, there is no 3D-printing technology available today which can overcome both of these challenges. This paper describes how a commercial thermoplastic extruder can be used to print phantoms with multiple tissues represented (except bone yet), during a single build process and using only one plastic. Our method uses the fill density print setting which creates an internal grid of plastic with air gaps of variable dimension. An infill of 100% creates a solid part, whereas a lower setting results in a smaller mass density (spatially averaged). Using this approach, we developed a calibration curve relating the fill density setting to the radiological density of a printed part as observed on x-ray CT. Initial testing with blocks of printed PLA plastic showed that the radiological density can be varied from 35 HU to -770 HU as the fill density is changed from 100% to 30%. As a demonstration, we developed a CAD model of a 4 cm section of an adult male torso with 5 segmented tissues: lung, fat, muscle, bone, and esophagus. This model was then downscaled by 40% to fit within our printer's build volume. The lung, fat, and muscle were printed in a single process using fill densities of 35%, 95%, and 100%, respectively. The bone and esophagus (air) regions were left as negative space. The bones were later filled in with a tissue-equivalent casting resin. While a comprehensive 3D-printing solution remains elusive, our research shows that much can still be accomplished within the limitations of current technology.

TPM-A1.7

Impact of Body Size on Dosimetry Calculations in Nuclear Medicine: The Need for Size-Dependent Computational Phantoms

Villoing D, Huang S, Liu J, Yao J, Summers D, Lee C
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Over the past decades, assessing the most accurate absorbed dose delivered to tumors and healthy tissues in Targeted Radionuclide Therapy has become crucial for optimizing those treatments, and patient-specific dosimetry stands as gold standard. Since it is not always possible to perform dosimetry on real patient images, realistic computational human phantoms for different age and gender are available to this end. However, aside from age and gender, body size could also impact the absorbed dose. The current study aimed at investigating how much those reference-size computational phantoms can represent patients with different Body Mass Index (BMI). To this end, Computed Tomography images from 10 adult patients (6 males, 4 females, BMI of 22.8-30.9) were collected from National Institutes of Health Clinical Center and major organs were segmented via an atlas-based/threshold algorithm. S-values were calculated for the 10 patients via Monte Carlo code GEANT4 for the pairs of 4 source/target organs (liver, spleen, kidney, and pancreas) for Iodine-131. The results were compared with the values calculated from International Commission on Radiological Protection (ICRP) 110 reference adult phantoms. Significant S-values differences were observed between patient-specific anatomy and ICRP reference phantoms, from self-absorption in kidneys (ratio of patient to ICRP 0.92 0.10 over all patients) to spleen/pancreas cross-irradiation (ratio of patient to ICRP 2.60 0.76 over all patients). Moreover, a correlation between S-values and BMI was observed: best mono-exponential fits were obtained for liver/pancreas and liver/ spleen cross-irradiation with the R-squared of 0.71 and 0.52, respectively. This study highlighted the inadequacy of using S-values calculated from average-sized reference phantoms to perform internal dosimetry for patients with different body sizes. The recent development of body size-specific phantoms may help to provide body size-specific S-values.

TPM-B1.1

Creating Hidex 300 SL Triple Label Quench Curves

Ball KF
National Institutes of Health

This presentation addresses the problem of creating a triple label quench curve for the Hidex 300 SL. Due to an error in the MikroWin operating program for the Hidex 300 SL, it was impossible to create a triple label quench curve the way Hidex had originally designed. In order to create a quench curve two ratios are needed per curve: the two Region of Interest Ratio and the Isotope Efficiency Ratio. This means that for a triple label six ratios are needed. The MikroWin Version 4.44 (English UI) only has the ability to use five. LabLogic, Hidex, and MikroWin attempted to solve this problem with the MikroWin Version 5.55 (English UI), but because of a miscommunication error among these companies the wrong problem was fixed. Due to this error the triple label quench curves must be entered manually using the program Null Driver. Using Null Driver, three dual label quench curves were created to determine the proper settings for the Regions of Interest for the final triple label quench curve. Quench sets for Tritium, Carbon-14, and Chlorine-36 were used for this determination and each set was counted thirty times to establish a mean for use in the MikroWin program. Chlorine-36 was used instead of Phosphorus-32 to eliminate potential issues with decay of Phosphorus-32 during the experiment. All programming was verified using a Microsoft Excel spreadsheet and the quench curves were placed into service.

TPM-B1.2
Experimental Validation of Secondary Neutron Dose from TOPAS with Bubble Detectors
Kuzmin GA, Mille MM, Thompson A, Lee C
National Cancer Institute, National Institute of Standards and Technology

In the last several years, the use of proton therapy has been increasing due to its promise of a dosimetric advantage over conventional photon therapy, which is of great importance in pediatric patients who have a higher risk of developing late effects. During proton therapy 90% of scatter dose is due to neutrons that can scatter out of the treatment field. In order to conduct epidemiological investigations of the risk of the long term adverse health effect in proton therapy patients, it is imperative to accurately assess radiation dose to healthy tissue. Tool for Particle Simulation (TOPAS) based on the GEANT4 Simulation Toolkit may be a computational option for normal tissue dosimetry to support large scale epidemiological investigations of proton therapy patients. While previous works have benchmarked TOPAS for proton dosimetry within treatment fields, there is a lack of validation for neutron scatter and energy spectrum. In the current study, we measured the energy spectrum of scattered neutrons using a simple phantom with Bubble Detectors irradiated by Californium-252 neutron source.

We conducted neutron measurements under a collaboration with the National Institute of Standards and Technology (NIST). We utilized bubble detectors (BTI, Canada) to measure neutron dose and energy spectrum. They are polymer gels with small droplets of a superheated gas that expand to form bubbles after an interaction with neutrons. The detectors provide six energy thresholds from 10 keV to 10 MeV. To simulate neutron scatter a polyethylene cylindrical phantom was milled for the detectors to be placed inside. Then it was irradiated with a Californium-252 neutron source to simulate secondary neutrons. Then we simulated the experiment in TOPAS to compute the neutron dose and energy spectrum. The measured spectrum was unfolded and compared to the simulated spectrum showing to be in good agreement. We validated the dose and energy spectrum of scattered neutrons computed from TOPAS Monte Carlo code by the measurements using the Bubble Detectors.

TPM-B1.3
Technology Developments in Monitoring Radiological Incidents in the Environment
Menge JP
Bertin Corp

People are terrified that they're being exposed to radiation all the time, whether from distant nuclear accident or following Radiological Dispersal Device (RDD) and/or Improvised Nuclear Device (IND) incidents.

The evolution of environmental monitoring has changed significantly since Chernobyl and Fukushima. The embracement of communication with deployable detectors and fixed installation ring of detectors of dose rate and gamma spectrometry provide key data to determine the appropriate actions to be taken the Protective Action Guidelines (PAGs).

As known, releases of radiation to the environment of gamma emitting radionuclides lead to external radiation exposures to the public. The importance of estimating the dose to the public for length of time became significant after Chernobyl and recently Fukushmia.

The identification of isotopes in the environment via gamma spectrometry in the air allows for the determination of external exposures of radionuclide specific absorbed dose rates and dose in a given time period to the public.

A review of the technology for use in radiation monitoring systems provide the key attributes for consideration in any radiation emergency monitoring systems. This presentation is focused on these key points for the instrumentation selection criteria to be utilized in upgrading/enhancing environmental monitoring systems.

TPM-B1.4
Drone UAV Instrumentation Selection Criteria
Menge JP
Bertin Corp

During a radiation incident whether from nuclear accident or following Radiological Dispersal Device (RDD) and/or Improvised Nuclear Device (IND) incidents, various quantities of particulates, vapors, gases and radionuclides are discharged to the environment. Ground level monitoring by field teams is outdated when we can use technology to measure stack emissions and plumes with Outfitted UAV Drones.

The evolution of UAV has significantly changed how we can think about monitoring plumes since Chernobyl and Fukushima. The embracement of UAVs with deployable detectors can provide key informational data of dose rate and gamma spectrometry to determine the appropriate actions to be taken the Protective Action Guidelines (PAGs).

In the event of a nuclear meltdown or other radiation incident, evacuations will inevitably jam major ground transportation arteries making response and conventional radiation surveys difficult, if not impossible. The use of UAVs is unaffected by the roadway conditions.

The smaller hobby drones offered for EPLAN applications with a 15 - 20 minute flying times are simply not practical for real world

Emergency Planning scenarios

A review of the technology for use with drones and the associated limitations of drones to provide reliable data. This presentation is focused on these key points for the instrumentation selection criteria to be utilized in UAV systems.

TPM-B1.5
Dose Calibrators-Measurements and Quality Assurance

Yusko MA
Capintec, Inc.

The presentation is a basic review of dose calibrators, their proper use, applications and limitations, measurement and calibration processes, and emerging areas of interest. It includes principles of operation and important design criteria for the types of models which are commonly used today in radiopharmacies, nuclear medicine and PET facilities, isotope production and sites, as well as biomedical, pharmaceutical, industrial, and academic research. It also includes a review of Quality Assurance Procedures, both yesterday and today, and well as common measurement errors. It is important to note that differences in design may require different QA procedures. For example an analog calibrator has different requirements when compared to a microprocessor or PC based calibrator. NRC regulations as defined in 10 CFR Part 20 Section 35.60 now refers to Manufacturer's Instructions or Nationally Recognized Standard. The topic is of interest to Health Physicists who are responsible for Radiation Safety and licensing requirements in facilities which use a dose calibrator.

TPM-B1.6
A Very Portable In-situ Gamma Spectrometer with Collimated CZT Detector

Bronson F, Muller W, Zickefoose J, Herman C
Canberra

Cadmium-Zinc-Telluride [CZT] detectors for gamma spectroscopic measurements and room-temperature operation have had a long history of promising good performance in the near future. Very small detectors [0.05-0.5cm3] have been commercially available for many years, but their small size creates problems for spectroscopy because of very low photopeak efficiency, especially at medium and high energies. Large CZT [4-6cm3] detectors have been shown to work nicely when complicated electronic and data processing algorithms are applied. We report here test results from a commercially available 1 cubic centimeter CZT detector housed in a portable custom Tungsten shield with a set of collimators with different apertures. The detector has 2-2.5% FWHM resolution at Cs-137 energies, and near-Gaussian shaped peaks. Efficiency calibrations can be quickly made for a wide variety of geometries using the ISOCS mathematical efficiency software. We show validation tests comparing accuracy of measurements on reference calibration point sources, line sources, and 200 liter drums. The low weight of the device [10kg including the shield and collimator] and low power [powered via USB from the PC] makes these devices particularly suitable for human-deployed in-situ measurements of large objects containing medium levels of activity – e.g. characterization of objects encountered during decommissioning, or waste being shipped to a disposal facility.

TPM-B2.1
The United States Nuclear Regulatory Commission Radiation Protection Computer Code Analysis and Maintenace Program

Bush-Goddard S, Nguyen M
Nuclear Regulatory Commission

The Radiation Protection Computer Code Analysis and Maintenance Program (RAMP) is the U.S. Nuclear Regulatory Commission's (NRC's) program for developing, maintaining, and distributing radiation protection, dose assessment, and emergency response computer codes. The codes in RAMP are RASCAL, RADTRAD, VARSKIN, GENII, HABIT, GALE, DandD and MILDOS. In addition RAMP distributes the Radiological Toolbox and PiMAL and graphical user's interface. RAMP codes are used extensively by NRC staff, other Federal agencies, Agreement States, licensees and international partners. This presentation summarizes the history and current status of these codes, the need for RAMP, and the benefits to its stakeholders. This presentation also discusses alternatives to RAMP, current activities, and future plans for the program. RAMP is a new initiative at the NRC, but it is patterned after successful programs that have been in place for decades for NRC's thermal hydraulic and severe accident computer codes. The thermal hydraulic program is called the Code Application and Maintenance Program (CAMP) (SECY 97 134, "Commercial Use of NRC Developed Thermal Hydraulic Codes by Non U.S. Organizations," dated June 24, 1997), and the severe accident computer code program is called the Cooperative Severe Accident Research Program (CSARP).

TPM-B2.2
NRC Evaluation of the Radioactive Source Security Regulations in 10 CFR Part 37

Cervera M, White D
U.S. Nuclear Regulatory Commission

The Nuclear Regulatory Commission (NRC) conducted a Congressionally-mandated review of the source security requirements contained in 10 CFR Part 37, "Physical Protection of Category 1 and Category 2 Quantities of Radioactive Material," to determine whether they are adequate to protect risk significant quantities of radioactive material. The evaluation considered inspection results and event reports from the first two years of implementation of the requirements by NRC licensees to address the mandate provided by Congress. To ensure that the evaluation was comprehensive in nature, the NRC expanded the scope of the review to include evaluation of seven additional areas. The additional evaluation areas included the following topics: an evaluation of the 10 CFR Part 37 trustworthiness and reliability program; consideration of the definition of aggregation as it applies to well logging sources; an assessment of the adequacy of the materials security training program for NRC and Agreement State inspectors; an evaluation of tracking and accounting of radioactive sources; conduct of a comparison between 10 CFR Part 37 requirements and international standards and guidance; an assessment of separate, independent aspects of 10 CFR Part 37 by three external consultants; and consideration of comments, questions, and recommendations made during stakeholder outreach. This presentation will describe each section of the program review, state the purpose for the consideration of each evaluation area, describe the methodology used to evaluate each area, and briefly describe the actions the NRC intends to take to utilize the results of the program review.

TPM-B2.3
Priorities for 2017-2021 Term of the International Commission on Radiological Protection

Clement CH
ICRP

The recommendations of the International Commission on Radiological Protection (ICRP) form the basis of standards, regulations, and practice of radiological protection worldwide. ICRP operates on four-year terms, the next commencing July 1, 2017. For the second time, membership in ICRP Committees will be elected from candidates accepted through an open nomination process. Four years ago, this same process resulted in a turnover in membership of 50%. The priorities for the next term fall into three broad categories: maintain and continue to improve the system of radiological protection; promote awareness of radiological protection and broaden access to ICRP recommendations; and, increase engagement with professionals, policy-makers, and the public. Part of the first of these priorities is to emphasize the integration of protection of people and the environment within the single system of radiological protection. This is supported by a revised four Committee structure wherein expertise in protection of the environment is integrated within the Committees on effects, dose, and application. Other priorities include efforts on low-dose and low-dose rate effects, substantial completion of dose coefficients for workers and members of the public, radiological protection in emerging medical applications, ethics in radiological protection, and improved communications with professionals and the public on the system of radiological protection.

TPM-B2.4
Medical Use Of Radiation Is Different — How Do NRC Regulations Reflect This Difference

Langhorst SM
Washington University in St. Louis

The three key principles of radiation protection — justification, optimization (ALARA), and limitation — provide the basis of the U.S. Nuclear Regulatory Commission's (NRC) regulatory requirements regarding occupational exposures, public exposures, and medical exposures of patients or human subjects. From the beginning of the U.S. Atomic Energy Commission first establishing these regulatory requirements, the medical use of NRC-licensed materials has been recognized as being different in its capacity to do more good than harm for the patient, human subject, and society. This recognition of benefit vs. risk has historically led to differences in the way the NRC defines radiation doses, controls the release of medical-use radioactive materials, and establishes dose limits associated with medical-use radiation sources. To some people, including NRC Commissioners and staff, who have had little experience in overseeing the NRC regulatory responsibilities associated with NRC-licensed materials used in medicine, these differences in medical-use regulations may seem to be inconsistent and at odds with the regulations established for other NRC-licensed materials and facilities. This presentation will discuss different NRC regulatory requirements and the historical NRC policy development associated with the medical use of NRC-licensed materials.

TPM-B2.5
Medical Use Of Radiation Is Different — NRC Limitations in Balancing Medical Benefit With Radiation Risk

Langhorst SM
Washington University in St. Louis

The U.S. Nuclear Regulatory Commission (NRC) recognizes medical use of byproduct material is different, and has established unique regulatory controls that differ from the regulatory controls applied to other uses of byproduct materials. The benefit to the patient of using radioactive drugs can be immediate and measurable, such as the diagnosis of an injury or disease, or the therapy to cure cancer. This recognizable benefit outweighs the theoretical risk from the patient's radiation dose making its use justifiable. The net benefit to the patient also translates to benefit to their family for proper medical care of their loved one, and to society as a whole in maintaining reliable, accessible, and economic health care. But, does the NRC recognition of medical use benefits vs. radiation risks go far enough; that is to say how may NRC medical use regulations still limit patients in maximizing benefits from the medical use of byproduct materials? This presentation will discuss the limitations due to NRC regulatory authority, use of training and experience requirements for medical personnel, inconsistency of medical use compliance measures with Agreement States, inability to evaluate overall patient risk when judging benefit, and challenges associated with medical event reporting.

TPM-B2.6
Introduction of HABIT v2.0 Code

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NRC Regulatory Guide (RG) 1.78 (2001), "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," is endorsed HABIT (1996) computational code. In brief, the code is designed for examining control-room (CR) habitability following a postulated release of toxic chemical or radionuclide in air. HABIT v1.1 is based on the complex EXTRAN (1991) atmospheric transport and diffusion (ATD) models to calculate transient chemical or radionuclide concentrations at a given downwind location using a Gaussian puff dispersion method and modified building-wake diffusion algorithm by Ramsdell (1995). Under a Federal contract, Lockheed Martin (LM) engineers rehosted HABIT v1.1 code for Windows 7/8 (64-bit) environments as HABIT v2.0 and added the capability of simulating denser-than-air contaminant diffusion using two well-established models

DEGADIS v2.1 (1989) and SLAB (1985). HABIT v2.0 detects when denser-than-air (negative buoyancy) effects will be important using criteria proposed by Britter and McQuaid (1988) for liquid burst, liquid leak, gas burst, and gas leak accident scenarios. They are 13 demos and test cases embedded with proper user instructions in the program. The code has been continuously scrutinized with a series of verification and validation methods that are consistent with NRC software QA and technical based requirements.

HABIT v2.0 code is available to download directly at RAMP (i.e., Radiation Protection Computer Code Analysis and Maintenance Program). We have benchmarking plans to ensure technical accuracy in the computational methods and look for your input and recommendations to enhance the overall quality of this new state-of-the-art ATD software package.

TPM-B2.7
Radiation Protection Challenges in the United Arab Emirates (UAE): A Call for National Action Agenda

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Radiation protection is becoming more and more vital with increasing use of radiation sources in the UAE. As in every country, there are issues and challenges which affect the safe use of ionizing radiation in different ionizing radiation practices. In 2009 the UAE government took the initiative to improve the level and implementation of radiation safety rules and regulation by issuing a federal nuclear Law that applies to all Emirates and establishes the Federal Authority for Nuclear Regulation FANR.FANR is a relatively young national regulatory body and it is responsible for regulating and licensing nuclear activities in the UAE. FANR has issued several radiation safety regulations and guides. FANR is playing an important role to raise the radiation safety awareness level of licensees and public via different communication channels, like " meet your regulator workshop",regular public outreach events all over the country, and continuous involvement of FANR stakeholders with regional and national workshops or training events hosted by FANR in co-operation with IAEA. Currently, there are many challenges facing UAE to regulate the radiation protection in the country such as shortage of qualified medical physicists, shortage of Quality Control (QC) testing providers, limited availability of qualified radiation safety training providers and Qualified Experts, and the need to enhance co-operation with other relevant regulatory authorities in the country. The purpose of this article is to describe the current and upcoming challenges in the area of radiation protection in UAE for different stakeholders and to suggest recommendations and solutions.

TPM-C.1
The Impact of Regulations on Patient Care

Conley TA
The University of Kansas Hospital

The intent of radiation regulations is to ensure that persons who provide patient care using diagnostic and therapeutic administration of radiation; patients; and the public are not exposed to unnecessary levels of radiation. Physicians and staff are required to meet stringent training and experience requirements before being authorized to use radioactive material or radiation producing devices. When a licensee possesses radioactive material at levels that could result in harmful levels of contamination requiring costly cleanup, a decommissioning funding plan is required to ensure that funds are available for the decommissioning in order that the public does not bear the financial burden. Due to a multitude of reasons, there are times when regulations negatively impact patient care. Examples of these are presented which include regulations that: do not keep up with advancing technology, do not anticipate changing and unusual circumstances when diagnosing or treating patients, and, when revised, do not address all situations that should have been anticipated. As a result, patient care is impacted in several way. The ability for patients to receive the most effective diagnostic procedures is delayed because the regulations require decommissioning funding plans that are prohibitively expensive and unnecessary. Well-qualified physicians are not able to fully practice independently due to unclear regulations that do not adequately address the qualifications of foreign physicians. Regulatory agencies need to have foresight and anticipate the future consequences of both actions and inactions when promulgating new or revised regulations.

TPM-C.2
Establishing Medical Imaging Acquisition Protocols

Mahadevappa M
Johns Hopkins University

Establishing medical imaging protocols can be similar to putting together a set of good food recipes. Like any good recipe depends on the ingredients and the way they are mixed together, similarly medical imaging protocols can be established upon understanding the various scan parameters and their respective interplay to create optimal images that can assist in diagnosing clinical indications. The main objective of this presentation is to discuss the process that is involved in developing imaging protocols with focus on CT. Since the radiation exposure from CT imaging contributes the most for man-made radiation, the presentation will focus on the process of establishing CT protocols and exposures. In addition, imaging protocols emphasizes engaging the entire imaging team, including radiologists, (cardiologists and other physicians), radiation technologists and medical physicists. Recent requirements on protocol reviews and recording/tracking of patient doses will also be discussed in this presentation.

TPM-C.3
The Evolving Role of the Physicist in Assuring Radiation Therapy Quality and Safety

Williamson J
University of Virginia

Most extant radiation therapy (RT) quality management program (QMP) guidance was formulated in the two-dimensional (2D) RT era and consisted of fixed menus of QC tests, acceptable outcomes and test frequencies for delivery systems, planning systems, and QC devices intended to comprehensively evaluate correct device function. With the advent of image-based and guided-therapies, high dose-rate brachytherapy, and intensity modulated RT (IMRT) which substantially increased clinic-to-clinic variability in high-tech RT implementation variability and technical complexity, such "one size fits all" device-centric QMPs were found both impractical. Moreover, such device-centric QMP was unable to reliably detect and prevent serious medical errors, which are mostly the result of human error. Thus RT QMP paradigm is rapidly trending towards more flexible, clinic-specific QMPs based on formal, end user-specific risk analyses. This approach emphasizes engaging the entire RT team, including physicians and therapists, in the design and monitoring of robust clinical planning and delivery processes.

TPM-C.4
The Impact of Accreditation Programs on Quality and Safety

Butler PF
American College of Radiology

The American College of Radiology (ACR)'s diagnostic imaging accreditation programs were developed to evaluate and improve the quality and safety of imaging practice to ensure patient confidence, payer confidence, meet criteria of state or federal government, and provide facilities a marketing tool to set high performing practices apart. The programs are a peer-reviewed, educationally focused evaluation of practice. The ACR's first offering was the Mammography Accreditation Program in 1987. Since that time, programs have been developed in Ultrasound, Breast Ultrasound, Stereotactic Breast Biopsy, MRI, Nuclear Medicine/PET, CT and Breast MRI. Accreditation is mandated under the Mammography Quality Standards Act, the Health Insurance Portability and Accountability Act and by several state radiation control programs. In 2016, the ACR programs accredited over 38,000 facilities. This presentation will share the success of the ACR Accreditation Programs in improving the quality and safety of imaging practice in the United States.

TPM-C.5
The Role of the Radiation Safety Officer in a Medical Environment

Kroger LA
UCDavis Med Center

Whether you are licensee utilizing radioactive materials or a facility utilizing radiation producing equipment, each organization should have a well-developed, documented, and implemented radiation protection program commensurate with the scope and extent of activities being carried out and sufficient to ensure compliance with the relevant regulations. Every such organization must appoint a Radiation Safety Officer (RSO), who is responsible for implementing the radiation protection program. The RSO's role is to ensure that radiation-related activities are being performed in accordance with approved procedures and regulatory requirements. The RSO must have the authority and resources to identify radiation safety problems, initiate and verify implementation of corrective actions and stop unsafe practices. The RSO is often a full-time employee of the facility. At some smaller facilities, the RSO may be part time or a contracted individual. In these cases, in order to fulfill the duties and responsibilities of the position, the RSO should be on site periodically to conduct reviews and have one-on-one interactions with staff commensurate with the scope of activities being carried out. Some of the typical duties and responsibilities of RSOs include: assuring up to date radiation protection procedures are developed, distributed, and implemented; ensuring unsafe activities are stopped; assuring radiation exposures are ALARA; maintaining timely and accurate records; performing annual program audits; and providing personnel training. The investigation of incidents and medical events are critical to uncovering causes, and taking appropriate corrective actions, to ensure patient safety. Often the RSO works closely with Medical Physics staff on patient safety issues. Together, this team can provide guidance to staff that allows for the use of ionizing radiation in patient care as safely as possible.

WAM-A1.1
US Air Force Health Physics in 2017

Nemmers S
US Air Force

A US Air Force staff bioenvironmental engineer offers a brief presentation of USAF health physics heritage milestones, regulatory drivers, policy documents, strategic dogma, and the challenges facing Air Force health physicists in the year 2017 and beyond.

WAM-A1.2
US Army Health Physics

Cuellar J
US Army

The Army Radiation Safety Program objective is to ensure the safe use of radiation sources and compliance with all applicable Federal and Department of Defense (DOD) rules and regulations. This objective is accomplished through the cooperation and collaboration of many Army organizations and personnel. This 2016 update of the Army Nuclear Medical Science Officer contributions to the Army Radiation Safety Program objective includes Army Medical Department efforts, Army Officer assignment allocations, and Army safety and occupational health reorganization and reengineering efforts.

WAM-A1.3
Navy Radiation Health Program and Community

Williams A
US Navy

The purpose of the Navy Radiation Health Protection Program is to preserve and maintain the health of personnel while they work in or around areas contaminated with radioactive material, or in areas where they are exposed to ionizing radiation. It also encompasses the monitoring of personnel who work around sources of non-ionizing radiation to ensure the work is being performed in a safe manner. The Program covers multiple sectors including medical, naval nuclear power, nuclear weapons, industrial, and research. The Radiation Health Officer and Enlisted Community is a critical part of effectively managing the Program. The presentation will discuss the following aspects of the Radiation Health Program and Community:

1. Brief history of the Program and Community
2. Functional areas of the Program
3. Current make-up and status of the Community
4. Potential changes in the Program and Community due to Defense Health Agency integration initiatives.

WAM-A1.4
Changing the Permitting Agency for Use of Radioactive Materials

Stewart HM

The Defense Health Agency (DHA) is changing the permitting agency for use of radioactive materials by establishing a Nuclear Regulatory Commission (NRC) Type A Broad Scope Medical License. DHA currently has three sites operating under separate US Navy Radioactive Material Permits: Walter Reed National Military Medical Center (Naval Support Activity, Bethesda, MD), Fort Belvoir Community Hospital (Fort Belvoir, VA), and the Medical Education and Training Campus (Fort Sam Houston, TX). Presented are the regulatory communication setting the stage for change of permitting agency, development of internal policies, establishment of a DHA Radiation Safety Committee, commitment to safe use of radioactive material, commitment to an As Low As Reasonably Achievable program, and the NRC radioactive material license application process. Disclaimer: The views expressed in this abstract are those of the author(s) and do not reflect the official policy of the Department of Army/Navy/Air Force, Department of Defense, or U.S. Government.

WAM-A1.5
Revising the Approach: Taking a Total Risk Perspective When Recommending an Operational Exposure Guideline

VanHorne-Sealy JD
US Army Nuclear and Countering WMD Agency

Operational Exposure Guidance (OEG) was originally developed to allow military commanders to provide a limit on the amount of radiation risk that they were willing to accept when engaged on the nuclear battlefield. Times evolved and additional guidance for response to other radiological events resulted in non-nuclear war guidance. This method and guidance was validated by the National Academy of Science in 1997. Radiation exposure is not well understood by the laymen and this guidance was designed to help put things in context. As we begin to look at radiation exposure for non-occupational events in military operations in the future, we must now ensure that we put it in context of all risks that the military members may encounter, whether it is a mine field, building collapse, or live fire with the enemy. It is time we focus on the total risk approach with our OEG recommendations.

WAM-A1.6
Health Physics Considerations During Processing Of Radiologically Contaminated Human Remains

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20th CBRNE Command, Army Public Health Center

In the event of a radiological emergency, fatally injured service members may have radioactive material deposited within or on their bodies. The Mortuary Affairs Contaminated Remains Mitigation Site (MACRMS) concept, under development by the Joint Mortuary Affairs Center, combines the field-deployable equipment, personnel and expertise needed to repatriate radiologically-contaminated human remains (R-CHRs), as well as other types of CHRs, who expire in an overseas deployed environment. The Army Public Health Center provided extensive input during the development and testing of the MACRMS R-CHR processing protocols. As the remains must meet US Department of Transportation and International Air Transport Association packaging standards, particular attention was paid to the establishment of reception, decontamination, and screening criteria such that the residual radiological hazard for any remains exiting the MACRMS would be sufficiently characterized to permit permanent sealing of the transfer case. Administrative and engineering controls of use in an austere environment, such as personal protective equipment, instrumentation and waste management requirements, were also developed to keep dose to the mortuary affairs (MA) soldiers ALARA. As currently envisioned, health physics personnel from outside agencies would augment the MA unit to assist in the safe processing of R-CHRs.

WAM-A1.7
DoD Biodosimetry Network

Reyes RA, Rezentes TB, Stewart HM, Blakely WF, Romanyukha A, Subramanian U, Hoefer M, Romanyukha L, Mendez M, Boozer D
Department of Homeland Security, US Army Office of the Surgeon General, Defense Health Agency, Armed Forces Radiobiology Research Institute, Naval Dosimetry Center

The use of biodosimetry, including the use of biological samples as biomarkers of radiation exposure, should be the most accurate way to establish an individual radiological dose. The human body registers and responds-to radiological insults without the effect of geometrical and confounders found in other dosimetry techniques. Using multiple modalities, such as cytogenetics, electron paramagnetic resonance, proteomics, etc., facilitates as-accurate-and-effective-as-possible measurements of these responses or effects in exposed or radiologically contaminated individuals. The DoD is one of the very few agencies that will intentionally send its members into a potentially radiological/nuclear hazard zone to meet mission requirements. Therefore, its radiation safety mission can be strengthen by offering the best protection it can to those sent into potentially dangerous radiation areas or accidentally exposed. Biodosimetry complements the DoD Radiation Safety mission. This section presents the initiative to assemble a joint multiparametric Biodosimetry network in support of the DoD mission.

WAM-A1.8

Radiation Dose Assessment by Electron Paramagnetic Resonance and Whole-Body Counting at the Naval Dosimetry Center

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Naval Dosimetry Center, Department of Homeland Security, Armed Forces Radiobiology Research Institute

In accordance with DOD guidance for early-phase response in suspected ionizing radiation overexposures, Naval Dosimetry Center (NDC) is capable of reading personal radiation dosimeters, and performing whole-body counting (WBC) and Electron Paramagnetic Resonance (EPR) dosimetry. It is important to have both external and internal dosimetry tools for accurate total dose assessment and medical diagnostic purposes. EPR dosimetry can provide accurate assessment of external radiation dose in case of absent or damaged personal dosimeters. This technique is based on detection of stable free radicals in solid matrix material (e.g., nail clippings, tooth enamel biopsy). EPR is a well-known method that is standardized in several international documents issued by ISO, ICRU and IAEA. EPR dosimetry in fingernails and tooth enamel biopsy has been successfully used to evaluate external doses after several radiation accidents. NDC maintains two WBC with pure-germanium and sodium-iodine detectors. WBC can provide accurate evaluation of internal exposure. NDC can potentially support truly multiple-parameter radiation dose assessment in combination with biodosimetry capabilities at Armed Forces Radiobiology Research Institute.

WAM-A1.9

Dose Assessment by Multiple Parameter Biodosimetry at AFRRI — DoD Biodosimetry Network

Blakely WF, Subramanian U, Romanyukha L, Mendez M, Hoefer M

Armed Forces Radiobiology Research Institute

Radiation diagnosis is typically based on use of clinical signs and symptoms using hematological and blood chemistry changes including recent efforts involving the use of plasma proteomic biomarkers of systematic inflammation and organ-specific injury, dosimetry information including evidence of exposure due to the individual's time near the physical location of the radiation source, personnel dosimeters, biophysical-based indicators of exposure (i.e., EPR measurement of dose in fingernail clippings, etc.), measurement of radionuclides to assess potential external and internal contamination, and dose assessment by use of cytogenetic biodosimetry. AFRRI has experience in hematological, cytogenetics, and proteomic biodosimetry, with the initial focus to establish a reference laboratory using cytogenetic biodosimetry to enhance operational activities supporting biodosimetry for the DoD. A DoD Multiparametric Biodosimetry Center/Network would provide diagnostic and triage capabilities to military personnel that are not available with sufficient capacity elsewhere, but could be needed urgently after a major radiological or nuclear event.

WAM-A1.10

Large Scale Emergency Dosimetry Based On Epr Spectroscopy: Evaluation of Q-band EPR on Tooth Enamel Mini-Biopsies

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The capacity of operational dose estimation for large-scale nuclear/radiological accidents/incidents remains limited regarding the number of persons possibly involved. If most of "gold standard" techniques; e.g. dicentric assays, have limited capacity, the networks allow increasing the capacity of measurement (e.g. Realizing the European Network of Biodosimetry (RENEB)). There is still a need to investigate new approaches or modalities/techniques. Recently, a new approach has been established in the field of EPR dosimetry: Q-band EPR. The aim of this development is to minimize the sample quantity needed for measurements. In the Q-band, only a few mg of samples is optimal; whereas, in the conventional X-band EPR the optimal mass is about hundreds of mg. As a result, it has been possible to perform accurate dose estimations on biological samples such as tooth enamel because the invasiveness of the sample collection was minimized. Recently, this approach was successfully used on radiological accident victims suffering from acute radiation syndrome. The biopsy collection was easily collected by a dentist in less than 5 minutes without pain or consequences for the patient. Moreover, the measurement can be performed in a few minutes. No sample preparation is necessary, the signal analysis does not require signal deconvolution and the dose estimation is done with a pre-established calibration curve. Therefore, it is worth evaluating the performance of this approach for a possible application in retrospective dosimetry for a large number of persons. We present and discuss the performance and the capacity of this approach.

WAM-A2.1

A Practical Approach to the Radiation Safety of Implanted Cardiac Devices in Patients Receiving External Beam Radiation Therapy

Jabir M

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Annually, about 500,000 cardiac devices, such as pacemakers and Implantable Cardioverter Defibrillators (ICDs), are implanted worldwide. Since implanted devices are sensitive to ionizing radiation, the potential for radiation damage to these implants may have serious consequences for individuals who rely on them. Therefore, patients with cardiac devices require additional attention when treated with radiation therapy. The energy of the electromagnetic radiation applied to patients with implanted cardiac devices should be limited to low therapeutic photon energies that do not produce neutrons. Particle radiation has a detrimental effect on such devices and should not be used on patients with these implants. Any medically administered radiation therapy should only result in exposing the pacemaker to scattered radiation. Thus, such devices should not be directly exposed to primary therapeutic radiation. Manufacturers set the radiation tolerance for each device model. Radiation therapy

treatment planning must comply with the guidelines set by manufacturers in order not to inflict harm on patients who are supported by cardiac devices, especially in cases where patients are "device dependent." We follow a protocol that is based on the recommendations of professional agencies and we consult with the device manufacturer for every case. We measure the amount of radiation received by each device with the use of commercially available optically-stimulated luminescence of aluminum oxide (Al2O3:C). This measurement includes the radiation received from image guidance (IGRT). Additionally, our center continuously consults with the patient's cardiology team.

WAM-A2.2
Normal Tissue Dose During Breast Cancer Radiotherapy Treatments

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National Institutes of Health, University of Michigan

Breast cancer radiotherapy treatments have been shown to reduce patient mortality, but have also been linked to increased secondary cancer risk and cardiovascular mortality. Due to these concerns, we conducted a pilot study to assess the current state of normal tissue dose during breast cancer radiotherapy. We obtained diagnostic chest CT images for thirty adult female patients from the National Institutes of Health Clinical Center. For each patient, we segmented the normal tissues of interest including the lungs, esophagus, heart and eight heart substructures (four heart chambers and four coronary arteries). We planned two different types of left breast treatments. The first plan included tangential beams with a wedge and was planned for twenty-five patients. The second plan utilized a field-in-filed approach and was planned for five patients. A prescribed dose of 50 Gy was used for both plans. The highest resulting normal tissues doses were absorbed by the left lung: 6.4 Gy and 3.5 Gy, the left ventricle: 3.5 Gy and 2.0 Gy, and left anterior descending artery: 2.0 Gy and 1.7Gy, for the tangential beam and field-in-field plans, respectively. The tangential beam with wedge plan resulted in higher normal tissues doses than the field-in-field plan. Additionally, the left anterior descending artery (LAD) dose was found to be an average of 1.4 times greater than mean heart dose, on average. This is significant because LAD dose is more strongly correlated with cardiovascular disease than mean dose to the heart as a whole. This study presents significant initial findings in the assessment of normal tissue dose during breast cancer radiotherapy. As the number of breast cancer survivors continues to grow, we must be aware of the long-term health effects that can result from the radiation dose absorbed by the lungs, esophagus and heart.

WAM-A2.3
Real Time Visualization of High Dose Rate Brachytherapy

Sandwall P, Handley J, Gerrein C, Spitz H
TriHealth Cancer Institute, University of Cincinnati, Canberra Industries

A new handheld instrument has been used to obtain real time visualization and spatial location of a Ir192 source used in high dose rate (HDR) brachytherapy. The instrument can eliminate misadministration by providing accurate spatial positioning and active visualization of the source. Although existing regulations require procedures for source control, they are limited in detecting misadministration due to incorrect source positioning, especially if the source becomes detached from the cable. The detector includes a camera and a masked CdTe semiconductor coupled to an integrated circuit that creates a 256 x 256 pixel image of source position. Images from the camera and CdTe detector are superimposed to provide real time visualization and spatial localization of the radioactive source. The instrument was tested by extending an HDR Ir192 source into a bucket of water to simulate delivery in a patient. The instrument provides the operator with a real time image of the source position and can potentially eliminate errors associated with loss of source control.

WAM-B1.1
The Colonel, the Captain, and the Commander

Johnston TP
NIST

While looking for background information on the formation of the Health Physics Society, serendipity, that old and sometimes familiar friend of scientific pursuits, visited and uncovered connections not previously known. A few years ago, this author's interest in historical biographies began to take shape. Research was underway to gather material on nuclear powered vessels (military and civilian), and nuclear powered vehicles (aircraft, spacecraft, land based portable nuclear reactors, and a nuclear powered locomotive). Concurrently, research was in progress collecting information to write biographical articles about the founding members of the Health Physics Society. One particular founding father of the HPS was John Pickering, health physicist, representative of the US Air Force, and member of the first HPS board of directors in 1955. Along the way, the career of John Ebersole, health physicist, MD, US Navy Medical Corps came into focus. The link between these two military officers not previously known to anyone, was uncovered. This relationship will make those that learn of this fascinating story think twice about our history. Imagine what other gems of history are hidden among members of the health physics profession.

WAM-B1.2
Review of Radiation Exposure Aboard USS Nautilus, 1955-1956

Johnston TP
NIST

This presentation reviews the radiation hygiene or health physics program utilized aboard the USS Nautilus and describes the exposure pattern of personnel during the first year of operation, 1955-1956. Although there was a specific program tailored to the unique situation that existed aboard a submarine, the program was based on the same general principles that would work in any industrial application and illustrated a similar exposure pattern. In the 1950s, the increased interest in the application of nuclear reactors to civilian industry indicated that radiation safety principles in the future would become a matter of common interest to the medical profession. A realistic knowledge of radiation safety was required for advice to a public already confused and apprehensive about a subject that was often, regrettably, falsely and unrealistically linked to the atom bomb in the layman's mind. In discussing the details of the submarine reactor problem, four important concepts that needed evaluation for reactor radiation hazards to personnel included: dose rates were far below that necessary to produce discernible biological effects; due to low exposure levels, proper instrumentation was required to determine exposure rates and integrated exposures received; there was little relation between radiation from an atomic burst and radiation from an operating reactor; and the then current radiation exposure limits had a large safety factor.

WAM-B1.3
The Future of HPS Meetings — An Update

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ORAU, MJW Corporation

In 2016, the HPS Task Force on Program Improvements was asked is to review the rules, procedures and traditions of the Program Committee, interaction with (and role of) the Local Arrangements Committee, and identify opportunities for improvement concerning scheduling, special sessions or symposia, enhancing the affiliate participation, and any other areas that would improve both member and affiliate experience at the Midyear and Annual Meetings. A summary of findings and recommendations based on a survey of membership, discussions within the Task Force and with HPS leadership are presented along with follow-on opportunities for membership to discuss and guide future meetings.

WAM-B2.1
US Environmental Protection Agency (EPA) and US Department of Energy (DOE) Panel on the Use of Risk and Dose Assessment Tools

Anderson A, Walker S
US DOE, US EPA

A panel discussion with representatives from US EPA Office of Superfund Remediation and Technology Innovation (OSTRI) and US DOE Office of Infrastructure and Deactivation and Decommissioning (D&D) in the Office of Environmental Management will focus on the various guidance from the two agencies on how tools such as the Preliminary Remediation Goals (PRG) calculator, the Dose Compliance Concentrations (DCC) calculator, and RESidual RADioactivity (RESRAD) should be used in environmental cleanup activities.

The US EPA OSTRI provides guidance to EPA remedial project managers on the cleanup of radioactive contamination at Superfund sites including risk assessments, remedy selection, cleanup levels, and the use of applicable or relevant and appropriate requirements. The EPA provides the PRG calculator as a tool to determine risk-based, conservative screening values to identify areas and contaminants of potential concern that may warrant further investigation for compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) compliance. The EPA also provides the DCC Calculator for use in assessing radionuclide dose in soil, water, and air.

The US DOE Office of Environmental Management is tasked with completing the safe cleanup of the environmental legacy brought about from five decades of nuclear weapons development and government-sponsored nuclear energy research. The US DOE Office of D&D and Facility Engineering within the Office of Environmental Management provides technical reviews, readiness assessments, assistance and guidance on facilities and their contents planned for environmental cleanup and supports various technical tools. Among technical tools supported by the US DOE is the RESRAD family of computer codes used to evaluate radioactively contaminated sites in accordance with DOE Order 458.1, Radiation Protection of the Environment and Public.

WAM-B3.1
Citizen-based Environmental Radiation Monitoring Network

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Natural Resources Defense Council

The Daiichi Nuclear Power Plant accidents in Fukushima have increased the desire of ordinary people to pay attention to radiation monitoring activities. This desire is particularly significant considering radiation monitoring data in Japan following the accident was inadequate and largely inaccessible to the public. As a result, various citizen science-based environmental radiation monitoring programs were launched to address these problems. An increasingly important citizen science platform, Citizen Radiation Monitoring is an application which provides citizens with information about radiation exposure. A Citizen Radiation Monitoring project was designed and implemented by the Natural Resources Defense Council. The goal of the project was to implement a radiation monitoring system that provides real-time radiation data which is accessible to the general public and relevant to the area where they live. The monitoring system consisted of usage of a radiation detector integrated with real-time data collection, communication, and visualization framework. The monitoring systems were installed at five different locations in Washington DC and Maryland areas. Background radiation data was collected and analyzed from each monitoring stations. The developed monitoring system demonstrated that citizen-based monitoring system could provide accessible radiation data to the general public and relevant to the area where they live.

WAM-B3.2
Simple Slides Can Explain Safety of Nuclear Waste Disposal

Brodsky A
Georgetown University

After explaining how, in the USA, nuclear plants in the USA have been made safe by the health physics and nuclear engineering professions, we then get the question, "What about nuclear wastes?" A simple slide presentation can be developed from the following "gedanken experiment": In the first slide, we show all the nuclear power waste in the USA in one year being spread out evenly within the top meter of soil all over the surface area of the nation (Of course, not recommended.) Then, we use bioaccumulation factors to obtain concentrations of the more radiotoxic nuclides in food grown in the USA, uptakes in humans from food, and concentrations in various body tissues. With ICRP internal dose conversion factors, we get the annual doses to the most exposed tissues of the body. Finding that the maximum annual internal tissue doses are below regulatory levels, we then point out that this waste would not be dispersed in unsealed form all over the United States. It would be sealed in glasses or insoluble matrices, and buried deep in deserts where it can not possibly diffuse to sources of food or water. So, what can we say about safety of nuclear waste plans now?

WAM-B3.3

Long-lived Airborne Gamma-emitting Particulate Radioactivity in the United States

Lowry RC
US EPA

The Environmental Protection Agency operates the RadNet air monitoring network. RadNet is the successor to the Environmental Radiation Ambient Monitoring System (ERAMS), which was a consolidation by EPA of several radiation monitoring networks begun in the 1950's by the Public Health Service. The current network consists of high volume air samplers at fixed locations in 137 population centers in all 50 states, Washington DC, and Puerto Rico. Sampling is almost continuous at about one cubic meter per minute, except for filter changes once or twice a week. The monitoring systems are equipped with near-real-time gamma and beta detectors that transmit data to Montgomery every hour. Exposed filters are mailed to the National Analytical Radiation Environmental Laboratory (NAREL) where they are screened for gross beta activity, with further analysis if the screening action level is exceeded. At the end of each year, all of the polyester filters collected from each station are composited by dry ashing in a muffle furnace. For a location where there were no gaps in sampling, the total air volume represented by the ash is over 500,000 cubic meters. Historically, the composites have been analyzed for Plutonium and Uranium. For this study, gamma spectrometry on the entire sample was performed prior to removing aliquots for the other analysis. The very large air volume facilitates measurement of trace radionuclides that are not normally detectable by other monitoring networks. Nationwide average airborne concentrations for 2014 and 2015 and their variability will be presented for: the cosmogenic nuclides Be-7 and Na-22; radon progeny Pb-210; and suspended surface soil nuclides K-40, Ra-228, Cs-137, and short lived radon progeny supported by their long lived parents. Information on how to find measurement results for individual locations in EPA's Envirofacts database will also be presented.

WAM-B3.4

Major Oxide Compositions and its Impact on Radioactivity on Some Rocks Obtained at Varying Depths in Abuja, North Central Nigeria

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Radioactivity and major oxides investigations by using HPGe and XRF to understand the geological provenience on subsurface structures at Dei-Dei and Kubwa area of Abuja. The activity concentrations at Dei-Dei borehole varies from 18.5 ± 1.7 to 37.1 ± 3.6 Bq kg–1, 44.6 ± 4.1 to 97.4 ± 8.1 Bq kg–1 and 253.5 ± 31.3 to 1195.6 ±151.2 Bq kg–1 for 238U, 232Th and 40K and their major oxide contents of SiO2, Al2O3 , TiO2 , K2O to SiO2,, Al2O3, K2O and P2O5 for 238U, SiO2, Fe2O3, Al2O3, FeO, K2O to SiO2, Al2O3, and K2O for 232Th and SiO2, Fe2O3, Al2O3, Na2O to SiO2, Fe2O3, Al2O3, FeO, K2O for 40K. Kubwa lithologic layers activity concentrations for 238U, 232Th and 40K ranges between 14.7 ± 1.2 to 51.8 ± 4.9 Bq kg–, 32.5 ± 4.1 to 85.3 ± 8.1 Bq kg– and 118.9 ± 15.7 to 751.2 ± 93.9 Bq kg– with oxides contents of SiO2, CaO, Al2O3 , MnO,, K2O to SiO2, Fe2O3 and Al2O3 for 238U, SiO2, CaO , Fe2O3, Al2O3 , FeO, MnO,, K2O to SiO2, Fe2O3 ,Al2O3 for 232Th and SiO2, Fe2O3 , Al2O3 to SiO2, CaO , Al2O3 , Na2O , K2O for 40K respectively. It revealed that the increase in of 232Th activity decreases the activity of 238U in the presence of SiO2, CaO, Al2O3, Na2O and K2O . This study provides useful information on the lithology radioactivity and for radiological mapping of the basement coastal pollution.

WAM-B3.5

Methodology for Determination of Radon Soil Concentration

Menge JP
Bertin Corp

"In the US, new homes are not required to meet a specified radon level. The potential for elevated radon levels is not uniform throughout the US. Understanding of the potential radon levels allows for proper systems to be installed during building vs installation of vent system after construction.

As we know, Radon emanation an isotope of radon produced by radioactive disintegration is dependent mainly on 226Ra content in the soil. The transport of the radon within the soil is governed by geophysical and geochemical parameters. However, the (flux/release) rate to the atmosphere is dependent on several factors; radon concentrations in the soil, permeability of the soil, moisture of soil and concentrations of radium-226 radionuclides. Overall this flux or release rate is controlled by transfer of energy between the land surface and the lower atmosphere conditions (Etiope and Martinelli, 2002).

Currently, the EPA does not recommend soil testing for determining whether a house should be built radon resistant.

There have been several research projects which have provided a better understanding of these factors that influence measurement results

a) The soil-gas radon concentration may vary, often very greatly, over a small distance often indicates the presence of faults or tectonic zones.

b) The sampling depth where backfill may have been utilized

c) Soil permeability-highly variable, being related to degree of weathering, porosity, moisture content.

Knowing the Radon soil gas activity concentration, measured at the sufficient depth to the building grade can provide key information in designing radon reduction method for an energy efficient home.

Following a standard methodology in performing the soil gas measurements minimizes induced errors. We have outlined a proposed methodology in soil gas measurements, which can be correlated to a radon risk classification.

With this knowledge, radon resistant constructions methods can be reviewed and would allow a builder to choose an optimal building technology.

WAM-C1.1

The Regulator's View for Successful Research Reactor Decommissioning

Watson BA, Smith TB, Hickman JB

US NRC

In 2007, the responsibility research reactor decommissioning was transferred from the Office of Nuclear Reactor Regulation to the Reactor Decommissioning Branch (RDB) in the Office of Nuclear Materials Safety and Safeguards. During the first years of RDB oversight, many of the RTR decommissioning projects were already in progress. With the first Research Reactor to submit a Decommissioning Plant to RDB, the staff began to identify issues that were general good practices and lessons learned from other complex decommissioning projects. This has evolved into an informal checklist to evaluate the licensee's decommissioning preparations and readiness to start physical decontamination activities. The checklist covers a broad spectrum of issues, including management oversight and involvement to public communications. It has become a routine part of the NRC's performance reviews.

WAM-C1.2

University of Arizona Research Reactor Decommissioning Project

Giebel S, Hickman JB, Watson BA

US NRC

The regulators view of the successful University of Arizona Research Reactor Decommissioning Project will be presented. The safe decommissioning of the facility, the technical and health physics issues and unique unexpected challenges will be discussed. The experience and lessons learned should be of value to other research reactors and decommissioning projects in general.

WAM-C1.3

Worcester Polytechnic Institute Decommissioning Project

Watson BA, Roberts M, Kurian V, Smith TB

US NRC

The regulator's view of the successful Worcester Polytechnic Institute Research Reactor Decommissioning Project will be presented. The safe decommissioning of the facility, the technical and health physics issues and unique unexpected challenges will be discussed. The experience and lessons learned should be of value to other research reactors and decommissioning projects in general.

WAM-C1.4

University of Michigan Ford Research Reactor Decommissioning Project

Giebel S, Smith TB

US NRC

The regulators view of the successful University of Michigan Ford Research Reactor Decommissioning Project will be presented. The safe decommissioning of the facility, the technical and health physics issues and unique unexpected challenges will be discussed. The experience and lessons learned should be of value to other research reactors and decommissioning projects in general.

WAM-C1.5

University of Illinois Research Reactor Decommissioning Project

Watson BA, Hickman JB

US NRC

The regulator's view of the successful University of Illinois Research Reactor Decommissioning Project will be presented. The safe decommissioning of the facility, the technical and health physics issues and unique unexpected challenges will be discussed. The experience and lessons learned should be of value to other research reactors and decommissioning projects in general.

WAM-C1.6

State University of New York at Buffalo Materials Research Center Decommissioning Project

Clements JP, Watson BA, Smith TB

US NRC

The regulator's view of the successful State University of New York at Buffalo Materials Research Center Decommissioning Project will be presented. The safe decommissioning of the facility, the technical and health physics issues and unique challenges will be discussed. The experience and lessons learned should be of value to other research reactors and decommissioning projects in general.

WAM-C1.7

Veterans Affairs Omaha Research Reactor Decommissioning Project

Giebel S, Conway K, Schlapper G

US NRC

The regulators view of the successful Veterans Affairs Omaha Research Reactor Decommissioning Project will be presented. The safe decommissioning of the facility, the technical and health physics issues and unique unexpected challenges will be discussed. The experience and lessons learned should be of value to other research reactors and decommissioning projects in general.

WAM-C1.8

The IAEA Research Reactor Decommissioning Demonstration (R2D2) Project: Sharing U.S.

Decommissioning Experience

Watson BA, Hickman JB, Smith TB, Vitkus T, Rowatt JH, Ljubenov V

US NRC, Oak Ridge Associated University, International Atomic Energy Agency

This presentation will outline the IAEA Research Reactor Decommissioning (R2D2) Project conducted to assist Member State Regulators with the decommissioning research reactors. The project included workshops on the full range of decommissioning topics that were held at a variety of worldwide venues. The presentation will focus on the workshops hosted in the United States at the State University of New York at Buffalo Research Reactor and Pacific Gas and Electric's Humboldt Bay Reactor Decommissioning Project.

WAM-C2.1
U.S. Nuclear Regulatory Commission (NRC) Non-Military Radium Program Overview

Jackson T, Browder R

US NRC

In 2007 the Nuclear Regulatory Commission was given regulatory jurisdiction over discrete sources of radium. As part of the effort to identify sites potentially contaminated with Ra-226 from historical unregulated uses, NRC contracted for a comprehensive survey of historical databases and records of radium purchases, sales, and commercial transactions of products containing radium to identify sites where radium was known to have been used for industrial or commercial use, or where radium products may have been or are being serviced. The commercial activities at these sites were evaluated, along with estimates of radium quantities, if known, involved in site activities over the years, to determine which sites have the potential to have unknown contamination at the site. The sites identified (29 in total in 6 Non-agreement States) were then placed into a tier system that splits the sites into two broad categories, confirmed radium use (Tiers 1-3), and suspected radium use (Tier 4). The NRC prioritized the confirmed sites (Tiers 1-3) based on potential radiological risk of exposure to the public. The potential risk to the public is based on site access and current use, since the amount of radium present, if any, is currently unknown. The NRC plans on visiting the sites typically at least twice, for an initial site visit, consisting of a overview and survey of the site, and a follow-up more detailed scoping survey. The initial site visits will begin in the latter part of 2016 and will allow the NRC to meet with the site owners and/or occupants and ensure there are no immediate concerns at the site. The scoping surveys will be scheduled in 2017 and beyond once there is a clearer picture of the level of effort needed at each site. This presentation will provide an overview of, and update to, the ongoing efforts of the NRC's Non-Military Radium program.

WAM-C2.2
Recent NRC Experience Regulating Radium 226

Jackson TJ

USNRC Region I

The Energy Policy Act of 2005 redefined the term "byproduct material", putting discrete sources of Ra-226 under the jurisdiction of the US Nuclear Regulatory Commission and Agreement States. Byproduct material now includes any Ra-226 source produced for use in a commercial, medical, or research activity. New regulations became effective in 2009 and experience with the regulations has evolved. Some locations with a historical legacy of radium use remain impacted today, even decades after Ra-226 was last used there. This discussion will describe the history of the Waterbury Clock Company in early US industrial applications of Ra-226, review the human impact those applications had on workers, and describe some of the recent experience and ongoing challenges presented today by the widespread past manufacturing, distribution, and use of products containing Ra-226.

AUTHOR INDEX

ABSTRACT BOOK

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