Health Physics Society 49th Midyear Meeting

Austin, TX

Renaissance Austin Hotel

Austin, Texas ◆ 31 January - 3 February 2016

Final Program

AAHP

USA CAN NRRPT

ABHP

IRPA CONGRESS 2024
ADELAIDE, SOUTH AUSTRALIA

The Australasian Radiation Protection Society is pleased to be bidding to host IRPA 16 in Adelaide, South Australia. Adelaide currently has an unprecedented level of infrastructure development and is renowned for its superb ease of access. Adelaide's abundance of tourist activities and proximity to natural wonders make it an ideal IRPA Congress host.

South Australia has a significant history of radiation protection activities, making it a highly relevant host for IRPA 16. Three of Australia's uranium mines are located in South Australia and the recently established Nuclear Fuel Cycle Royal Commission means an abundance of possibilities for the future of radiation protection.

We look forward to welcoming the international radiation protection community to Adelaide in 2024!

For more information please contact:

Associate Professor Tony Hooker, Immediate Past President - Australasian Radiation Protection Society
+61 8 8463 7818 / tony.hooker@epa.sa.gov.au

Health Physics Society Committee Meetings

All Committee Meetings are in the Renaissance Austin Hotel

Saturday 30 January 2016

NRRPT BOARD AND PANEL
9:00 AM - 4:00 PM — Ballroom A

HPS EXECUTIVE AND FINANCE COMMITTEE
Noon - 5:00 PM — Presidential Suite

Sunday 31 January 2016

HPS BOARD OF DIRECTORS
8:00 AM - 5:00 PM — San Antonio

AAHP EXECUTIVE COMMITTEE
8:30 AM - 5:00 PM — Frio

NRRPT BOARD AND PANEL
9:00 AM - 4:00 PM — Nueces

PROGRAM COMMITTEE MEETING
10:00 AM - NOON — Canadian

TASK FORCE ON ALTERNATIVE TECHNOLOGIES
2:00-5:00 PM — Concho

Monday 1 February 2016

NRRPT BOARD AND PANEL
9:00 AM - 4:00 PM — Nueces

ANSI N13.65
1:00 - 3:00 PM — San Antonio

Tuesday 2 February 2016

ANSI 42.17A AND B COMMITTEE MEETING
8:00 AM - Noon — San Antonio

NRRPT BOARD AND PANEL
9:00 AM - 4:00 PM — Nueces

SCIENTIFIC AND PUBLIC ISSUES COMMITTEE
Noon - 1:00 PM — Concho

IRPA 2024 NORTH AMERICAN TASK FORCE
1:30 - 3:00 PM — San Antonio

NRRPT/HPS POWER REACTOR JOINT SESSION
7:00 - 9:00 PM — Nueces

Wednesday 3 February 2016

PROGRAM COMMITTEE MEETING
11:30 AM - 1:00 PM — San Antonio

Table of Contents

Registration Hours
Rio Exhibit Hall

Sunday, 31 January . . . . 3:30-5:30 PM
Monday, 1 February . . . . 7:30 AM-3:00 PM
Tuesday, 2 February . . . . 8:00 AM-3:00 PM
Wednesday, 3 February . . . . . 8:00 AM-11:30 AM

Exhibit Hours
Rio Exhibit Hall

Monday

Noon-6:30 PM	Exhibits Open
Noon-1:15 PM	Complimentary Lunch
3:00-3:30 PM	Coffee Break
5:00-6:30 PM	Exhibitor Reception/ Poster Reception

Tuesday

9:30 AM-4:00 PM	Exhibits Open
9:45-10:15 AM	Coffee Break
Noon-1:30 PM	Complimentary Lunch
3:30-4:00 PM	Coffee Break

HPS Board of Directors

Nancy Kirner, President
Robert Cherry, President-Elect
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Program Committee/Task Force

Program Committee Chair:
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Harrison Agordzo
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Tony Mason
Chris Shaw

The 2016 Midyear Meeting
is presented by the
Health Physics Society

Thank you to our Sponsor:
Dan Caulk Memorial Fund

SOCIAL EVENTS

Sunday, 31 January

Welcome Reception

6:00 PM **Glass Oaks**

Plan on stopping in for the HPS Welcome Reception. There will be an opportunity to meet friends and to start your evening in Austin.

Monday, 1 February

Complimentary Lunch in Exhibit Hall

Noon-1:15 PM **Rio Exhibit Hall**

Poster Session

5:00-6:30 PM **Rio Exhibit Hall**

Exhibitor Reception

5:00-6:30 PM **Rio Exhibit Hall**

Join the exhibitors for food, a cash bar, and the latest in health physics equipment.

Tuesday, 2 February

Complimentary Lunch in Exhibit Hall

Noon-1:30 PM **Rio Exhibit Hall**

Technical Tour

Tuesday, 2 February, 1:00-4:00 PM

Nuclear Engineering Teaching Laboratory at University of Texas, Austin

Preregistration Only

REGISTRATION

Registration Hours

Sunday 31 January	3:30-5:30 PM
Monday 1 February	7:30 AM-3:00 PM
Tuesday 2 February	8:00 AM-3:00 PM
Wednesday 3 February	8:00 AM-11:30 AM

Speaker Ready Room

Canadian

Sunday	Noon-5:00 PM
Monday & Tuesday	7:00 AM-5:00 PM
Wednesday	7:00 AM - Noon

2016 HPS Midyear Meeting Exhibitors

Exhibits are located in Rio Exhibit Hall

Exhibit Hours
Rio Exhibit Hall

Monday

Noon-6:30 PM	Exhibits Open
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Tuesday

9:30 AM-4:00 PM	Exhibits Open
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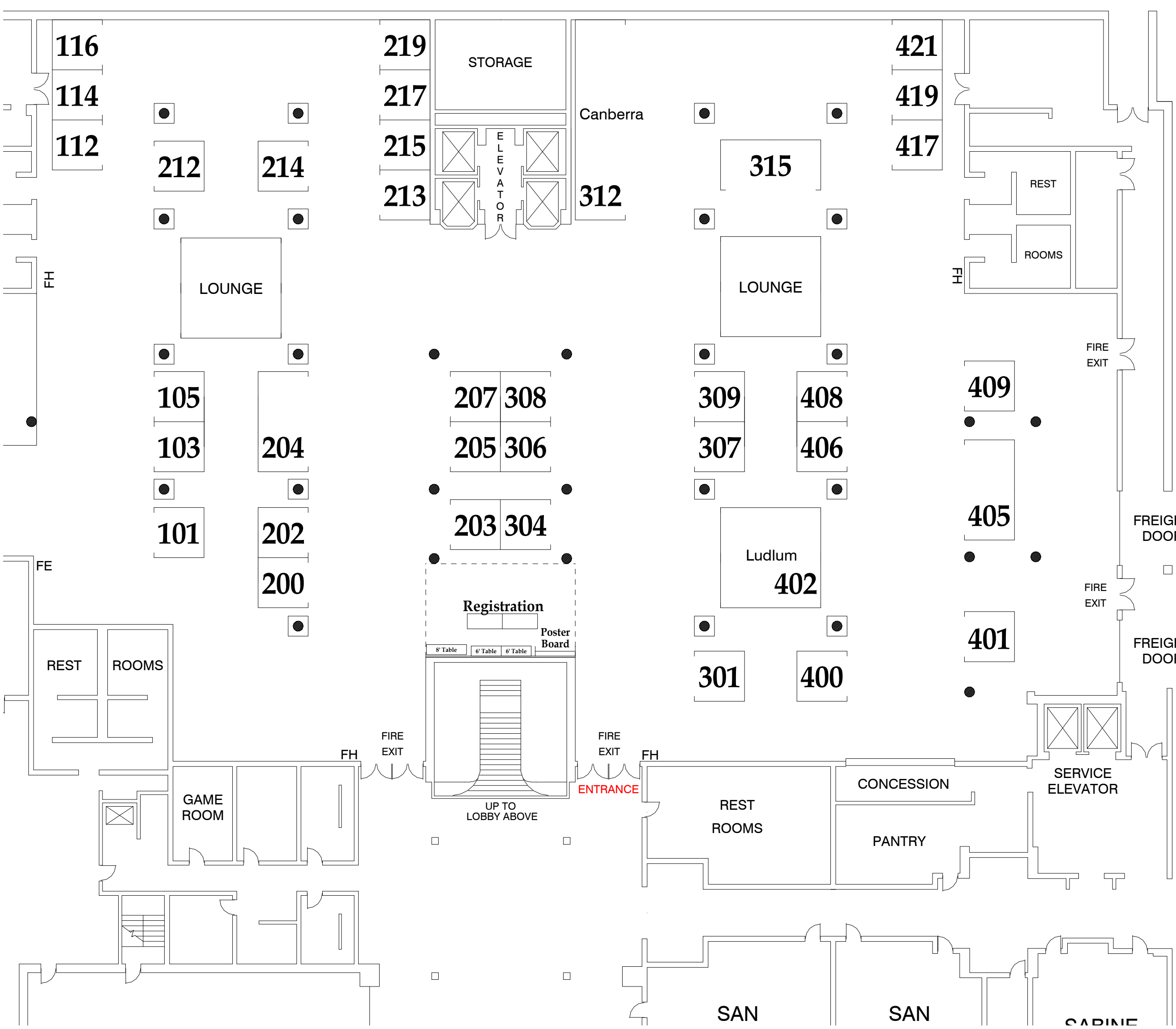
Noon-1:30 PM	Complimentary Lunch
3:30-4:00 PM	Coffee Break



2016 HPS Midyear Meeting Exhibitors

Exhibits are located in Rio Exhibit Hall

2016 Annual Meeting-Spokane **Booth: 215**

Best Dosimetry Services **Booth: 203**
865 Easthagan Drive
Nashville, TN 37217
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www.bestdosimetry.com/

Best Dosimetry Services (BDS) provides an economically priced radiation badge service for monitoring and tracking the radiation dose received by workers who are occupationally exposed to ionizing radiation. We serve a variety of customers including dental practices, veterinary practices, hospitals, and other organizations that utilize x-ray machines.

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Bionomics continues to be the leading service provider to generators of low level and mixed waste across the country. With a commitment to supporting their clients and the use of only the top tier processing and disposal facilities, Bionomics remains the top broker. Bionomics has been the leading voice for small waste generators during the development of regulations and polices surrounding the new burial site in Texas. We are the first company other than WCS to be approved to ship into the Andrews facility and are currently accepting sources for disposal at this facility. In addition to waste disposal services we provide assistance in other related fields including surveys and site closures.

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Meriden, CT 06450
203-639-2148; FAX: 203-235-1347
www.canberra.com

CANBERRA is the leading supplier of innovative and cost-effective nuclear measurement solutions and services used to maintain safety of personnel, assess the health of nuclear facilities and safeguard the public and the environment. Applications for CANBERRA offerings include health physics, nuclear power operations, Radiation Monitoring Systems (RMS), nuclear safeguards, nuclear waste management, environmental radiochemistry and other areas.

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109 Flint Rd
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Chase Environmental Group, Inc. is a full-service, decontamination, decommissioning, remediation, and waste management firm, providing safe, high quality, practical, cost effective solutions to your environmental needs.

CRCPD **Booth: 409**
1030 Burlington Lane, Suite 4B
Frankfort, KY 40601
502-227-4543; FAX: 502-227-7862
www.crcpd.org

The Conference of Radiation Control Program Directors, Inc. (CRCPD) is a nonprofit, non-governmental professional organization that promotes consistency in addressing and resolving radiation protection issues, encourages high standards of quality in radiation protection programs, and provides leadership in radiation safety and education.

Dade Moeller **Booth: 405**
1835 Terminal Drive
Suite 200
Richland, WA 99354
509-946-0410
www.moellerinc.com

Dade Moeller is a nationally recognized company that provides a full range of professional and technical services to federal, commercial and public sector clients. With our subsidiary, Dade Moeller Health Group, the company provides a variety of services to the health care industry, including medical physics and dosimetry, radiation safety training, radiation dosimetry, industrial hygiene, and laboratory support.

Eckert & Ziegler Analytics **Booth: 315**
1380 Seaboard Industrial Blvd.
Atlanta, GA 30318
404-352-8677; FAX: 404-352-2837
www.ezag.com

Eckert & Ziegler Isotope Products provides high quality, NIST traceable radioactive calibration sources, solutions and gases. We operate 3 ISO17025: 2005 DAkkS accredited calibration laboratories, 2 in the USA and one in Germany. Radiochemical performance evaluation samples are provided quaterly for effluent and environmental monitoring programs.

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Fluke Biomedical and Unfors RaySafe, a Fluke Biomedical company, strive to improve the quality of global health, one measurement at a time. We serve biomedical engineers, quality-assurance technicians, medical physicists, oncologists, radiation-safety professionals and are continually expanding our range of solutions to a broader range of health and safety professionals.

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201-490-3932; FAX: 201-368-8258
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Fuji Electric has a sophisticated line-up of high quality Radiation Detection instrumentation, including new personal electronic dosimeters, ultra-lightweight neutron survey meter and environmental monitors. Fuji Electric radiation instrumentation has been used widely in nuclear, industrial, and medical facilities. For over 60 years, we have been committed to maintaining the safety of personnel and safeguarding the public and environment.

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Gamma Products, Inc. has been designing and manufacturing scientific instruments for 50 years. We specialize in low background/automatic & manual proportional counting system, gas free automatic/counting system, Ra226/228 & gamma automatic sample changers, lead or steel counting and storage shields.

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858-549-2820; FAX: 858-549-9657
www.hi-q.net

HI-Q Environmental Products Company is an ISO 9001:2008 certified designer/manufacturer that has been providing air sampling equipment, systems and services to the nuclear and environmental monitoring industries since 1973. Our product line includes: Continuous duty high & low volume air samplers, radiation measurement instrumentation, radiation monitoring systems, air flow calibrators, radioiodine sampling cartridges, collection filter paper and both paper-only or combination style filter holders. Along with the ability to design complete, turn-key, stack and fume hood sampling system, HI-Q has the capability to test ducts and vent stacks as required by ANSI N13.1-1999/2011.

HPS Journal and WebOps **Booth: 112**
www.hps.org

J.L. Shepherd **Booth: 202**
1010 Arroyo Ave
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818-898-2361; FAX: 818-361-8095
www.jlshepherd.com

JLS&A's products include Cesium-137 and Cobalt-60 soures, in biological research, blood component, space effects testing, sterlization and process irradiators. Refurbished Gammacell 220's with Cobalt-60 Reloads and Uploads. Gamma, beta and neutron instrument calibration and dosimeter irradiation facilities. Irradiator/Calibrator security upgrades, service, repair, relocation and decommissioning for current and extinct manufacturers. LabView computer control upgrades.

LabLogic Systems, Inc **Booth: 417**
1040 E Brandon Blvd
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813-626-6848; FAX: 813-620-3708
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LabLogic specializes in instrumentation and software dedicated to the measurement and analysis of radioisotopes used in environmental, pharmaceutical, nuclear medicine and research laboratories. Our products include liquid scintillation counters, radiation monitors, personal dosimeters, radio-chromatography instruments and software, microplate readers and a variety of radiation safety consumables. Recent developments include an on-line water monitor for detection of low-level alpha and beta radionuclides.

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410-465-5558; FAX: 410-465-5257
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LAURUS Systems specializes in the sales and service of quality radiation detection instruments to emergency responders, health physics, homeland security, the military, scrap metal/recycling and the nuclear industry. LAURUS is a private, 100% woman-owned small business concern that also provides training, maintenance and calibration services

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800-622-0828; FAX: 325-235-4672
www.ludlums.com

Ludlum Measurements, Inc. (LMI) has been designing, manufacturing and supplying radiation detection and measurement equipment in response to the worlds' need for greater safety since 1962. Throughtout its 5 decade history, it has developed radiation detection technologies and instruments in support of enhancing the safety of personnel and the environment.

Mirion Technologies **Booth: 204**
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Suite 150
Smyrna, GA 30082
770-432-2744; FAX: 770-432-9179
www.mirion.com

For over half a century Mirion Technologies has been delivering world class products, services, and solutions in the world of radiation detection, measurement and protection. Mirion Technologies strives to deliver cutting edge products and services that constantly evolve based on the changing needs of our customers.

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www.nrrpt.org

To encourage and promote the education and training of Radiation Protection Technologists and, by doing so, promote the science of Health Physics.

ORTEC **Booth:306**
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ORTEC has over fifty years of experience providing solutions for a wide variety of Nuclear Detection Applications. Our team of highly qualified scientists and engineers is dedicated to providing measurement system solutions for Homeland Security, Waste Management, Personal Monitoring, In-Situ measurements, and Radiochemistry Laboratory Applications. Visit our booth today and allow us to assist you with your Nuclear Detection needs.

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Stratham, NH 03885
603-778-2871; FAX: 603-778-6879
www.radsafety.com

Established in 1989, RSCS, Inc. is a small business that offers expertise in all aspects of radiation safety and measurement applications. Our company specializes in operational and decommissioning services for nuclear power plants as well as for industrial, medical, and government radiological facilities. Our core services include health physics consulting, training, software, instrumentation (including design, installation, calibration, and repair), emergency planning, and specialized radiological characterizations and measurements. RSCS also represents several lines of radiation detection equipment and offers our own radiation training simulator devices.

Radiation Solutions, Inc **Booth: 307**
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Missauga, ON L4Z 1X2 Canada
905-890-1111; FAX: 905-890-1964
www.radiationsolutions.ca

Radiation Solutions Inc. (RSI) is a manufacturer of low level radiation detection instruments. Products include handheld nuclide identification (RIID) units, mobile systems for land vehicle, marine, airborne and stationary monitoring. Applications range from environmental, emergency response, security and geological mapping. The various systems offer Survey / Search, Nuclide ID, Mapping and Directional capabilities. In addition, vehicle portal monitoring systems are also produced for homeland security, the scrap metal recycling industry and for solid waste transfer stations and trash sites.

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Recent additions to TA's Health Physics instrument line include air and area monitors, which are smarter, more sensitive and more rugged than previously available, in addition to pipe and plume and the latest advances in portables.

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Thomas Gray & Associates, Inc., also representing Environmental Management & Controls, Inc. (EMC) and RWM-Utah, Inc., offers a full line of Health Physics services including LLRW disposal, consolidation, transportation, site remediation and HP services.

Final Technical Program

If a paper is going to be presented by other than the first author, the presenter's name has an asterisk (*)

All Sessions will take place in the Renaissance Austin Hotel

Monday

6:45-7:45 AM **Ballroom B**
CEL 1 Elements of Credibility for Professional Health Physicists
Johnson R; Radiation Safety Counseling Institute

8:10 AM - Noon **Ballroom A**

MAM-A Plenary Session

Chair: Nancy Kirner

8:10 AM **Introduction**
Nancy Kirner, HPS President

8:15 AM **Opening Remarks**
John Boice, NCRP

8:20 AM **MAM-A.1**
NCRP Scientific Committee 5-2 on TENORM Waste
Kennedy W
Dade Moeller, Inc.

8:50 AM **MAM-A.2**
Low and Intermediate Level Radioactive Waste Management: Practices and Challenges
Mele I
IAEA

9:20 AM **MAM-A.3**
Regulatory Perspective - NRC - GTCC
McKenney C
Chief of Performance Assessment Branch, NRC

9:40 AM **MAM-A.4**
Radioactive Waste Concern from the State Perspective
McBurney R
Conference of Radiation Control Program Directors

10:00 AM **BREAK**

10:30 AM **MAM-A.5**
Low-Level Radioactive Waste: An Operator's Perspective
Weissman J
US Ecology

10:55 AM **MAM-A.6**
Texas Innovations in Waste Management
Kirk JS
Waste Control Specialists

11:20 AM **MAM-A.7**
Decommissioning
Shrum D
EnergySolutions

11:45 AM **MAM-A.8**
State and Compact Perspectives regarding Emerging Issues in Commercial LLW Management
Slosky L
Rocky Mountain Compact and LLW Forum

Noon - 1:15 PM **Exhibit Hall**

Complimentary Lunch in Exhibit Hall for Registered Attendees

1:15 - 3:00 PM **Ballroom A**

MPM-A NCRP NORM/TENORM Logistics & Background (Overview of States)

Co-Chairs: John Frazier, Bill Kennedy

1:15 PM **MPM-A.1**
NORMs in Unconventional Oil and Gas Resources
Beitollahi M
University of Utah

1:40 PM **MPM-A.2**
TENORM Issues in the Petroleum Industry
Frazier J
Independent HP Consultant

2:05 PM **MPM-A.3**
An Overview of State Activities to Regulate TENORM
Thompson JW
Council of Radiation Control Program Directors (CRCPD)

2:30 PM **Panel Discussion**

3:00 PM **BREAK IN EXHIBIT HALL**

3:30 - 5:00 PM **Ballroom A**

MPM-B NCRP NORM/TENORM Potential Environmental Impacts (Air, Water, Environment)

Co-Chairs: John Frazier, Bill Kennedy

3:30 PM **MPM-B.1**
TENORM Litigation Issues - Part 1
Shank D
Coats Rose Law, Houston

3:55 PM **MPM-B.2**
TENORM Litigation Issues - Part 2
Escobar M
Coats Rose Law, Houston

4:20 PM **MPM-B.3**
TENORM Impacts in Pennsylvania
Allard D
Pennsylvania Department of Environmental Protection

4:45 PM **Panel Discussion**

1:00 - 5:00 PM **Ballroom B**

Dade Moeller Medical Health Physics Training Session 1A

Dade Moeller Courses are an additional fee

Chair: Frederic Mis

X-Ray Quality Assurance Course, Part 1A
Mis F
University of Rochester Medical Center

This course takes the student from the simplest types of x-ray generators (bremsstrahlung from high-energy betas) through generic x-ray systems to computed tomography (CT) dose testing. Included in the course will be discussions on xray definitions and units, protective measures, shielding design for x-ray rooms, industrial x-ray protection, and medical x-ray testing devices.

5:00 - 6:30 PM **Exhibit Hall**

Poster Session

P-1 Identification of Important Solutions by Surveying the Reports related to the Fukushima Daiichi Nuclear Power Plant Accident
Sasaki M
Central Research Institute of Electric Power Industry

P-2 To Rib or Not to Rib, That is the Question
Megan L, Alba Darrin G, Hickman DP, Jeffers KL
Lawrence Livermore National Laboratory, US Military Academy at West Point, Montana Tech of the University of Montana

P-3 The Methodology of Radiological Environmental Impact Assessment for Multi-Unit Npps Site During Normal Operation in Korea
Kim B, Lee B, Yoo S, Seo B
KINS

CEL Courses (Included in registration fee)

To upload a CEL talk, use this link and type in the corresponding CEL Code:

http://burkinc.net/HPS2016MYPEP.php

CEL-1-65262

CEL-2-70870

CEL-3-72959

CEL-4-64646

February 1-3, 2016

Renaissance Austin Hotel in Austin, TX

Medical Physicist & Health Physicist Training Courses:

X-Ray Quality Assurance, Mammography, and Medical Internal Radiation Dosimetry

Registration for the HPS Midyear Meeting can be found at **www.hps.org**

Registration for Courses:

*All Participants must be registered at the Midyear Meeting of the Health Physics Society.

These courses are pending CAMPEP credit and AAHP credit

Fees:
Course 1: $360
Course 2: $135
Course 3: $45
Course 4: $135

More info: www.hps.org

Dade Moeller Health Group
1835 Terminal Dr., Suite 201, Richland, WA 99354
Phone: 1-888-316-3644
E-mail: traininginfo@dmhg.net
Website: www.dmhg.net

X-Ray Quality Assurance

Course 1 Part 1: Monday PM - 4 Hours, February 1
Course 1 Part 2: Tuesday AM - 4 Hours, February 2
Frederic Mis, PhD

Mammography Quality Standards Act (MQSA) Medical Physicist Testing of Mammography Units

Course 2: Tuesday PM - 3 Hours, February 2
David Conover, MS, LMP

Cone Beam Breast CT: Technology, Clinical Images, Quality Control

Course 3: Tuesday PM - 1 Hour, February 2
David Conover, MS, LMP

Fundamentals of Medical Internal Radiation Dosimetry

Course 4: Wednesday AM - 3 Hours, February 3
Darrell Fisher, PhD

Tuesday

6:45-7:45 am **Ballroom A**

CEL 2 The Other A-Team: The Advisory Team for the Environment, Food and Health

Noska M; Food and Drug Administration, USPHS

8:15 - 9:45 AM **Ballroom A**

TAM-A NCRP NORM/TENORM Who's Exposed? (Scenario & Pathway Analysis)

Co-Chairs: John Frazier, Bill Kennedy

8:15 AM **TAM-A.1**

Colorado TENORM Experience

Johnson J

Tetra Tech

8:40 AM **TAM-A.2**

Pathways of Exposure from TENORM Generated from Unconventional Oil and Gas Development and Production

Rood A

K-Spar Inc.

9:05 AM **TAM-A.3**

TENORM Waste Issues

McArthur A

ALMAC Environmental Services

9:30 AM **Panel Discussion**

9:45 AM **BREAK IN EXHIBIT HALL**

10:15 AM - Noon **Ballroom A**

TAM-B NCRP NORM/TENORM TENORM Waste Disposal Options

Co-Chairs: John Frazier, Bill Kennedy

10:15 AM **TAM-B.1**

TENORM Waste Issues - Waste Acceptance Criteria

Weismann JJ

US Ecology, Inc

10:35 AM **TAM-B.2**

Measuring and Modeling NORM

Lombardo AJ

PermaFix

11:00 AM **TAM-B.3**

Deep Well Injection

Hebert MB

Lotus, LLC

11:25 AM **Panel Discussion**

11:50 AM **Summary**

8:00 AM - Noon **Ballroom B**

Dade Moeller Medical Health Physics Training Session 1B

Dade Moeller Courses are an additional fee

Chair: Frederic Mis

X-Ray Quality Assurance Course, Part 1B

Mis F

University of Rochester Medical Center

This course takes the student from the simplest types of x-ray generators (bremsstrahlung from high-energy betas) through generic x-ray systems to computed tomography (CT) dose testing. Included in the course will be discussions on x-ray definitions and units, protective measures, shielding design for x-ray rooms, industrial x-ray protection, and medical x-ray testing devices.

12:00-1:30 PM **Exhibit Hall**

Complimentary Lunch in Exhibit Hall for Registered Attendees

2:30 - 4:30 PM **Ballroom A**

TPM-A Dosimetry & Dose Assessment

Chair: Nolan Hertel

2:30 PM **TPM-A.1**

Radiation Dosimetry Results from the First Year of Operation of a Unique Ambulance-Based Computed Tomography Unit for the Improved Diagnosis and Treatment of Possible Stroke Patients

Guitierrez J

University of Texas Health Science Center at Houston

2:45 PM **TPM-A.2**

Enhancements to the Phantom with Moving Arms and Legs Software (PIMAL 4.0)

Hertel N

Georgia Institute of Technology, Oak Ridge National Laboratory

3:00 PM **TPM-A.3**

An Attempt to Develop a Urine Bioassay for a Micro-Beta Liquid Scintillation Counter

Lazaro P, Luke RM, Thomas TN, Muraca PW, Savely SM

Baylor College of Medicine

3:15 PM **TPM-A.4**

Recent International Intercomparison Of The Lawrence Livermore National Laboratory Nuclear Accident Dosimeters

Lobaugh ML, Wong CT, Topper JD, Merritt MJ, Heinrichs DP, Hickman DP, Wysong AR

Lawrence Livermore National Laboratory, Los Alamos National Laboratory

3:30 PM **BREAK IN EXHIBIT HALL**

4:00 PM **TPM-A.5**

Meeting the New Lens Dose Limits: Implications for Dosimetry and Radiation Protection at Nuclear Power Plants

Chase WJ

Ontario Power Generation

4:15 PM **TPM-A.6**

Comparison of Monoenergetic Photon Organ Dose Rate Coefficients for Stylized and Voxel Phantoms Submerged in Air

Bellamy M, Hiller M, Dewji S, Veinot K, Leggett R, Eckerman K, Easterly C, Hertel N

Oak Ridge National Laboratory, Easterly Scientific, Georgia Institute of Technology

1:00 - 4:00 PM **Ballroom B**

Dade Moeller Medical Health Physics Training Session 2

Dade Moeller Courses are an additional fee

Chair: David Conover

Mammography Quality Standards Act (MQSA) Medical Physicist Testing of Mammography Units

Conover D

University of Rochester

This short course endeavors to give a full overview of the specific requirements for the MQSA-qualified medical physicist (MP) to perform the required MP tests on mammography units. This includes initial requirements and training, continuing education, and additional training for new modalities. This course will also present the required MP testing of full-field digital mammography (FFDM) units, including both direct radiography (DR) and computed radiography (CR) receptors, and digital breast tomosynthesis (DBT) units.

4:00 - 5:00 PM **Ballroom B**

Dade Moeller Medical Health Physics Training Session 3

Dade Moeller Courses are an additional fee

Chair: David Conover

Cone Beam Breast CT: Technology, Clinical Images, Quality Control

Conover D

University of Rochester

This course presents detailed technical information that the medical physicist would need to know regarding what it takes to do complete, accurate testing of mammography units to meet MQSA requirements as well as help the customer to ensure the units are operating at their specified performance to give patients the best care.

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Wednesday

6:45-7:45 am **Ballroom A**

CEL 3 Radiation Safety Program Management of a Special Nuclear Materials License

O'Brien T; NIST

6:45-7:45 am **Ballroom B**

CEL 4 PAG Manual for Interim Use

DeCair S, Tupin E; EPA, Retired

8:00-9:30 AM **Ballroom A**

WAM-A Homeland Security, Emergency Planning/Response

Co-Chairs: Roland Benke, Patricia Milligan

8:00 AM **WAM-A.1**

Irradiator Security Alarms: A Year in Review

Luke RM, Pina LE, Thomas TN, Muraca PW, Savely SM

Baylor College of Medicine

8:15 AM **WAM-A.2**

Source in a Box: Website for Estimating Gamma-Ray Source Activity from Survey Measurements

Benke R

Atom Consulting

8:30 AM **WAM-A.3**

Basis of Emergency Planning Zone Size and Pre-Staging Potassium Iodide Beyond 10 Miles

Milligan PA

US Nuclear Regulatory Commission

8:45 AM **WAM-A.4**

Small Modular Reactors and Emergency Preparedness

Milligan PA

US Nuclear Regulatory Commission

9:00 AM **WAM-A.5**

Bone Marrow Shielding as an Approach to Protect First Responders in View of NCRP Report 165 and Commentary No. 19

*Milstein O, Waterman G**

StemRad, Inc

9:15 AM **WAM-A.6**

Gamma Source Reconstruction for Attribution and Safeguards using Ubiquitous Dosimeters

Hayes R

North Carolina State

9:30 AM **BREAK**

10:00 - 11:30 AM **Ballroom A**

WAM-B Instrumentation and Shielding

Chair: Mike Shannon

10:00 AM **WAM-B.1**

Use of Advanced Technology Land Scanning System at Former DOD Landfill Site

Newsom SA, McDonald MP

Amec Foster Wheeler

10:15 AM **WAM-B.2**

Serious Questions about Radiation Measurements

Johnson RH

Radiation Safety Counseling Institute

10:30 AM **WAM-B.3**

Management of Disused Devices Containing Depleted Uranium (DU) Used For Radiation Shielding

Hageman JP, Benitez-Navarro JC

Southwest Research Institute, International Atomic Energy Agency

10:45 AM **WAM-B.4**

Computer Modeling of Stray Radiation Produced External to a Conventional X-Ray Therapy Room using the Geant4 Monte Carlo Toolkit

Ezenekwe UO, Harvey MC

Texas Southern University

11:00 AM **WAM-B.5**

Optimization of Shielding Parameters for a High Dose Rate Research Irradiator Design Baseline

Shannon MP, Mickum GS

Hopewell Designs Inc

11:15 AM **WAM-B.6**

Development of the Survey Instrument on Radiation Safety Culture in Nuclear Power Plants

Jeon I

Korea Institute of Nuclear Safety

Noon **Lunch on your Own**

8:00 - 11:00 AM — Ballroom B

Dade Moeller Medical Health Physics Training Session 4

Dade Moeller Courses are an additional fee

Chair: Darrell Fisher

Fundamentals of Medical Internal Radiation Dosimetry

Fisher D

Dade Moeller Health Group

Medical internal radiation dosimetry (MIRD) provides fundamental quantities used for radiation protection, risk assessment, and treatment planning. This course presents the MIRD schema, methods, models, assumptions, mathematical formulas, and software for assessing internal radiation doses from administered radiopharmaceuticals. The MIRD approach simplifies the assessment dose for many different radionuclides—each with its unique radiological characteristics and chemical properties as labeled compounds—in the highly diverse biological environment represented by the human body, internal organs, tissues, and fluid compartments.

Noon — Lunch on your Own

1:00-4:00 PM — Ballroom A

WPM-A Contemporary Topics

Chair: Matt Moeller

1:00 PM — WPM-A.1

How to Help a Person Frightened by Radiation

Johnson RH

Radiation Safety Counseling Institute

1:15 PM — WPM-A.2

Writing a Book Chapter Titled "Radiation"

Moeller M

Dade Moeller

1:30 PM — WPM-A.3

Significant Developments in the History of Radiation Protection for US Aircrew

Shonka J

Shonka Research Associates, Inc.

1:45 PM — WPM-A.4

Going International: the Canadian Radiation Protection Association (CRPA)

Nichelson S

Canadian Radiation Protection Association

2:00 PM — WPM-A.5

Trinity Site - 70 Years of the Atomic Age

Cicotte GR, Blevins L, Matcek GF

US Army

2:15 PM — BREAK

2:45 PM — WPM-A.6

Failures of Plaintiff's Experts in Radiation Litigation

Johnson RH

Radiation Safety Counseling Institute

3:00 PM — WPM-A.7

Feasibility Study for Alpha-Emitting Radioisotopes in Wastewater Samples around the Texas Medical Center

Amoako K, Harvey MC

Texas Southern University

3:15 PM — WPM-A.8

Overcoming Stigmas and Making Clean Water

Moeller M

Dade Moeller

3:30 PM — WPM-A.9

Iodine 131 Metaiodobenzylguanidine (MIBG) Therapy from the Ground Up

Barnes JA, de la Guardia M, Granger M

Cook Children's Medical Center

3:45 PM — WPM-A.10

Radiological Engineering at Los Alamos National Laboratory

Griffin MA, Hetrick LD

Los Alamos National Laboratory

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CELs take place in the ***Renaissance***
6:45 - 7:45 AM Monday, Tuesday and Wednesday

Monday

CEL1 Elements of Credibility for Professional Health Physicists

Ray Johnson, MS, PSE, PE, FHPS, DAAHP, CHP
Director, Radiation Safety Counseling Institute

As professionals in radiation safety perhaps one of our most cherished attributes is our credibility. But, what is credibility? Is it trustworthiness, honesty, truthfulness, faithfulness, admiration from others, reliability, dependability, integrity, reputation, status, or believability? Our credibility probably has all of these elements and more. Our peers may judge our credibility according to how we are introduced as a speaker. Introductions often include information on our employment, service to the profession, college degrees, publications and awards, etc. The chances are that we have devoted a large part of our career to developing our technical expertise and credentials for credibility. While such efforts may establish credibility with our peers, how credible are we with members of the public, especially those who have concerns for radiation safety or health effects? Will technical or professional credentials suffice for public credibility? Despite many years of education and professional experience, many health physicists are challenged about how to achieve credibility with the general public. Our best efforts to convey the "truth" about radiation safety (as we understand it) have apparently not changed the public's sentiments about radiation. Generally members of the public would seem to be as concerned and afraid of radiation today as they were after the bombs in Japan. If we are telling the "truth" why aren't we believed? One of the elements for public credibility may be how well we can accept the public's dismay and fears about radiation. This can be especially difficult when their fears do not seem to have a rational technical basis. Perhaps it would be helpful to remind ourselves that the public may not care how much we know, until they know how much we care. Do we care? Yes, deeply, but how will others know? We might begin by letting people know that it's OK to be afraid of radiation. While technical expertise is crucial for credibility, so also may be our ability to identify with public fears. Some of the tools for achieving public credibility could include active listening (hearing and reflecting feelings), asking questions (rather than giving answers), providing opportunities for people to answer their own questions, and giving non-defensive responses. These and other options will be explored. This lecture will also look at how people determine truth and judge credibility.

Tuesday

CEL2 The Other A-Team: The Advisory Team for the Environment, Food and Health

Michael Noska
Food and Drug Administration, USPHS

The Advisory Team for the Environment, Food and Health is a federal interagency group of health physicists and other radiological health experts whose mission is to provide protective action recommendations to decision makers (Federal, State, local, tribal and territorial officials) following radiological or nuclear emergencies. The Advisory Team is comprised of representatives from four agencies: EPA, USDA, CDC and FDA. A major function of the Advisory Team is to interpret published guidance on radiation protection, known as Protective Action Guides or PAGs, in the context of the specific contamination or exposure scenario. These guidance documents include protective action guides from the EPA for the general public and emergency workers; guidance from the FDA on acceptable levels of contamination in food and animal feed; guidance from the FDA on the use of potassium iodide (KI) for the protection of the thyroid following releases of radioactive iodine, and; guidance from the Department of Homeland Security on long term recovery following incidents involving radiological dispersal devices (RDDs) or improvised nuclear devices (INDs). This presentation will include a discussion of the Advisory Team's mission and method of operations, including its integration into the Incident Command System and NIMS. The speaker will also discuss the resources that the Advisory Team can bring to bear in a radiological or nuclear emergency.

Wednesday

CEL3 Radiation Safety Program Management of a Special Nuclear Materials License

Tom O'Brien

The National Institute of Standards and Technology (NIST) conducts its mission, in part, under a Special Nuclear Materials license (10 CFR 70) and an Exempt Distribution license (10 CFR 32) issued by the Nuclear Regulatory Commission. NIST is also subject to 10 CFR 30, 36, 37, 40, 73 and 74. The framework and implementation of the NIST Radiation Safety Program will be presented. The challenges and successes of the program will be discussed.

Wednesday

CEL4 PAG Manual for Interim Use

Sara DeCair and Ed Tupin

In 2013, the U.S. Environmental Protection Agency (EPA) proposed an update to the 1992 Protective Action Guides (PAG) Manual. The PAG Manual provides guidance to state and local officials planning for radiological emergencies. EPA requested public comment on the proposed revisions, while making them available for interim use by officials faced with an emergency situation. Developed with interagency partners, EPA's proposal incorporates newer dosimetric methods, identifies tools and guidelines developed since the current document was issued, and extends the scope of the PAGs to all significant radiological incidents, including radiological dispersal devices or improvised nuclear devices. EPA also requested input on potential protective action guides for drinking water. New in the PAG Manual is planning guidance for the late phase of an incident, after the situation is stabilized and efforts turn toward recovery. Because the late phase can take years to complete, decision makers are faced with managing public exposures in areas not fully remediated. The proposal includes quick reference operational guidelines to inform re-entry to the contaminated zone. Broad guidance on approaches to wide-area cleanup and developing cleanup goals is also provided. EPA adapted the cleanup process from the 2008 Department of Homeland Security (DHS) "Planning Guidance for Protection and Recovery Following Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents" and the final PAG Manual will supersede that DHS guidance. Waste management guidance is also provided. Recognizing that an incident could result in radioactive waste volumes that severely strain or exceed available resources and capacity, officials may consider alternatives for disposal of waste that is relatively lightly contaminated. Waste management, which includes treatment, staging, and interim and long-term storage, must be an integral part of recovery.

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MAM-A.1 NCRP Scientific Committee 5-2 on TENORM Waste

Kennedy, Jr., WE
Dade Moeller & Associates

NCRP established Scientific Committee (SC) 5-2 to develop Recommendations for a Uniform Approach for Naturally Occurring Radioactive Material (NORM) and Technologically Enhanced NORM (TENORM) Waste Management and Disposal for the Oil and Gas Industry. This effort is consistent with the overall mission of NCRP to formulate and widely disseminate information, guidance and recommendations on radiation protection which represents the consensus of leading scientific experts. Since the early 20th century, it has been understood that rock formations, including those that host oil and gas production contain primordial concentrations of NORM radionuclides, typically the decay chains of uranium and thorium. Radium in pipe scale from oil production facilities is an example of TENORM concerns in years past. With increased demand for oil and natural gas, newer technologies using horizontal drilling coupled with hydraulic fracturing have been deployed. The U.S. Environmental Protection Agency has estimated that about 1,500,000 m3 y–1 of waste are produced by the oil and gas industry, including produced water, well casing scales, tanks, pipes sludge, and equipment. Some of this waste contains elevated concentrations of TENORM. There is no federal guidance for TENORM waste management; the regulatory authority lies with the states. Individual states that host hydraulic fracturing operations are left to cope with emerging TENORM waste management issues on an ad hoc basis with little scientific support. SC 5-2 is preparing a commentary that provides recommendations for a science-based, uniform NORM/TENORM waste management approach. In parallel with this midyear meeting of the Health Physics Society, NCRP is hosting a workshop on Monday afternoon and Tuesday morning to begin the discussions needed to develop the commentary.

MAM-A.2 Low and Intermediate Level Radioactive Waste Management: Practices and Challenges

Mele I
IAEA

The paper will present global overview of low and intermediate level radioactive waste (LLW and ILW) management, from inventories to strategies and programmes, practices and technical solutions. In addition to LLW and ILW from operation of nuclear power plants or other nuclear facilities it will address also L/ILW from decommissioning of nuclear facilities as well as waste from various nuclear applications including disused sealed radioactive sources. Technologies for managing L/ILW are mature and are part of normal industrial practices in many countries. More than hundred operating LLW/ILW disposal facilities worldwide provide evidence for the existence of safe, feasible and publicly accepted disposal solutions. But some challenges remain. One is related to the management of very large volumes of waste (in post-accidental situations, legacy waste from past activities, waste from mining, etc.). After Fukushima accident management of large quantities of waste is of particular interest and relevance and some lessons learned and experiences from past activities collected by the IAEA will be briefly presented. A challenging problem, but from another perspective, is also the management of small or very small volumes of radioactive waste. Many countries with small nuclear programmes or with nuclear applications only are faced with these challenges. The paper will briefly discuss these issues and also touch an important new area of development related to countries that are embarking on nuclear power. In parallel with the construction of their first nuclear power plants and preparations for their operation they are also faced with the need to develop necessary framework and infrastructure for radioactive waste management. A big challenge for the nuclear community and the IAEA is to increase awareness among these countries and also among nuclear industry on the need to address spent fuel and radioactive waste management timely.

MAM-A.3 Regulatory Perspective - NRC - GTCC

McKenney C
Chief of Performance Assessment Branch, NRC

MAM-A.4 Radioactive Waste Concern from the State Perspective

McBurney R
Conference of Radiation Control Program Directors

State radiation control programs regulate 86 percent of the non-reactor radioactive material licensees in the United States and are responsible for all of the technologically enhanced naturally occurring radioactive material (TENORM) that does not come under the Atomic Energy Act, as amended. The state programs are continuing to manage a variety of concerns regarding the associated radioactive waste from both AEA-licensed activities and TENORM. Some of the issues are currently being collectively addressed by the Conference of Radiation

Control Program Directors (CRCPD) and several federal agencies. These include: alternative disposal pathways for low-activity waste and TENORM; disused radioactive source disposal, including the use of the U.S. Nuclear Regulatory Commission's Branch Technical Position on Concentration Averaging for commercial disposal of higher activity sources; creation of more use of Type B shipping containers and licensing of qualified packagers for devices being shipped in Type B Containers; disposition of orphan sources; and pending changes to 10 CFR Part 61. Solutions to these waste management issues are needed in order to assure the continued beneficial uses of radioactive material and activities that produce TENORM in the United States.

MAM-A.5 Low-Level Radioactive Waste: An Operator's Perspective

Weissman J
US Ecology

MAM-A.6 Texas Innovations in Waste Management

Kirk JS
Waste Control Specialists

MAM-A.7 Decommissioning

Shrum D
EnergySolutions

MAM-A.8 State and Compact Perspectives regarding Emerging Issues in Commercial LLW Management

Slosky L
Rocky Mountain Compact and LLW Forum

The presentation will provide input and perspectives from two active working groups of the Low-Level Radioactive Waste Forum (LLW Forum) on timely and relevant activities in the field of waste management and disposal including the U.S. Nuclear Regulatory Commission's (NRC's) proposed rule to amend 10 CFR Part 61, Licensing Requirements for Land Disposal of Radioactive Waste, and the National Nuclear Security Administration's (NNSA's) mission to provide for the safe disposition of disused radioactive sources. Through the LLW Forum's Part 61 Working Group (P61WG), the sited states worked cooperatively to develop detailed comments on the Part 61 rulemaking initiative and offered perspectives re applicability of the proposed new requirements, policy considerations, and compatibility categories. The P61WG provided a detailed analysis in support of keeping the Part 61 regulations as written for traditional low-level waste streams, as well as retaining the current language in the Alternative Requirements for Waste Classification (§61.58) and its intended flexibility for NRC and Agreement States, and recommended that the NRC develop a new stand-alone regulation to address waste streams that were not previously anticipated (i.e., large quantities of depleted uranium). Over a 30-month period, the LLW Forum's Disused Sources Working Group (DSWG) took a holistic approach to study the life cycle of sealed sources from production to disposal, releasing a report containing 24 recommendations to improve their safe management and disposition. The presentation will highlight the DSWG's work, including the results of a survey to gather feedback from state radiation control program directors and the submittal of comments on the NRC's plans to conduct a financial scoping study to determine if financial planning requirements for decommissioning and end-of-life management for some radioactive byproduct material (including disused sources) are necessary, and will include recommendations for the HPS and DSWG to coordinate ongoing efforts.

MPM-A.1 NORMs in Unconventional Oil and Gas Resources

Beitollahi M
University of Utah

Naturally occurring radioactive materials (NORMs) have always been a part of our environment. Petroleum starts its life with naturally occurring chemicals (organic materials) in the ocean with the presence of NORMs and other sediments. Eventually, after going through geological processes (diagenesis) which occurs over millions of years, these chemicals become expressed in source rocks as oil and gas. NORM radionuclides may become mobile or be deposited by migration of water or oil. Some of the organic complexes, such as humic acids, create mobile complexes of uranium. Uranium and its decay products and trace elements have an affinity for crude oil; they are likely residues of consolidated organic and marine deposits. Petroleum is often assumed to have migrated to a position of minimum hydraulic potential in a reservoir rock, which may or may not be derived from the same source deposits as the petroleum. In conventional oil and natural gas fields, source rocks such as sandstone and carbonate are made of porous and permeable materials. In this situation, migration of hydrocarbons under the geological parameters such as hydrodynamic pressure will start from organic sources toward the impermeable reservoir cap rocks where they will be trapped with NORMs. However, in unconventional resources, hydrocarbons accumulations extend in a large area and are not significantly under the influence of geological pressure exerted by water; these types of source rocks are called "tight formations" (also known as "continuous formations") and have a higher NORM concentration. For example, shales, which contain at least 35 % clay minerals and a significant amount of potassium, can readily adsorb the NORM series radionuclides. The radionuclides that are present may also be bound to organic matter in minor minerals or as precipitates in the cementing material that binds the rock. This presentation is a brief review of the geological origins of NORMs and understanding of the biological, chemical and geochemical parameters that may control the mobility and behavior of the NORM radionuclides in unconventional oil and gas resources.

MPM-A.2 TENORM Issues in the Petroleum Industry

Frazier JR
Independent HP Consultant

Nearly every substance on or in the Earth contains naturally occurring radioactive material (NORM) and the amounts of NORM vary with location and the type of substance. NORM was discovered in natural gas (methane) around the beginning of the 20th century – soon after the discovery of radium. About 40 y later NORM was found to be present in various fluids and in production equipment during petroleum exploration and production (E&P) operations. As NORM was brought to the ground surface from underground oil- and gas-bearing formations certain NORM radionuclides were inadvertently concentrated, leading to the name "technologically enhanced" NORM or TENORM. During those early years there was little concern for environmental impact from TENORM as the material was "naturally occurring" and NORM concentrations were generally considered to be inconsequential. Similarly, there was little concern for occupational health and safety from TENORM during petroleum E&P as the measured radiation levels from TENORM were at the very low end of the measurement range of available survey instruments. However, the presence of radon progeny (especially 210Pb and 210Po) in elevated concentrations on internal components of natural gas processing equipment was realized and investigated in the early 1970s, and radiation protection actions for natural gas processing operations were recommended at that time. Following the discovery in the mid-1980s of significant amounts of TENORM (226Ra and 228Ra) in some petroleum E&P sites, persons responsible for environmental safety and health (ES&H) within the petroleum industry implemented programs to determine where and how TENORM was being generated during their operations and, if so, whether workers, members of the public, and the environment were being adequately protected. Those actions continue today but are generally developed and implemented without uniform guidance or standards for ES&H programs involving TENORM. In addition to current E&P operations, many sites having TENORM generated from previous E&P operations (often referred to as "legacy" sites) have been identified, characterized and, in many cases, remediated. These actions continue today, but as with current E&P operations, there is limited regulatory guidance for dealing with legacy sites. TENORM issues being faced by the petroleum industry today are associated with the details of ES&H activities at current and legacy E&P sites and with implementation of TENORM remediation/waste management programs at those sites.

MPM-A.3 Overview of State Activities to Regulate TENORM

Thompson JW
Council of Radiation Control Program Directors

State radiation control programs have been regulating radioactive contamination and waste management issues involved with technologically enhanced naturally occurring radioactive material (TENORM) for several decades. Since most of this material does not fall into the federal definition of source or byproduct material, the regulation of it is largely left to the states.

The Conference of Radiation Control Program Directors (CRCPD) has worked since the 1980s to develop model state regulations with applicable standards for TENORM in industries that had not come under the purview of radiation regulations previously. Since that time, several states have also addressed TENORM regulatory issues in their jurisdictions and CRCPD has modified the model state regulations. However, the standards remain inconsistent among the states that regulate TENORM. In addition, new pathways and changes in operations are directly affecting concentration of TENORM and environmental and worker impacts (e.g., fracking). As a result, CRCPD is reviewing current issues to refine the regulatory standards and guidance for TENORM, and is making recommendations for future actions to address technical assessment issues, training needs, and action levels.

MPM-B.1 TENORM Litigation Issues – Part 1

Shank D
Coats Rose Law, Houston

MPM-B.2 TENORM Litigation Issues – Part 2

Escobar M
Coats Rose Law, Houston

MPM-B.3 TENORM Impacts in Pennsylvania

Allard D
Pennsylvania Department of Environmental Protection

P-1 Identification of Important Solutions by Surveying the Reports related to the Fukushima Daiichi Nuclear Power Plant Accident.

Sasaki M
Central Research Institute of Electric Power Industry

Regarding radiation exposure of the members of the public and radiation workers due to the release of radioactive substances from the Fukushima Daiichi Nuclear Power Plant accident, several issues on dose/risk estimation, and on radiation protection were enumerated by domestic and international professional bodies. In order to apply those lessons learned and experiences for the development of protective actions and for the improvement of the system of radiation protection in the future, identification of main solutions is necessary. For this, by surveying dose and risk estimation reports published by the professional bodies, uncertainty factors have been categorized and assessed from the viewpoint of their characteristics such as the possibility of a substitute plan, etc., to identify the major requirements and corresponding solutions. Then, the relationship between those solutions and radiation protection issues were clarified. Consequently, it was found that the important solutions, which means common and noteworthy challenges for both dose/risk estimation and radiation protection issues, were implementation of personal monitoring at the emergency exposure situation for reduction of the uncertainty of dose estimation, and quantified assessment of low-dose radiation risks, which is the basis of adequacy judgement of risk evaluation and radiation protection standards.

P-2 To Rib Or Not To Rib, That Is The Question. Lobaugh

Megan L, Alba Darrin G, Hickman DP, Jeffers KL
Lawrence Livermore National Laboratory, US Military Academy at West Point, Montana Tech of the University of Montana

Given the large difference between mass attenuation factors for bone and muscle at low energies, the difference in efficiency calibration factors for phantoms with simulated ribs and without simulated ribs is thought to be significant. A series of lung measurements were made with the Lawrence Livermore National Laboratory torso phantom containing an Am-241/Eu-152 lung set with and without simulated ribs is presented. For photon energies greater than 39keV and chest wall thicknesses greater than 3cm, no significant difference in efficiency calibration factors was observed between the torso phantom with simulated ribs and the phantom without simulated ribs. For photon energies below 39keV and chest wall thicknesses less than 3cm, a noticeable difference was observed between the efficiency calibration factors for measurements made on the two torso phantoms. Therefore, a simulated rib cage is needed for efficiency calibrations of low energy photons in people with small chest wall thicknesses in order to account for the presence of bone.

P-3 The Methodology of Radiological Environmental Impact Assessment for Multi-Unit NPPs Site During Normal Operation in Korea

Kim B, Lee B, Yoo S, Seo B
KINS

The number of sites housing multi-unit nuclear power plants (NPPs) and other co-located nuclear facilities is recently increasing in Korea. That is why the nuclear laws related to the safety for those area are legislated and the need for developing a methodology for the radiological environmental impact assessment of those sites is raised by the Korea Institute of Nuclear Safety. For the evaluation of compliance with the radiation dose criteria at the Exclusion Area Boundary (EAB), the INDAC (Integrated Dose Assessment Code Package) code is developed on the basis of the ICRP 60 dose evaluation concept and the methodology of NRC Regulatory Guide 1.109. Also this code is implemented to evaluate the radiation dose assessment at the overlapped outermost boundary housing multi-unit EABs. In this presentation the methodology related to the multi-unit atmospheric dispersion factor, source release and dose assessment, which are applied in the INDAC, will be shown in detail.

TAM-A.1 Colorado TENORM Experience

Johnson J
Tetra Tech

Oil and gas exploration and production generate waste that may contain elevated concentrations of naturally occurring radioactive materials (NORM). The wastes must be disposed of properly to protect the environment and public health. Colorado is a major oil and gas producer ranking sixth in the nation of total production with approximately 1.6 trillion cubic feet of natural gas and 95 million barrels of oil produced in 2014. Disposal of technologically enhanced naturally occurring material (TENORM) waste is a critical issue for the state. At the present time, there is only one facility in Colorado licensed to accept oil and gas TENORM waste. The energy boom has engendered significant interest in providing alternative disposal options. Because there are no federal regulations for TENORM disposal, permitting disposal facilities is left to the state and local governments. The process for permitting a site to accept TENORM waste in Colorado requires extensive review by the county and a variety of state agencies including the Solid Waste and Radiation Control programs within the Colorado Department of Public Health and Environment (CDPHE) Hazardous Materials and Waste Management Division. The county where the proposed disposal facility will be located has final approval authority. Colorado is an Agreement State and regulates TENORM waste through its general authority to regulate radioactive materials even though there are no specific TENORM regulations. In accordance with a CDPHE draft guidance document, industrial landfills with specific permits are allowed to accept TENORM generated by the oil and gas industry with a combined 226/228Ra activity concentration up to 50 pC g–1. Potential doses to workers and members of the public from TENORM disposal facilities are limited to 25 mrem y–1. Radiation dose assessment is an integral part of the permit application process and involves identifying potentially exposed individuals, exposure pathways, estimating occupancy parameters. The RESRAD code is a generally accepted mechanism for assessing doses to workers and members of the public but it is dependent on realistic estimates of exposure parameter values. Several proposed alternate disposal sites are in various stages of the permitting process including dose and risk assessment.

TAM-A.2 Pathways of Exposure from TENORM Generated from Unconventional Oil and Gas Development and Production

Rood AS
K-Spar Inc.

Technologically enhanced naturally occurring radioactive material (TENORM) has long been an issue in conventional oil and gas production. Development of unconventional drilling and development methods such as horizontal drilling and hydraulic fracturing (termed “fracking”) has introduced new waste streams and potential exposure pathways. This presentation examines potential TENORM exposure pathways from unconventional oil and gas development and production, which also include exposure pathways from conventional oil and gas production. Potential exposure can occur during the drilling, development and production phases of oil and gas wells. In most cases, exposures are limited to workers, but public exposure can occur in the event of improper well construction and inadvertent release of production fluids and waste to the environment. In both conventional and unconventional oil and gas production, the magnitude of exposure is highly dependent on the local geology and the presence of naturally occurring radioactive materials (NORM) in the overlying formations, and more importantly in the producing formation. During the drilling phase, exposure pathways can include external exposure to recirculated drilling fluids, external exposure to drill cuttings, radon inhalation, and inhalation and inadvertent ingestion of drill cuttings and removable surface contamination on equipment. Exposures during this phase are similar for both conventional and unconventional drilling. However, if the producing formation contains elevated NORM, then unconventional horizontal drilling can produce higher exposures because more material from the producing formation is brought to the surface. The development phase includes hydraulic fracturing and installation of production equipment. Exposure pathways from unconventional oil and gas development and include external exposure to produce water and flow-back fluids used during the fracking process. The production phase includes the treatment and disposal of liquid and solid wastes, maintenance of production and distribution equipment, and equipment refurbishing, including pipe scale removal. Exposure pathways during this phase include external exposure and radon inhalation during transport and treatment of produce water and accumulated tank sludge, radon and external exposure in gas pipeline equipment, and external, inhalation, and ingestion exposure during pipe scale cleaning operations. A recent study by the Pennsylvania Department of Environmental Protection found little potential for radiological exposure during the drilling and development phase, but a potential for environmental radiological impacts resulting from inadvertent release of production and fracking fluids. During the production phase potential radiological exposures could occur in wastewater treatment facilities receiving oil and gas production wastes, and in natural gas processing plants. Release of untreated produce water, drilling fluids, and fracking fluids to the environment, and improper well construction that results in leakage of NORM produce water to potable aquifers can result in radiological environmental impacts and potential exposures to the public.

TAM-A.3 TENORM Waste Issues

McArthur A
ALMAC Environmental Services

Mr. McArthur has been instrumental in the development of naturally occurring radioactive material (NORM) waste management practices from the North Sea to Alaska where he was responsible for the development and operation in 1991 of the first NORM waste processing and underground injection disposal. He has continued to evaluate the issue of NORM waste and its management in the Middle East and Africa as well as the United States and Canada. At present he is investigating the NORM wastes associated with gas production, transmission and processing in many countries around the world. NORM from natural operations is providing unique challenges to operators at a time when operational margins are already stretched and preemptive actions by early identification will be critical to operator NORM waste management cost minimizations

TAM-B.1 TENORM Waste Issues – Waste Acceptance Criteria

Weismann JJ
US Ecology, Inc.

Many issues regarding technologically enhanced naturally occurring radioactive material (TENORM) have been raised recently due to the increase in exploration, development and production of oil and gas resources in the United States. These activities have led to increased volumes of low-activity radioactive wastes that require safe handling, transportation, and disposal due to the presence of TENORM nuclides such as 226Ra and 210Pb. TENORM is not federally regulated by either the U.S. Nuclear Regulatory Commission or the U.S. Environmental Protection Agency, so regulation for purposes of licensing is delegated to the individual states. This regulatory environment poses a challenge to companies that generate TENORM wastes since it is incumbent upon them to stay abreast of rapidly changing regulatory environments in a variety of different locales. Just over the past few years, several states (including Pennsylvania, North Dakota, Michigan, and Montana) have investigated their TENORM disposal regulations to determine whether changes should be made to adapt to the evolving conditions inside (and outside) of their states. This presentation will focus on the radioactive waste management aspects of TENORM, specifically disposal options for these generated radioactive wastes. A summary of state TENORM disposal regulations will be discussed as well as an overview of available TENORM disposal facilities and their respective waste acceptance criteria for prominent TENORM nuclides.

TAM-B.2 Measuring and Modeling NORM

Lombardo AJ
PermaFix

The regulatory release of sites and facilities (property) for restricted or unrestricted use has evolved beyond prescribed levels to model-derived dose and risk based limits. Dose models for deriving corresponding soil and structure radionuclide concentration guidelines are necessarily simplified representations of complex processes. A conceptual site model is often developed to present a reasonable and somewhat conservative representation of the physical and chemical properties of the impacted material. Dose modeling software is then used to estimate resulting dose and/or radionuclide specific acceptance criteria (activity concentrations). When the source term includes any or all of the uranium, thorium or actinium natural decay series radionuclides the interpretation of the relationship between the individual radionuclides of the series is critical to a technically correct and complete assessment of risk and/or derivation of radionuclide specific acceptance criteria. Unlike man-made radionuclides, modeling and measuring naturally occurring radioactive material (NORM) and technologically enhanced NORM (TENORM) source terms involves the interpretation of the relationship between the radionuclide present, e.g., secular equilibrium, enrichment, depletion or transient equilibrium.

Isotopes of uranium, radium and thorium occur in all three natural decay series. Each of the three series also produces a radon gas isotope as one of its progeny. In nature, the radionuclides in the three natural decay series are in a state that is approaching or has achieved secular equilibrium, in which the activities of all radionuclides within each series are nearly equal. However, ores containing the three natural decay series may begin in approximate secular equilibrium, but after processing, equilibrium may be broken and certain elements (and the radioactive isotopes of that element) may be concentrated or removed. Where the original ore may have contained one long chain of natural decay series radionuclides, the resulting TENORM source term may contain several smaller decay chains, each headed by a different longer lived member of the original series. This presentation presents the anatomy of common TENORM source terms and the pitfalls of measuring, interpreting and modeling these source terms. Modeling TENORM with common software such as RESRAD is discussed.

TAM-B.3 Deep Well Injection

Hebert MB

Lotus, LLC

The oil and gas industry has successfully been commercially disposing of naturally occurring radioactive material (NORM) residues and waste by deep well injection for nearly 25 y. This presentation will focus on presenting the general characteristics and mechanisms of permanent NORM disposal by deep well injection. Description, concentrations and general waste characteristics will be discussed. Radiation safety practices in waste preparation and disposal of waste will also be discussed.

TPM-A.1 Radiation Dosimetry Results from the First Year of Operation of a Unique Ambulance-Based Computed Tomography Unit for the Improved Diagnosis and Treatment of Possible Stroke Patients

Gutierrez JM, Emery RJ, Parker SA, Jackson K, Grotta JC

The University of Texas Health Science Center at Houston, Memorial Hermann Texas Medical Center

A “stroke” occurs when a blood clot blocks the blood supply to the brain or when a blood vessel bursts, resulting in brain cell death. Stroke is a main cause of death worldwide and is a common cause of disability. A common form of stroke, called ischemic stroke, is when blood flow to the brain is decreased. Research and clinical care has revealed the treatment within the very first hours of symptom onset is key for ischemic stroke with recanalization of occluded arteries by thrombolysis with alteplase. Research shows the time from first symptom to treatment is important. Computed tomography is one of the diagnostic tools to determine if this treatment path is appropriate. To determine if health outcomes of possible stroke patients can be improved by decreasing the time from symptom presentation to treatment, the first mobile stroke unit in the United States was deployed by The University of Texas Health Science Center at Houston in 2014, equipped with a computed tomography imaging system. The mobile stroke unit shortens the time to treatment for stroke patients by allowing prehospital treatment. Having completed its first year of operation, dosimetry data describing the doses delivered to various entities have been characterized. The mobile stroke CT operator’s cumulative deep dose equivalent for one year of operation was 1.14 mSv (114 mrem) resulting from the care of 106 patients. Area monitors and measurements were also performed to that demonstrated that general public doses limits did not exceed 0.02 mSv/hr (2 mrem/hr) or 1.0 mSv (100 mrem) in a year.

TPM-A.2 Enhancements to the Phantom with Moving Arms and Legs Software (PIMAL 4.0)

Hertel N

Georgia Institute of Technology, Oak Ridge National Laboratory

TPM-A.3 An Attempt to Develop a Urine Bioassay for a MicroBeta Liquid Scintillation Counter

Lazaro P, Luke RM, Thomas TN, Muraca PW, Savely SM

Baylor College of Medicine

In Baylor College of Medicine research laboratories, ingestion and inhalation are the most likely routes of exposure to beta radiation. Urine bioassays are the primary tool that Radiation Safety has at its disposal to ensure that beta radiation has not been internalized. Currently, urine bioassays are analyzed using a Packard TriCarb 1900 CA with an internal source. Given that this machine is more than 20 years old and has reached end-of-life status with the manufacturer, we set out to create a reliable urine bioassay that would enable us to use well plates, microliter amounts of urine and a Wallac MicroBeta 1450 for analysis. Results of our attempts will be presented and discussed.

TPM-A.4 Recent International Intercomparison Of The Lawrence Livermore National Laboratory Nuclear Accident Dosimeters

Lobaugh ML, Wong CT, Topper JD, Merritt MJ, Heinrichs DP, Hickman DP, Wysong AR

Lawrence Livermore National Laboratory, Los Alamos National Laboratory

Lawrence Livermore National Laboratory (LLNL) uses thin neutron activation foils, sulfur, and threshold energy shielding to determine neutron component doses and the total dose from neutrons in the event of a nuclear criticality accident. The dosimeter also uses an accredited Panasonic UD-810 thermoluminescent dosimetry system for determining the gamma dose. LLNL has participated in three international intercomparisons of nuclear accident dosimeters. In October 2009, LLNL participated in an exercise at the French Commissariat à l’énergie atomique et aux énergies alternatives (CEA) Research Center at Valduc utilizing the SILENE reactor . In September 2010, LLNL participated in a second intercomparison at CEA Valduc, this time with exposures at the CALIBAN reactor. This presentation discusses LLNL’s results of a recent third intercomparison hosted by the French Institut de Radioprotection et de Securite Nuclaire (IRSN) with exposures at two CEA Valduc reactors (CALIBAN and PROSPERO) in September 2014. For each irradiation, there were four arrangements of dosimeters: (1) placed on a phantom facing the core, (2) placed on a stand in free air facing the core, (3) on a phantom facing the core with a 45° orientation, or (4) on the back of a phantom facing the core with a 45° orientation (effectively a 225° orientation). After each irradiation at CEA, the dosimeters were transported by IRSN personnel to the Fontenay-aux-Roses facility, near Paris, approximately 3.5 hours away. The dosimeters arrived for measurement between 6 and 7 hours post irradiation. The LLNL PNAD performed extremely well for estimating neutron doses. The neutron KERMA results for the core-facing dosimeters were within 8% of the reference value. The accuracy and consistency of the gamma dose results were significantly different from the known gamma dose values. Additional evaluation is needed into the applicability of the current gamma dosimetry system for nuclear criticality accidents.

TPM-A.5 Meeting the New Lens Dose Limits: Implications for Dosimetry and Radiation Protection at Nuclear Power Plants

Chase WJ
Ontario Power Generation

In 2011 the International Commission on Radiological Protection (ICRP) recommended a reduced lens equivalent dose limit equal to its recommended effective dose limit. A result of this is that doses to the head higher than the rest of the body reduce the maximum allowable effective dose to less than its limit. For example, a Head to Trunk dose ratio of 2:1 and weighting factors of 0.11 for the Head and 0.89 for the Trunk means that the Lens Dose Limit of 20 mSv is reached at an effective dose of 56% of the limit, or 11.1 mSv. Currently, at most Nuclear Power Plants lens dose isn't recorded, or is estimated but not measured accurately. The new lens dose limit requires that lens dose be recorded for all radiation workers. For workers with doses well below the effective and lens dose limits, a better estimate of lens dose may suffice. For workers in non-uniform fields or with doses approaching the lens dose limit, lens dose measurement may be necessary. A lens dosimeter for a NPP must measure both beta and gamma doses accurately. This is problematic with a single-element lens dosimeter. Dosimeter design considerations are reviewed. Other radiation protection issues that will be discussed include new or improved protective glasses, new instrumentation to measure lens dose rate, and revisions to radiation protection programs, procedures, training, and computer systems for recording hazards and doses.

TPM-A.6 Comparison of Monoenergetic Photon Organ Dose Rate Coefficients for Stylized and Voxel Phantoms Submerged in Air

Bellamy M, Hiller M, Dewji S, Veinot K, Leggett R, Eckerman K, Easterly C, Hertel N
Oak Ridge National Laboratory, Easterly Scientific, Georgia Institute of Technology

Dose rate coefficients for organs and tissues in the human body were calculated due to external exposure to photons emitted by radionuclides distributed in air using the Oak Ridge National Laboratory adult male stylized phantom. Organ dose rate coefficients from the stylized phantom where compared to calculations of the same irradiation conditions performed with the ICRP reference adult male voxel phantom. The purpose of this study was to identify any major external dosimetry differences between the stylized and voxel phantoms and to identify the organs with the greatest deviation. Monte Carlo calculations were performed using MCNP6 for eight monoenergetic photon energies in the range from 30 keV to 5 MeV. For this work, both primary photons and secondary radiations (e.g. electrons and bremsstrahlung) were included in the transport calculations. All organs in the ICRP 103 definition of effective dose were considered. Statistical uncertainties the computed organ doses were below 5% for most organs. There is a general agreement between the voxel and the stylized phantom in the range of 50 keV – 5 MeV. For energies below 100 keV, differences in organ dose rate coefficients become increasingly prominent. Such differences were attributed to mass thicknesses that more strongly attenuate low energy photons between the phantom surface and the organs. This work was supported by the U.S. Environmental Protection Agency Office of Radiation and Indoor Air 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.

WAM-A.1 Irradiator Security Alarms: A Year in Review.

Luke RM, Pina LE, Thomas TN, Muraca PW, Savely SM
Baylor College of Medicine

All institutions with irradiators containing an aggregated category 1 or category 2 quantity radioactive material are familiar with the strict regulations and security surrounding the secured areas. There are multiple and various alarms that are triggered during normal day-to-day operations surrounding the irradiator room. At Baylor College of Medicine (BCM) each alarm is monitored and investigated by BCM Security Services , as well as Radiation Safety, commanding a substantial amount of time and resources from the institution. One year of irradiator alarms were reviewed, and analyzed. It was determined that the "forced/held door" alarm accounted for a majority of the issues. The description of this alarm is generic and can describe several different actions (forgetting to badge out, holding the door open too long, not waiting long enough after entering before attempting to badge out etc.). It does not provide Security Services or Environmental Safety with much information about the actual event or the person involved. However, each incident is investigated and a detailed incident report completed.

WAM-A.2 Source in a Box: Website for Estimating Gamma-Ray Source Activity from Survey Measurements

Benke RR
Atom Consulting

Radiation detection surveillance and radioactive material screening typically involve primary and secondary stages to maintain efficient operations. At facilities without state-of-the-art imaging, computed tomography, or active interrogation systems, secondary screening may rely on survey measurements with handheld instruments. Although handheld gamma-ray spectrometers are well suited to identify individual radionuclides, they are far less capable at estimating radioactive source strengths in sealed containers with unknown materials and geometries. To improve the ability of on-site personnel to assess the hazard and potential threat presented by concealed gamma-ray sources, a prescribed measurement procedure is outlined for handheld survey measurements. Test cases with a gamma-ray spectrometer are presented with sources in small containers of various materials and thicknesses. The accuracy of assessments with multiple gamma-ray sources in the container is compared to that for each source individually. Based on the test results, refinements are described and known limitations are identified. The status of website development and effectiveness of performing 16 measurements without access to the bottom surface of the container are discussed. Website development is geared toward users following the outlined survey procedure and performing the analysis themselves by acquiring survey data for the 16 measurements, subtracting background, converting the data into a standard format, and uploading the converted data along with the physical dimensions of the container, specific gamma-ray energies of interest, energy-dependent detection efficiency curve for the survey instrument expressed in the same standard format, and return email address for receiving the analysis results and corresponding input data. *The experimental research and website development described in this abstract are privately funded by Videnus LLC, Austin, TX.

WAM-A.3 Basis of Emergency Planning Zone Size and Pre-Staging Potassium Iodide Beyond 10 Miles

Milligan PA
US Nuclear Regulatory Commission

The NRC staff was directed by the Commission to identify additional recommendations related to lessons learned from the Fukushima Daiichi event beyond those identified in the near term task force report. Many additional recommendations were received both from NRC staff and external stakeholders. The additional recommendations identified for emergency preparedness considerations were reconsideration of the basis of the emergency planning zone size and prestaging of potassium iodide beyond 10 miles. The NRC received a petition for rulemaking in February 2012. The petitioner requested that the Commission amend its regulations in Part 50 of Title 10 of the Code of Federal Regulations (10 CFR) to expand existing emergency planning zones (EPZ). After review and the opportunity for public comment the NRC in 2013 denied the petition. However, the NRC staff committee to review information obtained from health studies on the impacted populations to see if the results of the studies to date challenge the emergency preparedness planning basis as well as the scope of potassium iodide distribution. This paper discusses the questions addressed by the NRC staff and conclusions.

WAM-A.4 Small Modular Reactors and Emergency Preparedness

Milligan PA
US Nuclear Regulatory Commission

Small modular reactors (SMRs) are part of a new generation of nuclear power plant designs. These small reactors are defined by the International Atomic Energy Agency as those with an electricity output of less than 300 MWe. They will be manufactured at a manufacturing plant and brought to the site fully constructed. There is less on-site construction, increased containment efficiency, and heightened nuclear materials security. Many of these SMRs are being designed with passive safety features and inherent safety features. These advanced designs with their enhanced safety features deserve a fresh look at emergency preparedness requirements. The NRC staff proposed to the Commission that rulemaking in EP should be undertaken to address the unique features of these SMRs and other advanced design reactors. The proposal includes consideration of a scalable emergency planning zone that could include emergency planning zones that extend only to the site boundary and there would be no requirement for an offsite emergency preparedness program. The Commission approved the staffs' proposal. This paper explores the challenges and opportunities associated with emergency preparedness for these reactors.

WAM-A.5 Bone Marrow Shielding as an Approach to Protect First Responders in View of NCRP Report 165 and Commentary No. 19

*Milstein O, Waterman G**
StemRad, Inc

NCRP Report 165 and Commentary No. 19 recognize the possibility of Acute Radiation Syndrome (ARS) among emergency personnel responding to radiological or nuclear terrorism. The importance of bone marrow (BM) in this syndrome and the shorter latency time of leukemia compared to other radiation induced cancers is also recognized. This highlights the importance of shielding BM tissue for prevention of both deterministic and stochastic effects. Due to the extraordinary regenerative potential of hematopoietic stem cells, to effectively shield BM, it is unnecessary to protect all or even most of the BM tissue. This is exemplified in transplantation, where only a fraction of the donor's BM (<5%) is sufficient to rescue a lethally irradiated recipient. This biological principle allows for the provision of a new class of personal protection equipment (PPE) which provides unprecedented attenuation of external radiation to a select amount of BM, thus deferring ARS to only much higher doses (>8 Gy vs. as low as 1 Gy today). From an operational standpoint, while these NCRP documents advise responders to shelter in place as long as dose rates are over 0.1 Gy h–1, NCRP Commentary 19 Section 6.6 recommends emergency responder actions within higher dose rate areas if necessary to save the lives of large populations. Moreover, NCRP 165 Section 3.2.2 sets decision dose at 0.5 Gy, yet allows incident commanders to decide on mission continuation beyond 0.5 Gy if deemed necessary. As BM-driven ARS may arise from doses as low as 0.75 Gy, effective BM PPE clearly complements the potential needs of emergency personnel as defined by these key NCRP documents. Moreover, since Commentary 19 points out that current standard protective gear does not protect against external radiation exposure and selective BM shielding is designed to do just that while retaining the mobility of responders, such PPE should be evaluated for inclusion with other standard protective gear in future reports and commentaries.

WAM-A.6 Gamma Source Reconstruction for Attribution and Safeguards Using Ubiquitous Dosimeters

Hayes RB
North Carolina State

Using Thermoluminescence (TL) and Optically Stimulated Luminescence (OSL), the bulk of all personnel dosimetry at nuclear facilities is accomplished. Secondary standard calibration of a gamma source to the National Institute for Standards and Technology can be accomplished through Electron Paramagnetic Resonance (EPR) of alanine dosimeters. Using proper sample preparation techniques, inorganic insulators such as ceramics, bricks and porcelains can all become effective dosimeters using OSL and TL. Similarly, organic insulators such as hard candy, bone and shells can also become effective dosimeters with proper sample preparation and analysis techniques followed by measurement with EPR. The Nuclear Engineering Department at North Carolina State University is bringing on line sufficient laboratory instrumentation to conduct proper EPR/TL/OSL dosimetry to enable dose depth profiling of ubiquitous dosimeters (telephone pole insulators, roof tiles, and confectionaries) to reconstruct an unknown source's position and energy. Source position is primarily found by analyzing dosimeters at multiple grid locations. Source energy is primarily obtained by evaluating dose as a function of depth into the material. The combination of grid positions with depth profiling is required in general to reconstruct an unknown source position and energy. This work paid for under federal grant NRC-HQ-84-14-G-0059.

WAM-B.1 Use of Advanced Technology Land Scanning System at Former DOD Landfill Site

Newsom SA, McDonald MP
Amec Foster Wheeler

Amec Foster Wheeler was tasked with performing radiological scan surveys for final survey release of a former DOD landfill site, using a state-of-the-science, real-time gamma spectroscopy scanning system (ScanPlot). The instrument selected by the client was based on suitability to the physical and environmental conditions at the site and the necessity to be able to locate and identify significantly small, discrete particles of various isotopes of radioactive materials within the surface and near-surface layer of the soil matrix, at levels sufficient to support the Data Quality Objectives (DQOs) established for the site. The ScanPlot system is composed of multiple large volume radiation detectors, operating as gamma spectrometers, coupled to a sub-meter accurate GPS system, mounted to and towed by an all-terrain vehicle. The detector output signals are processed by an in-house developed gamma spectroscopy software program, producing data relative to specific energy regions-of-interest and identified isotopes. A backpack-mounted version of the ScanPlot system was used in areas where the towed-array system could not be used. The maximum scan speed was 0.5 meter per second. At the completion of the scan survey of the 37 acre site, ~750 discrete radioactive items were identified, located and retrieved from surface/near-surface soils, then assayed for isotopic identification and activity concentration. The ability to detect these discrete items, in various states of degradation, malformation, and barely visible to the naked eye, demonstrates the ability of the ScanPlot system to accurately, and with great sensitivity and efficiency, locate and identify small discrete radioactive items in a soil matrix. Radiological and location data results were joined to create a tabular and iso-contour graphical representations of the areas surveyed. Discrete particles located by the ScanPlot system were removed from the soil matrix, assayed and then stored for off-site disposition.

WAM-B.2 Serious Questions about Radiation Measurements

Johnson RH
Radiation Safety Counseling Institute

How often do we find ourselves interpreting data based on someone else's radiation measurements without really knowing if the data are valid? Do we know for sure that the data justify our decisions for radiation safety? Unfortunately, many safety decisions are based on measurements with great uncertainties which are either unknown or neglected. Once a measurement is written down it seems to take on a life of its own and all uncertainties are lost. People commonly take written measurements as gospel and proceed to interpret the numbers as if they are real. We may not ask questions to verify the data, especially if the number seems to warrant some action. However, there are over 20 errors which can result in measurements that do not represent the real world. Since radiation is a random phenomenon, even with great care, radiation measurements are only "best estimates." When uncertainties are reported for measurements, in most cases they only account for the randomness of radiation. They do not include uncertainties due to calibration, energy response, and numerous operator judgment factors (geometry, location of measurement, speed of probe movement, etc.). Measurements are often made in contact with a source without taking into account the location of potentially exposed people and occupancy time. Other common errors include reading the wrong scale multiplier. For some analog instruments the switch setting is a multiplier and for others it is to choose a full scale reading. Errors have been made with digital instruments where people do not understand the symbol for micro. Because of fears of consequences, people may want to quickly implement safety decisions without confirming the initial measurements. The golden rule for defensible and justifiable radiation safety decisions should be to repeat the sample and measurement for confirmation, ideally with different people and instruments.

WAM-B.3 Management of Disused Devices Containing Depleted Uranium (Du) used for Radiation Shielding

Hageman JP, Benitez-Navarro JC
Southwest Research Institute, International Atomic Energy Agency

The International Atomic Energy Agency (IAEA) is preparing a report on the management of DU shielding, after the decommissioning of many types of irradiators and radiation devices. There is worldwide use of DU for shielding in teletherapy heads, accelerators, collimators, and source holders; portable radiography devices; self-contained irradiators; well–logging devices; transportation containers; and measurement gauges. DU waste can result at the end of the useful life of these devices. Due to the current issues associated with the safe management of disused high-activity radioactive sources, an important and emerging issue of immediate concern is the management of DU shielding associated with disused devices as a potential radioactive and chemically hazardous waste. The IAEA report will provide the much-needed information for the various options for the safe management of DU shields associated with disused radiation devices. The overall objective of this report is to countries in the safe management of disused DU shielding. Specific objectives of the report are to provide information on: • How to identify most devices containing DU used as shielding; • Dangers of DU found in such devices; • How to safely handle DU in such devices; • Various options for the safe management of DU shields; • Safety, security and safeguard considerations for the control and traceability of DU, arising from disused devices, based on international experience.

WAM-B.4 Computer Modeling of Stray Radiation Produced External to a Conventional X-Ray Therapy Room using the Geant4 Monte Carlo Toolkit

Ezenekwe UO, Harvey MC
Texas Southern University

Over the years, conventional shield designs of radiation therapy rooms have varied in layout and structure. Therapy room designs were generally based on circular accelerator movement about the patient. To that end, primary radiation has been limited to the direction of the accelerator; whereas, produced secondary radiations freely scattered about the treatment room surfaces (e.g., floors, walls, ceiling). The purpose of this project was to calculate the energy and magnitude of scattered radiation produced external to a conventional radiation therapy room. The Geant4 Monte Carlo Toolkit (version 10.00) was used to (1) design the walls of a computer-generated radiotherapy room and (2) simulate a source of photons consistent in energy with those produced from a conventional x-ray therapy unit. The photon source was positioned at a stationary point (i.e., isocenter) within the room and aimed at a 20 X 20 cm2 water phantom. Detectors consisting of water were placed just outside the walls of the room to detect the photons attenuated by the wall. For this case, calculations were performed to assess the energy and magnitude of stray radiation penetrating the walls of the radiotherapy room layout. Our preliminary results suggest that scatter radiation is mainly produced external to the primary barrier of the radiotherapy room.

WAM-B.5 Optimization of Shielding Parameters for a High Dose Rate Research Irradiator Design Baseline

Shannon MP, Mickum GS
Hopewell Designs Inc.

Several high dose rate applications require the use of a research irradiator for calibration and other supporting research & development activities. 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). There are several challenges with the legacy Gammacell 220 design including radiation protection issues. The present work explores an optimization study underway to develop a new baseline integrated shielding design. The study includes development of several high-fidelity monte-carlo models utilizing the Los Alamos National Laboratory MCNP N-particle transport code (MCNP6). As a technical starting point, estimates of Gammacell 220 shielding performance were modelled. The results were used to inform a series of shielding design perturbations which maximize irradiation chamber performance and minimize external dose to system operators. Finally, a new shielding baseline was developed. This talk will include an overview of the overall modeling effort, Gammacelll 220 shielding performance, estimates of an improved shielding design baseline and expected irradiation chamber and operator dose estimates.

WAM-B.6 Development of the Survey Instrument on Radiation Safety Culture in Nuclear Power Plants

Jeon I
Korea Institute of Nuclear Safety

Safety culture generally refers to the attitude and behaviors affecting safety performance of nuclear installations, which was introduced after the Chernobyl accident in 1986. In the similar context, recently, radiation safety culture was being emphasized as the core concept of radiation protection. However, there have been only a limited number of studies looking at the measurement of the radiation safety culture. This study aims at developing a survey instrument measuring radiation safety culture in nuclear power plants focusing on radiation protection. The safety dimensions which survey questionnaires in this study seeks to address are nine individual and organizational traits which Health Physics Society recommends including leadership, effective communications, and positive working environment, etc. To develop this survey instrument, while conducting literature review of safety culture and in-person interview with radiation protection staff in nuclear power plants, the author attempted to differentiate the unique concept of radiation safety culture centered on radiation protection from the overall safety culture. The survey was pilot-tested with staff in nuclear power plants to perform factor analysis and measure the reliability derived from the pilot data. The study results suggest that successful radiation safety culture require behavioral changes in both management and individual level, that is, a change of organizational culture. In South Korea, there is only one corporation operating domestic nuclear reactors, which means that there exists a single organizational culture. A culture is handed down from one generation to the next generation by learning. In the same way, an organizational culture is learned quickly if supported by the members of an organization. When an organization possesses inappropriate radiation protection culture such as prioritizing operating efficiency, organizational culture change may be crucial for the prime purpose of radiation safety.

WPM-A.1 How to Help a Person Frightened by Radiation

Johnson RH
Radiation Safety Counseling Institute

The word radiation is often associated with something dark, sinister, and frightening. Fears of radiation arise as an automatic function of our subconscious mind which is programmed to be constantly on the alert for dangers. Because of media repetition of the words "deadly radiation" most everyone now has an instinctive fear of radiation similar to fears of heights, snakes, spiders, immersion, and loud noises. When we encounter a frightened person, how can we be helpful? Because of our understanding and acceptance of radiation we may want to tell the frightened person, "It's OK, you do not have to be afraid." Most frightened persons will tell you this is not helpful, for several reasons. 1) Telling a fearful person not be afraid is discounting or making them wrong for their fears. 2) Fears arise from subconscious processes that do not hear qualifiers. Thus, the subconscious does not hear the word "not." Instead the subconscious hears "be afraid." 3) Telling a person not to be afraid is inviting them to make a conscious decision (that it is OK) when the fear decision comes from subconscious processes. Perhaps the first step is to affirm, "It's OK to be afraid." You may find this response difficult if you believe the person's fears are not justified. Once a person hears their fears are OK, they may be ready to consider the question, "How fearful is appropriate for the circumstances?" The best way for people to accept new information (if they want to) is for them to discover it themselves (not by us telling them our answers). Have the person perform their own measurements of radiation. Invite them to go through the same steps that you would use to make decisions on radiation safety. These steps from "cause to effect" include characterizing the source, determining its location, exposure rate, duration, and occupancy time, and how much radiation energy is deposited in the body. This information can then be evaluated by reference to studies on actual exposures and observed effects.

WPM-A.2 Writing a Book Chapter Titled "Radiation"

Moeller MP
Dade Moeller

For about one year, I have been working to update a chapter titled "Radiation" for a revision of the book titled Environmental Health – From Global to Local by Howard Frumkin, Dean of the School of Public Health, University of Washington. The book is written for graduate students with diverse backgrounds. This presentation describes the decisions and choices an author has to make when describing our field in about 30 published pages, the challenges associated with simplifying the science, and the realities of addressing "radiation" bias. The effort benefited greatly from how previous authors have approached their chapters and books on "radiation". One positive outcome is relearning the details of the discoveries of radioactive materials and radiation including their first applications. The earliest recorded theories of subatomic particles are thousands of years old. Another reality is grasping the bigger picture of the role of radioactive materials and radiation in broader scientific discovery, particularly as it relates to studying the atom. Our profession has extensive connections with other scientific disciplines including chemistry, medicine and industrial hygiene. These connections are essential to the past and to the future of our profession. Ultimately, narrowing down the description of our field for non-health physicists was a wonderful experience. While space restrictions meant that a lot of material was left out, the core science of our profession always remains.

WPM-A.3 Significant Developments in the History of Radiation Protection for US Aircrew

Shonka JJ
Shonka Research Associates, Inc.

US aircrew are a unique population of radiation workers whose protection is based on limited training documents provided to them by the FAA. UNSCEAR reports detail that aircrew constitute 3% of all radiation workers, yet receive 16% of all collective dose, a trend that has been increasing through the years. Aircrew are individually responsible for measuring and controlling their own radiation exposure. There is no evidence that any of the US aircrew do estimate or control their exposure. Aircrew employers have no responsibility to provide dosimetry, measure or estimate exposures or maintain exposure ALARA. The history of the development that has resulted in the lack of regulations for this class of radiation workers will be summarized. The historical scientific knowledge that formed the basis of the unusual path chosen by the FAA will be shown through the years. The performance of aircraft (cruising altitude, etc.) will be summarized as a function of years since the advent of the jet age. The path the FAA has chosen resulted in the lack of regulations. Although the FAA asserts that they follow the ACGIH guidelines, the FAA does not consider the issue of limitation (or ALARA) which forms one of the triad of principles on which modern radiation protection relies and which is required under ACGIH rules.

WPM-A.4 Going International: the Canadian Radiation Protection Association (CRPA)

Nichelson SM
Canadian Radiation Protection Association

This presentation provides an overview of the Canadian Radiation Protection Association (CRPA), and compares and contrasts the similarities and differences between the CRPA and the Health Physics Society (HPS). The comparison includes the following: a discussion of the histories, the various committees, the officers, staffing levels, membership types and numbers, publications, meeting styles and venues, typical attendance figures, and a brief overview of the radiation regulatory differences and similarities between Canada and the United States. In addition, certification issues within Canada and the United States are discussed. Typically the CRPA holds its annual conference in the May time frame, and the location rotates among the major cities in Canada, for example Toronto, Montreal, and Vancouver. In 2016, the annual meeting returns to Canada's largest city, Toronto, and is planned for the week following the IRPA meeting in the Republic of South Africa. The annual banquet is scheduled for the hockey hall of fame.

WPM-A.5 Trinity Site - 70 Years of the Atomic Age

Cicotte GR, Blevins L, Matcek GF
US Army (Civilian)

As with many advancements in science, technology, and industry, the Atomic – Nuclear Age was ushered in as a more effective means of destruction. The first operational test of a plutonium fission bomb was named Trinity by the "Manhattan Project" technical director, J. Robert Oppenheimer. The Trinity Site was selected in part in order to keep this new weapon as secret as possible, even though the explosion in the pre-dawn hours of July 16, 1945, lit the sky more brightly than the Sun. The site is located in the aptly-named Jornada del Muerto desert, about 35 miles southeast of Socorro, New Mexico. In 1965, twenty years after the test, the site was initially opened to the public, when it was named a National Historic Landmark district, with 650 people at the first "Open House." The effects of weathering and radioactive decay have reduced the external radiation dose rate from gamma emitters, primarily Cs-137, to about 2 microsieverts per hour, as compared with the approximately 6,200 microsieverts per year to which the average person is exposed, per NCRP 160. A visitor to Trinity Site for the entire length of the Open House could expect to receive about 16 microsieverts, about 1.6% of the 1 millisievert annual permissible exposure to a member of the public per 10 CFR 20, or about 0.26% of the expected annual exposure as estimated by the U.S. Environmental Protection Agency. Trinity Site Open House events are hosted by the U.S. Army up to two times per year, on the first Saturday of April and October. Major fallout pattern and intensity measurements have been conducted in the interim, and further evaluations are ongoing.

WPM-A.6 Failures of Plaintiff's Experts in Radiation Litigation

Johnson RH
Radiation Safety Counseling Institute

To justify their claims for radiation related damages plaintiffs retain persons as experts who will support their case. They may chose persons who seem to have knowledge of radiation, radiation safety experience, or even advanced degrees. Unfortunately, these indicators may not adequately qualify a person as an expert according to the Daubert Standard (validated methods, peer reviewed, known errors, follows standards, and wide acceptance). For example, in a case claiming damages from exposures to elevated levels of radon, one of the plaintiff's experts had a PhD in toxicology and experience as a pulmonary pathologist. However, this expert got all of the information for his report from public websites and had never written or presented a paper on radon measurements or radon health risks. He made numerous errors from lack of understanding the science behind radon risk assessment. In an another case, the plaintiff's expert, retained to collect radon and NORM measurements, failed to follow EPA and AARST testing protocols for radon. He assumed anyone could place activated charcoal detectors for radon. Both of these people had enough knowledge to sound like experts, but they could not stand up to rigorous scrutiny. Lessons learned for anyone who may serve as an expert: 1) only offer expertise in areas of extensive experience and knowledge and 2) question whether what you say or do will be defensible in court. When unsure, seek confirmation from others who are well known experts.

WPM-A.7 Feasibility Study for Alpha-Emitting Radioisotopes in Wastewater Samples around the Texas Medical Center

Amoako KO, Harvey MC
Texas Southern University

The medicinal use of radioisotopes for therapeutic and diagnostic applications in hospital environments are purported to account for a noticeable fraction of man-made radionuclides in wastewater. To this end, the identification and quantification of alpha-emitting radionuclides is crucial in environmental assessments at medical facilities. The purpose of this study was to perform an analysis for natural and man-made alpha-emitting radionuclides from several samples of institutional wastewater discharged at several locations around the Texas Medical Center (TMC) in Houston, TX. Of note is that we have not come across previous alpha-emitting radionuclide contaminant analysis reports at TMC facilities. Relative percent difference, relative error ratio, and absolute normalized difference are distinctly being explored as methods to determine differences among samples. Radionuclide tracer assessment is currently underway in our laboratory and will be studied using the Canberra Alpha Analyst Integrated Alpha Spectrometer bench top system. The Alpha Spectrometer system eliminates unnecessary attenuation effects; therefore, pristine detection resolution in low energy alpha peaks is also preserved in analysis.

WPM-A.8 Overcoming Stigmas and Making Clean Water

Moeller MP
Dade Moeller

The stigmas of "nuclear" and "radiation" are adversely impacting important humanitarian initiatives. Clean water is the most basic necessity promoting human health and welfare. It is essential to improving living conditions, reducing the prevalence of waterborne diseases, and increasing agriculture and livestock yields. Globally, 6.8 billion people rely on the 0.007 percent of the earth's water that is freshwater. Sadly, 783 million people worldwide, representing 1 in 9, do not have access to clean water, and 1 death in 5 of children under 5 is due to water-related diseases. Disadvantaged populations will never overcome health disparities or achieve health equity without access to sustainable quantities of clean water. While desalination of saline or ocean-based water is advancing worldwide with large-scale plants, such projects are not realistic in poor countries because of the high energy and infrastructure costs. The economics of desalination could be improved by using a self-contained power source and limiting the infrastructure to local water distribution. The technology exists to collocate a small nuclear reactor generating electrical power with a scalable desalination plant to provide clean water. Today's small modular reactor designs have inherently safe features and inaccessible fuel making them proliferation-proof, and they can provide continuous power for decades. While coupling these small-scale plants is a local solution addressing a global problem, the option is shunned. Educating decision-makers is one part of the solution. Our profession doing a better job of promoting good science is another. Perhaps there is common ground given the need for clean water.

WPM-A.9 Iodine 131 Metaiodobenzylguanidine (MIBG) Therapy From The Ground Up

Barnes JA, de la Guardia M, Granger M
Cook Children's Medical Center

Iodine 131 metaiodobenzylguanidine (MIBG) is targeted therapy used for treating neuroendocrine cancers; starting an MIBG therapy program can present many challenges. Concerns such as training; precautions for product handling, administration, and post therapy clean up all must be addressed before any patient can be treated. That as an organization, we found very few publications relating experiences and obstacles encountered when starting a new MIBG therapy program. We now recount our experiences during start-up; the program; and goals we set for ourselves. As an organization main concern was to give the maximum activity permitted within the clinical research protocols and keep exposures As Low As Reasonably Achievable (ALARA) for the staff and patient caregivers. May issues, concerns and problems manifested themselves over the years leading up to the first treatment. There was much that had to be completed even after the licensing issues were completed. Radiation isolation room layout, structural and shielding design had to be initiated and finalized; taking in consideration of keeping public access area are less than two microsieverts (0.2millirem) for regulatory compliance. Education and training had to be performed for over a hundred Oncology nurses, physicians, and other staff. Training had to be developed for patient caregivers that enter the isolation suite, who for the most part they are persons that have little to no background in radiation. Policies and Procedures had to be written and approved. The process of initializing and development the therapy program takes a multi-disciplinary team from the institution; every department that works on the nursing unit; support, maintenance staff and physicians, etc. need to communicate with each other to make the therapy program a viable option for the patients. Nevertheless, there are still changes that come up from time to time as we continue to learn and progress while the program matures.

WPM-A.10 Radiological Engineering at Los Alamos National Laboratory

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Los Alamos National Laboratory

An individual's career in health physics will have a drastically different look depending on that individual's interests as the field of health physics is broad. It is also rare for an individual to experience every aspect of health physics in their career, and it is common for an individual to specialize in one particular area of interest; such as environmental, medical, power reactor, accelerator, regulatory, educational, operational health physics. A complicating factor in this specialization process is that most jobs for radiation protection professionals only expose an individual to a few aspects of health physics. However, Los Alamos National Laboratory (LANL) offers a chance for an individual to be exposed to many aspects of health physics with radiological engineering. Radiological engineering is a branch of applied science and engineering that is essentially identical to health physics as both professions are concerned with the safe use and application of ionizing radiation in medicine and industry. Radiological engineers at LANL enjoy a diverse work scope supporting the laboratory's mission of solving national security challenges through scientific excellence.

Author Index

Notes

IRPA 2024, Orlando, Florida

Information on Health Physics Society bid for Orlando, Florida, 2024

The Health Physics Society is proud to be bidding on the opportunity to host the 16th Congress of the International Radiation Protection Association (IRPA) meeting which would be held in Orlando, Florida in 2024. The bid is co-sponsored by the Canadian Radiation Protection Association (CRPA) and the Sociedad Mexicana de Seguridad Radiológica (SMSR). The last North American IRPA Congress was in 1992; the last IRPA Congress held in the USA was in 1973. Since this time, much has changed and international collaboration is paramount to help solve difficult problems.

The meeting and accommodations will be on one site making this proposal very attractive to attendees! The ***Rosen Shingle Creek Hotel and Convention Center*** is nestled on a 230-acre site along Shingle Creek and just 10 minutes away from the Orlando International Airport (MCO). Most of the over 1500 guest rooms offer a stunning view of the golf course. Very affordable room rates have been negotiated for this prestigious IRPA Congress meeting with Rosen Shingle Creek.

Orlando is a place beloved for its theme parks: Walt Disney World, Universal Studios Florida, SeaWorld Orlando and many others. But it also beckons with world-class resorts, shopping opportunities for every budget, all -season golf courses and some of the most enticing dining opportunities on the planet.

Getting to Orlando is easy and affordable. Attendees arrive on more than 37 scheduled airlines, which provide nonstop service from 82 domestic and 34 international cities to Orlando International Airport. With new international service from British Airways, Avianca, Copa Airlines and TAM, Orlando is even more globally connected.

We hope to see you in Orlando in 2024!!

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