

Health Physics Society 48th Midyear Meeting *Norfolk, Virginia*



Norfolk Waterside Marriott
Norfolk, Virginia ♦ 1-4 February 2015

Final Program



Health Physics Society Committee Meetings

All Committee Meetings are in the Norfolk Waterside Marriott

Saturday 31 January 2015

NRRT BOARD AND PANEL

9:00 AM - 4:00 PM Frank/Shangri-La/Yorktown

HPS EXECUTIVE AND FINANCE COMMITTEE

Noon - 5:00 PM Presidential Suite

Sunday 1 February 2015

HPS BOARD OF DIRECTORS

8:00 AM - 5:00 PM Marriott V-VII

AAHP EXECUTIVE COMMITTEE

8:30 AM - 5:00 PM James I-II

NRRT BOARD AND PANEL

9:00 AM - 4:00 PM Frank/Shangri-La/Yorktown

PROGRAM COMMITTEE

10:00 AM - Noon Enterprise

Monday 2 February 2015

NRRT BOARD AND PANEL

9:00 AM - 4:00 PM Frank/Shangri-La/Yorktown

ANSI N42.54

2:30 - 5:30 PM James I-II

HP INSTRUMENTATION COMMITTEE

7:00 - 8:00 PM Frank/Shangri-La/Yorktown

Tuesday 3 February 2015

N13.65 WORKING GROUP

8:00 AM - Noon James I-II

NRRT BOARD AND PANEL

9:00 AM - 4:00 PM Frank/Shangri-La/Yorktown

ANSI N42.17A AND C

1:00 - 4:00 PM James I-II

SCIENTIFIC AND PUBLIC ISSUES COMMITTEE

4:00 - 6:00 PM York

AIRRS (OLD RSO) SECTION MEETING

5:00 - 6:00 PM Hampton Ballroom III

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Registration Hours Norfolk Ballroom Foyer

Sunday, 1 February	3:30-6:00 PM
Monday, 2 February	7:30 AM-3:00 PM
Tuesday, 3 February	7:30 AM-3:00 PM
Wednesday, 4 February	7:30 AM-1:00 PM

Exhibit Hours Norfolk Ballroom I-IV

Monday

9:30 AM-6:30 PM	Exhibits Open
9:45-10:15 AM	Coffee Break
Noon-1:00 PM	Complimentary Lunch
1:00-2:30 PM	Poster Session
3:15-3:45 PM	Coffee Break
5:00-6:30 PM	Exhibitor Reception

Tuesday

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

HPS Board of Directors

Barbara L. Hamrick, President
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Program Committee Chair: Tim Kirkham
Task Force Chair: Paul Burress
Bryan Lemieux
Tony Mason
Chris Shaw

The 2015 Midyear Meeting
is presented by the
Health Physics Society

Thank you to our Sponsor:
Dan Caulk Memorial Fund

SOCIAL EVENTS

Sunday, 1 February

Welcome Reception & Super Bowl Party!

6:00 PM **2nd Floor Great Room**
Plan on stopping in for the HPS Welcome Reception. There will be an opportunity to meet friends and to start your evening in Norfolk. We will also be watching the Super Bowl! Cash bar and light refreshments will be available.

Monday, 2 February

Complimentary Lunch in Exhibit Hall

Noon-1:00 PM **Norfolk Ballroom I-IV**

Poster Session

1:00-2:30 PM **Norfolk Ballroom I-IV**

Exhibitor Reception

5:00-6:30 PM **Norfolk Ballroom I-IV**
Join the exhibitors for food, a cash bar, and the latest in health physics equipment.

Tuesday, 3 February

Complimentary Lunch in Exhibit Hall

Noon-1:15 PM **Norfolk Ballroom I-IV**

Technical Tours

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

Hampton University Proton Therapy

Onsite \$40

As one of the first proton therapy centers, Hampton University Proton Therapy Institute (HUPTI) is dedicated to patient treatment and research. It is the world's largest free-standing proton therapy facility. Tour the facility and attend a seminar about proton therapy advantages over traditional radiation therapy.

Tuesday, 3 February, 1:00-4:00 PM

Thomas Jefferson National Accelerator Facility

Full!

Thomas Jefferson National Accelerator Facility (Jefferson Lab) is a nuclear physics research facility located in Newport News, Virginia. The lab's primary mission is to conduct basic research of the atom's nucleus using the lab's unique 12 GeV electron accelerator, known as the Continuous Electron Beam Accelerator Facility (CEBAF). The participants of the HPS midyear meeting technical tour will visit the SRF Institute, one of the worlds leaders in superconducting radiofrequency (SRF) science and technology, CEBAF control room, and various areas of accelerator and experimental end station enclosures.

WELCOME TO NORFOLK!

Norfolk has 144 miles of shoreline waiting to be explored! With fun, vibrant entertainment and culture and delicious cuisine, there are so many things to do here. Enjoy the Chesapeake Bay, Atlantic Ocean, and countless rivers - you are never far from the water.

Registration Fees 2015 Annual Meeting:

	Pre	On-Site
HPS Member	\$430	\$530
Non-Member	\$550	\$650
HPS Member + Dues	\$595	\$695
Student	\$ 70	\$ 70
Emeritus Member	\$215	\$265
One-Day Registration	\$275	\$300
HPS Member PEP Lecturer	\$130	\$230
HPS Member CEL Lecturer	\$280	\$380
Companion	\$110	\$110
Emeritus Companion	\$ 55	\$ 55

Speaker Ready Room

Enterprise

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

Headquarters Hotel

Norfolk Waterside Marriott

235 E Main Street

Norfolk, Virginia 23510

<http://www.marriott.com/hotels/travel/orfws-norfolk-waterside-marriott/>

757-627-4200

2015 HPS Midyear Meeting Exhibitors

Exhibits are located in Norfolk Ballroom I-IV

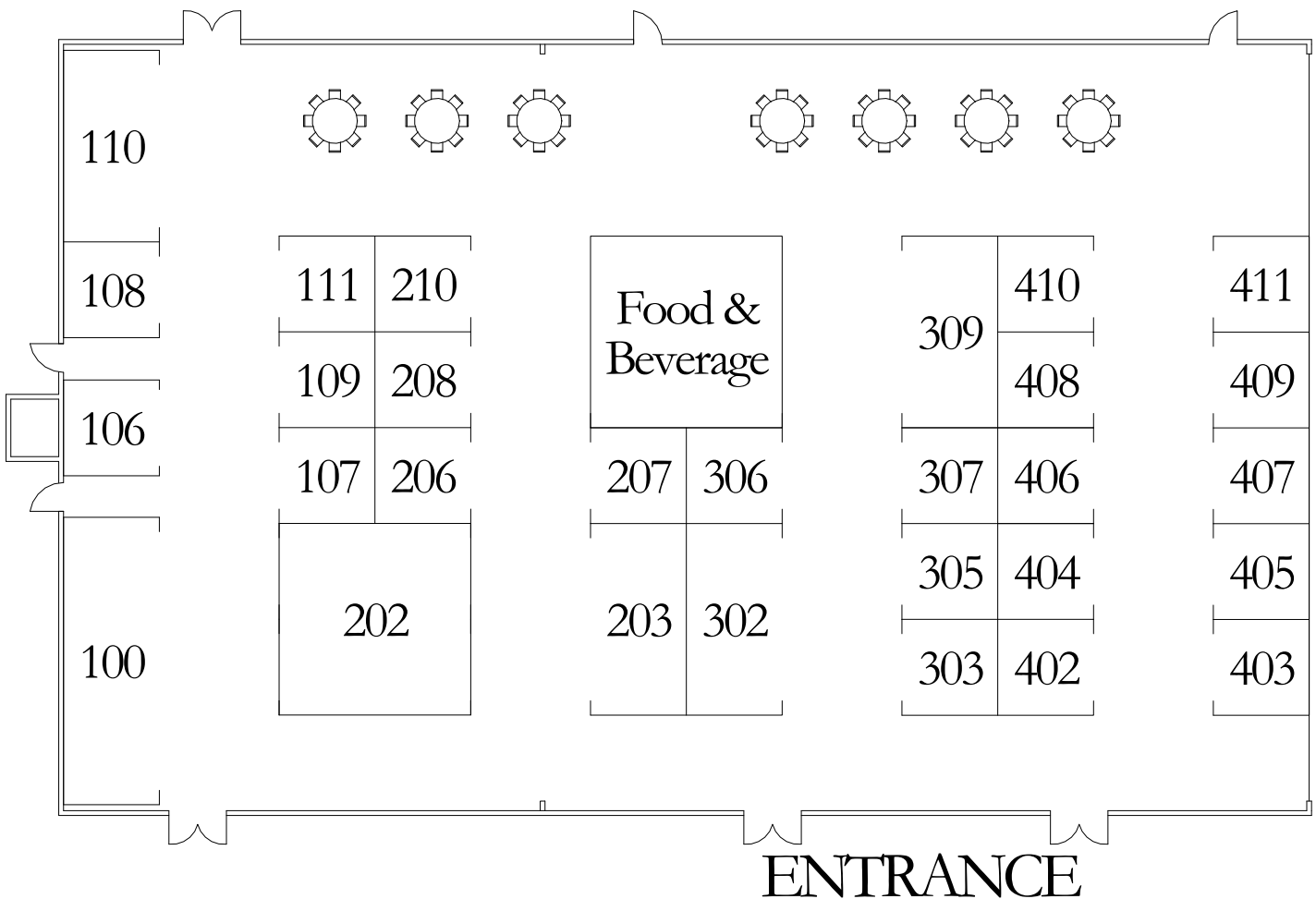
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2015 HPS Midyear Meeting Exhibitors

Exhibits are located in Norfolk Ballroom I-IV

2015 Annual Meeting-Indianapolis

Booth: 106

Best Medical International

Booth: 108

7643 Fullerton Road
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The Team Best Family of companies has been proudly developing, manufacturing, and delivering reliable medical equipment and supplies for over 35 years. Team Best includes over a dozen companies offering complementary products and services for brachtherapy, health physics, radiation oncology, blood irradiation, vascular therapy, imaging, and medical particle acceleration.

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Booth: 403

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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 policies 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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Booth: 100

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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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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.

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Booth: 309

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F&J Specialty Products, Inc., is the premier manufacturer of traditional and microprocessor controlled air sampling systems, airflow calibrators, tritium collection systems, and lightweight battery powered emergency response air samplers (including beta continuous air monitors [CAMS]). Other product lines include radio-iodine collection cartridges, radon detection products, filter media and personal air samplers, etc. Most instrumentation has the applicable North American ANSI/UL or European CE mark.

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Fuji Electric Corp. of America – Radiation is a wholly owned subsidiary of Fuji Electric Co., Ltd., and has a sophisticated line-up of high-quality Radiation Detection instrumentation, including our environmental monitors and ultra-lightweight Neutron Survey Meter. 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. Our goal is to continue to provide world-class radiation instrumentation solutions to meet the needs of the 21st century global market along with excellent customer and service support.

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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 systems, HI-Q has the capability to test ducts and vent stacks as required by ANSI N13.1-1999/2011.

Booth: 410

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Hopewell Designs, Inc., provides automated and manual irradiator systems and radiation shielding for government laboratories, nuclear power plants, private industry, medical laboratories, and universities throughout the world. Our expertise and experience in radiation and shielding design, software development, systems integration, manufacturing, training, and complex project management enables us to deliver quality products and service for hundreds of clients.

HPS Journal & WebOps **Booth: 110**
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www.kslab.com

K&S Associates Inc is a medical physics consulting organization offering accredited calibrations and TLD patient dose services. K&S is accredited by the AAPM offering radiation therapy calibrations, brachytherapy calibrations, and diagnostic calibrations. K&S is also accredited by HPS for the calibration of survey instruments. A2LA accredits K&S for all of the above services plus the calibrations of kVp, time, voltage, current, and light meters.

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www.lancsindustries.com

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The world's largest radiation dosimetry service provider utilizing the proprietary OSL technology found in both Luxel+ and InLight. InLight is a full-service personnel radiation monitoring program or turnkey onsite analysis system that meets routine personnel monitoring and emergency response requirements. Both dosimeter types are NVLAP and DOELAP accredited. Landauer's comprehensive diagnostic evaluation and reporting is backed by over 50 years' experience.

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LAURUS Systems, located in Ellicott City, Maryland, is a private, woman-owned small business specializing in radiation detection instrumentation, maintenance/calibration services, software, and training. LAURUS Systems is proud to present the new Rad-DX Mesh-Networked Area Monitor, PRDs, and portable portal monitors. All of our equipment and services are available through the GSA Advantage and various state contracts.

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

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Westerly, RI 02893
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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.

Booth: 408**Booth: 202****Booth: 302****Booth: 109**

ORTEC

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Booth: 303

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.

SE International

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www.seintl.com

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Manufacturer of the Radiation Alert product line, offering affordable handheld ionizing radiation detection instruments including Geiger counters, dosimeters, and multi-channel analyzers for surface and air contamination. Proven reliable in Emergency Response, environmental, industrial, laboratory, research, health physics, and educational fields. We provide excellence in instrumentation, reliability, and customer service.

Spectrum Techniques

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865-482-9937; FAX: 865-483-0473
www.spectrumtechniques.com

Booth: 405

Counting and gamma spectroscopy systems for teaching modern physics, chemistry and biology, health physics training, nuclear medicine, and research. Gross counting with GM and NaI detector systems. NaI detector based spectroscopy systems include built-in preamp, amp, HV, and ADC for spectroscopy and MCS (Multi Channel Scaling) applications. Exempt quantity sealed radioactive sources.

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Booth: 111

Thermo's Radiation Measurement and Protection division has supplied instrumentation and systems to facilities around the world for over 50 years. Our radiation-detection instrumentation and custom-designed shielding products represent the most complete line of quality products and systems on the market today. Our experience and equipment portfolio uniquely positions us to deliver the critical equipment necessary to address the radiation-detection requirements of the 21st century.

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Booth: 208

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865-381-1654
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Ultra Electronics - Lab Impex Systems specialize in the supply of radiation monitoring systems for nuclear and nuclear medical facilities. Brands: Area monitors, Continuous Air Monitors, Stack Effluent Monitoring.

UniTech Services Group, Inc.

Booth: 305

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UniTech Services Group, Inc., is the world's largest supplier of nuclear protective clothing and accessories. Our nuclear licensed decontamination facilities throughout the US and Europe provide the following services: radiological laundering of protective clothing, decontamination and testing of respirators, and the decontamination of tools & equipment (scaffolding, hand tools, portable HEPA vacuums, etc.). Our products and services are designed to provide our customers cost-effective protection for their workers with minimal generation of radioactive waste.

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 Norfolk Waterside Marriott

Monday

7:00-8:00 AM Hampton Ballroom II
**CEL 1 Comparison of the Radiation Risks of Flying
Versus other Means of Transportation**
Voss, T., Miaullis, A.; Voss Associates

8:15 AM-Noon Norfolk Ballroom V-VI

MAM-A Plenary Session
**Beginning at the End of the Cycle: Issues
and Solutions for Decommissioning
and Waste Disposal**
Chair: Barbara Hamrick

8:15 AM Introduction
Barbara Hamrick, HPS President

8:30 AM MAM-A.1
**Operations to Decommissioning: An Executive Per-
spective**
Stoddard, D.
Dominion Energy

9:00 AM MAM-A.2
Progress and Challenges for the Fukushima Cleanup
Barrett, L.
L. Barrett Consulting

9:45 AM BREAK

10:15 AM MAM-A.3
The Waste Isolation Pilot Plant
Stafford, J.
URS

11:00 AM MAM-A.4
**"A Decommissioning Renaissance"...If the Stalling
Nuclear Renaissance Has you Down, a Booming De-
commissioning Renaissance will Soon be Driving De-
mand, and Making Room, for New Nuclear Build**
Abelquist, E.
ORAU

Noon-1:00 PM

Norfolk Ballroom I-IV

Complimentary Lunch for Registered Attendees

*Crisp romaine with toasted croutons, parmesan cheese,
and caesar dressing*
Grilled fennel sausage with peppers and onions
Baked lasagna al forno with sauce bolognese
Grilled vegetable antipasti with roasted peppers
Linguine and clams in white wine herb sauce
Rustic garlic bread
Italian berry torte, tiramisu
Iced tea, water, coffee, decaf

1:00-2:30 PM

Norfolk Ballroom I-IV

**P.1 Application of a Radiological Consequence
Analysis Code to Dose Projections from Multiunit
Accident in a Korean Nuclear Site**
Park, S., Jeong, S.
Korea Institute of Nuclear Safety

**P.2 Evaluation of Hazard Radiation Doses to Some
Critical Organs During Pediatric Orthovoltage and
Supervoltage Radiotherapy**
Allehyani, S.H.
Medical Physics

**P.3 Excess Lifetime Cancer Risk of Workers in a Cs-
137 Contaminated Steel Recycling Facility**
Nwankwo, C., Ogundare, F.
*National Institute of Radiation Protection and Research,
University of Ibadan, Nigeria*

2:30-4:45 PM

Norfolk Ballroom V-VI

MPM-A Decommissioning, Reactor & Operational Health Physics

Co-Chairs: Bryan Lemieux, Frederic Mis

2:30 PM MPM-A.1
**Innovative ALARA Work Practices Used During
D&D Work**
Waggoner, L.
Lancs Industries

2:45 PM	MPM-A.2	4:00 PM	MPM-A.5
EP Dose Assessment at a Decommissioned Nuclear Plant		Historical Site Assessment and Survey for Release of the Seldon D. Feurt Memorial Building at UTHSC	
<i>Shannon, D.</i>		<i>Lemieux, B., Hansen, T.</i>	
<i>Dominion</i>		<i>University of Tennessee, Ameriphysics</i>	
3:00 PM	MPM-A.3	4:15 PM	MPM-A.6
Use of a CZT System and Collimator for Determination of Corrosion Activity in a Light Water Reactor		How Randomness Affects Our Decisions for Radiation Safety	
<i>Mis, F.</i>		<i>Johnson, R.</i>	
<i>University of Rochester</i>		<i>Radiation Safety Counseling Institute</i>	
3:15 PM	BREAK	4:30 PM	MPM-A.7
3:45 PM	MPM-A.4	Radiation Protection against Loss of Offsite Power during Shutdown Operation	
Pursuit of Decommissioning License Amendment for Routine Release of Buildings from Licensee Control		<i>Jeon, I.</i>	
<i>Lemieux, B., LaGroue, A.</i>		<i>Korea Institute of Nuclear Safety</i>	
<i>University of Tennessee</i>			
		5:00-6:30 PM	Norfolk Ballroom I-IV

Exhibit Hall Open Reception

Health Physics Society 60th Annual Meeting & Exhibition

Call for Papers

12–16 July 2015 - Indianapolis, Indiana



The deadline for submitting abstracts for the
2015 Annual Meeting is **7 February 2015**

Please submit your abstract (including Special Session abstracts!) through the HPS website

<http://hpschapters.org/2015annual/abstracts/>

Submittal & Presentation guidelines can be found at

<http://hps.org/meetings/>

Tuesday

6:45-7:45 AM Norfolk Ballroom V-VI
CEL 2 The Best Techniques of Great Gamma Calibrations
Voss, T.; Voss Associates

8:00-9:30 AM Norfolk Ballroom V-VI

TAM-A Environmental

Co-Chairs: Jeffrey Lively, Mark Miller

8:00 AM TAM-A.1
Nearest Neighbor Averaging and Its Effect on the Critical Level and Minimum Detectable Concentration for Scanning Radiological Survey Instruments for Performing Facility Release Surveys
Miller, M., Miltenberger, R., Fournier, S., Beall, P., Aleckson, T., Schierman, M.
Sandia, ERG, Inc.

8:15 AM TAM-A.2
The Art & Power of Data Imaging
Lively, J.
AMEC E&I

8:30 AM TAM-A.3
Environmental Radioactivity Levels in a Polycythemia Vera Cluster in Pennsylvania
Charp, P., Werner, L.
Centers for Disease Control and Prevention/ATSDR, ATSDR

8:45 AM TAM-A.4
Radioecological Impacts of Iron and Steel Industries
Khater, A., Bakr, W., Khater, A.
King Saud University, Egyptian Nuclear and Radiological Regulatory Authority

9:00 AM TAM-A.5
Consolidation of Environmental Monitoring Programs at a Treatment and Waste Disposal Facility
Matthews, T., Cortez, C., Shaw, C.
Waste Control Specialist

9:15 AM TAM-A.6
Seasonality in Air Monitoring at a Low-Level Waste Disposal Facility
Matthews, T., Cortez, C., Shaw, C.
Waste Control Specialist

9:30 AM BREAK

10:00 AM-Noon Norfolk Ballroom V-VI

PEP-T1: Review of Radon & Radon Progeny

Instructor: Robert Hayes, WIPP Site

This PEP course is worth 4 credit points and is included in registration fees

The following topics will be covered to try to provide an understanding sufficient to support operational decisions due to the effects of radon and radon progeny at nuclear facilities. This will start with radioactive decay chains, which generate radon and its progeny, the alpha and beta radiation that is emitted during the decay process, and radionuclide equilibrium. This will be followed by the basics of aerosol physics, which effect measurable radon alpha and beta activity and the impact of meteorological conditions on radon and progeny concentrations. Then the basics of instrumentation for measuring alpha spectra to include signal processing required to generate alpha and beta spectra. The last section will cover how dust impacts radionuclide assay and identification along with how radon can mask TRU alpha activity. The conclusions will address implications for measuring various air samples using alpha and beta spectrometry and traditional alpha spectrometry performed by radiochemistry.

Noon-1:15 PM Norfolk Ballroom I-IV

Complimentary Lunch for Registered Attendees

Romaine salad with Southwest dressing
Chile lime chicken breast
Fajita steak
Sauteed fajita-style peppers and onions
Soft flour tortilla shells
Apple cinnamon fried churros
Iced tea, water, coffee, decaf

1:15-3:15 PM Norfolk Ballroom V-VI

PEP-T2: Fundamentals of Gamma Spectroscopy

Instructor: David Pan, ORTEC

This PEP course is worth 4 credit points and is included in registration fees

This course offers a fast-paced review of the basic principles of gamma spectroscopic analysis. The course includes a review of the nature and origins of gamma-emitting radioactivity, basic physics of gamma interac-

tion with matter, consequences of gamma interactions on gamma spectra, gamma spectroscopy system components and calibrations, gamma spectroscopy analysis methods, and interpretation of gamma spectroscopy data.

3:15 PM

BREAK

3:45-4:45 PM

Norfolk Ballroom V-VI

TPM-A Accelerator, Instrumentation

Co-Chairs: Frazier Bronson, Samuel Baker

3:45 PM

TPM-A.1

Solving CARIBU Open Source Contamination Problems

*Baker, S., Greene, J., Levand, A., Pardo, R., Savard, G.
Argonne National Lab*

4:00 PM

TPM-A.2

Validation Testing of the Canberra Mobile FeedRoll Assay System

*Bronson, F., Suzuki, A., Ilie, G.
Canberra, Canberra-Japan*

4:15 PM

TPM-A.3

Validation Testing of the Canberra TruckScan Waste Assay System

*Bronson, F., Suzuki, A.
Canberra, Canberra-Japan*

4:30 PM

TPM-A.4

On-Line Low-Level Monitoring for SrY90 to Support the Fukushima Water Cleanup Project

*Bronson, F., Zickefoose, J.
Canberra*

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Wednesday

6:45-7:45 AM **Norfolk Ballroom V-VI**
CEL 3 Is Telling the Truth the Answer to Effective Radiation Risk Communication?

Johnson, R.; Radiation Safety Counseling Institute

6:45-7:45 AM **Hampton Ballroom II**
CEL 4 Mastering Neutron Instrument Calibrations
Voss, T.; Voss Associates

8:00-9:15 AM **Norfolk Ballroom V-VI**

WAM-A Regulatory/Legal Issues, Environmental II & Risk Analysis

Co-Chairs: Aaron Miaullis, Travis Matthews

8:00 AM **WAM-A.1**
The Joint Commission Standards with RSO/Health Physics Implications

Dielman, R.

CRCPD Liaison to the Joint Commission

8:15 AM **WAM-A.2**
United States Department of Transportation 2014 Radioactive Material Related Final Rulemaking

Williams, J.

U.S. Department of Transportation

8:30 AM **WAM-A.3**
The NRC's Allegation Follow-Up Program as It Applies to the Nuclear Materials World

Bermudez, H.

US NRC

8:45 AM **WAM-A.4**
Natural Cosmic Radiation Dose Rates (uSv/hr) vs. Altitude and Public and Soldier and Public Perceptions on Radiation

Miaullis, A.

AFRRI

9:00 AM **WAM-A.5**
It's Time for the FAA to Regulate Air Radiation Safety

Shonka, J., Bramlitt, E.

SRA, Self

9:15 AM **BREAK**

9:45-11:45 AM

Norfolk Ballroom V-VI

PEP-W1: Why Our Natural Intuitive Processes Fail for Radiation Risk Assessments

Instructor: Ray Johnson,

Radiation Safety Counseling Institute

This PEP course is worth 4 credit points and is included in registration fees

We often employ intuitive processes when we make assessments and choices in uncertain situations, such as dealing with radiation risks. The normal processes for safety decisions by a caveman confronted with a saber-toothed tiger do not do very well in today's world and may lead to decisions that are incongruous or even harmful. Studies have shown that the parts of our brain involved in decisions for risk assessments are closely connected to the seat of our emotions. The amygdala, which is linked to our emotional state, especially fear, is activated when we make decisions couched in uncertainty. Mechanisms by which people analyze situations involving chance are a complex product of evolutionary factors, brain structure, personal experience, knowledge, and emotion. Making wise assessments and choices in the face of uncertainty is a rare skill. We often start with a naive realism, namely the belief that things are what they seem. However, when viewed more broadly, we may realize that things are not what they seem, but something quite different. This is illustrated by the story of the wise men and the elephant. By necessity we employ certain strategies to reduce the complexity of risk assessments and our intuition about probabilities plays a role in that process. Our subconscious mind is designed to jump intuitively to conclusions, often with very little evidence. It is not designed to know the size of the jumps. Our confidence in our intuition is a function of the coherence of the story we construct. The quality or quantity of the evidence does not count for much because a very good story can be constructed based on very poor evidence. How many people automatically conclude that radiation is bad with very little (and likely very poor) evidence? Kahneman says, "Considering how little we know, the confidence in our intuitive beliefs is preposterous – and also is essential." We have to believe in something. Swimming against the tide of human intuition for safety decisions can be exceedingly difficult. Confidence in our intuition is not usually based on a logical analysis of the probability that our judgment is correct. Confidence in our intuition is a feeling based on the coherence of information from which we construct a story and the ease of processing that information. While it

is not common to admit uncertainty, expressions of high confidence mean we have constructed a coherent story, not necessarily that the story is true. For example, many people are very confident about their intuition regarding radiation risks even though their beliefs are based on mythology (beliefs not technically true).

1:00-3:00 PM Norfolk Ballroom V-VI

PEP-W2: Training First Responders on Radiological Dispersal Devices (RDDs) and Improvised Nuclear Devices (INDs) Events

Instructor: Ken Groves, S2 Sevorg Services

This PEP course is worth 4 credit points and is included in registration fees

This PEP will present an overview of the current training the author is presenting to first responders (firefighters, emergency medical technicians, law enforcement and others) who may encounter either a Radiological Dispersal Device (RDD or Dirty Bomb) or an Improvised Nuclear Device (IND) as a part of their emergency response activities. The emphasis of the training is putting the radiological/nuclear material in perspective as compared with other Weapons of Mass Destruction (WMD) materials such as chemical and/or biological weapon agents. A goal of the training is to help members of this first responder community understand that under almost all conditions, they can perform their primary mission of “putting out fires, rescuing and treating injured persons, and chasing bad guys” even in the presence of a relatively large amount of radiological/nuclear contamination. The rare cases of high-activity unshielded sources will be reviewed and explained. Current national/international guidance on dose “limits” will be discussed. The use of information contained in the new NCRP report title “Response to a Radiological or Nuclear Terrorism Incident: A Guide for Decision Makers”; NCRP Commentary No. 19, “Key Elements of Preparing Emergency Responder for Nuclear and Radiological Terrorism;” and the CRCPD “First Responders Handbook” will be used extensively in the presentation. A discussion of the use of time, distance, and shielding as well as appropriate personal protective clothing and how it will provide the needed protection while immediate actions take place early in an RDD/IND event will be reviewed. The use of appropriate radiation detection instrumentation, documented standard operating procedures along with realistic training, drills, and exercises are the key to a successful response to an RDD/IND event for this community of critical emergency responders.

3:00 PM

BREAK

3:30-4:30 PM Norfolk Ballroom V-VI

WPM-A External Dosimetry, Biokinetics/Bioeffects

Co-Chairs: Allen Brodsky, Nolan Hertel

**3:30 PM WPM-A.1
Dose Rate Coefficients for Exposure to Ground Contaminations**

Bellamy, M., Eckerman, K., Easterly, C., Leggett, R., Stewart, D., Hertel, N.
Oak Ridge National Laboratory, Georgia Institute of Technology*

**3:45 PM WPM-A.2
Updated External Dose Coefficients for Air Submersion and Water Immersion**

Bellamy, M., Eckerman, K., Easterly, C., Leggett, R., Stewart, D., Hertel, N.
Oak Ridge National Laboratory, Georgia Institute of Technology*

**4:00 PM WPM-A.3
Screening Radiation and Bystander-Response Genes and Exploring the Mechanism of Bystander Effects Using AHH-1 Exposure to the Different Dose of ⁶⁰Co Gamma Rays**

Yao X., Xian G., Daqin S., Ling H.
University of SMMU*

**4:15 PM WPM-A.4
Why All Radiation Bioeffects, Acute or Long-Term, Are Stochastic**

*Brodsky, A., Bradley, F.
Georgetown University, Private Consultant*



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Module 1: CT (Feb 2, Afternoon)

1. Basics of CT
2. Fundamentals of Backprojection and iterative reconstruction
3. Axial, helical volumetric scanners
4. Principles of image quality in CT
5. CTDI, DLP and dose monitoring in CT
6. ACR and Joint Commission level testing and accreditation process for CT

Module 2: Mammography (Feb 3, Morning)

1. Basics of mammography
2. Screen film mammography
3. Full field digital mammography
4. MQSA testing and compliance
5. Breast tomosynthesis systems

Module 3: Additional (Feb 3, Afternoon)

1. Safety Culture
2. Overview of ACR accreditation
3. Sentinel events in cardiology and interventional radiology

Continuing Education Lectures

CELs take place in the *Norfolk Waterside Marriott*
7:00 - 8:00 AM Monday, 6:45 - 7:45 AM Tuesday and Wednesday

CEL 1 Comparison of the Radiation Risks of Flying Versus other Means of Transportation

Voss, T., Miullis, A.; Voss Associates

This class discusses the pros and cons of flying versus other means of transportation. What are the risks and what are the consequences? Should the radiation risk be the only risk to be accounted for when making the decision to fly or drive? How do the radiation risks compare to the other risks we are exposed to each day? The instructor has many years of experience with radiation detection instruments, and are Certified Health Physicists. The instructor began his career in radiation measurements in 1967, working at a commercial nuclear power plant (then under AEC rules). His experience covers working with the AEC, NRC, DOE, US Military, Research, and the commercial world.

CEL 2 The Best Techniques of Great Gamma Calibrations

Voss, T.; Voss Associates

This class discusses the techniques for gamma calibrations. The instructor has many years of experience with radiation detection instruments. The lead instructor began his career in radiation measurements in 1967, working at a commercial nuclear power plant (then under AEC rules). The co-instructor has more than 10 years of experience working with radiation detectors. Between the two instructors their experience covers working with the AEC, NRC, DOE, US military, research, and the commercial world. The objective of this CEL is to provide calibration techniques for gamma survey instruments. The effects of geometry, distance, and scattering will be explored. Calculations of chamber current flow and correction factors for barometric pressure, temperature, and humidity will be presented. Interferences such as geotropism, EMF, relative humidity, and interfering radiations will be discussed. The performance of vented air ionization chambers will be compared to various other types of gamma survey instruments including pressurized ion chambers, energy compensated GM detectors, and scintillation detectors. Field survey techniques with the vented air ionization chamber will be discussed. A discussion of calibration techniques for personnel dosimeters versus hand-held radiation survey instruments will be included.

CEL 3 Is Telling the Truth the Answer to Effective Radiation Risk Communication?

Johnson, R.; Radiation Safety Counseling Institute

A well-known health physicist once told me, while shaking his finger in my face, "The answer to risk communication is simple; just tell people the truth!" I responded to say, "I believe in telling the truth; however, my studies show that truth has different meanings to different people." This HP then left in great disgust saying, "I can see that we are diametrically opposed." My studies of nearly 4,000 radiation safety specialists with the Myers Briggs Type Indicator (MBTI - a trademark of Consulting Psychologists Press) show that for the majority of HPs truth is what can be defended by logical rational analysis and corroborated by peers. However, for the majority of the general public truth may be what is best for people taking into account the circumstances, feelings, and emotions. These two views of the truth can be very different and both groups will honestly believe they are right and will swear they are telling the truth in a courtroom. The question to consider today is whether telling the "technical" truth about radiation is working. Have public sentiments against radiation mellowed over the decades since the advent of nuclear weapons? I believe most will agree that members of the public are as concerned about radiation safety today as they were decades ago. After all we now have proof that nuclear technology can go wrong (Three Mile Island, Chernobyl, and now Fukushima Daiichi). Apparently the truth we are telling people about radiation risks is not generally accepted. This begs the question, "How do people determine the truth?" Insights on this question were presented in a series of *Health Physics News* articles in 2012- 2013. I have attempted to describe how people make decisions on truth for radiation safety based on processing information as normal functions of the subconscious mind. Our subconscious mind is wired to constantly search for signs of danger. However, since radiation does not give us any physical sensation, we have to rely on imagination to determine our safety. Our subconscious mind has been programmed by education and the media to automatically associate all radiation with "deadly radiation." Thus, the associations by normal subconscious functions for safety will likely lead to decisions based on images of unacceptable consequences of radiation exposures. This class will explore many questions on effective risk communications, such as: What is the truth? How does truth relate to beliefs, faith, and ethics?

What is lying? How do we process data to determine the truth? How does randomness affect our lives? How does radiation mythology affect people's views? What are possible answers to effective radiation risk communication?

CEL 4 Mastering Neutron Instrument Calibrations

Voss, T.; Voss Associates

This class discusses the various neutron sources and their energies and the energy response of various types of neutron detectors. The instructor began his career in radiation measurements in 1967, working at a commercial nuclear power plant (then under AEC rules). The instructor's experience covers working with the AEC, NRC, DOE, US military, research, and the commercial world. The following detector types will be discussed: fast neutron detectors, thermal neutron detectors, and neutron spectrometers. Neutron moderation and absorption will be discussed. Common neutron sources including spontaneous fission, alpha-n reactions, and neutron generators (D-D and D-T) will be discussed. Neutron sources may have various types and amounts of moderation; how those relate to neutron instrument calibration will be discussed. Neutron detector responses to interfering radiation and how to deal with them will be discussed.

MAM-A.1 Operations to Decommissioning: An Executive Perspective

Stoddard, D.; Dominion Energy

MAM-A.2 Progress and Challenges for the Fukushima Cleanup

Barrett, L.; L. Barrett Consulting

MAM-A.3 The Waste Isolation Pilot Plant

Stafford, H.J.; URS. jim.stafford@urs-gmos.com

The Waste Isolation Pilot Plant (WIPP), located in Southeastern New Mexico, is the world's only underground repository for defense-generated transuranic (TRU) waste. The facility commenced waste disposal operations in March 1999, and operated until February 2014, when two events resulted in a suspension of TRU waste disposal activities. The first event occurred on February 5 when an underground salt haul truck caught fire in a drift (passageway) in the northern part of the underground. The second event occurred in the underground on February 14, 2014, and involved at least one drum of TRU waste that released some of the radioactive contents into the exhaust drift and parts of the active waste disposal panel. The underground ventilation system (UVS) was operating at approximately 400,000 standard cubic feet per minute (SCFM) at the time of release. After an underground monitor detected airborne radioactivity the UVS shifted to HEPA filtration at approximately 60,000 SCFM. Radioactive contamination was dispersed throughout some areas of the underground, and resulted in small but detectable amounts of TRU activity on the surface. A WIPP recovery plan to safely restart WIPP operations was approved and issued by the Secretary of Energy on September 30, 2014. The plan provides an aggressive schedule that documents return to interim waste disposal operations by March 31, 2016. Much of the plan deals with decontaminating parts of the underground mine. That aspect of the recovery plan will be the focus of today's presentation.

MAM-A.4 "A Decommissioning Renaissance"...If the Stalling Nuclear Renaissance Has you Down, a Booming Decommissioning Renaissance will Soon be Driving Demand, and Making Room, for New Nuclear Build

Abelquist, E.; ORAU. Eric.Abelquist@orau.org

While the nuclear renaissance struggles to gain traction (particularly in the U.S.), a renaissance of sorts is occurring at the back-end of the nuclear life cycle. Decommissioning is on the cusp of an impressive surge in

activity both in the U.S. and internationally. Indeed, as China and India lead the world in constructing nuclear reactors, with nearly 40 under way, Europe and the U.S. are decommissioning more than they're building. Whether it's cheap natural gas or slack electricity demand, market forces are driving nuclear power plant decommissioning, such as the Kewaunee Nuclear Power Plant in WI and Vermont Yankee Nuclear Power Plant. Decommissioning is also planned or under way at the Crystal River Nuclear Plant in FL, Humboldt Bay Power Plant and San Onofre Generating Station in CA, and Zion Nuclear Facility in IL. Significant decommissioning activities continue on the Magnox reactors in the U.K., and Germany plans to dismantle a dozen of its nuclear reactors over the next two decades. And as Japan focuses on the decommissioning of Fukushima Daiichi Nuclear Power Station, many of Japan's nuclear fleet will likely be prematurely decommissioned. Apart from nuclear power plant decommissioning, environmental cleanup will benefit from increased government and private sector funding. Defense cleanup projects in the U.S. and U.K. have multibillion dollar budgets, and Canada is ramping up its cleanup program. The Army Corps of Engineers has a \$100 million budget for the Formerly Utilized Sites Remedial Action Program (FUSRAP), and the Department of Energy's cleanup program has an annual budget close to \$6 billion (likely to be near that level for decades). Not to be outdone, the U.K. government recently doubled its total estimate for cleanup (particularly the Sellafield complex) to more than \$100 billion. Decommissioning projects regulated by the U.S. Nuclear Regulatory Commission have increased markedly in recent years, including Title I and Title II uranium recovery site and other materials sites including AAR Manufacturing, Inc., Mallinckrodt Chemical, Inc., UNC Naval Products, and Westinghouse Electric-Hematite Facility, to name a few. Also considering Agreement State decommissioning projects, NORM/TENORM remediation projects, Department of Defense facility cleanup projects, among others, decommissioning is certainly on the verge of a renaissance. In addition to detailing the anticipated decommissioning industry performance, this paper will address challenges and ongoing developments in U.S. and international decommissioning.

P.1 Application of a Radiological Consequence Analysis Code to Dose Projections from Multiunit Accident in a Korean Nuclear Site

Park, S.H., Jeong, S.Y.; Korea Institute of Nuclear Safety. shp@kins.re.kr

All nuclear power plant sites in Korea are operating at least 5 - 6 reactors. So dose projection capability for accident from two or more reactors on a single site should be secured as a part of emergency preparedness and response. In this study, radiological releases and projected offsite doses from multiunit accident were estimated using a computer code, RASCAL (Radiological Assessment System for Consequence AnaLysis) version 4.3. A scenario, in which three KSNP (Korea Standard Nuclear Power Plant) reactors were damaged coincidentally by a great natural disaster, was considered to verify applicability of the codes to accidents in Korean nuclear sites. Source terms of each unit were calculated individually using LOCA (Loss of Coolant Accident) option, assuming rapid developing accident sequence. Total source term and integrated offsite doses were acquired using a source term merge function in the code. Total amounts of release into environment were up to 3.5×10^{18} Bq. Release amounts were relatively high, because reduction by coolant refilling during uncovered period was ignored. The maximum radius for protective actions, such as sheltering, evacuation and thyroid blocking, were within about 2 km under given weather condition. Also calculated source terms were compared with those from LTSBO (Long Term Station Black Out) option, considering slowly developing sequence of accident. Projected doses from LTSBO option were higher than LOCA option. Differences in doses were caused by release characteristics, such as higher iodine releases and longer duration. RASCAL, with newly equipped functions, i.e. source terms merging and options for longer time frame accident sequence, can be useful tool for radiological consequence projection of postulated accidents in Korean nuclear sites.

P.2 Evaluation of Hazard Radiation Doses to Some Critical Organs During Pediatric Orthovoltage and Supervoltage Radiotherapy

Allehyani, S.H.; Medical Physics. saud8882001@yahoo.com

The levels of scattered radiation doses imparted to the eyes, thyroid and gonads of pediatric patients treated with supervoltage radiation (300 kVp, 2.0 mmCu HVL) and with a 6-MV linear accelerator, were determined by making thermoluminescent dosimeter (TLD) measurements in three paraffin phantoms of different sizes. These

phantoms were made from molds of mannequins used for store display, of approximate heights 30", 40" and 50" representing children of ages 1-2, 4-5 and 8-10 yr., respectively. The sites chosen for irradiation were whole brain, chest, kidney, whole abdomen and spinal column. These sites are normally treated in such pediatric malignancies as medulloblastoma, neuroblastoma and Wilms' tumor. Some of the doses measured are less than 10 cGy for an entire treatment regime, and would therefore be categorized as low-level doses. Where radiation was the only mode of treatment for long-term survivors of such malignancies, especially those treated 20-30 yr ago with orthovoltage radiation; useful data may be extracted for contributing to our knowledge about the long-term effects of low levels of radiation

P.3 Excess Life Time Cancer Risk of Workers in a Cs-137 Contaminated Steel Recycling Facility

Nwankwo, C.U., Ogundare, F.O.; National Institute of Radiation Protection and Research, University of Ibadan, Nigeria. rapuluchi@yahoo.com

There has been a reported case of contamination by Cs-137 in a scrap metal recycling facility in Nigeria. Though the level of contamination is low, it is a source of serious concern especially for the workers of the facility. This study sets out to assess the radiation hazard indices and the excess lifetime cancer risk (ELCR) associated with exposure to the Cs-137 contaminated area. The activity concentration of the Cs-137 at different sampling points was determined using high pure germanium gamma spectroscopy. The activity concentration of Cs-137 ranged from 1.7 to 5146.2 Bq/kg. The dose rate and annual effective dose equivalent ranged from 0.3 to 823.4 Gy/hr and 1.7 to 5052.4 μ Sv respectively. The ELCR ranged from 0.006E-3 to 17.7E-3. Many of the ELCR were greater than the world average of 1.45E-3. Most of the samples with high hazard indices were from the fly ash from the furnace and materials made from the ash. These results imply that the risk of cancer is high for humans that live or work at or near the contaminated area. Though there is no increased cases of cancer yet, since the accident is relatively new (around 2008-2010) but this may not be the case in the near future. Strong recommendations have been made to the regulatory body to ensure good cleanup of the area.

MPM-A.1 Innovative ALARA Work Practices Used During D&D Work

Waggoner, L.O.; Lancs Industries. Lwaggoner@wave-cable.com

Several Department of Energy Sites are undergoing deactivation, decontamination, decommissioning and demolition (D&D) activities as part of reducing their radiological footprint. Innovative ALARA work practices are being used to reduce worker's radiation exposure, eliminate contamination spread and protect the environment. This presentation will discuss radiological work practices that have proved successful in accomplishing this work. Experience has shown that D&D work is different than the normal work to operate, overhaul and refuel a radiological work facility or operating nuclear plant. Workers and managers had to learn new skills. Workers had to learn to use new hand tools and how to operate remotely operated tools. Mockup training was used to teach the workers, ensure the tools were adequate and refine the work document. Managers were required to make risk-based decisions on the methods used to accomplish the work. The innovative work practices include the use of fixatives, new decontamination techniques, misting, expandable foam, cutting tools, filtered ventilation, and remotely operated tools.

MPM-A.2 EP Dose Assessment at a Decommissioned Nuclear Plant

Shannon, D.J., Dominion. dan.j.shannon@dom.com

This presentation provides a summary of the challenges associated with Emergency Planning (EP) dose assessment at a decommissioned nuclear plant, based on the Kewaunee Power Station (KPS) decommissioning experience. The Kewaunee Power Station located in the town of Carlton, WI, permanently ceased operation on May 7th, 2013, and was permanently defueled on May 14th, 2013. The plant is being decommissioned using the SAFSTOR method. The challenges for performing dose assessments at a decommissioned nuclear plant include: (1) the change in the source term of the remaining credible, postulated fuel handling accident; (2) performance of dose assessment calculations to support emergency plan exemption and license amendment requests, with little or no regulatory guidance for performing these calculations; (3) development of decommissioned emergency action levels for radiological events using industry guidance that is based on an operating plant; and (4) development of a dose assessment method that accurately reflects the new accident source term, is easy to use, and is economical to maintain. The presentation will describe the methods used at KPS to address these challenges.

MPM-A.3 Use of a CZT System and Collimator for Determination of Corrosion Activity in a Light Water Reactor

Mis, F.J.; University of Rochester. mis@urmc.rochester.edu

Gamma spectroscopy measurements of various Containment and Auxiliary Building (PWRs) and Reactor Building (BWR) piping using CZT technology have been performed in the United States since the spring of 2010. This was a new measurement device for the American light water reactor industry. Previous gamma spectroscopy measurements were performed using a liquid cooled GeLi system. These systems were effective in doing a detailed analysis of various plant components, but were difficult to install, may have required their own scaffolding, and required liquid nitrogen as a coolant. A CZT campaign provides similar important data as a GeLi system, but may be operated by one individual, be hand carried, and does not require additional plant support other than radiological protection escorts in specific areas, or when areas are difficult to find. The resulting analysis from both gamma spectroscopy systems allows the chemistry program to determine the impact on the source term from the online chemistry regimen. It also provides the Radiation Protection Program data to improve its accuracy for the measurement of occupational exposure. The identified energy spectrums will allow better calibration of radiation measurement instruments including thermo-luminescent dosimeters (TLDs), electronic dosimeters (ED), and other devices designed to measure the dose of legal record (DLR).

MPM-A.4 Pursuit of Decommissioning License Amendment for Routine Release of Buildings from Licensee Control

Lemieux, B., LaGroue, A.; University of Tennessee. ble-mieux@uthsc.edu

The University of Tennessee Health Science Center is in the midst of several major on campus demolition, construction and significant renovation projects, involving 6 buildings where radioisotopes have been used. The UTHSC was founded in 1911 in Memphis TN and has a rich history of medical education and biomedical research. We will review the approach taken by UTHSC to develop the procedures used for the assessment, survey and release of these campus structures in accordance with the UTHSC Broad Scope license. The overall goal was to establish a process which combined due diligence without committing to overly invasive or unnecessarily expensive outlays while complying with TN regulations and the conditions of the license.

MPM-A.5 Historical Site Assessment and Survey for Release of the Seldon D. Feurt Memorial Building at UTHSC

Lemieux, B., Hansen, T.; University of Tennessee, Ameri-physics. blemieux@uthsc.edu

The Seldon D. Feurt Memorial Building (Formerly the Pharmacy and Dental Research Building) on the University of Tennessee Health Science Center main campus in Memphis TN was selected for demolition to make room for a new Simulation Center. This necessitated removing the Feurt building from licensee controls in accordance with the UTHSC Broad Scope License and TN regulations. A Historical Site Assessment was performed, survey parameters were set, and the building was surveyed and cleared for unrestricted release. We will review how the process unfolded and the lessons learned.

MPM-A.6 How Randomness Affects Our Decisions for Radiation Safety

Johnson, R.H.; Radiation Safety Counseling Institute. ray@radiationcounseling.org

As health physicists we understand that radiation is a random phenomenon and that our practice of ALARA is to minimize the future random chance of cancer. Thus, dealing with randomness is a normal part of our practice as specialists in radiation safety. Unfortunately, most of the rest of the world wants to deal only with absolutes and does not want to know about uncertainty or probabilities. Most people want specific answers to questions such as, “Am I safe or not safe?” “Will I be harmed or not harmed?” Most people do not want to hear about risk estimates. When presented with a probability of cancer as a risk of one out of some number of those exposed, they will often conclude that they are the one. Or, not understanding risk probabilities, they may substitute an easier question, such as, “How do I feel about getting cancer?” This is a question they can readily answer without any knowledge of radiation science or statistics. This approach eliminates any concerns for randomness or probabilities. Everyone knows of someone who has had cancer and they are aware of the awful consequences. The prospects of radiation causing cancer become an overwhelming influence on decisions for radiation safety. Our natural human instincts for safety are not well suited to situations involving randomness or uncertainty. Thus, while people may not be certain about the risks of radiation effects, they are certain that they do not want to become a victim of cancer. Research has shown that, when chance is involved, peoples’ thought processes are often seriously flawed. When information is lack-

ing this invites competing interpretations. Unfortunately, misinterpretation of data may have very negative consequences. This paper will look at how we make choices and the processes that lead us to make poor decisions for radiation safety when confronted with randomness and uncertainty.

MPM-A.7 Radiation Protection against Loss of Offsite Power during Shutdown Operation

Jeon, I.; Korea Institute of Nuclear Safety. k137jiy@kins.re.kr

The loss of offsite power (LOOP) is an infrequent event in nuclear power plants. However, it can pose a significant threat to the existing radiation protection system of nuclear power plants, if there is no appropriate preparedness against it. In particular, the LOOP occurrence during shutdown operations or refueling outages when lots of workers are carrying out lots of radiation works may have a significantly negative impact to the radiological safety of workers, deteriorating the radiation protection capabilities of power plants in short time. In the nuclear power plants in the United States, there had been 53 occurrences of the LOOP events during the shutdown operations compared to 46 occurrences during the critical operations for the calendar years 1986-2012. The LOOP is a threatening event from a view point of radiation protection because it can influence negatively on all kinds of plant system directly or indirectly related to radiation protection. Moreover, the environmental and psychological stress following the LOOP makes workers and health physicists more difficult to keep the existing radiation protection procedures. This study explored what should be planned and prepared against the LOOP in the perspective of radiation protection, based on the experiences during the LOOP of South Korea. The author discusses what improvement should be done on the plans, programs, equipment, and facilities in order to protect radiation workers effectively in the event of the LOOP. In addition, the author suggests that the study findings be the basis for the radiation protection against station blackouts of nuclear power plants.

TAM-A.1 Nearest Neighbor Averaging and Its Effect on the Critical Level and Minimum Detectable Concentration for Scanning Radiological Survey Instruments for Performing Facility Release Surveys

Miller, M.L., Miltenberger, R.P., Fournier, S.D., Beall, P.S., Aleckson, T.J., Scheirman, M.J.; Sandia, ERG, Inc. mmiller@sandia.gov

Sandia National Laboratories recently worked via the SNL-New Mexico Small Business Assistance (NMS-BA) program with the Environmental Restoration Group (ERG) Inc. to verify and validate a novel algorithm used to determine the scanning Critical Level (Lc) and Minimum Detectable Concentration (MDC) (or Minimum Detectable Areal Activity) for the ERG-102F scanning system. This system employs a nearest-neighbor averaging (NNA) technique to improve the sensitivity of the instrument and reduce the variance of the data. Through the use of Monte Carlo statistical simulations the algorithm mathematically demonstrates a reduction in the Critical Level and Minimum Detection Level when a nearest-neighbor averaging (NNA) technique was used that is proportional to the number of neighbors. The field tests also concluded that the NNA technique increases the sensitivity (decreases the Lc and MDC) for high-density data maps that are obtained by scanning radiological survey instruments. This technique can be used to improve the cost efficiency and confidence with which Multi-Agency Radiation Survey Investigation and Release (MARSSIM) - type release surveys are conducted.

TAM-A.2 The Art & Power of Data Imaging

Lively, J.W.; AMEC E&I. jeffrey.lively@amec.com

Data imaging and visual data assessment are veritable gold mines in the scientist's quest to understand and accurately interpret numerical data. Graphical displays of various aspects of a dataset offer insight to the data that no mathematical computation or statistic can provide. It is difficult for even a skilled and observant statistician to understand the underlying structure of a dataset. Often, there is either too little data to get a good "picture" of the data structure or there is so much data that it cannot be readily assimilated. Of course, too much data is, in reality, no problem at all given the abilities of modern computers and software systems to manage large amounts of data. Advances in computer technology and the advent of the global positioning satellite system have enabled scientists from many fields of endeavor to collect and view data in its spatial context. Visual images constructed from spatially referenced data reveal the inherent richness and structure in the data and lead to more informed conclusions. So powerful is data collected with

spatial context that a relatively new branch of mathematical statistics, geospatial statistics, has emerged. Geospatial statistics seek to exploit this context rich data form to better understand the spatial and co-relationships that might exist, but would be otherwise hidden in tabular data or obscured with classic statistical approaches. This presentation will show the power that visual data assessment possesses to understand radiological scanning data and to make confident and accurate decisions based on the data images. It will challenge the traditional mathematical concept of detection limits for scanning. It will demonstrate that more data, even if the individual datum comprising the dataset is of "poorer quality", is significantly more powerful than a smaller dataset comprised of higher quality measurements. This presentation will cause the open-minded health physicist to rethink how they prescribe, collect, evaluate, and make decisions based upon radiological scan data.

TAM-A.3 Environmental Radioactivity Levels in a Polycythemia Vera Cluster in Pennsylvania

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Polycythemia vera (PV) is a rare illness in which too many red blood cells are produced. A few studies, published more than 25 years ago and prior to genetic testing, reported that PV could possibly be caused by exposure to chemicals or radiation. In 2004, four cases of PV were found in people living on the same rural road near the Borough of Tamaqua, in Schuylkill County, Pennsylvania. The Pennsylvania Department of Health (PADOH) reviewed the cancer cases reported in the State's Cancer Registry from two counties surrounding the Tamaqua area. PADOH found that the overall cancer rate in this area was similar to that in other parts of the state, but there were more PV cases than expected in a population of this size. The state health department requested ATSDR's help in investigating and confirming the high number of PV cases reported in the Tamaqua area and to find any other cases of PV in Carbon, Luzerne, and Schuylkill counties. A statistically significant cluster of PV cases was identified at the nexus of the three counties. As a result of the original PV cluster investigation, ATSDR initiated a large research portfolio, including multiple health studies and several environmental sampling projects. As part of the environmental studies, over 100 surface and groundwater, soils, sediments, and air samples have been collected and evaluated. Results showed possibly elevated radium isotopes in residential soils and elevated radon in residential drinking water averaging over 148 Bq/L and indoor air averaging 0.6

Bq/L. Several recommendations were made including additional soil characterizations, education on private well water/indoor air radon testing, radon mitigation, and improvements in private well water quality. The findings and conclusions in this presentation have not been formally disseminated by the Centers for Disease Control and Prevention/the Agency for Toxic Substances and Disease Registry and should not be construed to represent any agency determination or policy.

TAM-A.4 Radioecological Impacts of Iron and Steel industries

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Iron and steel industry produces a huge amount of solid wastes that contain a significant concentration of hazards heavy metals and radionuclides. About 2-4 tonnes of various solid wastes (slag, sludge, dusts and scales) are generated per ton of steel production. Ore, solid wastes and soil samples were collected from four iron and steel industries that cover the different processes and production technologies of iron and steel production. Natural radionuclides such as U-238, Ra-226, Po-210, Pb-210, Ra-228 and K-40 were measured using different techniques; gamma-ray spectrometry, alpha particles spectrometry and inductively coupled plasma-mass spectrometry. The activity concentrations of some radionuclides are highly elevated, up to about 6 Bq/g. Occupation dose due dust inhalation were evaluated as well as pollution indices. The solid wastes of iron and steel industries should be completely characterization to control their potential hazards and evaluate their environmental impacts due to their disposal and/or applications.

TAM-A.5 Consolidation of Environmental Monitoring Programs at a Treatment and Waste Disposal Facility

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Waste Control Specialist LLC (WCS) is a Texas-based waste management firm that operates state-of-the-art facilities in Andrews County, Texas. The WCS site is licensed by the Texas Commission on Environmental Quality (TCEQ) for the treatment and storage of radioactive waste and for the disposal of byproduct material and low-level radioactive waste (LLRW). Each of these facilities had separate Radiological Environmental Monitoring Programs (REMPs) with inconsistent requirements. WCS has consolidated the REMPs for the processing and storage facility, the Byproduct Material Disposal

Facility and the Low-Level Radioactive Waste Disposal Facility. This abstract covers the process of consolidating these programs into one comprehensive program. This consolidated program has simplified the collection of environmental monitoring samples and the evaluation of the analytical results of these samples.

TAM-A.6 Seasonality in Air Monitoring at a Low-Level Waste Disposal Facility

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Trending data over time is an important part of an Environmental Monitoring Program. The purpose of tracking data is to identify trends. Seasonality can complicate the assessment of a given dataset. This paper examines the seasonal variation of air monitoring data collected at the Low-Level Waste Disposal Facility operated by Waste Control Specialists LLC (WCS). The site is operated by WCS and is located in Andrews County, Texas near the Texas/New Mexico Border.

TPM-A.1 Solving CARIBU Open Source Contamination Problems

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The CALifornium Rare Ion Beam Upgrade (CARIBU) for the Argonne ATLAS heavy ion accelerator has successfully utilized open Californium-252 sources of increasing strength to perform physics experiments with neutron-rich fission fragments. Over 100 nuclear masses have been measured and the latest source prepared at ORNL is of sufficient strength—63 GBq (1.7 Ci)—for experiments with accelerated fission fragments. To stop the californium recoils while allowing the fission fragments to be collected, we place a thin cover foil over the source. This cover foil also provides some containment for any poorly adhering source material. Fortunately the electro-deposited material adheres well to the source plate. However, alpha contamination problems have been an issue primarily because thin aluminum and nickel cover foils used initially have failed. Tests conducted indicate chemical damage from HCl used to dissolve the californium source material. Gold and graphene foils did not show chemical damage in the tests, but the aluminum foil and nickel foils failed. A gold cover foil was used for the 63 GBq source and has remained intact. As a result, contamination levels are now greatly reduced. Containment efforts following foil failure have prevented personnel contaminations. Containment techniques employed during source transfer and use with failed cover foils are described. *This work is supported by the U.S. Department

of Energy, Office of Nuclear Physics, under Contract No. DE-AC02-06CH11357.

TPM-A.2 Validation Testing of the Canberra Mobile FeedRoll Assay System

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The accident at the Fukushima Nuclear Power station in Japan has caused much of the agricultural land in the Fukushima Prefecture to become contaminated. The dominant radionuclides are Cs-134 and Cs-137. The agricultural land is used for many types of crops, one of which is grass or hay to feed cattle. This material is traditionally harvested and sealed in large sacks, so they can be stored for future use. These are called feedrolls and approximately 1m diameter and 1m tall. Due to the accident, cattle in a wide region of Fukushima Prefecture cannot be fed locally harvested feedrolls, but must import them from other regions. Canberra has created a special truck to monitor these feedrolls. On the bed of the truck is a shielded large 3x5x16" LED-stabilized NaI detector. The detector and the MCA are housed in a water proof box, which is surrounded on the bottom and all sides by a 15cm thick steel shield. A portion of the shield at the top is open where the detector can view samples placed there. The Japanese version of the Canberra Genie software is used to analyze the spectra and compute the Bq/kg concentration of the feedroll. The truck will drive to the field where the farmer's feedrolls are stored. For assay, the feedroll is placed on top of the shield so the bottom of the feedroll covers the shielded opening. Validation tests were carried out to demonstrate to the authorities that the device can perform as promised. To validate the accuracy of the measurement, 4 independent assays of selected feedrolls with elevated radioactivity were performed. The MDA for Cs-137 was 11.9 Bq/kg at 30 seconds, 8.2 Bq/kg for 60 seconds, and 1.1 Bq/kg at 3600 seconds. The regulatory limit is 30 Bq/kg for feed to dairy cattle. It was concluded that 60 seconds is sufficient to give a high reliability that each feedroll measured will be properly categorized if it was near the 30 Bq/kg level.

TPM-A.3 Validation Testing of the Canberra TruckScan Waste Assay System

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In Japan, as a result of the Fukushima NPP accident, there are a large number of bags containing radioactive debris from environmental remediation. The primary radionuclides are Cs-137 and Cs-134. These bags

are nominally 1.1m diameter by 1m tall, and typically 0.5 to 1.5 metric tons. These bags will soon be consolidated into several Interim Storage Facilities [ISF] within the Fukushima Prefecture. Typically 8-10 bags are loaded onto a truck and transported to the ISF. To determine the disposition of the bags at the ISF, Canberra has developed the TruckScan, which will measure the bags on the truck as it arrives at the ISF, and report the activity of each individual bag. The full-scale TruckScan will consist of eight 3x3" NaI detectors, each in a lead shield with a collimated view of the truck. Four detectors are on each side of the truck, at about 1 meter from the truck. The truck measurement period is short – typically 15 seconds. Each of the 8 spectra are analyzed for Cs134 and Cs137, followed by special software to determine the activity in each of the 10 bags. A single default geometry is used for all bags. The ISOCS software created the efficiency calibrations for the collimated NaI detector. A Maximum Entropy software is used to convert the 8 whole-truck results into the activity for each individual bag. A small-scale demonstration was conducted to demonstrate the validity of the process. The ISOCS calibrations for each bag were validated by comparison to multiple samples from the bags analyzed by a Ge detector. Then multiple bags of soil and vegetation, each with known concentrations, were loaded onto trucks and assayed for comparison to the known concentrations. This process was repeated with various sample types and activity levels. The average activity of each sack was in good agreement with the expected values. From these tests the TMU was determined to be 18.4%. If accurate fill heights could be obtained for each bag, the TMU could be reduced to 16.6%.

TPM-A.4 On-line Low-level Monitoring for SrY90 to Support the Fukushima Water Cleanup Project

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The response to the Fukushima reactor accident has created very large volumes of radioactive water that must be cleaned before it can be released. Much of the water has been processed to remove most of the Cs-134 and Cs-137, however there is still too much Sr/Y-90 for release. Hitachi has been awarded a contract to construct a processing system to remove the SrY90 and other residual radionuclides from the water; the name of this system is HERO. Canberra has received a contract to design and build an on-line monitoring system to measure Sr90 concentration in the final processed water product. The measurement requirement is to show that the radioactivity is less than 10 Bq/kg of Sr90, and to do this in a continuous manner. The system takes advantage

of the detector panels in the Canberra Argos Total Body Monitor. These panels have a very thin plastic scintillator detector with large area [16x35cm]. Two of these modules are used. The modules are facing each other, and sandwiched in-between them is a container of water, also 16x35cm in size by 0.7cm thick. The outer faces of this container are thin carbon fiber, 0.5mm thick, for maximum beta transmission. These dimensions were optimized by MCNP simulations. The MCNP simulations were also used to minimize the signal from other nuclides that might be present in the water. The detector-water-detector sandwich is inside a lead shield to protect it from the elevated background in the operating environment. Tests are currently underway to determine the best detector type – either a beta-only sensor or a dual sensor with a separate output for betas and gammas. These tests will also confirm the estimated MDA and assay time to meet that MDA.

WAM-A.1 The Joint Commission Standards with RSO/Health Physics Implications

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The Joint Commission (TJC) as a “deeming” accreditation body for the Centers for Medicare & Medicaid Services (CMS) makes periodic changes to its standards which impact health care facilities who use radiation and Radioactive Material (RAM) for diagnosis and treatment. Current and proposed changes impact Computed Tomography (C), Nuclear Medicine (NMPET), Magnetic Resonance (MRI), physician qualification, and fluoroscopy. Areas addressed in the standards include: physician and technologist competency, equipment performance evaluations, management of safety tasks, collection of data and “dose” management. We will examine the operational impact of these changes upon the facilities and their RSO’s. A brief review of selected standards, history, efficacy of purpose, cost, marginalizing factors, relevant studies, alternative solutions and constructive discussion is planned.

WAM-A.2 United States Department of Transportation 2014 Radioactive Material Related Final Rule-making

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As part of its continued efforts to harmonize the radioactive material related U.S. Hazardous Materials Regulations with international standards and regulations, the Pipeline and Hazardous Materials Safety Administration (PHMSA) published a final rule on July 11, 2014 to

incorporate changes adopted in the International Atomic Energy Agency (IAEA) Safety Standards publication titled “Regulations for the Safe Transport of Radioactive Material, 2009 Edition, Safety Requirement, No. TS-R-1.” These changes are designed to help ensure that the classification, packaging requirements, and hazard communications for shipments of radioactive materials provide the requisite level of public safety and are consistent with those employed throughout the world. As the Nuclear Regulatory Commission (NRC) is preparing a parallel rulemaking, PHMSA authorized voluntary compliance with the final rule beginning on the date of publication in the Federal Register. To allow the NRC time to address comments received to their Notice of Proposed Rulemaking, and to ensure concurrent compliance dates for our parallel rulemakings, mandatory compliance is delayed until July 13, 2015. Historical background information and selected highlights of the rulemaking, such as changes in contamination control, package documentation retention, and placarding requirements as well as revised scope and definitions are provided.

WAM-A.3 The NRC’s Allegation Follow-Up Program As It Applies To The Nuclear Materials World

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The NRC relies and requires that licensees keep and/or provide complete and accurate information in all material respects that apply to NRC-regulated activities. Unfortunately, that is not always the case. That is why the NRC’s allegation follow-up program is a crucial part of our regulatory functions. An allegation, or concern or complaint can be received from any number of sources: a licensee employee, a former licensee employee, a member of the public, the news media, anonymously (by telephone, through a third party, or by other means), and by the NRC staff (this is known as “staff suspected wrongdoing” (SSW)) to name a few. This paper discusses the NRC’s allegation follow-up process with regard to users of radioactive materials in the medical, commercial and academic settings and provides examples when a follow-up to a somewhat trivial allegation have resulted in significant enforcement actions. The paper ends addressing possible consequences of allegations of misconduct against NRC personnel.

WAM-A.4 Natural Cosmic Radiation Dose Rates (uSv/hr) vs. Altitude and Public and Soldier and Public Perceptions on Radiation

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Cosmic radiation photon dose rates (uSv/hr) were measured recreationally with a simple Geiger Muller

meter on over 25 national and international commercial flights. The cosmic radiation photon dose rates were correlated with the cruising altitude. The cosmic radiation photon dose rates increased with altitude in a log-normal fashion that has a good correlation ($R^2=0.954$) to the following thumb rule: Dose Rate ($\mu\text{Sv/hr}$) = $(0.09 \mu\text{Sv/hr}) \text{EXP}[+9.7\text{E-}05(\text{altitude in feet})]$. The standard cruising altitude for a commercial flight (35,000 feet) produces an average cosmic radiation photon dose rate ($\sim 2.7 \mu\text{Sv/hr}$) which is 30 times over the background radiation photon dose rate ($0.09 \mu\text{Sv/hr}$) at sea level as measured on an inexpensive (\$159) publically available Geiger Muller radiation survey meter. This increase in cosmic radiation photon dose rates were used in Department of Defense briefings and exercises to compare a safe, commonly experienced cosmic radiation photon dose rate on flights to an operational dose rate. By having the author recently experience and measure a natural cosmic radiation photon dose and dose; Soldiers were able to comfortably respond to dose rates multiple times over background. From April to September 2014, the author comfortably safely received over 120 μSv of cosmic radiation photons on flights. With a more complex meter, neutron rates over one neutron per second at were measured at elevations over 30,000 feet. At no time on any commercial flight did a member of the public mention that they were concerned about the cosmic radiation dose rate (no radiophobia), and they often asked to assist with the study during the flight.

WAM-A.5 It's Time for the FAA to Regulate Air Radiation Safety

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Aircrew were not traditionally considered to be radiation workers in that the source of most of their exposure was not man-made and there was no obvious means for reducing exposure in a cost-effective manner. A petition in 1985 to the Federal Aviation Authority (FAA) that US aircrew be declared as radiation workers was denied. However, in 1991, the International Commission on Radiation Protection (ICRP) review led the ICRP to recommend that aircrew be treated as radiation workers. Following that recommendation, the FAA asserted that they followed ICRP guidance. The FAA provided a computer means for aircrew to estimate their individual exposure from what was considered to be the dominant source, galactic cosmic radiation (GCR). This method was cumbersome and remains unused by most aircrew. Over the following years, the FAA modified their guidance and also altered the assertion of what guidance was followed.

Today, the FAA asserts that they follow the American Council of Government Industrial Hygienists (ACGIH) as the source for their program. The FAA does have an OSHA compliant safety program, including dosimetry, for ground workers who service radar systems and may be exposed to x-rays. Their program for aircrew imposes no requirements on carriers and does not require active or passive means to measure exposure. The basis for not requiring dosimetry for aircrew is based on estimates of aircrew exposure that have varied over the years, and has not included all sources of exposure. We assert that court decisions in the 1990s provide a legal basis for mandating an OSHA compliant program along with dosimetry. The laissez-faire approach to regulation by the FAA with no requirements imposed on carriers has proven to be ineffective in reducing aircrew exposure.

WPM-A.1 Dose Rate Coefficients for Exposure to Ground Contaminations

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The U. S. Environmental Protection Agency's (EPA) Federal Guidance Report 12 (FGR12) provided dose coefficient data for 825 radionuclides that has been used for general application in assessing human exposure to radionuclides for environmental sources of radionuclides since 1993. FGR12 tabulated dose rate coefficients for external exposure to photons and electrons emitted by radionuclides distributed in air, water, and soil using nuclear decay data from Publication 38 of the International Commission on Radiological Protection and a stylized dosimetric hermaphrodite phantom representing the reference adult. Those dose coefficients were intended for use by U.S. federal agencies in computing dose equivalent to organs and tissues of the body. The Oak Ridge National Laboratory's Center for Radiation Protection Knowledge and dosimetry research group has recently completed a major revision of FGR12. Age Reference Persons (gender-average) effective dose rate coefficients for external exposure to photons and electrons emitted by 1252 radionuclides distributed in soil using the tissue weighting factors recommendations of ICRP Publication 103 are presented. The coefficients are based on the nuclear decay data of ICRP Publication 107 and a series of stylized dosimetric hermaphrodite phantoms representing nonadults (ages 15, 10, 5, and 1 y; and a newborn infant) and gender-specific phantoms representing the adult male and female. The approach to performing the revision of the report will be described

and the revised dose rate coefficients for people standing on the surface of the soil will be presented and compared to the previous publication.

WPM-A.2 Updated External Dose Coefficients for Air Submersion and Water Immersion

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The Oak Ridge National Laboratory's (ORNL's) Center for Radiation Protection Knowledge recently revised and expanded Federal Guidance Report No. 12 to provide sex-averaged age-specific effective dose rate coefficients for external exposure to each of 1252 radionuclides. The coefficients are based on tissue weighting factors recommended in Publication 103 of the International Commission on Radiological Protection (ICRP, 2007), nuclear decay data of ICRP Publication 107 (2008), a series of stylized dosimetric hermaphrodite phantoms representing ages 15, 10, 5, and 1 y and a newborn; and stylized sex-specific phantoms for adults. The effective dose rate coefficients will be published in hard-copy form as Federal Guidance Report 15 and also will be available in electronic form, along with tissue-specific dose rate coefficients. This paper describes the method of derivation of the updated coefficients for reference persons submerged in contaminated air or immersed in contaminated water. The updated values are compared with values tabulated in FGR12, which were based on tissue weighting factors of ICRP Publication 60 (1991), nuclear decay data of ICRP Publication 38 (1983), and a stylized dosimetric hermaphrodite phantom representing the reference adult. This work was supported by the Office of Radiation and Indoor Air, U. S. Environmental Protection Agency (EPA), under Interagency Agreement DOE No. 1824 S581-A1, under contract No. DE-AC05-00OR22725 with UT-Battelle.

WPM-A.3 Screening Radiation and Bystander-Response Genes and Exploring the Mechanism of Bystander Effects Using AHH-1 Exposure to the Different Dose of ⁶⁰Co Gamma Rays

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Study on the gene expression profile of normal human lymphoblastoid cells (AHH-1) response to ⁶⁰Co gamma-ray radiation and co-culture with unirradiated AHH-1, analyses the essential expression changes of genes response to ionizing radiation and bystander effects in mechanism of the biological effect. Methods: we

have measured global gene expression by microarrays 8 hours after bystander and direct gamma-ray exposure of AHH-1. This trend was substantiated by analyses of the microarray data in bioinformatics and PCR experiments. Results: We discovered a number of radiation-response and unirradiate bystander-response genes. Expression of some genes from data analysis and filter results were confirmed by PCR reactions. In the confirmatory experiment of 15 candidate genes induced by radiation or bystander effects, there are apparently differences of the RNA expression in these genes. We have found that activity of Caspase8 decrease in irradiate and bystander effects $P < 0.05$, this pheromones disappear when add into phosphorylation inhibitor. We also found a increase of Caspase8 activity in 30-day cultured of irradiate cells $P < 0.05$, there is no obvious change in bystander cells. Conclusion: These genes including 3 transmembrane related genes, 2 cellular material transduction related genes, 4 genes in nuclear regulation of translation, cell cycle and apoptosis and 5 genes unknown, may probably engage in low dose response, and supported the standpoint that radiation induced bystander effect. The decrease of Caspase 8 activity in irradiated and bystander cells indicate that low dose radiation regulated many apoptosis or P53 related genes, but would not induce apoptosis at that moment.

WPM-A.4 Why All Radiation Bioeffects, Acute or Long-Term, Are Stochastic

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We know clear communication of radiation risks to all of the public is important, including to scientists and teachers outside our field of health physics. It is unfortunate that some expert groups have discriminated between acute and long-term effects of radiation exposures by calling acute effects "non-stochastic." Evidence of the stochastic nature of acute, as well as long-term, bioeffects is abundant in the literature. Examples of dose-response data of all ionizing radiations show them to be a result of stochastic processes. To begin with, all of the initial interactions of radiation with matter result from atomic interactions with wave functions, which when multiplied by their complex conjugates become probability density functions of space and time. All processes in between interactions and the final expressions of mutant or damaged cells are stochastic. Finally, acute effects are described in literature as occurring with probabilities over ranges of dose, just as the incidences and lethalties of various cancers occur over ranges of dose.

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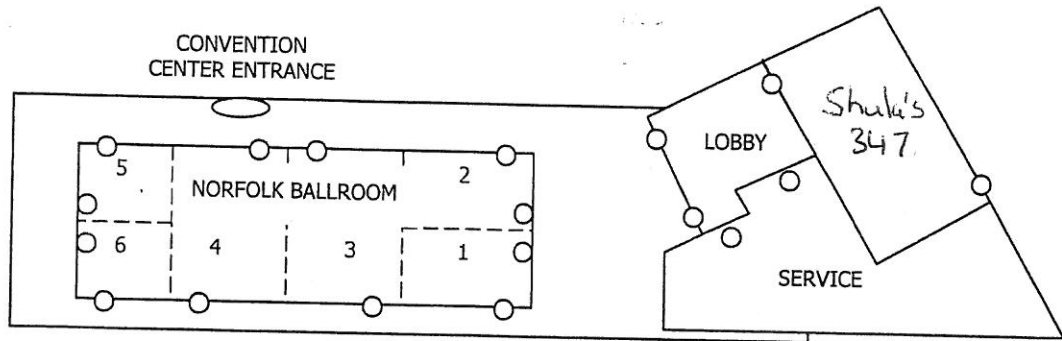
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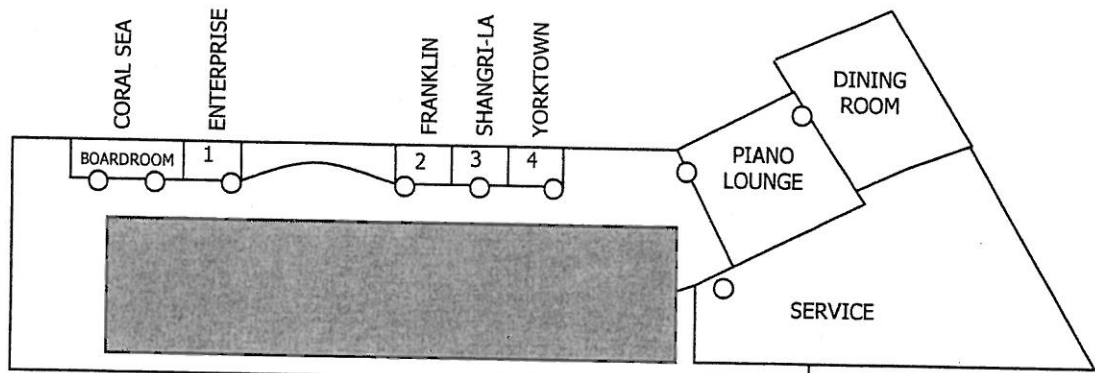
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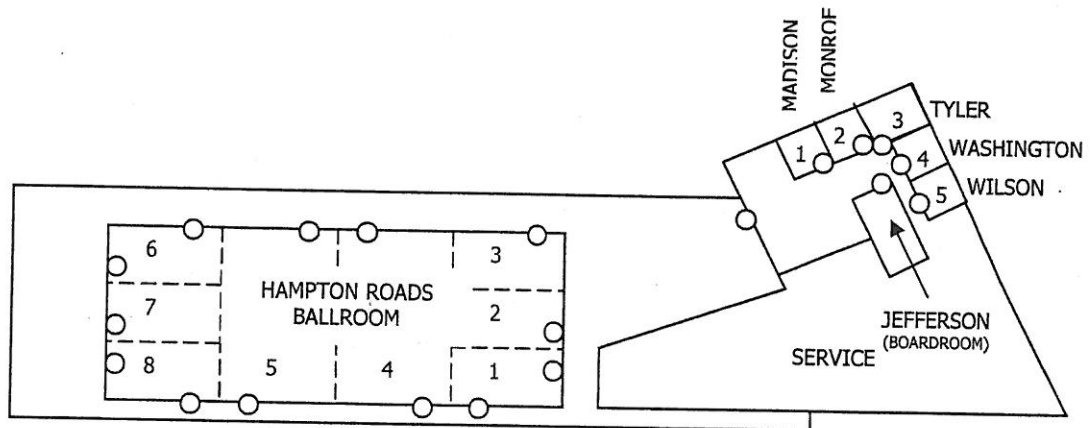
1st
FLOOR



2nd
FLOOR



3rd
FLOOR



4th
FLOOR

