出國報告（出國類別：開會）

參加第 61 屆美國保健物理年會

服務機關：行政院原子能委員會
姓名職稱：林琦峰技正
派赴國家：美國
出國期間：**105** 年 **7** 月 **16** 日至 **105** 年 **7** 月 **25** 日
報告日期：**105** 年 **8** 月 **5** 日

摘　要

本次公差係奉派參加第61屆美國保健物理年會(61st Annual Health Physics Society Meeting)。第61屆美國保健物理學會年會於2016年7月17日至21日假美國華盛頓州斯波坎市國際會議中心(Spokane Convention Center)舉行，會議內容包含專題演講、口頭報告及壁報論文等，討論的議題包含輻防導則修訂、輻射效應及福島事故後之環境調查等，許多議題均與本會業務相關。會議結束後，另透過駐美經濟文化代表處與美國核管會協助安排，順道參訪華盛頓州立大學之核子反應器中心，該校反應器之組成及運轉歷史均與我國清華大學THOR反應器相近，故其輻防管制措施亟可供我國參考。本報告將說明公差過程及會議之重點內容，並提出心得與建議。

目　次

頁次

一、目的：

為蒐集各國游離輻射防護及環境輻射監測與管制等相關管制資訊，職依據本會105年編列之出國計畫「參加2016年輻射安全管制相關國際會議」，奉派至美國參加第61屆美國保健物理學會（American Health Physics Society, AHPS）年會，希冀能藉由參加此國際知名且歷史悠久的會議，瞭解美國現今關注的輻防議題，及輻射防護實務與管制上之現況與發展趨勢，以作為本會管制游離輻射安全參考。此外，為了實地瞭解美國核子設施對於輻射安全之管理經驗，也於年會後順道參訪華盛頓州立大學研究用反應器（Washington State University Reactor），該反應器與清華大學THOR反應器同樣於1961年初臨界，且亦為教學研究暨同位素生產（Teaching Research Isotope production General Atomics, TRIGA）型反應器，故其對於排放監測、環境監測與區域管制等面向所採取之管理措施亟具參考價值，可供本會管制研究型反應器之輻射安全作為參考。

二、行程：

日期	到達地點	工作內容
105.7.16(六)~ 105.7.16(六)（換日）	台北→斯波坎	去程
105.7.17(日)~ 105.7.21(四)	華盛頓州斯波坎	參加 61st HPS 年會
105.7.22(五)	華盛頓州普爾曼	參訪華盛頓州立大學 核子反應器中心
105.7.23(六)~ 105.7.25(一)（換日）	斯波坎→台北	回程

三、會議與參訪紀要：

(一)美國保健物理學會年會：

美國保健物理學會創立於 1955 年，為歷史悠久且在國際上頗具規模之學術組織，於輻射防護研究學術領域中具有重要地位，該學會為了促進會員間的技術交流，並提供學者與學生發表其研究成果的機會，自 1956 年開始，每年均舉辦 3~5 日的研討會。由於參加該組織所舉辦的年會可獲得輻射防護研究的最新資訊，更可當面向頂尖學者交流、請益，故本會近年均盡量派員出席。

本屆（第 61 屆）美國保健物理學會之年會係於 2016 年 7 月 17 日至 21 日假美國華盛頓州斯波坎市國際會議中心(Spokane Convention Center)舉行。年會期間，主辦單位除大規模舉辦 7 場專題演講、43 場口頭報告及 47 篇壁報論文發表等學術活動，也藉學會會員齊聚之便，舉辦 50 多場專業技術研習訓練，藉此提升相關從業人員之專業水平。此外，主辦單位也特別規劃一展場，供儀器製造商、研究機構及政府單位展示其技術能力或招募人才。以下重點摘述年會內容及參加過程。

1. 專題演講

本次大會之開幕會由美國保健物理學會會長 Nancy Kirner 主持（圖 1），開幕會上安排 7 場專題演講（圖 2），演講主題包含組織運作、福島環境輻射調查、美國加速器設施清理、保健物理從業人員經驗分享、保安管制等，今年更納入太空人輻射劑量的探討，讓參加者能獲得輻射防護技術的最新資訊。每場演講約安排半小時，並提供提問時間，讓講者與台下聽眾得以面對面直接交流。

第 1 場報告的主題為「歐洲輻防管制合作」（Regulatory cooperation and radiation protection in Europe），由愛爾蘭輻射安全署的 S.M. Magnusson 主講。Magnusson 先生說明，2007 年，歐洲 31 個國家共 51

個輻防管理單位創立了一跨國性的輻防合作機構—歐洲輻防聯合組織（Heads of European Radiological protection Competent Authorities, HERCA），其目的為統合歐洲參加國，並依據各國輻防措施之執行實務面，草擬一致的管制措施，具體而言，該組織現行的工作包含研擬醫用輻射管制措施、緊急應變研究、教育訓練，以及將歐洲原子能共同體(EURATOM)的基本安全標準（Basic Safety Standards, BSS）納入各國法律。Magnusson 先生也說明了一些組織經費來源、運作方式等細節，供與會者瞭解 HERCA 實際的運作情形。

第 2 場報告的主題為「聯合委員會近況說明」（Update from Joint Commission），由 A.D. Browne 主講。Browne 女士說明，聯合委員會的工作項目為修訂診斷影像標準，該組織係藉由反饋現場調查經驗及彙整網路資訊，逐步修訂相關標準。經由確認醫療設施是否符合該組織的標準，進而確保病患的輻射安全及醫療品質可獲得保障。

第 3 場報告的主題為「福島環境輻射水平」（Environmental Levels of Radiation around Fukushima），由 S. Yoshida 博士主講。Yoshida 博士正主持一項有關福島環境輻射調查的研究，其調查範圍涵蓋福島及其臨近地區，項目包含環境取樣分析，室內、室外(除污後)之污染調查，以及輻射劑量評估等，調查結果顯示，放射性銫為室內表面污染的主要來源，此外，室內表面污染的程度與取樣位置距福島一廠的距離平方呈反比，相關研究成果已於今年 5 月的 Nature 期刊上發表。Yoshida 博士的團隊未來將研究攝入、吸入等途徑所造成的體內劑量，其中顆粒再懸浮的情形、氣膠尺寸分佈及活性中數空氣動力學直徑（activity median aerodynamic diameter, AMAD）等參數的評估均為研究重點。

第 4 場報告的主題為「加速器設施的清理」（Clearance of Materials from Accelerator Facilities），由 S.H. Rokni 主講。講者 Rokni 說明：美國能源部目前正針對加速器設施的清理擬定新的技術標準草案

（DOE-STD-6004），此標準草案除納入設計與運轉大型反應器的專門知識與經驗，也針對清理過程的管理面、技術面及運作面提供相關指引，並說明清理標準、程序知識及量測方法等要素，其中清理標準係依據 ANSI N13.12-2013 的篩選標準（劑量約束 10 微西弗/年）而制定，此外，本標準的附錄也收錄了 DOE-O-458-1 中有關電子、光子加速器活化金屬清理的程序知識與量測方法。

第 5 場報告的主題為「保健物理的社會、管制與政治面」（Lessons Learned and Unlearned from the Social, Regulatory and Political Aspects of Health Physics），由 R.E. Toohey 主講。講者提到輻防人員的目標是維護輻射安全，但難免會和團隊的主要目標衝突，導致輻防人員在團隊中的立場尷尬，此外，保健物理有其在科學上的專業，但不免需和世界上的社會活動有所連結，而人類面對風險時，常常會採取較保守的態度，因此制定的法規不完全會依據科學，而是一個與政策妥協的結果。以線性無閾值假說為例，雖然大多數情況下，工作人員接受的輻射年劑量低於 100 毫西弗，而 100 毫西弗 以下的輻射劑量對人體的傷害迄今尚無明確的科學證據，但目前為求保守，且為管制方便，許多國家仍採用此項嚴格的假說作為立法精神。綜言之，主講人認為現今輻防世界有許多矛盾與荒謬之處，但人類已經歷過二戰、冷戰及核災，未來應有足夠的智慧能解決廢棄物處置與輻射恐佈攻擊的問題。

第 6 場報告的主題為「美國保健物理學會國土保安組之簡介」（The Wild and Wonderful World of Health Physics : Homeland Security Section），由 J.J. Lanza 主講。911 事件發生後，美國對於國土安全日益重視，美國保健物理學會為了協助政府單位防範輻射恐攻，於 2012 年成立國土保安組，該組織的主要目標為「藉由輻射保安教育，降低放射性或核武威脅，以保障國土安全」，其 8 個工作小組分別為：「輻射應變技術小組」、「醫療應變小組」、「訓練小組」、「核子恐攻應變小組」、「輻

射彈應變小組」、「清理及復原工作小組」、「放射性物質禁運小組」，本報告即由國土保安組組長 Lanza 先生就該組織的近況進行簡報。

第 7 場報告的主題為「火星探險之輻射效應研究」（Space the Final Frontier – Research Relevant to Mars），由 J.D. Boice 主講。此講題相當新穎，講者說明，依據美國太空總署（NASA）的研究，太空人完成一趟火星探險，將接受到 200 毫戈雷的輻射劑量，因輻射來源為帶有高能粒子的宇宙射線，因此人體接受到的有效劑量將高達約 900 毫西弗（曝露率 1 毫西弗/日）。為了更瞭解輻射劑量對人體健康造成的影響，NASA 投入一項名為「百萬人研究」（Million Person Study, MPS）的計畫，其內容為大規模調查代表群體（健康的美國男性及女性）的輻射健康風險，因其調查規模約為日本原爆流行病學調查的 20 倍大且涵蓋較多的高劑量（> 100 毫西弗）案例，故預期能獲得更精確的評估結果，並能比較性別對輻射反應的差異，此外，該計畫也將研究輻射劑量與神經失調、心血管疾病之間的關係。

有別於一般法規以劑量限值管制職業曝露，NASA 則是以健康風險值作為管制依據，以癌症致死風險（risk of exposure-induced death）為例，NASA 將 95%信心水平下，3%的癌症致死風險訂定為終身劑量限值。「百萬人研究」可改善風險評估之不確定度，因而能提高太空人留在外太空的時間。另依據日本原爆的流行病學調查資料，女性對輻射的敏感程度約為男性的 2 倍，但日本的研究結果未排除老人與小孩，且其樣本數為 30,000 名成年女性與 21,000 成年男性，「百萬人計畫」則將調查 250,000 名成年女性與 750,000 名成年男性，因而能更精準地評估性別癌病風險，可讓女性太空人於外太空停留更多時間。

2. 口頭報告

本次年會口頭報告共達 43 場，因議題範圍甚廣，且有多場討論會

時間衝堂，無法全數參與。以下謹概述數場較重要口頭報告：

2.1 美國輻射防護與度量委員會（National Council on Radiation Protection & Measurements, NCRP） 一般建議之更新情形

美國輻射防護與度量委員會及國際放射防護委員會（International Commission on Radiological Protection, ICRP）均為提供輻防建議之科學研發組織，兩組織現行針對游離輻射防護的基本建議分別為 1993 年的 NCRP 116 報告及 2007 年的 ICRP 103 報告，兩者目標相同，但達成方式有些許差異，NCRP 最近希望更新其基本建議，以與國際標準及建議調和。NCRP 基本建議將更新內容含輻射劑量與傷害風險資訊的更新，並將以往未考量的曝露（例：病患、看護、動植物等）也納入考量，此外，也強化「正當化」、「最適化」等與道德相關的原則在輻防管制上的重要性。NCRP 目前正協同 ICRP 及美國的科學家一同建立這份新的基本建議，並預計於 2018 年發表。

2.2 美國太平洋西北國家實驗室氣體排放背景值上升案例

美國太平洋西北國家實驗室（Pacific Northwest National Laboratory, PNNL）的放射性化學處理實驗室因有操作放射性核種且需排放放射性氣體，為符合美國法規的要求，故該實驗室於排氣主煙囪執行放射性氣體連續取樣與監測。實驗室人員最近執行連續監測器年度校正時，發現其阿伐與貝他/加馬背景計測值與歷史數據相較，呈一持續上升的趨勢，經過比對評估，背景值增加係來自鉛-212、鉍-212 及釙-208 等核種，而這些核種均為氡-220 的子核。為了控制連續氣體監測背景值增加的情形，除了降低排氣量，更需確認其來源，經盤查發現，熱室中貯存的物質可能為氡-220 的來源，因此該實驗室已於 2016 年 6 月執行熱室貯存物質之重裝工作。

針對這個案例，該實驗室的結論為：連續氣排監測系統的警報設定值可用於確定是否發生大量的放射性物質外釋，而監控背景值的變化趨勢則可偵測到微量而穩定的外釋，兩者均有其特別的目的。

2.3 新型輻防輔助儀器

本次年會中，亦有數名講者口頭報告其最新之輻防輔助儀器。茲說明其中的 3D 加馬攝影機與電腦輔助輻防訓練：

A. 3D 加馬攝影機（圖 3）：

3D 加馬攝影機為一可在實景圖中顯示加馬熱點、核種類別及劑量率梯度之偵檢儀器，可用於控制污染區中殘餘的放射性物質、避免工作人員或訪客接近輻射熱區，並可強化合理抑低（As Low As Reasonably Achievable, ALARA）措施，此外，也可延伸應用於評估屏蔽效果，而該儀器使用鎘-鋅-碲加馬能譜偵檢器，其特性為室溫下亦可使用，因此能在資源較為缺乏的環境偵測放射性能譜。雖有上述特色，但 3D 攝影機於使用上仍有些限制，例如其每次進行偵測約需半小時之偵測時間，無法達到迅速偵測的效果，也因此難以偵測放射性污染確切的洩漏位置，但仍是一套相當實用的輻射熱區定位工具。

B. 電腦輔助輻防模擬訓練（圖 4）：

電腦輔助輻防模擬訓練（Realistic, Adaptive, Interactive Learning System, RAILS）為一套能應用於核電廠、醫學單位及實驗室的工作人員訓練軟體，係由 Spectral Labs 所開發，此軟體具有模擬工作人員執行輻射作業時所接受的劑量、提供輻射作業指引等功能，可讓使用者在虛擬環境下進行模擬操作，如此可減少工作人員於受訓時所接受的劑量，也可減少訓練人

力，工作人員亦可重複參加訓練，以提升訓練效能。

3. 壁報論文

本次年會共有 47 篇壁報論文，主題包含取樣分析、屏蔽計算、劑量評估等，以下謹摘述數篇較重要之壁報論文：

3.1 RESRAD-OFFSITE 新版功能介紹

RESRAD 係為美國阿岡諾國家實驗室所開發之劑量評估軟體，可用於評估物質或核設施場址中，殘餘放射性核種對於受體所造成之輻射劑量和風險。此軟體依其用途差異，又區分出各種子軟體，其中 RESRAD-OFFSITE 係用於評估場址中殘餘之放射性核種經過遷移，而對人體造成之輻射劑量。此軟體於本次年會之能見度相當高，我國於規劃核電廠除役及用過核子燃料最終處置時，均採用該軟體評估民眾可能接受之輻射劑量。

本次 RESRAD-OFFSITE 改版係因應污染源位置與地下水水位的差異而新增部份功能。經研究，如核設施之地下水水位較高，導致污染源低於地下水位時，核種遷移模式將與一般情形不同，新版 RESRAD-OFFSITE 特別加入這項情節。本程式之開發負責人余家禮博士（圖 5）強調，如台灣待除役之核電廠的地下水水位較高，此項功能對於準確評估民眾之輻射劑量將亟有幫助。

3.2 日本 6 地區飲食中之鍶-90 含量分析

福島事故發生後，日本政府為維護食品安全，核撥大量經費成立食品調查研究計畫，以進行廣泛的食品放射性含量調查。本項研究係由日本國立醫藥食品衛生研究所執行，針對東京、大阪、長崎及福島縣 3 地區市面上 14 類食品進行放射性鍶-90 含量分析，其樣品前處理係使用鉻(III)陽離子交換樹脂分離出放射性鍶，再以氣流式比例計數器進行計測，活度分析結果配合攝食量、劑量轉換因數

等參數，可估算得日本 6 地區居民因攝食含鍶-90 食品所接受的劑量約為 0.00034~0.00076 毫西弗/年，遠低於食品攝食劑量標準（1 毫西弗/年），且各地居民居住地與福島一廠間的距離和居民攝食鍶-90 所導致的劑量並無顯著的相關性。

雖本研究係針對難測核種鍶-90 進行調查，但在場說明的研究員也強調，此屬調查研究，非例行監測。

3.3 屏蔽設計工具之選擇

本報告以 Hanford Tank Waste Treatment and Immobilization Plant 玻璃化設施的屏蔽設計為例，說明如何選擇最適當的屏蔽設計工具。考量的面向有：技術難度、分析結果的保守程度、屏蔽結構的複雜程度、建模所需要的時間、程式運跑所需要的時間、計算結果的不確定度、設計工具所需之軟硬體等，經由建立上述面向對各種屏蔽設計工具的評分表，便能較易選擇適當的屏蔽設計工具。

4. 專業訓練

本次主辦單位安排了 4 種專業訓練，分別為繼續教育講習（Continuing Education Lectures, CEL）、專業育成學校（Professional Development School, PDS）、專業充電課程（Professional Enrichment Program, PEP）及美國保健物理學會課程（Course of American Academy of Health Physics, AAHP Course），除繼續教育講習可免費參加外，其餘三種課程需付費 30~850 美元。以下謹重點摘錄繼續教育講習之講課內容：

4.1 天然放射性物質 NORM/TENORM 之輻防管理概述（NORM/TENORM : History + Science + Common Sense）

本課程說明 NORM/TENORM 於工業上的主要來源及相關輻防議題。由於岩石中含鈾系、釷系核種及鉀-40，這些放射性核種在採礦、精煉的過程中有可能成為輻射劑量的來源，對於

NORM/TENORM 廢棄物管理，美國迄今並無訂定聯邦導則，而是授權由各州自行管理，各州法規未必是基於科學基礎，而是基於其特殊情況，因此各州的管制規定可能迥異，但這可能對業者於規劃輻防措施時造成困擾，對此講者倡議美國應調合出一套通用的標準。

4.2 輻射風險溝通的12個盲點（Twelve Barriers to Effective Radiation Risk Communication）

溝通專家傳達輻射風險資訊時，一般會遇到 12 個盲點：(1)命令(2)威脅(3)說教(4)給予建議(5)教導(6)批評(7)讚揚(8)貼標籤(9)診斷(10)同情(11)質問(12)轉移注意，這些盲點因缺乏對溝通對象的同理心，有可能因此導致溝通失敗。事實上，對於風險溝通，聽眾的感受為溝通能否成功的要素，這些聽眾希望他們的感受能受到理解與認同，但技術專家常常僅著重於其專業訓練與經驗，卻未關心聽眾的感受，自認為聽眾受到錯誤資訊誤導，而嘗試用指正的方式導正聽眾的想法，但這樣的做法很容易讓聽眾關上溝通的大門。講師強調，關心聽眾的感受才是促進有效溝通的重點。

5. 輻射儀器展示與人才招募

因美國保健物理學會年會同時聚集了許多保健物理從業人員，主辦單位也借用旺盛的人氣，招攬許多廠商於會場設置攤位(圖 6)。會場中三分之二以上的廠商為儀器商，展示的商品多為手持式偵檢器、可攜式核種分析儀及液體閃爍計數器等，國內常見之輻射偵檢器之原廠廠家均有參展。除儀器商之外，美國國防部亦有參展，並於現場招募新兵。此外，多所設有保健物理科系的大專院校（如科羅拉多州立大學及本次順道參訪的華盛頓州立大學等校）為招募新生，亦在會場設攤。

圖 1 保健物理學會會長 Nancy Kirner 主持開幕會

圖 2 專題演講之講師

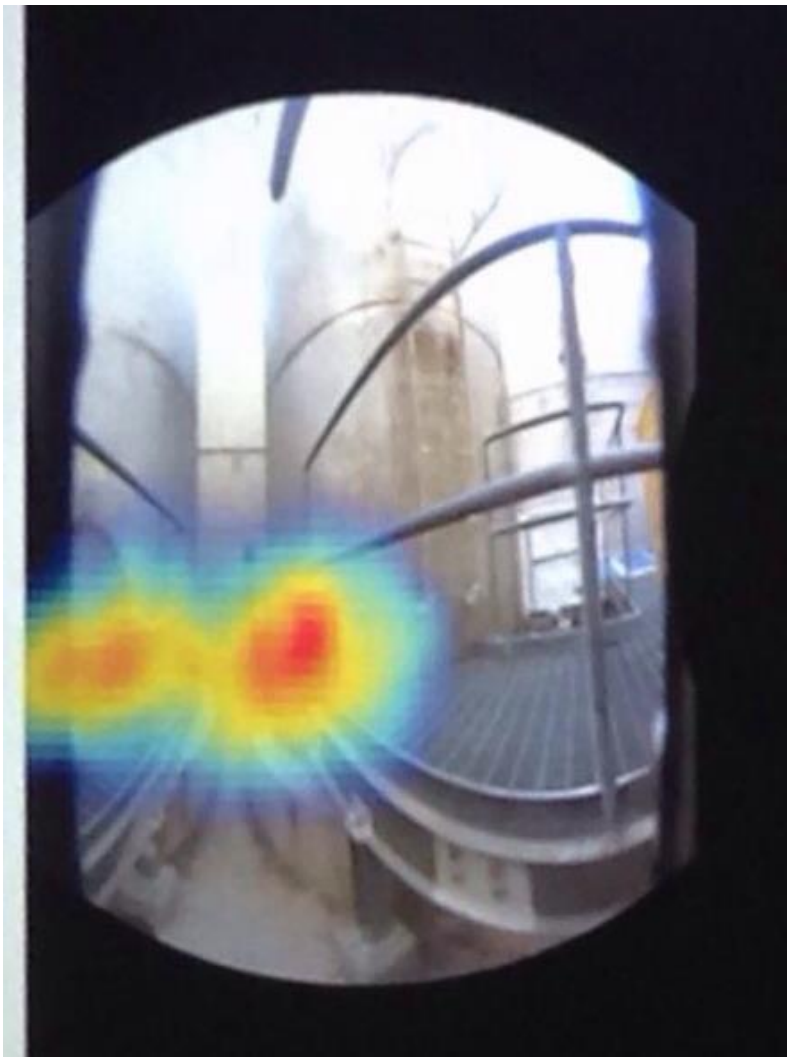


圖 3　3D 加馬攝影機功能展示

圖 4 電腦輔助輻防模擬訓練之操作畫面

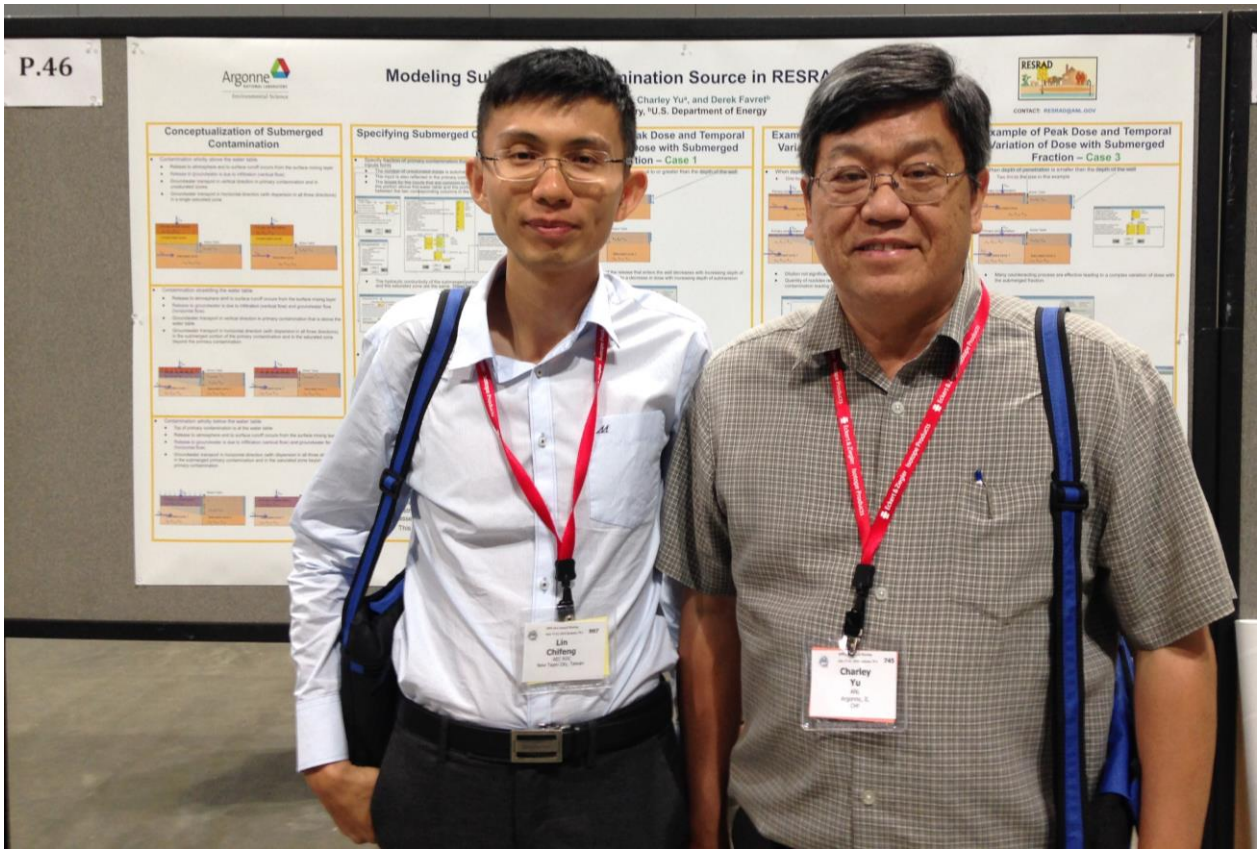

P.46
Argonne
RESRAD
Conceptualization of Submerged Contamination
Specifying Submerged
Example of Peak Dose and Temporal Variation of Dose with Submerged Fraction – Case 3
Lin
Chifeng
Charley
Yu

圖 5 與余家禮博士合影

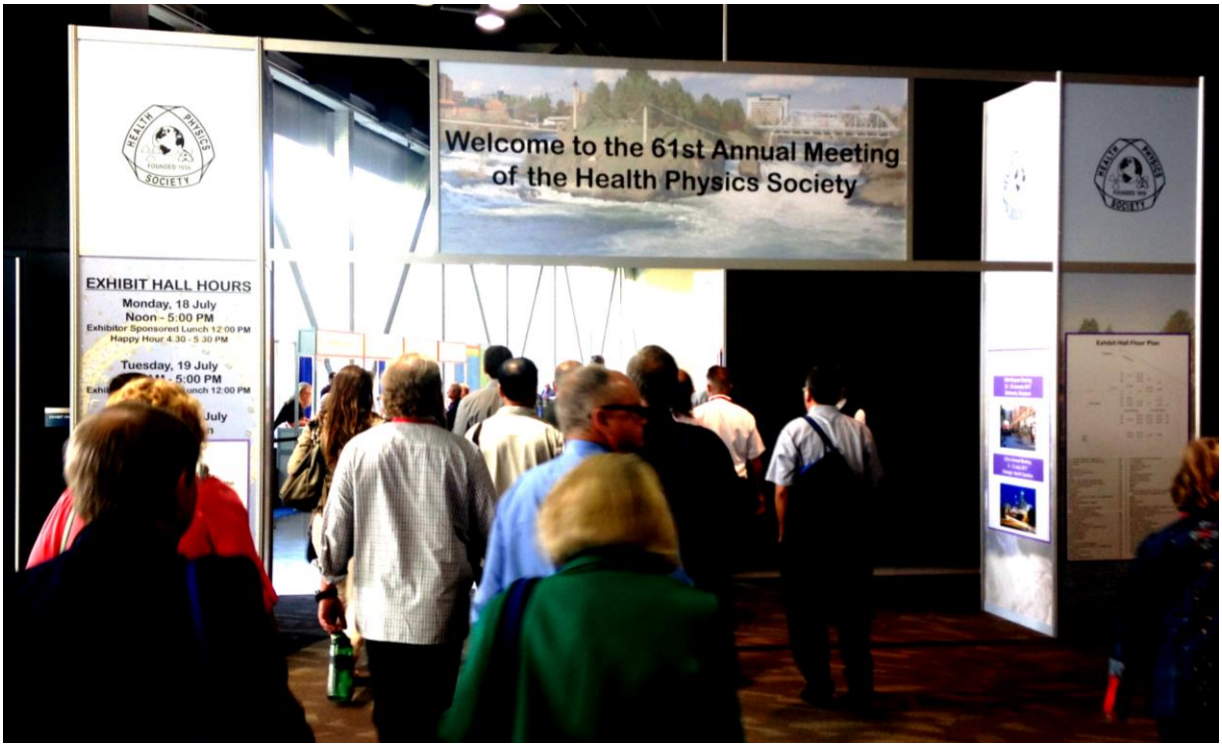

Welcome to the 61st Annual Meeting
of the Health Physics Society
EXHIBIT HALL HOURS
Monday, 18 July
Noon - 5:00 PM
Exhibitor Sponsored Lunch 12:00 PM
Happy Hour 4:30 - 5:30 PM
Tuesday, 19 July

圖 6 會場剪影

(二)華盛頓州立大學研究用反應器(Washington State University Reactor)：

1. 概述

華盛頓州立大學核子反應器中心創立於 1961 年，位於該大學之普爾曼(Pullman)校區內（如圖 7），佔地約 13,000 平方英呎，其業務範圍包含研究用反應器營運、商用同位素生產、中子活化分析、放射性化學分析、X 光繞射實驗等部門。

本次參訪係安排參觀該中心之研究用反應器，此反應器於 1961 年 3 月 7 日初次臨界，原使用 MTR（Material Test Reactor）片狀燃料，後於 1966 年改為 1000 kW TRIGA 燃料反應器。1975 年，反應器爐心的部份燃料升級為鈾濃縮度較高的長生命週期燃料（fuel lifetime improvement fuel, FLIP fuel），同年美國眾議院發出命令，要求所有研究用反應器僅能使用低濃縮鈾燃料，華盛頓州立大學受限於經費，遲至 2008 年 10 月 7 日方完成研究用反應器燃料轉換工程，並持續使用低鈾濃縮度燃料至今。在運轉 50 年後，華盛頓州立大學於 2011 年 9 月 30 日完成美國核管會規定之反應器執照更新作業，使其反應器可再延用 20 年。

我國清華大學 THOR 反應器為 TRIGA 型反應器，於 1961 年 4 月 13 日初次臨界，當時反應器額定熱功率為 1 MW，使用鈾濃縮度 20%之 MTR 片狀燃料，1970 年轉換為 93%高濃縮度之同型鈾燃料，但當時國際間逐漸採行防核武擴散政策，以致高濃縮度鈾燃料之取得日益困難，故自 1977 年起 THOR 反應器逐步改為使用 TRIGA 型低濃縮度燃料。1998 年，反應器額定功率提升至 2 MW。該校於 2001 年及 2011 年依序取得效期 10 年之更新執照。

綜上所述，美國華盛頓州立大學反應器與我國清華大學 THOR 反應

器之運轉歷史相近，故其對於排放監測、環境監測與區域管制等面向所採取之管理措施亟具參考價值，可供本會管制研究型反應器之輻射安全作為參考。

2. **參訪行程安排**

安排本次參訪行程時，除依據校方網頁上之說明（http://nrc.wsu.edu/Tours）事先提出參訪申請，另也依據台美會議第三工作小組議題 AE-NR-Z9 於 2015 年 12 月之會議決議，惠請美國核管會及駐美經濟文化代表處協助聯繫，本次參訪始得成行。行前也事先將所本會關切的輻防管制議題電郵至校方聯絡窗口，俾利校方安排參訪行程與解說。

3. **參訪過程**

參訪當天由該校承辦人 C. Corey Hines 接待，於該校之核子反應器中心—Dodgen Research Facility 進行參訪（圖 8）。一開始於該設施門口辦理人員進出手續及劑量配章佩戴，爾後由 Hines 先生帶領至反應器控制室，由該校接待人員說明反應器各項運作功能與該設施採取之輻防管制措施，並現場踏查該設施周圍環境。

本次對該校提出之研究用反應器輻防管制議題包含放射性氣體排放監測、環境輻射監測及管制區內之輻射監測，該校回應概述如下：

(1) 放射性氣體排放監測：該校表示其氣體排放監測係使用碘化鈉偵檢器對氬-41 進行線上監測，再利用劑量評估模式，計算附近居民所受到的影響。另依據該校經驗，其氣體排放監測系統僅曾因儀器故障而發出警報，但從未發生監測值超出警報值之情事。

(2) 環境輻射監測：因該設施周圍 3 英哩範圍內罕有居民，該校僅定期於館舍周遭以手持式偵檢器進行環境輻射劑量率量測，並未執行環境樣品取樣分析。

(3) 管制區內之輻射監測：該校僅於反應器燃料破損時，方執行管制區內空浮微粒量測。

實地踏查該核子設施周圍環境時，發現該設施周遭土地大部份為高爾夫球場，該處並無居民，故該核子設施對附近民眾應不致造成健康風險。

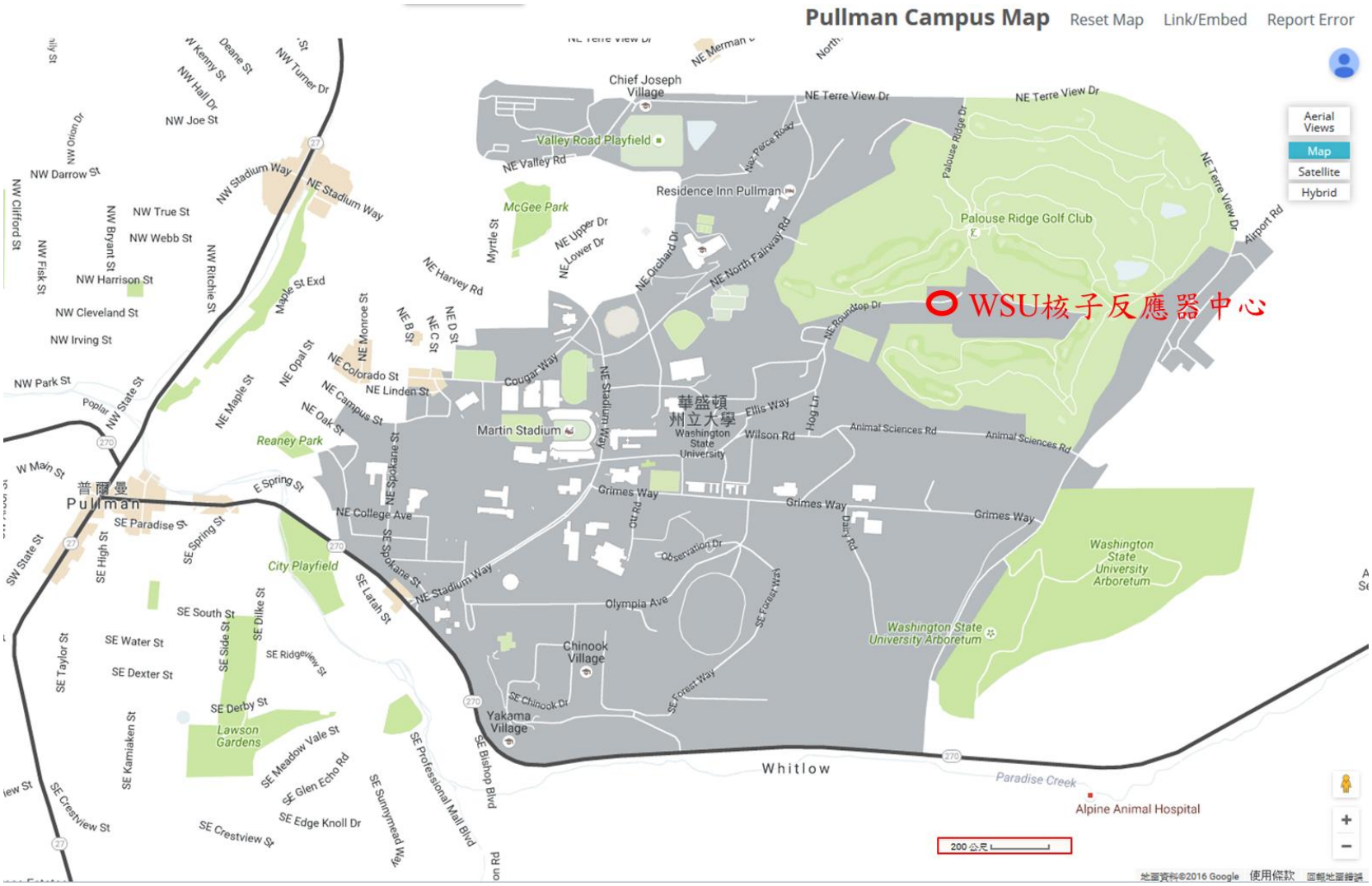


圖 7 華盛頓州立大學(WSU)核子反應器中心位置

圖 8　華盛頓州立大學核子反應器中心--Dodgen Research Facility

四、心得與建議：

(一) 心得：

1. 針對低劑量輻射對人體健康的影響，許多與會學者同意 100 毫西弗以下的輻射劑量對人體健康的影響不顯著，因此線性無低限模型（Linear Non-Threshold, LNT）的合理性於年會中多次被提出討論。但事實上，為評估人體累積劑量，進而管制人員劑量，LNT 仍是較易於使用的模型。

2. 在「未來挑戰」（future challengers）專題討論中，主辦單位安排了數項有關大學、研究所保健物理教育的議題。講師的資料顯示，美國研讀保健物理科系的學生人數呈一逐漸減少的趨勢，講師將此歸因於三個要素：1.學費昂貴 2.公立學校經費減少 3.缺乏就業機會。當學生人數逐年減少，此產業便可能出現人才斷層，進而影響技術發展與傳承。反觀我國，亦有類似的問題，而即便國內核能電廠陸續除役，除役時間預計將長達 25 年，因此仍需持續補充保健物理人才。為扭轉此劣勢，講師提出數項建議：1.研究計畫應互相合作，以提高資源的運用效率 2.產業與政府應提供足夠的資源（研究經費、獎學金等）3.管制機關應針對特定職業，設定應具備保健物理專業資格，綜言之，大致上是希望「提供資源」及「建立需求」，這些建議或可提供國內相關單位作為參考。

3. 本次年會有不少課程與報告涉及輻射風險溝通，可見輻射風險溝通在美國也是一項重要議題，觀察各課程的進行情況，除了由講師講述重點原則外，另也以工作坊的形式，安排學員實地演練，並由講師現場指導，學員的參與情形相當踴躍。就我國而言，輻射安全同為一項民眾相當關切的重要議題，因此若要深切地瞭解民眾的需求，提供正確的輻防知識，可向美國看齊，藉由舉辦工作坊，由導

師引導，持續精進相關從業人員對於輻射風險之溝通能力。

4. RESRAD 為功能強大之劑量評估軟體，美國核管會已同意核設施持照人使用該軟體評估核設施除役所導致之一般人輻射劑量，但該軟體需輸入數百項水文、地質、氣候等參數，就實務面而言，如需完整蒐集這些參數將甚為困難，對此該軟體提供乙項「參數靈敏度分析」的功能，可篩選出較為關鍵的參數，本會科技計畫「核設施除役之輻射安全技術研究」今年特別針對此項功能進行研究，然據計畫委託單位回報，「參數靈敏度分析」功能仍需依場址實際情況，輸入程式所需之各項參數，此似與該功能原有旨意相悖。本次年會巧遇 RESRAD 開發負責人余家禮博士，特別對此向其請教，余博表示，參數篩選係為一疊代(iteration)的過程，經由初步調查場址參數，配合「參數靈敏度分析功能」，找出關鍵參數，再對關鍵參數進行更詳細的調查，如此評估結果將更為精確。

5. 本次參訪華盛頓州立大學之主要目的，係瞭解該校針對研究用反應器所採取之輻防管制措施。有關環境輻射監測，該校因周遭居民較少，故僅定期以手持式偵檢器進行輻射劑量率監測，而未執行環境樣品取樣分析。反觀我國因地狹人稠，為嚴密監控核設施對周遭居民之影響，降低民眾可能接受到的健康風險，仍需對核設施採取較美國更為嚴謹的環境輻射監測措施。

(二) 建議：

1. NCRP 目前正跟隨 ICRP 103 號報告的腳步，研擬在其新的輻射防護基本標準中將動、植物的輻射防護納入考量，但與會學者也有人提出質疑：人員輻射防護已是很大的議題，應考量是否再將動、植物的輻射防護納入，且如納入動、植物的輻射防護，以往許多針對人員的輻射防護措施便需要進一步修正。而在大會的口頭報告中，有

學生的研究題目為搜救犬的輻射劑量評估，但會場中也有人提出道德問題，例如搜救犬的輻射劑量過高，是否仍讓其參與搜救，此問題也在會場引起爭論。針對動、植物的輻射防護，我國可再觀察 NCRP 未來對此議題的態度，但仍建議務實考量，將主要資源投入人員防護，如有餘力，再將防護範圍拓展至動、植物。

2. 有關天然放射性物質 NORM/TENORM 之管制，美國各州迄今無一致的管制規定，但已有業者呼籲政府協調出一致的標準。建議未來應持續追蹤該國對於天然放射性物質的管制動態。

3. 福島事故發生至今已超過 5 年，目前大部份主題仍限於環境輻射監測及人員劑量評估。我國與日本地理位置相近，因此國人相當關心日本民眾的健康受到福島事故的影響，此外，福島災民的健康調查資料或可說明低輻射劑量的健康效應，故建議未來仍需持續注意有關福島事故健康效應之相關研究。

4. 由太平洋西北國家實驗室對於氣體排放監測系統背景值異常之案例得知，連續氣排監測系統的警報設定值可用於確定是否發生大量的放射性物質外釋，而監控背景值的變化趨勢則可偵測到微量而穩定的外釋，兩者均有其特殊目的。我國核設施對於排放系統、區域監測器等輻防儀器多以警報設定值管控氣、液體排放及工作場所內之輻射狀態，未來可建議各設施亦對背景監測值建立追蹤機制。

5. 「電腦輔助輻防模擬訓練」可讓使用者在虛擬環境下進行模擬操作輻射作業，其優點為可減少工作人員受訓時接受的劑量，降低訓練人力，亦可供使用者重複參訓，美國核管會正審查其課程內容是否能折抵訓練時數，建議我國參考美國核管會的審查結果，並綜合考量相關效益，決定是否引進此套軟體。

HEALTH PHYSICS SOCIETY

FINAL PROGRAM

61st Annual Meeting

Spokane Convention Center
Spokane, Washington
17-21 July 2016

61st Annual Meeting

Health Physics Society

Spokane Convention Center • Spokane, Washington • 17-21 July 2016

Registration Hours and Location

Spokane Convention Center, Hall A/B

Saturday, 16 July
2:00 pm - 5:00 pm

Sunday, 17 July
7:00 am - 5:00 pm

Monday, 18 July
7:30 am - 4:00 pm

Tuesday, 19 July
8:00 am - 4:00 pm

Wednesday, 20 July
8:00 am - 4:00 pm

Thursday, 21 July
8:00 am - 11:00 am

Future Midyear Meeting

50th Midyear Meeting
22-25 January 2017, Bethesda, MD

Future Annual Meetings

62nd Annual Meeting
9-13 July 2017, Raleigh, NC

63rd Annual Meeting
15-19 July 2018, Cleveland, OH

64th Annual Meeting
7-11 July 2019, Orlando, FL

Look online for future meeting details
hps.org/meetings

Table of Contents

Officers

Nancy Kirner, President
Robert Cherry, President-elect
Eric Goldin, Secretary
Kathleen L. Shingleton, Treasurer
Michael Lewandowski, Treasurer-elect
Barbara Hamrick, Past President
Brett J. Burk, Executive Director

Board of Directors

James Bogard
Elizabeth L. Gillenwalters
Tracy A. Ikenberry
Ken Krieger
Elaine Marshall
Debra McBaugh Scroggs
Cheryl L. Olson
Sandy Perle
David R. Simpson

Advisory Panel to the Board

Web Operations Editor in Chief, Howard Dickson
Ask the Experts Editor, Genevieve S. Roessler
Deputy Editor in Chief, Kelly Classic
Technical Writer/Editor, Linnea Wahl
Journal Editor in Chief, Michael T. Ryan
Agency Liaison and Operational Radiation Safety Editor in Chief, Craig A. Little
Congressional Liaison, David Connolly
Parliamentarian/Rules Chair, Glenn Sawtelle
Program Committee Chair, Jack Kraus
Student Support Committee Chair, Chu Wang
NRRPT Representative, Robert Wills

Local Arrangements Committee

Co-chairs: Gene Carbaugh and Kathy Pryor

Members:

Cheryl Antonio
Tony Brooks
Lorna Brown
Susan Carbaugh
Jodie Carnes
Darrell Fisher
Jeanne Fisher
Earl Fordham
Wayne Glines
Tracy Ikenberry
Erica Jordan
Jeffrey Kulp
Tim Lynch
Kyle Maloy
Sean Murphy
Alex Nazarali
Dale Pryor
Paul Stansbury
Bryony Stasney
Don Stewart
Sergei Tolmachev
Steve Woolfolk

2016 Task Force – Spokane

Chris Shaw, Task Force Chair
Jack Kraus, Program Committee Chair
Corrin Chlebowy
Jason Davis
Joy Epps
Mike Mahathy
Tony Mason
Kathy Pryor
Tim Taulbee

Headquarters Hotel

The Davenport Grand Hotel

333 W. Spokane Falls Blvd, Spokane, WA 99201, Direct Phone (509) 458-3300

The Davenport Grand Hotel is connected to the Convention Center by Skybridge.

Overflow Hotel

The Doubletree Spokane

322 N. Spokane Falls Court, Spokane, WA 99201, Direct Phone (509) 455-9600

The Doubletree Spokane is connected to the Convention Center by Skybridge.

Speaker Ready Room

Spokane Convention Center, Room 102CD

Sunday, 2:00-5:00 pm

Monday-Wednesday, 7:30 am-5:00 pm

Thursday, 7:30 am-12:30 pm

You must check in at the Ready Room
(even if you have already submitted your presentation).

See page 9 for more information.

Note For CHPs

The American Academy of Health Physics has approved the following meeting-related activities for continuing education credits for CHPs:

- Meeting attendance is granted 1 CEC per contact hour, excluding meals and business meetings;
- AAHP 8-hour courses are granted 16 CECs each;
- HPS 2-hour PEP courses are granted 4 CECs each;
- HPS 1-hour CELs are granted 2 CECs each.

Student Events

Student Orientation
Saturday, 5:45-6:45 PM
Davenport Meeting Room 10

Quiz Bowl
Sunday, 4:00-5:30 PM
Davenport Meeting Room 12

Welcome Reception
Sunday, 6:00-7:30 PM
Davenport Grand Ballroom 4-5

Exhibitor Luncheons
Monday & Tuesday, 12:00-1:30 PM
Exhibit Hall AB

Student/Mentor Reception
Monday, 5:30-6:30 PM
Davenport, Meeting Room 1

Awards Dinner
Tuesday, 7:00-9:00 PM
Davenport Grand Ballroom AB

Sunday-Thursday

PEPs, CELs, and Sessions will be at the Spokane Convention Center

2016 HPS SPONSORS

Gold Sponsor

PerkinElmer®
For the Better

Silver Sponsor

HI-Q ENVIRONMENTAL PRODUCTS COMPANY, INC.
Air Sampling & Radiation Monitoring Equipment, Systems & Accessories

Bronze Sponsors

MIRION TECHNOLOGIES

Eckert & Ziegler
Isotope Products

INDUSTRY DAY SPONSORS

Dade Moeller, an NV5 Company
Energy Solutions
US Ecology
SECURE Energy Solutions

IMPORTANT EVENTS

3rd Annual Quiz Bowl

You and your friends can test your knowledge against other HPS members (members are encouraged to group with students and young professionals). Join us Sunday 17 July, 4:00-5:30 pm, at the Meeting Room 12, Davenport Grand Hotel.

Welcome Reception

Please plan on stopping in at the Davenport Grand Hotel, Grand Ballroom, Sunday 17 July, from 6:00-7:30 pm. There will be an opportunity to meet friends to start your evening in Spokane. Cash bar and light snacks will be available.

Exhibits

Free Lunch! Free Lunch! – 12:00 pm, Monday, 18 July and Tuesday, 19 July. All registered attendees are invited to attend a complimentary lunch in the Exhibit Hall.

Breaks Monday Afternoon-Wednesday Morning – Featuring morning continental breakfasts and afternoon refreshments such as fruit, ice cream, and cookies. Be sure to stop by and visit with the exhibitors while enjoying your refreshments!

AAHP Exam

Monday, 18 July Davenport Grand Hotel, Grand A
Part 1 - 8:00-11:00 am; Part 2 - 12:30-6:30 pm

Sessions and Course Locations

PEPs, CELs, and all sessions Sunday through Thursday will take place at the Spokane Convention Center.

AAHP Awards Luncheon

Spokane Convention Center
Tuesday, 19 July • Noon-2:00 pm • 202ABC
Tickets available at HPS Registration Desk

HPS Awards Banquet

Spend an enjoyable evening with members of the Health Physics Society. This event will be held on Tuesday, 19 July, in Grand AB of the Davenport Grand Hotel, and is an excellent opportunity to show your support for the award recipients as well as the Society. The awards will be presented after the dinner and the event will last from 7:00-9:00 PM. Included in Member, Non-Member, Emeritus, Past President, and Student Registrations.

HPS Business Meeting

Spokane Convention Center, Conference Theater
Wednesday, 20 July, 5:30-6:30 pm

Again this YEAR!

PEP Courses will have presentations posted online for those who have signed up for them prior to the meeting. There will be no hard copy handouts.
See page 45 for course information

Things to Remember!

All speakers are required to check in at the Speaker Ready Room in the Convention Center at least one session prior to their assigned session.

All posters up
Monday–Wednesday in Exhibit Hall

Poster Session featured Monday, 1:00-3:00 pm
No other sessions at that time

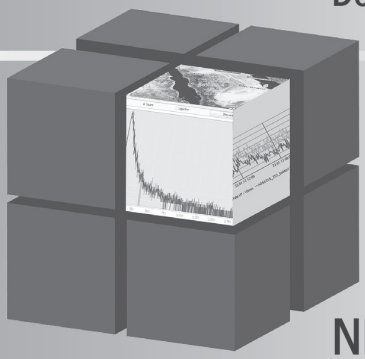
ENVINET

Leading in Environmental Radiation Detection

MIRA
Gamma Dose Rate
Monitoring System

SARA
Spectroscopic Gamma
Monitoring System

MONA
Mobile Radiation
Detection System



NMC
Monitoring Center

For 30 years, our customers have been relying on ENVINET's solutions in monitoring environmental parameters. With over 4,500 online detectors in operation, we are the leading manufacturer of networks for the monitoring of environmental radiation. ENVINET's products and solutions reflect the experience and innovative capacity of our team. We guarantee top quality and both extremely reliable and functional solutions.

We create turnkey integrated solutions for radiation monitoring, especially:

- nationwide early warning systems
- ring monitoring systems around nuclear plants
- area monitoring systems within nuclear facilities
- water monitoring systems for use in either sweet or salt water
- mobile solutions for the detection and location of radioactive contamination

We offer a full range of products from detector to central control and analysis software, thereby guaranteeing optimally configured functionality.

Let us convince you of ENVINET and its products "Made in Germany".

ENVINET GmbH
Hans-Pinsel-Straße 4 ▪ 85540 Haar (Munich)
Germany
Phone +49 (89) 45 66 57-800
Fax +49 (89) 45 66 57-820
Email info@envinet.com

ENVINET GmbH ▪ Germany ▪ www.envinet.com

HPS AWARDS DINNER

Tuesday Evening Awards Reception & Banquet

Join your peers in honoring the following awardees while enjoying a delicious meal. Brief award presentations will immediately follow the dinner. All attendees are strongly encouraged to stay and show support for the award recipients.

This event will take place in in Grand AB at the Davenport Grand on Tuesday, 19 July from 7:00pm – 9:00pm.

The following awards are to be presented:

Founders Awards
Raymond H. Johnson, Jr.

Elda E. Anderson
Charles A. Wilson, IV

Distinguished Public Service Award
John D. Boice, Jr.

Distinguished Scientific Achievement Award
Nolan E. Hertel

Honor Roll Award
Peter V. O'Connell

Fellows
Robert Barish
Jeff Chapman
Paul Charp
Lynne Fairobent
Rodney Nickell
Chrles "Gus" Potter
Adela Salame-Alfie
Steve Simon

Banquet Menu

BARTLETT PEAR SALAD
Mesclun greens, caramelized walnuts, Pont Reyes blue cheese, Walnut-apple vinaigrette

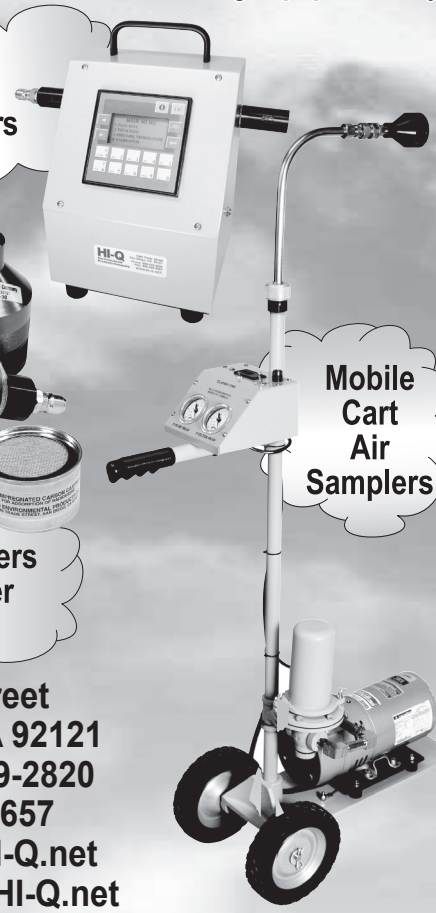
Duo entree of HAZELNUT CRUSTED CHICKEN BREAST and SEARED SALMON FILET
Shiitake risotto and seasonal vegetables

WASHINGTON APPLE CRISP
Fresh Washington Gala apples
Baked and topped with a crispy cinnamon streusel

Freshly baked rolls
Freshly brewed Starbucks regular and decaffeinated coffee. hot teas

HI-Q ENVIRONMENTAL PRODUCTS COMPANY, INC.

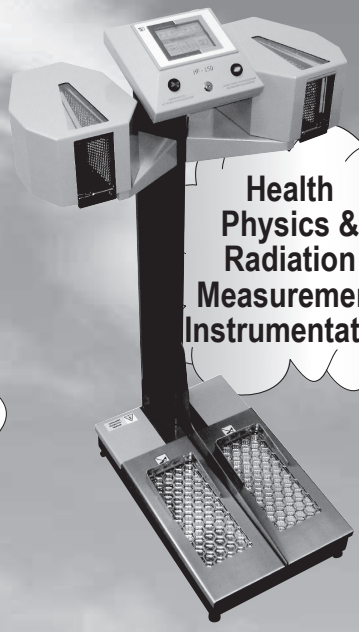
Air Sampling & Radiation Monitoring Equipment, Systems & Accessories



Air Flow Calibrators

Filter Holders and Filter Media

Mobile Cart Air Samplers



Health Physics & Radiation Measurement Instrumentation

ANSI N13.1-2011 Stack Sampling Location Qualification Testing & System Design

Continuous Duty High & Low Volume Air Samplers

7386 Trade Street
San Diego, CA 92121
Phone: **858-549-2820**
Fax: **858-549-9657**
Email: **info@HI-Q.net**
Internet: **www.HI-Q.net**

Our product line also includes:

- Calibration & Repair Services
- Silver Zeolite Cartridges
- Filter Holders (In-Line, Open Faced, Combination)
- Filter Paper
- Outdoor Ambient Air Samplers & Shelters
- Custom Product & System Design
- TEDA Impregnated Carbon Cartridges

61st Annual Meeting

Health Physics Society

Spokane Convention Center • Spokane, Washington • 17-21 July 2016

Welcome

The Columbia Chapter of the Health Physics Society is thrilled to welcome you to the City of Spokane, Washington, for the 61st HPS Annual Meeting. It's been 11 years since the HPS celebrated its 50th Anniversary meeting here, and the city and environs are as beautiful as ever.

Registration Fees:

	Pre	On-Site
PDS	$650	$750
HPS Member	$430	$530
HPS Dues Renewal	$170	$170
Non-Member	$550	$650
Student	$70	$70
Emeritus Member	$215	$265
One-Day Registration	$275	$300
HPS PEP Lecturer	$130	$230
HPS CEL Lecturer	$280	$380
Companion	$110	$110
Emeritus Companion	$55	$55

Session Location

All sessions will take place in the Spokane Convention Center unless noted otherwise.

Local Arrangements Committee Room

Spokane Convention Center, Sunday-Thursday Room 102B

Speaker Information

Technical Sessions Speaker Instructions

You are allotted a total of 12 minutes of speaking time unless you have been notified otherwise.

The Ready Room (Meeting Room 102CD) will be open Sunday from 2:00-5:00 PM, Monday through Wednesday from 7:30 AM-5:00 PM, and Thursday 7:30 AM-12:30 PM. You must check in at the Ready Room (even if you have already submitted your presentation) no later than the following times:

Presentation Time	Check-In Deadline
Monday AM	5 PM Sunday
Monday PM	11 AM Monday
Tuesday AM	5 PM Monday
Tuesday PM	11 AM Tuesday
Wednesday AM	5 PM Tuesday
Wednesday PM	11 AM Wednesday
Thursday AM	5 PM Wednesday
Thursday PM	11 AM Thursday

Please report to your session room 10 minutes prior to the Session start to let your session chair(s) know that you are there.

Posters in Exhibit Hall must be put up for display between 10:00 AM-Noon on Monday, and removed on Wednesday by 11:00 AM.

PEP/CEL Ready Room

The PEP/CEL Ready Room will combined with the Speaker Ready Room in Meeting Room 102CD in the Spokane Convention Center from Sunday-Thursday

TOURS & EVENTS

Monday, 18 July

Cruise on Scenic Lake Coeur d'Alene

1:00 pm–5:00 pm
Onsite: $55

Leaves from the DoubleTree Hotel Lobby

Travel to Idaho where you'll board the cruise boat for a two hour private cruise on Lake Coeur d'Alene. National Geographic reports this as one of the most beautiful lakes in the world, see why! The cruise is narrated and there is seating both inside on the main floor and in the open air up top. Along the way, pass by the famous floating green at the Coeur d'Alene Resort Golf Course. After the cruise, there is free time to browse in the shops, walk the world's longest floating boardwalk or grab a drink in one of the many cafés. Tour price includes bus transportation, guide and two hour cruise on the lake. Snacks, beer, wine and cocktails are available for purchase.

Historic Walking Tour of Downtown Spokane and Wine Tasting

1:30 pm–4:30 pm
Onsite: $30

Leaves from the Convention Center Front Entrance

This leisurely walk of about 2 miles will inform you about the Native Americans, early fur traders and pioneers who settled along the Spokane River. See the former Expo' 74 site, now Riverfront Park and view the Spokane Falls. As you walk through downtown, your guide will tell you about architects and point out ornate details on the buildings they created after the Great Fire of 1889. Learn about what these buildings were originally built for and some interesting and colorful stories about Spokane in the late 1800s. Along the way, we will stop for a wine tasting at the Nectar Tasting Room which features five wineries from around Washington State.

Spokane Indians Baseball Game

5:30 pm
Onsite: $25 (includes ticket and shuttle)

Leaves from the Davenport Grand Hotel Lobby

Take us out to the ball game. The Spokane Indians, a minor league member of the Class A Short Season Northwest League and a farm team for the Texas Rangers, will play the Vancouver Canadians at Avista Field, a short taxi ride or hotel shuttle from downtown. Game time is 6:30 pm. Meet at 5:30 in the Grand Hotel lobby for the hotel shuttle or arrange your own transportation.

Open Mike Night

8:30 pm–12:30 am
Free

nYne Bar
232 W Sprague Ave
Spokane, WA 99201

Check Registration Desk for further details.

Tuesday, 19 July

5K Fun Run/Walk

6:30 am–8:30 am
Onsite: $30

Leaves from the breezeway between the Convention Center and the INB Performing Arts Center

Our course begins on the river side of the Spokane Convention Center, between the Convention Center and the INB Performing Arts Center, a two minute walk from the Davenport Grand Hotel lobby. We will follow the Centennial Trail east, across the Spokane River, through the Gonzaga University campus, to Mission Park and back. Fun awards presented after the run.

Historic Spokane's "Age of Elegance" Bus Tour
1:30 pm–4:30 pm
Onsite: $30

Leaves from the Convention Center Front Entrance

Enjoy a bus tour of the rich history, historic homes and attractions of Spokane. Learn about the Native Americans that first discovered this area and where the city began as we travel along the Spokane River, view the Spokane Falls and the grounds of the former Expo '74 site, now Riverfront Park. See the Looff Carousel built in 1909, named one of the "Top Ten Carousels in the US" by the National Carousel Association. Then, ascend up "The Hill" with views of the city and stunning mansions. Tour inside the majestic Saint John's Cathedral, said to be one of the most beautiful cathedrals in the Pacific Northwest. Marvel at the stained glass windows, wood carvings and design. Discover Manito Park while strolling through the formal French Renaissance gardens, Perennial Gardens, Rose Gardens, authentic Japanese Gardens, and flower-filled Conservatory. Trip Advisor's Travelers Choice Awards rated Manito Park "One of the Top 25 Parks in the US." See the historic area of Browne's Addition where many of the old mansions, built in the late 1800s, have been restored to their original splendor. Stop at Bing Crosby's childhood home to see the largest public collection of Crosby's memorabilia in the Country.

Star Party
9:00 pm–10:30 pm
Free

Meet on King Cole Pedestrian Bridge that connects to the North side of the Spokane Convention Center

Things are looking up! That is, the Accelerator Section is going to host a free star party at the meeting for your enjoyment. It will be a modest affair that will be held within easy walking distance from the Spokane Convention Center and the Davenport Grand Hotel, and will follow immediately after the Awards Banquet on Tuesday night, July 19, 2016, from 9 PM to 10:30 PM. The location will be on the small pedestrian bridge that connects to the north side of the Spokane Convention Center. Please plan to stop by and enjoy the wonders of the nighttime sky with us. After all, stars are particle accelerators, too!

Wednesday, 20 July

Relish Spokane™ Food Walking Tour
2:00 pm–5:00 pm
Onsite: $45

Leaves from the Spokane Convention Center Main Entrance

Between tantalizing your taste buds with the delicious food of Spokane, you will be engulfed by the quaint, historical vibe of the city. Our walking food tour makes 6 stops over about 1.5 to 2 miles. As you stroll the city, you will be satisfied with several savory tastings from local bakeries, bistros, and other local unique shops. The visits range from French delights to saucy bites that will provide enough of the local ethnic eateries to get you acquainted to the real Spokane, WA! And all of this is accompanied with fun facts about the town's culture, people, architecture and history. Our small group tours allow for a more intimate experience, leaving your appetite and hunger to learn about our small-big city satiated! Not recommended for people with special food needs or allergies.

Spokane Pub Crawl
6:30 pm till ????
Onsite: $25

Leaves from the Front entrance to the Davenport Grand

An HPS annual meeting tradition! Not only is Washington State the home to some fabulous Northwest microbrews, Washington Wine Country is famous for its "perfectly balanced" wines! Whether you prefer a pint glass or a wine glass, it's all available within easy walking distance in downtown Spokane. Destinations that are a bit farther will also be identified for those who want to stretch their legs. Crawlers will leave from the front of the Davenport Grand Hotel. Includes a commemorative t-shirt; variety of colors available with pre-registration.

Night Out, O'Doherty's Irish Grille and Pub, plus an Evening of Songs and Stories of the Pacific Northwest

6:30 pm–9:30 pm

Onsite: $45

This fun Night Out will take place at O'Doherty's Irish Grille and Pub, a short walk across the street and parking lot from the Davenport Grande.

Enjoy a delicious meal followed by Songs and Stories of the Pacific Northwest. Your meal will include your choice of Tullamore Dew Whiskey Steak (cooked medium), Donegal Salmon (baked with lemon butter) or Corned Beef and Cabbage, with a Caesar salad, Shepherd's bread, and garlic mashed potatoes as accompaniments and a no-host cash bar. Following the meal we will be treated to Songs and Stories of the Pacific Northwest by noted Northwest folk entertainer Hank Cramer. Hank is in high demand for folk festivals, concerts, and cultural presentations, and hails from Winthrop, Washington (home to our President Nancy Kirner, who highly recommends him). He even has some ties to our profession as a former emergency planner.

Thursday, 21 July

Hanford B-Reactor Tour

7:30 am–6:00 pm

Onsite: $55

Meet at Bus. Leaves from the Spokane Convention Center Main Entrance.

Visit the Hanford B-Reactor, the world's first production nuclear reactor, which created plutonium for the Manhattan Project. It is now part of the Manhattan Project National Park. This tour will depart from the Convention Center by bus for a three-hour ride to Hanford. A delicious box lunch will be provided from the Shrub Steppe Smokehouse (your choice of pulled pork sandwich, Caesar salad with brisket of beef, or vegetarian Caesar salad, with a potato salad side and drink). The tour will have over two hours at the B-Reactor, allowing ample time to explore this historic facility at your leisure. We will return to Spokane at approximately 6 pm.

Meal Preference:
Pulled Pork Sandwich, Caesar Salad w/ Brisket of Beef, Caesar salad (no meat)

COMPANION PROGRAM

Information for Registered Companions

Companion Registration cost is $110 and includes the Welcome Reception, Monday-Thursday breakfast buffet at the Doubletree Hotel, and lunch and breaks in the Exhibition hall. There will not be a separate Hospitality Room, however the Local Arrangements Committee staff in Convention Center Room 102B will be happy to answer your questions or assist in finding the answer.

Sunday 17 July

Welcome Reception

6:00-7:30 pm, Grand Ballroom, Davenport Grand Hotel
Come see old friends and make new ones! Enjoy hors d'oeuvres with a cash bar, 6:00-7:30 pm.

Monday, 18 July - Thursday, 21 July

Companion Breakfast

6:00-10:30 am, Shutter's Café, the DoubleTree Hotel

Companion Registration includes Monday – Thursday breakfast buffet at Shutter's Café in the Doubletree Hotel, 6:00 to 10:30 a.m. A delicious buffet awaits you including made-to-order omelets, scrambled eggs, breakfast meats (sausage and bacon), French toast, pancakes, hot oatmeal, assorted pastries, fresh fruits, juice, coffee, and tea.

Registered companions are welcome to come to the lunch and breaks in the Exhibition Hall.

Monday, 18 July

Welcome to Spokane Companion Orientation

Spokane Representative – 9:00-10:30 am
Shades Conference Room, the DoubleTree Hotel

The city orientation takes place Monday, 18 July from 9:00 to 10:30 a.m. at the Shades Conference Room in the Doubletree Hotel. The room is just across from Shutter's Café. A representative from Visit Spokane will be on hand to describe some of the many opportunities, provide maps, and answer questions.

Be sure to consider the tour options on pages 10–12 for the HPS sponsored events.

COMMITTEE MEETINGS

Meetings take place at the Spokane Convention Center (CC) or Davenport (D)

Friday 15 July 2016

ABHP Board Meeting
8:30am – 5:00pm — Meeting Room 6 (D)

Saturday 16 July 2016

ABHP Part II Panel
8:00am – 5:00pm — Meeting Room 1 (D)

Finance Committee
8:30am – Noon — Redwood Boardroom (D)

NRRPT
8:30am – 4:30pm — Meeting Room 3 (D)

HP Journal Editorial Board
3:00pm – 5:00pm — Meeting Room 2 (D)

Sunday 17 July 2016

ABMP Written Exam
8:00am – 1:00pm — Meeting Room 11 (D)

ABHP Part II Panel
8:00am – 5:00pm — Meeting Room 1 (D)

NRRPT
8:30am – 4:30pm — Meeting Room 3 (D)

AAHP Executive Committee
8:30am – 5:00pm — Meeting Room 2 (D)

HPS Board of Directors
9:00am – 5:00pm — Birch Ballroom (D)

Program Committee Meeting
10:00am – 2:00pm — 102CD (CC)

Accelerator Section Awards Meeting
4:30pm – 6:30pm — 206A (CC)

Monday 18 July 2016

Elda Anderson Breakfast
6:45am – 8:00am — 202A (CC)

Idaho State Univ. Alumni Breakfast
7:00am – 9:00am — Meeting Room 12 (D)

ICC Welcome Breakfast for Int'l Attendees
7:30am – 8:00am — Meeting Room 1 (D)

NRRPT
8:30am – 4:30pm — Meeting Room 3 (D)

Medical HPS Board Meeting
Noon – 2:00pm — 201C (CC)

Ask the Editors Meeting
Noon – 3:00pm — 201B (CC)

Nominating Committee
1:00pm – 2:00pm — 101 (CC)

Decommissioning Section Executive Committee
1:00pm – 3:00pm — 102A (CC)

Chapter Council Meeting
1:30pm – 2:30pm — 100C (CC)

ANSI N13.65
1:30pm – 3:30pm — 202C (CC)

History Committee
2:00pm – 4:00pm — Redwood Boardroom (D)

Section Council Meeting
2:30pm – 3:30pm — 207 (CC)

Membership Committee
3:00pm – 5:00pm — 201C (CC)

Student/Mentor Reception
5:30pm – 6:30pm — Meeting Room 1 (D)

Purdue Alumni Reception
5:30pm – 7:00pm — Meeting Room 12 (D)

Tuesday 19 July 2016

Exhibitor Breakfast
8:00am – 9:00am 202BC (CC)

HPS Journal/ORS Meeting
8:00am – 9:30am 201B (CC)

ANSI N13.61
8:30am – Noon Redwood Boardroom (D)

NRRPT
8:30am – 4:30pm Meeting Room 3 (D)

N13.11 Working Group
9:00am – 1:00pm 101 (CC)

President Meeting with Committee Chairs
9:00am – 5:00pm 201C (CC)

International Collaborations Committee
Noon – 2:00pm 102A (CC)

AEC/Program Directors Meeting
Noon – 2:00pm Terrace Room West (D)

Student Support Committee
1:30pm – 2:30pm Redwood Boardroom (D)

ANSI N13.32
2:00pm – 5:00pm 101 (CC)

ANSI N13.8 – Radiation Protection in Uranium Mines meeting
2:15pm – 4:00pm 205 (CC)

ANSI N42.33
2:15pm – 4:15pm 201B (CC)

AAHP Nominating Committee
3:00pm – 4:00pm 102A (CC)

Government Relations Committee
4:00pm 102A (CC)

HPS/AAHP/AAPM/Med Section
5:45pm – 6:45pm 201B (CC)

Instrumentation Committee
7:00pm – 9:00pm Meeting Room 3 (D)

Wednesday 20 July 2016

S. Texas Chapter Breakfast
7:45am Madeleine's Cafe & Patisserie

NSI 42.17A/C Working group
8:00am – 11:00am 202B (CC)

PDS Committee
8:30am – 9:30am 201B (CC)

ANSI N13 Revision
9:00am – 5:00pm Skybridge Boardroom (D)

Science Support Committee
Noon – 2:00pm 201B (CC)

AEC/Student Branch Society Support Committee
Noon – 2:00pm Birch Ballroom (D)

Standards Committee
12:30pm – 2:30pm 101 (CC)

Continuing Education Committee
1:00pm – 2:00pm 202A (CC)

Web Operations Meeting
1:00pm – 5:00pm 102A (CC)

President Mtg with Section Presidents
1:00pm – 5:00pm 201C (CC)

Academic Education Committee
2:00pm – 4:00pm Birch Ballroom (D)

HPS Business Meeting
5:30pm – 6:30pm Conference Theater (CC)

Thursday 21 July 2016

Local Arrangements Committee
7:30am – 9:30am — Room 102B (CC)

HPS Finance & Executive Committees
8:00am – 10:00am — Redwood Boardroom (D)

ANSI N13 Revision
9:00am – 5:00pm — Skybridge Boardroom (D)

HPS BOD
11:45am – 2:15pm — Maple Ballroom (D)

HPS Program Committee
12:30pm – 2:00pm — 102CD (CC)

Friday 22 July 2016

ISO WG14
9:00am – 5:00pm — Skybridge Boardroom (D)

Saturday 23 July 2016

ISO WG14
9:00am – 5:00pm — Skybridge Boardroom (D)

Business Meetings

MONDAY

4:30 PM — Conference Theater
Decommissioning Section Business Meeting

TUESDAY

11:30 AM — 111B
Environmental Radon Section

11:45 AM — 111C
Accelerator Section

1:00 PM — 111A
Non-ionizing Radiation Section

4:30 PM — Conference Theater
AAHP

4:30 PM — 111C
AIRRS

WEDNESDAY

10:30 AM — 205
Nanotechnology Section

2:30 PM — 100C
Homeland Security

THURSDAY

Noon — 100C
Medical Section

LECTURESHIP TRUST FUNDS

Landauer Memorial Lectureship

The Landauer Memorial Lectureship was instituted in Chicago in 1971 under the auspices of Northwestern University in honor of Dr. Robert S. Landauer, a prominent radiological physicist and teacher for many years in the Chicago area. This award was funded initially by his students, friends, and family. In 1973, the Landauer Lectureship was established and sponsored by R.S. Landauer, Jr. and Co., now known as Landauer, Inc. The purpose is to honor prominent individuals who have made significant contributions to the field of radiation research and protection.

The recipient of the Landauer Lecture award will be joining a group of distinguished individuals who have been so honored in the past. A large plaque is displayed at the corporate headquarters of Landauer, Inc. commemorating all of the recipients of this award.

Dade W. Moeller Lectureship

"When you are near a fountain of knowledge, do everything possible to get thoroughly soaked."
– Dr. Dade W. Moeller

Since 2009, Dade Moeller & Associates, Inc. ("Dade Moeller") has bequeathed funds to the Health Physics Society to maintain the Dade Moeller Fund. The Fund has been established to advance Dr. Moeller's deeply held belief that continued education, sharing of knowledge, exposure to new ideas, and strong professional relationships are integral to an individual's success in his or her career. The Fund sponsors the Dade Moeller Lectureship and Scholarship Awards. The Lectureship Award enables distinguished experts to share their knowledge with our membership at society meetings.

Dr. Moeller (1927-2011) was very active in the Society, serving as New England Chapter President in 1966 and national President in 1971-1972. He served on and chaired many committees for the NRC, EPA, NCRP, ICRP, NAS, and AAEES. He was a consultant to the WHO for 15 years, and following 16 years on the NRC's Congressionally-appointed Advisory Committee on Reactor Safeguards became in 1988 the founding Chairman of the agency's Advisory Committee on Nuclear Waste, on which he served for 5 years.

Dr. Moeller is remembered for his practicality, humility, thoughtfulness, gentle nature, generosity, and humor. Despite his multitude of awards and accomplishments including induction in the National Academy of Engineering, he remained genuinely humble, always able to explain complex technical issues with uncanny clarity and simplicity. He was a leader in every sense of the word, a skilled mentor to so many, and an inspiration to the thousands of students, employees, and colleagues who knew him. He was one of those rare giants in our profession with a work ethic and moral compass worthy for all of us to emulate.

G. William Morgan Lectureship

When G. William Morgan died in 1984, he bequeathed a substantial fund to the Health Physics Society. The will requires that the fund's interest be used to have internationally known experts present papers at the Society's meetings. Michael C. O'Riordan of the United Kingdom's National Radiation Protection Board was the first international expert to be supported by the Society through the Morgan Fund. O'Riordan's presentation "Radon in Albion" was part of the Indoor Radon Session at the 1989 Albuquerque meeting.

G. William Morgan was a Charter member of the Society and during the Society's early years a very active member. Bill began his health physics career at Oak Ridge National Laboratory as part of the Manhattan Project. He later joined the Atomic Energy Commission and was instrumental in the development of the initial regulations that became part of 10 CFR Part 20. He was a great champion of education and helped establish the AEC Health Physics Fellowship Program. Bill later became very successful in the real estate business, but always retained his interest in the health physics profession. The Society's Presidents Emeritus Committee has responsibility for the selection of the international experts who will be supported by the G. William Morgan Trust Fund.

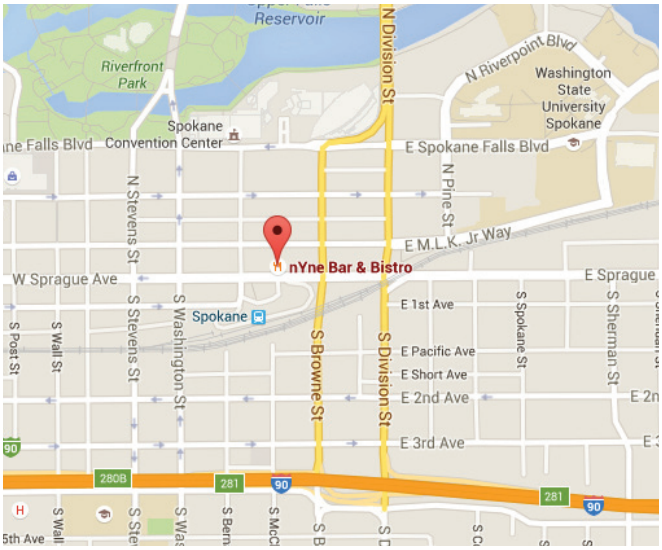
The Health Physics Society Presents

OPEN "MIKE" NIGHT

07 . 18 . 2016 @ 8:30PM

nYne Bar @ 232 W. Spokane Ave

61st ANNUAL MEETING OF HPS



SIGN UP TO PLAY AND SING OR JUST SIT BACK WITH A DRINK AND ENJOY THE AMAZING MUSICAL TALENT YOUR FRIENDS IN THE INDUSTRY HAVE TO OFFER.

THERE WILL BE BAR FOOD AND A CASH/CREDIT BAR AVAILABLE TO MAKE GETTING UP IN FRONT OF A ROOM FULL OF HEALTH PHYSICISTS FAR LESS TERRIFYING.

SPONSORED BY:

TIDEWATER INC
ENGINEERS / SCIENTISTS / PROGRAM MANAGERS

Radiation Safety Associates, Inc.

SE INTERNATIONAL

CHASE Environmental Group INC.

MIRION TECHNOLOGIES

RSCS
Radiation Safety & Control Services

FINAL SCIENTIFIC PROGRAM

Presenter's name is asterisked (*) if other than first author.

MONDAY

7:00 AM

CEL-1 Room 207
Strategies for Keeping Your Radiation Safety Program on Course in a Sea of Constant Change
Emery, R.
University of Texas School of Public Health

CEL-2 Room 206A
Five Tools for Effective Responses to Workers, the Public, and the Media
Johnson, R.
Radiation Safety Counseling Institute

CEL-3 Room 206B
Current Uses of Radiopharmaceuticals in Nuclear Medicine Therapy
Stabin, M.
Vanderbilt University

8:15 AM – Noon Room 100 AB

MAM-A: Plenary Session: The Wild and Wonderful World (Universe) of Health Physics
Chair: Nancy Kirner

8:15 AM INTRODUCTION
Nancy Kirner, HPS President

8:25 AM MAM-A.1
Regulatory Cooperation and Radiation Protection in Europe
Magnusson, S.M. (G. William Morgan Lecturer)
Icelandic Radiation Safety Authority

9:00 AM MAM-A.2
Update from the Joint Commission
Browne, A. (Robert S. Landauer Lecturer)
The Joint Commission

9:30 AM MAM-A.3
What Has Changed and What Has Not Changed: The Consequences of Remediation in Evacuation Areas Caused by the Fukushima Accident
Yoshida, H.
Tohoku University (Dade Moeller Lectureship)

10:00AM BREAK

10:30 AM MAM-A.4
Clearance of Materials from Accelerator Facilities
Rokni, S.
SLAC

10:50 AM MAM-A.5
Lessons Learned and Unlearned from the Social, Regulatory, and Political Aspects of Health Physics
Toohey, R.
M.H. Chew & Assoc.

11:15 AM MAM-A.6
The Wild and Wonderful World of Health Physics: Homeland Security Section
Lanza, J
Florida Department of Health

11:30 AM MAM-A.7
Space the Final Frontier – Research Relevant to Mars
Boice, J.
NCRP, Vanderbilt University

Noon – 1:00 PM Exhibit Hall

Complimentary Lunch in Exhibit Hall

1:00 PM – 3:00 PM Exhibit Hall

P: Poster Session

Environmental Monitoring

P.1 Radiation Safety Experience with Actinium-225 in an Academic Research Environment
Gibbons, W., Weaver, A.
University of South Florida

P.2 MARSSIM Support Features in Visual Sample Plan (VSP)
Newburn, L., Wilson, J., Fortin, D., Newburn, L.
Pacific Northwest National Laboratory

P.3 Multi-attribute Shielding Analysis Methodology Selection for Shielding Design of Varying Complexity
Woolfolk, S.
Bechtel/NS&E

P.4 A Comparison of National and International Paradigms for the Protection of Non-Human Biota
Ruedig, E., Gillis, J.
Los Alamos National Laboratory

P.5 Radiocesium Dynamics in Irrigation Ponds in the Proximity of Fukushima Dai-ichi Nuclear Generating Station
Byrnes, I., Johnson, T.*
Colorado State University, Fort Collins

P.6 Vertical Distribution of Radiocesium in Soils and Sediment Deposits on the Contaminated Areas After the Fukushima Daiichi Nuclear Power Plant Accident
Carradine, M., Johnson, T.*
Self-Employed, Colorado State University

P.7 Cesium and Plutonium Partitioning in Mammalian (Boar, macaque)
Anderson, D., Hinton, T., Johnson, T.
Colorado State University, University of Fukashima

P.8 Anthropogenic Radioistopic Distribution in Sediments
Gibson, K., Carroll, J., Adzanu, S., Ankrah, M., Han, F.
Alcorn State University, St. Catherine College, Jackson State University

P.9 Radium in Soils Collected in the Vicinity of Coal Ashpond
Harris, E., Giddings, A., Billa, J., Kanganti, S., Adzanu, S., Ankrah, M., Han, F.
Alcorn State University, St. Catherine College, Jackson State University

P.10 Evaluation of Naturally Occuring Radioactive Materials in Sediments Collected from Lower Reaches of Mississippi River
Nandi, S., Gella, U., Billa, J., Adzanu, S., Han, F., Ankrah, M.
Alcorn State University, Jackson State University, St. Catherine College

P.11 Radiation Transfer Factor in Selected Farm Products Produced around a Nuclear Plant
Burrell, C., Bailey, J., Billa, J., Ankrah, M., Han, F., Adzanu, S.
Alcorn State University, St. Catherine College, Jackson State University

P.12 Survival and Growth of Chironomus Dilutes and Hyalella Azteca in Sediment Containing Legacy 239,240Pu Downstream of Los Alamos National Laboratory
Fresquez, P., Hansen, L., Gaukler, S., McNaughton, M.
Los Alamos National Laboratory

P.13 Radiological Assessment of Organic Manures
Queen, K., Tepeh, J., Billa, J., Adzanu, S., Ankrah, M., Han, F.
Alcorn State University, St. Catherine College, Jackson State University

P.14 Gamma Spectroscopy Measurements of Soil from the Vicinity of a Mineral Sand Processing Plant in the Eastern Coast of Sri Lanka
Warnakulasuriya, T., Weerakkody, T., Williams, S., Wickremasinghe, R., Waduge, V., Ediriweera, D., Siriwardena, N.
University of Kelaniya, Sri Lanka, Atomic Energy Board, Sri Lanka

P.14.5 Concentration Ratios of 137Cs for Hydrobionts of the Techa River
Sharagin, P., Shishkina, E., Popova, I., Osipov, D., Pryakhin, E.
Urals Research Center for Radiation Medicine, Chelyabinsk

P.15 Reconstructed Mass Model Investigation of the Particulate Matter Load of the Ambient Air of a Tropical Location in Southwestern Nigeria
Akinlade, G., Olise, F., Owoade, O., Olaniyi, H., Hopke, P.
Obafemi Awolowo University, Nigeria, Clarkson University

External Dosimetry

P.16 Practical Lessons for a Dosimetry Progarm
Baca, M., Hopponnen, C.
Mirion Technologies, Inc.

Instrumentation

P.17 Minimum Detection Limits of Lead in Bone Phantoms Using a Dedicated Microbeam XRF System
Gherase, M., Freire-Gama, A.
California State University, Fresno

P.18 Obtaining the Neutron Dose Equivalent through Energy Identification of the Emitting Source's Shavano Series of Dose Meters
Scott, P., Hoshor, C., Oakes, T., Myers, E., Rogers, B., Currie, J., Young, S., Crow, J., Miller, W., Bellinger, S., Sobering, T.J., Frank, R.G., Shultis, J.K., McGregor, D.S., Hicks, D.I., Caruso, A.N.
University of Missouri - Kansas City, U2D Incorporated, University of Missouri - Columbia, Kansas State University

P.19 Theoretical Performance Analysis of a Novel Hemispherical Tissue Equivalent Proportional Counter for Neutron Monitoring and Dosimetry
Broughton, D., Orchard, G., Waker, A.
University of Ontario Institute of Technology

P.20 Impact of Sample Preparation on Radioactivity Measurement
Mensah, C., Billa, J., Adzanu, S., Atkins, M., Green, B.
Alcorn State University

P.21 Calculation of Self Attenuation Factors for Unidentified Materials by Using Numerical Simulation Method in $\hat{I}^3$-Ray Spectrometry Routine Work without Collimator
Badawi, M., Thabet, A., Elsafi, M., Gouda, M., El-Khatib, A., Abbas, M.
Alexandria University, Egypt, Pharos University in Alexandria, Egypt

Internal Dosimetry

P.22 Using a Graphical User Interface When Running Multiple Monte Carlo Simulations
Graham, H., Waller, E.
University of Ontario Institute of Technology

P.23 Assessment of Dose and the Occupational Suitability in Case of Single Emergency Ingestion Intake of 137Cs
Korneva, E., Gantsovsky, P., Granovskaya, E., Kasymova, O., Kretov, A., Kukhta, B., Podvarko, I., Tsovyanov, A., Yatsenko, V.
State Research Center – Burnasyan Federal Medical Biophysical Center of Federal Medical Biological Agency

P.24 Estimation of Dietary Intake of Strontium-90 in Six Regions in Japan after the Fukushima Daiichi Nuclear Power Plant Accident
Nabeshi, H., Tsutsumi, T., Uekusa, Y., Hachisuka, A., Matsuda, R., Akiyama, H., Teshima, R.
NIHS

Medical Health Physics

P.25 Compact DD Generator based in Vivo Neutron Activation Analysis (IVNAA) System to Determine Sodium and Calcium Concentrations in Human Bone
Coyne, M., Liu, Y., Zhang , X., Nie, L.
Purdue University

P.26 Radiation Safety Aspects of MIBG Patient Treatments
Harvey, B.
MD Anderson Cancer Center

Radiation Effects

P.27 Voxel Phantom Model of Beehive for Determining the Acceptable Dose Levels of Bees and Bee Larvae
Junwei, J.
Oregon State University

P.28 The Radiation Carcinogenesis Paradox
Raabe, O.
University of California, Davis

P.29 Graphical User Interface for Simplified Transport Calculations
Schwarz, R.
Visual Editor Consultants

P.30 Database of Mayak Workers' Families and Their First-, Second- and Third-Generation Offspring: Establishment Principles and Potential Application
Azizova , T., Zhuntova , G., Rusinova , G., Korneva , D.
Southern Urals Biophysics Institute

P.31 Zooplankton of the Radioactively Contaminated Lake Karachay
Osipova, O., Osipov, D., Pryakhin, E.
Urals Research Center for Radiation Medicine, Chelyabinsk, Russia

P.32 Characteristics of Zoobenthos in the Reservoir-17
Peretykin, A., Deryabina, L., Pryakhin, E.
Urals Research Center for Radiation Medicine, Chelyabinsk, Russia, Chelyabinsk State University, Russia

Radiation Bioassay

P.33 Quantifying Biomarkers in Wildlife Exposed to Low Doses of Environmental Radiation
Halim, N., Bailey, S., Johnson, T., Hinton, T.
Colorado State University, Fukushima University

P.34 Electron Spin Resonance of Plutonium and Cesium in Mammalian Wildlife near Fukushima Daiichi Nuclear Power Plant
Heard, J., Hinton, T., Johnson, T.
Colorado State University, Fukushima University

Risk Assessment

P.35 Radiation Dose Estimation of Sand Samples Collected from Selected Public Beaches in Texas
Brempong, O., Oloko, O., Tsorxe, I., Billa, J., Han, F., Ankrah, M., Adzanu, S.
Alcorn State University, Texas A and M, College Station, Jackson State University, St. Catherine College

P.36 Radiological Implication of Locally Produced Construction Materials
Dimpah, J., Norwood, A., Billa, J., Adzanu, S.
Alcorn State University

P.37 HDF5 as a Good Way to Store Large and Complex Scientific Data
Yurkin, A.
Soutern Urals Biophysics Institute, Russia

Works-In-Progress

P.38 Dynamic Modeling of Cesium in an Eutrophic Lake through Deterministic and Stochastic Methods
Miller, V., Jeong, H., Johnson, T., Pinder, J.
Colorado State University

P.39 NRC's Implementation of Its Jurisdiction over the Remediation of Military Radium
Chang, R.
USNRC, Jackson, T*, USNRC

P.40 Alpha Air Sample Counting Efficiency Versus Dust Loading: Evaluation of a Large Data Set
Hogue, M., Slack, T., Smiley, J., Owensby, B., Gause-Lott, S.
SRNS

P.41 The Uptake and Translocation of Tc, I, Cs, Np and U into Andropogon Virginicus
Montgomery, D., Edayilam, N., Tharayil, N., Martinez, N., Powell, B.
Clemson University

P.42 Survival Guidelines for Journalists Reporting on Significant Radiation Incidents
MacKenzie, C.
University of California, Berkeley

P.43 Assessing the Use of Photon Fluence Calculations for Simple and Reasonable Dose Estimations in an Industrial Radiation Accident in Nanjing, China
Steiner, J., Donahue, W., DiTusa, R., Wang, W., Yu, N., Jia, G.
Louisiana State University, Institute of Radiation Protection - Nanjing

P.44 Direct Surface Contamination Measurement of Low Energy Beta and Electron Capture Isotopes
Iwatschenko-Borho, .M, Loew, R.
Thermo Fisher Scientific Messtechnik GmbH

P.45 Methodology for Calculating External Dose Coefficients for Multiple Exposure Geometries for Improvised Nuclear Device Radionuclides
Chamber, S., Wang, C., LePoire, D., Yu, C., Favret, D.
Argonne National Laboratory, US Department of Energy

P.46 Modeling Submerged Contamination Source in RESRAD-OFFSITE
Gnanapragasam, E., Yu*, C., Favret, D.

P.47 Reassessment of Empirical Resuspension Factors Following Radionuclide Release
Marshall, S., Medich, D., Potter, C.
Worcester Polytechnic Institute, Sandia National Laboratories

1:00 PM — Room 100 C

MPM-A: Special Session: Updating NCRP's General Recommendations

Co-Chairs: Ken Kase, John Boice

1:00 PM MPM-A.1
Principles and Ethics of the System of Protection
Cool, D., Boyd, M.
Electric Power Research Institute, US EPA

1:30 PM MPM-A.2
The Next NCRP Recommendations for Radiation Protection in the U.S.: An Overview
Kase, K.
NCRP

2:00 PM MPM-A.3
Appropriate Use of Effective Dose in Radiation Protection and Risk Assessment
Fisher, D., Fahey, F.
Dade Moeller Health Group, Children's Hospital Boston

2:30 PM MPM-A.4
Engaging Stakeholders & Communicating the System of Protection
Irwin, W., Ansari, A., Hyer, R., Till, J.
Vermont Dept of Health, Centers for Disease Control, Center for Risk Communication, Risk Communication Corporation

3:00 PM BREAK

3:30 PM MPM-A.5
Protection of the Environment
Higley, K.
Oregon State University

4:00 PM MPM-A.6
Tissue Reactions Following Radiation Exposure
Woloschak, G.
Northwestern University

4:30 PM Panel Discussion

3:00 PM Room 111 A

MPM-B: Special Session: HPS Wants Your Vision for Future Meetings

Chair: Elizabeth Brackett

Round Table Discussion on the Future of HPS Meetings
Brackett, E., Braun, J., Kirkham, T., Lewandowski, M., Mahathy, J., McFee, M., Wilson IV, C.
MJW Companies, Mayo Clinic, RTI, International, 3M, ORAU, Louisiana State University

3:15 PM Room 111 B

MPM-C1: Radiobiology/Biological Response

Chair: Grady Calhoun

3:15 PM MPM-C1.1
A Review of the Effect of Dose and Dose Rate on Various Aspects of Plant Life
Gladfelder, G., Higley, K.
Oregon State University

3:30 PM MPM-C1.3
Dose Rate Effect on Double-Stranded DNA Damage and Repair in Mammalian Cells Exposed to Low-LET IR.
Ozerov, I., Tsvetkova, A., Grekhova, A., Pustovalova, M., Osipov, A.
State Research Center – Burnasyan Federal Medical Biophysical Center of Federal Medical Biological Agency (SRC-FMBC), Moscow, Russia

3:45 PM MPM-C1.4
Candidate Biomarkers of Radiation Response in Plasma of Metastatic Melanoma Patients
Sproull, M., Tandle, A., Kramp, T., Shankavaram, U., Rosenberg, S., Citrin, D., Camphausen, K.
National Institutes of Health/National Cancer Institute

4:00 PM Room 111 B

MPM-C2: Radiation Effects

Co-Chairs: Otto Raabe, Lavon Rutherford

4:00 PM MPM-C2.1
The 2016 Annual Conference of the Canadian Radiation Protection Association
Shonka, J.
Shonka Research Associates

4:15 PM MPM-C2.2
Concerning Ionizing Radiation-Induced Cancer from Internally-Deposited Radionuclides
Raabe, O.
University of California, Davis

4:30 PM MPM-C2.3
Integrated Spatial and Temporal Stochastic Model for Radiation Biology: Design and Application
Liu, R., Higley, K.
Oregon State University

4:45 PM MPM-C2.4
Clinical Features of Subacute Radiation Syndrome
Krasnyuk, V., Ustyugova, A.*
Burnasyan FMBC of FMBA of Russia, Moscow, Russia

3:00 PM — Room 111 C

MPM-D: Academic
Co-Chairs: Kim Kearfott, Charles Wilson

3:00 PM — MPM-D.1
Seventeen Seventy and Eighteen Seventy Seven: Numbers and Intercultural Radiation Risk Communication
Kearfott, K., LaGarry, H.
University of Michigan, Oglala Lakota College

3:15 PM — MPM-D.2
Radiation in Pop Culture
Wilson, C., DiGregorio, T., Wang, W.
Center for Energy Studies, Louisiana State University, Texas A&M Nuclear Engineering Department

3:30 PM — MPM-D.3
LNT and ALARA: An Invitation to Frivolous Litigation
Fellman, A.
Dade Moeller, an NV5 Company

3:45 PM — MPM-D.4
My Biggest Mistakes and My Greatest Lessons
Ford, M.
Ford ES&H Solutions, LLC

4:00 PM — MPM-D.5
Mobile Radiation Detection Security Sweeps as Teaching Tool
Marianno, C., Falkner, J.*, Jacob-Hood, T., Trevino, J., Dromgoole, L., Shah, M., Boyd, M., Emory, G., Murchison, D.
Texas A&M University

4:15 PM — MPM-D.6
Risk Assessment and Radiation Safety Climate in a University Setting
Root, C., Sinclair, R., Povod, K., Martinez, N.
Clemson University

4:30 PM — MPM-D.7
Radiation Shielding in the Future
Waite, D.
Retired

3:00 PM — Conference Theatre

MPM-E: Decommissioning & Decontamination
Chair: Ray Johnson

3:00 PM — MPM-E.1
How Clean is Clean? The Psychology of Decontamination
Johnson, R.
Radiation Safety Counseling Institute

3:15 PM — MPM-E.2
Radiation Protection at U.S. Department of Energy Clean-up Sites
Anderson, A.
U.S. Department of Energy

3:30 PM — MPM-E.3
Rad Decon App - A Decision Support Tool for Selecting Radiation Decontamination Technologies Following a Large-Scale Radiological/Nuclear Incident
Cardarelli II, J., Carney, D.
US EPA, CSS Dynamac

3:45 PM — MPM-E.4
Decommissioning an Oil and Gas Waste Water Treatment Facility with Known Impacts from Naturally Occurring Radioactive Material
Weddermann, C., Lopez, A.
Amec Foster Wheeler

4:00 PM — MPM-E.5
The University of Rochester and Challenges to the Environment from Historical Research
Mis, F.
University of Rochester

4:15 PM — MPM-E.6
Oak Ridge Gaseous Diffusion Plant Deactivation and Demolition - A Summary of Lessons Learned
Long, M.
URS|CH2M

4:30 PM — Decommissioning Business Meeting

3:00 PM Room 207

MPM-F: Instrumentation
Chair: Alex Boerner

3:00 PM MPM-F.1
Advancements in Radon Detection and Spectrometry Using Tensioned Metastable Fluid Detectors
Boyle, N., Archambault, B., Taleyarkhan, R.
Purdue University, Sagamore Adams Labs LLC

3:15 PM MPM-F.2
Penetrating Heavy Charged Particle Dose Measurements Are Invariant with Angle of Incidence
Bahadori, A., Kroupa, M.
Kansas State University, Lockheed Martin

3:30 PM MPM-F.3
Electret Ion Chamber System for Survey Measurements of Pulsed Radiography X-Ray Unit
Paulus, L., Brown, R., Gomez, J., Walter, J., Zubiate, X.
Sandia National Laboratories

3:45 PM MPM-F.4
Response Characterization of 11 cm x 42.5 cm x 5.5 cm NaI(Tl) Detectors
Sulieman, N., Seow, C., Cao, S., Frank, S., Boria, A., Calma, J., Kuznetsov, D., Lynch, R., Liu, K., Kearfott, K.
University of Michigan

4:00 PM MPM-F.5
Characterization of Dose Rate Discrepancies Between Energy Compensated Geiger Mueller Tubes and Pressurized Ionization Chambers Due to Cosmic Radiation
Gift, M., Rademacher, S.
Colorado State University, United States Air Force

4:15 PM MPM-F.6
Low Pressure Proportional Counter Responses in Accelerator-Based High Altitude Neutron Fields
Orchard, G., Waker, A.
University of Ontario Institute of Technology

4:30 PM MPM-F.7
Do You Trust Your Radiation Measurements?
Johnson, R.
Radiation Safety Counseling Institute

3:00 PM Room 205

MPM-G: Power Reactors/Waste Management
Chair: Barbara Fisher

3:00 PM MPM-G.1
Case Studies of Spent Nuclear Fuel Pool Leaks
Fisher, B.
Illinois Institute of Technology

3:15 PM MPM-G.2
Activated Corrosion Source Term Characterization and Their Dose Assessment During the Outage of China's NPPs
Liu, L., Cao, Q., Wang, C., Xu, H., Wang, K., Li, Z.
China Institute for Radiation Protection, CNNC – Nuclear Power Operations Management Co., JiangSu Nuclear Power Co.

3:30 PM MPM-G.3
Radiological Conditions Generated by a Defective Fuel Rod
Hanni, J.
Duke Energy

3:45 PM MPM-G.4
Managing Noble Gas Release During Reactor Vessel Head Removal After Operating with a Defective Fuel Rod
Hanni, J.
Duke Energy

4:00 PM MPM-G.5
Braidwood Groundwater Tritium: Assessing Abnormal Plant Discharges from Leaking Plant Structures
Lake, I.
ChemStaff/Illinois Institute of Technology

4:15 PM MPM-G.6
Discussions on Radiation Protection Design under Accident Condition of China Pressurized Water Reactor Power Plant
Wang, X., Mi, A., Mao, Y.
China Nuclear Power Engineering Co.,Ltd, Beijing

NORM/TENORM

HPS INDUSTRY DAY 2016 Sponsored by Dade Moeller An NV5 Company

A one-day event held as part of the **Health Physics Society Annual Meeting** for those interested or involved in NORM/TENORM issues, notably in mining and oil & gas industries.

Schedule of Events

7:00–8:00	**Continuing Education Lecture**
	NORM/TENORM: History + Science + Common Sense = ???
8:15–8:30	**Welcome**
8:30–9:30	**Understanding the Basics**
	What Is Radiation and How Is It Detected?
	What Is NORM/TENORM?
9:30–10:00	**Coffee Break**
10:00–12:00	**Oral Presentation Session**
	Uranium Mining and NORM: A North American Perspective
	NORM Safety for Oilfield Workers
	NORM Radiation Protection for Alum Production and Storage
	TENORM Waste Streams in the Oil and Gas Sector
	Baseline Surveys, Environmental Monitoring, and Assessment for TENORM Facilities
12:00	**Complimentary Buffet Lunch**
12:00–3:00	**Free Time: Poster Session, Demonstrations, Exhibits**
3:00–3:30	**Coffee Break**
3:30–4:30	**Panel Discussion**
	Featuring representatives from EPA, CRCPD, US Ecology, and Radiation Safety Counseling Institute
4:30–5:00	**Closing**
5:00	**Happy Hour**

With increased demand for oil and natural gas, newer technologies based on horizontal drilling and hydraulic fracturing have been deployed in several regions across the United States. Application of these technologies creates potential radiation exposures from NORM/TENORM, environmental protection concerns, and waste management issues. According to the U.S. EPA, each year the petroleum industry generates about 150,000 cubic meters of waste including produced water, scales, sludge, and equipment that potentially contains NORM/TENORM.

The purpose of Industry Day is to provide a forum for individuals and organizations wanting to know more about potential radiation issues in industries with NORM/TENORM. Our goal is to promote the exchange of information among involved stakeholders including state agencies, affected industries and their workers, the general public, and other interested groups.

All Health Physics Society Annual Meeting attendees are welcome to attend, entrance is included as part of the meeting!

Dade Moeller®
An NV5 Company

TUESDAY

7:00 AM

CEL-4 Room 207
NORM/TENORM:
History + Science + Common Sense = ???
Kennedy, Jr., W.
Dade Moeller, an NV5 Company

CEL-5 Room 206A
Herbert M. Parker (1910-1984): Laying the Foundations of Medical and Health Physics
Kathren, R.
Washington State University at Tri-cities, Richland

CEL-6 Room 206B
Channeling Richard Feynman: How Lessons from the Great 20th Century Physicist Can Inform and Inspire Great Health Physics in the 21st Century
Hoover, M.
National Institute for Occupational Safety and Health

8:30 AM Room 100 C

TAM-A: Special Session: USTUR: Five Decade Follow-up of Plutonium and Uranium Workers
Chair: Patricia R. Worthington

8:30 AM TAM-A.1
KEYNOTE
The USTUR: Where We Have Been and Where We Are Going
Kathren, R.
Washington State University at Tri-cities

9:15 AM TAM-A.2
KEYNOTE
The Atomic Man: Case Study of the Largest Recorded 241Am Deposition in a Human
Carbaugh, E.
Dade Moeller, an NV5 Company

10:00 AM BREAK IN EXHIBIT HALL

9:30 AM Exhibit Hall

PID: Poster Session: Industry Day

PID.1 Performance Assessment Modeling for NORM/TENORM Disposal
Kennedy, Jr., W.
Dade Moeller, an NV5 Company

PID.2 Measurement of RN-222 Alpha Decay from Barite Pipe Scale
Thompson, D.
Sulas Radiation Safety Consultants, LLC

PID.3 Survey and Disposition of NORM-Containing Refractory Brick
Ikenberry, T.
Dade Moeller, an NV5 Company

PID.4 Radium Gamma-Ray Signatures through Pipe-Walls
McNeil, W.
Kansas State University

PID.5 The US Abandoned Uranium Mines Project
Manglass, L., Townsend, A., Liles, D.
Arcadis

PID.6 The Top 10 Things Oil Producers Need to Know About Technologically Enhanced Naturally Occurring Radioactive Material
Rhea, G.
SECURE Energy Services

10:30 AM Room 100 C

TAM-A1: Technical Session I:
USTUR Internal Research
Co-Chairs: Carol Iddins, Dunstana Melo

10:30 AM TAM-A1.1
Estimation of Actinide Skeletal Content from a Single Bone Analysis
Tolmachev, S., Kathren, R.
USTUR, Washington State University

10:45 AM TAM-A1.2
Updating ICRP 70 Skeleton Weight vs. Body Height Equation
Avtandilashvili, M., Tolmachev, S.
USTUR, Washington State University

11:00 AM TAM-A1.3
USTUR Case 0785: Modeling Pu Decorporation Following Complex Exposure
Dumit, S., Avtandilashvili, M., Breustedt, B., Tolmachev, S.
USTUR, Washington State University, Karlsruhe Institute of Technology

11:15 AM TAM-A1.4
Digital Autoradiography of Am-241 Spatial Distribution within Trabecular Bone Regions
Tabatadze, G., Miller, B., Tolmachev, S.
USTUR, Washington State University, Pacific Northwest National Laboratory, University of Arizona

11:30 AM TAM-A1.5
Reanalysis of Radiation and Mesothelioma in the U.S. Transuranium and Uranium Registries
Zhou, J., McComish, S., Tolmachev, S.
U.S. Department of Energy, USTUR, Washington State University

8:15 AM Room 111 A

TAM-B: Special Session: Sealed Source D&D

Chair: John Hageman

8:15 AM TAM-B.1
Realistic Adaptive Interactive Learning System (RAILS): Achieving Search and Secure Program Sustainability through E-Learning
Uhrig, K., Winso, J., Taplin, T., Kahn, R., McRee, B., Miller, R.
MELE Associates/DOE-NNSA, Spectral Labs Incorporated, DOE-NNSA, ANL, PNNL-DOE, SNL

8:30 AM TAM-B.2
Recommendations for Improving the Management and Disposition of Disused Sources
Robertson, G., Lovinger, T.
Disused Sources Working Group/Low-Level Radioactive Waste Forum

8:45 AM TAM-B.3
Update on Current Activities of the Off-site Source Recovery Program and Coping with the Extended WIPP Closure
Feldman, A., Manzanares, L., Drypolcher, K.
Los Alamos National Laboratory

9:00 AM TAM-B.4
National Nuclear Security Administration and the Off-Site Source Recovery Project Domestic Recovery Lessons Learned
Rasmussen, R.
Los Alamos National Laboratory

9:15 AM TAM-B.5
Summary of the IAEA Report on Decommissioning of Irradiators and Management of Associated Radioactive Sources
Hageman, J., Benitez-Navarro, J.
SW Research Inst, IAEA

9:30 AM BREAK IN EXHIBIT HALL

10:00 AM TAM-B.6
Utilization of the International Isotopes Inc. Mobile Hot Cell to Support the Recovery and Disposition of Disused Sources
Miller, J.
International Isotopes Inc.

10:15 AM TAM-B.7
IAEA Assisted Source Consolidation of Cat 3-5 Nuclear Gauges
Tompkins, A., Benitez-Navarro, J.
IAEA

10:30 AM TAM-B.8
Transportation Challenges for Shipping Sealed Radioactive Sources
Zarling, J., Stewart, W., Taplin, T.
Idaho National Laboratory, Los Alamos National Laboratory, National Nuclear Security Administration

10:45 AM TAM-B.9
Disposal of High Activity Sealed Sources Under the Revised Concentration Averaging Branch Technical Position
Stewart, W., Martin, D.
Los Alamos National Laboratory, Energetics Inc.

11:00 AM TAM-B.10
The Source Collection and Threat Reduction Program: A Summary of Experience with the Commercial Disposal of Sealed Radioactive Sources
Meyer, C., McBurney, R., Rogers, A.
Conference of Radiation Control Program Directors

11:15 AM TAM-B.11
Options of Disposal of Sealed Sources at WCS Disposal Facilities
Kirk, S.
Waste Control Specialists LLC

11:30 AM TAM-B.12
Sealed Source Disposal
Rogers, V.
EnergySolutions

11:45 AM TAM-B.13
Update on IAEA Report on Management of Disused Depleted Uranium (DU) Used for Radiation Shielding
Hageman, J., Benitez-Navarro, J.
SW Research Inst, IAEA

8:30 AM Room 111 B

TAM-C: Special Session: Environmental Radon
Chair: Matthew Barnett

8:30 AM TAM-C.1
Environmental Radiation Dosimetry for the Techa River Population
Napier, B., Degteva, M.
PNNL, Urals Research Center for Radiation Medicine

9:00 AM TAM-C.2
Monitoring and Displaying Radon Measurements in Washington
Brennan, M., Echeverria, T.
Washington Office of Radiation Protection, Washington Department of Health

9:15 AM TAM-C.3
A Comparison of $11CO_2$ And 85Kr as Calibration Gases for a Beta-Detecting Stack Monitor for Pet Manufacturing Facilities
Krueger, D., Moroney, W., Plastini, F., Parkin, J.
Siemens Molecular Imaging, Ultra Electronics Nuclear Control systems

9:30 AM TAM-C.4
Evaluation of an Upward Trend in Background Counts from a Stack Continuous Air Monitor
Barnett, J., Rishel, J.*
PNNL

9:45 AM BREAK IN EXHIBIT HALL

10:15 AM TAM-C.5
The WIPP Radiological Release Effluent Correlations
Hayes, R.
North Carolina State University

10:30 AM TAM-C.6
Open Sites with Radiocesium Contaminated Soil: Evaluating Dose Rates and Remediation Strategies
Malins, A., Kurikami, H., Nakama, S., Machida, M., Kitamura, A.
Japan Atomic Energy Agency

11:00 AM TAM-C.7
Darlington Newbuild Environmental Assessment – An Overview
Chambers, D.
Arcadis

11:30 AM Environmental Radon Business Meeting

9:30 AM Room 111 C

TAM-D: Special Session: Accelerator
Chair: Elaine Marshall

9:30 AM TAM-D.1
High Power Beam Dump Hydrogen Detection Technology
May, R., Fanning, H., Gonzales, R.
Jefferson Lab

9:45 AM TAM-D.2
Shielding Analysis for a New High Power Electron Accelerator at the Idaho State University Idaho Accelerator Center
Kadiri, A., Harris, J.
Idaho State, Purdue University

10:00 AM TAM-D.3
Development of a Laser-Induced Ionizing Radiation Dose Yield Model at SLAC for High-Intensity Short-Pulse Laser Facilities
Liang, T., Bauer, J., Liu, J., Rokni, S.
SLAC National Accelerator Laboratory, Georgia Institute of Technology

10:15 AM BREAK IN EXHIBIT HALL

10:45 AM TAM-D.4
Design of Radiation Safety Systems for LCLS-II Accelerator at SLAC
Rokni, S., Blaha, J., Liu, J., Mao, S., Nicolas, L., Santana, M., Xiao, S.
SLAC National Accelerator Laboratory

11:00 AM TAM-D.5
Activation and Shielding Analyses for China ADS Research Facility
Luo, P.
Institute of Modern Physics, CAS

11:15 AM TAM-D.6
Decommissioning and Repurposing of LLNL's B865 Legacy Accelerator Facility
Castro, M.
Institute of Modern Physics, CAS

11:45 AM Business Meeting

8:30 AM Conference Theatre

TAM-E: Special Session: AAHP – Nuclear Weapons – Present and Past Hazards, Part I

Co-chairs: Robert Miltenberger, Charles "Gus" Potter

8:30 AM TAM-E.1
Nuclear Weapon Basics
Walker, S.
Sandia National Laboratories

9:15 AM TAM-E.2
Prompt Effects from Nuclear Detonation
Potter, C.
Sandia National Laboratories

10:00 AM BREAK

10:30 AM TAM-E.3
Fallout from a Nuclear Detonation, Delayed Effects and Shelter Opportunities
Buddemier, B.
LLNL

11:15 AM TAM-E.4
Health Impacts from Nuclear Weapon Effects in Modern Urban Environments
Stricklin, D., Wentz, J., Millage, K., Dant, T., Kramer, K., Blake, P.
ARA, DTRA

Again this Year!

Tuesday, 10:00-11:30 am, 206A

Workshop: Publishing in Health Physics and Operational Radiation Safety

Speakers: Mike Ryan, Deanna Baker, Craig Little, MaryGene Ryan

A workshop geared towards first-time authors who are interested in publishing but are uncertain of the process. There will be a tutorial as well as presentations from both editors in chief. This workshop will answer many questions regarding the flow of a manuscript from submission to publication. This is also a good refresher for authors who have already published with HPJ or ORS but would like to have a better understanding of the process.

HPS Awards Banquet

Spend an enjoyable evening with members of the Health Physics Society. This event will be held on Tuesday, 19 July, in the Davenport Grand Hotel, and is an excellent opportunity to show your support for the award recipients as well as the Society. The awards will be presented after the dinner and the event will last from 7:00-9:00 pm. Included in Member, Non-Member, Emeritus, Past President, and Student Registrations.

9:30 AM — Exhibit Hall B

TAM-F: Interactive Session: Industry Day
Chair: Bill Kennedy

Egidi, P.
USEPA

8:30 AM — Room 205

TAM-G: NORM/TENORM Industry Day
Co-Chairs: Tracy Ikenberry, Alan Fellman

8:15 AM
Introduction

8:30 AM TAM-G.1
What Is Radiation and How Is It Detected?
Kennedy, W.
Dade Moeller, an NV5 Company

9:00 AM TAM-G.2
What Is NORM/TENORM?
Fellman, A.
Dade Moeller, an NV5 Company

9:30 AM BREAK IN EXHIBIT HALL

10:00 AM TAM-G.3
Uranium Mining and NORM, a North American Perspective
Brown, S., Chambers, D.
SHB Inc, Arcadis Canada

10:20 AM TAM-G.4
NORM Safety for Oilfield Workers
Johnson, R.
Radiation Safety Counseling Institute

10:40 AM TAM-G.5
NORM Radiation Protection for Alum Production and Storage
Ikenberry, T., Arana, J.
Dade Moeller, an NV5 Company

11:20 AM TAM-G.4
Technologically Enhanced Naturally Occurring Radioactive Material Waste Streams in the Oil and Gas Sector
Rhea, G.
SECURE Energy Services

11:40 AM TAM-G.5
Baseline Surveys, Environmental Monitoring and Assessment for TENORM Facilities.

2:30 PM Room 100 C

TPM-A: Technical Session II: USTUR Collaborative Research

Co-chairs: Isaf Al-Nabulsi, Ray Guilmette

2:30 PM TPM-A.1
Red Marrow Dosimetry for Former Radium Workers
Toohey, R., Goans, R., Iddins, C., Dainiak, N., McComish, S., Tolmachev, S.
M.H. Chew & Assoc., MJW Corp., ORISE, USTUR

2:45 PM TPM-A.2
The Pseudo Pelger-Huet Cell as a Retrospective Dosimeter: Analysis of a Radium Dial Painter Cohort
Goans, R., Toohey, R., Iddins, C., Daniak, N., McComish, S., Tolmachev, S.
MJW Corporation, M.H. Chew and Associates, ORISE, USTUR

3:00 PM TPM-A.3
EURADOS Intercomparison on Measurements of Am-241 in 3 Skull Phantoms
Lopez, M., Nogueira, P., Vrba, T.
Ciemat, Spain, Hmgu, Germany, Ctu-Prague, Czech Rep.

3:15 PM BREAK IN EXHIBIT HALL

3:45 PM TPM-A.4
The Importance of Plutonium Binding in Human Lungs
Birchall, A., Puncher, M., Tolmachev, S.
Global Dosimetry Ltd. , UK., Public Health England, UK, USTUR, Washington State University

4:00 PM TPM-A.5
USTUR Case 0846: Modeling Americium Biokinetics after Intensive Decorporation Therapy
Breustedt, B., Avtandilashvili, M., McComish, S., Tolmachev, S.
KIT, Karlsruhe Institute of Technolgoy, USTUR, Washington State University

4:15 PM Roundtable Discussion with USTUR Former Directors

4:45 PM Roundtable Open Discussion

2:30 PM Room 111 A

TPM-B: Special Session: Future Challenges

Co-Chairs: Jeff Chapman, Nolan Hertel

2:30 PM TPM-B.1
Future Challenges for Undergraduate Health Physics Programs
Jokisch, D.
Francis Marion University, Oak Ridge National Laboratory

2:50 PM TPM-B.2
Future Challenges for Graduate Health Physics Programs
Higley, K.
Oregon State University

3:10 PM TPM-B.3
Future Challenges in Computational Radiation Dosimetry - How Precise Do We Need to Get?
Hiller, M., Dewji, S.
Oak Ridge National Laboratory

3:50 PM TPM-B.5
Challenges for Next Generation Health Physicists in the Public Health Arena – An Epidemic of Academic Proportion
Finklea, L.
Centers for Disease Control and Prevention

4:10 PM TPM-B.6
Future Challenges in Operational Health Physics at National Laboratories
Bliss, J.
LANL

4:30 PM BREAK iN EXHIBIT HALL

4:50 PM TPM-B.8
Future Challenges in University Radiation Protection
Samuels, C., Tabor, C.
Georgia Institute of Technology

5:10 PM TPM-B.9
Re-building Society Membership
Brodsky, A.
Georgetown University

2:30 PM Room 111 B

TPM-C: Special Session: NESHAPS/RADAIR
Chair: Matthew Bennett

2:30 PM TPM-C.1
U.S. Department of Energy NESHAPS Subpart H Report
Ostrowski, C., Snyder, S.*
U.S. DOE, PNNL

2:45 PM TPM-C.2
U.S. Environmental Protection Agency Update on 40 CFR 61, Subpart H Radioactive Air Emissions
Rosnick, R., Egidi, P.*
EPA-HQ

3:00 PM TPM-C.3
Update on Standards, Guides and Directives for Monitoring Radioactive Air Emissions
Glissmeyer, J., Blunt, B.
PNL

3:15 PM TPM-C.4
Does CAP-88 Underestimate the Gamma Dose from an Overhead Plume?
McNaughton, M., Gillis, J.*, Ruedig, E., Whicker, J., Fuehne, D.
Los Alamos National Laboratory

3:30 PM TPM-C.5
Dose Comparisons for a Site-Specific Reference Person Using the Age-Dependent Dose Factors in CAP88 PC Version 4
Jannik, G., Moore, K., Dixon, K., Stone, D., Newton, J.
Savannah River National Laboratory, Augusta University

3:45 PM BREAK IN EXHIBIT HALL

4:15 PM TPM-C.6
Deposition Calculator Revision
Blunt, B.
Blunt Consulting LLC

4:30 PM TPM-C.7
Oak Ridge Reservation Environmental Protection RadNeshaps Source and Dose Databases and Rad Inventory Web Database
Scofield, P., Smith, L.
Oak Ridge National Laboratory

4:45 PM TPM-C.8
Modeling Considerations for Ingestion Pathway Dose Calculations Using CAP88
Stuenkel, D.
Trinity Engineering Associates

5:00 PM TPM-C.9
Modification in Applying Appendix D of 40 CFR Part 61 to Heated Radionuclide Solid Materials with High Melting and Boiling Points
Smith, L.
Oak Ridge National Laboratory

2:30 PM Room 111 C

TPM-D: Special Session: AIRRS
Chair: Kendall Berry

2:30 PM Session Presentations

4:30 PM AIRRS Business Meeting

2:30 PM Conference Theatre

TPM-E: Special Session: AAHP – Nuclear Weapons – Present and Past Hazards, Part 2
Co-Chairs: Robert Miltenberger, Charles "Gus" Potter

2:30 PM TPM-E.1
Fallout: You Can Take It to the Bank
Brooks, A., Church , B.
Washington State University, BWC Enterprises Inc

3:15 PM TPM-E.2
Internal and External Dosimetry of the Early Nuclear Weapons Workers
Brackett, E., Smith, M.
MJW Corporation, Dade Moeller, an NV5 Company

4:00 PM BREAK IN EXHIBIT HALL

4:15 PM TPM-E.3
Nuclear Weapons Worker Compensation Energy Employees Occupational Illness Compensation Program Act
Kotsch, J.
U.S. Department of Labor

4:30 PM AAHP Business Meeting

2:30 PM Exhibit Hall B

TPM-F: Interactive Session: Industry Day
Chair: Bill Kennedy

WEDNESDAY

7:00 AM

CEL-7 Room 207
Twelve Barriers to Effective Radiation Risk Communication
Johnson, R.
Radiation Safety Counseling Institute

CEL-8 Room 206A
Overview of Federal Resources Available for Response to a Radiological/Nuclear Accident or Incident
Groves, K.
FHPS

8:30 AM Room 100 C

WAM-A: Special Session: Homeland Security
Co-Chairs: John Lanza, Doug Draper

8:30 AM WAM-A.1
Federal Agency Response to Radiological Accidents/ Incidents
Groves, K.
FHPS

9:00 AM WAM-A.2
The National Alliance for Radiation Readiness (NARR): Activities Update Since Fukushima
Lanza, J.
Florida Dept. of Health

9:30 AM WAM-A.3
DOE Overview of Actions Resulting from the Fukushima Accident
Blumenthal, D.
DOE/NNSA

10:00 AM BREAK

11:00 AM WAM-A.5
Enhancing Response Capabilities for Radiological Emergencies Post Fukushima 'The States' Perspective
Mulligan, P., Irwin, B.
Conference of Radiation Control Program Directors

11:30 AM WAM-A.6
EPA PAG Revisions Considering Fukushima
Decair, S.
USEPA, ORIA

8:30 AM Room 111 A

WAM-B: External Dosimetry
Co-Chairs: Tim Taulbee, Alexander Brandl

8:30 AM WAM-B.1
Dosimeter Archeology
Kirr, M., Passmore, C., Koperski, B., Moscatel, M., Zhang, R.
Landauer, Inc

8:45 AM WAM-B.2
Improvements in Radiation Monitoring Trending
Passmore, C., Kirr, M., Murthy, S., Harbison, L.
Landauer, Inc

9:00 AM WAM-B.3
Back to Basics: the Optically Stimulated Luminescence (OSL) External Dosimetry Program at PNNL
Jones, R., Pierson, R.
Columbia Chapter, Richland

9:15 AM WAM-B.4
Design of an Affordable Modular Optically Stimulated Luminescence Dosimetry System for the Investigation of New Dosimetric Materials
Frank, S., Kearfott, K.
University of Michigan

9:30 AM BREAK IN EXHIBIT HALL

10:00 AM WAM-B.5
Design of an Affordable and Efficient Optically Stimulated Luminescent (OSL) Annealer
Abraham, S., Frank, S., Rucinski, B., Dawson, A., Liu, K., Kuznetsov, D., Kearfott, K.
University of Michigan

10:15 AM WAM-B.6
Performance Evolution of TLD-700H/600H Dosimetry System at Extended Issue Periods
Romanyukha, A., Morgan, B., Grypp, M., Williams, A.

Naval Dosimetry Center

10:30 AM WAM-B.7
Preliminary Investigation of the Fading Properties of Several Optically Stimulated Luminescent Materials
West, W., Kearfott, K., Seow, C.*
West Physics, University of Michigan

10:45 AM WAM-B.8
Biokinetics of Strontium-90 in Male Nonhuman Primates
Krage, E., Poudel, D., Swanson, J., Guilmette, R., Brey, R.
Idaho State University, Lovlace Respiratory Research Institute

11:00 AM WAM-B.9
Dosimetry for Low Dose Rate Neutron Exposures in Mice
Phillips, P., Borak, T., Weil, M.
Colorado State University

11:15 AM WAM-B.10
Evaluation of Photon and Neutron Dose Response of Al2O3:C Optically Stimulated Luminescence Dosimeters for Nuclear Accident Dosimetry Applications
Rathbone, B.
Pacific Northwest National Laboratory

11:30 AM WAM-B.11
Selective Shielding of Astronauts for Solar Particle Events During Deep Space Missions
Milstein, O., Waterman, G., Zlatsin, Y., Nix, T., Murow, D., Gaza, R., Lytle, B., Hussein, H.
StemRad, Ltd, Lockheed Martin Space Systems Company

11:45 AM WAM-B.12
Body-Size Dependent Exponential Regression Coefficients for Dose Coefficients for Adult Males Exposed to External Photon Fields
Chang, L., Lee, C.
National Cancer Institute

8:30 AM Room 111 B

WAM-C: Special Session: Patient Release Following I-131 Therapy

Chair: Tom Mohaupt

8:30 AM WAM-C.1
Medical Protocols for I-131 Administration
Sigg, D.
Nuclear Medicine Specialist

9:00 AM WAM-C.2
I-131 Patient Dosimetry
Stabin, M.
Vanderbilt University

9:30 AM WAM-C.3
Doses to Members of the Public from I-131 Patient Release
Dewji, S
Oak Ridge National Laboratory

10:00 AM BREAK IN EXHIBIT HALL

10:30 AM WAM-C.4
NCRP 155, Patient Releasability and Post-Release Precautions
Zanzonico, P.
Memorial Sloan-Kettering Cancer Center

11:00 AM WAM-C.5
IAEA Publications on Patient Release After Radionuclide Administration
Gilley, D.
International Atomic Energy Agency

11:30 AM WAM-C.6
I-131 Therapy Releases: The RSO Perspective
Kroger, L.
UC Davis Medical Center

8:30 AM Room 111 C

WAM-D: Special Session: Supporting Decisionmaking with Non-Technical Language

Chair: Ted Lazo

8:30 AM WAM-D.1
Informing Decision Making in Non-Technical Language
Lazo, E.
OECD Nuclear Energy Agency

9:00 AM WAM-D.2
Working Session: Communicating Radiation Information to Targeted Audiences
Nesky, AB, Lazo, E
US EPA, OECD NEA

11:45 AM Closing Remarks

8:30 AM Conference Theatre

WAM-E: Special Session: McCluskey Room

Chair: Wayne Glines

8:30 AM WAM-E.1
Explosion in Waste Treatment Box at Hanford's Plutonium Finishing Plant Americium Recovery Process Results in Extreme Contamination of Facility and Long Term Lay Up
Glines, W., Bladow, T., Harder, B.
Dade Moeller, an NV5 Company, CH2M Plateau Remediation Company

9:00 AM WAM-E.2
Investigating, Evaluating and Preparing for Radiological Hazards for Waste Treatment Box in Situ Size Reduction, Based Upon Similar Activities Performed on Less Hazardous Waste Treatment Boxes.
Glines, W., Bladow, T.*, Harder, B.
Dade Moeller, an NV5 Company, CH2M Plateau Remediation Company

9:30 AM WAM-E.3
Specialized Equipment and Training in Preparation for 242-Z Demolition and Destruction
Glines, W., Bladow, T., Harder, B.*
Dade Moeller, an NV5 Company, CH2M Plateau Remediation Company

10:00 AM BREAK IN EXHIBIT HALL

10:30 AM WAM-E.4
In-Situ Size Reduction of Unprepared and Highly Contaminated Waste Treatment Boxes by Mechanical Cutting.
Glines, W., Bladow, T.*, Harder, B.
Dade Moeller, an NV5 Company, CH2M Plateau Remediation Company

11:00 AM WAM-E.5
Dose Management and ALARA Techniques Used for Mitigation and Final Dose Evaluation
Glines, W., Bladow, T., Harder, B.*
Dade Moeller, an NV5 Company, CH2M Plateau Remediation Company

11:30 AM WAM-E.6
Panel Discussion on Decontamination and Decommissioning of "McCluskey Room"
Glines, W., Bladow, T., Harder, B., Carbaugh, E.
Dade Moeller, an NV5 Company, CH2M Plateau Remediation Company

8:30 AM Room 205

WAM-F: Special Session: Nanotechnology
Chair: Mark Hoover

8:30 AM WAM-F.1
Nanotechnology and Radiation Protection
Hoover, M., Marceau-Day, M., Cash, L., Davis, J., Ficklen, C., Holiday, S.
National Institute for Occupational Safety and Health, Scientist Emerita, Los Alamos National Laboratory, Oak Ridge Associated Universities, Ficklen and Associates, Nuclear Regulatory Commission

9:00 AM WAM-F.2
Nanomaterials: A Health Physicist's Role in Determining the Risks
Davis, J., Nichols, G.
Oak Ridge Associated Universities

9:20 AM WAM-F.3
Nanomaterials: Size Really Does Matter
Davis, J., Nichols, G.
ORAU

9:40 AM WAM-F.4
How Nanotechnology will Impinge on the Practice of Health Physics - Examples from Accelerator-Related Research and Development
Day, L.
LSU

10:00 AM Open Discussion

10:30 AM Nanotechnology Business Meeting

2:30 PM Room 100 C

WPM-A: Special Session: Homeland Security
Co-Chairs: John Lanza, Doug Draper

2:30 PM WPM-A.1
'WARP: Where are the Radiation Professionals?'
Toohey, R.
M. H. Chew & Associates

3:00 PM WPM-A.2
Rad Responder
Crawford, S.
DHS/FEMA

3:30 PM WPM-A.3
The Thule Greenland Nuclear Weapons Accident
Taschner, J., Groves, K.
Retired, FHPS

4:00 PM Homeland Security Business Meeting

2:30 PM Room 111 A

WPM-B1: Internal Dosimetry
Chair: Alexander Brandl

2:30 PM WPM-B1.1
Discover a Million Ways to Fill a Bottle: How PNNL Knows Who Gets to Try
Jones, R., Pierson, R.
Columbia Chapter, Richland

2:45 PM WPM-B1.2
Body-Size Dependent Exponential Regression Coefficients for Dose Coefficients for Adult Males Exposed to External Photon Fields
Chang, L., Lee, C.
National Cancer Institute

3:00 PM WPM-B1.3
Biokinetics of Plutonium in Adult Nonhuman Primates
Poudel, D., Guilmette, R., Krage, E., Brey, R.
Idaho State University, Lovelace Respiratory Research Institute, Ray Guilmette and Associates, LLC

3:15 PM WPM-B1.4
Development and Application of Voxelized Dosimetric Models for Biota: Characterization of the Uncertainty in the International Commission on Radiological Protection's Wildlife Dosimetry System
Caffrey, E., Johansen, M., Higley, K.
Oregon State University, Australian Nuclear Science and Technology Organization

3:30 PM WPM-B1.5
Dosimetric Monitoring of a Case of Actinide Intake through Damaged Skin
Ephimov, A., Sokolova, A., Ishunina, M.*
Southern Urals Biophysics Institute

3:45 PM BREAK

4:00 PM Room 111 A

WPM-B2: Dose Reconstruction
Chair: Eric Miller

4:00 PM WPM-B2.1
A Monte Carlo Methodology for Individualized Reconstruction of Mean Organ Doses of Patients treated for Hodgkin's Lymphoma: Progress Towards Correlating Dose with Late Toxicities
Petroccia, H., Mendenhall, N., Bolch, W.
University of Florida, Gainesville, University of Florida Health Proton Therapy Institute, Jacksonville

4:15 PM WPM-B2.2
Rapid Acute Radiation Dose Assessment Using MCNP6
Owens, A., Bertelli, L., Sugarman, S., Johnson, T.
Colorado State University, Los Alamos National Lab, REAC/TS

4:30 PM WPM-B2.3
Voxel Phantom Model of the Pine Tree
Condon , C., Higley , K.
Oregon State University

4:45 PM WPM-B2.4
Organ Doses from Diagnostic Medical Radiography-Trends Over Eight Decades (1930 to 2010)
Melo, D., Simon, S.*, Miller, D., Chang, L., Moroz, B., Linet, M.
Lovelace Respiratory Research Institute, National Cancer Institute, FDA

5:00-600PM Room 207

ABHP USEFUL EQUATION SHEET WORKSHOP

The ABHP is having a workshop on content and use of the Useful Equation Sheet. This is a continuation of a discussion that began this year about whether or not the equation sheet is useful and the need to verify and reference all items included on the sheet. Any CHPs and prospective examinees are encouraged to attend and be a part of the discussion.

5:00 PM WPM-B2.5
Thermoluminescence Characteristics of Household Salts for Retrospective Dosimetry in Radiological Events
Datz, H., Horowitz, Y.*, Druzhyna, S., Oster, L., Orion , I.
Soreq Nuclear Research Center, Ben Gurion University of the Negev, Sami Shamoon College of Engineering

2:45 PM Room 111 B

WPM-C: Environmental 1
Co-Chairs: Michael Witmer, Paul Ward

2:45 PM WPM-C.2
Visualizing High Order Daughters' Activities Using Wolfram Mathematica
Wilson, C., Hamideh, A., Wang, W.
Louisiana State University

3:00 PM WPM-C.3
Quantification of the Spatial Distribution of Radionuclides in a Field Lysimeter with a Collimated High-Resolution Gamma-Ray Spectrometer
Erdmann, B., DeVol, T., Powell, B.
Clemson University

3:15 PM BREAK

3:45 PM WPM-C.4
Radon Transport through a Landfill Leachate Collection System
Morris, R., Ulsh, B.
M. H. Chew & Associates, Inc

4:00 PM WPM-C.5
TENORM at Abandoned Uranium Mine Sites in the Southwestern United States
Manglass, L., Liles, D., Townsend, A., Manglass, L.
Arcadis

4:15 PM WPM-C.6
Measuring Isotopic Ratios of Uranium and Thorium on the Pine Ridge Reservation
Cano, J., Sandoval, D.
Oglala Lakota College

4:30 PM WPM-C.7
Computational Techniques for Quantifying the Non-Linear Dynamics of Indoor Radon Concentrations
Khan, N., Loun, W., Rafique, M., Khan, S.
University of Azad Jammu & Kashmir, Muzaffarabad

2:15 PM Room 111 C

WPM-D: Special Session: Radiation Protection History & Culture

Co-Chairs: Elizabeth Gillenwalters, Nicole Martinez

2:15 PM Introduction
N. Martinez
Clemson University

2:30 PM WPM-D.1
Women in Radiation Science: a History
Martinez, N., Gillenwalters, E.
Clemson University, Ameriphysics

2:45 PM WPM-D.2
Elda Emma Anderson: Who Was He?
Kearfott, K.
University of Michigan

3:00 PM WPM-D.3
A Pictorial History of the Health Physics Society
Willison, J.
AECOM

3:15 PM WPM-D.4
Reality Health Physics in the Early 1960's: Three Personal Vignettes
Zimbrick, J.
Purdue University and Colorado State University

3:30 PM BREAK

4:15 PM WPM-D.6
Importance of Diversity Demographics in Radiation Protection
Gillenwalters, E., Martinez, N.
Ameriphysics, Clemson University

4:30 PM WPM-D.7

Aspire, Think and Do: the Training of Today's Health Physics Students
Wang, C.
University of Pittsburgh

4:45 PM Panel Discussion

2:15 PM Conference Theater

WPM-E: Special Session:
Power Reactor Health Physics & NRRPT
Chair: Tom Voss

2:15 PM WPM-E.1
Update on Potential Regulatory Changes Impacting the Commercial Nuclear Power industry
Hiatt, J.
NEI

2:30 PM WPM-E.2
Powernet - Useful Tool or Not?
Sewell, L.
PG&E Diablo Canyon

2:45 PM WPM-E.3
Personnel Contamination Events (PCEs) – Why We Do What We Do and Where the Industry is Headed with Accountability and Tracking!
Benfield, E.
NRRPT

3:00 PM WPM-E.4
Applications of the H3D Cadmium Zinc Telluride Gamma Camera in Commercial Nuclear Power
Wirth, M.
Palo Verde Nuclear Generating Station

3:15 PM BREAK

3:45 PM WPM-E.5
Realistic Computer Based Training for Optimized Radiation Learning Retention
Rolando, J., Winso, J., Uhrig, K.
Spectral Labs, Mele Associates

THURSDAY

7:00 AM

CEL-9 Room 207
Communicating Radiation Safety Information to the Public, the Media, and Other Non-Health Physicists
Karam, P.
NYPD Counterterrorism

CEL-10 Room 206A
Radiation Dosimetry as Part of an Integrated Radiation Protection Program
Potter, C.
S. H. Goke, Sandia National Laboratories

8:30 AM Room 100 C

THAM-A: Medical Health Physics, 1
Co-Chairs: Mike Stabin, Linda Kroger

8:30 AM THAM-A.1
Assessing the Impact of Phantom Alignment in Monte Carlo Simulations on Organ Doses in Reconstructed Cardiac Fluoroscopic Procedures
Marshall, E., Borrego , D., Fudge, J., Bolch, W.
University of Florida, Gainesville, UF Health, Gainesville

8:45 AM THAM-A.2
Using the HP Volunteer Program for a Research Project Sponsored by the Medical Section of HPS
Leinwander, P.
University of California, Davis

9:00 AM THAM-A.3
Release Criteria Methodology and Patient Instructions for I-131 Therapy
Kroger, L.
University of California Davis Health System

9:15 AM THAM-A.4
Hybrid Computational Canine Phantom Series to Support Preclinical Dosimetry and Biokinetic Modeling for Therapeutic Radiopharmaceuticals
Sands, M., Milner, R., Bolch, W.
University of Florida

9:30 AM THAM-A.5
A Dosimetric and Computational Speed Comparison Between the Voxelized UF Refernece Phantom and Converted Polygonal Phantom
Brown, J., Bolch, W., Sands, M., Borrego, D.
University of Florida

9:45 AM THAM-A.6
Health Physics Concerns Regarding the Use of Cesium-131 Sealed Sources for Non-Prostate Manual Brachytherapy
Hann, P., Keklak, J.
Thomas Jefferson University Hospital

10:00 AM BREAK

10:30 AM THAM-A.7
Survey of Policies and Practices for the Inspection of Lead Aprons at Medical Facilities
Olson, A., Simpson, D., King, S.
Bloomsburg University, Penn State Hershey Medical Center

10:45 AM THAM-A.8
Development of a Low Dose Lung Cancer Screening CT Protocol
Gamble, G., DeRosa, R., Bottorff, M., Cooney, B., Farah, R., LaVoy, T.
V.A. Medical Center Syracuse, New York, S.U.N.Y. Upstate Medical University Syracuse, New York

11:00 AM THAM-A.9
Patient Dose Comparison for Intraoperative Imaging Devices Used in Orthopedic Lumbar Spinal Surgery
Moore, B., Womack, K., Nguyen, G., Foster, N., Blizzard, D., Richardson, W., Yoshizumi, T.
Duke University, U.S. Nuclear Regulatory Commission, Duke University Medical Center, Hospital for Joint Diseases at NYU Langone Medical Cente

11:15 AM THAM-A.10
Anatomically Predictive Extension of Computational Human Phantoms for Retrospective Epidemiological Studies of Second Cancer in Radiotherapy Patients
Kuzmin, G., Jung, J., Pelletier, C., Lee, C., Lee, C.
National Cancer Institute, East Carolina University, University of Michigan

11:30 AM THAM-A.11
Current Radiation Safety Guidance for Death of Patients Treated with Sealed Or Unsealed Radioactive Therapy Sources - Part I
Steiner, J.
Louisiana State University

11:45 AM THAM-A.12
Current Radiation Safety Guidance for Death of Patients Treated with Sealed Or Unsealed Radioactive Therapy Sources - Part II
Meng, B.
Duke University

Noon Medical Section Business Meeting

8:30 AM Room 111 A

THAM-B: Environmental, 2

Co-Chairs: Michael Witmer, Paul Ward

8:30 AM THAM-B.1
Preliminary Identification of Lineaments (Potential Contaminant Pathways) through Satellite Imagery of Northwestern Fall River and Southwestern Custer Counties, South Dakota
Vasek, P., LaGarry, H.
Oglala Lakota College

8:45 AM THAM-B.2
Determination of Uranium Minerals and Radionuclide Concentrations of Selected Sites on the Pine Ridge Reservation and Vicinity, South Dakota and Nebraska
Vasek, P., LaGarry, H., Sanovia, J.
Oglala Lakota College

9:00 AM THAM-B.3
Predicting Seismic Events with Unattached Radon Decay Products
Harley, N., Chittaporn, P., Fisenne, I.
NYU School of Medicine, USDOE Retired

9:15 AM THAM-B.4
Spatial Interpolators: the Risks and Rewards of Several Approaches and Algorithms
Ruedig, E., Whicker, J.
Los Alamos National Laboratory

9:30 AM THAM-B.5
Investigation of Indoor Radon Levels in Bloomsburg University Campus Buildings
Dubil, C., Cuff, S., Stacy, A., Dendler, J., Simpson, D., Fallahian, N.
Bloomsburg U.

9:45 AM BREAK

10:15 AM THAM-B.6
Modeling of Cesium Movement through a Terrestrial-Aquatic Forest Ecosystem near Fukushima
Townsend, A., Ruedig, E., Gomi, T., Sakai, M., Johnson, T.
Colorado State University, Los Alamos National Laboratory, Tokyo University of Agriculture and Technology

10:30 AM THAM-B.7
Indoor Temporal Variations in Background Gamma Ray Spectrum Determined with an 11 cm x 40 cm x 5.5 cm NaI(Tl) Detector
Cao, S., Frank, S., Lynch, R., Rucinski, B., Sulieman, N., Kuznetsov, D., Liu, K., Kearfott, K.
University of Michigan

10:45 AM THAM-B.8
Uranium in Phosphate Cycle in Saudi Arabia
Khater, A., Ebaid, Y.
King Saud University

11:00 AM THAM-B.9
Public Health Effects of Uranium Legacy Sites in Central Asia
Shandala, N., Seregin, V., Filonova, A.*, Tukov, A., Kiselev, S., Titov, A., Pozhidaev, A., Abasova, G., Hojyion, M.
State Research Center – Burnasyan Federal Medical Biophysical Center, Moscow, Russia, Federal Center for Nuclear and Radiation Safety, Moscow, Russia, Ministry of Emergency Situation, Bishkek, Kyrgyzstan, State Unitary Enterprise – Tajik Rare Metals – Chkalovsk, Tajikistan

11:15 AM THAM-B.10
Estimation of Lifetime Cancer Risk from Indoor Radon in Akoko Region of Southwest Nigeria
Ajayi, I.
Crawford University, Igbesa, Ogun State, Nigeria.

11:30 AM THAM-B.11
Estimation of Fatality Risk from Indoor Exposure to Radon in Some Homes in Akoko Region of Ondo State, Southwestern, Nigeria.
Asere, A., Ajayi, I.
Adekunle Ajasin University, Akungba Akoko, Nigeria

11:45 AM THAM-B.12
Radiological Air Sampling During Wildfires in Central Idaho
Ritter, P.
State of Idaho

8:30 AM Room 111 B

THAM-C: Emergency Response I
Co-Chairs: Lorne Erhardt, Stuart Hinnefeld

8:30 AM THAM-C.1
Radioactive Deposition Measurements from a Radiological Dispersal Device
Erhardt, L., Lebel, L., Korpach, E., Berg, R., Inrig, E., Watson, I., Liu, C., Quayle, D.
Defence Research and Development Canada, Institut de radioprotection et de sûreté nucléaire, Health Canada, Radiation Protection Bureau

8:45 AM THAM-C.2
Preliminary Dose Assessment for Emergency Response Exercise at Disaster City Using Unsealed Radioactive Contamination
Dromgoole, L., Marianno, C., Poston, J.
Texas A&M University

9:00 AM THAM-C.3
Relative Hazard of Cutaneous Radiation Injury and Acute Radiation Syndrome during Urban Evacuation following Nuclear Terrorism
Adams, T., Yeddanapudi, N., Clay, M., Asher, J., Appler, J., Casagrande, R.
Gryphon Scientific, LLC, BARDA ADS

9:15 AM THAM-C.4
Gamma Dose from an Overhead Plume
McNaughton, M., Gillis, J.*, Ruedig, E., Whicker, J., Fuehne, D.
Los Alamos National Laboratory

9:30 AM THAM-C.5
Learning from Fukushima: Analysis of Ongoing Recovery Efforts as Reported in Japanese Media
Vidoloff , K., Finklea, L., Donovan, J., Salame-Alfie, A., Ansari, A.
U.S. Centers for Disease Control and Prevention

9:45 AM THAM-C.6
Bone Marrow Shielding as an Approach to Protect Explosive Ordinance Disposal Personnel
Waterman, G., Nix, T., Zlatsin, Y., Milstein, O.
StemRad, Ltd

10:00 AM BREAK

10:30 AM THAM-C.7
The Importance of Effective Communication Between Health Physicists and Healthcare Providers
Sugarman, S., Dainiak, N.
REAC/TS

10:45 AM THAM-C.8
How to Make Your Radiation Risk Communications Believable
Johnson, R.
Radiation Safety Counseling Institute

11:00 AM THAM-C.9
Community Reception Center Modeling a Tool to Assist Resource Management for Emergency Planners
Finklea, L., Caspary, K., Salame-Alfie, A., Ansari, A.
Centers for Disease Control and Prevention, Oak Ridge Associated Universities

8:30 AM Conference Theater

THAM-D: Movies

2:30 PM Room 111 C

THPM-A1: Medical Health Physics, 2
Co-Chairs: Mike Stabin, Linda Kroger

2:30 PM THPM-A1.1
An Estimate of Dose from Cervical Spine Radiographic Exposures in Pediatric Patients Using a Monte Carlo Simulation
Gearhart, A., Carver, D., Parikh, A., Marta Hernanz-Schulman, M., Pruthi, S., Stabin, M.
Vanderbilt University

2:45 PM THPM-A1.2
Health Physics; Applying Hard Statistics to a Soft Science
Leuenberger, R.
Louis Stokes Cleveland VA Medical Center

3:00 PM THPM-A1.3
Nuclear Regulatory Commission Revised Licensing Guidance for Radioactive Seed Localization
Sheetz, M.
University of Pittsburgh

3:15 PM THPM-A1.4
Monte Carlo Based Internal Dosimetry Assessment of Cancer Bearing Canine Patients Treated with Cu-64-ATSM
Bell, J., Mann, K., Kraft, S., Brandl , A.
Colorado State University

3:30 PM THPM-A1.5
Response Comparison between a Geiger Muller Tube and Ion Chamber Detectors with Commonly Used Radiopharmaceuticals
Barnes, J., de la Guardia, M., Granger, M.
Cook Children's Medical Center

3:45 PM THPM-A1.6
Participation in the NATO HFM 222 2015 Exercise: Diagnosing Acute Radiation Syndrome and Medical Management Based on Clinical Signs and Symptoms
Dant, J., Stricklin, D., Reeves, G.
Applied Research Associates, Inc.

4:00 PM BREAK

4:15 PM Room 111 C

THPM-A2: Regulatory Licensing
Chair: Mark Roberts

4:15 PM THPM-A2.1
An Evaluation of the Security of Radioactive Source Regulations (10 CFR 37)
Dodd, B., Cervera, M.
BDConsulting, USNRC

4:30 PM THPM-A2.2
Over 100 mSv from Neutrons During a Day of Air Travel
Bramlitt, E., Shonka, J.
Retired

4:45 PM THPM-A2.3
Distribution of License-Exempt Products Containing Radioactive Material During 2014 and 2015
Reber, E.
USNRC

5:00 PM THPM-A2.4
Recommendations for Improving the Management and Disposition of Disused Sources
Robertson, G., Lovinger, T.
Disused Sources Working Group, Low-Level Radioactive Waste Forum

5:15 PM THPM-A2.5
Background Checks for Information Technology Employees
Harvey, R., Harvey, R.
Roswell Park Cancer Institute, University of Buffalo

2:30 PM Room 111 A

THPM-B: Sources and Irradiation
Chair: Marcia Maria Campos-Torres

2:30 PM THPM-B.1
Development of a Database to Track and Authorize Use of Radioactive Sealed Sources at SLAC
Campos Torres, M.
SLAC

2:45 PM THPM-B.2
Calibration of an Irradiation Facility
Marcinko, R., Johnson, T.
Colorado State University

3:00 PM THPM-B.3
Development of a High Dose Rate Research Irradiator Design
Shannon, M., Mickum, G., Hope, Z.
Hopewell Designs, Inc.

3:15 PM BREAK

3:30 PM THPM-B.4
Radioactive Sources Used for Neutron Dosimetry Standards - Historical Overview and the Role of Cf-252
Murphy, M., Thompson, A.
Battelle-PNNL, National Institute of Standards & Technology

3:45 PM THPM-B.5
Beyond Californium-252 a Neutron Generator Alternative for Dosimetry and Instrument Calibration in the U.S.
Mozhayev, A., Piper, R.*, Thompson, A.
Pacific Northwest National Laboratory, National Institute of Standards and Technology

4:00 PM THPM-B.6
Investigation of Workplace-like Neutron Calibration Fields via a Deuterium-Tritium (DT) Neutron Generator
Mozhayev, A., Piper, R., Rathbone, B.
Pacific Northwest National Laboratory, Richland, WA

4:15 PM THPM-B.7
Cs-137 Dosimeter Irradiation Facilities: Calibration Frequency, Precision, and Accuracy
Boria, A., Rucinski, B., Dawson, A., Seow, C., Abraham, S., Miklos, J., Kearfott, K.
University of Michigan

2:30 PM Room 111 B

THPM-C1: Emergency Response II
Co-Chairs: Lorne Erhardt, Kim Kearfort

2:30 PM THPM-C1.1
Calculation of Scaled Dose Rate Conversion Factors for Search and Rescue Dogs
Trevino, J., Marianno, C., Poston , J., Ford, J.
Texas A&M University

2:45 PM THPM-C1.2
Mitigation of Cs-137 Contaminated Waters from Further Environmental Spread
Ng, G., Higley, K.
Oregon State University

3:00 PM THPM-C1.3
Generic Dose Assessment for an Incidental Radiological Contamination of a Reservoir-Based Urban Water Supply
Guerrido, L., Cao, S., Leak, C., Seow, C., Pachek, E., Son, W., Kearfott, K.
University of Michigan

3:15 PM BREAK

3:45 PM Room 111 B

THPM-C2: Homeland Security
Chair: Roland Benke

3:45 PM THPM-C2.1
Collection, Management, Analysis and Dissemination of Environmental Radiation Monitoring Data for a Public Outreach Project
Lynch, R., Frank, S., Jacobs, M., Rucinski, B., Kearfott, K.
University of Michigan

4:00 PM THPM-C2.3
Development of Bayesian Statistical Algorithms for Radiation Detection at the Decision Threshold
Brogan, J., Brandl, A.
Colorado State University

4:15 PM THPM-C2.4
Source in a Box: Website for Estimating Threats Posed by Radioactive Material in Sealed Containers
Benke, R.
Atom Consulting

PROFESSIONAL ENRICHMENT PROGRAM (PEP)

Sunday 17 July through Thursday 21 July

ONCE AGAIN

The Professional Enrichment Program (PEP) handouts for the Annual Meeting will not be available in hard copy. For those who preregister, you will be provided with an access code for downloading the handouts approximately two weeks prior to the meeting. For those who register for courses on-site, you will be provided the code when you register.

Please note, not all instructors provide downloadable information.

The Professional Enrichment Program (PEP) provides a continuing education opportunity for those attending the Health Physics Society Annual Meeting. The two hours allotted each course ensure that the subjects can be discussed in greater depth than is possible in the shorter programs offered elsewhere in the meeting.

On Sunday, 17 July, a series of 24 courses will be offered between 8:00 am - 4:00 pm.

In addition to the above-mentioned sessions for Sunday, five PEP lectures are scheduled on Monday-Thursday, and four on Thursday afternoons from 12:15 - 2:15 pm. Registration for each two-hour course is $90 and is limited to 60 attendees on a first-come, first-served basis. Those whose registrations are received before the preregistration deadline will be sent confirmation of their PEP course registration.

Students with a current ID card will be admitted free of charge to any sessions which still have space available after the waiting list has been admitted. Student admission will be on a first-come, first-served basis and will only begin 15 minutes after the start of the session to allow for completion of ticket processing.

Please Note!!

Please be on time for your sessions. The lecturer will begin promptly at the scheduled time. Please allow time for check-in. The HPS reserves the right to schedule a substitute speaker or cancel a session in case the scheduled speaker is unavailable.

Attendees not present at the starting time of the session cannot be guaranteed a space, as empty spaces will be filled from the wait list at that time. Spaces left after the wait list has been admitted may be filled with students. If your duties at the meeting cause you to be late for your lecture (e.g., chairing a session), contact the PEP registration desk so that your name can be placed on the waiver list and your space held.

Sunday 8:00 AM – 10:00 AM

1-A EH&S "Boot Camp" for Radiation Safety Professionals, Part 1

Emery, R., Gutierrez, J.
The University of Texas School of Public Health

It is currently quite rare for organizations to maintain stand-alone radiation safety programs. Resource constraints and workplace complexities have served as a catalyst for the creation of comprehensive environmental health & safety (EH&S) or risk management (RM) programs, which include, among other health and safety aspects, radiation safety programs. But many of these consolidations were not inclusive of staff training to instill an understanding of the areas now aligned with the radiation safety function. This situation is unfortunate because when armed with a basic understanding of the other safety programs, the radiation safety staff can provide improved customer service and address many simple issues before they become major problems. This unique Professional Enrichment Program (PEP) series is designed to address this shortcoming by providing an overview of a number of key aspects of EH&S and RM programs from the perspective of practicing radiation safety professionals who now are involved in a broader set of health and safety issues. The PEP series will consist of three 2 hour segments:

Part 1 will address "The Basics of Risk Management & Insurance" and "The Basics of Fire & Life Safety". The risk management & insurance portion of the session will address the issues of retrained risks (those which are not covered by insurance) and transferred risks (those covered by a financial vehicle), and how these aspects impact EH&S and RM operations. Included in the fire & life safety segment will be a discussion on the basic elements of the life safety code and the fire detection and suppression systems. The requirements for means of egress will also be discussed

Each PEP segment is designed so that participants can take any session individually, although the maximum educational benefit will be derived from the participation in all three sessions. The particular topics included in the PEP series have been consistently identified as extraordinarily useful to participants in the highly successful week-long "University of Texas EH&S Academy". Ample time will be allotted for questions answers and discussion, and each segment will be supplemented with key reference information.

1-C Randomness and Interpretation of Radiation Measurements

R. Johnson
Radiation Safety Counseling Institute

For a health physicist, radiation risk assessments begin ideally with measurements to characterize the source of radiation. While we depend on radiation instruments to tell us about radiation, how often do we evaluate the quality or uncertainties of measurements? Misunderstandings abound when it comes to interpretation of measurements. Most people want absolute values for measurements and do not want to know about uncertainties and seldom ask questions such as, "Was the best instrument used, was it calibrated and working properly, was it used properly, was the measurement taken in the right place, etc.? There are over 20 factors that can affect the quality of measurements that may not be considered when interpreting measurements. Two key factors, in particular, govern measurement interpretations: 1) measurements have no meaning until interpreted and 2) measurements only have meaning in terms of how they are interpreted. Thus, recorded or reported radiation measurements have no inherent meaning by themselves, they are just numbers Interpretations of measurements may also have as much to do with attitudes and perceptions of risks as they do about technology. For example, a worker at an industrial facility observed the RSO taking readings with a Geiger counter and saw the meter go off scale. That was enough information for this worker to start an uproar that eventually involved several hundred other workers, the union, and management. Another worker at a food production facility heard a GM meter in use for surveying the installation of a new x-ray machine for product quality control. He raised concerns and when the company manager heard there was radiation in his facility, he told the x-ray company to remove their machine. This resulted in the loss of a $4 million sale for 20 x-ray machines. Radiation safety specialists have the advantage for interpreting radiation measurements based on knowledge of comparative readings from background and other sources. Most people without this specialized knowledge do not know that we live in a sea of radiation which surrounds us all the time. Furthermore, a screaming Geiger counter may sound alarming, but radiation risks depend on many other factors, such as the type of radiation, the proximity of people, and the duration of exposures. A Geiger counter reading or other measurements of radiaton are only part of the information which specialists would use for assessing potential risks. Unfortunately, all radiation measurements have many potential sources for errors which people may

not know about and may therefore assume the measurements represent the real world. For interpreting radiation measurements, how much do we rely on technical understanding and how much on our interpretation as an emotional reaction regarding safety?

1-D Status of (1) ANSI N42 RPI Standards and (2) International Electrotechnical Commission (IEC)

Technical Committee 45 and Subcommittee Nuclear Standards
M. Cox
Co-chair RPI and HSI standards

This summary covers the current status of American National Standards Institute (ANSI) N42 standards for health physics instrumentation in two sections:

(1)This section includes the discussion of some seventeen ANSI N42 standards for Radiation Protection Instrumentation (RPI) in effect, being revised or being combined, including those for performance & testing requirements for portable radiation detectors, in ANSI N42.17A for normal environmental conditions and in ANSI N42.17C for extreme environmental conditions, being combined; and now published ANSI N42.323A/B, for calibration of portable instruments over the entire range of concern, i.e., in the normal range and for near background measurements; performance criteria for alarming personnel monitors in ANSI N42.20; airborne radioactivity monitors in ANSI N42.30 for tritium, ANSI N42.17B for workplace airborne monitoring, ANSI N42.18 for airborne and liquid effluent on-site monitoring, and ANSI N323C for test and calibration of airborne radioactive monitoring; instrument communication protocols in ANSI N42.36; in-plant plutonium monitoring in ANSI N317; reactor emergency monitoring in ANSI N320; quartz and carbon fiber personnel dosimeters in ANSI N322; installed radiation detectors in ANSI N323D; ANSI N42.26 for personnel warning devices; radon progeny monitoring in ANSI N42.50; and radon gas monitoring in ANSI N42.51.

The new ANSI N42.54 standard is combining the salient materials for airborne radioactivity monitoring from ANSI N42.17B, ANSI N42.18, ANSI 323C and ANSI N42.30, with a comprehensive title of "Instrumentation and systems for monitoring airborne radioactivity".

This section includes the discussion of twenty ANSI N42 standards recently developed, being developed, or being revised and updated for Homeland Security Instrumentation (HSI), including those for performance criteria for personal radiation detectors in ANSI N42.32 in revision; portable radiation detectors in ANSI N42.33 in revision soon; portable detection and identification of radionuclides in ANSI N42.34; all types of portal radiation monitors in ANSI N42.35; for training requirements for homeland security personnel in ANSI N42.37 in revision; spectroscopy-based portal monitors in ANSI N42.38 in revision; performance criteria for neutron detectors in ANSI N42.39, needing attention; neutron detectors for detection of contraband in ANSI N42.40, not addressed; active interrogation systems in ANSI N42.41; data formatting in ANSI N42.42, revised and updated; mobile portal monitors in ANSI N42.43; checkpoint calibration of image-screening systems in ANSI N42.44; criteria for evaluating x-ray computer tomography security screening in ANSI N42.45; performance of imaging x-ray and gamma ray systems for cargo and vehicles in ANSI N42.46; measuring the imaging performance of x-ray and gamma ray systems for security screening of humans in ANSI N42.47; spectroscopic personal detectors in ANSI N42.48; personal emergency radiation detectors (PERDs) in ANSI N42.49A for alarming radiation detectors and in ANSI N42.49B for non-alarming radiation detectors; backpack-based radiation detection systems used for Homeland Security in ANSI N42.53; and portable contamination detectors for emergency response in ANSI N42.58.

(2)This presentation of international standards covers the efforts of 16 working groups & project teams addressing important issues such as 1) the instrumentation & control (I&C), & electrical power for nuclear facilities; 2) radiation detection & protection for workplace personnel, the public & the environment, & from airborne & waterborne effluents; and 3) safeguarding special nuclear materials at all locations.

Those efforts are from working groups and project teams in IEC Technical Committee 45, and from Subcommittees SC 45A and SC 45B. The overall work is distributed among over more than 250 experts as volunteers from some twenty countries of the world.

The SC 45B standards include those from Working Group (WG) B-5 responsible for radioactive aerosol measurements and environmental monitoring; WG B-8 for electronic personnel and portable detectors, plus passive radiation dosimeters; WG B-9 is responsible for installed radiation monitoring systems at all nuclear facilities including power reactors; WG B-10 continuously handles all of the issues of radon and radon progeny monitoring; WG B-15 is responsible for controlling the illicit trafficking of all types of radioactive materials, using a variety of

detectors; WG B-16 develops standards for radioactive contamination monitors & meters; and WG B-17 covers security inspection systems using active interrogation with radiation.

The SC 45A standards include those from WG A-2 for sensor & measurement technology; WG A-3 uses the application of digital processing to safety in nuclear power plants; WG A-5 responds to special processing measurements & radiation monitoring; WG A-7 addresses the reliability of electrical equipment in reactor safety systems; WG A-8 covers the design of control rooms; WG A-9 is termed instrument systems; WG A-10 is upgrading & modernizing I&C systems; and WG A-11 addresses all electrical systems.

1-E Radiation Protection at Accelerator Facilities

M. Quinn
Fermilab

The Radiation Protection at Accelerator Facilities class will present an overview of the composition of accelerator radiation fields for electron, proton, and ion accelerators at all energies. Ionizing radiation produced by high-intensity laser sources will also be discussed. General methods of designing radiation shielding at accelerators will be presented, with special attention being devoted to low-energy neutron phenomena that are found at nearly all accelerators. The production of induced radioactivity in both accelerator components and environmental media will be covered, along with a discussion of radiation detection instrumentation commonly used at accelerator facilities.

1-F Air Monitoring in Nuclear Facilities - Part 1

J.T. Voss
Los Alamos National Laboratory

A. Basic Fundamentals of Air Sampling and Air Monitoring

Basic fundamentals of air sampling and monitoring includes basic calculations, interferences, and limitations of air sampling and monitoring systems.

The following exercises are presented
- Calculate concentration using count rate, counting efficiency, and sample volume
- Concentration conversion factors (such as pCi/L to uCi/mL or Bq/M3)
- Calculate DAC (Derived Air Concentration) and DAC-h
- Calculate the DAC level on a filter from the number of DPM on the sample filter and the sample time and the sampling rate
- Calculate the number of DAC-h on a filter from the number of DPM on the filter and the air sampling rate
- Calculate the DPM on a filter to reach an 8 DAC-h accumulation
- Calculate the mrem/h and mrem from inhaling airborne radioactivity

The following discussion of the interferences encountered in air sampling and air monitoring for airborne radioactive materials is presented.
- Radon and Thoron interference in aerosol and gas sampling
- Uranium-238 decay chain
- Thorium-232 decay chain
- Comparison of typical radon/thorn progeny concentrations compared to desired concentration limits for transuranic airborne activity

B. Air Sampling and Air Monitoring Regulatory Requirements

An overview of the requirements the following is presented.
- 10 CFR 20 (Standards for Protection Against Radiation)
- 10 CFR 20 Subpart D (Radiation Dose Limits for Individua10 CFR 20 (Standards for Protection Against Radiation)
- Nureg 1400 (Air Sampling in the Workplace)
- 10 CFR 835 (Occupational Radiation Protection)
- 29 CFR 1910 (Occupational Safety and Health Standards)
- 40 CFR 50 (National Primary and Secondary Ambient Air Quality Standards)
- 40 CFR 50 Appendix B (Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere)
- 40 CFR 61 (Radiological National Emission Standards for Hazardous Air Pollutants)
- ANSI N13.1-1999 R2011 (Sampling and Monitoring Releases of Airborne Radioactive Substances From the Stacks and Ducts of Nuclear Facilities)

1-G Heat Stress for Health Physicists, Part 1 of 2

G. Ceffalo
Bechtel

Heat, or thermal stress, is a work hazard related on a worker being exposed to low temperatures and wind chill; or high temperatures, radiant heat and humidity. These thermal factors can stress a worker, reducing their effectiveness, and requiring controls, typically in the form of heat management or time limitations. From a HP perspective, accommodating heat stress controls can either adversely affect radiological controls, or harmonize with a set of controls and optimize worker safety.

Part 1 of this two-PEP series is intended to aid an HP understand the concepts, measurements and terms associated with heat stress. While heat stress is typically the specialty of Industrial Hygienists, part 1 of this PEP set should enable a HP to be an active participant in hazards evaluation and control processes that include thermal stress. The PEP will demonstrate the fundamentals of measuring and quantifying the contributors to heat stress, and understanding the effect of different contributors to heat stress. Evaluating controls and mitigation will be discussed in part 2 of 2.

1-H Laser Safety for Health Physicists

B. Edwards
Vanderbilt University

This course provides an overview of laser physics, biological effects, hazards, and control measures, as well as a concise distillation of the requirements in the ANSI Z136.1-2014 Standard for the Safe Use of Lasers. Non-beam hazards, emerging issues, and accident histories with lessons learned will also be covered. Course attendees will learn practical laser safety principles to assist in developing and conducting laser safety training, performing safety evaluations, and effectively managing an institutional laser safety program. While some knowledge of laser hazards will be helpful, both experienced and novice health physicists with laser safety responsibilities will benefit from this course. Attendees may find it helpful to bring their own copy of ANSI Z136.1-2014.

Sunday 10:30 AM – 12:30 PM

2-A EH&S "Boot Camp" for Radiation Safety Professionals, Part 2

R. Emery, J. Gutierrez
The University of Texas School of Public Health

See description for PEP 1-A. Part 2 will examine "Security 101 for Radiation Safety Professionals" and "The Basics of Biological & Chemical Safety". The first part of this session will focus on security as it is applied in the institutional settings. Various strategies employed to improve security controls will be presented. The second part of the session will address the classification of infectious agents and the various assigned biosafety levels. Aspects of chemical exposures, exposure limits, monitoring and control strategies will also be discussed

Each PEP segment is designed so that participants can take any session individually, although the maximum educational benefit will be derived from the participation in all three sessions. The particular topics included in the PEP series have been consistently identified as extraordinarily useful to participants in the highly successful week-long "University of Texas EH&S Academy". Ample time will be allotted for questions answers and discussion, and each segment will be supplemented with key reference information.

2-B Update to U.S. DOT Regulations

S. Austin
Plexus Scientific

The harmonization of domestic and international standards for hazardous materials transportation enhances safety by creating a uniform framework for compliance. Harmonization also facilitates international trade by minimizing the costs and other burdens of complying with multiple or inconsistent safety requirements and avoiding hindrances to international shipments. Harmonization has become increasingly important as the volume of hazardous materials transported in international commerce grows. The U.S. Department of Transportation (DOT) amended the Hazardous Materials Regulations to incorporate changes adopted in the 2009 Edition of the IAEA Safety Standards publication titled "Regulations for the Safe Transport of Radioactive Material, 2009 Edition."

These changes to DOT regulations affect the packaging and transportation of radioactive material. The changes impact marking of packages, reporting of total activity in a package, placarding of certain shipments of LSA-I and

SCO-I materials, several key definitions, shipping paper retention requirements, surveys, labeling, and assessment of radiation hazards from packages or conveyance that have been suspected to leak radioactive material. Organizations that are offering packages of radioactive material for transport or transporting these materials need to be aware of these changes and incorporate them into their existing shipping program.

2-C Why Our Natural Intuitive Processes Fail for Radiation Risk Assessments

R. Johnson
Radiation Safety Counseling Institute

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).

2-D Search and Secure and RAILS

K. Uhrig, R. Kahn
MELE Associates

In today's volatile world, it is imperative that radioactive sources are protected or securely disposed. The Office of Radiological Security (ORS) works hard to secure radioactive sources both domestically and internationally by protecting, reducing, and removing radioactive sources. ORS's Search and Secure (S&S) Program works directly with foreign governments to assist in establishing effective and sustainable programs to improve radiological security by providing training and equipment for the search, location, identification, recovery, transportation, and secure storage of sealed radiological sources that have fallen out of regulatory control (i.e., orphan sources). These training courses are conducted in partner countries where participants are taught key S&S concepts and practical skills on how to plan, organize and conduct searches. To sustain these capabilities, training participants are given access to RAILS, the Realistic Adaptive Interactive Learning System. RAILS allows users to refresh their training and train new individuals in a virtual hands-on interactive environment, where they can practice using radiation detection equipment to locate orphan sources. This PEP will discuss the importance of the S&S mission, key search concepts, and discuss key radiation detection equipment. It will also demonstrate RAILS and its use for sustaining training. Participants will be provided a RAILS account and may bring a mobile device or laptop to access it. Devices will also be available at the PEP for testing RAILS.

2-E Integration of Health Physics into the Medical Management of Radiation Incident Victims

S. L. Sugarman,
REAC/TS

In the event of a radiation incident it is essential that the radiation dose a patient may, or may not, have received is rapidly assessed so that proper medical treatment can be planned. The initial information needs to be easily obtained and able to provide a realistic potential of dose magnitude. Various techniques can be employed to help gather the necessary information needed. Evaluation of nasal swabs and wound counts can help with ascertaining the potential for significant intakes of radioactive materials, and mathematical dose estimations can help with determining the potential magnitude of external doses. Externally contaminated areas must be assessed so that treatment and decontamination priorities can be determined. As time goes on and more information, such as bioassay or biological dosimetry data, is received the health physicist will be called upon to interpret that data and communicate its meaning to the healthcare staff. Support duties can also include assistance with communicating with the patient, other medical staff, or external entities such as regulators and the media. Coupled with a good event history and other data, health physicists and physicians can develop a strategy for providing proper medical care to individuals who may have been involved in a radiological event. It is, therefore, essential that health physicists are able to seamlessly integrate themselves into the patient care environment and effectively communicate their findings to a wide variety of people. This PEP will describe methodologies to rapidly assess radiation doses and use real case reviews to reinforce the teaching points.

2-F Air Monitoring in Nuclear Facilities – Part 2

J.T. Voss
Los Alamos National Laboratory

A. Methods of Extracting Representative Samples from Stacks, Ducts, the Environment, and Work Areas

Deposition 2001a software developed at Texas A&M University is demonstrated. Sampling rakes and shrouded probes for stacks and ducts are discussed as well as methods of measuring air flow rates through stacks and ducts. Isokinetic sampling limitations are discussed. The guidance in ANSI N13.1-1999 R2011 (Sampling and Monitoring Releases of Airborne Radioactive Substances From the Stacks and Ducts of Nuclear Facilities) is more fully explored using Depo 2001a.

B. Equipment used for Air Sampling and Air Monitoring

- Types of air pumps are discussed and their operational characteristics are explained.
- Types of vacuum and pressure lines are discussed and operational characteristics are explained.
- Types of sample nozzles are discussed and their operational characteristics are explained.
- Types of sample flow controllers are discussed and their operational characteristics are explained.
- Types of sample flow measurement systems are discussed and their operational characteristics are explained.
- Power versus air sampling rate for various types of air sampler pumps is discussed.
- Types of filter media are compared and the suggested applications for each are discussed.
- Typical operation, maintenance, and calibration procedures are presented.

2-G Heat Stress for Health Physicists, Part 2 of 2

G. Ceffalo
Bechtel

Heat, or thermal stress, is a work hazard related on a worker being exposed to low temperatures and wind chill; or high temperatures, radiant heat and humidity. These thermal factors can stress a worker, reducing their effectiveness, and requiring controls, typically in the form of heat management or time limitations. From a HP perspective, accommodating heat stress controls can either adversely affect radiological controls, or harmonize with a set of controls and optimize worker safety.

Part 2 of this two-part PEP will provide information on techniques and equipment available to help manage heat stress. If an HP can be part of the design of the hazard control set, more effective controls can be selected, optimizing worker safety, comfort and radiological consequences. The controls will include PPE selection, respiratory protection, cooling devices for both the worker and the areas; and discussion of time management.

2-H Performing ANSI Z136-based Laser Hazard Calculations

B. Edwards
Vanderbilt University

This course provides a step-by-step guide to performing laser hazard calculations based on the principles and methodology in the ANSI Z136.1-2014 Standard for the Safe Use of Lasers. Attendees will gain an understanding of how to complete these calculations for continuous wave, pulsed, and repetitively pulsed laser systems. While some knowledge of laser hazards will be helpful, both experienced and novice health physicists with laser safety responsibilities will benefit from this course. However anyone not already familiar with the fundamentals of radiometry and the arcane conventions of the Z136 series of standards for the safe use of lasers would benefit from attending the Laser Safety for Health Physicists PEP so they'll have some familiarity with the concepts under discussion. Attendees will also find bringing their own copy of ANSI Z136.1-2014 a useful reference.

3-A EH&S "Boot Camp" for Radiation Safety Professionals, Part 3

R. Emery, J. Gutierrez
The University of Texas School of Public Health

See description for PEP 1-A. Part 3 will focus on "Measuring and Displaying Radiation Protection Program Metrics That Matter to Management". Radiation protection programs typically accumulate data and documentation so that regulatory officials can assess compliance with established regulations. The implicit logic associated with this activity is that compliance equates to safety. But in this era of constricted resources, mere regulatory compliance is no longer sufficient to justify all necessary programmatic resources. Radiation protection programs are now expected to readily demonstrate how they add tangible value to the core missions of an organization. The demonstration of this value is expected to be in the form of some sort of performance metrics, but this is an area in which many radiation safety professionals have not been trained. The issue is further compounded by the need to display the metrics in manners that are succinct and compelling, yet another area where formal training is often lacking. This session will first describe a variety of possible radiation protection program performance measures and metrics, and then will focus on the display of the information in ways that clearly convey the intended message. Actual before and after data display "make-overs" will be presented, and ample time will be provided for questions, answers, and discussion.

Each PEP segment is designed so that participants can take any session individually, although the maximum educational benefit will be derived from the participation in all three sessions. The particular topics included in the PEP series have been consistently identified as extraordinarily useful to participants in the highly successful week-long "University of Texas EH&S Academy". Ample time will be allotted for questions answers and discussion, and each segment will be supplemented with key reference information.

3-B So Now You're the RSO: Elements of an Effective Radiation Safety Program

T. L. Morgan
Columbia University

Designation as a Radiation Safety Officer brings with it unique opportunities and challenges. The author will offer insights on how to manage a radiation safety program from his 20+ years' experience as a RSO at medical, university, and industrial facilities. Regardless of the type of facility, number of radiation workers, or scope, an effective radiation safety program must be driven from the top down. Senior management must embrace the goals of the program. The RSO must have the trust of senior management as well as a good working relationship with line managers and workers. These relationships are built on the integrity, knowledge, experience, and accessibility of the RSO. This talk will focus on the role of the RSO in achieving and maintaining an effective program.

3-C Errors in Randomness and Understanding of Stochastic Risk Assessments

R. Johnson
Radiation Safety Counseling Institute

While health physicists usually understand that radiation is of main concern for stochastic effects (future random chance of cancer), most of the world does not understand stochastic effects, randomness, or probabilities. Most people just want to know if they will be "Safe or Not Safe." They do not want to hear about radiation risk estimates as probabilities. When confronted with a risk probability, they are inclined to substitute an easier question, such as, "How do I feel about getting cancer?" They can easily answer this question without any technical knowledge or understanding of randomness or probabilities. Research has shown that when chance or randomness is involved, people's thought processes for safety decisions are often seriously flawed. Not many

people understand the principles that govern chance and how these processes play out in decisions for radiation safety. The normal processes for safety decisions can lead to mistaken judgments and technically inappropriate reactions for radiation safety (consider reactions following Fukushima Dai-ichi). Health physicists have long been puzzled and often frustrated about how people can make instant decisions regarding radiation with little or no actual data. Studies in psychology show that our ability to make instant decisions for safety is a part of how our brains are wired for our protection. We are programmed to fear first and think second. We have survived by this innate ability to foresee dangers and take protective actions accordingly. Instant prediction of danger is not something we do consciously by evaluation of facts or circumstances. This is done by our subconscious mind which functions as a superfast computer processing all incoming signals by associations with images and experiences in our memories. Thus we are programmed for instant response without any conscious thought. While this instinct for safety is important for our survival, it is also prone to substantial errors for some dangers, such as radiation. There are at least 15 or more ways that our subconscious is prone to errors relative to the actual circumstances. My studies are showing that even professionals with technical understanding are also prone to errors. This can be demonstrated by the question, "Are your sources of radiation safe?" An instant answer to this question can only come from the subconscious because a conscious evaluation of data takes time to process. Also, when asked, "How do you know?" the answers invariably come down to beliefs in what we have heard or read about radiation safety. Out subconscious mind is prone to running ahead of the facts to draw coherent conclusions from a few scraps of evidence. Subconscious impressions then become the basis for instant decisions and long term beliefs about radiation.

3-D Overview of NRC Regulations in 10 CFR Part 37, "Physical Protection of Category 1 and Category 2 Quantities of Radioactive Materials

R. C. Ragland, Jr.
Nuclear Regulatory Commission, Region I Office

The presentation will provide an overview of the NRC Regulations in 10 CFR Part 37, "Physical Protection of Category 1 and Category 2 Quantities of Radioactive Materials." Special emphasis will be placed on new requirements for the development of an access authorization program and procedures, a security plan, implementing security procedures, coordination with local law enforcement, development and implementation of a security training program, development of an audit program, response to the identification of suspicious activity, and lessons-learned/experience gained from NRC Implementation. The target audience includes individuals who are responsible for developing, maintaining, or overseeing a 10 CFR Part 37 security program.

3-E Excel: Tips and Tricks for the Health Physicist

J.Guido, A. Wilding

Course will focus on the use of spreadsheet programs in the performance of health physics related calculations and activities. Main focus will be the use microsoft excel but additional insight into the use of non-spreadsheet alternatives (such as R / R Studio) will be explored. Areas to be covered will include advanced spreadsheet functions such as pivot tables and data consolidation techniques as well as the extension of excel capabilities using visual basic and other add-in applications

---

3-F Air Monitoring in Nuclear Facilities – Part 3

J.T. Voss
Los Alamos National Laboratory

A. Hands-on use of Air Sampling and Air Monitoring Equipment Including Analysis Methods and Algorithms

- Calibration equipment is provided to demonstrate how the air samplers and monitors are calibrated
- Various air sample filters are used in the hands-on demonstration
- Air sample filters are counted and airborne concentrations are calculated
- Various sample analysis methods and algorithms are demonstrated

Air sampling pumps demonstrated are rotary vane, centrifugal, diaphragm, and ejectors. Air sample flow controllers such as throttling valves, mass flow controllers, critical flow orifices, and pinch valves are demonstrated. Air sampling rate meters such as dP gauges, mass flow meters, and rotameters are demonstrated.

B. Detection Levels, Interferences, and Limitations

The uncertainties in reference standards are explored, including standard calibration sources, decay correction for radioactive sources, ingrowth for radioactive sources, reproducible placement of the standard calibration sources in proximity to the detector. The uncertainties in

the device to be calibrated are explored. The effects of background count rate, sample count time, and detector efficiency are explored. Interferences in the detection device are explored. All pertinent interferences and uncertainties are explored. Methods of determining the limitations of the measurements are explored.

3-G Archival Systems for Managing and Organizing Radiological Data

B. D. Fisher
Argonne National Laboratory

Archival systems are an efficient tool for managing and organizing radiological data, but not everyone has the time to maintain and check the quality of information stored in the system. This program will discuss guidance for large sets of data and information. It will provide recommendations for designing the framework of an archive system, with a focus on maintaining data quality through evolving standards; techniques for developing metadata and linking data; and how to address incomplete data sets. What interpolation or error statistics should you apply, when you suddenly discover that your data is missing information, and you can neither retrieve nor repeat the data collection? The program will provide scenarios, and conclude with the various ways to present radiological data to stakeholders in addition to confidence building methods for information that results from sets of data.

3-H Non-ionizing Radiation: An Overview of Biological Effects and Exposure Limits

B. Edwards
Vanderbilt University

This course provides a fundamental overview of non-ionizing radiation (NIR) hazards and biological effects. Course attendees will learn the basic terminology and nomenclature, spectral region designations, regulatory framework, and consensus guidance associated with NIR. The course material will begin at the edge of the ionizing part of the electromagnetic (EM) spectrum and walk participants through a tour of the optical, radiofrequency (including microwave), and extremely low frequency (ELF) portions of the EM range, finally ending with static electric and magnetic fields. The existence of a series of exposure limits covering the entire NIR spectrum forms one of the course's basic themes. This continuous line of "safe" exposure levels helps establish the concept that NIR dose response curves are at least well enough understood at all parts of the spectrum to provide a reasonably safe exposure envelope within which we can operate. After completing this course, attendees will be conversant in the major sources and associated hazards in each part of the NIR spectrum, along with the recognized exposure limits and control measures for those sources. Armed with this information, safety professionals can better recognize, evaluate, and communicate the hazards associated with the spectrum of significant NIR sources, and address workers' concerns in a credible, fact-based, knowledgeable, and professional manner.

While some knowledge of optical, radiofrequency, ELF, and static electromagnetic field characteristics may be helpful, both experienced and novice health physicists with NIR interests or responsibilities will benefit from this course.

Monday 12:15 pm – 2:15 pm

M-1 Neutrons – Discovery and Application

J. Chapman
Oak Ridge National Laboratory

This session will present the interesting and somewhat contradictory circumstances that lead to the discovery of the neutron, in 1932, by James Chadwick. With its discovery, the physics community—primarily lead by Fermi—studied the experimental behavior of neutron capture, and ultimately fission, induced by thermal neutron capture. Later, the determination of neutron multiplicity was sought, and with almost complete surprise the average number of neutrons per fission was measured at greater than 2, sufficient to sustain a neutron chain reactor. Applications of the neutron will be discussed, as well as some of the more interesting health physics issues that arise in the detection and interpretation of dose resulting from neutron exposure.

M-2 Radiation Safety's Role in Mitigating the "Insider Threat" Risk

R. Emery
The University of Texas School of Public Health

While organizations maintain many layers of controls to prevent outsiders from gaining unauthorized access to cause loss or harm, persons who have been granted legitimate access can become an "insider threat", and because they are very difficult to detect, cause over $100 billon is losses annually. Although the typical insider targets assets or data, in some cases their actions can also have significant impacts on workplace and environmental health and

safety. Because much of an organization's radiation safety program activities are carried out with the workers in their workplace, this represents a unique opportunity to assist in the possible detection of insider threats. This presentation will discuss the threats represented by insiders and will detail their recognized traits so that radiation safety professionals can enhance their situational awareness and report suspicions to the appropriate authorities.

M-3 How Randomness Affects Our Decisions for Radiation Safety

R. Johnson
Radiation Safety Counseling Institute

As health physicists we understand that radiation is a random phenomenon. We also understand 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 horrible 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.

How do people make judgments and decisions when faced with imperfect, incomplete, or uncertain information? Research has shown that when chance is involved, people's thought processes are often seriously flawed. What are the principles that govern chance, the development of ideas about uncertainty, and how those processes play out in decisions for radiation safety? We will look at how we make choices and the processes that lead us to make mistaken judgments and poor decisions when confronted with randomness and uncertainty. When information is lacking, this invites competing interpretations. Unfortunately, misinterpretation of data may have very negative consequences. How often is past performance a good indicator of the future? The human mind is built to identify a definite cause for each situation and it can have a hard time accepting the influence of unrelated or random factors. According to Mlodinow, "Random processes are fundamental in nature and ubiquitous in our everyday lives, yet most people do not understand them or think much about them." This PEP session will explore the role of chance in the world around us and how chance affects our decisions for radiation safety.

M-4 Radiation Safety Instruments for Emergency Responders – What Responders Need and How the Instruments are Used

P. A. Karam
NYPD Counterterrorism

There are currently far more radiation detectors in the hands of emergency responders than there are in the hands of radiation safety professionals, but the health physics community, in general, just isn't familiar with the people who are using these instruments, how the instruments are being used, or what emergency responders need – what does a firefighter need, for example, when responding to a radiological emergency compared to a cop involved in an interdiction mission? Not to mention the fact that information gathered by cops might be used for evidentiary purposes. In this PEP we'll first take a look at the people who are using radiation detection instruments in an emergency response capacity and will then look at their various missions. From there we'll go on to see what characteristics might go into making a good instrument for this category of users and how they can be used effectively.

M-5 Preforming Depositional Studies in Sample Lines with Deposition Calculator, Version 1

B. Blunt
Blunt Consulting LLC

Deposition Calculator is an object oriented software package that is used to estimate losses (deposition) of particulate material in sample lines. This software package was written as a replacement for Deposition 2001A. ANSI N13.1-2011 requires that a sample transport system be designed such that depositional losses of a 10 micron AED particle is less than 50%. The Deposition Calculator can be used to estimate the losses of any size particle, or a particle distribution and thus demonstrate compliance with ANSI N13.1-2011.

This course discusses the uses of Deposition Calculator and will delve into the studies included in the software package as they relate to sample line design and performance. Additional topics will include the mechanisms of depositional losses, bend calculations, flow related decisions made by the software, and methods for modeling a shrouded probe. The course will also discuss the limitations of the software and the models. The student will leave the class with a much better understanding of the subject of depositional losses and how to best use the available software to estimate such losses in sample transport systems.

Deposition Calculator Version 1 will be supplied to each student.

Tuesday 12:15 pm – 2:15 pm

T-1 Nanotechnology and Radiation Safety

Mark D. Hoover
National Institute for Occupational Safety and Health

This course will present an update for health physics professionals on relevant national and international experience and resources in nanotechnology safety, including a graded approach to sampling, characterization, and control of nanoparticles in the workplace. Case studies of good practice as well as experience "when things have gone wrong" will be presented. Nanotechnology and nanoengineered structural materials, metals, coatings, coolants, ceramics, sorbents, and sensors are increasingly being evaluated and applied in radiation-related activities. Anticipating, recognizing, evaluating, controlling, and confirming protection of worker safety, health, well-being, and productivity during these activities is essential.

T-2 Estimating Patient Peak Skin Dose from DICOM Information for Fluoroscopically Guided Interventional Procedures

C. Martel
Philips Healthcare

The current method generally accepted method for assigning peak skin dose to patients during fluoroscopically guided interventional procedures uses the cumulative air kerma displayed at the fluoroscopy console. However, limitations with this approach result in significant underestimates and overestimates of actual peak skin dose. Underestimating peak skin dose can result in missed skin reactions. Overestimating peak skin doses can result in increasing healthcare costs and burdens to patients and staff when patients are asked to return to the clinic for observation. The DICOM file available from fluoroscopic systems that employ Radiation Dose Structured Reporting provides information that can be used to estimate peak skin dose. Examples of calculating peak skin dose estimates using DICOM files will be presented.

T-3 A Contemporary Approach to Managing Low-Level Radioactive and Mixed Waste at an Academic Institution

M. J. Zittle
University of Washington

Management of low-level radioactive and mixed waste at academic institutions is challenging due to the small quantities and wide variety of wastes generated. These organizations are often non-profit or government funded and it is critical to maintain regulatory compliance while minimizing disposal costs, despite the unpredictable and often unreasonable cost of waste disposal.

This course will present waste management strategies for various waste streams and processes including sanitary sewer disposal, decay-in-storage, bench top treatment, minimization techniques and waste processing services, as well as the EPA mixed waste conditional exemptions. This course emphasizes the importance of training generators and utilizing process knowledge, accurate sample analysis, standard operating procedures, and quality assurance to efficiently manage radioactive and mixed waste.

The presenter recently overhauled the course to include an updated broker/processor directory, a variety of new recycling and disposal options, and case studies of waste disposal challenges and successes. Participants with low-level radioactive or mixed waste disposal challenges are encouraged to bring detailed descriptions of their waste for discussion of disposal options.

T-4 Understanding Ionizing Radiation Carcinogenesis

O. G. Raabe
University of California-Davis

A comparative evaluation is described for two types of radiation carcinogenesis.

Ionizing radiation induced cancer from internally deposited radionuclides is analyzed with data from human studies for Ra-226, and from laboratory animal studies for alpha radiation associated with Ra-228, Ra-226, Ra-224,

Pu-238, Pu-239, Th-228, Cf-252, Cf-249, and Am-241 and for beta radiation associated with Sr-90, Y-90, Y-91, and Ce-144. Intake routes included ingestion, inhalation, and injection.

Cancer induction risk associated with protracted ionizing radiation exposure is observed to be a rather precise function of lifetime average dose rate to the affected tissues rather than a function of cumulative dose. The lifetime effects are best described by a three-dimensional average dose-rate/time/response relationship that competes with other causes of death during an individual's lifetime. At low average dose rates the time required to induce cancer may exceed the natural lifespan yielding a lifetime virtual threshold for radiation induced cancer.

In sharp contrast the Atomic Bomb Survivor Studies display a somewhat linear relationship of proportionality between increased lifetime solid cancer rates and acute ionizing radiation exposures. Resolving this paradox involves the conclusion that two completely different carcinogenesis mechanisms are associated with these two types of exposures to ionizing radiation.

These are induction of cancer in the case of protracted exposures and promotion of carcinogenic processes in the case of single acute exposures.

T-5 Elements of Credibility for Professional Health Physicists

R. Johnson
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 PEP will also look at how people determine truth and judge credibility.

Wednesday 12:15 pm – 2:15 pm

W-1 Internal Dosimetry Developments from 1949 to 2016

D. J. Strom
Dade Moeller, an NV5 Company

Standard Man was born as an adult at the 1949 Tri-Partite Conference held at Chalk River, and has evolved through variations of Reference Man into today's 'reference family' and 'reference hermaphrodite." Although much work had been done on ingestion intakes of radium prior to 1949, and considerable attention had been given to intakes of radionuclides during the Manhattan Project, this conference was the formal beginning of the concepts, quantities, and units of the "dosimetry" of "internal emitters," as radionuclides in the body were called in the old days. This PEP class covers some history as well as applications and computations associated with radionuclides in the body (as opposed to on the body or outside of the body). The progress in ICRP Publication 130 (2015), with the additions of the NCRP wound model, the ICRP Human Alimentary Tract Model (HATM), and the revised Human Respiratory Tract Model are presented, as are the new digital phantoms, and the very unscientific decision

to average men and women. A brief discussion of the history of radon and thoron decay products is presented, along with the ICRU's latest foray into that field. Medical dosimetry (mird), dose reconstruction for compensation programs like EEOICPA, and dose reconstruction for radiation epidemiology are briefly discussed. The class emphasizes the fact that for assessment of external irradiation we do personnel dosimetry for individuals, but for assessment of internal irradiation we do dosinference (or worse, doswaggery) not on an individual, but on Reference Man. Except perhaps for tritium and the alkali metals like 40K and 137Cs, so-called internal dosimetry does not provide the dose you got and will get, but the dose Reference Hermaphrodite would have gotten had ½(he) + ½(she) inhaled, excreted, or carried a given activity, conditional on the models being correct. Course participants will be directed to numerous resources on internal dosimetry on the Internet.

W-2 Uses and Misuses of Dosimetric Terms in Patient Radiation Protection

C. Borrás
Radiological Physics and Health Services Consultant

According to the Linear Non-Threshold Dose Hypothesis, all radiation doses carry risks. To minimize them, the International Commission on Radiological Protection (ICRP), introduced many years ago the principles of practice justification, protection optimization and dose limitation, and defined the dosimetric terms: equivalent dose, effective dose, committed dose and collective effective dose. Although all these terms are based on mean absorbed dose, they cannot be measured directly; instead they are inferred using operational quantities defined by the International Commission on Radiation Units and Measurements (ICRU). To determine external exposure, ambient dose equivalent, H*(10), and directional dose equivalent, H'(0.07, Ω), are used for area monitoring; and personal dose equivalent, Hp(d), is utilized for individual monitoring. Compliance with dose limits can be ascertained with the use of properly-worn dosimeters. To link the protection and operational quantities to physical quantities which characterize the radiation field (such as tissue absorbed dose, air-kerma free-in-air and particle fluence), the ICRU advises the use of computed conversion coefficients. To assess internal exposure, the ICRP recommends the use of activity quantities in combination with dose coefficients based on physiological models and 4-D computations. The unit for all the ICRP and ICRU quantities listed above is the sievert (Sv); doses are assumed to be well below 100 mSv, and thus, only stochastic effects are considered. At doses above about 0.5-1 Sv, where tissue reactions (deterministic effects) may occur, the dosimetric quantity to use is the absorbed dose in the irradiated tissue modified by the radiobiological effectiveness of the radiation for the biological endpoint of concern. The unit is the gray (Gy). Exposures in radiotherapy are clearly expressed in absorbed dose to the irradiated tissue,and exposures in medical imaging should be expressed also in this way. Yet, many publications use the term 'patient effective dose' instead, ignoring the huge uncertainties incurred when applying population risks to individual patients. Effective dose was meant to be used in planned exposure situations to show regulatory compliance with dose limits and constraints for workers and the public. It is applied to a reference person - the terms wR and wT used in its computation are derived averages over age and gender from large populations - and it was never intended to provide a measure of risk to individuals. That measure can be assessed only by determining organ doses, a task which is not trivial. Current methods of organ dose calculations, like placing external dosimeters such as TLD or OSL on the patient's skin, making measurements in physical phantoms which simulate patients, and performing Monte Carlo radiation transport calculations using mathematical phantoms, not only are time-consuming but also they have large uncertainties. The question is whether we need to assess individual risk in order to optimize patient protection. If the goal is not to assess risk, but to reduce it, dose-related machine parameters can be measured easily and compared against previously-established diagnostic reference levels (DRLs). The ICRU recommends the following determinations: For radiography/fluoroscopy, use incident or entrance air-kerma, and for computed tomography, use CT air-kerma (or dose) index, CT air-kerma (or dose) length-product and more recently, CT size-specific dose estimate.

This course will focus on the definition and determination of quantities and units used for radiation protection in the medical field, and those which are acceptable for patient dosimetry.

W-3 A Forgotten Nuclear Accident — Bravo

C. Sun
U.S. Nuclear Regulatory Commission

This presentation is based on decades of personal experience from managing the Marshall Islands Radiological Safety Program (MIRSP) at Brookhaven National Laboratory (BNL).

It starts with the selection of Bikini Island for the US Pacific Test Ground in the Republic of Marshall Islands (RMI).

Later, on March 1, 1954, the Bravo detonated. Since then, Bikini has never been the same -- space and the people. The catastrophic event resulted (1) from unpredicted weapon yields and (2) from the nuclear debris and fallout reached to the east of many inhabited Atolls.

BNL scientists played an important role in the radiological health and medical care of exposed populations funded by the Department of Energy (DOE) for about 40 years. The MIRSP was established for bioassay monitoring and internal dose assessment. The overview will explain the dose assessment methods including whole-body counting, urinalysis and LLNL's environmental and diet/intake studies.

Finally, the presentation summarizes and analyzes the operational activity as lesson learned that could be applied and implemented to modern emergency planning and accident preparedness.

W-4 Setting Up and Operating a Radiation Instrument Calibration Facility for a Major Law Enforcement Agency

P. A. Karam
NYPD Counterterrorism

Over the last decade emergency response agencies have purchased a tremendous number of radiation detectors for use in both interdiction and emergency response capacities. Although the radiation safety community recognizes the value of annual instrument calibrations, the cost of doing so can be prohibitive for those with large numbers of instruments. In addition, the training received by most emergency responders does not include radiation safety or instrument calibration. Yet the benefits of setting up and operating an in-house calibration facility are undeniable. This PEP describes the path taken by one such agency, culminating in establishing and operating an instrument calibration facility for a major city police department. Included in this presentation will be a description of the instruments that are being calibrated, the physical space and equipment used, ALARA considerations, training police officers to calibrate instruments, and developing procedures aimed at meeting all regulatory requirements while allowing for the most efficient use of time and resources. We will also discuss the calibration goals, including the possibility that instruments must be able to meet both regulatory and evidentiary performance standards; and the fact that ANSI standards are not always consistent with these requirements – and in some cases, do not cover some particular instrumentation needs. Finally, we will discuss some of the additional work performed in our calibration laboratory (including testing new instrument designs), and some possible expansions of our role in coming years.

W-5 Overview of Nondestructive Assay Systems

J. Chapman
Oak Ridge National Laboratory

This session will present an overview of NonDestructive Assay (Assay) systems currently deployed across the U.S. for the measurement of transuranic waste. Additionally, and where applicable, measurement devices used in the "IAEA community" for the conduct of Material Control and Accountancy will be discussed. Methodology, Instrumentation, and application limitations will be discussed.

Thursday 12:15 pm – 2:15 pm

Th-1 Developing Radiation Safety Materials for Emergency Responders — Recognizing What They Need to Know and Communicating It Effectively

P. A. Karam
NYPD Counterterrorism

Emergency responders are involved in interdiction missions every day and they must also be prepared to respond to any sort of radiological event – not only the terrorist attacks we all worry about, but even relatively minor events such as vehicular accidents involving radioactive materials. It's only fair to the responders to teach them about the potential risks they might be exposed to, in addition to trying to alleviate whatever fears they might have. At the very least, it's important for responders to understand how to keep themselves safe – and how to recognize when they are in potential danger. Unfortunately, there is only a limited amount of time available for training – this makes it important to get the most utility out of every training session, and also means distilling a huge body of knowledge down to its fundamentals – and finding a way to present it that will stick with the students. In this PEP we will discuss what the responders really need to know and will review some ways to present this information – written and verbally – to help communicate the most important knowledge to the responders. In addition, we will discuss how to augment this basic training for more advanced students.

Th-2 CAP88 PC Version 4 Topics

R. J. Rosnick
U.S. Environmental Protection Agency

This lecture is an introduction to the CAP88 version 4 code, including what it does, how it does it, the models and equations used behind the scenes, how and where to download, install, and run the code, the file types and where the files would be located, etc. Also included (for more advanced users) is how to correctly interpret output reports and error logs, how to modify input files (including population files), and a more detailed explanation of the limitations of the CAP88. This course would be intended for a novice or new user, although more experienced users could also benefit from the background information.

Th-4 Decay Chain Calculations, A Primer

D. Stuenkel
Trinity Engineering Associates

Many problems encountered in health physics require the calculation of the activities of radionuclides in a decay chain or cascade at a later time based on the initial activities and/or production rates of the radionuclides in that decay chain. This PEP session presents a system of differential equations describing the decay and ingrowth of radionuclides in a decay chain along with methods to solve it. It will include discussion of both analytical solutions (i.e., the Bateman equations) and numerical methods for practical problems that involve decay branching, physical or biological removal mechanisms, and external sources. Understanding the system of differential equations describing the decay and ingrowth of radionuclides and some of the methods to solve this system of equations will help the health physicist to select an appropriate solution method when confronted with such a problem.

Th-5 A Million Ways to Fill a Bottle

R. Jones
Pacific Northwest National Laboratory

A well-rounded internal dosimetry program contains several important elements. Within the Department of Energy complex, most of these elements are heavily assessed as well as accredited. One of the least discussed, yet arguably the most critical part of an internal dosimetry program is determining who to sample. As the nuclear workforce ages and legal remedies for illness have been tested, a growing need is developing to provide defendable answers on an individual basis to the question: "why didn't I get a sample." This presentation will cover methods of integrating an internal dosimetry program into radiological work planning in order to determine how people are selected for radiobioassay sampling. Also covered is the evolution of the Pacific Northwest National Laboratory's approach from within the Hanford program to an independent service over the last generation. In addition, the presentation will provide a high-level review of the internal dosimetry program at the Pacific Northwest National Laboratory, as a separate entity from the Hanford site. Be prepared to interact with the speaker and each other.

CONTINUING EDUCATION LECTURES (CELS)

Monday 18 July through Thursday 21 July

Monday

CEL-1 Strategies for Keeping Your Radiation Safety Program on Course in a Sea of Constant Change

R. Emery, University of Texas School of Public Health

The University of Texas School of Public Health recently conducted a straw poll of approximately fifty very experienced safety professionals (inclusive of health physicists) and the results were astonishing: 80% had reported to the person they current report to for a period of less than 5 years, and 25% for a period of less than 1 year! These striking results underscore the old adage that "change is constant". But adapting to change is not something that is traditionally addressed in our academic preperation. Interestingly, although change is indeed constant, the underlying data that drives radiation safety programs doesn't change. What does change is the framing of the delivery of this important information to ensure continued program support. This presentation will discuss the dilemma of constant change and provide some tips on the personal management of change and will present options to consider for communicating essential information to the ever-changing environment.

CEL-2 Five Tools for Effective Responses to Workers, the Public, and the Media

R. Johnson, Radiation Safety Counseling Institute

Most health physicists have had extensive education in the technology of radiation safety and perhaps little in the area of risk communication and dealing with upset people. One of the reasons many of us choose health physics is because we like the technical challenges. And then we discover that from day-to-day people issues may demand more of our time and energy, and that we may not be well prepared for dealing with such issues. To help HPs better deal with people issues, this lecture will present five simple tools to consider when addressing radiation risk concerns of workers, the public, and the media. These include 1) Active Listening, which is a response that reflects the content and feeling of another person's message. In many cases when another person's feelings are really heard, their upset goes away. 2) Asking questions, rather than giving answers. When we give answers, which we are technically trained for, we may discover that others will discount our answers, or that we are actually answering the wrong questions. 3) Providing opportunities for others to answer their own questions. People have a vested interested in their own answers. 4) Staying non-defensive, recognizing defensiveness and deciding to throw back marshmallows when others are throwing rocks. 5) Options on what to say, when you do not know what to say, or what you might think of saying may cause more difficulties. Each of these tools will be presented with examples. Attendees are encouraged to bring at least one scenario to this CEL where one of or more of these communication tools may be applied. Time will be allowed for practicing these tools during this lecture, however, skill in the use of these tools will only come from continued practice.

CEL-3 Current Uses of Radiopharmaceuticals in Nuclear Medicine Therapy

M. Stabin, Vanderbilt University

A variety of radiopharmaceuticals are used in nuclear medicine therapy. The use of radioiodines to treat thyroid diseases and P-32 to treat polycythemia vera [Ferreira et al. 2007] (which is no longer in use) were established decades ago. Development and investigation of new agents is always progressing; an important issue, however, is clinical acceptance of new therapies that are intended to replace existing therapies. Resistance to change can cause difficulties in sustaining new products, as the approval process for new drugs is quite expensive, and poor market performance has caused distribution of some very good agents to be discontinued. Nonetheless, some very effective new agents have been developed recently, and the future of radiopharmaceutical therapy is bright. In this talk, we will overview the existing agents and their application. We will also review how implementation of patient-individualized dosimetry for these therapies is needed to optimize the effectiveness of these agents; at present this is not a common practice.

CEL-4 NORM/TENORM: History + Science + Common Sense = ???

W. E. Kennedy, Jr., Dade Moeller, an NV5 Company

Since the early twentieth century, beginning with the search for domestic sources of radium, it has been understood that rock formations contain primordial concentrations of naturally occurring radioactive materials (NORM). NORM includes the radionuclides associated with the uranium or thorium decay chains, and Potassium-40. These sources are all around us to some degree in rocks and soil. They are of primary concern during mineral resource recovery, where human actions modify the NORM concentrations or isotopic distributions, creating technologically enhanced NORM (TENORM). Sources of NORM/TENORM span many human activities, including: using clay for production of bricks or ceramics; mining waste from extracting rare earths or other metals such as aluminum; using heavy casting sands which potentially contain thorium; purifying drinking water, which can concentrate radium or uranium in waste; and recovering oil and gas, which can produce large volumes of TENORM waste. Most recently, there have been news reports and concerns about TENORM waste issues associated with application of newer oil and gas recovery technologies, using horizontal drilling coupled with hydraulic fracturing. The major radiation protection concerns of NORM/ TENORM are protecting workers, members of the public, and the environment similar to any activity involving radioactive materials, with one important difference: there is no Federal guidance for NORM/TENORM waste management – the regulatory authority lies with the States. Individual States are left to cope with emerging NORM/TENORM radiation protection issues on an ad hoc basis with little scientific support. As a result, State guidance and regulations vary greatly. A harmonized approach would be most beneficial. We are currently at the confluence of history, science, and common sense. This continuing education lecture will provide an overview of NORM/TENORM issues, with an eye to developments which may shape, or reshape, future industrial applications.

CEL-5 Herbert M. Parker (1910-1984): Laying the Foundations of Medical and Health Physics

R. L. Kathren, Washington State University at Tri-cities, Richland

This presentation chronicles the life and legacy of Herbert M. Parker and how his contributions have impacted the parallel professions of medical and health physics. In 1938, after six highly productive years in Manchester, England, during which he codeveloped a revolutionary cancer radiotherapy treatment system that bears his name, Parker accepted an invitation to come to Swedish Hospital in Seattle to research supervoltage x-ray therapy for cancer. Four years later, at the urging of Simeon Cantril, he joined Clinton Laboratories at Oak Ridge, serving as head and principal architect of the health physics organization and as the principal architect of the program there. Subsequently he was personally selected by Arthur Holly Compton as the best possible choice to cope with the extraordinary problems associated with plutonium production at Hanford Pu production site to which he transferred in the summer of 1944. Here, Parker developed a highly successful radiation protection program that included included the first DAC, derived for plutonium, and new quantities and units for physical and biological dose that live on today in the form of the gray and sievert. After WWII, he was instrumental in creating and managing the Hanford Laboratories whose contributions to health physics, radiation biology and environmental protection, achieved world reknown. He personally made numerous important contributions across the entire spectrum of health physics, often through the many committees on which he served, including prescient contributions in the areas of radioactive waste management, dosimetry, standards, and environmental protection. His his many honors include the HPS Distinguished Scientific Achievement Award and the AAPM Coolidge Medal and he is the only health physicist to grace the cover of the national magazine Business Week.

CEL-6 Channeling Richard Feynman: How Lessons from the Great 20th Century Physicist Can Inform and Inspire Great Health Physics in the 21st Century

M. D. Hoover, National Institute for Occupational Safety and Health

Whether working on the atomic bomb, exploring and explaining quantum physics, investigating the Challenger disaster, or declaring his prescient vision of a future for nanotechnology ("There's plenty of room at the bottom."), Richard P. Feynman (1918-1988) was an insightful and thoroughly grounded practitioner and thinker. This lecture will revisit some of the many experiences of this great 20th century physicist that can inform and inspire our pursuit of great health physics in the 21st century, especially our need to make decisions in the face of uncertainty.

Individuals planning to attend the lecture are invited to read the entertaining and informative collection of Prof. Feynman's writings The Pleasure of Finding Things Out.

Wednesday

CEL-7 Twelve Barriers to Effective Radiation Risk Communication

R. Johnson, Radiation Safety Counseling Institute

Communication specialists have identified twelve barriers or roadblocks that could interfere with our best efforts to provide helpful information to persons concerned with radiation risks. These roadblocks are called the "dirty dozen" (as defined by Dr. Thomas Gordon) and they represent our typical approaches to communications. Thus, the use of any of these approaches is not about right or wrong, but whether our normal approach opens or closes the door for further dialogue. People with concerns for radiation risks usually want their concerns (feelings) heard and to know their concerns are understood and appreciated. Feelings are an element of every communication, especially involving risks or safety. Technical people, such as specialists in radiation safety, may often miss the feeling dimension of risk communication and focus only on the technical aspects for which they have training and experience. It may seem that other person's concerns for radiation are misguided and our response may be to attempt to straighten out their misunderstandings of radiation. Would you agree that pointing out another person's errors of technical understanding may not be the best way to open a dialogue? This approach is only one of the following dozen that will be described in this lecture, including:

1. Ordering, directing, commanding
2. Warning, threatening, promising
3. Moralizing, preaching, giving shoulds and oughts
4. Advising, giving solutions, suggestions, and answers
5. Teaching, lecturing, giving logical arguments
6. Judging, criticizing, disagreeing
7. Praising or agreeing
8. Name calling, labeling, stereotyping
9. Interpreting, analyzing, diagnosing
10. Reassuring, sympathizing, consoling
11. Probing, questioning, interrogating
12. Withdrawing, distracting, humoring, sarcasm, diverting.

The common factor in each of these twelve approaches is that they all miss the feelings of the other person. We might want to remind ourselves that "People may not care how much you know, until they know how much you care." We will explore how each of these twelve approaches could be barriers that interfere with radiation risk communications.

CEL-8 Overview of Federal Resources Available for Response to a Radiological/Nuclear Accident or Incident

K. Groves, FHPS

This presentation will review those resources that the Federal Government either provides or funds to support local, regional or state entities in the event of a radiological/nuclear accident or incident. Most are provided by the Department of Defense through NORTHCOM, the Department of Energy through the NNSA's Office of Emergency Operations, and the Environmental Protection Agency's Radiological Emergency Response Team. Other Federal Agencies also provide support, including the Department of Health and Human Services through the Centers for Disease Control and Prevention, and the Department of Veterans Affairs. Federal funded State resources include the National Guard's Weapons of Mass Destruction Civil Support Teams in each state and territory. While most emergencies are local and local assets need to be able to respond in the early phase; two of the Federal response teams can respond to assist within hours; they are the DOE's Radiological Assistance Program (RAP) teams and the State's Civil Support Teams (CSTs).

Thursday

CEL-9 Communicating Radiation Safety Information to the Public, the Media, and Other Non-Health Physicists

P. A. Karam, NYPD Counterterrorism

Let's face it – most of the people we meet or communicate with don't understand radiation and are inclined to be frightened of it. And a surprisingly large number of scientists – including health physicists – either try to avoid speaking to the public or to the media or they don't do a good job of communicating what they know in a manner that the public is able (or willing) to absorb. As a result, the radiation-related stories that come out tend to be dominated by people who are either not terribly knowledgeable about radiation or who have an agenda to push. We need to do better. In this PEP, we'll discuss some of the Do's

and Don'ts of communicating radiation information to the public, drawing upon Andrew Karam's experience working with members of the media in over 100 interviews. We'll also discuss some factors to keep in mind when developing graphics for showing the public, whether for use in video interviews or for your own blog or website.

CEL-10 Radiation Dosimetry as Part of an Integrated Radiation Protection Program

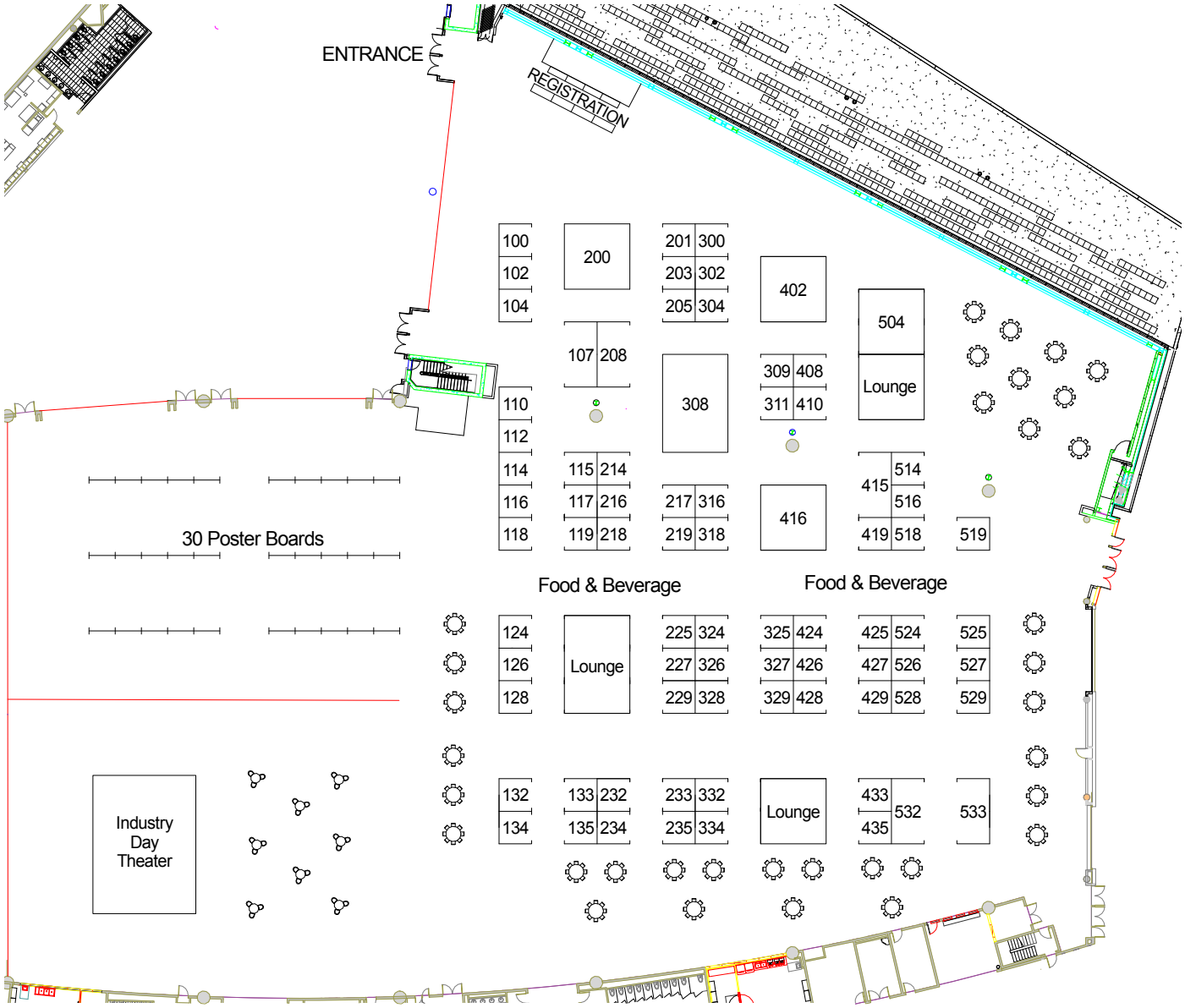
C. A. Potter, S. H. Goke, Sandia National Laboratories

Radiation protection programs are designed to provide engineered and administrative controls that prevent workers from receiving unnecessary radiation dose, whether from an external radiation field or from radioactive material that individuals may have taken internally. Radiation dosimetry programs are frequently designed with the objective being to assess and report doses to management and ultimately to regulating bodies. While this one of the important reasons for having a dosimetry program, it does not result in the possibly more important goal of preventing additional exposure following uncontrolled contamination or generation of a radiation field.

A radiation protection program can work more effectively if rather than considering workplace control and dosimetry separate tasks, the design is around defense in depth. In this paradigm, the first line of defense is the understanding of the radiation sources and the worker's procedures, including those invoked following the identification of an anomaly that could cause exposure. The second line of defense would be the periodic radiation survey program that identifies unaddressed contamination and external fields. The third line of defense is the dosimetry program.

An effective dosimetry program is well-integrated into the radiation protection program. Under normal operations it is a quality assessment on the effectiveness of the radiation survey and workplace control processes ensuring that there are not unidentified losses of control. Under abnormal operations where contaminations or exposures have occurred, it helps with recovery by identifying exposures that have occurred or are continuing and evaluating the significance. This CEL will describe experience at Sandia National Laboratories on how program integration is achieved and how feedback is looped into the workplace control process to ensure that unnecessary exposures are minimized.

2016 EXHIBIT HALL FLOOR PLAN



Breaks – Monday PM, Wednesday AM

Featuring morning continental breakfasts and afternoon refreshments. Be sure to stop by and visit with the exhibitors while enjoying your refreshments.

EXHIBITOR LISTING

2017 Annual Meeting - Raleigh, NC ..... Booth: 526
2017 Midyear Meeting - Bethesda, MD ..... Booth: 527
AAHP/ABHP ..... Booth: 529
AIHA ..... Booth: 528
Ameriphysics, LLC ..... Booth: 217
Army Medical Recruiting ..... Booth: 415
Arrow-Tech Inc. ..... Booth: 133
Bayer ..... Booth: 419
Berkeley Nucleonic Corporation ..... Booth: 424
Bertin Instruments ..... Booth: 316
Best Dosimetry Services ..... Booth: 300
Bionomics ..... Booth: 309
Bladewerx LLC ..... Booth: 525
Canberra ..... Booth: 308
Centers for Disease Control and Prevention ..... Booth: 233
Centronic LLC ..... Booth: 410
Chase Environmental Group ..... Booth: 201
ChemStaff ..... Booth: 116
Colorado State University ..... University Table
Conference of Radiation Control Program Directors, Inc. ..... Booth: 429
Dade Moeller, an NV5 Company ..... Booth: 402
Eckert & Ziegler Isotope Products ..... Booth: 208
ENVINET GmbH ..... Booth: 425
F&J Specialty Products ..... Booth: 519
FLIR Systems ..... Booth: 524
Fuji Electric Co., Ltd ..... Booth: 218
G/O Corporation ..... Booth: 518
Gamma Products ..... Booth: 110
GEL Laboratories, LLC ..... Booth: 514
H3D, Inc. ..... Booth: 114
Health Physics Instruments ..... Booth: 203
HI-Q Environmental Products Company, Inc. ..... Booth: 100
Hitachi,Ltd. ..... Booth: 327
Hopewell Designs, Inc. ..... Booth: 205
HPS Journal ..... Booth: 532
HPS Web Ops/Newsletter ..... Booth: 533
Illinois Institute of Technology ..... Booth: 232
J.L. Shepherd ..... Booth: 318
K&S Associates ..... Booth: 304
LabLogic Systems, Inc ..... Booth: 124
Landauer, Inc. ..... Booth: 416
LND, Inc. ..... Booth: 104
Ludlum Measurements ..... Booth: 200
Mazur Instruments ..... Booth: 102
Mirion Technologies ..... Booth: 504
NATS, Incorporated NATS, Inc ..... Booth: 117
NRRPT ..... Booth: 326
NSSI ..... Booth: 302
Office of Radiological Security, National Nuclear Security Administration ..... Booth: 426
ORAU ..... Booth: 427
Oregon State University ..... University Table
ORTEC ..... Booth: 107
Perkin Elmer ..... Booth: 118
Purdue University ..... University Table
Qal-Tek ..... Booth: 126
Quest Environmental & Safety Products, Inc. ..... Booth: 516
Rad Source Technologies, Inc. ..... Booth: 128
Radiation Safety & Control Services Inc (RSCS) ..... Booth: 408
Radiation Solutions Inc ..... Booth: 214
SafetyStratus ..... Booth: 329
S.E. International, INC. ..... Booth: 219
Spectral Labs Incorporated ..... Booth: 428
Spectrum Techniques ..... Booth: 216
TestAmerica Inc. ..... Booth: 229
Thermo Fisher Scientific ..... Booth: 324
Thomas Gray & Associates, Inc. ..... Booth: 119
Ultra Electronics ..... Booth: 311
Unfors RaySafe, Inc and Fluke Biomedical ..... Booth: 115
United States Transuranuium and Uranium Registeries (USTUR) ..... Booth: 325
University of Alabama at Birmingham ..... University Table
US Ecology ..... Booth: 227
US Nuclear Corp - Technical Associates ..... Booth: 112
Versant Medical Physics and Radiation Safety ..... Booth: 332
Washington State University ..... University Table
X-Z LAB, Inc. ..... Booth: 225

2016 EXHIBITORS

EXHIBIT HALL HOURS

Monday 18 July
Noon – 5:00pm

Tuesday 19 July
9:30am – 5:00pm

Wednesday 20 July
9:30am – Noon

2017 Annual Meeting — Booth: 526
Raleigh, NC

hps.org/meetings

2017 Midyear Meeting — Booth: 527
Bethesda, MD

hps.org/meetings

AAHP/ABHP — Booth: 529

www.hps1.org/aahp

AIHA — Booth: 528

3141 Fairview Park Drive, Suite 777
Falls Church, VA 22042
703-849-8888, FAX: 703-207-3561
www.aiha.org

As a sister professional organization, AIHA has the utmost respect for the Health Physics Society and its members. We share many of the same values and objectives and AIHA is pleased to continue a long-standing reciprocal partnership by joining the other exhibitors at the 2016 HPS Annual meeting.

Ameriphysics, LLC — Booth: 217

9111 Cross Park Drive, Suite D200
Knoxville, TN 37923
865-470-4176, FAX: 865-470-4179
www.ameriphysics.com

Ameriphysics, LLC is a full service radiological and waste solutions provider. Our personnel exhibit a wide range of expertise in radiation protection, waste management and health physics consulting. From simple laboratory surveys to complex cyclotron removals and MARSSIM-based decommissioning projects; Ameriphysics has the knowledge and experience to complete a variety of projects in an economical and timely manner. Ameriphysics is a SDVOSB.

Army Medical Recruiting — Booth: 415

c/o U.S. Army Medical Recruiting Brigade
1307 Third Avenue, Bldg. 1307
Fort Knox, KY 40121
888-550-ARMY, FAX: 502-626-1981
www.goarmy.com

You can make a difference in the lives of Soldiers and their families by becoming an officer on the U.S. Army health care team. Working alongside professionals at the top of their fields, you'll have access to the most advanced resources. You'll feel proud of your skills and even more proud of your service. Please visit the Army booth to learn more about part time or full time career opportunities in the United States Army.

Arrow-Tech Inc. — Booth: 133

417 Main Avenue West - PO Box 1420
Rolla, ND 58367
701-477-6461, FAX: 701-477-6464
www.dosimeter.com

Arrow-Tech, Inc. manufactures the Direct-Reading Dosimeter and offers a full-line of radiation detection equipment. Arrow-Tech maintains a world wide customer base and provides them with quality, reliable, durable products and services. Arrow-Tech provides calibration services to ANSI and NIST Standards for most types of dosimeters, survey meters and area monitors. Industries served include Health Physics, Homeland Security, First Responders, and Non-Destructive Testing, Industrial and Medical Radiography.

Bayer — Booth: 419

100 Bayer Blvd, PO Box 915
Whippany, NJ 07981
862-404-3000
www.bayerpharma.com

Bayer is a global enterprise with core competencies in the Life Science fields of health care and agriculture. Its products and services are designed to benefit people and improve their quality of life. At the same time, the Group aims to create value through innovation, growth and high earning power.

Berkeley Nucleonic Corporation — Booth: 424

2955 Kerner Blvd
San Rafael, CA 94901
415-453-9955, FAX: 415-453-9956
www.berkeleynucleonics.com

Berkeley Nucleonics Corporation is a leading solution provider for radiological detection. BNC offers a broad spectrum of radiological security products and services to industries involved in environmental monitoring, emergency response, radiation protection and counter-terrorism.

Bertin Instruments — Booth: 316

155 Gibbs Street, Suite # 533
Rockville, MD 20850
301-339-8103, FAX: 301-563-9426
www.bertin-corp.com

Based on Saphymo's strong expertise, Bertin Instruments has developed and optimized Nuclear equipment to provide state-of-the-art instrumentation for the customer. Its products are associated with personal protection as well as process and environmental monitoring: Dosimetry systems, Contamination monitors, Environmental radiation monitoring systems, Survey meters and Access control.

Best Dosimetry Services — Booth: 300

865 Easthagan Drive
Nashville, Tennessee 37217
613-591-2100
www.teambest.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.

Bionomics — Booth: 309

PO Box 817
Kingston, TN 37763
865-220-8501; FAX: 865-220-8532
www.bionomics-inc.com

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.

Bladewerx LLC — Booth: 525

4529 Arrowhead Ridge SE
Rio Rancho, NM 87124
505-892-5144
www.bladewerx.com

Bladewerx and its subsidairy Shieldwerx provide instrumentation, custom software, neutron and gamma shielding, and neutron activation foils to the radiation protection and measurement industry.

Canberra — Booth: 308

830 Research Parkway
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.

Centers for Disease Control and Prevention — Booth: 233

4770 Buford Highway, NE; Mailstop F-59
Chamblee, Georgia 30341
770-488-3800, FAX: 770-488-1539
emergency.cdc.gov/radiation

The Centers for Disease Control and Prevention Radiation Studies Branch has developed two Radiation Emergency Tool Kits to provide guidance and resources to assist state and local officials plan for and respond to radiation emergencies. For more information visit: emergency.cdc.gov/radiation or stop by booth #233 to learn how to order a free kit.

Centronic LLC — Booth: 410

16203 Park Row Suite 110
Houston , TX 77084
281-578-7900, FAX: 291-578-7902
www.Centronic.us

Centronic LLC is the leading manufacturer and distributor of gas filled radiation detectors in North America. Centronic's product lines include numerous styles of Geiger Mueller tubes, X-ray proportional counters, He-3 and BF3 neutron proportional counters and Gamma Ion Chambers.

Chase Environmental Group — Booth: 201

200 Sam Rayburn Parkway
Lenoir City, TN 37771
865-816-6015, FAX: 865-816-6251
www.chaseenv.com

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.

ChemStaff — Booth: 116

3180 Theodore Street #205
Joliet, IL 60435
800-741-5211
www.chemstaff.com

ChemStaff is an Engineering consulting company for the global power industry with core expertise in Power Plant Chemistry, Engineering, Environmental, and Health Physics Programs. ChemStaff's is comprised of 40+ full-time and contract employees with over 800 years of power plant experience. Expertise areas include Chemistry/Radiochemistry, Engineering, Thermal efficiency improvement, Laboratory and Environmental, and Source term reduction/dose control. As industry leaders, ChemStaff incorporates deep nuclear plant knowledge and process implementation skills into their chemistry program solutions.

Conference of Radiation Control Program Directors, Inc. — Booth: 429

1030 Burlington Lane, Suite 4B
Frankfort , KY 40601
502-2274543
www.crcpd.org

The Conference of Radiation Control Program Directors (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, an NV5 Company

Booth: 402

1835 Terminal Drive, Suite 200
Richland, WA 99354
509-946-0410, FAX: 509-946-4412
www.dademoeller.com

Dade Moeller, an NV5 Company, specializes in radiation protection, worker safety, industrial hygiene, environmental protection, and safety training. In addition to Certified Industrial Hygienists, Certified Safety Professionals, Professional Engineers, and others with certifications and licenses, we employ more CHPs than any other private entity. We joined NV5 in May 2016.

Eckert & Ziegler Isotope Products

Booth: 208

1380 Seaboard Industrial Blvd.
Atlanta, GA 30318
404-352-8677, FAX: 404-352-2837
www.ezag.com

Eckert & Ziegler Analytics supplies high quality, NIST traceable radioactive calibration sources and solutions. We operate 4 ISO17025 accredited calibration laboratories, three in the USA and one in Germany. Radiochemical performance evaluation samples are provided quarterly for effluent and environmental monitoring programs.

ENVINET GmbH

Booth: 425

Hans-Pinsel-Strasse 4
Haar, Bavaria 85540
Germany
+49 89 45 66 57-0, FAX: +49 89 45 66 57-820
www.envinet.com

For over 30 years, our customers have been relying on ENVINET's solutions in monitoring environmental parameters. With more than 4,500 online detectors, we are the leading manufacturer of networks for monitoring of environmental radiation. We provide:
• Nationwide Early Warning Systems
• Ring and Area Monitoring Systems
• Water Monitoring Systems
• Mobile Solutions"

F&J Specialty Products

Booth: 519

404 Cypress Road
Ocala, FL 34472
352-680-1177, FAX: 352-680-1454
www.fjspecialty.com

F&J manufactures traditional and microprocessor controlled air sampling systems, airflow calibrators, tritium collection systems and lightweight battery powered emergency response air samplers. F&J also manufactures systems for the nuclear power plant RETS-REMP compliance monitoring programs. F&J is the world's largest manufacturer of radioiodine collection cartridges, such as TEDA impregnated charcoal and silver zeolite cartridges.

FLIR Systems

Booth: 524

27700 SW Parkway Ave
Wilsonville, OR 97070
877-692-2120
www.flir.com/detection

FLIR identiFINDER R-Series products help emergency responders detect, locate and identify radioactive materials. We offer a complete line of handheld systems ranging from small belt-worn spectroscopic pagers to large highly sensitive devices capable of rapidly locating and precisely identifying radioactive material. NEW in 2016: identiFINDER R200 super-pager capable of identification.

Fuji Electric Co., Ltd

Booth: 218

Gate City Ohsaki, East Tower, 11-2, Osaki 1-chome
Shinagawa-ku, Tokyo 141-0032 Japan
+81-3-5435-7276
www.fujielectric.com/products/radiation

Fuji Electric has a sophisticated line-up of high quality Radiation Detection instrumentation, including new electronic personal dosimeters 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.

G/O Corporation — Booth: 518

70161 Highway 59, Suite "E"
Abita Springs, LA 70420
800-933-8501, FAX: 985-809-7440
www.gocorp.com

G/O Corporation is a supplier of custom designed products for the nuclear industry, the D.O.E., weapon sites, shipyards, various industrial and pharmaceutical accounts. Our distribution facility is located in Abita Springs, Louisiana. For over 28 years we have served our customers with custom made products consisting of H.P. supplies, garments, containments, barriers, all types of signage and D. Con supplies.

Gamma Products — Booth: 110

7730 W. 114th Place
Palos Hills, IL 60465
708-974-4100
www.gammaproducts.com

Gamma Products, Inc. has been designing and manufacturing scientific instruments for over 45 years. We specialize in low background α/β automatic & manual proportional counting system, gas free automatic α/β counting system, Ra226/228 & gamma automatic sample changers, lead or steel counting and storage shields.

GEL Laboratories, LLC — Booth: 514

2040 Savage Rd
Charleston , SC 29407
843-556-8171, FAX: 843-766-1178
www.gel.com

GEL Laboratoreis, LLC is a world wide provider of radiochemistry, analytical chemistry, and bioassay services.

H3D, Inc. — Booth: 114

3250 Plymouth Road, Suite 303
Ann Arbor, MI 48105
734-661-6414
www.h3dgamma.com

H3D offers the world's highest-performance gamma-ray imaging spectrometers. From storage to measurement in two minutes, we guarantee 1.0% FWHM at 662 keV and omnidirectional isotope-specific images, all in a portable package. Polaris-H is used in nuclear power plants globally, and we have products for defense, security and medical applications.

Health Physics Instruments — Booth: 203

330 So. Kellogg Avenue, Suite D
Goleta, CA 93117
805-964-3615, FAX: 805-964-3162
www.fwt.com

Health Physics Instruments manufactures instruments and detectors that measure gamma, neutron, beta, and alpha radiation. The product line includes portable neutron survey meters and Geiger-counters, sophisticated fixed monitors, rem meters, dosimeters, multichannel analyzers and custom solutions. HPI has been serving the Health Physics community for over 40 years.

HI-Q Environmental Products Company, Inc. — Booth: 100

7386 Trade Street
San Diego, CA 92121
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.

Hitachi, Ltd. — Booth: 327

2-16-1,Higashi-Ueno
Taito-ku, Toyko 110-0015 Japan
+81-3-6284-3673
www.hitachi.com/businesses/healthcare

Hitachi, Ltd provides a wide variety of radiation measuring instruments in many fields. Our products play important roles in safety management and research with radiation. Having much experience of R&D for radiation measurement, we are pleased to introduce our products to customers in health physics all over the world.

Hopewell Designs, Inc. Booth: 205

5940 Gateway Drive
Alpharetta, GA 30004
770-667-5770, FAX: 770-667-7539
www.hopewelldesigns.com

Hopewell Designs, Inc. provides automated and manual irradiator systems and radiation shielding for government laboratories, nuclear power plants, private industry, medical laboratories and universities in the Americas and throughout the world. We began operations in 1994 by designing and manufacturing the first fully automated calibration laboratory for the Department of Energy at the Savannah River Site. Today we are the primary provider of automated irradiator systems for calibrating radiation survey meters. 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 Booth: 532

www.hps.org

HPS Web Ops/Newsletter Booth: 533

www.hps.org

Illinois Institute of Technology Booth: 232

10 W. 32nd St.
Chicago, IL 60616
312-567-7973, FAX: 312-567-3802
www.science.iit.edu

Health Physics Master's Degree from Illinois Tech. SY Chen, PhD, CHP, program director. Expert faculty. Rigorous and relevant curriculum. Designed for working professionals. Input from premier advisory board. Doable online with one hands-on, weeklong course in instrumentation. Future radiochemistry track. Apply today! Visit iit.edu/health physics

J.L. Shepherd Booth: 318

1010 Arroyo St.
San Fernando, CA 91340
818-898-2361, FAX: 818-361-8095
www.jlshepherd.com

J.L. Shepherd & Associates, established in 1967, product lines include biological research, blood component, space effects testing, and sterilization gamma irradiators, gamma, beta and neutron detection instrument calibration and dosimeter irradiation facilities. Both manual and automated controls with databases are available. Security upgrades, service, repair, relocation and decommissioning for current and extinct manufacturers.

K&S Associates Booth: 304

1926 Elm Tree Drive
Nashville, TN 37210
615-883-9760, FAX: 615-871-0856
www.kslab.com

K&S Associates is a medical physics consulting organization offering accredited calibrations and TLD patient dose services. K&S is an accredited Laboratory by the AAPM offering radiation Therapy Calibrations, Brachytherapy Calibrations, and Diagnostic Equipment Calibrations. K&S is accredited by A2LA for the calibration of survey meters, kVp meters and light meters.

LabLogic Systems, Inc Booth: 124

East Pointe Park, 1040 E Brandon Blvd
Brandon, FL 33511
813-626-6848, FAX: 813-620-3708
www.lablogic.com

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.

Landauer, Inc. Booth: 416

2 Science Road
Glenwood, Illinois 60425
708-755-7000, FAX: 708-755-7011
www.landauer.com

The industry leader for more than 60 years, Landauer provides integrated radiation safety solutions, including dosimetry technology to measure radiation exposure; informatics to track and analyze radiation data; and health and medical physics consulting expertise. Landauer uniquely provides solutions to improve worker and patient safety, ensure compliance and lower costs.

LND, Inc. Booth: 104

3230 Lawson Blvd.
Oceanside, NY 11572
516-678-6141; FAX: 516-678-6704
www.lndinc.com

Designers and manufacturers of nuclear radiation detectors. Products include GM tubes, x-ray proportional counters, He-3 and BF-3 proportional counters, ionization chambers, polymer window detectors, and custom detectors.

Ludlum Measurements Booth: 200

501 Oak Street
Sweetwater, TX 79556
325-235-5494, FAX: 325-235-4672
www.ludlums.com

Ludlum Measurements, Inc. has been manufacturing radiation detection and measurement equipment since 1962. For more than 50 years LMI has developed radiation detection technologies to increase the safety of both people and the environment. Ludlum offers one of the largest lines of radiation detection instrumentation available from any single company.

Mazur Instruments Booth: 102

200 South Wilcox St #448
Castle Rock, CO 80104
303-660-5247, FAX: 303-496-6000
www.MazurInstruments.com

Mazur Instruments designs, develops and manufactures handheld survey meters used by professionals and organizations across the globe to detect, measure and monitor nuclear radiation. Made in the USA, the company's instruments are competitively priced and offer ruggedness, high reliability, outstanding battery life, autonomous data-logging, inline statistics and wireless connectivity.

Mirion Technologies Booth: 504

5000 Highlands Parkway, Suite 150
Smyrna, GA 30082
770-432-2744, FAX: 770-432-9179
www.mirion.com

Mirion Technologies Health Physics Division provides a full range of instrumentation and engineering services for health physics and radiation monitoring systems for all nuclear facilities and civil defense markets. We are #1 in North America in electronic dosimetry. Mirion Technologies Dosimetry Services Division is a worldwide leader in radiation dosimetry services. Offering the broadest array of dosimetry products in the marketplace, under the Global Dosimetry Solutions brand, we are fully accredited through several organizations.

NATS, Inc Booth: 117

511 Centerpoint Drive
Middletown, CT 06457
860-635-6820, FAX: 860-635-4962
www.nats-usa.com

NATS is a US corporation offering a complete line in radiation detection instruments and systems. The company currently offers instruments and systems used in all aspects of nuclear radiation detection and analysis. These areas include nuclear spectroscopy, radiation dosimetry, health physics, environmental analysis and in medical applications. With a Global network for sales and services NATS is present in over 25 countries with factory trained support in several US and and overseas locations.

NRRPT — Booth: 326

PO BOX 3084
Westerly, RI 99336
401-637-4811, FAX: 401-637-4822
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.

NSSI — Booth: 302

PO Box 34042
Houston, TX 77234
713-641-0391, FAX: 713-641-6153
www.nssihouston.com

NSSI has been licensed to possess, use, & process radioactive materials since 1971; obtaining its final Part B permit for hazardous, non-hazardous, & mixed waste in 1990. NSSI provides treatment options for hazardous, non-hazardous, and mixed waste. NSSI also offers Tritium Recycling as an alternative to ground disposal.

Office of Radiological Security, National Nuclear Security Administration — Booth: 426

1000 Independence Ave, SW
Washington, DC 20585
202-287-6845
www.nnsa.energy.gov/RSP

The National Nuclear Security Administration Office of Radiological Security (ORS) works with businesses and healthcare facilities to enhance the security of radioactive sources. ORD collaborates with its partners to protect sources, remove and dispose of disused sources, and reduce the reliance on sources by facilitating replacement with viable alterative technologies.

ORAU — Booth: 427

PO Box 117
Oak Ridge, TN 37831
www.orau.org

ORAU provides a variety of services in the radiological sciences: Training, environmental surveys, decommissioning, epidemiology, and, emergency response.

ORTEC — Booth: 107

801 S. Illinois Ave
Oak Ridge, TN 37831
865-483-2124, FAX: 865-425-1380
www.ortec-online.com

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.

Perkin Elmer — Booth: 118

68 Elm St
Hopkinton, MA 03086
781-663-6900
www.perkinelmer.com

PerkinElmer is a global leader focused on improving human and environmental health, for the better. We offer complete Radiometric Detection solutions for Life Science Research, Environmental Monitoring and Health Physics. Our Instruments, radiochemicals, cocktails, vials and microplates were developed together to provide you tools for your most sensitive assays.

Qal-Tek — Booth: 126

3998 Commerce Circle
Idaho Falls, Idaho 85401
208-523-5557
www.qaltek.com

Qal-Tek is a Radiation Safety company offering a comprehensive array of solutions to assist those seeking to strengthen their radiation protection programs while ensuring regulatory compliance.

Radiation Detection & Protection Products • Regulatory Compliance Licensing, Auditing, Procedure Writing, NOV Response • Radiation Safety Training• Instrument Calibration & Repair • Instrument Inventory Management

Quest Environmental & Safety Products, Inc. — Booth: 516

9892 E. 121st Street
Fishers, IN 46037
317-594-4500, FAX: 317-594-4501
www.quantumwearsuit.com

Quest® manufactures the patented Quantumwear® PPE Protective coveralls used in radiological & D&D environments to reduce the risk of PCE.

Rad Source Technologies, Inc. — Booth: 128

480 Brogdon Road, Suite 500
Suwanee, GA 30024
678-765-7900
www.radsource.com

Rad Source Technologies is the only company in the world with a comprehensive line of X-ray irradiators designed to replace self-shielded gamma sources. Products are used for irradiation of blood, small animals, cell suspensions (NEW Dedicated Cell Irraditor RS 1800), insects (SIT applications), viruses, plants, and other scientific applications.

Radiation Safety & Control Services Inc (RSCS) — Booth: 408

91 Portsmouth Ave
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, technical staffing, training, instrumentation (including sales, installation, calibration, and repair), emergency planning, and specialized radiological characterizations and measurements.

Radiation Solutions Inc — Booth: 214

5875 Whittle Road
Mississauga, Ontario L4Z 2H4
Canada
905-890-1111, FAX: 905-890-1964
www.radiationsolutions.com

Radiation Solutions Inc (RSI) is a manufacturer of low level radiation detection instruments. Specializing in large and small scale mobile systems for land vehicle, marine, airborne and stationary monitoring as well as handheld nuclide identification (RIID) units. Applications range from environmental, emergency response, security and geological mapping. The various systems offer Survey/Search, 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.

SafetyStratus — Booth: 329

714 Valley Road
Brooktondale, NY 14817
(607)280-6047
www.safetystratus.com

SafetyStratus is a cloud-based EHS software platform. Our Radioactive Management System manages the process of purchasing through disposal of radioactive materials across the campus for the purposes of tracking, safety and compliance. The key components are: Material Management, Permitting, Purchasing, Delivery, Waste Pickup, Shipment, Inventory, Assets, and Reporting.

S.E. International, Inc. — Booth: 219

PO BOX 39
Summertown, TN 38483
931-964-3561, FAX: 931-964-3564
www.seintl.com

S.E. International, Inc. is the manufacturer of the Radiation Alert® product line offering handheld ionizing radiation detection instruments for surface and air contamination. Proven to be reliable in the environmental, laboratory, research, health physics and educational fields. Come by and see our two new products, Area Monitor and Frisker.

Spectral Labs Incorporated — Booth: 428

15920 Bernardo Center Drive
San Diego, CA 92127
858-207-3727, FAX: 818-940-1736
www.spectrallabs.com

Spectral Labs Incorporated's (SLI) portfolio ranges from immersive simulation training software and apps to air particle and contraband detectors and technology interfaces. SLI's Employee Owners demonstrate a "Passion for Practical Solutions" through innovative hardware and software technologies that benefit military, responder and law enforcement customers.

Spectrum Techniques — Booth: 216

106 Union Valley Road
Oak Ridge, TN 37830
865-482-9937, FAX: 865-483-0473
www.spectrumtechniques.com

Spectrum Techniques LLC is your primary source for exempt quantity radionuclides and radiation detection and measurements instrumentation. Applications include teaching and training in nuclear medicine, health physics, chemistry, biology and nuclear engineering. See our web site at Spectrumtechniques.com for MCAs, nuclear counters, ratemeters, and disk, rod, laminated and needle sources. For the best in nuclear counting, count on Spectrum Techniques!

TestAmerica Inc. — Booth: 229

2800 George Washington Way
Richland, WA 99354
509-375-3131, FAX: 509-375-5590
www.testamericainc.com

Primary services are Environmental Radiochemistry and Radiobioassay analyses via alpha spectrometry, gamma spectrometry, alpha scintillation, gas proportional counters, liquid scintillation, kinetic phosphorescence and ICP/MS. Also offer ICP, Cr-6 via spectrophotometer and Asbestos bulk and fibers via PLM and PCM. Certifications/ Accreditations include ISO 17025, NELAP, DODELAP, AIHA and numerous states.

Thermo Fisher Scientific — Booth: 324

27 Forge Parkway
Franklin, MA 2038
800-274-4212
www.thermofisher.com/us/en/home/industrial/radiation-detection-measurement.html

From routine monitoring and surveillance to emergency response situations, our advanced, integrated radiation detection instruments mitigate the threat and keep you safe. Thermo Fisher Scientific offers radiation detection solutions that provide comprehensive, real-time monitoring, early warning and complete information in the palm of your hand. Visit Booth 324 to learn more about our complete line of solutions, including the Thermo Scientific™ RadHalo™.

Thomas Gray & Associates, Inc. — Booth: 119

1205 W Barkley Ave
Orange, CA 92868
714-997-8090, FAX: 714-997-3561
www.tgainc.com

Thomas Gray and Associates, Inc. is a licensed radioactive services company that offers a full suite of health physics consulting that includes facility decommissioning, on-site services, training, radioactive materials processing, disposal brokerage, nuclide identification, transportation, packaging, and decay-in-storage services. See www.tgainc.com for current copies of licenses, permits, and insurance certificates.

Ultra Electronics Nuclear Control Systems — Booth: 311

Lancaster Road
Ferndown Industrial Estate
Wimborne, Dorset BH21 7SQ
UK
+44 (0)44 (0) 1202 850450; FAX: +44 (0)1202 850452
www.ultra-ncs.com

Ultra Electronics NCS - Lab Impex Systems specialise in the supply of radiation detection systems to the nuclear industry. Product supplied include measurement instruments for the measurement of radioactive concentration in air and liquids. Ultra Electronics NCS - Lab Impex Systems support operating NPP's, fuel cycle facilities and decommissioning projects in the USA.

Unfors RaySafe, Inc and Fluke Biomedical — Booth: 115

86 South Street, Suite A
Hopkinton, MA 01748
508-435-5600; FAX: 508-435-5665
www.raysafe.com

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.

United States Transuranuium and Uranium Registeries (USTUR) — Booth: 325

1845 Terminal Drive, Suite 201
Richland, WA 99354
509-946-6870, FAX: 509-946-7972
www.ustur.wsu.edu

The United States Transuranium and Uranium Registries is a federal-grant program funded by the U.S. DOE since 1968. The Registries and associated National Human Radiobiology Tissue Repository is a unique resource worldwide for the comprehensive study of the biokinetics and internal dosimetry of actinide elements in the human body.

US Ecology — Booth: 227

251 E Front Street, Suite 400
Boise , Idaho 83702
800-592-5489
www.usecology.com

US Ecology is a leading North American provider of treatment and disposal of hazardous and radioactive wastes. We pioneered low-activity radioactive waste disposal at non-licensed waste disposal facilities enabling us to manage NORM/TENORM and exempt radioactive materials in support of cleanup and remediation projects across the country.

US Nuclear Corp Technical Associates — Booth: 112

7051 Eton Ave.
Canoga Park, CA 91303
818-883-7043, FAX: 818-883-6103
www.tech-associates.com

US Nuclear Corp features drone mounted radiation detectors for Alpha, Beta, Gamma. Real-time continuous liquid & effluent monitors, & Tritium monitors with outstanding quality & longevity. Aerial Radiation Detection includes plume detection, search & location tool, anti-smuggling, FlyCamUAV's Cypher 6 Hexcopter drone, and wireless download. US Nuclear Corp & its subsidiaries is publicly traded ticker UCLE.

Versant Medical Physics and Radiation Safety — Booth: 332

251 N Rose Street, #200
Kalamazoo , MI 49007
888 316 3644
www.versantphysics.com

Versant Medical Physics and Radiation Safety is a health service support company, focusing on medical physics, radiation safety, and commissioning through expert consultation and training. Our core values are integrity, enpowerment, and diligence. We are a woman-owned small business providing services throughout the US.

X-Z LAB, Inc. — Booth: 225

2440 Camino Ramon Suite 264
San Ramon, CA 94583
925-359-6908 , FAX: 925-380-6784
www.x-zlab.com

X-Z LAB, Inc., is an engineering company based in California, with research and development as well as design and manufacturing capabilities in China. X-Z LAB provides radiation detection solutions based on All Digital X-Plor Technology consisting of our patented multi-voltage threshold (MVT) algorithm and solid-state silicon photomultiplier (SiPM). X-Z LAB has pioneered the production of its detector technology in high-volume, industry-standard semiconductor fabrication facilities, delivering unprecedented performance, uniformity, quality, reliability, and low cost.

UNIVERSITY TABLES

Colorado State University

Colorado State University offers both PhD and an ABET accredited MS program in in health physics, as well as concentrations in radioecology and radiochemistry. We have an established relationship with Fukushima University where many of our students perform their research. Most students are supported via grants from multiple agencies.

Oregon State University

The School of Nuclear Science and Engineering (NSE) at Oregon State University supports nationally recognized programs at the undergraduate and graduate level in health physics and nuclear engineering. NSE is known for its cutting edge research, large-scale test facilities, international footprint and industry and governmental partnerships.

Purdue University

Purdue University's School of Health Sciences is committed to creating, disseminating, preserving and applying knowledge in the areas of Radiological, Occupational and Environmental Health Science through leading-edge scholarly research, teaching and engagement. The School offers a long-standing and nationally recognized educational program in Radiological Health Science (Health Physics).

University of Alabama at Birmingham

The new Master of Science in Health Physics Program is the only one of its kind in Alabama, and offers a rigorous academic curriculum supplemented by hands-on training opportunities at our cyclotron and other medical facilitates. Our faculty are invested in your success. Visit us at uab.edu/shp/cds/health-physics, and apply today.

Washington State University

The Graduate Certificate in Radiation Protection at WSU/TC is new, so new that a few more approvals are needed. However, students can start enrolling in graduate classes that will earn the certificate. The objective of the program is to give students a cluster of graduate courses that will allow them to contribute to projects with significant radiation components with little time needed to come up to speed.

WORKS-IN-PROGRESS ABSTRACTS

P.38 Dynamic Modeling of Cesium in an Eutrophic Lake through Deterministic and Stochastic Methods

Miller, V, Jeong, H, Johnson, T, Pinder, J
Colorado State University

An experimental addition of an acute input of Cs-133 to a eutrophic lake in South Carolina, USA, provided the opportunity to obtain a robust set of biota and water Cs measurements and biomass estimates that subsequently allowed for the modeling and evaluation of the kinetic behavior of Cs in the lake ecosystem. A deterministic compartment model is proposed for the major flow paths of Cs through the different trophic levels of this lake. The model estimates uptake, loss, and transfer coefficients between the different compartments through evaluating the solutions to a proposed set of differential equations. The ability to determine transfer coefficients within the proposed lake food web allows for a kinetic evaluation of the Cs behavior that is not possible with uptake and loss rates alone. A Markov Chain simulation of the lake behavior using the deterministic model results allow for further evaluation of the kinetic behavior. An assessment of the transfer parameters and their uncertainty may also be able to be derived through a Bayesian Inference approach. A benefit of the Bayesian approach is that prior knowledge on the behavior of Cs flow in a lake system can incorporated in the model. Given the data provided from the lake study and an appropriate prior distribution, a posterior distribution that displays the uncertainty in the results can be obtained. Additionally, the method of approximate Bayesian computation is evaluated to see if the parameters and their uncertainties may be estimated simultaneously. It is anticipated that the coefficients obtained through the Bayesian approach will have the additional benefit of an associated uncertainty distribution for each parameter, and this will be useful for better understanding the kinetic behavior of Cs-133 in the lake.

P.39 NRC's Implementation of its Jurisdiction over the Remediation of Military Radium

Chang, R., Jackson, T.*
USNRC

The Energy Policy Act of 2005 redefined the term "byproduct material", putting discrete sources of radium 226 under the jurisdiction of the US Nuclear Regulatory Commission (NRC) and Agreement States, including any source produced for use in a commercial, medical, or research activity. New regulations became effective during 2007 in NRC jurisdiction, including applicable military materials used similarly to commercial situations. Specifically excluded from regulation were military operational uses of radium 226, such as combat and related training. NRC's jurisdiction over radium contamination and items and equipment is summarized in Regulatory Issue Summary 2016-06. NRC and the Department of Defense (DoD) finalized a Memorandum of Understanding (MOU) for NRC's involvement with DoD's remediation of radium and other unlicensed radioactive material under the CERCLA process. The MOU defines a comprehensive and consistent process for all DoD services and which will avoid dual regulation of activities. Under the MOU, NRC may adopt a "stay-informed" or "monitoring" role instead of licensing. This poster presents information on what constitutes these "stay-informed" and "monitoring" roles, and describes how the NRC plans to work with Agreement States as the new MOU is put into practice.

P.40 Alpha Air Sample Counting Efficiency versus Dust Loading: Evaluation of a Large Data Set

Hogue, M., Slack, T., Smiley, J. Owensby, B., Gause-Lott, S.
SRNS

Dust loading on air sample filters is known to cause loss of efficiency for direct counting of alpha activity on the filters. A large database of air sample results at the Savannah River Site is examined to evaluate the impact of dust loading on alpha activity. Dust loading data is not directly available, so sample volume is used as a proxy measure. The review uses ratios of beta and alpha activity in a plutonium facility.

The need for additional correction for dust loading is examined rather than the total correction factor. Total correction factor would also include such considerations as attenuation due to filter penetration, particle self-attenuation and sampling efficiency.

Statistically significant losses of alpha activity are observed based on beta to alpha ratios and confirmed based on reported activity concentrations. The technique used is to match the distribution of activity ratios (beta/(beta + alpha) in one volume range to that of another volume

range by testing a range of correction factors on the alpha result. The best-fit results with this method are compared to reported activity concentrations. Both methods suggest a very close match for an additional correction factor.

P.41 The Uptake and Translocation of Tc, I, Cs, Np and U into Andropogon Virginicus

Montgomery, D., Edayilam, N., Tharayil, N. Martinez, N., Powell, B.
Clemson University

The purpose of this work is to quantify the uptake of Tc-99, Cs-133 (stable analog for Cs-137), I-127 (stable analog for I-131), Np-237 and U-238 into the grass species Andropogon virginicus in order to elucidate the potential for plant mediated upward migration in Savannah River Site soil columns as well as translocation in the plants themselves. These risk driving radionuclides were chosen for their wide range of biogeochemical behaviors and A. virginicus was selected as it is a common ground covering at the Savannah River Site and in the Southeastern United States. Hydroponic experiments in a laboratory setting were used to determine the potential for A. virginicus to physically take up the nuclides, giving insight into the mechanisms that may cause previously observed upward soil column migration. The hydroponic studies consisted of growing established A. virginicus specimens in Hoagland nutrient solution containing the aforementioned nuclides under a 12 hour light cycle with plants being harvested in groups of four at 24 hours, three days and five days. Analysis of nutrient solution and plant material was conducted through inductively coupled plasma mass spectrometry, liquid scintillation counting and autoradiography to compare uptake and translocation between the three different exposure times. Preliminary results from autoradiography and liquid scintillation counting show that technetium is readily taken up into the plant; concentration ratios for Tc-99 in the shoots ranged from 6.13 to 16.57 L/kg and in the roots from 1.45 to 8.82 L/kg. Analysis of Np-237, U-238, Cs-133 and I-127 content are currently in progress. Studies are also being conducted to investigate the influence of plant life stage and growth in natural light on uptake. Results of this study inform ongoing studies on the uptake, translocation and migration behavior of nuclides in small soil columns and in field lysimeters.

P.42 Survival Guidelines for Journalists Reporting on Significant Radiation Incidents

MacKenzie, C.
University of California, Berkeley

It is a journalist's job to be on the front lines and report important information to the public on significant events in a timely manner. Because of this, journalists may find themselves vulnerable to unexpected hazards as they carry out their job duties. These survival guidelines for journalists reporting on radiation incidents are intended to both instruct in the critical basic information that is needed to protect themselves and to convey accurate information to the public on this topic. In the case of a significant radiation incident, providing the public with accurate timely information on actions they can take to protect themselves is critical to their protection. Journalists have an indispensable role to play in communicating this factual information and these survival guidelines are intended to help with the dissemination of this information. These guidelines were developed with input from a group of international journalists who participated in the Rotterdam Nuclear Security Workshop for International Journalists organized by Atomic Reporters and the Stanley Foundation in early 2016.

P.43 Assessing the Use of Photon Fluence Calculations for Simple And Reasonable Dose Estimations in an Industrial Radiation Accident in Nanjing, China

Steiner, J., Donahue, W., DiTusa, R. Wang, W., Yu, N., Jia, G.
Louisiana State University, Institute of Radiation Protection - Nanjing

Intro/Purpose: In 2014, the maximally exposed individual (MEI) carried a 26 Ci Ir-192 source near their thigh for several hours in Nanjing, China. This work tests the accuracy of photon fluence calculations for fast, simple dose estimation compared to Monte Carlo calculations.

Methods: Dose was computed to the MEI using two Monte Carlo (MC) codes, EGSnrc and Geant4, and determining photon fluence to convert to dose. Dose was calculated to critical structures within the MEI's CT data set.

Results: Preliminary results using the standard MIRD phantom showed agreement between MC and fluence calculations, such as the thigh surface dose of 160.8 Gy (MC) and 143.5 Gy (fluence calculations). It is expected that utilization of the CT data will show similar agreement.

Conclusion: Simple fluence conversions agreed with more time-intensive MC calculations. These simple methods can be used by the health physicist to reasonably and efficiently estimate dose in emergency situations.

P.44 Direct Surface Contamination Measurement of Low Energy Beta and Electron Capture Isotopes

Iwatschenko-Borho, M., Loew, R.
Thermo Fisher Scientific Messtechnik GmbH

Most surface contamination survey meters have a very low sensitivity for electron capture and low energy beta emitters. While some of those activation products, e.g. Mn-54 and Cr-51 can be measured via gamma spectroscopy, others such as Fe-55 and Ni-63 are very hard to detect and may require laboratory analysis via liquid scintillation techniques. This work proposes the direct measurement of the related surface contamination by a dual scintillation probe in a new measuring mode as a fast and straightforward alternative. This new mode can be alternatively selected and complements the normal usage of a dual probe for beta / alpha discrimination. Compared to most conventional beta/gamma friskers an order of magnitude enhancement of detection sensitivity can be achieved for hard-to-detect-isotopes. Beyond the huge improvement in the measurement of electron capture nuclides and beta emitters with maximum energy < 100 keV, a significant enhancement of the signal to noise ratio under high gamma background conditions of up to 50 µSv/h is achieved for further isotopes such as C-14 (or S-35) with maximum beta energy < 200 keV. Additionally it is shown, that this new operation mode provides direct insight into the average beta energy of the contamination.

P.45 Methodology for Calculating External Dose Coefficients for Multiple Exposure Geometries for Improvised Nuclear Device Radionuclides

Kamboj, S., Wang, C., LePoire, D. Yu, C., Favret, D.
Argonne National Laboratory, US Department of Energy

The RESRAD-BUILD code was used in the past to calculate the external dose coefficients (DCs) for multiple exposure geometries for radiological dispersal device (RDD) radionuclides. The external dose model in RESRAD-BUILD code for area and volume sources is based on a semi-infinite slab source with corrections for geometrical factors. The geometrical factors account for finite source area, source thickness, shielding between the source and receptor, source and shielding materials, and position of receptor relative to the source. Argonne is currently updating its RESRAD-RDD software tool to include Improvised Nuclear Device (IND) radionuclides. The current version of the RESRAD-BUILD code does not have many IND radionuclides and also does not have the DCs based on the International Commission on Radiological Protection's ICRP 60 methodology and its ICRP 107 nuclide decay data. The RESRAD family of codes has multiple files in the database that contain information about the DCs, transfer factors, slope factors, depth and cover factors, and area and shape factors. Only some of the information contained in the database is relevant in estimating the instantaneous external dose at time zero (the information required for external DCs for IND radionuclides). To obtain the IND external DCs for multiple geometries based on the ICRP 60 methodology and ICRP 107 nuclide decay data, IND radionuclides were added to the RESRAD-BUILD code, and two database files that contain information on the DCs, depth and cover factor, and area and shape factors were modified. The revised RESRAD-BUILD code was run to obtain the direct external dose from unit concentration of each IND radionuclide. A separate run was made for each of multiple geometries. The external DCs generated from the code for IND radionuclides for different geometries will be discussed.

P.46 Modeling Submerged Contamination Source in RESRAD-OFFSITE

Gnanapragasam, E., Yu, C.*, Favret, D.
Argonne National Laboratory, US Department of Energy

The RESRAD-OFFSITE code, Version 3.2, has formulations to model a submerged primary contamination source. The primary contamination may be either partially or completely submerged. In a partially submerged scenario, part of contamination may be above the water table, whereas the rest of it is below the water table. In the fully submerged case, the contamination source is constrained to be located right beneath the water table, that is, with its top at the water table. This submerged source-term feature was developed under the sponsorship of the U.S. Department of Energy. RESRAD-OFFSITE is a computer code to calculate the radiological consequences (exposure, radiological dose and risk, and environmental concentrations) to a receptor located outside the primary contamination area. The code considers releases to air, ground water, and surface runoff when computing the radiological consequences from a uniformly contaminated area of fixed dimensions. The code models the release resulting from moisture that flows through the primary contamination, including both the infiltration from the top of the primary contamination and

the aquifer flow from the upgradient side of the primary contamination. Any of the release mechanisms available in the RESRAD-OFFSITE code can be applied to the submerged primary contamination. The code models the transport of the nuclides, vertically in the unsubmerged part of the primary contamination and horizontally in the submerged part of the primary contamination. The code also allows either or both parts of the primary contamination to be subdivided to better model the transport of the progeny nuclides produced during transport. The conceptualization of the release, specifically the dilution and transport, both within the primary contamination and in the offsite aquifer, will be presented. Sample plots of dose from primary contaminations that are submerged to different degrees will also be presented for the different release mechanisms in the code.

P.47 Reassessment of Empirical Resuspension Factors Following Radionuclide Release

Marshall, S., Medich, D., Potter, C.
Worcester Polytechnic Institute, Sandia National Laboratories

A recent analysis of historical radionuclide resuspension datasets confirmed the general applicability of the Anspaugh and modified Anspaugh models of resuspension factors following both controlled and unintended releases. The observations appear to increase in variance earlier in time, however all points were equally weighted in statistical fit calculations, inducing a positive skewing of resuspension coefficients. Such data are extracted from the available deposition experiments spanning 2900 days. Measurements within a ~3-day window are grouped into singular sample sets to construct standard deviations. A refitting is performed using a relative instrumental weighting of the observations. The resulting best-fit equations produces tamer exponentials which give decreased integrated resuspension factor values relative to those reported by Anspaugh. As expected, the fits attenuate greater error amongst the data at earlier time. The reevaluation provides a sharper contrast between the empirical models, and reaffirms their deficiencies in the short-lived timeframe wherein the dynamics of particulate dispersion dominate the resuspension process.

AUTHOR INDEX

-M-

-N-

-O-

-P-

-Q-

-R-

-S-

-T-

-U-

-V-

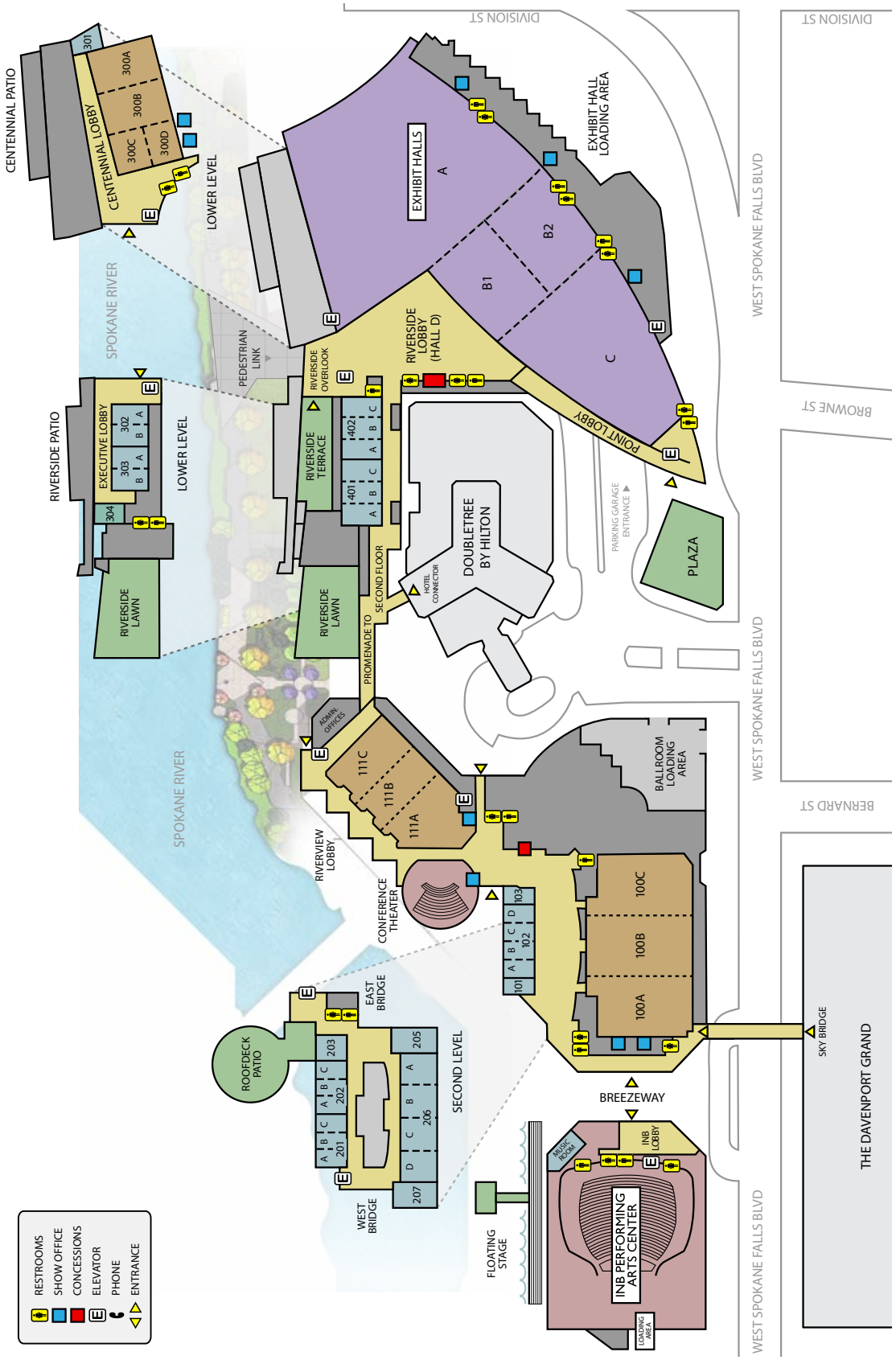
-W-

-X-

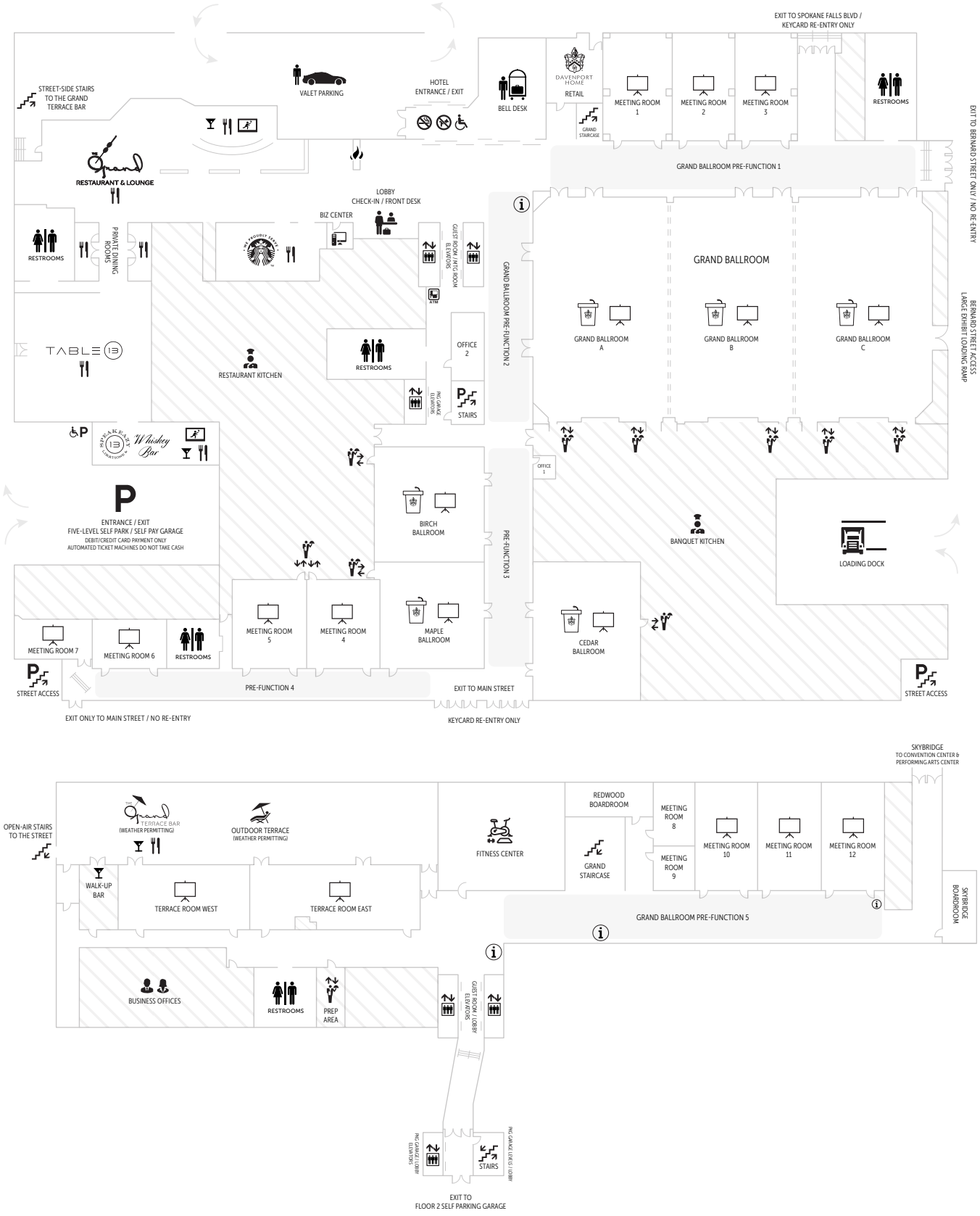
-Y-

-Z-

SPOKANE CONVENTION CENTER FLOOR PLAN



DAVENPORT GRAND HOTEL FLOOR PLAN



SCHEDULE AT-A-GLANCE

Saturday, 16 July

All AAHP Courses take place at the Davenport Grand

AAHP 1 The Role of a Radiological Operations Support Specialist (ROSS)
8:00 AM-5:00 PM — Meeting Room 10

AAHP 2 Lessons in Communication from HPS's Ask the Experts
8:00 AM-5:00 PM — Meeting Room 11

AAHP 3 How Randomness Affects Understanding of Radiation Risk Assessments and Decisions for Radiation Safety
8:00 AM-5:00 PM — Meeting Room 12

Sunday, 17 July

All Sunday PEP Courses take place at the Convention Center

(Monday-Thursday PEPs take place in the Convention Center)

PEP 1-A thru 1-H
8:00-10:00 AM

PEP 2-A thru 2-H
10:30 AM-12:30 PM

PEP 3-A thru 3-H
2:00-4:00 PM

Welcome Reception
6:00-7:30 PM
Davenport Grand

Sunday PEP Locations

PEP A = Room 201 ABC
PEP B = Room 202 ABC
PEP C = Room 205
PEP D = Room 206 A
PEP E = Room 206 B
PEP F = Room 206 C
PEP G = Room 206 D
PEP H = Room 207

Monday-Thursday PEP Locations

1 - Room 207
2 - Room 206 A
3 - Room 206 B
4 - Room 206 C
5 - Room 206 D

KEY

MAM = Monday AM Session
MPM = Monday PM Session
TAM = Tuesday AM Session
TPM = Tuesday PM Session
WAM = Wed. AM Session
WPM = Wed. PM Session
THAM = Thurs. AM Session
THPM = Thurs. PM Session

Monday, 18 July

CEL1 Strategies for Keeping Your Radiation Safety Program on Course in a Sea of Constant Change
7:00-8:00 AM — Room 205

CEL2 Five Tools for Effective Responses to Workers, the Public, and the Media
7:00-8:00 AM — Room 206 A

CEL 3 Current Uses of Radiopharmaceuticals in Nuclear Medicine Therapy
7:00-8:00 AM — Room 206 B

ABHP Exam – Part 1
8:00-11:00 AM — Grand A (D)

MAM-A Plenary
8:00 AM-Noon — Ballroom 100 AB

Complimentary Lunch in Exhibit Hall for all Registrants and Opening of Exhibits
12:15-1:30 PM — Exhibit Hall AB

PEP Program — 12:15-2:15 PM

M-1 Neutrons – Discovery and Application

M-2 Radiation Safety's Role in Mitigating the "Insider Threat" Risk

M-3 How Randomness Affects Our Decisions for Radiation Safety

M-4 Radiation Safety Instruments for Emergency Responders – What Responders Need and How the Instruments are Used

M-5 Radiation Safety's Role in Mitigating the "Insider Threat" Risk

ABHP Exam – Part II
12:30-6:30 PM — Grand A (D)

Poster Session
1:00-3:00 PM — Exhibit Hall AB

MPM-A Special Session: Updating NCRP's General Recommendations
3:00-4:30 PM — Room 100 C

MPM-B Special Session: HPS wants Your Vision for Future Meeting
3:00-4:45 PM — Room 111 A

MPM-C1 Radiobiology/Biological Response
3:15-4:00 PM — Room 111 B

MPM-C2 Radiation Effects
4:00-5:00 PM — Room 111 B

MPM-D Academic
3:00-4:30 PM — Room 111 C

MPM-E Decommissioning & Decontamination
3:00-4:30 PM — Conference Theater

MPM-F Instrumentation
3:00-4:30 PM — Room 207

MPM-G Power Reactors/Waste Management
3:00-4:45 PM — Room 205

Student/Mentor Reception
5:30-6:30 PM — Meeting Room 1 (D)

Tuesday, 19 July

CEL4 NORM/TENORM: History + Science + Common Sense = ???
7:00-8:00 AM — Room 205

CEL5 Herbert M. Parker (1910-1984): Laying the Foundations of Med and HP
7:00-8:00 AM — Room 206 A

CEL6 Channeling Richard Feynman: How Lessons from the Great 20th ...
7:00-8:00 AM — Room 206 B

PID Poster Session: Industry Day
9:30 AM-4:30 PM — Exhibit Hall

TAM-A Special Sess: USTUR: 5 Decade Follow-up of Plutonium & Uranium Workers
8:30-10:00 AM — Room 100 C

TAM-A1 Technical Session I: USTUR Internal Research
10:30 AM-Noon — Room 100 C

TAM-B Special Sess: Sealed Source D&D
8:15 AM - Noon — Room 111 A

TAM-C Special Session: Environ Radon
8:30 AM-Noon — Room 111 B

TAM-D Special Session: Accelerator
9:45 AM - Noon — Room 111 C

TAM-E Special Session: AAHP - Nuclear Weapons - Present and Past Hazards, Part I
8:30 AM - Noon — Conference Theater

TAM-F Interactive Session: Industry Day
8:00-10:00 AM — Exhibit Hall B

TAM-G NORM/TENORM Industry Day
10:00 AM - Noon — Room 205

AAHP Awards Luncheon
Noon-2:00 PM — Room 202 ABC

Complimentary Lunch — Exhibit Hall

PEP Program — 12:15-2:15 PM

T-1 Nanotechnology and Radiation Safety

T-2 Estimating Patient Peak Skin Dose from DICOM Information for Fluoroscopically Guided Interventional Procedures

T-3 A Contemporary Approach to Managing Low-Level Radioactive and Mixed Waste at an Academic Institution

T-4 Understanding Ionizing Radiation Carcinogenesis

T-5 Elements of Credibility for Professional Health Physicists

TPM-A Technical Session II: USTUR Collaborative Research
2:30-5:00 PM — Room 100 C

TPM-B Special Session: Future Challenges
2:30-5:10 PM — Room 111 A

TPM-C Special Session: NESHAPS/RADAIR
2:30-5:15 PM — Room 111 B

TPM-D Special Session: AIRRS
2:30 - 5:00 PM — Room 111 C

TPM-E Special Session: AAHP...Part 2
2:30-5:00 PM — Conference Theater

TPM-F Interactive Session: Industry Day
2:30-5:00 PM — Exhibit Hall B

AAHP Open Meeting
4:30 PM — Conference Theater

HPS Awards Banquet
7:00-9:00 PM — Grand Ballroom AB

Wednesday, 20 July

CEL7 Twelve Barriers to Effective Radiation Risk Communication
7:00-8:00 AM — Room 205

CEL8 Overview of Federal Resources Available for Response to a Radiological/Nuclear Accident or Incident
7:00-8:00 AM — Room 206 A

WAM-A Special Session: Homeland Security
8:30-11:45 AM — Room 100 C

WAM-B External Dosimetry
8:30-11:45 AM — Room 111 A

WAM-C Special Session: Medical Health Physics
8:30 AM-Noon — Room 111 B

WAM-D Special Session: Supporting Decisionmaking with Non-Technical Language
8:30 AM - Noon — Room 111 C

WAM-E Special Session: McCluskey Room
8:30 AM - Noon — Conference Theater

WAM-F Special Session: Nanotechnology
8:30-10:30 AM — Room 205

PEP Program — 12:15-2:15 PM

W-1 Internal Dosimetry Developments from 1949 to 2016

W-2 Uses and Misuses of Dosimetric Terms in Patient Radiation Protection

W-3 A Forgotten Nuclear Accident — Bravo

W-4 Setting Up and Operating a Radiation Instrument Calibration Facility for a Major Law Enforcement Agency

W-5 Overview of Nondestructive Assay

WPM-A Special Session: Homeland Security
2:30-5:00 PM — Room 100 C

WPM-B1 Internal Dosimetry
2:30-3:45 PM — Room 111 A

WPM-B2 Dose Reconstruction
4:00-5:15 PM — Room 111 A

WPM-C Environmental 1
2:45-4:45 PM — Room 111 B

WPM-D Special Session: Radiation Protection History & Culture
2:15-5:00 PM — Room 111 C

WPM-E Special Session: Power Reactor Health Physics & NRRPT
2:15-5:00 PM — Conference Theater

HPS Business Meeting
5:30-6:30 PM — Conference Theater

Thursday, 21 July

CEL9 Communicating Radiation Safety Information to the Public, the Media, and Other Non-Health Physicists
7:00-8:00 AM — Room 205

CEL10 Radiation Dosimetry as Part of an Integrated Radiation Protection Program
7:00-8:00 AM — Room 206 A

THAM-A Medical Health Physics, 1
8:30 AM - Noon — Room 100 C

THAM-B Environmental 2
8:30 AM - Noon — Room 111 A

THAM-C Emergency Response I
8:30-11:30 AM — Room 111 B

THAM-D Movies
8:30 AM - 5:00 PM — Conference Theater

PEP Program — 12:15-2:15 PM

Th-1 Developing Radiation Safety Materials for Emergency Responders — Recognizing What They Need to Know and Communicating It Effectively

Th-2 CAP88 PC Version 4 Topics

Th-3 Developing a Laser Safety Program—Where Does a Health Physicist Begin and How Do You Establish a Program from Scratch?

Th-4 Decay Chain Calculations, A Primer

THPM-A1 Medical Health Physics, 2
2:30-4:00 PM — Room 100 C

THPM-A2 Regulatory Licensing
4:15-5:15 PM — Room 100 C

THPM-B Sources and Irradiation
2:30-4:30 PM — Room 111 A

THPM-C1 Emergency Response II
2:30-3:15 PM — Room 111 B

THPM-C2 Homeland Security
3:45-4:45 PM — Room 111 B

Registration Hours

Registration at the Spokane Convention Center

Saturday	2:00 - 5:00 PM
Sunday	7:30 AM - 5:00 PM
Monday	8:00 AM - 4:00 PM
Tuesday	8:00 AM - 4:00 PM
Wednesday	8:00 AM - 4:00 PM
Thursday	8:00 - 11:00 AM

Exhibit Hall Hours

Exhibit Hall A/B

Monday	Noon - 5:00 PM
Tuesday	9:30 AM - 5:00 PM
Wednesday	9:30 AM - Noon

BUSINESS MEETINGS

MONDAY

4:30 PM — Conference Theater
Decommissioning Section Business Meeting

TUESDAY

11:30 AM — Room 111 B
Environmental Radon Business Meeting

11:45 AM — Room 111 C
Accelerator Section Business Meeting

1:00 PM — Room 111 A
Non-Ionizing Radiation Section Business Meeting

4:30 PM — Conference Theater
AAHP Business Meeting

4:30 PM — Room 111 C
AIRRS Business Meeting

WEDNESDAY

10:30 AM — Room 205
Nanotechnology Section Business Meeting

2:30 PM — Room 100 C
Homeland Security Business Meeting

THURSDAY

Noon — Room 100 C
Medical Section Business Meeting

NOTE FOR CHPs

The American Academy of Health Physics has approved the following meeting-related activities for continuing education credits for CHPs:

- Meeting attendance is granted 1 CEC per contact hour, excluding meals and business meetings;
- AAHP 8-hour courses are granted 16 CECs each;
- HPS 2-hour PEP courses are granted 4 CECs each;
- HPS 1-hour CELs are granted 2 CECs each.