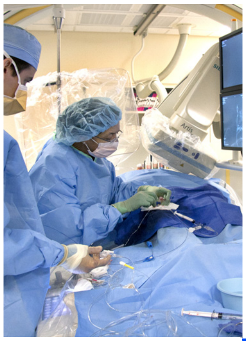

Forty-Eighth
Annual Meeting Program

Emerging Issues in Radiation Protection in Medicine, Emergency Response, and the Nuclear Fuel Cycle

March 12–13, 2012

Hyatt Regency Bethesda
One Bethesda Metro Center
7400 Wisconsin Avenue
Bethesda, MD 20814

NCRP®
National Council on Radiation Protection & Measurements

Top: Physicians performing an interventional-radiology procedure [provided by Henry Douglas, Yale University].

Middle: TEPCO photo of the Fukushima Daiichi Nuclear Facility [http://www.tepco.co.jp/en/news/gallery/nuclear-e.html, accessed January 23, 2012].

Bottom: Emergency response personnel at the entrance to the 20 km exclusion zone around the damaged Fukushima Daiichi Nuclear Facility [provided by Steven M. Becker, University of Alabama at Birmingham].

Introduction

Emerging Issues in Radiation Protection in Medicine, Emergency Response, and the Nuclear Fuel Cycle

Forty-Eighth Annual Meeting of the National Council on Radiation Protection and Measurements (NCRP)

Two recent events have focused public and governmental attention on issues surrounding the increasing use of ionizing radiation in medicine and industry. The first was the publication of NCRP Report No. 160, *Ionizing Radiation Exposure of the Population of the United States* (2009), which showed that medical exposures now account for about 50 % of the annual radiation dose received by the entire population of the United States. The second was the accident at the Fukushima Daiichi nuclear reactors and spent-fuel storage facilities in March of 2011. The 2012 Annual Meeting of the National Council on Radiation Protection and Measurements (NCRP) will focus on these events and the resulting societal issues.

The meeting will begin with a session on medical exposures, with a discussion of the latest recommendations of the International Commission on Radiological Protection, the development of a safety culture in radiation oncology, patient protection in interventional radiology, and standardization of nomenclature and protocols in computed tomography scanning.

Turning to the Fukushima accident, the meeting will discuss the circumstances of the accidents and lessons learned, its environmental and community impacts, and guidance for developing community resilience for such events. Finally, the emergency response provided by U.S. federal agencies will be described, including speakers from the Centers for Disease Control and Prevention, the National Nuclear Security Administration, and others.

Each session will include a panel discussion by the invited speakers, with an opportunity for questions and comments from the attendees. The meeting is open to all individuals with an interest in radiation protection and measurements.

Monday, March 12, 2012

Opening Session

8:15 am **Welcome**
Thomas S. Tenforde, *President*

Ninth Annual Warren K. Sinclair Keynote Address

8:30 am **Childhood Exposure: An Issue from Computed Tomography Scans to Fukushima**
Fred A. Mettler, Jr.
New Mexico Federal Regional Medical Center

Radiation Protection of the Patient: An Integral Part of Quality of Care

Julie E.K. Timins, *Session Chair*

9:30 am **Radiological Protection of the Patient: An Integral Part of Quality of Care**
Claire Cousins
Addenbrooke's Hospital NHS Trust, United Kingdom

10:00 am **Enhancing Safety in Radiation Therapy: Structural and Cultural Underpinnings**
Michael Steinberg
University of California–Los Angeles

10:30 am **Break**

10:50 am **Efforts to Optimize Radiation Protection in Interventional Fluoroscopy**
Donald L. Miller
U.S. Food and Drug Administration

11:20 am **Standardization Versus Individualization: How Each Contributes to Managing Radiation Dose in Computed Tomography**
Cynthia H. McCollough
Mayo Clinic

11:50 am **Q&A**

12:20 pm **Lunch**

Implications of the Fukushima Daiichi Accident for Radiation Protection: Part I

Steven M. Becker, *Session Chair*

1:45 pm **What Happened at Fukushima and Lessons Learned**
Michael L. Corradini
University of Wisonsin–Madison

2:25 pm **Fukushima Daiichi Accident: Community Impacts and Responses**
Steven M. Becker
University of Alabama at Birmingham School of Public Health

3:05 pm **Break**

3:20 pm **Rad Resilient City: A Preparedness Checklist to Save Lives Following a Nuclear Detonation**
Monica Schoch-Spana
Center for Biosecurity of University of Pittsburgh Medical Center

4:00 pm **Q&A**

Thirty-Sixth Lauriston S. Taylor Lecture on Radiation Protection and Measurements

4:30 pm **Introduction of the Lecturer**
Roger O. McClellan

From the Field to the Laboratory and Back: The *What Ifs*, *Wows*, and *Who Cares* of Radiation Biology
Antone L. Brooks
Washington State University Tri-Cities (retired)

5:30 pm **Reception in Honor of the Lecturer**

Program Summary

Tuesday, March 13

8:15 am **NCRP Annual Business Meeting**

Implications of the Fukushima Daiichi Accident for Radiation Protection: Part II

Richard E. Toohey, *Session Chair*

9:00 am **U.S. Public Health Response to the Fukushima Radiological Emergency: One Agency's Perspective**
Charles W. Miller
Robert C. Whitcomb, Jr.
Jennifer Buzzell
M. Carol McCurley
Armin Ansari
Lynn Evans
Centers for Disease Control and Prevention

9:30 am **U.S. Department of Energy/National Nuclear Security Administration's Response to the Fukushima Daiichi Nuclear Power Plant Emergency**
Joseph J. Krol, Jr.
U.S. Department of Energy

10:00 am **Break**

10:30 am **Reference Levels in the Context of Fukushima: Lessons Learned and Challenge to Radiation Protection System**
Kazuo Sakai
National Institute of Radiological Sciences, Japan

11:00 am **Findings of the Blue Ribbon Commission on America's Nuclear Future**
Richard A. Meserve
Carnegie Institution for Science

11:30 am **Q&A**

11:50 am **Closing Remarks**
Thomas S. Tenforde

12:00 pm **Adjourn**

Monday, March 12, 2012

Opening Session

8:15 am

Welcome
Thomas S. Tenforde, *President*
National Council on Radiation Protection and Measurements

Ninth Annual Warren K. Sinclair Keynote Address

8:30 am

Childhood Exposure: An Issue from Computed Tomography Scans to Fukushima
Fred A. Mettler, Jr.
New Mexico Federal Regional Medical Center

Potential radiation effects on children have been, and will continue to be, of great social, public health, scientific, and clinical importance. The focus of interest on ionizing radiation and children has been clear for over half a century and ranges from interest in the effects of fallout from nuclear weapons testing to exposures from accidents and medical procedures. There is a common expression that "children are three to five times more sensitive to radiation than adults." Is this really true? In fact, children are more at risk for some health effects but not all. For a few effects children may be more resistant. Which are those effects and why do they occur? While there are clear instances of increased risk of some tumors in children compared to adults, there are other tumor types in which there appears to be little or no difference in risk by age at exposure, and some in which the published models are not supported by the data. The United Nations Scientific Committee on the Effects of Atomic Radiation has formed a task group to produce a comprehensive report on the subject. The factors to be considered include relevant radiation sources, developmental anatomy and physiology, dosimetry and stochastic and deterministic effects.

Radiation Protection of the Patient: An Integral Part of Quality of Care

Julie E.K. Timins, *Session Chair*

9:30 am

Radiological Protection of the Patient: An Integral Part of Quality of Care
Claire Cousins
Addenbrooke's Hospital NHS Trust, United Kingdom

Modern medicine now demands rapid diagnosis and treatment often centred on multiple investigations using ionizing radiation, particularly computed tomography (CT). Technological development continues at a rapid pace and there is also an inexorable rise in minimally invasive therapy using fluoroscopically-guided techniques. This has offered great benefit to many patients, who otherwise may not be fit enough for more invasive surgery. However, there are now many younger patients being treated using such techniques, where the risks of radiation in the longer term become more of an issue.

Patient dose, and hence, risk can be managed in different ways. Justification and optimization are important principles of radiological protection of the patient, although dose limitation is not applicable in medical practice. It is also important that health professionals are educated to ensure there is justification of investigations and procedures for individual patients. Without such measures, there is a danger that repeated CT scans may be requested and performed as frequently as plain x rays. Any examination also requires appropriate optimization and increasingly, in many subspecialty areas, this necessitates dedicated and specialized teams.

Diagnostic reference levels (DRLs) have been used as a tool to monitor the performance of departments locally, regionally or nationally by establishing a range of doses considered acceptable for different diagnostic examinations. These allow for the identification of "outliers" both above and, also importantly, below the range. However, a DRL should not be applied to an individual patient. More recently, the concept of a DRL is being extended to both radiological and cardiological interventional procedures, where the range of doses is much wider, even for the same procedure. Standardization of data with regard to patient size and weight is an issue and revision of the data produced over the last 10 to 15 y will become necessary as these parameters continue to increase.

The education and training of health professionals in radiological protection needs to be appropriately structured for referrers and operators. Those performing procedures using ionizing radiation require expertise to both complete the procedure and to reduce radiation dose wherever possible. There is also a trend towards the increasing use of ionizing radiation by professionals outside a radiology department, often with little or no training, and this issue will have to be addressed to ensure continuing radiological protection of patients. Such training is expensive in terms of human resource and time, and the number of individuals available to deliver the training is often limited. The International Commission on Radiological Protection has and will publish guidance on training and dose management in these situations.

Parameters to assess the quality of healthcare typically include rates of morbidity, mortality, complications, and waiting times. Yet, the radiation dose to the U.S. population from medical radiation is now almost equal to that of background radiation. Much of this exposure has been a benefit to patients with regard to timely diagnosis and less invasive treatment. Amidst the many factors that constitute good management of the patient, it must not be forgotten that radiological protection of the patient is also an integral part of the total quality of care.

10:00 am

Enhancing Safety in Radiation Therapy: Structural and Cultural Underpinnings

Michael Steinberg
University of California–Los Angeles

Radiation therapy is efficacious for the treatment of many cancers. The complexity of radiation therapy has increased steeply in the past 15 y. Technological developments have led to the automation of complex treatment planning and treatment delivery processes, the addition of in-room imaging systems including cone-beam computed tomography, and the proposal to enable modification of the treatment plan based on the patient's radiation response, a process termed adaptive radiation therapy. These technologies have provided the ability to increase the radiation conformality and precision, improving the outcomes for many radiation therapy patients. This increase in treatment sophistication and complexity requires a commensurate enhancement of quality assurance procedure intricacy and erudition.

Reports of radiation overdoses and misadministrations have come to the attention of healthcare providers and have appeared in the press, highlighting some of the new risks generated by the emerging treatment paradigm. While radiation therapy is extremely safe, the public and radiation therapy professionals want to improve the safety record. There are many initiatives taking place in the radiation therapy professional associations to guide users in methods of improving the safety and quality of treatments. However, most of these either reemphasize or expand on the quality assurance paradigms that were developed prior to this new era of increased complexity.

The fact is that in order to significantly improve the radiation therapy safety track record, we will have to make significant changes in our training, workflow, and monitoring as well as address important cultural aspects of organizational change required to improve safety outcomes. To this end, the main stakeholders in radiation therapy, including physicians and medical physicists, professional organizations, the U.S. Food and Drug Administration, equipment manufacturers, software manufacturers, and patient advocates, will need to come together to articulate a systematic approach to significantly improve safety in radiation therapy. We propose that the components of the plan include: safety recording, monitoring, standardization, training, accreditation, and a robust organizational social infrastructure to implement the safety culture.

- *Safety recording*: An important ingredient in developing a long-term plan to increase radiation therapy safety is having data that tell us the types and causes of errors. Individual institutions are beginning to develop such reporting systems, but to date, there are few and without interconnectivity or data sharing. A broad, national and required reporting system is recommended so that radiation therapy can more accurately gather data and plan safety improvements.
- *Monitoring*: The independent verification that prescribed safety procedures are optimal and correctly implemented. This includes internal and external peer review and in the future will also include automated computer-controlled monitoring systems.
- *Standardization*: The development and use of standardized treatment directives, policies and procedures. Currently, most clinics develop their own procedures based on individual training, conventional wisdom and biases of their providers. This results in wide variation in practice. However, absent treatment outcome differences due to the variation and the potential risk for increased mistakes in treatment delivery, there is little rationale to continue this wide-ranging approach. The safety benefit of standardization would be that sophisticated risk analyses could be broadly implemented.
- *Training*: This includes the concept of retraining using simulations that have built-in errors. Radiation therapy simulations could be used to train, retrain, and evaluate effectiveness of staff in detecting and mitigating errors.
- *Accreditation*: Properly conducted accreditation can ensure minimum

standards of care and safety in each facility.
- *Safety culture*: Beyond implementation of the robust safety infrastructure, the social and cultural aspects of embracing attitudes of "no-fault" reporting in the context of the pursuit of zero mistakes completes the components of an effective approach to safety for radiation therapy.

10:30 am **Break**

10:50 am **Efforts to Optimize Radiation Protection in Interventional Fluoroscopy**

Donald L. Miller
U.S. Food and Drug Administration

While it has been known for decades that fluoroscopy presents radiation risks to both the physician and the patient, patient skin injuries from fluoroscopy became increasingly rare after the 1930s, and radiation risk appeared to be adequately controlled. Beginning in approximately 1975, new technologies and materials for catheters, guide wires, and other interventional devices were developed, and new devices and procedures were introduced. Skin injuries began to occur in patients. These injuries provoked changes in technology and practice that continue today.

At a 1992 American College of Radiology/U.S. Food and Drug Administration workshop, four central issues were identified:

- equipment;
- quality management;
- operator training; and
- occupational radiation protection.

Equipment issues included an inconsistent relationship between radiation dose and image quality, abuse of the high-dose fluoroscopy mode, inability to monitor patient radiation dose, and a lack of dose metrics other than fluoroscopy time. Quality management was inadequate-dose and was neither monitored nor recorded and there was no patient follow-up for radiation effects. Nonradiologist operators typically had little or no training in radiation safety. Other than standard lead aprons, no radiation protection was typically available for operators and staff, because none had been thought necessary.

Numerous advances in equipment design have occurred in the past 20 y. These include digital fluoroscopy, pulsed fluoroscopy, anatomic programming, virtual collimation, stored fluoroscopy loops, automatic spectral filtration, and radiation dose monitoring. Radiation dose monitoring and measurement are among the most important innovations.

In the United States, most physicians who performed interventional-fluoroscopy procedures were not familiar with the new dose measurement capabilities of their fluoroscopy systems, and did not take advantage of them. In any event, no benchmark data were available for comparison. In the past decade, attempts have been made to automate dose data collection and to adapt the concept of reference levels to interventional fluoroscopy. Preliminary U.S. reference levels have been developed for some interventional-radiology procedures, but a national dose registry is a necessary next step.

Europe leads the United States in regard to operator training. AAPM Report No. 58, *Managing the Use of Fluoroscopy in Medical Institutions* (1998) recognized the need for a process for training and credentialing users of fluoroscopy equipment. This was still an issue when NCRP Report No. 168, *Radiation Dose Management for Fluoroscopically-Guided Interventional Medical Procedures*, was released in 2010. As of

2011, only 27 states have enacted legislation regarding radiation education for operators of fluoroscopic procedures. In the United States, most guidelines for training in radiation protection and radiation management have come from professional societies.

NCRP Report No. 122, *Use of Personal Monitors to Estimate Effective Dose Equivalent and Effective Dose to Workers For External Exposure to Low-LET Radiation* (1995) and Report No. 133, *Radiation Protection for Procedures Performed Outside the Radiology Department* (2000) provided specific recommendations for radiation monitoring of individuals who participate in fluoroscopically guided procedures. Current algorithms for estimating effective dose to staff tend to overestimate effective dose, and it is possible that none are optimal for all interventional procedures. This is a minor problem, however, in view of the 25 to 50 % of interventionalists who deliberately refrain from wearing their monitors.

The 2011 *ICRP Statement on Tissue Reactions* recognized the radiation sensitivity of the lens of the eye. It has become clear that physicians and staff involved in interventional-fluoroscopy procedures are at risk of developing radiation-induced lens opacities. Recently, professional societies have issued guidance on occupational radiation protection during fluoroscopically-guided procedures, emphasizing the importance of dose monitoring, optimizing personal protection, and optimizing patient dose. NCRP Report No. 168 addresses these subjects in considerable detail.

Challenges remain for the future, especially in regards to radiation dose recording, quality improvement, and training. However, with the increasing awareness of the importance of these issues, increased attention and resources are being devoted to them.

11:20 am

Standardization Versus Individualization: How Each Contributes to Managing Radiation Dose in Computed Tomography

Cynthia H. McCollough
Mayo Clinic

The radiation required for a computed tomography (CT) examination is dependent on patient size and also highly dependent on the diagnostic task. Thus, individualization of scan parameters is essential to managing dose on a patient-by-patient basis and to achieving the image quality required for the specified diagnostic task.

Standardization, however, is also important to providing high-quality medical care. Variations in the dose delivered and/or the image quality obtained must be identified and reduced. One valuable tool used to accomplish this is use of diagnostic reference levels. For a specific patient size and exam type, surveys of doses in routine clinical practice are performed to determine the distribution of actual doses, and to set diagnostic reference levels (typically, the 75th percentile of the distribution). When a site consistently exceeds these levels, an investigation should occur to determine if and how the site could reduce their dose settings.

Stratification of the results of dose surveys according to patient size is essential, because in the x-ray energy range used in CT, approximately half of the photons are removed from the beam for approximately every 4 cm of tissue traversed. Thus, to deliver the same number of photons to the detector (hence, producing the same level of image noise), the scanner output must be doubled for every 4 cm of additional patient attenuation above standard patient size and halved for every 4 cm of tissue below a standard patient size. A reasonable level of adaptation relative to a “standard” adult (~70 to 80 kg) would be decreasing scanner output by about a factor of five for a newborn, and increasing scanner output by as much as a factor of 10 for a morbidly obese adult.

However, even in reports that have accounted for variations in patient size, considerable variability exists in current clinical practice with regard to the scanner output levels used for similar diagnostic tasks. Hausleiter and colleagues found approximately a factor of two variation in typical output levels for cardiac CT angiography, with the primary predictor of higher scanner output levels being the type of scanner used. However, considerable variability existed between sites using the same scanner model. Raff and colleagues found that this site-to-site variation, and the overall dose levels used, could be reduced through educational initiatives.

One difficultly in such educational efforts, however, is that in CT, acceptable image quality and dose can be achieved using many different combinations of scan parameters. There is no single “right answer.” In a movement toward standardization of best practices in CT imaging, the American Association of Physicists in Medicine, with participation from the American College of Radiology, the American Society of Radiologic Technologists, the U.S. Food and Drug Administration, and each of the major CT scanner manufacturers, has begun establishing, and making publically available, a set of reasonable scan protocols for frequently performed CT examinations. These protocols summarize the basic requirements of the exam and give several model-specific examples of reasonable scan and reconstruction parameters. This allows individual users to benchmark their protocols against a reference standard that has received significant peer review, providing guidance as to “best” (or at least reasonable) practices. In addition, the working group has developed and published a CT Lexicon to allow users to translate important CT acquisition and reconstruction terms between different manufacturers' systems, each of which uses brand-specific names to describe similar parameters. The lexicon represents a first step in the ongoing efforts of several organizations to standardize the terminology associated with CT scan parameters.

11:50 am **Q&A**

12:20 pm **Lunch**

Implications of the Fukushima Daiichi Accident for Radiation Protection: Part I

Steven M. Becker, *Session Chair*

1:45 pm

What Happened at Fukushima and Lessons Learned

Michael L. Corradini
University of Wisconsin–Madison

The earthquake, which occurred at 2:46 pm on Friday, March 11th on the east coast of northern Japan, is believed to be the one of the largest earthquakes in recorded history. Following the quake on Friday afternoon, the plants at Fukushima Daiichi, Fukushima Daini, Higashidori, Onagawa, and Tokai Daini sites were affected and emergency systems were activated. The Tohoku earthquake caused a tsunami, which hit the east coast of Japan, and caused a loss of all on- and off-site power at the Fukushima Daiichi site, leaving it without any emergency power. The resultant damage to fuel, reactor and containment caused a release of radioactive materials to the region surrounding the plants. Although not directly affected, the U.S. nuclear power industry will take lessons from this accident.

The American Nuclear Society (ANS) formed a special committee to examine the Fukushima Daiichi accident. The committee was charged to provide a clear and concise explanation of the accident events, health physics, and accident cleanup as well as safety-related issues that emerged. The committee also evaluated actions that ANS should consider to better communicate with the public during a nuclear event.

The committee used publically available source material from the Japanese industry and government as well as their reports to the international community as indicated in the references. The committee views do not reflect any major inconsistencies regarding accident events, health physics, and accident cleanup. The safety-related recommendations identified by the committee are consistent with what has been noted in the reports already issued from many regulatory agencies. Finally, the committee focused on risk communication as a major issue that the ANS needs to address in the future.

2:25 pm

Fukushima Daiichi Accident: Community Impacts and Responses

Steven M. Becker
University of Alabama at Birmingham School of Public Health

In response to the March 2011 Japan earthquake-tsunami disaster and the Fukushima Daiichi nuclear accident, a special nongovernmental Radiological Emergency Assistance Mission flew to Japan from the United States. Invited by one of Japan's largest hospital and healthcare groups, and facilitated by a New York-based international disaster relief organization, the mission included an emergency physician, a health physicist, and a disaster management specialist. All three team members had extensive experience with radiation issues and radiological/nuclear disasters and emergencies. During the 10 d mission, which began in April 2011, team members conducted fieldwork in areas affected by the earthquake, tsunami, and nuclear accident; visited cities and towns in the 20 to 30 km Emergency Evacuation Preparation Zone around the damaged nuclear plant; visited other communities affected by the nuclear accident; met with mayors and other local officials; met with central government officials; and exchanged observations, experiences and information with Japanese medical, emergency response, and disaster management colleagues. Perhaps most importantly, the mission also provided radiological information and training to more than 1,100 Japanese hospital and healthcare personnel and first responders. Based on this on-scene work, the mission produced many insights with potential relevance for radiological/nuclear emergency preparedness and response. Several key "lessons learned" were published in December 2011. Since that time, many additional insights from the mission and mission follow-up have been identified. In this presentation, these additional lessons learned—particularly those related to community impacts and responses—will be highlighted.

3:05 pm **Break**

3:20 pm **Rad Resilient City: A Preparedness Checklist to Save Lives Following a Nuclear Detonation**

Monica Schoch-Spana
Center for Biosecurity of University of Pittsburgh Medical Center

The Rad Resilient City Checklist is a local planning tool that can help save tens of thousands of lives following a nuclear detonation. If prevention of nuclear terrorism fails, then reducing exposure to radioactive fallout is the intervention that can save the most lives following a nuclear detonation. Yet, most Americans are not familiar with correct safety measures against fallout, and many believe that nothing can be done to reduce the suffering and death inflicted by a nuclear attack. Moreover, cities have no checklist on how to prepare the emergency management infrastructure and the larger population for this hazard, despite hundreds of pages of useful guidance from the federal government and radiation professional organizations. The Rad Resilient City Checklist reverses this situation by converting the latest federal guidance and technical reports into clear, actionable steps for communities to take to protect their residents from exposure to radioactive fallout. The checklist reflects the shared judgment of the Nuclear Resilience Expert Advisory Group, a national panel led by the Center for Biosecurity and comprised of government decision makers, scientific experts, emergency responders, and leaders from business, volunteer and community sectors.

4:00 pm **Q&A**

Thirty-Sixth Lauriston S. Taylor Lecture on Radiation Protection and Measurements

4:30 pm

Introduction of the Lecturer
Roger O. McClellan

From the Field to the Laboratory and Back: The *What Ifs*, *Wows*, and *Who Cares* of Radiation Biology

Antone L. Brooks
Washington State University Tri-Cities (retired)

My scientific journey started at the University of Utah chasing fallout, it was on everything, in everything, and was distributed throughout the ecosystem. This resulted in radiation doses to humans and caused me great concern. From this concern I asked the question. Are there health effects from these radiation doses and levels of radioactive contamination? I have invested my scientific career trying to address this basic question. While conducting research I became acquainted with many of the ***what ifs*** of radiation biology. The major ***what if*** in my research was; What if we have underestimated the radiation risk for internally deposited radioactive material? While conducting research to address this important question many other ***what ifs*** came up related to dose, dose rate, and dose distribution. I also encountered a large number of ***wows***. One of the first was when I went from conducting environmental fallout studies to research in a controlled laboratory. The activity in fallout was expressed as pCi L^{-1} whereas it was necessary to inject laboratory animals with μCi g^{-1} body weight to induce measurable biological changes, chromosome aberrations, and cancer. ***Wow***, that is seven to nine orders of magnitude above the activity levels found in the environment. Other ***wows*** have made it necessary for the field of radiation biology to make important paradigm shifts. For example, one shift involved changing from "hit theory" to total tissue responses as the result of bystander effects. Finally, ***who cares*?** While working at the U.S. Department of Energy headquarters and serving on many scientific committees I found that science does not drive regulatory and funding decisions. Public perception and politics seem to be major driving forces. If scientific data suggested that risk had been underestimated—everyone cared; when science suggested that risk had been overestimated—no one cared. This result dependent ***who cares*** was demonstrated as we tried to generate interactions by holding meetings involving individuals involved in basic low dose research, regulators, and the news media. As scientists presented their "exciting data" that suggested that risk was overestimated many of the regulators simply said we cannot use such data. The newspaper people simply said it is not possible to get such information by my editors. In spite of these difficulties research results from basic science must be made available and considered by the public as well as by those that make regulatory recommendations. Public outreach and sharing of the data are critical and must continue to be a future focus to properly address the question of ***who cares***. My journey in science, like many of yours, has been a mixture of chasing money, punishment, beatings, and joys of unique and interesting research results. Perhaps we can, through our experiences, improve research environments, funding, and use of the valuable information that is generated. Scientists that study at all levels of biological organization from the environment, to the laboratory and human experience must share expertise and data to address the ***what ifs*, *wows*,** and ***who cares*** of radiation biology.

5:30 pm

Reception in Honor of the Lecturer

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Tuesday, March 13

8:15 am

NCRP Annual Business Meeting

Implications of the Fukushima Daiichi Accident for Radiation Protection: Part II

Richard E. Toohey, *Session Chair*

9:00 am

U.S. Public Health Response to the Fukushima Radiological Emergency: One Agency's Perspective

Charles W. Miller
Robert C. Whitcomb, Jr.
Jennifer Buzzell
M. Carol McCurley
Armin Ansari
Lynn Evans
Centers for Disease Control and Prevention

On March 11, 2011, northern Japan suffered first a magnitude 9.0 earthquake centered ~208 km off the eastern coast and then an ensuing tsunami. These natural events caused widespread death and destruction in Japan. One location hit was the Fukushima Daiichi Nuclear Reactor Complex. The destruction at this site initiated a cascade of events that led to multiple reactors overheating, core meltdown, and radionuclide releases causing widespread radioactive contamination of residential areas, agricultural land, and coastal waters. The public health and medical community in Japan faced many challenges as a result of these multiple events. Our sympathies go out to the Japanese people, who will be dealing with the consequences of this incident for years to come.

As the radionuclide releases from the Fukushima Daiichi Nuclear Reactor escaped into the atmosphere and the ocean, the impact of this disaster was felt around the world. Like many other nations, the U.S. public health system was concerned about the safety of both its citizens living in Japan and citizens residing in the United States as the radioactive materials released from Fukushima were detected in trace amounts as they traveled around the globe. As with any crisis, these events present opportunities to learn and prepare for similar incidents in the future. Events in both Japan and the United States during the response illustrated some U.S. preparedness gaps that previously had been anticipated, and others that were newly identified. The Secretary of Health and Human Services has forwarded a report to the National Security Staff discussing public health preparedness gaps and challenges identified by the Fukushima incident. Some of these gaps include the following:

- equipment and personnel resources to monitor potentially-exposed people for radioactive contamination is insufficient;
- there is no public health authority to detain people contaminated with radioactive materials;
- public health and medical expertise, and treatment capacities, for response to radiation emergencies are limited;
- there is an insufficient number of radiation health experts;
- public health communications regarding radiation emergency preparedness, health effects of radiation exposures, resilience, and response actions are inadequate;
- national and international exposure standards for radiation measurements (and units) and protective action guides lack uniformity;
- access to radiation emergency monitoring data is limited and procedurally complex; and
- the policy on stockpiling potassium iodide in the Strategic National Stockpile should be revisited.

This event was a major disaster for the people of Japan, but it was also a significant public health emergency for the U.S. public health community. We should capitalize upon this rare opportunity to improve our public health preparedness based on the experience of our Japanese colleagues and our own.

9:30 am

U.S. Department of Energy/National Nuclear Security Administration's Response to the Fukushima Daiichi Nuclear Power Plant Emergency

Joseph J. Krol, Jr.
U.S. Department of Energy

The Office of Emergency Operations from the U.S. Department of Energy (DOE) National Nuclear Security Administration deployed an emergency response team to Japan to conduct aerial and ground-based environmental radiation monitoring following the accident at the Fukushima Daiichi Nuclear Power Station. The team partnered with U.S. Forces Japan to support both U.S. military and government of Japan objectives. The deployed team was supported domestically by the Radiation Emergency Assistance Center/Training Site, the National Atmospheric Release Advisory Center, and the DOE Consequence Management Home Team. An overview of the activation, deployment, capabilities, response objectives, coordination, and activities will be discussed.

10:00 am

Break

10:30 am

Reference Levels in the Context of Fukushima: Lessons Learned and Challenge to Radiation Protection System

Kazuo Sakai
National Institute of Radiological Sciences, Japan

After the nuclear accident, a number of reference levels were set, including one regarding the use of school playgrounds in Fukushima. Considering the band of 1 to 20 mSv y^{-1} recommended by the International Commission on Radiological Protection (ICRP) for public exposure under the existing exposure situation, Japanese authorities set 20 mSv y^{-1} on April 19, 2011 as a "start line" for reducing the dose to school children. When the level of 20 mSv y^{-1} was announced, the meaning of a reference level was explained at the press conference. However, the "20 mSv y^{-1}" led to considerable confusion among members of the public and some experts. They thought that the dose limit was increased to 20 mSv y^{-1}, 20 times as high as before and that the school children are to be exposed to 20 mSv y^{-1}. Factually, later in May, based on the measurement of ambient dose rates in schoolhouses as well as playgrounds, the actual dose was estimated around 10 mSv y^{-1} at most.

Confusion was also caused by lack of information on dose dependent characteristics of biological effects of radiation and misunderstanding of radiation protection concepts. A challenging issue was raised in regard to the higher radiosensitivity of children. In ICRP recommendations a higher risk coefficient is given to whole population than to adult population, because the whole population includes children, a subpopulation of higher sensitivity. The point was whether lower reference levels are to be set, when only children are considered.

Including these examples, lessons to be learned will be presented and discussed.

11:00 am

Findings of the Blue Ribbon Commission on America's Nuclear Future

Richard A. Meserve
Carnegie Institution for Science

At the request of the President, Secretary Chu formed the Blue Ribbon Commission on America's Nuclear Future in January 2010. The purpose of the Commission is to provide recommendations for the development of a safe, long-term solution to managing the nation's used nuclear fuel and nuclear waste. The Commission is chaired by former Congressman Lee Hamilton and former National Security Advisor Brent Scowcroft. I serve as a member.

The Commission conducted its work through periodic public meetings at which presentations were made by knowledgeable experts. The Commission also formed three subcommittees, covering disposal, storage and transportation, and advanced technologies. Each of the subcommittees engaged in extensive outreach efforts and developed draft reports that were made publicly available for comment and were considered by the full Commission.

The Commission issued a draft report in July 2011 for public comment. Perspectives on the report were also sought in public meetings that were held in Denver, Atlanta, Boston, Washington and Minneapolis. As this abstract is being written, the comments are being reviewed by the Commission for the purpose of preparing a final report for issuance at the end of January 2012.

The presentation will discuss the various recommendations and findings that emerge in the final report.

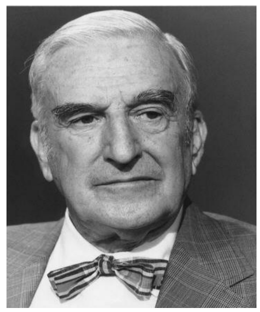
11:30 am **Q&A**

11:50 am **Closing Remarks**
Thomas S. Tenforde
National Council on Radiation Protection and Measurements

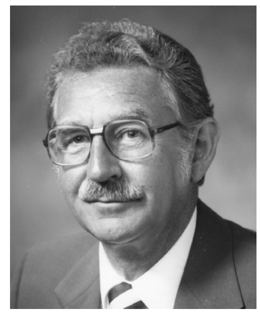
12:00 pm **Adjourn**

Mission Statement

To support radiation protection by providing independent scientific analysis, information and recommendations that represent the consensus of leading scientists.



Lauriston S. Taylor
1929–1977



Warren K. Sinclair
1977–1991

Charles B. Meinhold
1991–2002

Thomas S. Tenforde
2002–

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Registration

Monday, March 12, 2012	7:00 am – 5:00 pm
Tuesday, March 13, 2012	7:00 am – 11:00 am

(registration fee is $100 and $35 for students)

Register online: http://ncrp.eventbee.com

2013 Annual Meeting

Radiation Dose and Impacts on Exposed Populations

S.Y. Chen & Bruce A. Napier, *Co-Chairs*

March 11–12, 2013
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Publications (http://NCRPpublications.org) (http://jicru.oxfordjournals.org)

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Report No. 168	Radiation Dose Management for Fluoroscopically-Guided Interventional Medical Procedures (2010)	$ 150
Report No. 167	Potential Impact of Individual Genetic Susceptibility and Previous Radiation Exposure on Radiation Risk for Astronauts (2010)	75
Report No. 166	Population Monitoring and Radionuclide Decorporation Following a Radiological or Nuclear Incident (2010)	85
Report No. 165	Responding to a Radiological or Nuclear Terrorism Incident: A Guide for Decision Makers (2010)	75
Report No. 164	Uncertainties in Internal Radiation Dose Assessment (2009) [PDF only]	100
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Report No. 162	Self Assessment of Radiation-Safety Programs (2009)	50
Report No. 161	I. Management of Persons Contaminated With Radionuclides: Handbook (2008)	165
	II. Management of Persons Contaminated with Radionuclides: Scientific and Technical Bases (2008) [PDF only]	80
Report No. 160	Ionizing Radiation Exposure of the Population of the United States (2009)	125
Commentary No. 22	Radiological Health Protection Issues Associated With Use of Active Detection Technology Systems for Detection of Radioactive Threat Materials (2011)	30
Commentary No. 21	Radiation Protection in the Application of Active Detection Technologies (2011)	30
Commentary No. 20	Radiation Protection and Measurement Issues Related to Cargo Scanning with Accelerator-Produced High-Energy X Rays (2007)	40

ICRU	Title	Price
Report 85a-revised	Fundamental Quantities and Units for Ionizing Radiation (2011)	$ 198
Report 86	Quantification and Reporting of Low-Dose and Other Heterogeneous Exposures (2011)	198

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"As with most NCRP reports, the information supplied is well referenced. I have been involved with emergency preparedness planning for more than 25 years and this is by far the best written guidance I have seen on this subject. I was surprised at how many new insights I got from reviewing this report and would highly recommend it to any one involved in emergency preparedness planning." — *Dean Broga, Ph.D.* [Med. Phys. **38**(10), 2011]

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