ARPS2017

CONFERENCE HANDBOOK

Science and the Art of Radiation Protection

BROADENING THE HORIZON

Novotel Wollongong Northbeach, NSW 6-9 August 2017

ansto
Radiation Services

The Australian Nuclear Science and Technology Organisation (ANSTO) has over 35 years' experience in radiation safety management and offers expert advice and services tailored specifically to meet your needs

OVER 35 YEARS EXPERIENCE

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CONFERENCE ORGANISING COMMITTEE

Nicole Willetts
2017 Conference Convenor
The Children's Hospital Westmead

Bill Bartolo
Bartolo Safety Management Service

Robert Blackley
ANSTO Radiation Services

John Bus
ANSTO Radiation Protection Services

Alice Caldwell
Royal Prince Alfred Hospital

Cameron Jeffries
St Vincent's Hospital

Tina Paneras
ANSTO Radiation Services

Alison Parkes
MARPS

Andrew Popp
ANSTO Radiation Protection Services

CONFERENCE MANAGERS

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Contents

Welcome

On behalf of the organising committee and the New South Wales branch, I welcome all members of ARPS, radiation safety professionals, enthusiasts, students, supporting suppliers, businesses and related industries to the 42nd Annual Conference of the Australasian Radiation Protection Society.

With the theme **"Science and the Art of Radiation Protection: Broadening the Horizon"** the conference aims to enrich our understanding of non-ionising and ionising radiation, highlight the importance of effective communication and stakeholder involvement, showcase new technologies, and generate discussion across a broad range of radiation protection aspects from ethics to environment to industry.

We extend an invitation for you to enjoy the conference, with a program that kicks off with a cosmic welcome at the Science Centre & Planetarium, two very different breakfast workshops—one on the role of the laser safety officer and another on the requirements and implementation of RPS8: The Code of Practice for the Exposure of Humans to Ionizing Radiation for Research Purposes—an interactive panel session on communicating radiation risk to various audiences, and a full day non-ionising radiation stream that concludes with an opportunity for robust discussion in a Q&A panel session. To top it all off, our program includes six international Keynote Presenters and Invited Speakers, and the Boyce Worthley Oration given this year by George Anastas.

The organising committee encourages you to partake in the wonderful selection of both business and social aspects of the 42nd ARPS Conference.

We welcome you and look forward to your participation in ARPS 2017, and we hope you enjoy your time in Wollongong.

Nicole Willetts MARPS
42nd ARPS Conference Convenor

REGISTRATION DESK

The Registration Desk is located at the Novotel Wollongong North Beach in the Ballroom Gallery. Please direct any questions you may have regarding the conference to the team from Leishman Associates. The registration desk will be open at the following times:

Sunday 6 August	3.00pm – 5.30pm
Monday 7 August	7.15am – 5.00pm
Tuesday 8 August	7.30am – 5.00pm
Wednesday 9 August	8.15am – 5.00pm

ACCOMMODATION

If you have any queries relating to your accommodation booking, please first see the staff at your hotel. Your credit card details have been passed onto the hotel to secure your booking. If you have arrived 24 hours later than your indicated arrival day you may find that you have been charged one nights accommodation.

SPECIAL DIETS

All catering venues have been advised of any special diet preferences you have indicated on your registration form. Please identify yourself to venue staff as they come to serve you and they will be pleased to provide you with all pre-ordered food. For day catering, there may be a specific area where special food is brought out, please check with catering or conference staff.

TWITTER

Join the conversation at #ARPS2017.

WEBSITE

Updated Conference information can be found at www.arpsconference.com.au

CONFERENCE NAME BADGES

All delegates and exhibitors will be provided with a name badge. Please wear your name badge at all times as it will be your entry into all sessions and all social functions.

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CONTINUING PROFESSIONAL DEVELOPMENT

ACPSEM CPD Endorsement

ACPSEM Australasian College of Physical Scientists & Engineers in Medicine

The Australasian College of Physical Scientists & Engineers in Medicine have endorsed the 2017 ARPS Conference as a quality CPD activity. A total of 15 CPD points may be awarded for attendance to the full Conference.

The following CPD points will be awarded for each day of attendance:

5 points for full day attendance on Monday 7 August

5 points for full day attendance on Tuesday 8 August

5 points for full day attendance on Wednesday 9 August

ENTRY TO CONFERENCE SESSIONS

It is suggested that delegates arrive at preferred sessions promptly to ensure a seat. If sessions become full then delegates will not be allowed entry.

INFORMATION FOR PRESENTERS AND SESSION CHAIRS

All speakers will be asked to check into the Speakers Preparation Room to load their presentations onto the conference network. This must be done AT LEAST three hours before you are due to present.

An audio visual technician from Staging Connections will be available throughout the conference. Speakers are asked to introduce themselves to their session chair during the break if possible and arrive in the room on time.

The Speakers Preparation is located at the rear of the Plenary Room. Please see the staff at the registration desk for further assistance or directions.

POSTER PRESENTATIONS

Posters will be displayed in the Ballroom Foyer for the duration of the conference. There will be a poster session on Tuesday 8 August from 12.00pm - 1.00pm and Wednesday 9 August 1.00pm - 2.00pm during the lunch breaks.

ENTRY TO SOCIAL EVENTS

Entry to social events will not require a ticket.

Attendees and additional guests will appear on a guest list and must wear a name badge. If you are unsure about whether you are registered, please see one of the team from Leishman Associates.

DRESS CODE

The dress code for the conference sessions and social functions is smart casual.

CONFERENCE WIFI

Delegates have access to complimentary WIFI for the duration of the conference. Please enter the username **Novotel Conference**, and password **ARPS2017** for access. Please note that movies, music or illicit downloads are restricted.

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UNSW CANBERRA

PHOTOGRAPHS, VIDEOS & RECORDING

Delegates are not permitted to use any type of camera or recording device at any of the sessions unless written permission has been obtained from the relevant speaker.

MOBILE PHONES

As a courtesy to other delegates, please ensure that all mobile phones are turned off or in a silent mode during all sessions and social functions.

DISCLAIMER

The 2017 ARPS Conference reserves the right to amend or alter any advertised details relating to dates, program and speakers if necessary, without notice, as a result of circumstances beyond their control. All attempts have been made to keep any changes to an absolute minimum.


NOVOTEL
HOTELS & RESORTS
WOLLONGONG
NORTHBEACH
Welcome

ARPS2017

SUNDAY 6 AUGUST 2017

3.00pm	**ARPS Executive Meeting** Invitation Only	
3.00pm - 5.30pm	**Registration Desk Open** Attendees are encouraged to register early if you are in the vicinity	HOTEL FOYER
5.30pm	Coach Departs for Welcome Reception	RALLY POINT NOVOTEL HOTEL FOYER
6.00pm - 8.00pm	**Welcome Reception** Included in full registrations	WOLLONGONG SCIENCE CENTRE AND PLANETARIUM

MONDAY 7 AUGUST 2017

7.15am - 5.00pm	**Registration Desk Open**	BALLROOM GALLERY
7.30am - 9.00am	**BREAKFAST WORKSHOP** Optional event $60 registration fee applies. Pre-registration required **RPS8 IN 2017 AND BEYOND** *Facilitated by Dr Richard Smart*	HOSKINS ROOM
8.30am - 9.15am	Barista Coffee available proudly sponsored by ANSTO	ansto Radiation Services
	PLENARY SESSION 1 ***Chair: Nicole Willetts***	MCCABE/THROSBY ROOM
9.15am - 9.30am	**Convenor Opening Comments & Welcome** *Nicole Willetts*	
9.30am - 10.00am	**Official Conference Opening** *Dr Helen Maynard-Casely, ANSTO*	
10.00am - 10.45am	**THE ART OF THE PRACTICE OF RADIATION SAFETY** *Dr Andrew Karam, PhD, CHP* *Sponsored by*	NSW EPA
10.45am - 11.15am	**Morning Refreshments & Trade Exhibition** *Enjoy Barista style coffee proudly sponsored by ANSTO* *Refreshments sponsored by University of Wollongong*	BALLROOM GALLERY CENTRE FOR MEDICAL RADIATION PHYSICS · UNIVERSITY OF WOLLONGONG AUSTRALIA · ansto Radiation Services

	SESSION 1	SESSION 2
	EDUCATION, TRAINING AND SAFETY CULTURE	COMMUNICATIONS
	Chair: Alice Caldwell	***Chair: Andrew Popp***
	MCCABE/THROSBY ROOM	HOSKINS ROOM
11.15am - 11.35am	ANSTO RADIATION PROTECTION SERVICES STRATEGIC OPERATIONAL PLAN *Robin Foy, ANSTO*	EMERGENCY PREPAREDNESS AND RESPONSE EVOLUTION @ARPANSA *Dr Gillian Hirth, ARPANSA*
11.35am - 11.55am	DEVELOPMENTS IN SAFETY CULTURE - WHY AUSTRALIANS SHOULD TAKE NOTE *John Ward, ARPANSA*	COMMUNICATING WITH GOVERNMENT AND THE PUBLIC *Dr Richard O'Brien*
11.55am - 12.15pm	EFFECTIVE WORKPLACE RADIATION SAFETY TRAINING *John Bus, ANSTO*	EXPERIENCES ON THE NUCLEAR CITIZEN'S JURY *Cameron Jeffries, ARPS*
12.15pm - 12.35pm	AUSTRALIAN NATIONAL RADIATION DOSE REGISTER (ANRDR) IN REVIEW *Ben Paritsky, ARPANSA*	PERCEPTION AND SCIENCE *Dr Richard O'Brien*
12.35pm - 12.55pm	SESSION 1 – ADDITIONAL QUESTION TIME	SCIENCE AND ART IN RADIATION RISK COMMUNICATION *Jim Hondros, JRHC Enterprises*

1.00pm - 2.00pm **Lunch & Trade Exhibition** — BALLROOM GALLERY

Thank you to our exhibiting companies.
Please visit them throughout the conference

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CENTRE FOR MEDICAL RADIATION PHYSICS — UNIVERSITY OF WOLLONGONG AUSTRALIA — ansto Radiation Services

PLENARY SESSION 2 — MCCABE/THROSBY ROOM

Chair: Robert Blackley

2.00pm - 2.45pm **"FUKUSHIMA RECOVERY NOW" - ENVIRONMENTAL MONITORING, RISK COMMUNICATIONS AND HUMAN RESOURCE DEVELOPMENTS IN FUKUSHIMA**

Dr Yasuhiro Uezu, Japan Atomic Energy Agency

Sponsored by ansto Radiation Services

2.45pm - 3.45pm **Communications Panel**

Featuring insights from:

Andrew Karam, Christopher Clements, Douglas Boreham & Cassandra Casey

Closing Summary

3.45pm - 4.30pm **Afternoon Refreshments & Trade Exhibition** — BALLROOM GALLERY

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CENTRE FOR MEDICAL RADIATION PHYSICS — UNIVERSITY OF WOLLONGONG AUSTRALIA — ansto Radiation Services

4.30pm - 6.00pm **ARPS Annual General Meeting**

All members are welcome to attend

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TUESDAY 8 AUGUST 2017

7.30am - 5.00pm	**Registration Desk Open**	BALLROOM GALLERY
7.30am - 9.00am	**BREAKFAST WORKSHOP** Optional event $60 registration fee applies. Pre-registration required **THE ROLE OF THE LASER SAFETY OFFICER – BRIDGING THE GAP BETWEEN THEORETICAL AND PRACTICAL LASER SAFETY IN THE LAB** *Facilitated by Andrew Gibson-White*	HOSKINS ROOM
	PLENARY SESSION 3 ***Chair: Alice Caldwell***	MCCABE/THROSBY ROOM
9.20am - 9.30am	Opening Comments	
9.30am - 10.15am	**BETWEEN A ROCK AND A HARD PLACE: THE ART OF RADIATION PROTECTION IN THE WIRELESS ERA** *Professor Dariusz Leszczynski, University of Helsinki*	
10.15am - 10.30am	**ANSTO Major Sponsor Presentation** *Robert Blackley, Manager ANSTO Radiation Services*	ansto Radiation Services
10.30am - 11.00am	**Morning Refreshments & Trade Exhibition** *Enjoy Barista style coffee proudly sponsored by ANSTO* *Refreshments sponsored by AINSE*	BALLROOM GALLERY AINSE ansto Radiation Services

	SESSION 3	SESSION 4
	SESSION 3 NON-IONISING RADIATION ***Chair: Bill Bartolo*** MCCABE/THROSBY ROOM	**SESSION 4** PLANNED EXPOSURE SITUATIONS ***Chair: Tina Paneras*** HOSKINS ROOM
11.00am - 11.20am	DETERMINING THE AETIOLOGY OF IDIOPATHIC ENVIRONMENTAL INTOLERANCE ATTRIBUTED TO ELECTROMAGNETIC FIELDS: RF EXPOSURE OR NOCEBO EFFECT? *Adam Verrender, Australian Centre for Electromagnetic Bioeffects Research*	WHAT DOES "REASONABLY" MEAN IN ALARA *Frank Harris, Rio Tinto*
11.20am - 11.40am	BIOLOGICAL EFFECTS OF LOW-INTENSITY RADIOFREQUENCY ELECTROMAGNETIC RADIATION – TIME FOR A PARADIGM SHIFT IN REGULATION OF PUBLIC EXPOSURE *Dr Priyanka Bandara, ORSAA*	AUSTRALIA'S RADIATION PROTECTION STANDARDS – THE CODE FOR RADIATION PROTECTION IN PLANNED EXPOSURE SITUATIONS (2016), RPS C-1 *Keith Dessent, ARPANSA*
11.40am - 12.00pm	WHAT DOES SLEEP TELL US ABOUT NON-IONISING RADIATION AND HEALTH? *Sarah Loughran, Australian Centre For Electromagnetic Bioeffects Research*	WORKING SAFELY WITH IONISING RADIATION: GUIDELINES FOR EXPECTANT OR BREASTFEEDING MOTHERS *Andrew Popp, ANSTO*

12.00pm - 1.00pm	**Lunch, Trade Exhibition & Poster Session** Thank you to our exhibiting companies. Please visit them throughout the conference *Enjoy Barista style coffee proudly sponsored by ANSTO* *Refreshments sponsored by AINSE*	BALLROOM GALLERY AINSE ansto Radiation Services

	SESSION 5 NON-IONISING RADIATION *Chair: Cameron Jeffries* MCCABE/THROSBY ROOM	SESSION 6 EXISTING EXPOSURE SITUATIONS *Chair: John Bus* HOSKINS ROOM
1.00pm - 1.20pm	RADIO FREQUENCY EXPOSURE RISK ASSESSMENT AND COMMUNICATION, CRITIQUE OF ARPANSA TR-164 REPORT. DO WE HAVE A PROBLEM? *Victor Leach, ORSAA*	RADIATION PROTECTION IN EXISTING EXPOSURE SITUATIONS IN AUSTRALIA *Dr Stephen Solomon, ARPANSA*
1.20pm - 1.40pm	IMPROVING PUBLIC HEALTH RELATING TO ULTRA-VIOLET RADIATION EXPOSURE – INNOVATIONS AND PLANS AT ARPANSA *Dr Gillian Hirth, ARPANSA*	ASSESSING RADIATION DOSE FROM EXPOSURE TO RADON AND ITS PROGENY, OR WHAT GOES AROUND COMES AROUND *Dr Stephen Solomon, ARPANSA*
1.40pm - 2.00pm	LEVELS OF RADIOFREQUENCY ELECTROMAGNETIC FIELDS FROM WI-FI IN AUSTRALIAN SCHOOLS *Lydiawati Tjong, ARPANSA*	(SOME) LESSONS LEARNED FROM THE WESTERN NEW YORK NUCLEAR SERVICE CENTER, YUCCA MOUNTAIN AND THE WASTE ISOLATION PILOT PLANT *George Anastas*
2.00pm - 2.40pm	NIR PANEL, Q&A AND DISCUSSION *Rodney Croft, Victor Leach, Dariusz Leszczynski*	ACCEPTANCE TESTING OF THE TASL RADON DOSIMETRY SYSTEM *Brendan Tate, ARPANSA*
2.20pm - 2.40pm		THE SCIENTIFIC BASIS FOR FUTURE MANAGEMENT OPTIONS OF THE LITTLE FOREST LEGACY SITE *Hefin Griffiths, ANSTO*

2.40pm - 3.00pm **Afternoon Refreshments & Trade Exhibition**

BALLROOM GALLERY

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PLENARY SESSION 4

Chair: Alison Parkes

MCCABE/THROSBY ROOM

3.00pm - 3.45pm **EVIDENCE FOR PARADIGM SHIFTS IN LOW DOSE RADIATION (LDR) BIOLOGY: RE-EVALUATION OF THE LINEAR NO-THRESHOLD (LNT) RISK MODEL USING MODERN MOLECULAR STUDIES**

Professor Douglas Boreham, Northern Ontario School of Medicine, Canada

Closing Summary

6.30pm - 11.00pm **ARPS Conference Dinner**

Included in full registrations

ILLAWARRA ROOM, NOVOTEL WOLLONGONG

WEDNESDAY 9 AUGUST 2017

8.15am - 5.00pm	**Registration Desk Open**	
	PLENARY SESSION 5 ***Chair: Bill Bartolo***	MCCABE/THROSBY ROOM
9.00am - 9.15am	**Opening Comments**	
9.15am - 10.00am	**Boyce Worthley Oration** **A RADIATION PROTECTION VIEW OF AUSTRALIA AND ARPS: A VIEW FROM ACROSS THE POND WITH SOME INSIGHTS FOR DISCUSSIONS** *George Anastas, FARPS, PE, CHP, FHPS, BCEE*	
10.00am - 10.45am	**ANOTHER LOOK AT THE SILVER LINING OF THE FUKUSHIMA ACCIDENT: IMPROVING THE SYSTEM OF RADIOLOGICAL PROTECTION** *Christopher Clements, International Commission on Radiological Protection*	
10.45am - 11.15am	**Morning Refreshments & Trade Exhibition** *Enjoy Barista style coffee proudly sponsored by ANSTO* *Refreshments sponsored by AINSE*	BALLROOM GALLERY AINSE ansto Radiation Services

	SESSION 7 RADIOTHERAPY ***Chair: Cameron Jeffries*** MCCABE/THROSBY ROOM	**SESSION 8** NEW TECHNOLOGY ***Chair: Andrew Popp*** HOSKINS ROOM
11.15am - 11.35am	DOSES IN THE TREATMENT ROOM DURING MICROBEAM RADIOTHERAPY AT THE AUSTRALIAN SYNCHROTRON *Dr Duncan Butler, ARPANSA*	CALIBRATION OF A DRILLER-DEPLOYABLE DOWNHOLE GAMMA PROBE FOR IN SITU MEASUREMENT OF WASTE MATERIAL RADIOACTIVITY *Dr Fred Blaine, Imdex Limited*
11.35am - 11.55am	USE OF A RADIOTHERAPY RECORD AND VERIFY SYSTEM TO DETERMINE SHIELDING CALCULATION PARAMETERS *Michael Gilhen, Peter MacCallum Cancer Centre*	DATA ANALYTICS FOR RADIATION MANAGEMENT AT OLYMPIC DAM *Amrinder Dhindsa, BHP Billiton*
11.55am - 12.15pm	SHIELDING CONSIDERATIONS FOR A NEW LINEAR ACCELERATOR INSTALLATION *Dr Peter Harty, ARPANSA*	EVALUATION OF A NOVEL GAMMA RAY IMAGING TECHNOLOGY *Dr Mathew Guenette, ANSTO*
12.15pm - 12.35pm	DEVELOPMENT OF A SECURITY PLAN FOR A HIGH DOSE RATE (HDR) BRACHYTHERAPY UNIT IN A NEW HOSPITAL *Professor Tomas Kron, Peter MacCallum Cancer Centre*	COMMISSIONING A BeO OSL DOSIMETRY SYSTEM FOR USE AS A NATIONAL DOSIMETRY SERVICE OPERATED BY PERSONAL RADIATION MONITORING SERVICE, PRMS, AT ARPANSA *Michael Litwin, ARPANSA*
12.35pm - 12.55pm	INTERNATIONAL COMPARISON OF HP(10) WITH HIGH ACCURACY USING PASSIVE DOSIMETERS *Dr Duncan Butler, ARPANSA*	CHARACTERISTIC LIMITS AND THEIR APPLICATION TO PERSONAL DOSIMETRY *Dr Stephen Long, ARPANSA*

1.00pm - 2.00pm	**Lunch, Trade Exhibition & Poster Session** Thank you to our exhibiting companies. Please visit them throughout the conference *Enjoy Barista style coffee proudly sponsored by ANSTO* *Refreshments sponsored by AINSE*	BALLROOM GALLERY
	PLENARY SESSION 6 ***Chair: Alison Parkes***	MCCABE/THROSBY ROOM
2.00pm - 2.45pm	**PROTON BEAM THERAPY AT MAYO CLINIC** *Professor Kevin Nelson, Mayo Clinic, Arizona*	
2.45pm - 3.15pm	**Afternoon Refreshments & Trade Exhibition** *Enjoy Barista style coffee proudly sponsored by ANSTO* *Refreshments sponsored by AINSE*	BALLROOM GALLERY

	SESSION 9	SESSION 10
	DIAGNOSTIC IMAGING AND NUCLEAR MEDICINE	PLANNED EXPOSURE SITUATIONS
	Chair: Tina Paneras	***Chair: John Bus***
	MCCABE/THROSBY ROOM	HOSKINS ROOM
3.15pm - 3.35pm	MANAGEMENT OF PATIENT RADIATION DOSE FROM INTERVENTIONAL RADIOLOGY *Dr Donald Mclean, ACT Health*	RADON MONITORING IN THE VICINITY OF OLYMPIC DAM *Amrinder Dhindsa, BHP Billiton*
3.35pm - 3.55pm	AREA RADIATION MONITORING AND DOSE ASSESSMENT IN RADIATION THERAPY, MOLECULAR IMAGING AND RADIOIODINE TREATMENT FACILITIES IN A NEW CANCER HOSPITAL *Michael Gilhen, Peter MacCallum Cancer Centre*	NUCLEAR INSPECTION ROBOTS – AND OTHER TECHNOLOGIES USED FOR IAEA SAFEGUARDS *Dr Craig Everton, ASNO*
3.55pm - 4.15pm	THE COMPLEXITIES OF HIGH DOSE 131I-MIBG THERAPY IN THE PAEDIATRIC ENVIRONMENT: EDUCATION AND TRAINING *Nicole Willetts, The Children's Hospital at Westmead*	NUCLEAR MATERIAL DISPOSAL – IAEA SAFEGUARDS REQUIREMENTS *Rebecca Stohr, ASNO*

4.25pm - 4.45pm	**CONFERENCE AWARDS, PRIZES AND CLOSE**	BALLROOM
	Conclusion of ARPS Conference. Have a safe journey home	

THURSDAY 10 AUGUST 2017 **OPTIONAL TOUR - additional fee applicable**

9.00am	**ANSTO Technical Tour** Coach Departs Novotel Wollongong for ANSTO, Lucas Heights
9.45am	Arrive at ANSTO
10.00am	Facility Tours Commence – lunch break included
2.00pm	Coach Departs ANSTO
3.00pm	Coach to Drop off delegates at Sydney Domestic Airport

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ARPS2017

WELCOME TO WOLLONGONG...

...Australia's ninth largest city with a population approaching of approximately 220,000.

Wollongong is a vibrant city nestled between seaside mountains and the Pacific Ocean.

Wollongong is located 80km south of Sydney on a narrow coastal strip bordered by the Royal National Park to the north, Lake Illawarra to the south, the Tasman Sea to the east and the Illawarra Escarpment to the west.

This year the ARPS Conference will open with a bang....

...a Big Bang!

Welcome **Reception**

The internationally-recognised, Science Centre and Planetarium is the largest hands-on science centre in NSW.

Guests will sample local food and wine, experience the planetarium's star show and get hands-on with over 100 exhibits. All while networking and catching up with colleagues under the stars.

Date	Sunday 6 August
Time	6.00pm – 8.00pm
Venue	Wollongong Science Centre and Planetarium
Cost	Included in full registrations. Additional tickets $85 per person
Transfers	Coach departs at 5.30pm from the Novotel

Conference **Dinner**

Beginning with pre-dinner drinks on The Deck overlooking Northbeach, we will then move into the Illawarra Room for a delicious 3 course dinner together with Australian wines.

If you will not be attending the dinner, please let the team from Leishman Associates know.

Date	Tuesday 8 August 2017
Time	6.30pm – 11.00pm
Venue	Illawarra Room, Novotel Wollongong North Beach
Cost	Included in full registrations. Additional tickets $150 per person

RPS8 IN 2017 AND BEYOND

Date	Monday 7 August
Time	7.30am - 9.00am
Cost	$60 per person. Pre-registration required. Additional fee applies
Inclusions	Light Breakfast
Presenter	Dr Richard Smart

Dr Richard Smart, formerly of St George Hospital, also a member of the ARPANSA Working Party which drafted RPS8.

ABOUT THE WORKSHOP

RPS8, The Code of Practice for the Exposure of Humans to Ionizing Radiation for Research Purposes, was published in 2005 and has now been used throughout Australia for 12 years. This workshop will examine a range of issues which arise when the requirements of RPS8 are implemented in the real world. Issues to be discussed include the risk terminology to use in the report, the appropriateness of the radiation dose constraints, multi-centre trials, current references for patient doses, the “clinical management versus research” conundrum and the possible impact of the proposed new Medical Code of Practice.

THE ROLE OF THE LASER SAFETY OFFICER – BRIDGING THE GAP BETWEEN THEORETICAL AND PRACTICAL LASER SAFETY IN THE LAB

Date	Tuesday 8 August
Time	7.30am - 9.00am
Cost	$60 per person. Pre-registration required. Additional fee applies
Inclusions	Light Breakfast
Presenter	Andrew Gibson-White

Andrew is a qualified Laser Safety Officer (LSO) and a Standards Australia Laser Safety Committee Member, with a background in Physics and Aviation from the University of Newcastle.

ABOUT THE WORKSHOP

This workshop aims to examine the role of the Laser Safety Officer and how to make implementing laser safety practical and as easy as possible for the users.

The workshop will consist of:

- Basic laser safety review
- Discussion around the various ways to reduce laser hazards
- Overview of protective eyewear (PPE) standards and selection
- Overview of laser safety barrier products for both lab and hospital environments
- Discussion of how to utilise available resources to help promote a safe working culture based around user involvement and education.

POST-CONFERENCE TOUR

ANSTO

Date	Thursday 10 August 2017
Time	9.00am – 3.00pm
Cost	$55.00 per person. Pre-registration required. Additional fee applies
Dress	Casual, long trousers and closed in shoes recommended

The ARPS Post Conference tour will feature a technical tour of the Australian Nuclear Science and Technology Organisation, Lucas Heights site facilities.

With three tour options to select on the day, all will include a tour of the Open Pool Australian Lightwater (OPAL) reactor.

The state-of-the-art 20 megawatt multi-purpose reactor that uses low enriched uranium (LEU) fuel to achieve a range of nuclear medicine, research, scientific, industrial and production goals.

Pre-registration to the Tour is required. There are limited places available.

Transport to Sydney Domestic Airport will follow.

BOYCE WORTHLEY ORATION

Boyce Wilson Worthley (1917-1987), medical physicist, was educated at Adelaide High School, Adelaide Teachers' College and the University of Adelaide. During his marvellous career he developed comprehensive medical physics roles in cancer treatment and the early application of reactor-produced radionuclides in diagnostic nuclear medicine. He published more than forty papers, and a book with J. Tooze and R. M. Fry, Dosage Estimation in Radiotherapy and the Wheatley Integrator (1955).

BOYCE WORTHLEY ORATION

GEORGE ANASTAS

Wednesday 9 August 2017
9.15am – 10.00am

George Anastas is a Fellow of the Australasian Radiation Protection Society (ARPS), a Member of the ARPS Fellowship Committee, a frequent contributor at ARPS Annual Meetings and a Past-President of the Health Physics Society. He is a Certified Health Physicist, a Fellow of the Health Physics Society, a Professional Nuclear Engineer and a Board Certified Environmental Engineer in Radiation Protection.

He has held technical and leadership positions in industry, government and academia for more than 50 years in radiation safety, industrial hygiene, occupational safety and engineering.

He received a Bachelor's Degree in Physics from the State University of New York at Albany and a Masters of Public Health in Environmental/Radiological Health from the University of Minnesota.

He is currently engaged in "pro bono publico" technical and administrative implications of the continued operation of the Waste Isolation Pilot Plant (WIPP) in New Mexico and evaluating criticality concerns at Los Alamos National Laboratory (LANL).

He served as a consultant to numerous bio-technology firms and chip manufacturing firms in the San Francisco Bay Area.

He has taught Health Physics and Radiological Engineering at Rensselaer Polytechnic Institute, San Diego State University and California State University, Sacramento

George Anastas Abstract continued

A RADIATION PROTECTION VIEW OF AUSTRALIA AND ARPS: A VIEW FROM ACROSS THE POND WITH SOME INSIGHTS FOR DISCUSSIONS

Australia and New Zealand have a rich and robust history in nuclear science and radiation protection. The work by Ernest Rutherford, Sir William Henry Bragg, William Lawrence Bragg, Dr. Michael Goldsworthy and Dr. Horst Struve is highlighted.

The Australasian Radiation Protection Society and its predecessor, the Australian Radiation Protection Society (1975), have a noble professional history in promoting the safe and effective use of radiation.

Several examples of ARPS and Australian Leadership in Radiation Protection are identified.

Some "Clinical" Observations between Australia/New Zealand and the United States are discussed along with some differences and similarities between Australia/New Zealand and the United States.

The author then discusses how the Australian approach to radiation protection might be perceived by others.

It turns out that medical exposure from CT scans is an important issue both in Australia and the United States.

A comparison of key policy directions of ARPS, the Canadian Radiological Protection Association, the Health Physics Society and the Society for Radiological Protection is presented.

OFFICIAL CONFERENCE OPENING

DR HELEN MAYNARD-CASELY

Australian Nuclear Science and Technology Organisation (ANSTO)

Monday 7 August
9.30am – 10.00am

Helen Maynard-Casely is a Planetary Scientist based at the Australian Centre for Neutron Scattering, part of ANSTO's landmark infrastructure. There, she is an instrument scientist, co-responsible for the WOMBAT (high-intensity powder diffraction) instrument. Aside from assisting other researchers in the use of this instrument, she also conducts a program of planetary materials research aimed at understanding the materials that make up the surfaces and interiors of the icy bodies in our solar system. She has a PhD in high-pressure physics from the University of Edinburgh and has been lucky enough to have collected data in facilities all over the world, blowing up a few diamonds along the way. Always keen to tell anyone who'll listen about planetary science, she writes a column 'The Tides of Venus' for The Conversation.

DR ANDREW KARAM PHD, CHP

Karam Consulting, LLC

Monday 7 August
10.00am – 10.45am

Andrew Karam is a nationally and internationally respected radiation safety professional with over 35 years of experience in his field. He began his career in the US Navy's nuclear power program, assigned as a radiation safety specialist on a nuclear attack submarine. Upon leaving the Navy he continued his career, taking positions in academia, state government, and as a consultant in private practice before taking his current position as a WMD scientist with the New York City Police Department's Counterterrorism Division.

Andrew has earned degrees in Geology (BA and MS) and Environmental Science (PhD) and is board-certified in health physics by the American Board of Health Physics. He has authored 17 books, 6 book chapters, and over 30 refereed papers in addition to hundreds of editorials, essays, magazine and encyclopedia articles, and blog postings on various aspects of radiation and nuclear safety. He also presents papers, invited lectures, and posters at meetings throughout the US and internationally.

Andrew also tries to remain active in his profession outside of work. To that end, he has served on two committees of the National Council on Radiation Protection and Management, a committee of the US National Academy of Science, and serves as Web Manager for the International Radiation Protection Association. He has made a number of international trips on behalf of the IAEA and the Health Physics Society, including to Cambodia, Cyprus, and Paraguay. Most recently he travelled to Japan shortly after the tsunami and reactor accident, providing training to emergency and medical responders caring for patients from radiological areas. Andrew's current focus is on issues related to radiological and nuclear weapon interdiction and response to terrorist attacks. To that end, he works extensively with emergency responders at all levels of government as well as with instrumentation companies to develop instruments, procedures, and operational concepts, and more.

THE ART OF THE PRACTICE OF RADIATION SAFETY

As radiation safety professionals we think of ourselves as being principally scientists, living and working in a quantitative world. But in reality, for most of us, our work is far from over when we hit the "=" key on the calculator. Once the calculations are done, the easy part is over and our role changes – we have to explain what these numbers mean to our management, to our clients, to the public, or to whoever has asked for this work. And if we are not at least as adept at the non-quantitative part of our job as we are at the number-crunching then we are not likely to be effective health physicists. Not only that, but in many cases radiation safety is only a part of the answer to the problems we have to address – there are also economic, social, psychological, and even political aspects to what we do. Unfortunately, most of us feel more comfortable explaining work to our peers than to non-scientists, even though it's the non-scientists (or at least, non-health physicists) to whom we ultimately answer more often than not. And if we cannot master these non-quantitative aspects of our profession there is a limit to how effective we can be. This is what we'll explore in this talk – the art of the practice of radiation safety that comprises so much of what we do.

KEYNOTE SPEAKER

DR YASUHIRO UEZU

Japan Atomic Energy Agency (JAEA), Fukushima Research Institute

Monday 7 August
2.00pm – 2.45pm

Dr Uezu, received a Ph.D. in Science from Niigata University. His doctoral thesis was "Studies on Determination of Natural and Artificial Radionuclides based on Their Lives". Dr Uezu has been developing a new analytical method of radionuclides, environmental monitoring, and evaluation of public exposure in Tokai-mura since April 1992.

In 2011, Dr Uezu moved to Fukushima to manage radiation protection after The Great East Japan Earthquake. Now, a group leader of The Safety Administration and Radiation Measurement Group, Fukushima Environmental Safety Center (March 2017). His main works are in the management of safety, planning of monitoring programs (environmental and public exposure) and evaluation of these results. Furthermore, Dr Uezu is trying to develop human resources through bidirectional communications.

"FUKUSHIMA RECOVERY NOW" - ENVIRONMENTAL MONITORING, RISK COMMUNICATIONS AND HUMAN RESOURCE DEVELOPMENTS IN FUKUSHIMA

The Great East Japan Earthquake hit on March 11, 2011. The Earthquake and following tsunami struck huge area. The Fukushima Dai-ichi Power plant run by Tokyo Electric Power Company lost power and reactor cooling failed due to an operative power generator. As a result, hydrogen explosions occurred in unit 1, 3, and 4.

Japan Atomic Energy Agency (JAEA) was requested by Ministry of Education, Culture, Sports, Science and Technology (MEXT) to dispatch specialist to monitor the levels. JAEA's environmental monitoring staff were dispatched from Nuclear Emergency Assistance and Training Centre (NEAT) using Japan Self Defence Force (JSDF) transport helicopter on March 11. JAEA's environmental monitoring staff planned and prepared for environmental monitoring, and monitored radiation, air dust, iodine. A monitoring vehicle with Ge detector, monitoring vehicles, vehicles with whole body counting (WBC) system, surface contamination monitoring vehicle and a human decontamination vehicle were dispatched.

New monitoring methods of unmanned remote monitoring such as unmanned air planes, unmanned helicopters and drones for aerial monitoring, an unmanned ship for marine monitoring, plastic scintillation fiberscope for huge aerial radiation monitoring and gamma plotter for contamination mapping were developed.

As a result, about 500,000 inhabitants in Fukushima Prefecture, almost all of whom are under a 1-2mSv of external exposure. This is based on calculations of the air dose in the residential areas because the residents did not have personal dosimeter.

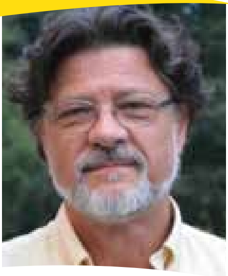
About internal exposure, about 300,000 inhabitants who have been screened using WBC, only 26were over 1mSv of committed effective dose. Using this data, it was able to conclude that 99.9% of inhabitants were below 1mSv. Because the radioactivity in foodstuffs has been monitored since the earliest stages, and this monitoring has been effective in keeping the food safe to consume.

Furthermore, based on thyroid echo checks, it was difficult to think that the thyroid cancer found at present is nuclear accident origin, a specialist estimated.

This presentation shows JAEA's and Fukushima Prefecture's activities such as an environmental emergency monitoring, evaluation personal exposure, decontamination and so on.

PROFESSOR DARIUSZ LESZCZYNSKI

University of Helsinki, Finland



Tuesday 8 August
9.30am – 10.15am

Dariusz Leszczynski, PhD, DSc, Adjunct Professor of Biochemistry at the University of Helsinki, Finland and Chief Editor of 'Radiation and Health'; specialty of the 'Frontiers in Public Health', Lausanne, Switzerland.

Holds two doctorates, in molecular biology (DSc) and biochemistry (PhD), from Jagiellonian University, Krakow, Poland, and Helsinki University, Finland, respectively.

For nearly 22 years (1992-2013) worked at the Finnish Radiation and Nuclear Safety Authority with responsibility for research on biological and health effects of non-ionizing radiation. During the years 2003-2007 was Head of Radiation Biology Laboratory and from 2000 to 2013 Research Professor.

Held several visiting appointments: 1997-1999 Assistant Professor at the Harvard Medical School, 2006-2009 – Guangbiao Professor at the Zhejiang University School of Medicine, Hangzhou, China and 2012-2013 Visiting Professor at the Swinburne University of Technology, Melbourne, Australia.

An internationally recognized expert in the field of biological and health effects of radiation emitted by wireless communication devices. In this capacity testified in 2009 before the US Senate Committee, in 2015 before the Committee of the Canadian House of Commons and in 2014 advised the Minister of Health of India.

In 2011 was one of the 30 experts invited by the International Agency for Research on Cancer who classified cell phone radiation as possibly carcinogenic to humans.

BETWEEN A ROCK AND A HARD PLACE: THE ART OF RADIATION PROTECTION IN THE WIRELESS ERA

Wireless communication devices and its infrastructure, emitting man-made modulated radiofrequency electromagnetic radiation (RF-EMF), is omnipresent in our lives and environment.

This technology, developed for the US military, was not tested for human health hazard before it was commercially deployed. The US Food and Drug Administration (US FDA) justified permission for such deployment by the "low-power exclusion rule" – the radiation was assumed to be unable to affect human health.

However, afterwards, epidemiological case-control studies and studies examining the sleep EEG have provided a compelling, though indirect, evidence that this low-power radiation affects human physiology.

In 2011, epidemiological case-control studies, together with animal studies, were the basis for the International Agency for Research on Cancer (IARC) to classify low-power RF-EMF emitted by the wireless communication devices as a possible human carcinogen.

Because the appropriate scientific studies in human volunteers remain to be not executed (!) we do not know the biophysical mechanism how low-power RF-EMF elicits physiological responses.

In the vast majority of the human volunteer studies the study subjects were acutely exposed to low-power RF-EMF and either already during, or shortly after the exposure, asked to describe their feelings; including whether they recognized when the RF-EMF exposure was on or off. Such a set-up of experiments is too crude and biased, by the potential emotional stress of the study subjects, to prove or disprove the existence of any physiological effect. Furthermore, such studies do not provide any answers about delayed responses or outcomes of chronic exposures.

The lack of the acute effects does not automatically mean that low-power RF-EMF has no impact on human physiology. Only studies examining changes in the biochemistry of human body, in response to low-power RF-EMF exposure, will provide scientifically valid information on the potentially affected physiological processes.

It is very likely that individual sensitivity to low-power RF-EMF affects part of the population. The unanswered question is, what is this RF-EMF power level?

Epidemiological case-control studies indicate that the current safety limits for the radiation emitted by the wireless communication devices do not protect all users. Results of these studies are based on experimental data where people used cell phones that were in full compliance with the current safety limits. However, avid use of such cell phones has been shown to increase risk of developing brain cancer.

This means that the safety limits, set by the International Commission on Non-Ionizing Radiation Protection and by the International Committee on Electromagnetic Safety, are insufficient to protect all users and need to be revised.

The new 5th generation technology for wireless communication (5G) and the internet of things (IoT) are being fast developed by the industry. Again, technology is to be implemented without knowledge of its impact on human health. There is a complete lack of biomedical research on effects, if any, of the 5G radiation (millimetre-waves) on humans. Industry's only justification for such hasty and premature deployment of 5G and IoT is that it will emit only low-power radiation.

But we know, from the past experience when the US FDA permitted deployment of untested for human health hazard RF-EMF emitting devices, the low-power emissions alone is an insufficient reason to justify deployment.

Concluding, in the current situation of scientific uncertainty, shown by the 2011 IARC carcinogenicity classification, the Precautionary Principle, as defined by the European Union, should be invoked for the currently deployed wireless communication technology: "…Whether or not to invoke the Precautionary Principle is a decision exercised where scientific information is insufficient, inconclusive, or uncertain and where there are indications that the possible effects on environment, or human, animal or plant health may be potentially dangerous and inconsistent with the chosen level of protection…".

Furthermore, the lack of research on the biological effects of radiation emitted by the 5G and IoT technologies should be the reason for a temporary moratorium on the preparations for the massive deployment of 5G and IoT and for urgent setting up research projects to examine biological effects of 5G- and IoT-emitted radiation on humans.

PROFESSOR DOUGLAS BOREHAM

Bruce Power/Northern Ontario School of Medicine, Canada

Tuesday 8 August
3.00pm - 3.45pm

Dr Boreham is currently a professor at the Northern Ontario School of Medicine (NOSM) and Division Head for the Medical Sciences Division. He is also the principal scientist at Bruce Power, Manager of the Integration Department, and is the NOSM/Bruce Power Research Chair in Radiation and Health.

Dr Boreham is a recognized leader in the field of radiation health and environmental effects. He was selected as an expert Canadian delegate for the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) in 2012. He has earned several awards including: McMaster President's Award for Excellence in Instruction (2004), Canadian Nuclear Achievement Award for outstanding Education and Communications (2005), Canadian Radiation Protection Association – Distinguished Achievement Award in Recognition of Outstanding Contributions in the Field of Radiation Protection (2009), Radiation Research Society – Mentor of the Year Award for Scholars in Training (2010). The International Dose-Response Society selected Dr Boreham as recipient of the 2015 Outstanding Leadership Award in the field of Dose Response.

Dr Boreham currently conducts research on low dose impacts from natural and man-made radiation. Low dose cancer risk and radioprotection is a primary focus of his research.

EVIDENCE FOR PARADIGM SHIFTS IN LOW DOSE RADIATION (LDR) BIOLOGY: RE-EVALUATION OF THE LINEAR NO-THRESHOLD (LNT) RISK MODEL USING MODERN MOLECULAR STUDIES

The linear no-threshold (LNT) model is still used to estimate low dose radiation health risks, despite recommendations from many scientists that it is not appropriate. The model overlooks biological response thresholds and postulates that health risks caused by ionizing radiation are directly proportional to dose. Consequently, even the smallest radiation dose has the potential to cause an increase in cancer risk. The main goal of this review is to summarize the modern cellular and molecular literature in low dose radiation biology and provide new paradigms that better represent the biological effects in the low dose range. We identified approximately 400 manuscripts recently published over the past 5 years (2012-2016) on biological effects of low dose radiation. Inclusion/exclusion criteria identified 198 manuscripts suitable for the review. These reports showed that low radiation activates a variety of cellular defense mechanisms including DNA repair systems, programmed cell death (apoptosis), cell cycle arrest, senescence, adaptive memory, bystander effects, epigenetics, immune stimulation, and tumor suppression. The evidence is overwhelming and reveals that there are likely no health risks (cancer) from low dose exposure, and that a threshold dose is necessary to achieve the harmful effects classically observed with high doses of radiation. Advances in our understanding of the complexity of cancer processes will demonstrate cancer cannot be predicted based on exposure to a single physical event such as an ionization. Knowledge gained from this review can help the radiation protection community in making informed decisions regarding future radiation policy and limits.

CHRISTOPHER CLEMENTS

International Commission on Radiological Protection

Wednesday 9 August
10.00am – 10.45am

Christopher has a Master of Science degree in Medical Physics, and is a Certified Health Physicist. He has nearly thirty years of experience in radiological protection, working in environmental remediation, radiological counter-terrorism, and as Director of Radiation Protection at the Canadian Nuclear Safety Commission overseeing radiation protection regulation in all sectors across the country. For several years he represented Canada at the IAEA Radiation Safety Standards Committee, and the OECD Nuclear Energy Agency's Committee on Radiation Protection and Public Health. He has received two honours from the Canadian Radiation Protection Association: the Distinguished Achievement Award in 2011, and the Richard V. Osborne Founders' Award in 2015. In 2012 he was elected to the Executive Council of IRPA.

Since 2008, Christopher has been Scientific Secretary of the International Commission on Radiological Protection (ICRP), the tenth to hold this position since 1928, following luminaries such as Lauriston Taylor, Bo Lindell, and fellow Canadian David Sowby. He oversees the daily business of ICRP, represents the organisation in many international fora, and has presented well over 150 invited lectures in more than 25 countries on the work of ICRP and radiological protection. As Editor-in-Chief of the Annals of the ICRP he has overseen the production of more than two dozen ICRP publications, the basis of radiological protection standards, legislation, and practice world-wide.

ANOTHER LOOK AT THE SILVER LINING OF THE FUKUSHIMA ACCIDENT: IMPROVING THE SYSTEM OF RADIOLOGICAL PROTECTION

There is no question that the triple disaster of the earthquake, tsunami, and Fukushima Daiichi nuclear power plant accident of March 11, 2011, was a terrible tragedy. However, in 2013, this author wrote a guest editorial for a special issue of the Journal of Radiological Protection on some of the good that has come out of this adversity (The silver lining: recommendations to improve the system of radiological protection. J. Radiol. Prot. 33 (2013) E13-E14). This presentation examines the silver lining again, in the light of four more years of experience. The role of the International Commission on Radiological Protection (ICRP) is to advance radiological protection for the public good, primarily by making recommendations. Given this, it is not surprising that we have focused so much attention on the accident to draw lessons to improve the system of radiological protection. Within two months, ICRP established a Task Group on Initial Lessons Learned from the NPP Accident to guide the ICRP programme of work. Sixteen months later, the resulting summary report 'Issues Identified from the NPP Accident in Japan and Recommendations to Improve the System of Radiological Protection' identified 18 issues and made 11 recommendations to the ICRP Main Commission. Subsequently, ICRP initiated a significant effort, still underway, to revise recommendations on radiological protection in emergency and post-accident situations. In addition, the ICRP Fukushima Dialogue Initiative was launched, a cooperative effort working directly with residents of Fukushima to help where we can, and to learn directly from those effected. It is our moral obligation to make the best of this silver lining presented to the radiological protection community, but we must never forget the cloud in which it came.

PROFESSOR KEVIN NELSON, PH.D., CHP

Mayo Clinic, Arizona USA

Wednesday 9 August
2.00pm – 2.45pm

Dr Kevin Nelson has been working as a medical health physicist at Mayo Clinic for the last 22 years. He has served as the Radiation Safety Officer for both Mayo Clinic in Jacksonville, Florida and the Mayo Clinic in Phoenix, Arizona. Dr Nelson also holds an appointment as an Assistant Professor in the Mayo Clinic College of Medicine.

Prior to joining the Mayo Clinic in 1995, Dr Nelson worked as an operational health physicist in industry, academia, research, and state government. He served as a health physicist for the 3M Company in St. Paul, Minnesota, as a senior health physicist for the University of Minnesota in Minneapolis, Minnesota, as a project scientist in the Radiological Sciences Division of the Brookhaven National Laboratory in Upton, New York, and as a power reactor drill coordinator and joint public information officer for the State of Minnesota's Department of Health.

Dr Nelson has been very active in the Health Physics Society. He has served as the President-elect, President and past-President of the Society. He has served as a Society Director, as Chair of the Human Capital Crisis Committee and the Legislation & Regulation Committee, and as a member of various committees including Finance and Membership.

Dr Nelson has held a comprehensive certification by the American Board of Health Physics since 1992.

Dr Nelson lives in Cave Creek, Arizona with his 15 year old daughter, Alexis. He enjoys the mountains in the area and loves hiking.

PROTON BEAM THERAPY AT MAYO CLINIC

The use of proton beam therapy to treat tumours adjacent to critical organs or to treat sensitive populations has expanded dramatically in the past decade. In the United States, the use of ionizing radiation producing machines on humans is regulated by individual states. Unfortunately, regulations pertaining specifically to proton beam therapy are very minimal or non-existent. This talk will provide an overview on the theory behind proton beam therapy as well as some of the regulatory issues and our patient experience to date.

NOTES

INFORMATION FOR PRESENTERS AND SESSION CHAIRS

All speakers will be asked to report to the Speakers Preparation Area to load their presentations onto the conference network. Even if you are using your own laptop, please see the AV technicians, so they are prepared for your presentation.
If possible, please do this at least 2-3 hours prior to your presentation.

An audio visual technician will be available throughout the conference.

If possible, speakers are asked to introduce themselves to their session chair and where possible familiarise themselves with the room set up. The Speakers Preparation Area is located in the McCabe/Throsby Room at Novotel Wollongong. Please speak to the Leishman team for assistance.

SESSION 1: EDUCATION, TRAINING AND SAFETY CULTURE

11.15AM – 1.00PM

ANSTO RADIATION PROTECTION SERVICES STRATEGIC OPERATIONAL PLAN

ROBIN FOY[1], MR ANDREW POPP[1], MRS TINA PANERAS[1]

1 ANSTO

Robin Foy has been the Manager, Radiation Protection Services at ANSTO since 2012, having arrived in Australia in 2010 to join ANSTO as a Radiation Protection Adviser.

Robin is a Chartered Radiation Protection Professional, holds a current Certificate of Competence to be a Radiation Protection Adviser in the UK and remains a member of the UK Society for Radiological Protection as well as being a member of the Australasian Radiation Protection Society.

Robin has worked in Radiation Protection since 1978. The first 32 years of his career was spent in the UK with the company best known as Amersham International or Amersham plc and is currently GE Healthcare. This organisation produced radioactive sources and radioactive materials for use in research and industry as well as radiopharmaceuticals, which it still produces.

Robin has worked as a Health Physics Surveyor, Operational Health Physicist, Project Health Physicist and Emergency Planner and became one of the formally appointed Radiation Protection Advisers within the GE Healthcare in the UK.

He was a Working Group Member of RADSAFE (the UK Industry Emergency Response for the Transport of Radioactive Materials) until he left the UK.

ABSTRACT

The Radiation Protection Services (RPS) group at ANSTO are required to provide a high quality radiation protection advice and assurance service to multiple types of facilities (nuclear reactor, linear accelerators, cyclotrons, radiopharmaceutical production, multiple research departments and others) which give rise to a diverse range of ionising radiation safety challenges. In order to maintain high standards and recognise development opportunities to ensure that best practices are employed the RPS group developed a Strategic Operational Plan to identify continuous improvement opportunities to maintain “best practice” in radiation protection within this diverse organisation. This presentation will explore some of those opportunities to ensure continuous improvement in radiation protection practices at ANSTO.

DEVELOPMENTS IN SAFETY CULTURE - WHY AUSTRALIANS SHOULD TAKE NOTE

JOHN WARD[1]

1 Arpansa

John is the Manager, Continuous Improvement Section of the Regulatory Services at the Australian Radiation and Nuclear Safety Agency (ARPANSA).

John is registered as a professional engineer at incorporated level by the UK Engineering Council and is a member of the UK based Institution of

Engineering Designers. His formal qualifications are in mechanical and production engineering.

John has 30 over years of experience in the nuclear industry. In industry, he was involved in the design of nuclear components and equipment, environmental trials, product and production support. John's experience includes the preparation of nuclear safety cases, risk assessment, ageing management and decommissioning.

In 2005 John joined ARPANSA, initially working on the assessment and regulation of the Australian research reactors. John led the development of the ARPANSA's Holistic (Systemic) Approach to safety including the promotion of the concept to licence holders. This approach is considered by ARPANSA to be best practice. Now as Manager of Continuous improvement, John continues to lead ARPANSA's holistic approach to safety and the incorporation of this into ARPANSA's regulatory practices. In addition, his role is to assess and improve the performance of ARPANSA's regulatory services and thus influence improvements of its regulated stakeholders.

ABSTRACT

This presentation highlights work at ARPANSA and international developments in safety culture which impact the behavioural expectations of anyone using radiation in Australia. Using data from incidents and analysis it shows that safety improvements can still be made in Australia.

BACKGROUND

Safety culture was brought to attention after the 1986 disaster at Chernobyl when it was used in the 'Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident'. Since then the concept has broadened and developed to recognise that safety is a function of a socio-technical environment that has dependencies in the mix of human, organisational and technical factors.

The Need to Improve Safety Culture

We all like to think that we have a good safety culture and safety performance. The number of reported safety incidents across Australia is low, but the underlying causes have changed little for many years. Analysis suggests incident rates could be lowered further through addressing some relatively simple organisational behaviours and learning from others. Developments in the area of safety culture and holistic safety may help.

Developments in Safety Culture

In 2002 the International Atomic Energy Agency (IAEA) published INSAG 15 establishing the standard guidance for safety culture. Advances in understanding safety in organisations have been undertaken since but INSAG 15 remains a primary source of guidance for many. In 2016 the IAEA published new requirements on Leadership and Management for Safety for all users of radiation, including a requirement to consider human, organisational and technological factors and how they interact.

Many international organisations have published their own guidance and standards since INSAG 15. In 2012, ARPANSA published Holistic Safety Guidance which, alongside safety culture, includes other modern principles for safety including resilience, non-technical skills and human factors. Another notable publication is the 2012 Institute of Nuclear Power Operators (INPO) safety culture traits which has been adopted by many organisations outside of the INPO group.

In 2016, INPO, in partnership with the IAEA, commenced a worldwide consultation process to harmonise the international approach to and language for safety culture. Workshops were held in South Korea, the USA and Austria to develop new, internationally agreed, attributes for safety culture and reflect the need to consider the interactions between human organisational and technological factors. Publication of an IAEA document based on this work is planned for 2018. This will be one of several IAEA documents providing guidance to meet the new IAEA safety requirements.

EFFECTIVE WORKPLACE RADIATION SAFETY TRAINING

JOHN BUS[1]

1 ANSTO

John is a Senior Health Physicist who joined ANSTO in 2004. John has been the Radiation Protection Advisor for the OPAL Research Reactor since 2013. Where, he supports ANSTO's Nuclear Operations by managing radiation protection resources and providing radiation protection advice and training to enable a safe and productive workplace.

John was the Nuclear and Radiological Emergency Preparedness and Response Officer for the Regional Security of Radioactive Sources Project during 2010-13. John was also the Project Leader for the Enhancement of Indonesia's Nuclear and Radiological Emergency Preparedness and Response during 2011-12. In both cases John was responsible for developing training material related to radioactive source security and safety, identification and recovery of orphaned sources, and emergency preparedness and response for radiological security-related incidents.

During 2007-10, John was a Radiation Protection Advisor for the Institute of Environmental Research, Life Sciences, ANSTO Health, the National Medical Cyclotron and the Molybdenum-99 Project.

ABSTRACT

Effective workplace radiation safety training is achieved through the implementation of the Systematic Approach to Training (SAT) process. SAT is a multi-step, iterative process for the development and continuous improvement of radiation safety training. Key components of SAT are the training needs analysis, overarching training program, learning objectives, content and assessment development and training effectiveness evaluation.

The fundamentals of radiation safety as it applies at ANSTO are covered by the Basic Radiation Safety course followed within three months by the scenario-based Radiation Safety Workshop, that classified workers enrolled on the ANSTO dosimetry service are required to complete every five years. To complement this there has been radiation safety training developed on the specific radiological hazards encountered and the radiation protection arrangements at the Open Pool Australian Lightwater (OPAL) reactor. This training consists of an OPAL radiation safety training course for staff new to the facility, and an online OPAL radiation safety training refresher which is required to be completed every three years. The initial training is a full-day instructor led course that consists of a mixture of lectures, workshops, a practical exercise, a tour of the facility and a written exam. The online refresher training consists of two parts: reading key radiation safety documents specific to OPAL followed by an online exam, and an online module that

consists of interactive tasks, maps, photos and information followed by an online exam.

This oral presentation examines how by using the SAT process an effective radiation safety training program has been developed for classified workers at the OPAL reactor to ensure they have the desired knowledge, skills, experience and attitude to radiation safety.

AUSTRALIAN NATIONAL RADIATION DOSE REGISTER (ANRDR) IN REVIEW

BEN PARITSKY[1]

1 ARPANSA

Since joining the ANRDR in 2012, Ben has progressed the operation, ongoing maintenance and development of the ANRDR. Most recently, Ben has driven the activities related to the expansion of the dose register beyond uranium mining and coordinated the redevelopment of the database, portal and quality management system.

ABSTRACT

The Australian National Radiation Dose Register (ANRDR), launched in 2011, is a centralised database designed for the collection, storage and maintenance of dose records for occupationally exposed workers. In line with international best practice, these records must be maintained until the worker attains the age of 75, and until at least 30 years after cessation of work resulting in occupational exposure.

The ANRDR provides a single uniform national approach to the management of radiation dose records and safeguards their longevity in a central location to ensure they remain available to workers on request. The analysis of data in the ANRDR provides valuable information for industry to facilitate optimisation of radiation protection programs.

The ANRDR is expanding to capture radiation dose records for all occupationally exposed workers. Currently, the expansion activities are focused on engagement with the medical sector. The ANRDR now has full coverage of the uranium mining and milling industry and partial coverage of the mineral sands mining and processing industry, as well as Commonwealth organisations.

This paper will provide an update on expansion activities, including a review of the medical sector survey, analysis of existing data, and a review of the processes and challenges of implementation of the ANRDR.

SESSION 2: COMMUNICATIONS

11.15AM – 1.00PM

EMERGENCY PREPAREDNESS AND RESPONSE EVOLUTION @ARPANSA

DR GILLIAN HIRTH[1], DR MARCUS GRZECHNIK[1]

1 Australian Radiation Protection And Nuclear Safety Agency (arpansa)

Dr Gillian Hirth is the Chief Radiation Health Scientist and Head, Radiation Health Services (RHS) Branch of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) since August 2016.

Dr Hirth completed a PhD in environmental radiochemistry in 1999 and from 2000 to 2003 she was a Post-Doctoral Research Fellow at the Australian Nuclear Science and Technology Organisation. Her research focussed on the transport of uranium decay series in the environment and their transfer to the biota.

Dr Hirth worked for the Australian Defence Organisation from 2003 to 2010 in the field of hazardous materials and environmental management, this work included the management of radiation sources and facilities, nuclear materials, occupational exposures and waste across the organisation. She has been with ARPANSA since 2010 initially working in codes and standards development she then led a project examining radionuclide activity concentration ratios in wildlife inhabiting uranium mining environments and was Director of the Monitoring and Emergency Response Section in RHS Branch from 2014 to August 2016.

Dr Hirth worked on the OECD/NEA Expert Group on Radiological Protection Science (EGRPS) and is a member of an IAEA working group preparing a safety report on occupational radiation protection in uranium mining and processing industry. Dr Hirth is the Australian representative on the IAEA's Emergency Preparedness & Response Safety Standards Committee (EPReSC). Dr. Hirth is also a member of the Board of Council of the International Union of Radioecology.

Dr Hirth joined the Australian delegation to UNSCEAR in 2013. She serves as representative of Australia for the 64 session (2017).

Dr Grzechnik qualified for his PhD in Applied Mathematics at the University of Adelaide in 2000. He proceeded to work in the UK for 7 years in the assessment of dose from atmospheric and marine discharges, and has been employed by ARPANSA since 2008. Marcus' contribution has included projects in protection of the environment, emergency preparedness and response, contribution to and adoption of international safety standards, provision of advice to stakeholders and radiological assessment. Marcus has been Director of the Monitoring and Emergency Response Section since September 2016.

ABSTRACT

Over the last few years the Australasian Radiation Protection Society (ARPS) Conference has been host to a number of presentations and workshops on the setting of Reference Levels and other aspects relating to Emergency Preparedness and Response (EPR). The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) has been reassessing and refining its capabilities in the

area of EPR in line with national capabilities and international advice.

Recent occurrences include;

- Recommendation of an emergency reference level of 50mSv to the CEO of ARPANSA by the Radiation Health and Safety Advisory Council (RHSAC):
- Development of the "Guide for Radiation Protection in Emergency Exposure Situations" through the Radiation Health Committee (RHC);
- Participation in the IAEA ConvEx 3 emergency exercise over 36-hours in June 2017, testing national and international arrangements;
- Refinement of terms of reference for RHSAC Working Group 4 in order to plan for the strengthening of EPR arrangements in Australia.

During this presentation it is intended to describe the outcomes included above, as well as speculate on the future direction of EPR at ARPANSA and in Australia. The following two topics provide the main topics of discussion:

- Crisis Communication – International work is being undertaken on the value of effective communications before and during a crisis. Of particular importance is the effective use of Social Media in these situations, where timeliness and accuracy of information exchange is vital to maintain credibility.
- Capability Refinement – The upcoming International Regulatory Review Service (IRRS) Mission to Australia will help to identify gaps in Australian capability and capacity in radiological EPR. Plans for improving integration across Jurisdictions are to be reviewed and refined in order to optimise resources and protection across Australia.

COMMUNICATING WITH GOVERNMENT AND THE PUBLIC

DR RICHARD O'BRIEN[1]

1 Retired, 3/82 Doncaster Road, Balwyn North, Victoria 3104.

Rick joined ARL in April 1981 and retired from ARPANSA in July 2016. During his 35 years in radiation protection he worked in areas such as uranium mining, radon, internal dosimetry, NORM, waste management, and impact assessment. He also participated in the verification studies during the Maralinga clean-up. He was involved in several IAEA programs, including EMRAS 1 and EMRAS 2, and has contributed to several IAEA documents and the revised ICRP gastro-intestinal tract model.

ABSTRACT

For many years scientists have been regarded as poor communicators when dealing with non-scientists such as politicians and members of the public. One of the major criticisms has been levelled at the use of technical jargon by scientists when dealing with non-scientists. There is no doubt that science can be complex and that technical jargon can facilitate discussion between scientists. However, this approach does not work very well when discussing scientific ideas with, or explaining science to, non-scientists.

There are other problems in communicating with non-scientists which have not received much attention. These include lack of clarity, spin, and the ten-second sound bite favoured by television news reporters.

Lack of clarity can result from the inability or unwillingness of the scientist to develop simple ways to explain complex scientific ideas. Another cause of lack of clarity can result from a poor choice of definitions and terminology, in

particular by changing the meanings of words. Examples which occur frequently in radiation protection are natural radionuclide, NORM, natural source, exposure pathway, existing exposure and dose reconstruction.

The way in which these terms can cause confusion are pointed out and alternatives are suggested which remove the confusion.

Two examples of spin which occur in the regulatory sphere are "self-regulation" and "regulation ensures safety".

Brevity is demanded when dealing with television reporters. However, emphasising brevity at the expense of clarity does not always result in good communication.

Some possible causes of these problems are discussed, and some straightforward remedies are suggested.

EXPERIENCES ON THE NUCLEAR CITIZEN'S JURY

CAMERON JEFFRIES[1]

1 Australasian Radiation Protection Society

Cameron Jeffries completed a Master of Applied Science at Queensland University of Technology. He gained radiation protection experience in uranium mining while working at Olympic Dam mine and has worked as a radiation protection regulator with the Environment Protection Authorities in New South Wales and South Australia. He is currently the Radiation & Laser Safety Officer at St Vincent's Hospital, Sydney, and also provides radiation safety consultancy services.

Cameron is the President of the Australasian Radiation Protection Society. He is a member of the Australasian Radiation Protection Accreditation Board and a member of the NSW Radiation Advisory Council. Cameron encourages all presenters at this conference to submit a written paper to the ARPS Journal, Radiation Protection in Australasia.

ABSTRACT

The South Australian government undertook a Royal Commission into the Nuclear Fuel Cycle to investigation the potential benefits for the state. Following the completion of the Royal Commission the government undertook further consultation in the form of Citizen's Juries to consider responses to the recommendations. The first citizen's jury was asked to identify key issues to be discussed during state wide consultation on the Royal Commission report. The second Citizen's Jury was asked to consider a specific proposal for South Australia to provide a service to dispose of spent nuclear fuel rods. The author was one of 25,000 South Australians invited to register interest, and was ultimately invited to be part of the second jury.

This presentation will discuss the citizen's jury from the perspective of a jury member. The topics covered will include the jury process, communication tools used, the task presented to the jury and one perspective of the jury's deliberations and findings. Some challenges for ARPS arising from the jury will be presented.

PERCEPTION AND SCIENCE

DR RICHARD O'BRIEN[1]

1 Retired, 3/82 Doncaster Road, Balwyn North, Victoria 3104

See previous Biography

ABSTRACT

One of the major problems associated with ionizing radiation is

that of dealing with public and media views. Many of these views are based on misunderstanding or lack of knowledge of the subject, or ignore the principle that the scientist has to follow, namely that scientific conclusions have to be based on the concepts of repeatability, reproducibility and peer review.

The formal (dictionary) definition of perception refers to intuition and the process by which an organism detects and interprets information from the external world by means of the sensory receptors. Information obtained in this way is usually qualitative.

Scientific method is the acquisition, analysis and interpretation of data by utilising three processes, repeatability, reproducibility and peer review. This has evolved as a way of ensuring, as far as possible, that the conclusions of a piece of scientific work can be reliably used as the basis for further work. Therefore science is intended to be quantitative.

Peer review is sometimes regarded as implying that once a piece of scientific work has been published it is somehow inviolate. However, science is an evolving discipline, and the conclusion(s) expressed in a scientific paper can change if new information on the subject of the paper becomes available.

Intuition certainly has a place in science, as it frequently provides a starting point for the development of more rigorous and quantitative work.

However, there are many “perceptions” regarding ionising radiation that are either misleading, unsustainable, or in some cases are not perception at all but can be more accurately described as examples of confirmation bias or illusory correlation.

Confirmation bias is the tendency to search for, interpret, favour and recall information that confirms pre-existing beliefs or hypotheses. An example of this is the statement any exposure to ionising radiation causes cancer. Despite a very large body of evidence that clearly shows this statement to be false, it still has a surprising level of credibility.

Illusory correlation is a specific form of confirmation bias, which occurs when people falsely perceive an association between two events or situations. In radiation protection this often occurs when an individual has been exposed to ionising radiation and subsequently develops cancer. There is a strong tendency to associate these events, even when rigorous scientific analysis shows that the dose received is so low that the probability of developing cancer is negligibly small.

SCIENCE AND ART IN RADIATION RISK COMMUNICATION

JIM HONDROS[1]

1 JRHC Enterprises

Having worked for more than 30 years in the mining industry in operational, management, corporate and consulting roles for both small and large uranium and non uranium mining companies, Jim has extensive practical expertise.

Currently, Jim has his own consulting firm, JRHC Enterprises, and works with a range of companies, providing high radiological level policy advice through to radiological impact assessment and baseline monitoring.

Jim has also spent a number of years working with Indigenous groups in Australia and continues that work.

ABSTRACT

Radiation and its effects are not well understood in the wider community, with direct consequences being the ongoing irrational fear of radiation and poorly informed decision making based on perceptions rather than fact.

There are a range of current and historical reasons for this, including; difficulties with the concept of risk, the complexity of the system of radiation protection and community preconceptions about radiation. As radiation practitioners, we struggle with communicating the complex approach to radiation and approach to radiation protection and we get frustrated when people just don't get it.

The aim of this presentation is to discuss some thoughts and initiatives in radiation risk communications, including work by ARPS in relation to a wider international initiative by International Radiation Protection Association (IRPA).

SESSION 3: NON-IONISING RADIATION

11.00AM – 12.00PM

DETERMINING THE AETIOLOGY OF IDIOPATHIC ENVIRONMENTAL INTOLERANCE ATTRIBUTED TO ELECTROMAGNETIC FIELDS: RF EXPOSURE OR NOCEBO EFFECT?

ADAM VERRENDER[1,2], RODNEY CROFT[1,2], SARAH LOUGHRAN[1,2]

1 Australian Centre for Electromagnetic Bioeffects Research

2 School of Psychology, Illawarra Health & Medical Research Institute, University of Wollongong, Australia

Adam is a PhD candidate in the University of Wollongong's School of Psychology and is supervised by Prof. Rodney Croft and Dr Sarah Loughran. He received a Bachelor of Psychology (Hons) at the University of Wollongong in 2013 before enrolling as a PhD student in 2014. Adam is part of ACEBR's human neurophysiology research group. His research focuses on the neurobiological and psychological determinants of Idiopathic Environmental Intolerance attributed to Electromagnetic Fields (IEI-EMF), commonly known as Electromagnetic Hypersensitivity. He is also interested in a range of bioelectromagnetic health issues, including the effect of radiofrequency exposure on human brain function and cognition, and the mechanisms associated with these effects.

ABSTRACT

Idiopathic Environmental Intolerance attributed to Electromagnetic Fields (IEI-EMF) is a condition in which a small proportion of the population report experiencing a wide range of non-specific symptoms which they attribute to the non-ionising electromagnetic fields (EMF) emitted by various electronic and wireless devices[1]. To date, there has been no evidence of a relationship between EMF exposure and the symptoms reported by IEI-EMF sufferers, with the majority of double-blind provocation studies failing to find any significant differences in symptom severity between active and sham exposure conditions[2-4]. A number of studies have also shown that sham exposures are sufficient to trigger symptoms in IEI-EMF participants, leading many to suggest that the condition may be the result of a harmful nocebo effect[5-9], where conscious or subconscious symptom expectation following a perceived exposure to EMF leads to the formation or detection of symptoms.

Yet, despite the importance of such IEI-EMF symptoms, the aetiology of the condition remains highly contentious. A number of methodological concerns have been raised which some believe may explain the current null findings in relation to EMF exposure. While it is possible that these potential limitations may have masked real effects of EMF exposure on symptoms, this needs to be determined empirically. Furthermore, much remains to be clarified in terms of the nocebo effect itself. While there has been some suggestion that mainstream media reports[10] and science communications[11,12] negatively influence people's beliefs about EMF exposure, only one study has demonstrated that this may contribute to the presentation of a nocebo effect, and only in those with high pre-existing levels of anxiety[10].

Building on these concepts, the results of two studies investigating the determinants of IEI-EMF will be presented. The first addresses the methodological concerns of IEI-EMF provocation studies by taking a novel, case-study approach to testing (self-reported) sensitive individuals, using a sufficient number of EMF-tailored sham and active provocation

trials to determine statistically, within an individual, whether any individually-tailored symptom – exposure relationship is significant. The second study aims to test whether watching a short video which claims that EMF is harmful can influence symptom detection, risk perception and physiological response in a general population sample, including those who do not have high pre-existing levels of anxiety.

Given the increasing prevalence of distressing and debilitating IEI-EMF symptoms in the general public, there is a great need to better understand the determinants of this condition.

BIOLOGICAL EFFECTS OF LOW-INTENSITY RADIOFREQUENCY ELECTROMAGNETIC RADIATION – TIME FOR A PARADIGM SHIFT IN REGULATION OF PUBLIC EXPOSURE

DR PRIYANKA BANDARA[1,2], MR STEVE WELLER[1]

1 Oceania Radiofrequency Scientific Advisory Association (ORSAA) Inc,

2 Environmental Health Trust

Dr Priyanka (Pri) Bandara is an independent researcher and educator in environmental health. As a former academic clinical/basic researcher (Westmead and Royal Prince Alfred Hospitals as well as University of Sydney Medicine and UNSW) she gained research experience in clinical hepatology, biochemistry and molecular genetics and molecular pharmacology. Dr Bandara also served as a senior manager in the NSW health system coordinating a dynamic research team and a clinical team at Westmead Children's Hospital (Neurogenetics Research Unit and the Institute for Neuroscience & Muscular Research). She chose to become a stay-at-home Mum in 2008 and subsequently became involved in environment health realising the need to focus on prevention of chronic diseases.

Pri studied genetic regulation of cellular oxidative stress responses for her doctoral studies at UNSW in the late 1990s and has continued her interest in this area - pathologically involved in almost every disease. Investigating cytotoxic effects of various environmental pollutants via complex cellular pathways, she furthers the understanding of the health impact of our changing world.

Pri has a particular interest in the biological and health effects of currently permitted "low intensity" microwave/radiofrequency electromagnetic radiation (MW/RF-EMR) widely used for mobile and wireless communication and surveillance technologies.

ABSTRACT

Man-made non-ionizing electromagnetic radiation(EMR), both radio frequency (RF) (including microwaves) emanating from modern wireless communication/surveillance systems and extremely low frequency electromagnetic fields from power lines/ electrical appliances have been investigated to assess the potential impact on human health. Here, we focus on RF-EMR that has increased exponentially around the globe over the last few decades due to a rapid expansion of mobile/wireless/satellite technologies. The WHO/IARC classified RF-EMR as a 2B possible human carcinogen in 2011. Scientific evidence has emerged since, epidemiological evidence linking mobile/cordless phone use to brain cancer, as well as experimental evidence of genotoxicity and carcinogenicity has led to calls for an update to this classification.

Current RF exposure regulation in many countries, including Australia,

is based on the International Commission on Non-ionization Radiation Protection (ICNIRP) 1998 RF guidelines. Several scientific organizations, including the US National Toxicology Program and EPA, as well as American and European academies for environmental medicine have raised concerns about the thermal basis of ICNIRP guidelines which takes into account acute tissue heating effects only. There is strong scientific evidence of non-thermal biological effects which cannot be prevented by current thermal guidelines. Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) RF standard (RPS3) has therefore inherited the same limitation – inability to assure safety from chronic non-thermal effects. ARPANSA has been reluctant to accept potential health effects arising out of low intensity (non-thermal) RF-EMR biological effects due to a lack of an "established" mechanism other than heating. Our detailed study of the scientific literature challenges this paradigm. We present the experimental evidence and theoretical background of RF-EMR induced oxidative stress, a key non-thermal mechanism of biological effects at low intensity exposures.

Over 100 animal and cell culture studies have so far shown increased levels of endogenous oxidative stress markers and/or affected antioxidant levels in various tissue/cell types upon exposure to RF-EMR. Some studies have further demonstrated ameliorative effects upon supplementation with a range of antioxidants. These are complemented by several human studies where RF exposure demonstrated oxidative stress and/or reduced antioxidant status. Evaluation of the scientific literature by ARPANSA (TRS-164 report) has failed to critically review oxidative stress and assess its impact on public health.

We present oxidative stress as a key central mechanism underlying adverse biological effects related to RF-EMR exposure such as DNA damage and neurodegeneration. Considering the well-established role of oxidative stress in pathobiology of a wide array of chronic diseases, exposure standards require urgent reforms.

WHAT DOES SLEEP TELL US ABOUT NON-IONISING RADIATION AND HEALTH?

SARAH LOUGHRAN[1,2,3]

1 Australian Centre for Electromagnetic Bioeffects Research

2 School of Psychology, Illawarra Health & Medical Research Institute, University of Wollongong, Australia,

3 Population Health Research on Electromagnetic Energy

Sarah is currently a research fellow at the University of Wollongong and part of ACEBR's human neurophysiology research group, as well as an associate investigator with PRESEE. She received degrees in physiology and psychology from Deakin University before completing a PhD in cognitive neuroscience and psychophysiology in 2007 at Swinburne University in Melbourne. She subsequently spent several years as a postdoctoral fellow at the University of Zurich, Switzerland, specialising in bioelectromagnetics, sleep, and EEG signal analysis research. During this time she was accepted as an experienced research fellow in the Marie Curie Training in Sleep and Sleep Medicine initiative. She was also recently awarded both the Alessandro Chiabrera and ICNIRP young scientist awards for excellence in bioelectromagnetics research. Her research focuses on a wide range of bioelectromagnetic health issues including the effects on sleep, human brain function, and the mechanisms associated with these effects, as well as sleep and cognitive neuroscience research more generally. She is a member of the current World Health Organisation (WHO) RF

Environmental Health Criterion evaluation committee and is an elected member of the International Commission on Non-Ionizing Radiation Protection's (ICNIRP) Scientific Expert Group as well as the current secretary on the board of the International Bioelectromagnetics Society.

ABSTRACT

Sleep is an essential part of our health and wellbeing. It is a natural, periodically recurring state of reduced activity that is characterised by a reduction in consciousness, as well as by a number of specific changes in physiology, particularly in relation to brain activity.

There is now substantiated evidence that low-level RF EMF has an impact on the human electroencephalograph (EEG; a measure of large scale ensembles of synchronised postsynaptic potentials within the brain). For example, several studies have now shown an effect of RF EMF exposure on neural function, specifically the alpha and spindle frequency ranges during sleep (Borbely et al., 1999; Huber et al., 2003; Loughran et al., 2012; Loughran et al., 2005; Regel et al., 2007; Schmid et al., 2012a; Schmid et al., 2012b). These effects have been replicated in independent laboratories, and have also been shown to be dose-dependent (Regel et al., 2007) and sensitive to individual differences between participants (Loughran et al., 2012).

The mechanisms underlying the effects on the sleep EEG, as well as potential functional consequences of the effect, remain unknown, and therefore forms the basis for the WHO including this as a high priority research need in their most recent research agenda.

Based on this, the results of previous studies investigating the effects of RF EMF on sleep will be presented, as well as current ongoing research investigating the underlying mechanisms, functional consequences, and effects of other frequencies on sleep, such as visible light emitted from screens. The advantages of using sleep and electrophysiology as a tool for measuring the impact of different sources of radiation, and evaluating the health and safety of modern technologies, will also be detailed.

SESSION 4: PLANNED EXPOSURE SITUATIONS

11.00AM – 12.00PM

WHAT DOES "REASONABLY" MEAN IN ALARA

FRANK HARRIS[1]

1 Rio Tinto

Frank has been in the field of radiation protection for almost 30 years. In that time he has worked for mining companies, Government and the IAEA. He has worked on uranium mining, other NORM industries, research reactors, radiopharmaceutical production and environmental protection.

ABSTRACT

The concept of As Low As Reasonably Achievable, societal and economic factors being taken into account (ALARA), is a cornerstone of the optimisation of radiation protection. It can be argued that it is the major reason behind the current low doses in most aspects of radiation protection. However, the term "reasonable" is not defined and is the critical aspect of the implementation of ALARA. The ALARA concept may be subject to misunderstanding, misuse and abuse on the part of all parties involved whether the operator, the Radiation Safety Officer (RSO), the regulator or outside parties. How to interpret, communicate and implement "reasonably" is essential to optimising the approach to ALARA, itself an optimisation process. A wide range of different approaches can be applied and the approach needs to be matched with the particular nature of the tasks being evaluated. Having a formalised approach which is clearly defined and well communicated can lead to more efficient ALARA implementation. Care must be taken that ALARA is not solely a dose consideration and the need for consideration of the human factors is critical for success.

AUSTRALIA'S RADIATION PROTECTION STANDARDS – THE CODE FOR RADIATION PROTECTION IN PLANNED EXPOSURE SITUATIONS (2016), RPS C-1

KEITH DESSENT[1]

1 Arpansa

Keith Dessent worked in the Best Practice Regulation Section of ARPANSA from late 1999 to July 2013. He is now a Senior Regulatory Officer with the Source Control Section of the Regulatory Services Branch at ARPANSA. Before joining ARPANSA, he worked as a physicist in the Radiation Safety Section of the Victorian Department of Health and Human Services for just under 16 years.

Keith obtained his BSc (physics) from Deakin University in 1982 and a Graduate Diploma in Occupational Hygiene from Deakin University in 2002.

Keith has been a member of ARPS since 1983 and is currently the honorary treasurer of the Victorian Branch.

ABSTRACT

Since 1995, Australia's radiation protection standards have been based on the International Commission on Radiological Protection (ICRP) publication ICRP 60 (1990), Recommendations of the International Commission on Radiological Protection. These radiation protection standards were first established in the NHMRC Radiation Health Series as publication 39 (RHS39) and were later rebadged in ARPANSA's Radiation Protection Series as RPS1.

In 2007, the ICRP revised its 1990 recommendations and published ICRP103 (2007), *The 2007 Recommendations of the International Commission on Radiological Protection*. The International Atomic Energy Agency has also published its *Fundamental Safety Principles* SF-1 (2006) and subsequently revised its *Basic Safety Standards* as GSR Part 3.

In light of the changes to these international publications, ARPANSA's Radiation Health Committee reviewed RPS1 and recommended that it be rewritten to take into account ICRP103, SF-1 and GSR Part 3. RHC agreed that RPS1 be replaced by:

- a 'top-tier' document setting out the underlying principles and philosophies forming the basis of the system of radiation protection in Australia, and
- a series of codes that would set out in a regulatory style the requirements to be met by radiation users.

The top tier Australian publication, the *Fundamentals for Protection against Ionising Radiation, RPS F-1*, was published in February 2014 and provides an understanding of the harmful effects of ionising radiation and associated risks for the health of humans and of the environment. RPS F-1 however, contains no mandatory requirements. Regulatory elements for adoption by the Australian radiation regulators would be contained in subsequent radiation protection codes.

Drafting commenced on a code for radiation protection in planned exposure situations (RPS C-1) concurrently with the preparation of RPS F-1. The intention of RPS C-1 was to set out the requirements for the protection of occupationally exposed persons, the public and the environment in planned exposure situations in Australia.

Following two periods of public consultation and approval from the Office of Best Practice Regulation, RPS C-1 was published in December 2016. This presentation outlines some of the changes introduced in RPS C-1 and their implications for regulators and users.

WORKING SAFELY WITH IONISING RADIATION: GUIDELINES FOR EXPECTANT OR BREASTFEEDING MOTHERS

ANDREW POPP[1], SARAH TUREK[1], JOHN BUS[1], PRASHANT MAHARAJ[1], TINA PANERAS[2], PAULA BERGHOFER[3], VANESSA VOZZO[4], HONG DUONG[5], ROBIN FOY[1]

1 Radiation Protection Services, Australian Nuclear Science and Technology Organisation (ANSTO)

2 ANSTO Radiation Services

3 Regulatory Affairs, ANSTO

4 Work Health and Safety, ANSTO

5 Risk Management, ANSTO

Andrew is a Senior Health Physicist and provides radiation protection advice and services to a range of operational areas and capital projects to ensure the safety of staff and compliance with ANSTO's regulatory requirements. He mentors other health physicists and health physics surveyors in the provision of radiation protection services. He also contributes his knowledge, skills and experience to emergency preparedness and response, and commercial consultancy and training services as required.

Additional to this role, Andrew is an ANSTO Incident Controller, who in the event of accident or incident would assume control of the situation and provide operational *support to emergency responders and the ANSTO Emergency Operational Manager.*

A physicist by background, Andrew holds a Master of Science in Radiation and Environmental Protection, a Bachelor of Science with honours, and has worked in the radiation protection industry for over 12 years.

He is a member of the Australasia Radiation Protection Society, the UK Society for Radiological Protection, and the UK Institute of Physics.

ABSTRACT

The Australian Nuclear Science and Technology Organisation's (ANSTO) Radiation Safety Standard outlines the elements developed and implemented by ANSTO to assist management and workers to establish and maintain a healthy and safe workplace. This Standard supports ANSTO in delivering excellence in its work health and safety performance with regard to all aspects of radiation safety, including the requirements of the ARPANSA Planned Exposure Code RPS C-1 (2016).

For those actions that have been assessed and are deemed to be justified this Standard describes a Dose Optimisation Framework to maximise the overall benefit as far as is reasonably achievable under the prevailing circumstances. It also describes additional restrictions that apply to occupational exposure for a female worker who has notified ANSTO of pregnancy or is breastfeeding.

To encourage early notification and to provide assurance that appropriate controls are considered and put in place where required ANSTO has published guidelines for expectant or breastfeeding mothers. This document provides advice for workers who may be exposed to ionising radiation during the course of their work at ANSTO. It is specifically aimed at female workers who are planning a family or are currently pregnant or breastfeeding.

This guideline explains how ANSTO takes a collaborative approach to protect workers and their families. The guide aims to assist ANSTO in achieving its duty of care to its workers during pregnancy and breastfeeding and as a tool for education and awareness of early notification for expectant or breastfeeding mothers and their managers and supervisors

This presentation describes the development of this document, and summarises the advice given.

SESSION 5: NON-IONISING RADIATION

1.00PM - 2.40PM

RADIO FREQUENCY EXPOSURE RISK ASSESSMENT AND COMMUNICATION, CRITIQUE OF ARPANSA TR-164 REPORT. DO WE HAVE A PROBLEM?

VICTOR LEACH[1], STEVE WELLER[2]

1 ORSAA

2 BSc (Monash) Majors Microbiology and Biochemistry MORSAA

Vic (Victor) has worked as a radiation health physicist and atmospheric scientist for the past 40 years in both the private sector (uranium & coal mining) and public sector with a number of Commonwealth (Australian Radiation Laboratory now ARPANSA) and State Government Health Departments (QLD & NT). He was at the inaugural formation of ARPS in 1975 and has been a past treasurer and on the organising committee of conference in Melbourne, Sydney, Brisbane and Darwin. He has been involved in many occupational and environmental aspects of many mining and non-mining projects at both the planning and operational stage. He has published in refereed scientific and engineering journals on subjects of dust and radioactivity exposure and the inhalation effects on health of workers and members of the public. He was University Radiation Advisor (RPA) at both the Queensland University of Technology (QUT) and the University of Queensland (UQ) just prior to retirement. Since taking up the Role as URPA at QUT in 2006 he has been increasing interested in the standards setting of non-ionising EMR-RF. He has been actively involved with the formation of a not-for-profit association called the Oceania Radiofrequency Scientific Advisory Association Inc. (ORSAA).

ABSTRACT

ARPANSA's Technical Report Series No. 164 (TRS-164) was written by a panel of three academics and three ARPANSA support staff whose main task was to assess the available peer-reviewed scientific literature in order to determine whether the current RPS3 thermal-based standard (modelled on ICNIRP 1998 Guidelines) was still relevant and appropriate for providing the general public a high level of protection. The TRS-164 report considered 12 years of accumulated scientific research along with the May 2011 announcement by the International Agency for Research on Cancer (IARC), that RF is a Group 2B or "possible" carcinogen. The conclusion of the TR-164 report is very much supportive of the original ICNIRP exposure guidelines and corresponding reference limits.

The authors obtained from ARPANSA all the studies in their database that would have been available to the scientific panel when producing the TRS-164 report, which covered the specific period from January 2000 to August 2012. Although 1,354 studies were available in ARPANSA's database it is apparent that only a small number were actually used in the ***in-vivo*** / ***in-vitro*** assessment. The aforementioned 1,354 studies can be individually selected from more than 2,300 studies that can be found in the Oceania Radiofrequency Scientific Advisory Association Inc. (ORSAA) Electromagnetic Radiation (EMR) bio-effects database.

This paper demonstrates that thermal limits as advised by ARPANSA and ICNIRP may not afford suitable protection against a range of biological effects associated with RF exposure at athermal

levels. It may have been true that when ICNIRP first established their original guidelines almost 20 years ago, there was insufficient evidence for biological damage that would be reasonably likely to result in disease in vulnerable people. That situation has now clearly changed. While cancer, neurological degeneration or other disease outcomes may not currently (or in the immediate future) be able to be conclusively linked to oxidative stress that has resulted specifically from permitted microwave exposures, there is enough evidence through medical research that suggests the oxidative stress pathway can lead to disease. When linked with the large body of research showing that exposure to microwaves (at or below basic restrictions) can produced oxidative stress, there is sufficient evidence to require the RPS3 revision currently underway to seek to minimise biological effects from environmental exposures and provide warnings to achieve this when using personal devices.

IMPROVING PUBLIC HEALTH RELATING TO ULTRA-VIOLET RADIATION EXPOSURE – INNOVATIONS AND PLANS AT ARPANSA

DR GILLIAN HIRTH[1], DR MARCUS GRZECHNIK[1], ANTHONY AINSWORTH[1]

1 Australian Radiation Protection And Nuclear Safety Agency (arpansa)

See previous Biographies

ABSTRACT

ARPANSA's mission is to protect the Australian people and the environment from the harmful effects of radiation. Australia has a naturally high solar ultraviolet radiation (UVR) environment due to its location and latitude, with UVR levels 2 to 3 times those in Europe, in addition to a predominantly fair-skinned population and a climate conducive to an outdoor lifestyle. Excessive exposure to UVR is shown to cause adverse health effects, including skin cancer, eye disease and immunosuppression.

The *ARPANSA UVR Strategy 2016-2019* outlines key areas for work that aim to facilitate improved decision making, provide clarity in prioritization of issues and ensure appropriate resources are committed to deliver positive health outcomes.

In order to deliver on the aims of the strategy there are a number of projects that have been completed or are underway. These include;

- Collaborative arrangements and public messaging in association with partners, including through Social Networks;
- Development and expansion of product testing regimes;
- Availability of long-term datasets;
- Improvements of existing monitoring systems, networks and online displays; and
- Increased profile at outdoor events where UVR damage is more likely.

It is intended that the paper to be presented will provide specific examples relating to the topics outlined above. Successes, challenges and plans for the future will be provided.

LEVELS OF RADIOFREQUENCY ELECTROMAGNETIC FIELDS FROM WI-FI IN AUSTRALIAN SCHOOLS

LYDIAWATI TJONG[1], KEN KARIPIDIS[1], STUART HENDERSON[1], DON WIJAYASINGHE[1], RICK TINKER[1]

1 Australian Radiation Protection and Nuclear Safety Agency

Lydia is a Science Officer at ARPANSA with over 8 years of experience in activities relating to radiation protection, especially in electromagnetic radiation. She obtained degrees in Chemical and Biomedical Engineering before joining ARPANSA in 2009. Key responsibilities include handling public enquiries as part of the "Talk to a Scientist" team, monitoring radiation literature, and being the secretary of an ARPANSA committee called the Electromagnetic Energy Reference Group.

ABSTRACT

The use of Wi-Fi has increased rapidly in recent years and is now present in the majority of Australian schools. This has given rise to public concern especially parents that the exposure to radiofrequency (RF) electromagnetic fields (EMF) resulting from Wi-Fi use can adversely affect their children's health. To alleviate public concern, ARPANSA undertook a comprehensive measurement study of the RF EMF levels from Wi-Fi in 23 Australian schools. The RF levels at all the schools were much lower than the reference levels recommended by the ARPANSA RF Standard (which is in line with international guidelines) for protection against established health effects. The typical and peak RF levels from Wi-Fi in locations occupied by children in the classroom were of the order of 10^{-4} and 10^{-2}% of the limits in the exposure standard, respectively. In the classroom, the typical RF levels due to Wi-Fi were higher than other RF sources except radio. In the schoolyard, the typical RF levels due to Wi-Fi were lower than radio, TV, and mobile phone base stations. This study confirmed that the typical RF exposure of children from Wi-Fi at school is very low and comparable or lower to other RF sources in the environment.

SESSION 6: EXISTING EXPOSURE SITUATIONS

1.00PM - 2.40PM

RADIATION PROTECTION IN EXISTING EXPOSURE SITUATIONS IN AUSTRALIA

DR STEPHEN SOLOMON[1], DR FIONA CHARALAMBOUS[1], MR BRENDAN TATE[1]

1 ARPANSA

Until July 2017, Dr Solomon was the Principal Scientific Advisor to the CEO at the Australian Radiation Protection and Nuclear safety Agency (ARPANSA). Previously he was the Chief Radiation Health Scientist and Head of the Radiation Health Services Branch at the ARPANSA, where he was responsible for leading ARPANSA programs on radiation protection of public, workers and the environment. He has a PhD in Nuclear Physics and has nearly forty years' experience in health physics and radiation protection. He was a co-author for ICRP 126, Radiological Protection against Radon Exposure. Following the Fukushima Daiichi Nuclear Power Plant accident in 2011, Dr Solomon lead the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) assessment team on doses and risks to humans and biota for the 2013 UNSCEAR Report on Assessment of Levels and Effects of Radiation Exposure due to The Nuclear Accident after the 2011 Great East Japan Earthquake and Tsunami.

ABSTRACT

Existing exposure situations are exposure situations that already exist when a decision on the need for control has to be taken. Existing exposure situations include situations of exposure to natural background radiation. They also include situations of exposure due to residual radioactive material that derives from past practices that were not subject to regulatory control or that remain after an emergency exposure situation.

Recent International Commission on Radiological Protection (ICRP) and International Atomic Energy Agency (IAEA) recommendations, in particular the Requirements of the IAEA's; Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards General Safety Requirements Part 3, GSR Part 3 referred to as the Basic Safety Standards (BSS) of GSR Part 3, establishes a best practice framework for radiation protection in existing exposure situations.

ARPANSA, through its Radiation Health Committee, has developed a Guide for Radiation Protection in Existing Exposure Situations that the sets out the Australian approach to protection of occupationally exposed persons, the public and the environment in existing exposure situations (ARPANSA Radiation Protection Series RPS G-2). This paper provides an overview of the Guide and discusses the application the Guide to some specific exposure situations in Australia.

ASSESSING RADIATION DOSE FROM EXPOSURE TO RADON AND ITS PROGENY, OR WHAT GOES AROUND COMES AROUND

DR STEPHEN SOLOMON[1]

1 ARPANSA

See previous Biography

ABSTRACT

Radon is a naturally occurring radioactive gas formed through the decay of radium in the uranium decay series. When radon decays, it forms a number of short-lived radioactive decay products, known as radon progeny. The inhaled short-lived radon progeny are particles that can deposit in the nose, throat and lungs. The inhalation of radon and its progeny have been recognised as a cause of lung cancer by the International Agency for Research on Cancer.

In 1993, International Commission on Radiological Protection (ICRP) defined a factor for the conversion of radon progeny exposure to inhalation dose that was based on epidemiological studies, mainly involving the follow-up of disease in underground uranium mine workers and from the epidemiological studies of Japanese atomic bomb survivors. In 2010, the ICRP doubled its estimate of risk from exposure to radon, based on a review of more recent epidemiological studies of the association between lung cancer and exposure to radon and its progeny. The ICRP also stated its intent to apply an alternative method for deriving the radon progeny dose conversion factors using the ICRP reference biokinetic and dosimetric models, as is the approach taken by the ICRP for all radionuclides other than radon progeny. It is expected that new radon progeny dose coefficients will be published in ICRP Occupational Intakes of Radionuclides Part 3 (OIR3) in the next year.

This paper provides an overview of the changes to the radon progeny dose assessment and discusses the implications for the protection of public and workers from exposure to radon and radon progeny in Australia. The paper will also provide a perspective on what these changes means for practical occupational exposure assessment and potential research needs.

(SOME) LESSONS LEARNED FROM THE WESTERN NEW YORK NUCLEAR SERVICE CENTER, YUCCA MOUNTAIN AND THE WASTE ISOLATION PILOT PLANT

GEORGE ANASTAS[1]

1 GA and Associates

ABSTRACT

"Those who do not remember the past are condemned to repeat it." Jorge Santanya

The Western New York Nuclear Service Center was established by the State of New York in the early 1960s to be the hub of commercial nuclear fuel reprocessing followed by Mixed Oxide fuel fabrication. Nuclear Fuel Services (NFS), a Division of Davidson Chemicals, at the "urging" " of the Atomic Energy Commission and the Joint Committee on Atomic Energy, elected to construct and operate the world's first (and only!) commercial nuclear fuel reprocessing facility. After six years of operation, because of licensing constraints and "commercial impracticability" (no reasonable commercial market for Plutonium-239) NFS turned the facilities, including two

low level waste disposal areas, the reprocessing facility and over 660,000 gallons of high level waste, over to the State of New York, the landlord. The funding available to the State for clean-up was a pittance of what was needed.

Lessons Learned:

- If it is too good to be true then…
- Beware the promoters.

The Yucca Mountain Repository was to be perpetual home for 70,000 tonnes of spent nuclear fuel and high level waste. Located about 80 miles from Las Vegas on United States land adjacent to the former Nuclear Weapons Test Site, Yucca was under study and construction for over 30 years. Approximately $8 billion has been spent on the project. A 2008 estimate for the research, construction and operation of Yucca over 150 years was $96 billion. Yucca was highly contested by the general public, the Western Shoshone peoples, and many politicians. Because of the continuing opposition to Yucca, its future is at best clouded.

Lessons Learned:

- In order to burden future generations, it is best to obtain a positive overwhelming consensus of the current generation.
- Credibility of the sponsoring organization is vital.

The Waste Isolation Pilot Plant (WIPP) in southern New Mexico is the nation's repository for "defence" transuranic waste (TRU) located ~2150 feet (660 meters) underground in very large salt deposits. After lawsuits, promises made by the Department of Energy (DOE), agreements, environmental analyses, relocation of the repository, Congressional and Presidential Approval of the WIPP Land Withdrawal Act, DOE received the first shipment of TRU on September 9, 2000.

Lessons Learned:

- Independent oversight of any radioactive waste repository is critical.
- The sponsoring organization is obligated to abide by the results of lawsuits, agreements and promises.

ACCEPTANCE TESTING OF THE TASL RADON DOSIMETRY SYSTEM

BRENDAN TATE[1], DR STEPHEN LONG[1]

1 ARPANSA

Brendan completed an MSc degree at La Trobe University in 1998. He then continued working at the University on the FedSat project, modelling the measurement of Ionospheric and Plasmaspheric electron density using both the FedSat and GPS satellites.

Brendan joined ARPANSA's non-ionising radiation branch in August 2006, as part of the UV section. He moved to the radiation health services branch in March 2008. Brendan is now a part of ARPANSA's measurement and emergency response section, working mostly in the area of measurement of radon and radon progeny.

ABSTRACT

ARPANSA has purchased TASL (Track Analysis Systems Ltd) Radon dosimetry systems for the automated reading of nuclear track-etch plaques used in radon dosimetry measurements. ARPANSA has operated an in-house developed programme for radon dosimetry for many years. This programme has involved human readers and more recently an

automated system. Both of these methods have proven to be time intensive and prone to higher than acceptable uncertainties. It was believed that the TASL system would provide a more robust solution that would be simpler to operate and provide more consistently accurate results.

The system was tested by preparing a linearly graded exposure regime, where plaques were exposed to an approximately constant radon atmosphere for successively longer periods, from four hours up to ten days. The exposures were measured using ARPANSA's calibrated radon exposure system. The plaques were then processed using the TASL system and a comparison between the ARPANSA measurements and the TASL system was performed.

An uncertainty analysis was then performed to determine the characteristic limits of the TASL system. Using the Currie method the critical limit (L_C) and the detection limit (L_D) were determined to be 487 and 980 Bq.day.m^{-3} respectively. The minimum reportable level of the system was found to be 825 Bq.day.m^{-3}. At the Australian indoor average level of 11 Bq.m^{-3}, the characteristic limits for the TASL system require that monitors would need to be exposed for 90 days to guarantee an exposure above the detection limit, and 45 days to exceed the critical limit. This period is within the recommended 3-month placement currently used by ARPANSA for radon track-etch monitors.

The presentation will discuss in detail the measurement regime and uncertainty analysis. The TASL system has been found to operate well within the specifications required and will provide a significant improvement to the radon dosimetry service provide by ARPANSA.

THE SCIENTIFIC BASIS FOR FUTURE MANAGEMENT OPTIONS OF THE LITTLE FOREST LEGACY SITE

HEFIN GRIFFITHS[1]

1 Ansto

Hefin has worked in the nuclear industry for over 30 years. Prior to accepting the role as General Manager, Safety, Environmental and Radiological Assurance at ANSTO, he worked in both the civil and military sides of the UK Nuclear Industry for over twenty years in the fields of radiation and nuclear safety and emergency planning,

Hefin's current role oversees a multi-disciplinary team covering Radiation Protection, Waste Management and Environmental Monitoring services to ANSTO. As Chief Nuclear Officer, Hefin reports directly to the Chief Executive Officer of ANSTO, where he is responsible for the nuclear safety assurance and compliance function across the organisation.

ABSTRACT

From 1960 to 1968, the former Australian Atomic Energy Commission (AAEC) disposed of radioactive waste at Little Forest, near its Lucas Heights research facility on the southern periphery of Sydney. The waste was disposed of in a series of trenches, following the international practices which were used at that time for the disposal of low-level solid and liquid wastes.

The successor to the AAEC, the Australian Nuclear Science and Technology Organisation (ANSTO) controls and manages the site through continuous care, maintenance, surveillance, monitoring and research activities at the site, through which ANSTO has contributed to international research on such

legacy disposal sites.

Over the period since operations ceased there has been intermittent subsidence of the soil covering the trenches due to voids developing in the buried wastes, this has led to a mobilising effect known as the 'bathtub effect' which has been seen at other legacy trench sites.

This has been described as a process in which the waste material has degraded, producing voids within a disposal trench and subsequent subsidence of the overlying soil, enabling entry of surface water into the trench. As the soil surrounding the trenches is sufficiently impermeable, the trenches filled with water. Any overflow of water from this 'bathtub' has the potential to distribute radionuclides derived from the wastes directly across the surrounding ground surface, Following such events, which have led to localised, low levels of surface contamination, further soil cover has been added, which has proved to be an effective remediation.

In July 2016, the LFLS became the first site identified as a Legacy site under the Australian Radiation Protection and Nuclear Safety Act. A condition was placed on this licence to develop a plan to address the arrangements for managing the wastes and the facility over both the medium and long-term. The management plan needs to be sufficiently well developed, with contingency plans identified, to cope with foreseeable changes in Australia's radioactive waste management policy.

ANSTO has commenced a research project at LFLS to enable the assessment of possible management options including continuing the current regime of maintenance and monitoring, in-situ remediation, or exhumation. This presentation will describe the scientific basis being applied to the options analysis and decision-making with the aim of informing an Environmental Safety Case which substantiates the preferred option.

SESSION 7: RADIOTHERAPY

11.15AM – 1.00PM

DOSES IN THE TREATMENT ROOM DURING MICROBEAM RADIOTHERAPY AT THE AUSTRALIAN SYNCHROTRON

DR DUNCAN BUTLER[1], MR MICHAEL LITWIN[1], DR JESSICA LYE[1], DR JAYDE LIVINGSTONE[2]

1 ARPANSA

2 Australian Synchrotron

Duncan is the manager of the Radiotherapy Section at ARPANSA, where has worked for 17 years. The Section holds the primary standards for radiation dosimetry for Australia

ABSTRACT

Micro-beam radiotherapy (MRT) is an experimental synchrotron technique that combines spatial fractionation and high dose rates to treat cancer. Still in a developmental phase, part of the radiation safety case required for human treatment is to map the out-of-field doses both inside the patient and around the room. Dosimetry in the beam has already been established. We report on the measurements of dose on the walls of the room during a treatment of a RANDO phantom. This work took place in parallel with an experiment to measure the doses inside the phantom using $Al_2 0_3$ Optically Stimulated Luminescent Dosemeters (OSLDs) and radiochromic film, which will be reported separately. A RANDO phantom was positioned in the beam and a 20 mm x 20 mm broad beam (i.e. without spatial fraction) cranial treatment delivered in experimental hutch 2B. The average energy of the beam was approximately 95 keV. An Exradin A5 100 cm^3 spherical chamber was used to measure the air kerma in the room at different distances from the treatment site. Beryllium oxide personal dosemeters (Dosimetrics GmbH, Munich) were positioned at regularly spaced intervals on the walls of the room to map the dose distribution. The raw Hp(10) readings from the dosemeters were in the range 0.3 to 6 mSv for a 10.3 kGy treatment (dose to water at 2 cm depth in the head), in a pattern consistent with the inverse square law with RANDO as the point of origin. The combined standard uncertainty in the personal dose equivalent was estimated from the known energy response of the (near tissue-equivalent) BeO dosemeters, and the change in backscatter when the dosemeters are mounted on the steel and Pb-lined walls of the room. The air kerma was measured to be 520 mGy near the RANDO head, and 5 mGy adjacent to the nearest wall. The results allow the approximate doses in the room to be calculated for different MRT treatments, for calculations for radiation protection purposes.

USE OF A RADIOTHERAPY RECORD AND VERIFY SYSTEM TO DETERMINE SHIELDING CALCULATION PARAMETERS

MICHAEL GILHEN[1], NICHOLAS HARDCASTLE[1,2], CHRISTOPHER FOX[1], TOMAS KRON[1,2]

1 Physical Sciences, Peter MacCallum Cancer Centre, Melbourne, VIC, Australia

2 Centre for Medical Radiation Physics, University of Wollongong, Wollongong, NSW, Australia

Building upon health physics in the defence, mining and industrial sectors, Mr Gilhen has been the radiation safety officer for Peter Mac for just over 12 months. The *appointment follows the relocation of Peter Mac's main premises in June 2016.*

ABSTRACT

Introduction: Contemporary radiotherapy includes a large range of delivery parameters based on anatomical location and treatment aims. Such variation is not included in radiotherapy bunker shielding calculation parameters such as those presented in NCRP 151 and IAEA Report 47. Radiotherapy record and verify (R&V) systems have been utilised for two decades to record radiotherapy delivery parameters. This study reports on the interrogation of a radiotherapy R&V system to determine shielding parameters for 16 linear accelerators comprising the Peter MacCallum Cancer Centre radiotherapy network.

Methods: The Mosaiq R&V (Elekta, Sweden) database was interrogated using SQL script to determine the following parameters for each beam treated between 1st January 2016 and 31st December 2016: gantry angle, dose at isocentre, monitor units and use of intensity modulation (IMRT). From this data the workload, use factor and IMRT factor were calculated. Change in practice with beam energy from 1st January 2016 to 31st March 2017 was also evaluated due to introduction of linear accelerators capable of emitting 10 MV photons.

Results: A total of 66,573 beams were delivered in the specified period. This resulted in an average workload for each machine of 20,500 Gy. Average use factors exhibited a more uniform distribution of beam angles compared with NCRP 151 recommendations; 0° and 180° were 22% and 17%, with all other angles in 45° increments 10%. The average IMRT factor was 3.7. The use of 10 MV photons increased from 0.7% to 4.3% of all beams, as 18 MV use reduced from 25% to 17% during 1st January 2016 to 31st March 2017 with the replacement of 7 linacs with 10 MV capable machines.

Conclusions: A radiotherapy R&V has been used to determine bunker shielding parameters for a contemporary radiotherapy network. Workloads were typically lower than that used for shielding calculations indicating the conservative nature of bunker shielding. A more uniform beam angle distribution was observed. Reduction of 18 MV photons was also observed, indicating a move from neutron-producing high energy beams.

SHIELDING CONSIDERATIONS FOR A NEW LINEAR ACCELERATOR INSTALLATION

DR PETER HARTY[1], MR ANDREW CLEGG[1], DR DUNCAN BUTLER[1], A/PROF IVAN WILLIAMS[1]

1 ARPANSA

Peter has a PhD in nuclear physics from the University of Melbourne. Since 2008 he has worked at ARPANSA in the Radiotherapy Section of the Medical Radiation Services Branch, where he maintains and develops the primary standards of absorbed radiation dose for linear accelerator beams and teletherapy sources. He also conducts research at the Australian Synchrotron, developing dosimetry techniques for the Imaging and Medical Beamline based on calorimetry.

ABSTRACT

ARPANSA is planning to install a new linear accelerator (linac) above an operating existing linac. In order that the two linacs can be operated simultaneously and not expose any staff to annual doses above our dose constraints, it will be necessary to have extensive shielding installed. Various shielding

plans were considered, as well as options such as a maze, to allow entry without having to wait for an interlocked door to be opened. After consideration, a steel door was preferred to the maze option, in order to maximise space for a conference room immediately outside the linac bunker.

The design of the linac bunker and the associated shielding depends critically on the intended usage of the linac. For instance, for the flattening-filter-free (FFF) operating mode, the beam rate is much higher than with the normal operating mode that includes the flattening filter. These higher beam rates require more shielding, due to the higher rates of scattered radiation produced. The shielding requirements are also highly dependent on the beam qualities to be used in linac operation. For instance, for 18 MV photon beams numerous scattered neutrons are produced, requiring extra concrete thicknesses. At these higher photon beam qualities, photoneutrons are also produced when high energy photons hit steel shielding materials, requiring the inclusion of borated polyethylene on the back side of the steel, to keep the dose rates low. Extensive concrete shielding is also needed above the linac, to allow roof access to personnel during operation. In order to keep doses ALARA, access to the area directly above the linac bunker needs to be made inaccessible by barrier controls.

Altogether the design involves over 800 tonnes of concrete and steel shielding required to keep the doses from the new linac in an acceptable range for the specified workload. The addition of this much extra weight to the building requires significant strengthening of the foundations.

Despite having a good linac shielding design, there may be operating modes which require extra administrative controls in order to minimise dose rates to personnel. Examples of such operating modes will be discussed, and the appropriate administrative controls.

DEVELOPMENT OF A SECURITY PLAN FOR A HIGH DOSE RATE (HDR) BRACHYTHERAPY UNIT IN A NEW HOSPITAL

PROFESSOR TOMAS KRON[1], MR MICHAEL GILHEN[1], MR KURIAN GEORGE[1], DR RAY BUDD[1]

1 Peter MacCallum Cancer Centre

Tomas Kron is Director of Physical Sciences at Peter MacCallum Cancer Centre in Melbourne, the largest cancer treatment and research institution in Australia. He holds academic appointments at several universities and is interested in radiation protection, clinical trials and education of medical physicists as demonstrated in many invited presentations and more than 250 publications. Tomas has a particular interest in the role of professional organisations as a means to support members, advance important issues and provide services to the general public. In 2014 he was awarded an Order of Australia Medal (OAM) for services to medicine, research and education.

ABSTRACT

Introduction: There has been heightened concern about the security of radioactive sources which is reflected in a requirement for establishing a security plan in addition to radiation safety measures before being able to obtain a license for use of a high activity radioactive source. We are describing the development of a security plan for a high dose rate (HDR) 192-Ir source to be used for brachytherapy in a major cancer hospital.

Methods: The main campus of Peter MacCallum Cancer Centre moved in June 2016 from a location in East Melbourne to new premises at the Victorian Comprehensive Cancer Centre (VCCC) in Parkville close to Melbourne University. A new brachytherapy facility was to be established using a newly purchased Nucletron Flexitron HDR brachytherapy afterloading unit. The unit operates with a nominally 370GBq 192-Ir source which is classified as a high consequence source for security purposes.

Results: As no security assessors were accredited for work in Victoria at the time of the move, an interstate consultant was engaged. A security plan was developed addressing (amongst others) the following issues:

- Facility and Source Characterisation
- Site Security and Threat Assessments
- Security Accountability and Responsibilities
- Communication Strategy
- Incident Response,
- Escalation of Threat
- Protective Security Measures Review

Of particular concern was the definition of who has 'access' to the source the fact that the source was to be used in two locations, an operating theatre and a minor operations room. The security plan was co-ordinated with the building manager, the security service and the regulatory authority.

Conclusion: The development of the security plan was found to be a useful process to assess the potential risks associated with the operation of a complex brachytherapy service. It helped to establish dialogue and collaboration between the clinical staff and radiation safety and security personnel in the new hospital.

INTERNATIONAL COMPARISON OF HP(10) WITH HIGH ACCURACY USING PASSIVE DOSEMETERS

DR DUNCAN BUTLER[1], T KURASAWA[2], M LITWIN[1], J MAZARAKI[1], N SAITO[2]

1 Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Yallambie, Victoria 3085, Australia

2 National Measurement Institute of Japan (NMIJ), AIST, Tsukuba, 305-8568 Japan

See previous Biography

ABSTRACT

A comparison of personal dose equivalent Hp(10) for ^{137}Cs radiation was conducted between the primary standards laboratories of Japan (NMIJ) and Australia (ARPANSA). A set of 120 commercially available passive beryllium oxide OSL dosemeters were used (Dosimetrics GmbH, Munich), provided by the ARPANSA Personal Radiation Dosimetry Service (PRMS). The aim was to investigate the precision which could be obtained with this technique, and to confirm the personal dose equivalent delivery methods in each standards laboratory. A dose of 5 mSv was delivered to 40 dosemeters in each country, 11 days apart, and 40 dosemeters were used as controls. The result of the comparison was a ratio of Hp(10) in Japan to Australia of 1.006 with a combined standard uncertainty of 3.2%. The statistical uncertainty was 0.32% indicating that, under carefully controlled conditions, passive dosemeters can be used for comparisons of high precision.

As primary standards laboratories, NMIJ and ARPANSA regularly compare standards of air kerma as part of their obligations under international metrology arrangements. The results of the Hp(10) comparison are in agreement with the most recent air kerma comparison.

SESSION 8: NEW TECHNOLOGY

11.15AM – 1.00PM

CALIBRATION OF A DRILLER-DEPLOYABLE DOWNHOLE GAMMA PROBE FOR IN SITU MEASUREMENT OF WASTE MATERIAL RADIOACTIVITY

DR FRED BLAINE[1] DC LAWIE[1], C ROODT[2], C ERASMUS[2]

1 Imdex Limited

2 Iluka Resources Limited

Fred Blaine is a geoscientist with 9 years' experience in the mining and exploration industry. He completed a PhD in geochemistry with the University of Waterloo and has subsequently held positions in academia, consulting and industry. Although strongly based in geochemistry, his experience with technology implementation and data analytics has allowed him to work across multiple disciplines and across multiple phases of the industry from green-fields exploration to mineral processing and reclamation.

ABSTRACT

Accurate and detailed assessment of the radioactivity of historic waste material, as required for regulatory purposes and responsible reclamation, can be a time-consuming and costly process. This process typically involves significant drilling, sampling and chemical analysis which allows for the calculation of the radioactivity ($Bq \cdot g^{-1}$, defined as the number of disintegrations per $second \cdot g^{-1}$) based on K-U-Th concentrations. Inherent in this process are the associated sampling and collection errors, and limitations of the analytical method. Detailed, in-situ measurement would be preferred; however, the cost of implementation of spectral gamma logging to measure K, U and Th-content by professional wire-line service companies is prohibitive.

This study assesses the viability of using a driller-deployable, downhole total count gamma probe (REFLEX EZ-GAMMA) for direct measurement of the in-situ radioactivity of waste material contained within historic mineral sand waste dumps. Gamma-response (cps, API) and chemical data were collected both in-field, and in controlled lab experiments for assessment and calibration of the method. Gamma responses were averaged over the sampled interval and compared to the lab-analysis based calculations. Results show an excellent linear relationship between measured cps and $Bq \cdot g^{-1}$ over the range of radioactivities measured (0.26-21 $Bq \cdot g^{-1}$) and a single calibration is applicable over the range of Th-U ratios encountered (Th:U=6.5-18.6). This direct linear relationship under all observed conditions indicates that the effects of attenuation, variable composition, density/measured-volume, etc., are intrinsic to the calibration for the material tested.

Direct measurement of total count gamma has been found to be a convenient proxy for determining material radioactivity for mineral sand waste. As demonstrated, with appropriate testing and calibration, driller-deployable gamma tools have the potential allow rapid, detailed and cost effective assessment of radioactive waste material in-situ.

DATA ANALYTICS FOR RADIATION MANAGEMENT AT OLYMPIC DAM

AMRINDER DHINDSA[1],
MR CHUONG PHAM[1]

1 BHP Billiton

Current Role : Specialist Radiation and Regulatory Affairs at BHP Billiton, Olympic Dam

Education : B.E. (Electronics and Communication), B.Sc. (Physics) RMIT University, Melbourne

Areas of Interest : Radiation Protection and Dosimetry, Risk Management, Modelling and Simulation of Physical Systems, Data Science and Machine Learning

LinkedIn : https://www.LinkedIn.com/in/amrinder-dhindsa-47a94878

ABSTRACT

A significant amount of radiation management related data has been collected at Olympic Dam since the inception of operation in 1988. This includes monitoring data for various radiation exposure pathways, medical surveillance records for designated workers and demographics data. The data is currently stored in the Olympic Dam Health and Hygiene database (Medgate™) and is used for routine analysis and reporting, radiation risk assessments, operational feedback and ad-hoc analysis requirements.

Opportunities for enabling a data driven approach using the Spotfire Business Intelligence (BI) platform have been investigated. Currently the Spotfire dashboard provides a direct connection to the Medgate™ database allowing real-time visualization and analysis of radiation exposure results for workers/workgroups at Olympic Dam with detail-on-demand as necessary. This reduces reliance on spreadsheets and manual data processing and allows an opportunity to streamline routine reporting, conduct continuous quantitative risk assessments, provide continuous feedback to operational areas, drive planning decisions and enable capabilities for predictive analytics.

Future work would involve integration of multiple data sources into an integrated dashboard including data from Medgate™, SAP™ Work Management, Human Resource, Safety, Production and Ventilation Systems. This would allow more comprehensive radiation exposure assessment for workers at Olympic Dam and unlock opportunities for long term reduction in exposures.

EVALUATION OF A NOVEL GAMMA RAY IMAGING TECHNOLOGY

DR MATHEW GUENETTE[1,]
DR DAVID BOARDMAN[1,] MR ADAM SARBUTT[1,] MS ALISON FLYNN[1,]
DR DALE PROKOPOVICH

1 Australian Nuclear Science And Technology Organisation

Mathew Guenette is a physicist in the Nuclear Stewardship group at ANSTO. Previously he worked as a Post-Doctoral fellow at the ANSTO Institute of Materials Engineering on the topic of plasma-surface interactions for nuclear fusion reactors and before that completed a PhD in Physics at the University of Sydney.

ABSTRACT

We present the imaging results from a novel single pixel gamma-ray imaging system, developed at ANSTO, which is capable of providing quantitative, spectroscopic gamma images using a fast and efficient imaging methodology.

Gamma ray imaging can assist in surveying active areas by providing information of the radiation environment in areas which are hard to reach (e.g. in enclosed spaces or at height) and by gaining valuable information about the radiation environment whist limiting exposure to personnel in high dose rate environments.

The system design provides a large field of view (360° × 70°) and covers a wide energy range of 40 keV to 1.5 MeV. The gamma ray image is overlaid on a 360° panoramic optical image of the scene, which allows for easy location of the gamma emitting radionuclides that are present. By selecting different regions of interest in the recorded gamma spectrum, separate radionuclide specific images, of the area being surveyed, can be visualised. Calibration of the detector allows for quantitative mapping of where each component of the dose rate at the detector originates. This can be converted into activity with *a priori* knowledge of the scene geometry.

Gamma-ray images have been experimentally obtained for both point sources and extended sources in controlled testing environments and these results will be presented. The imaging results from a range of real world operational environments, around the ANSTO site, will be presented and demonstrate the systems capability for locating sources of radiation in nuclear industry applications.

COMMISSIONING A BeO OSL DOSIMETRY SYSTEM FOR USE AS A NATIONAL DOSIMETRY SERVICE OPERATED BY PERSONAL RADIATION MONITORING SERVICE, PRMS, AT ARPANSA

MICHAEL LITWIN[1], DR STEPHEN LONG[1], MR JAMES MARAZAKI[1], DR DUNCAN BUTLER[1], DR REINER ESSER[2]

1 ARPANSA

2 Dosimetrics GmbH

Michael has worked at ARPANSA for 10 years. In that time he has worked extensively in both the Personal Radiation Monitoring Section (PRMS) and the Emergency Preparedness and Response (EPR) Section.

ABSTRACT

A commercially available optically stimulated luminance (OSL) system (Dosimetrics GmbH, Munich) has been commissioned for use as a national dosimetry service operated by the Personal Radiation Monitoring Service (PRMS) at ARPANSA. The system uses beryllium oxide (BeO) personal dosemeters, which are nearly tissue equivalent in their energy response. The system meets the IEC 62387-1 standard for the characteristics and performance requirements for instrumentation for passive dose monitoring. The system has been type-tested in Germany by the German National Metrology Institute, Physikalisch Technische Bundesanstalt (PTB), and is approved for operation in Germany.

In order to confirm the operation of the system, the PRMS performed acceptance testing and commissioning tests at ARPANSA. Firstly, a system of regular ^{137}Cs

quality control irradiations was developed to check the long-term performance, in addition to the internal ^{90}Sr check-sources supplied with the system. The energy response of the BeO dosimeters was confirmed by irradiating them to a single dose to energies ranging from an
70 kVp X-ray beam (effective energy 33.7 keV) to ^{60}Co (1.25 MeV). All doses were delivered following ISO 4037 and are traceable to Australian standards of air kerma. The linearity was confirmed by irradiating a set of BeO dosimeters with photons from ^{137}Cs to graded doses from 0.001 mSv to 100 mSv. From these data the minimum sensitivity of the system was found to be 0.01 mSv, the minimum detectable limit (MDL) to be 0.05 mSv and the minimum reportable dose (MRD) to be 0.1 mSv.

CHARACTERISTIC LIMITS AND THEIR APPLICATION TO PERSONAL DOSIMETRY

DR STEPHEN LONG[1], MR MICHAEL LITWIN[1], MR JAMES MAZARAK[1]

1 Arpansa

After completing a doctorate in nuclear physics, Stephen Long joined ARPANSA in 1997. Stephen's early career was spent working on the Maralinga Rehabilitation Project. Stephen has also been responsible for upgrading the measurement capabilities of the radioanalytical laboratory at ARPANSA. Recently, Stephen was the leader of the team drafting the revised Australian and New Zealand Standard on radiation protection in laboratories and has lead an IAEA team reviewing the occupational radiation protection systems in Malaysia.

ABSTRACT

50 years ago, Lloyd Currie was struck by the plethora of definitions and formulations for 'detection limit'. This led to the publication of his seminal paper (Currie, L.A., Analytical Chemistry, volume 40, issue 3, pp 586-593, 1968), in which he rigorously defined three characteristic limits for a measurement: the critical limit, the detection limit and the quantification limit. Unfortunately, it was not until 1995 that Currie's definitions received official status with their recognition by the International Union of Pure and Applied Chemists (IUPAC). It took a further five years before they were given official status by the International Standards Organisation in ISO11929.

Despite the fact that 'detection limit' is now a rigorously defined term, it is still used rather loosely by many. Using the formulations defined by Currie for these limits is particularly important in situations where measurements are made relative to a significant background signal.

The measurement of occupational dose is an example of such a situation. ARPANSA was obliged to calculate these characteristic limits for its new personal dosimetry measurement system. The importance of using the definitions provided by Currie will be demonstrated using these calculations as examples.

SESSION 9: DIAGNOSTIC IMAGING AND NUCLEAR MEDICINE

3.15PM – 4.15PM

MANAGEMENT OF PATIENT RADIATION DOSE FROM INTERVENTIONAL RADIOLOGY

DR DONALD McLEAN[1]

1 Medical Physics and Radiation Engineering, The Canberra Hospital

Donald McLean started work as a medical physicist in Westmead Hospital where early on he specialised in diagnostic radiology, developing QA equipment testing protocols and patient dosimetry methodologies. Interest in mammography and in paediatric CT dose developed while teaching at Sydney University. Twelve years ago an opportunity to serve internationally resulted in 6 years at the IAEA working as a medical physicist in diagnostic radiology. A focus on education and dosimetry saw the publication of over 20 IAEA publications including the handbook in Diagnostic Radiology Physics and the Human Health Series publication on Paediatric Dosimetry. Donald now works at the Canberra Hospital continuing his interests in shielding and clinical medical physics including patient dose estimation in CT, angiography and paediatrics.

ABSTRACT

Interventional radiology, although small in the relative number of procedures performed, accounts for ~7% of the medical dose to the Australian population. This is often seen in the higher occupational doses recorded in this environment. More recently a focus on occupational eye dose, has been highlighted by the lowering of the internationally eye dose limit. However the potential for patient skin tissue damage is high and should be reflected in management strategies to protect the patient and reduce institutional risk.

Experience at a local teaching hospital has illustrated the regular occurrence of skin doses to patients in excess of 2 Gy including some over 5 Gy and up to 14 Gy. While a radiation management plan was in place that pointed to ARPANSA requirements, including mechanisms to alert both staff the referring physicians to high dose events, local staff requested confirmation on this approach from major teaching hospitals in Australia. To this end a survey was circulated to medical physicists that asked the details of relevant management systems in place at their institution.

Nine centres responded reporting on management strategies adopted in New Zealand and the states of Queensland, NSW and Victoria. All centres that responded had in place a system that involved providing clinical staff with real time levels for substantial radiation dose levels, a determination of the peak skin dose from case details usually by the medical physicist, the recording of these patient doses in the patient records and some form of notification of either the referrer or patient to facilitate follow up of the patient. In the states of Queensland and Victoria there is also a regulatory need to inform the regulator when peak skin doses exceed a given threshold. While the details regarding trigger levels applied varied at various stages in the process the substance of the management plans was consistent.

Good radiation safety practice surely involves education and the monitoring of personal doses including periodic checking of

occupational eye dose, however a clear management strategy to monitor patient skin dose is required along with a process to deal with high doses when they occur. Analysis of facility doses reveals that equipment quality is an important dose indicator, however associated with the continual dose reduction associated with technology improvements is a corresponding increase in the technical difficulty of the procedures being undertaken, reinforcing the need for a vigilance well-designed management plan to allow good patient outcomes.

AREA RADIATION MONITORING AND DOSE ASSESSMENT IN RADIATION THERAPY, MOLECULAR IMAGING AND RADIOIODINE TREATMENT FACILITIES IN A NEW CANCER HOSPITAL

MICHAEL GILHEN[1], PROF TOMAS KRON[1], MR DAVID BINNS[1]

1 Peter MacCallum Cancer Centre

See previous Biography

ABSTRACT

Peter MacCallum Cancer Centre (Peter Mac) relocated from premises at St Andrews Place, East Melbourne into a new purpose built oncology facility at the Victorian Comprehensive Cancer Centre (VCCC), Melbourne in June 2016. Given the complexity of the services in a large tertiary cancer hospital, workload and effectiveness of shielding and room design is difficult to predict. To coincide with delivering radiation therapy (external beam and radioiodine therapy) and molecular imaging services (PET, nuclear medicine and radionuclide therapy) in new facilities, the Victorian Department of Health and Human Services (DHHS) made an additional radiation management licence condition that required Peter Mac to 'demonstrate that dose limits for occupationally exposed persons and members of the public are not exceeded'. The condition describes the radiation monitoring method, locations, duration and reporting timeframes.

The area monitoring program utilised pairs of LiF:Mg,Cu,P TLDs with a minimal detectable dose limit below 0.01mGy. Monitoring was undertaken at 10 locations in the radiation therapy department, 13 locations in molecular imaging and 3 locations adjacent to radioiodine therapy treatment suites. The monitoring will cease in June 2017, by which time, area monitors will have been in place for > 200 days in each location.

Annual dose calculations will be reviewed against occupational and public dose limits. Monthly records to date confirm the assumptions made in the design. Annual dose calculations will be compared to personal occupational radiation monitoring doses received by radiation therapy, molecular imaging and nursing staff during the corresponding area monitoring periods.

THE COMPLEXITIES OF HIGH DOSE ^{131}I-MIBG THERAPY IN THE PAEDIATRIC ENVIRONMENT: EDUCATION AND TRAINING

NICOLE WILLETTS[1], MS CATRIONA GREEN[1]

1 The Children's Hospital At Westmead

Nicole Willetts has been employed as the Radiation and Laser Safety Officer for the Children's Hospital at Westmead since 2014. Nicole holds a Master of Applied Science (Medical Physics) from Queensland University of Technology (QUT) and a Certificate of Professional Development in Radiation

Protection from the University of Strathclyde.

Nicole began her career as a Health Physics Surveyor at ANSTO, she moved to the Royal Brisbane and Women's Hospital to work as a Medical Physics Registrar in Radiation Oncology, before returning to ANSTO as a Health Physicist. Prior to commencing work at the Children's Hospital at Westmead, Nicole worked in the uranium mining industry as a Radiation Safety Officer.

ABSTRACT

High dose ^{131}I-meta-iodobenzylguanidine (^{131}I-mIBG) therapy is increasingly being applied to neuroblastoma patients who are refractory to initial induction therapy or who have recurrence of disease after therapy. Practical issues arise with small children and infants that make this form of therapy difficult. They require considerable personal care and emotional support from parents, carers and staff, which is particularly difficult to implement as they are required to be in an isolation room for at least 3 days after administration of the ^{131}I-mIBG, as per discharge radioactivity limits.

Depending on the age, personality and any separation anxiety, there may be a clinical decision required regarding the use of sedation and/ or general anaesthetic. As general anaesthetic is not routinely performed outside of specialised units within the hospital, extensive collaboration and consultation between all relevant working groups is required on a case by case basis.

To ensure consistency in the radiation safety training and education of parents, carers and staff during these complex therapies, a working group was established with members from relevant departments (Anaesthetics, Nuclear Medicine and Oncology) and a suite of training packages were created and implemented.

This presentation will outline the radiation safety aspects of high dose ^{131}I-mIBG therapy, from patient selection and admission to patient discharge.

SESSION 10: PLANNED EXPOSURE SITUATIONS

3.15PM – 4.15PM

RADON MONITORING IN THE VICINITY OF OLYMPIC DAM

AMRINDER DHINDSA[2], DR CHES MASON[1], CHUONG PHAM[2]

1 GCMP Consulting

2 BHP Billiton

See previous Biography

ABSTRACT

Data from a network of air monitoring stations in the vicinity of mining operations at Olympic Dam have been analysed. Long-term monitoring results taken at ten minute intervals for radon concentration and radon decay product (RDP) concentration have been combined with wind-speed and wind direction data to reveal some interesting patterns of correlation. The results also show that any increase in radon or RDP exposure at these monitoring stations that could be attributed to operations at Olympic Dam is unmeasurably small.

NUCLEAR INSPECTION ROBOTS – AND OTHER TECHNOLOGIES USED FOR IAEA SAFEGUARDS

DR CRAIG EVERTON[1], MS REBECCA STOHR[1], MS LYNDELL EVANS[1]

1 Australian Safeguards and Non-proliferation Office (ASNO)

Dr Craig Everton is Director of the IAEA Safeguards Section in the Australian Safeguards and Non-Proliferation Office (ASNO), with responsibility for administering Australia's national nuclear safeguards system, providing policy advice on international non-proliferation and safeguards issues, and managing Australia's international engagement on safeguards with the IAEA and other partners, such as through the Asia-Pacific Safeguards Network (APSN).

In Craig Everton's thirteen years in ASNO he has worked on: managing Australia's compliance with IAEA safeguards requirements; administering the export and tracking of Australian uranium through the international nuclear fuel cycle; specialist safeguards advice in the negotiations of several of Australia's bilateral nuclear cooperation agreements and associated administrative arrangements; negotiating safeguards resolutions at IAEA General Conferences; and, advising Government on international and domestic non-proliferation/safeguards matters.

Craig Everton has a PhD in experimental particle physics and a research Masters of Science in applied nuclear measurement techniques, both from the University of Melbourne.

ABSTRACT

Technology plays an essential role in IAEA safeguards activities for verifying compliance with nuclear non-proliferation commitments; from in-field inspections, to monitoring activities, to headquarters analysis. IAEA inspectors use a range of technologies: detectors to measure nuclear material attributes; cameras and tamper-indicating seals to contain and surveil nuclear material; mass spectrometry for detecting trace quantities of nuclear material; and, other measuring systems to check the design features of nuclear facilities. When new or improved technologies become available, they can improve the confidence the IAEA can

assign to its conclusions and therefore the confidence the international community holds in non-proliferation compliance findings. Likewise, gradual utility improvements in technologies over the years, such as battery life, miniaturisation, portability and ease of communication, have led to significant improvements in the efficiency of IAEA inspections.

This paper will describe some of the key technology challenges the IAEA faces in verifying non-proliferation compliance, and how the IAEA is meeting these challenges with new and emerging technologies. The paper will focus particularly on areas in which Australia is contributing, such as 3D laser scanning, high precision mass spectrometry, and land and water based robotics systems for streamlining more repetitive inspections activities.

NUCLEAR MATERIAL DISPOSAL – IAEA SAFEGUARDS REQUIREMENTS

REBECCA STOHR[1], DR CRAIG EVERTON[1]

1 Australian Safeguards and Non-proliferation Office

Rebecca Stohr is an Assistant Director in the Australian Safeguards and Non-Proliferation Office (ASNO). She works in a regulatory role, with responsibility for oversight of and advice to permit holders on a range of safeguards issues.

Previously, Rebecca led investigations into the safety of spent fuel management for the South Australian Nuclear Fuel Cycle Royal Commission. She has also worked in several other roles providing policy advice to government and as an oil and gas engineer.

Ms Stohr holds a Master of Nuclear Science and Technology, a Bachelor of Materials Engineering and a Bachelor of Science.

ABSTRACT

Nuclear material in Australia is subject to oversight by the International Atomic Energy Agency (the Agency). The Agency's mandate is designed to maintain international confidence that all nuclear material is accounted for and solely used for peaceful purposes. The Agency does this through a combination of in-field verification (i.e. inspections) and head-quarters analysis. When considering disposal, nuclear material no longer needs to be available for IAEA inspection, so long as it is rendered "practicably irrecoverable" in accordance with Agency requirements.

In upholding Australia's international commitments, the Australian Safeguards and Non-Proliferation Office (ASNO) regulates holders of nuclear material through a system of permits. Under this system, permit holders are required to seek approval prior to consuming, diluting or disposing of nuclear material. These requirements are separate from any safety standards that apply to radioactive material at the end of its useful life. This paper will explain the criteria the IAEA uses for assessing whether a plan to consume, dilute or dispose of nuclear material meets the test of "practicably irrecoverable". It will also explore the day-to-day implications for persons who routinely use nuclear material and broader implications for managing waste in Australia.

NOTES

POSTER PRESENTATIONS

Posters will be displayed in the Ballroom for the duration of the conference. There will be a poster session on Tuesday 8 August 2017 from 12.00 - 1.00pm and Wednesday 9 August 1.00pm - 2.00pm during the lunch breaks. It is encouraged to have at least one author available during these times to answer any questions.

POSTER 1

RADIATION DOSE FROM INTRA ORAL EXAMINATION- IS IT WORTH THE ATTENTION?

NEHAL AHMED[1], MR ANDREW FINCH, DR STEPHEN NEWBERY

1Radiation Protection Unit, DHHS, Tasmania

Nehal has a background in Engineering and completed Masters in Medical Radiation Physics from University of Wollongong. Nehal has significant experience in project management and has been working as a Regulator in the field of Radiation Protection around eight years.

Nehal has been involved in administering the Radiation Protection Act of the Northern Territory almost seven years before taking the role of Senior Health Physicist within the Radiation Protection Unit of Department of Health and Human Services, Tasmania.

Nehal is involved in regulatory audits, inspection, research and testing of medical and industrial radiation equipment, provide expert advice on radiation safety matters, and has developed policies and guidelines to assist industries to comply with the requirements from the Act and Regulations. In his current and previous roles, Nehal has worked collaboratively with a diverse range of professionals such as dentist, diagnostic radiographer, medical practitioner, medical physicist and various industrial operators.

ABSTRACT

Intra oral radiography is the most frequent x-ray examination to assess a variety of dental conditions. The radiation doses to patients from Intra oral x-ray are low when compared with panoramic or cone beam CT (CBCT) radiography. Intra oral radiographs are taken by a range of dental professionals such as dentist, dental assistant, dental therapist and dental hygienist. The imaging technique may vary among the dental professionals depending on qualification and experience. Dental imaging technology has shifted significantly in recent years due to the introduction of Direct Digital (DR) and Computed Radiography (CR). There is a possibility to increase patient dose from DR and CR imaging systems, if appropriate imaging techniques are not used. Radiation dose to patients should be optimized in accordance with the ALARA principle. There is no national dataset or Diagnostic Reference Level (DRL) to compare radiation dose to patients from intra oral radiographs. The study was aimed to compare imaging techniques, exposure factors, diagnostic image quality and entrance dose for a range of dental professionals and equipment type. Skin entrance dose was used as a suitable and easily measurable quantity to establish DRL for intra oral radiography.

Dentists and associated dental professionals were requested to image a child and adult dental phantoms using Intra oral x-ray equipment for a specific clinical protocol (periapical view- molar) , considering the phantoms as real patients. Image assessment was performed using Image J software and diagnostic Image Quality was assessed by a Senior Dentist in accordance with the American Dental Association guideline. Skin entrance dose was measured using Instadose dosimeters. The study found a wide variation in exposure factors, entrance dose and diagnostic image quality of Intra oral radiographs.

POSTER 2

RADIATION DOSE REDUCTION IN PULMONARY EMBOLISM DIAGNOSIS OF PREGNANT AND BREASTFEEDING PATIENTS

ROSALIE BABICHEVA[1]

1 Bankstown/Lidcombe Hospital

Rosalie is a Medical Physics Specialist in Nuclear Medicine field.

ABSTRACT

Background: The incidence of pulmonary embolism (PE) is greatly increased in pregnant patients and is the leading cause of maternal death. The clinical diagnosis of PE is complicated by normal physiological changes during pregnancy. Ventilation perfusion lung scanning was the most commonly performed for diagnosis of PE until the newer technology of Computer Tomography Pulmonary Angiography (CTPA) was introduced in 1990's. CTPA offers direct imaging of pulmonary arteries and is often favoured due to its greater availability for PE diagnosis.

Aim: Clinical audit of the CTPA estimated effective radiation dose in pregnant and recent post-partum patients and associated CTPA diagnostic yield at a single institution in order to reduce radiation dose to this group of patients.

Method: Retrospective review of CTPA patient data for PE between June 2012 and December 2016 was performed. 13 female patients were available for reviews including 7 pregnant and 6 breastfeeding patients within a few weeks from giving birth. One patient had 3 scans: CTPA, abdomen and pelvic CT. Only the CTPA dose data of this patient was entered to study.

The diagnostic outcome of each CTPA study was reviewed as positive or negative.

CTPA effective chest dose (E) was calculated by formula:

$$E = DLP \times K$$

where DLP is dose length product and K is coefficient of region specified normalised effective dose of chest using tissue-weighting factors of ICRP 110 table.

Results: All CTPA studies were negative for the diagnosis of PE. Average estimated effective dose of CTPA was 11.4mSv, with max 20.5mSv and min 6.9mSv. In comparison half dose perfusion lung scan dose (110MBq of Tc-99MAA) is 1.2 mSv. Furthermore there is an estimated at least 30 fold greater in CTPA breast dose with CTPA than with low dose perfusion scintigraphy.

Conclusion: CTPA exposes patients to much higher whole body and breast radiation doses compared with lung scanning. Given the zero positive diagnostic yield of CTPA and high radiation exposure in this audited group of patients it is important to use CTPA more judiciously in pregnant and post-partum women and to consider using low dose lung scanning instead.

POSTER 3

EVALUATION OF THE SHIELDING CHARACTERISTICS OF A NOVEL, COPPER SCALE MAILLE CONTRALATERAL BREAST SHIELD : SMART ARMOUR

DR MARTIN BUTSON[2,3], MACINLEY BUTSON[1], SUSAN CARROLL[2], ROBIN HILL[2,3]

1 The Illawarra Grammar School, Western Ave, Mangerton NSW 2500 Australia

2 Department of Radiation Oncology, Chris O'Brien Lifehouse, Camperdown, Australia

3 Institute of Medical Physics, University of Sydney, Camperdown, Australia

Martin is a clinical medical physicist with 25 years' experience in treatment, research and education. Interests include improvements to radiotherapy treatment and clinical dosimetry. Martin has published more than 130 papers and is employed at the Chris O'Brien Lifehouse - cancer therapy centre and affiliated with the University of Sydney.

ABSTRACT

During breast radiotherapy treatment, the contralateral breast receives radiation doses to the skin and subcutaneous tissue caused mainly by incident electron contamination and low energy x-ray scatter radiation. Measurements have shown that for a typical hybrid tangential treatment, these dose levels can be up to 17 % of maximum applied dose if no shielding is used during the treatment process. This work shows a simple and novel method to substantially reduce this dose level with the use of a copper scale maille sheet which can be easily and accurately draped over a patient's contralateral breast during treatment. The copper scale maille is flexible and can thus conform around typical breast shapes. It can also form irregular shaped edges to match those outlined by typical tangential treatment fields. As the shield is made from copper, it is non-toxic and could potentially be used directly on patients for treatment. The designed copper scale maille has shown to reduce contralateral breast skin and subcutaneous dose by up to 75% for typical radiation fields used in breast radiotherapy.

POSTER 4

PRACTICAL TIME CONSIDERATIONS FOR OPTICALLY STIMULATED LUMINESCENT DOSIMETRY (OSLD) IN TOTAL BODY IRRADIATION

DR MARTIN BUTSON[1,2], MAMOON HAQUE[1,2], LEON SMITH[3], ETHAN BUTSON[2], DAVID ODGERS[1], DANE POPE[1], TINA GORJIANA[1], MAY WHITAKER[1], JOHNNY MORALES[1,4], ANGELA HONG[1,3], ROBIN HILL[1,2]

1 Dept of Radiation Oncology, Chris O'Brien Lifehouse,

2 Institute of Medical Physics, University of Sydney,

3 Sydney Medical School , University of Sydney,

4 School of Chemistry, Physics and Mechanical Engineering, Queensland University of Technology,

See previous Biography

ABSTRACT

Total Body Irradiation (TBI) treatments which involve irradiating the whole body are mainly used in a preparative regimen for hematopoietic stem cell (or bone marrow) transplantation. Our standard clinical regimen is a 12 Gy in 6 fraction, bi-daily technique using 6MV x-rays at an extended

Source-to-Surface distance (SSD) of 300 cm. Utilizing these characteristics, the beam dose rate is reduced below 7 cGy per minute as is standard for TBI treatment. Dose received by the patient is monitored using optically stimulated luminescent dosimetry (OSLD). This work presents some practical calibration corrections based on time-dependant factors for OSLD calibration related to TBI procedure. Results have shown that a negligible difference is seen in OSL sensitivity for 6MV x-rays irradiated in standard SSD (100 cm) and high dose rate (600 cGy/Min) conditions compared to extended SSD (300 cm) and low TBI dose rate (6 cGy/Min) conditions. Results have also shown that whilst short term signal fading occurs in the OSL after irradiation at a high dose rate (37% reduction in signal in the first 15 minutes), thereafter, negligible differences are seen in the OSL signal between 600 cGy/min and 7 cGy/min irradiations.

Thus a direct comparison can be made between calibration OSLs and clinical TBI OSLs between 15 minutes and 2 hours. Finally a table is presented to provide corrections between calibration OSL readout and clinical TBI dose readout for a period up to 7 days. Combining these three results allows users to pre-irradiate their calibration OSLs at standard dose rate and SSD, up to one week prior to clinical treatment, and still provide accurate in-vivo dosimetry. This can help with time saving and work efficiency in the clinic.

POSTER 5

ENHANCING RADIATION SAFETY IN AUSTRALIA THROUGH APPLIED TRAINING AND OUTREACH

ANDREW POPP[1], MRS TINA PANERAS[2], MR ROD DOWLER[3]

1 Radiation Protection Services, ANSTO

2 ANSTO Radiation Services

3 ANSTO Discovery Centre

See previous biography

ABSTRACT

The Australian Nuclear Science and Technology Organisation (ANSTO) is the centre of Australia's nuclear science capabilities and expertise, operating in Sydney the nation's only nuclear reactor, OPAL, and in Melbourne the Australian Synchrotron. In order to successfully run the landmark infrastructure at ANSTO we need suitably qualified and experienced workers who understand and embrace radiation safety culture. This is achieved, in part, through in-house development and regular delivery of applied training so that knowledge, skills and experience in radiation safety is fostered and sustained.

ANSTO has been recognised as setting the benchmark for radiation safety training in Australia and also offers radiation safety training to external clients in mining, health care, government, education, universities and research industries.

To maintain and enhance our social licence to operate our nuclear and radiological facilities, and to demonstrate leadership in the education of Australia's next generation, ANSTO communicates to a wide range of different stakeholders, including community groups, pupils, university students, teachers,

regulatory officers, industry and government representatives, and international partners. This is done using various methods, such as tours of landmark infrastructure, teacher professional development, school workshops, online resources, and interactive community events.

This poster describes the methods employed, and highlights some of the activities and outcomes of this applied training and outreach.

POSTER 6

FLUOROSCOPIC SCATTER MEASUREMENTS IN SIR CHARLES GAIRDNER HOSPITAL

SEONAID RODGERS[1], CAMERON STORM[1], ALICIA HARVEY[1], MEGAN MCMANUS[1]

1 Sir Charles Gairdner Hospital

Seonaid commenced her Bachelor of Physics with a specialisation in Astrophysics in 2011 at Curtin University in Western Australia. During her studies she was accepted into a summer scholarship at the International Centre for Radioastronomy Research where she completed a project developing an educational teaching tool using antennas from the Murchison Wide Field Array. Through this experience she gained a position as a Science Outreach Presenter for Curtin University, where she taught science to students and the general public and co-directed the Conoco-Phillips Science Experience 2015. After graduating, she gained a position as a Diagnostic Imaging Medical Physicist in the department of Medical Technology & Physics at Sir Charles Gairdner Hospital. After 2 years working in Radiation Physics she hopes to commence her Masters in Medical Physics at The University of Western Australia in 2018.

ABSTRACT

The aim of this project was to provide an indication of the radiation exposure (dose rate) for staff members who would typically be exposed to scatter radiation while working in the interventional fluoroscopy suites at Sir Charles Gairdner Hospital. Staff members in these areas show widely diverse attitudes towards radiation risk, and with lengthy screening times that can exceed one hour, a simple understanding of radiation exposure is imperative to all staff in the area.

Scatter measurements were taken from five fixed fluoroscopy units in both Radiology and Cardiovascular Medicine departments. Each room was treated individually with consideration given to its clinical purpose. The set-up and exposure factors of each fluoroscopic unit were based on typical clinical factors hence differed from room to room. Data was collected in a grid-like pattern around the room and used to create colour-coded maps of regions of high dose rate. The easy to visualise colour maps make it simple to convey this information to both radiation workers and non-radiation workers in the hospital. The data has been most relevant to the interventional radiologists and nursing staff who need to be close to the patient (primary source of scatter) throughout lengthy procedures.

Additional data was collected to investigate the increased risk that is present when using high dose rate acquisition imaging and changing fluoroscopy technique factors such as the pulse rate, x-ray tube voltage and x-ray field size. Further work was done to produce simple diagrams that illustrate the benefits of using the radiation shields available effectively in both nurse's and interventionalist's position.

POSTER 7

^{177}LU-DOTATATE V ^{131}I-MIBG FOR TREATMENT OF HIGH RISK NEUROBLASTOMA: A RADIATION SAFETY PERSPECTIVE

NICOLE WILLETTS[1],
MS BRIONY TOMLIN[1]

1 The Children's Hospital At Westmead

See previous biography

ABSTRACT

For patients with recurrent or refractory multifocal disease in high risk neuroblastoma there are limited therapeutic options available. Radionuclide therapy is a systematic treatment that uses a molecule labelled with a radionuclide to deliver a high level of radiation to treat neuroblastoma. Presently at The Children's Hospital at Westmead two different radionuclide therapies are administered for treatment of neuroblastoma. Historically, patients with high mIBG (^{123}I-mIBG) uptake on diagnostic images have been administered ^{131}I-meta-iodobenzylguanidine (^{131}I-mIBG) radionuclide therapy as either a single agent or in a combination with other therapeutic treatments. In the last two years there has been an increase in the use of ^{177}Lu-DOTATATE radionuclide therapy for high risk neuroblastoma patients, based on high DOTATATE (^{68}Ga-DOTATATE) uptake on diagnostic images. Both Iodine-131 and Lutetium-177 are beta and gamma emitting radionuclides, but are labelled to different types of molecules, and as such attach to different aspects of the neuroblastoma cells.

Practical issues arise with the use of radionuclide therapy in small children and infants. They require considerable personal care and emotional support from parents, carers and staff, and it is from this perspective that this poster will compare the radiation safety aspects of the two radionuclide therapies.

POSTER 8

TOWARDS PERSONALISED EXPOSURE PRESCRIPTION IN MEDICAL X-RAY RADIOGRAPHIC IMAGING

DR XIAOMING ZHENG[1]

1 Charles Sturt University

Dr Xiaoming Zheng is a senior lecturer and presiding officer of radiation safety committee at Charles Sturt University. He has been teaching medical radiation science courses at CSU since 1998 and presiding officer of radiation safety committee since 2008. He was a medical physicist at the Prince of Wales Hospital, Sydney, prior to his current appointment at CSU. He earned his PhD in physics from the University of Newcastle and subsequently worked as a postdoctoral fellow in applied mathematics at the University of Wollongong and an associate lecturer in theoretical chemistry at the University of Sydney. He spent some seven months doing research at the University of Massachusetts Medical School, USA. His current research interest is focused on radiation dose reduction and image quality optimisation in medical X-ray imaging.

ABSTRACT

The purpose of this poster is to present an automatic personalised exposure prescription scheme and system in medical X-ray radiographic imaging. Thickness of body part or imaging region is measured by using laser beams of patient positioning. Scan parameters of averaged body sizes recommended by manufacturers are used as reference. Patient size based governing

equations for optimal selection of scan parameters are used in calculating individual patient's exposure. Radiation dose to patient is expected to be reduced from current level in clinical practice by employing the personalised exposure prescription technique.

POSTER 9

CHARACTERISING MOBILE PHONE RADIOFREQUENCY-ELECTROMAGNETIC FIELD EXPOSURES USING AN APP

CHHAVI R. BHATT[1,] DR. MARY REDMAYNE, PROF. MICHAEL J. ABRAMSON, PROF. MALCOLM R. SIM, DR. GEZA BENKE

1 Centre for Population Health Research on Electromagnetic Energy (PRESEE), School of Public Health & Preventive Medicine, Monash University

Chhavi R. Bhatt, BSc (Radiol Tech), MSc (Radioecology), PhD (Radiation Epidemiology – Monash University) has demonstrated scholarship and interest in radiation and public health research. He has knowledge and hands-on experience in radiation exposure, radiation safety and health risk evaluations. He is passionate about communicating evidence-based knowledge on radiation and potential health concerns to general public and occupational populations in order to improve their understanding of (omnipresent) radiation.

ABSTRACT

The World Health Organization emphasises the need for objective assessment of radiofrequency-electromagnetic field (RF-EMF) exposures, including mobile phone (MP) exposures, in human populations. The aim of this study was to objectively characterise the RF-EMF exposures associated with the use of MPs in a sample of an Australian population.

Methods: Ten participants provided daily objective data on their MP RF-EMF exposures (i.e. transmitted and received power densities) - cumulative transmitted power density, cumulative received power density (µWh/m^2) attributed to different modes of MP usage such as cellular calls, cellular data and Wi-Fi. The data were continuously collected over two months with the Android OS app, Quanta Monitor–MonashResearch™. Descriptive statistics (medians [25th and 75th percentiles]) were calculated from the exposure data: total cumulative transmitted power density weekly (cellular calls, data and Wi-Fi), cumulative transmitted power density (cellular calls) weekly, transmitted power density weekly (Wi-Fi), total cumulative received power density (cellular calls, data and Wi-Fi) weekly, received power density (cellular calls and data) weekly and received power density (Wi-Fi) weekly.

Results: The estimated weekly cumulative median (25th and 75th percentiles) transmitted RF-EMF exposure levels were: i) total transmitted power density (cellular voice call, data and Wi-Fi) was 1.78×10^7 (1.05×10^7, 4.94×10^7) mWh/m^2, ii) transmitted power density (cellular voice calls) was 1.91×10^6 (4.24×10^5, 6.19×10^6) mWh/m^2, iii) transmitted power density (cellular data) was 8.66×10^6 (3.61×10^6, 2.44×10^7) mWh/m^2, and iv) transmitted power density (Wi-Fi) was 1.55×106 (5.75×10^5, 7.51×10^6) mWh/m^2. Similarly, the estimated weekly cumulative median (25th and 75th percentiles) received RF-EMF exposure levels were as follows: i) the total received power density was 212.42 (19.28, 1176.75) mWh/m^2, received power density (cellular voice calls and data) [mobile phone base station] was 9.54 (2.02, 516.34) mWh/m^2, and received power density (Wi-Fi) was 167.12 (17.86, 395.91) mWh/m^2.

Conclusion: The study demonstrated that Quanta Monitor app could be employed in prospective evaluation of human exposures to MP in epidemiological studies. The findings indicated that combined RF-EMF exposure due to transmitted RF-EMF signals during calls, data and Wi-Fi surfing could be in the order of 104 times higher compared to that due to the MP and Wi-Fi received signals.

POSTER 10

EDUCATION AND TRAINING IN RADIATION PROTECTION AND IDENTIFICATION OF MUTUAL RECOGNITION OF QUALIFICATIONS IN AUSTRALIA, CANADA, NEW ZEALAND, GERMANY AND UK

AUJ TAQADDAS[1]

1 Independent Research Physicist, Research Wormhole Canada

ABSTRACT

Radiation therapy plays an important role in the management of various cancers. However, it is equally important to keep radiation levels as low as reasonably achievable to protect radiation staff and general public from harmful effects of radiation. This requires implementation of good radiation protection practices at all times which in turn requires good training and knowledge in radiation protection issues.

Radiation is used in various sectors such as nuclear, medical and research and the expertise in radiation protection is on decline. Thus, maintaining excellent radiation protection practices and competencies is essential in ensuring safe use of ionizing radiation. More over there is lack of mutual recognition of qualified experts across many countries of the world.

This paper discovers education and training approaches employed for radiation protection training for qualified experts (Radiation protection experts, Radiation Protection officers, Radiation protection supervisors and Radiation protection advisors) in Australia, New Zealand, Canada, UK and Germany with respect to medical sector especially radiation oncology and radiotherapy.

This study also assesses whether mutual recognition of training across these countries exist or not. The study also assesses what is equivalent to what and who can do what.

This will assist in harmonizing and standardization of training in these countries as well as will help in establishing infrastructure for mutual recognition of training for Radiation Protection Experts. This in turn will guarantee fast movement of skilled workers. The process of harmonization of radiation protection training has already started in Europe and by expanding this process to Australia, Canada and New Zealand will eventually help in developing a compatible system of radiation protection training and expertise across these countries which in turn will help in establishing international standardisation of radiation protection training. Moreover, it will help tackle decline in radiation protection expertise and will ensure availability of excellent radiation protection knowledge and skills which can meet demands of the future.

This is unique research in the sense that it has not been carried out in Canada, Australia and New Zealand.

ANSTO Radiation Services

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Internationally recognised as a leader in radiation safety management, the Australian Nuclear Science and Technology Organisation (ANSTO) is the centre of Australia's nuclear science capabilities and expertise - operating the nation's only nuclear reactor. The ANSTO Radiation Services team offers advice, training, instrument calibration and consultancy services, tailored to client needs, to ensure the safe, effective use and management of radiation in all industry sectors including; mining, construction, manufacturing, healthcare, government, education, universities, research and other fields where radiation is present.

www.ansto.gov.au/radiationservices

Radiation Services

The Australian Nuclear Science and Technology Organisation (ANSTO) has over 35 years' experience in radiation safety management and offers expert advice and services tailored specifically to meet your needs

OVER 35 YEARS EXPERIENCE

Consultancy

Our experienced radiation consultancy team offer a unique and highly specialised service, providing advice and cost effective solutions to assist businesses with radiation management

Training

Delivered by industry specialists our recognised radiation safety training courses provide participants with valuable knowledge and expertise in radiation protection

Calibration

Offering a comprehensive, fast turnaround radiation instrument calibration service that meets Australian standards

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The NSW Environment Protection Authority (EPA) is responsible for the administration of legislation covering hazardous materials and radiation. This includes licensing individuals to use and persons responsible for regulated materials; responding to emergencies involving hazardous materials; coordinating emergency preparedness and advice; participating in disaster planning and multi-agency emergency management exercises; conducting audits and inspections to ensure compliance with legislation; and providing policy advice and policy guidance in relation to applications of radiation control.

www.epa.nsw.gov.au

CENTRE FOR MEDICAL RADIATION PHYSICS

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unsw.adfa.edu.au

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The Centre for Medical Radiation Physics (CMRP), University of Wollongong, is the largest institution in Asia Pacific for education and research in medical radiation physics, with 18 academic and research staff and approximately 70 PhD and Masters research students.

The CMRP has strong expertise, with industry partnerships, in the development and commercialisation of radiation detection and dosimetry instrumentation, based on semiconductor detectors, for quality assurance in radiation therapy, radiation protection, space dosimetry and military applications.

www.uow.edu.au/eng/phys/cmrp

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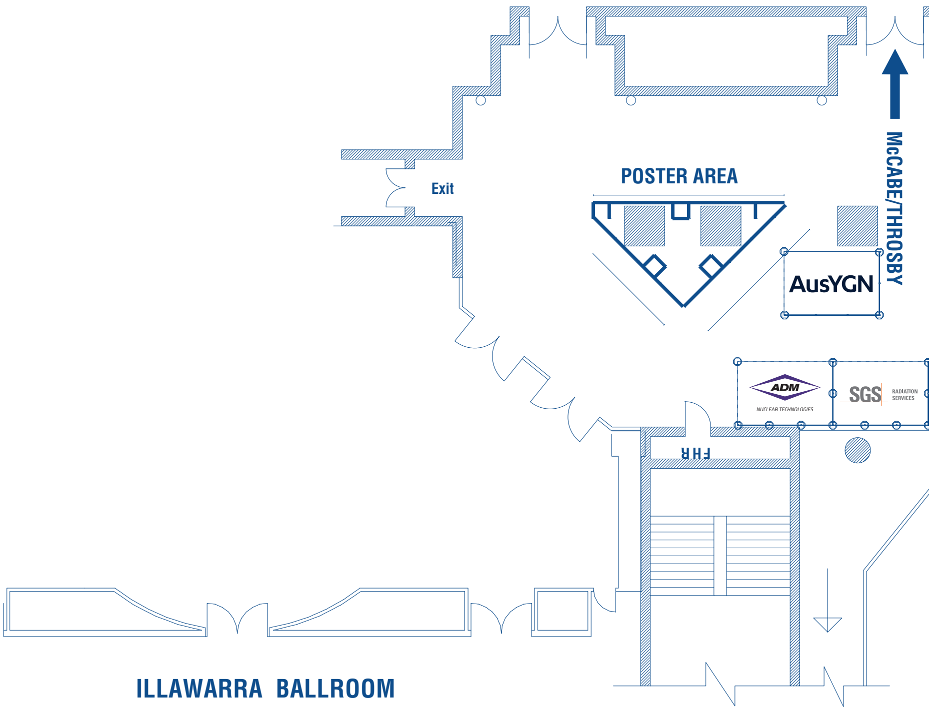


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ENTRY
Up
Down

ACPSEM

The Australasian College of Physical Scientists & Engineers in Medicine (ACPSEM) proudly supports the 42nd Annual Conference of the Australasian Radiation Protection Society in Wollongong. We congratulate all radiation safety professionals on their achievements in protecting the community.

ACPSEM is a joint sponsor of the Certification in Radiation Protection offered by The Australasian Radiation Protection Accreditation Board (ARPAB). If you are interested in achieving this certification, please contact the ACPSEM office by email at education@acpsem.org.au

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www.industry.gov.au

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Australian Young Generation in Nuclear aims to:

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- Represent the interests of young workers to the rest of the nuclear industry
- Encourage young Australians to take up a career in the nuclear industry
- Promote the benefits of nuclear science and technology to other young Australians

www.ausygn.org

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www.landauer.com.au

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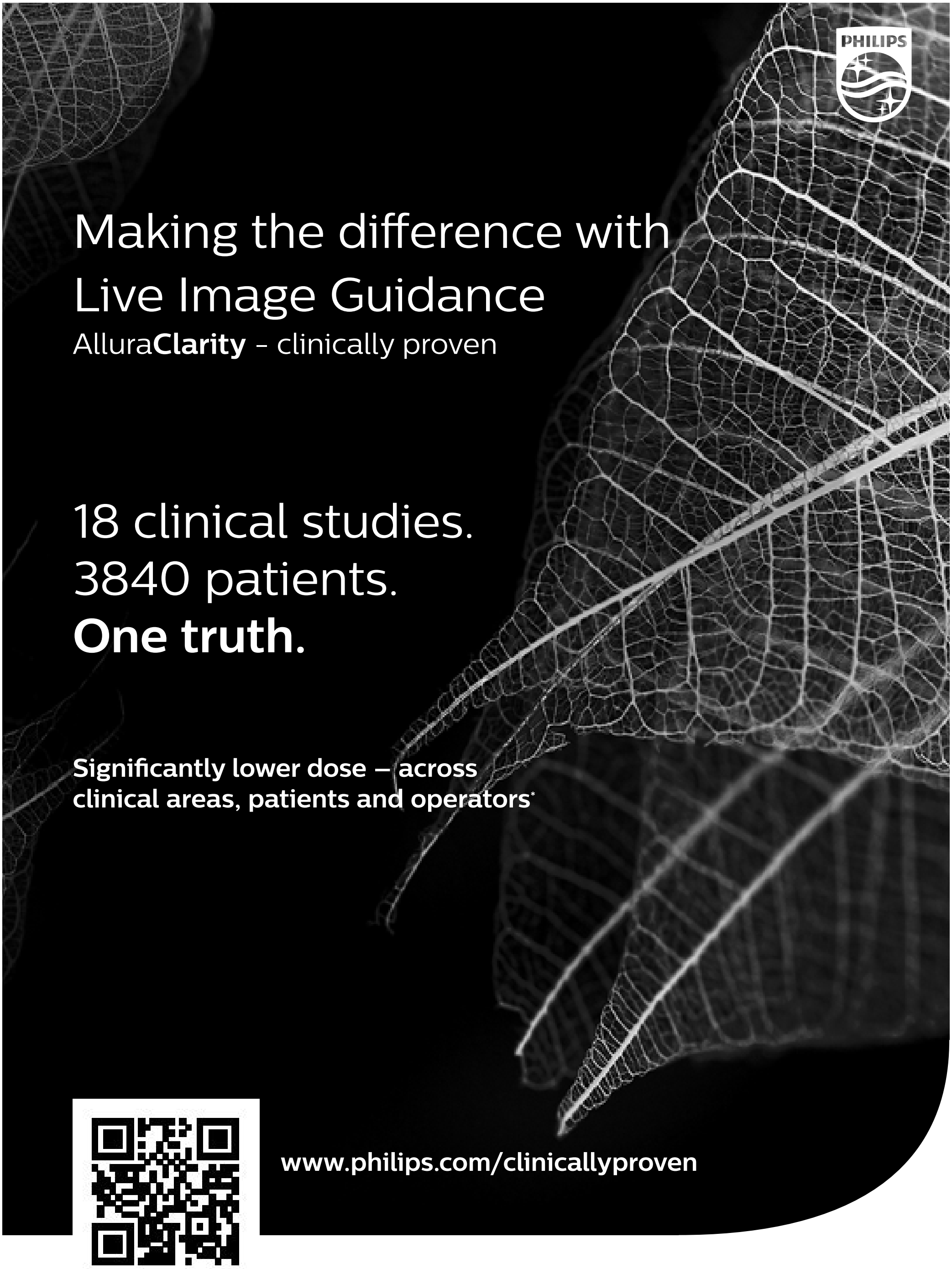

*In 18 individual comparative studies, Philips ClarityIQ was associated with reductions in patient radiation exposure.1-18

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