出國報告（出國類別：其他）

出席第 22 屆全球核能婦女會年會暨相關參訪活動

服務機關：行政院原子能委員會
姓名職稱：邱絹琇　聘用主任工程師
派赴國家：澳大利亞
出國期間：**103** 年 **10** 月 **18** 日至 **25** 日
報告日期：**103** 年 **12** 月 **24** 日

摘　要

第 22 屆全球核能婦女會（Women in Nuclear Global）年度大會由澳洲分會（WiN Australia）主辦，於今（2014）年 10 月 20 至 23 日在澳洲第一大城雪梨舉行。擁有豐富鈾礦的澳洲雖然沒有核電廠，但在核子醫學與科技運用方面非常傑出。WiN Australia 成立於 2003 年，會員 150 位、主要就業於核子醫學與核能科研的領域。全球核能婦女會總共約有近 4,700 名會員，來自 105 個國家/地區，而這次會議有來自 38 國約 150 人參加，其中有 20 人來自開發中國家的代表，由 IAEA 補助機票與膳宿費用。我國由原能會邱絹琇主任工程師(WiN Global 執行理事)、台電公司陳怡如組長(WiN Global 理事)及財團法人核能資訊中心管理師林庭安(WiN Global 會員) 3 人代表赴會。此行主要任務有三：與全球核能界女性建立人脈關係；維持執行理事會席次，在理事會積極參與會務；了解各國尤其是主辦國的核能發展狀況。

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一、任務

今年（第 22 屆）WiN Global 年會於 10 月 20 日至 23 日假澳洲雪梨舉行，議程包含執行理事會議與理事會議、會員大會、專題演講、議題研討與論文壁報發表等；會後並安排核能設施的參訪活動。此行任務有三：

1. 出席全球核能婦女會(以下簡稱 WiN Global)執行理事與理事會討論會務，討論與表決相關會務與提案;藉由積極參與會務,拓展核能外交,維持我國在 WiN Global 所建立的聲譽、地位，及執行理事會席次；
2. 出席全球核能婦女會 2014 年會,吸取新知和經驗,報告我國分會會務活動及國家核能概況，並與出席年會之各國核能界女性交流。了解澳洲及各國之核能現況，同時在各國分享 WiN 組織之活動時，留意可參考借鏡之處；
3. 參訪澳洲國家級核能研究機構及其研究用反應爐 OPAL 與放射性同位素生產設施等，以了解澳洲核能應用之發展與安全管制之現況，以茲借鏡，並建立聯繫管道作為未來國際合作之基礎。

二、行程

本次出國公差行程包含前後旅途時間為期 8 天，首先於 10 月 18 日啟程次日上午飛抵澳洲布里斯班後，轉搭澳洲國內班機至雪梨，下榻大會建議的首選旅館 Four Points by Sheraton，旋即與理事長及多位執行理事相約商討隔日執理會議相關議題。10 月 20 日一早先於下榻旅館辦理報到手續後，赴 Royal Park Hotel 出席 WiN Global 執行理事會議與理事會議。10 月 21~22 日兩天參加於 Cockle Bay Warf 之 Dockside 會議中心舉行的 WiN Gloabl 包含各項報告研討等議程的年會活動，10 月 23 日參訪大會安排的澳洲國家核能科學技術組織(ANSTO)及核能相關設施。上述活動重點表列如下：

日期	活動重點
10/18 (六)~ 10/19 (日)	去程：台北→澳洲布里斯班→雪梨；下榻 Four Points by Sheraton 晚間與理事長/執行理事進行會前協商
10/20 (一)	報到，於 Royal Park Hotel 出席 WiN Global 執行理事會議與理事會議
10/21 (二)	參加 WiN Global 年會：開幕、頒獎、專題演講、各分會報告

10/22 (三)	參加 WiN Global 年會：技術專題研討、會員大會、閉幕、晚宴
10/23 (四)	參訪 ANSTO 之新反應爐 OPAL、同位素製藥設備、舊反應爐 HIFAR、加速器中心及訪客中心
10/24 (五) ~ 10/25 (六)	返程：澳洲雪梨→布里斯班→台北

三、我國代表團名單

我國由原能會邱絹琇主任工程師(WiN Global 執行理事)等三人代表與會，名單如下：

姓 名	服 務 單 位 / 職 稱
邱絹琇	行政院原子能委員會綜合計畫處/主任工程師(WiN Global執行理事)
陳怡如	台電公司核能技術處企劃組/組長(WiN Global理事)
林庭安	財團法人核能資訊中心/管理師(WiN Global會員)

四、WiN Global 介紹及我國參與狀況

(一) WiN Global 簡介

全球核能婦女會 (Women in Nuclear Global,簡稱 WiN Global,網址 http://www.win-global.org/)於 1992 年 11 月在瑞士蘇黎士成立，旨在聯合全球核能、輻射防護、核醫等相關專業領域之婦女，互相交流，並與民眾溝通，進而促進大眾對原子能民生應用的了解和支持。WiN Global 成立迄今已 22 年，現有會員多達近 4700 人，遍及 105 個國家，已成立加上規劃中的分會組織(WiN Chapters)合計將近 40 個，若將各個分會的成員加總起來，有超過 25,000 名會員，已發展成非常典型的大型國際網絡。

WiN Global 之組織包括理事長/副理事長、執行理事會、理事會與會員大會。理事長由各分會推薦候選人，經執行理事會和理事會投票選出，最後由會員大會認定，任期 2 年，連選得連任一次。副理事長由理事長任命，經相同程序認定。WiN Global 設 8-15 名之執行理事，與理事長、副理事長組成執行理事會，是推動各項會務的核心。執行

理事任期 2 年，可連任三屆共 6 年。理事會為 WiN Global 決策單位，由每個分會派一位代表，再加執行理事及卸任理事長組成，沒有分會的國家或地區可推派一名會員代表為聯絡人，列席理事會議；每一分會除一席理事外，必要時亦可另派聯絡人，列席理事會議。執行理事會所擬訂的議案，均提交理事會表決後推動執行。WiN Global 每年舉行會員大會，理事長在會中報告會務，並將人事如理事長、副理事長、執行理事等交付會員大會認定。

歷任理事長為：瑞士籍 Irene Aegerter (1992-1996)、瑞典籍 Agneta Rising (1996-2000)、法籍 Annick Carnino (2000-2004)、日本籍小川順子(Junko Ogawa; 2004-2008)、美籍 Cheryl Boggess (2008-2012)；現任理事長為韓籍朴世文(Se-Moon Park; 2012-2016)。WiN Global 與世界核能協會(WNA)簽有合作協議，WNA 願意支援整理會員名冊、每季出版 WiNFO、更新網站、做會議紀錄。自 2012 年朴世文接任理事長後，大部分工作已由韓國分會接手。

(二) WiN Global 年會

WiN Global 每年召開會員大會一次，原則上由歐洲、美洲、亞洲/非洲輪流主辦，年會中除由各分會代表報告自己國家或地區的核能現況及活動外，也是執行理事與理事面對面溝通的機會。此外主辦單位也提供技術交流平台，以增加出席率，會中安排兩天技術報告，以及壁報論文發表。專題報告係就核能安全、核能科技的發展、放射性廢棄物管理、核醫應用、輻射防護、核能教育及兩性平權等議題進行經驗交流，使會員們對全球的原子能民生科技之現況有概括了解，並互相學習溝通的經驗。今年 WiN Global 年會由 WiN Australia 主辦；歷年年會之主辦情形彙整如下表：

屆數	年度/月份	會議地點	辦理情形
21	2013/10	南非/約翰尼斯堡	與會者來自27個國家，共約150人參加，我國由鍾玉娟(會長)、邱絹琇、陳怡如與會，會後參訪南非NECSA核能設施。
20	2012/5-6	瑞典/卡爾瑪	與會者來自35個國家，共約200人參加，我國組4人代表團與會，會後參訪芬蘭Olkiluoto核能設施。
19	2011/6	保加利亞/瓦爾納	與會者來自23 個國家，約150人參加，我國組5人代表團與會。會後參訪Kozloduy 核能電廠，以了解保加利亞核電發展與安全管制現況。

屆數	年度/月份	會議地點	辦理情形
18	2010/5	南韓/釜山	約有300人參加，會前參訪斗山重工、會後參訪古里/新古里核電廠。我國組9人代表團與會。適逢WiN Japan成立10週年，多國代表會後受邀轉往日本青森參加慶祝行程，我國由邱絹琇代表。
17	2009/7	美國/華府	約有600人參加，會後參訪TMI/Calvert Cliffs核電廠、會前參訪 NRC、並安排與國會議員溝通。我國組6人代表團與會。
16	2008/5	法國/馬賽	約有300人參加，會前參訪 Marcule園區、會後參訪 Cadarache園區。我國組6人代表團與會。
15	2007/4	印尼/巴里島	本由中國主辦，後因台灣名稱問題，改由印尼主 辦。約有150人參加，會前參訪 Bandung 研究用反應爐、Yogyakarta, Kartini研究用反應爐。我國組10人代表團與會。會後參觀巴里島(WiN Taiwan 代表團未參加)。
14	2006/5-6	加拿大/Waterloo	約有500人參加，會前參訪Pickering 核電廠，會後參訪Bruce核電廠，我國4人與會。
13	2005/4	捷克/Cesky K.	我國賴惠京(會長)、陳文芳、謝瀛春與會
12	2004/5	日本/東京	約有300人參加，會後參訪柏琦刈羽核電廠。我國組16人代表團盛大與會。
11	2003/6	美國/拉斯維加	約有600人參加,與WIN US會員大會一併舉行,會後參訪亞卡山、WIPP，我國4人與會。
10	2002/6	法國/巴黎	邱絹琇(全球執行理事)、賴淑瑛(副會長)與會
9	2001/5	南韓/首爾	約有95人參加，會後參訪靈光核電廠、KAERI, NETEC，我國組6人代表團與會。
8	2000/6	芬蘭/赫爾辛基	我國黃祝卿、蘇碩懿與會
7	1999/5	美國/華府	約有600人參加,與 WIN US 成立大會一併舉行, 會後參訪 Calvert Cliffs 核電廠。我國陳文芳(會長)、陳怡如、杜美鈴與會。
6	1998/4	台灣/台北	約有60人參加，會後參訪I核研所
5	1997	西班牙/瓦倫西亞	我國王小佗會長單獨與會
4	1996	俄羅斯/聖彼得堡	我國賴惠京、杜美鈴與會
3	1995/6	瑞典/戈登堡	約有60人參加，會後參訪Ringhal核電廠及Forsmark低放處置場SFR，我國邱絹琇、陳怡如、陳淑貞與會。
2	1994/5	德國/波昂	我國邱絹琇(會長)、陳蜀瓊(副會長)與會
1	1993/7	法國/巴黎	我國邱絹琇、高莉芳與會

(三) 我國參與的狀況

我國分會 WiN Taiwan 創會會長邱絹琇於 1995 年起擔任 WiN Global 理事，1998 年升任執行理事，至 2004 年三期任滿後回任理事，由 WiN Taiwan 第二屆會長陳怡如接任執行理事(2004-2010)，積極參與會務的規劃及執行，2010 年陳怡如任期屆滿，執行理事改選，邱絹琇再度當選(2010-2016)，陳怡如改任理事。此外，並指派每屆的 WiN Taiwan 會長為 WiN Global 理事會的分會聯絡人，擴大國際參與。

我國於 WiN Global 創會之初，1993 年夏即派員赴巴黎出席第一屆年會，旋於次年初在國內成立分會-WiN Taipei, R.O.C. (2003 年更名為 WiN Taiwan)。於 1998 年主辦第六屆年會，是 WiN Global 首次在歐洲以外的國家召開年會，有來自 11 個國家 60 位代表參加；WiN Global 在簡訊 WiNFO 中稱此舉為「從西方到東方」，引發歐美會員對亞洲地區核能發展有嶄新的認識，並邁開 WiN 組織活動全球化的腳步。自首屆起，我國核能界婦女出席年會從未間斷，除增進各國對台灣之認識進而互相交流、擴展外交外，對少有出國參加國際會議的代表提供了一個增廣見聞的難得機會，也激勵大家對推廣核能發展與應用、增進核能安全與輻射防護、加強公眾教育與風險溝通、促進女性進入科技職場並取得工作與生活平衡等的使命感，進而建立更清晰的願景。

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SYDNEY 2014
OCTOBER 20 - 25

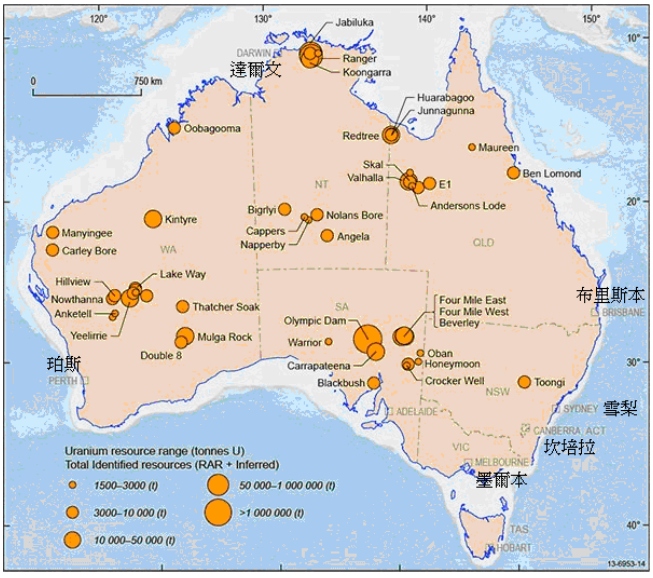
貳、過程

一、主辦單位 WiN Australia 及澳洲簡介

WiN Australia 於 2003 年成立，目前會員有 135 人。本次年會由會長 Jasmin Craufurd- Hill 率會員籌備，除了澳洲國家核能科學技術組織(ANSTO)之外、並沒有國內其他組織機構的贊助或支持，能夠辦理 150 人左右的國際會議，實在相當不易。本次會議在雪梨 Darling 港邊 Cockle Bay Wharf 的舉行，會場、坐船、海生館、動物園、大會安排的旅館等都在這港區附近步行的距離內。

澳洲是大洋洲中最大國，是大英國協的會員，2012 年之 GDP 為 69,000 美元(台灣的 3 倍)。澳洲人被稱為是坐在礦床上的人，澳洲是全球最大之煙煤、鋁礬土、鉛、鑽石、鋅礦出口國；第 2 大之氧化鋁、鐵礦石、鈾礦出口國；第 3 大之鋁及黃金出口國。此外，澳洲原油及天然氣等能源產品蘊藏亦豐，石油產量居全球第 26 位，天然氣產量現居第 4 位。澳洲 2012 年出口前 5 項大部分為能礦產品：鐵礦(547 億澳元)、煤礦(412 億澳元)、黃金(155 億澳元)、天然氣(134 億澳元)、原油(109 億澳元)，總額達 1,359 澳元，足見其重要性。

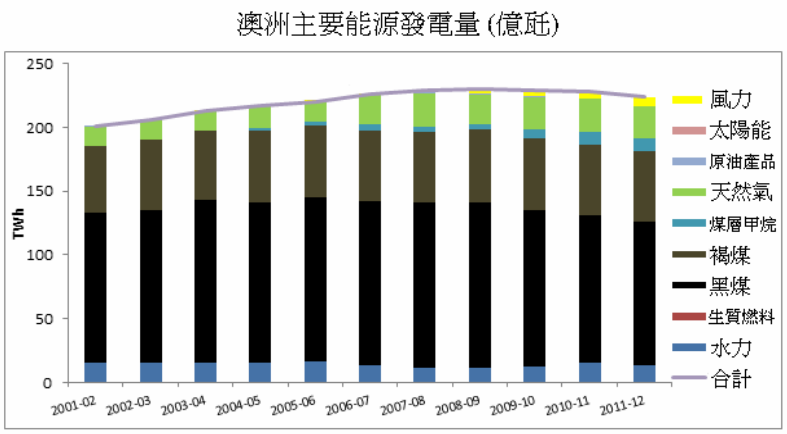
澳洲民眾普遍反核，澳洲反核已有近 60 年的歷史，因為英國於 1956 年 9 月底開始，持續長達 13 個月在澳洲中南部馬拉林加（Maralinga）等數個地方進行了多次的核子試爆，在澳洲人民心中留下了陰影。雖然澳洲沒有核能電廠，澳洲是全球第 3 大鈾礦出口國，僅次於哈薩克與加拿大，和十幾個國家簽訂售鈾合約，美國、中國、日本與歐盟為澳洲鈾礦的主要採購國，台灣則含在美國的合約之內。



澳洲主要靠火力發電，占比超過 75%，2013 年 CO2 人均排放量為 17.43 噸 CO2/人，比 OECD 國家平均 9.95 噸 CO2/人高出甚多，在各國越來越關注全球溫升議題之時，澳洲也覺得必須減排，於 2007 年簽署《京都議定書》，並考慮推動核能

發電及核燃料循環工業，但首先要面對的是解決反核的態度。在本次會議中亦分享核能溝通的心得。

註：以上資料參考澳洲能源供應協會與維基百科



▲ 澳洲鈾礦分布情形（單位：噸）

二、第 22 屆 WiN Global 年會會務及大會活動

今年(2014)第 22 屆 WiN Global 年會由澳大利亞分會 WiN Australia 主辦，於 10 月 20 至 24 日以澳大利亞雪梨喜來登經營之福朋酒店(Four Points by Sheraton Hotel)為中心進行年會相關活動，年會期間之主要 (10 月 21 至 22 日) 會場則設於鄰近之 Cockle Bay Wharf 的 Dockside(碼頭邊)會議中心；議程如附錄一，大會邀請函如附錄二。此次年會有來自 38 個國家，約 150 人參加，其中澳大利亞本國人佔多半，並有 20 位來自開發中國家的代表，由 IAEA 補助機票與膳宿費用。除本地人外，韓國代表團 12 人規模最大，保加利亞其次，有 8 人，中國大陸 6 人，UAE 與日本為 4 人，我國則有 3 人代表出席。雪梨是澳洲最大城市，且該年會唯一贊助單位 ANSTO 距離雪梨僅 1 小時車程，便於本國與會者與貴賓出席以及會議的支援工作。

(一) 執行理事會議與理事會議 (10 月 20 日全天)

WiN Global 有 15 位執行理事，執行理事會是運作本組織的核心，所有計畫、業務均由執行理事會規劃討論出來後，交付理事會議討論表決後執行。理事會之成員有三種：(1)由每一個國家或區域性分會(WiN Chapter)推派一名理事，(2)執行理事，(3)卸任會長；目前共計 46 名。理事會是決策中心，所有的議題均交付理事會討論表決後推動執行。本屆執行理事名單及該會議出席情況如下表 (Y—出席；N—請假 ；＃—代理)：

韓國 Y	Se Moon Park/理事長	法國 ＃	Dominique Mouillot/副理事長 (授權 Irene Aegerter 代理)
澳洲 Y	Jasmin Craufurd Hill	巴西 N	Nelida del Maestro
加拿大 N	Colleen Sidford	法國 ＃	Anne Marie Birac (授權 Eva Gyane 代理)
匈牙利＃	LudmillaKiss-Zoltanne (授權 Irene Aegerter 代理)	IAEA Y	Eva Gyane
日本 Y	Keiko Chitose	南非 Y	Ntebatse Matube
西班牙 N	Maribel Gomez Bernal	瑞士 Y	Irene Aegerter
瑞典 Y	Olga Ernandes	台灣 Y	Jessie Chiu 邱絹琇
美國 ＃	Cheryl Boggess (由 Kelly Semanco 代表出席)	秘書 Y (WNA)	Gabrielle Flannery

執行理事會議於 10 月 21 日上午 9:00-11:00 舉行，由理事長 Se-Moon Park 主持，WiN Taiwan 代表僅邱絹琇出席。會中理事長報告會務及主持多項議題討論，執理會議議程與理事會議議程相同，討論內容請參考下節。其中邱執理代表選舉委員會報告理事長與副理事長連任以及 5 位新任執行理事選舉結果，並表示理事的網路參與及投票率仍待提升。此外，國旗與會籍名稱議題的處理亦獲共識，即 WiN 為非政治組織，網站與文宣資料將不放國旗，亦將避免使用 country 字眼，均以 chapter 稱之，如分會報告為 chapter report。

接著於上午 11:00 起舉行理事會議，仍由理事長 Se-Moon Park 擔任主席，與會者除上

述執行理事外，並增加澳洲、保加利亞、中國、捷克、日本、韓國、馬來西亞、巴基斯坦、斯洛伐克、南非、瑞士、台灣(陳怡如)、土耳其、阿聯、英國、美國等分會之理事；及多名各國代表或分會聯絡人列席。會議至下午 3:00 結束。報告、討論與決議綜簡如下：

1. WiN Chapters 已增加至 33 個，會員 4675 人，來自 105 個國家/分會。最新成立的分會是 WiN Poland。南非刻正主導非洲成立 WiN Africa，目前有 Kenya, Nigeria, Tunisia 想成立分會，請南非給予協助。

2. 請各個分會隨時主動將分會的相關新聞與活動通知或報導上載至網站上供大家參閱，若有新會員申請，請各分會儘速批准 (按：WiN Taiwan 原由陳怡如與鍾玉娟維護分會會員的個資，將配合會長改選作調整)。

3. 由邱絹琇執理報告今年兩項選舉結果：Park 續任理事長、Mouillot 續任副理事長，任期 2014-2016；5 位執行理事任期屆滿：巴西 Nelida del Maestro、日本 Keiko Chitose、南非 Ntebatse Matube、瑞士 Irene Aegerter 與美國 Cheryl Boggess。新任執理當選人為巴西 Margarida Hamada、日本 Yoko Kobayashi、南非 Margaret Mhkosi、英國 Melissa Denecke 與美國 Marilyn Kay。2016 年將有 3 位執理屆滿。

4. 執行理事須積極委身本組織，如果執行理事既不出席、又不回應 e-mail，應該有退場機制。決議執理於每兩年任期中至少須出席一次實體會議。

5. 本屆 WiN Award 獲獎人為澳洲物理學家 Margaret Elcombe，WiN Honorary Award 獲獎人為即將由 IAEA 退休的前 WiN Global 執行理事 Gabriele Voigt。

6. 明(2015)年年會預定於 8 月 24-28 日以 Women in Nulcear Meet Atoms for Peace 為主題假奧地利維也納國際原子能總署(IAEA)總部舉行 (按：詳參 IAEA 網站 http://www-pub.iaea.org/iaeameetings/46531/23rd-WiN-Global-Annual-Conference-Women-in-Nuclear-Meet-Atoms-for-Peace)。

7. 2016 年年會將由阿聯大公國(UAE)主辦，原規劃於 2 月初在首都阿布達比舉行，惟考量與前一年年會時間(8 月底)間隔及當地氣候，可能延至 11 月舉行。

8. WiN Global 多年來一直與歐洲核能學會(ENS)合作，於每年年初在歐洲舉行之 PIME 會議中召開 WiN Global 執行理事與理事會議並為 PIME 舉辦一場核能溝通工作坊(workshop)。2015 年 PIME 於 3 月 1-4 日在斯洛伐克首府 Bratislava 舉行。

由於報名費昂貴又有 WiN Session 場地費的問題，尚須與 ENS 再商洽(按：已談妥定案，WiN 理事會議訂於 3 月 2 日召開)。

9. WiN Global 每年舉行兩次實體(face-to-face)的理事會議/執理會議，一次在年會開始的前一天，另一次不一定要在 PIME 中舉行，各分會若有意願亦可主辦。WiN UK 表示若理事會議與 WNA 年會同步或在英國倫敦舉行則可協辦。理事長亦詢問大家未來去濟州島出席理事會議的可能性。

10. 在 WNA 會議中為 WiN Global 擺攤：該活動已進行多年，主要是提供 WiN Global 宣傳的機會(按: 台灣分會亦曾於 2010 年支援 WiN Global 在 WNA 香港國際研討會中所擺的攤位)，由 WNA 提供攤位， 將視需要決定是否持續該活動。

11. 2017 年之年會應輪由美洲主辦，若巴西、美、加年底前未提出主辦計畫，中國表示願意接辦，並已提出初步構想的口頭報告。

12. 重新成立 Strategic Planning 小組來規劃 WiN Global 之未來方向，由 Irene Aegerter 領導，另有 Flannery, Giane, Semanco，Voigt 等成員；歡迎更多理事加入。

13. 其它: 表決 WiN Global 褶頁文宣之色調；鼓勵年輕人參與 WiN Global 活動。

(二) 開幕式與頒獎儀式 (10月21日上午)

10 月 21 日上午舉行開幕式，由 WiN Global 理事長 Se-Moon Park (朴世文女士)及澳洲分會(WiN Australia)會長 Jasmin Craufurd-Hill 致歡迎詞，並由主要贊助單位 ANSTO 執行長 Adi Paterson 致詞。Paterson 曾負責南非 PBMR(球床模組式反應器)計畫的開發與營運，2009 年由 ANSTO 所網羅擔任執行長，並獲選為澳洲科技工程學院院士 (Fellow of the Australian Academy of Technological Sciences and Engineering)。他說核能的發展迄今超過百年，人類所開發的各式反應爐、加速器提供了電力等產品，對人類有很大貢獻。許多國家在研發核融合，希望找到永續的能源。現在再生能源很熱門，也都是想找到永續的能源，他相信核能在全球人類的生活中仍扮演重要角色。女性在核能發展中作出相當大的貢獻，居禮夫人就是一個先例，但他特別推崇加拿大第一位女性核

子物理學家、諾貝爾化學獎得主拉塞福指導的第一位研究生 Harriet Brooks，她以發現放射性原子反作用力著名，可惜 31 歲即依當時大學規定因結婚被迫退出職場，然其學術成就在當時女性中僅次於居理夫人。Paterson 並以其母為單親醫師的自身體驗為例，印證在以男性為主的舊時代中，女科技人在職場奮鬥的辛苦，並闡述 ANSTO 支持女性員工的理念與推動性別主流化的成果。

隨後進行 WiN Global 兩個獎項的頒獎儀式，由 Paterson 與 Park 共同頒發。WiN Global 於 1996 年設立**全球核能婦女會獎 (WiN Award)**，由會員提名，經執行理事會議、理事會議審核 定案，每年選出一名（或一小組）在致力民眾對核能或輻射應用之溝通、教學、指導等有重要貢獻者，於年會時頒贈獎狀。此獎項雖為獎勵女性而設，但得獎人不限女性。今年共有 5 位傑出女性被提名，由服務於 ANSTO 達 41 年的 Margaret Elcombe 博士以絕對優勢勝出，她在物理及中子照射方面學有專精、是澳洲女性從事核反應爐工作之先驅。雖然她是核能科技專家、卻非常擅於與人溝通。在領導方面 Margaret 在中子散布儀器(neutron scattering instrument)之設計、開發、興建方面為世界級領導人。2012 年 WiN Global 為表揚對組織有重要貢獻的會員，著手設立**全球核能婦女會榮譽獎 (WiN Honorary Award)**，於 2013 年首度頒發該獎項。今年為第二屆，有兩位被提名，得獎人為即將由 IAEA 退休的 Gabriele (Gabi) Voigt 博士。她是輻射防護的專家，曾調查車諾堡事故後的輻射情形，以及哈薩克 Semipalatinsk 試爆場的輻射與生態影響。Gabi 在 IAEA 擔任過 Seibersdorf Laboratories 所長、及核子保防分析業務處長等職，曾獲得 IAEA 及美國放射化學學會的獎項。她擔任許多核能後進的導師(mentor)，尤其樂意幫助女性勝任職場工作。Gabi 此次不克前來受獎，由同事 WiN IAEA 會長 Eva Giane 代表領獎。

開幕的壓軸節目，是 ANSTO 副董事長 Erica Smyth 的主題演講—Australia’s Place in the Nuclear World。Erica 為地質學家，也是現任 Toro Energy(鈾礦開發公司)董事長，並擔任 Emeco(採礦機械公司)董事。她首先介紹澳洲的鈾礦，澳洲鈾礦產量占全球第三名，僅次於哈撒克(占 1/3)與加拿大，較具生產規模的礦區有 3 個。澳洲有 OPAL 反應爐、同步輻射(synchrotron)、加

速器(Accelerator)等核能設施；所生產的同位素藥物名聞全球，其中以使用 LEU 之 OPAL 所生產的鉬 99(M-99)將在全球市場扮演越來越重要的角色，輻射應用在醫療及診斷方面也與其他先進國家並駕齊驅。核能對澳洲人的生活有相當大的貢獻。


與理事長、澳分會會長及中國代表合影

(三) 各國分會報告 (10月22日下午)

WiN Global 目前有 33 個分會組織(WiN Chapters)，由於連續兩年在南半球 (去年在南非) 舉辦年會，不少分會，如加拿大、芬蘭、法國、德國、匈牙利、西班牙等今年未能出席年會。第一次組團參加的中國分會並未提出分會報告，其他如斯洛伐克等則是有會員出席年會但未受命代表分會報告。此次共計 17 個分會提出報告，大致依照分會名稱之英文字母順序，各國報告核能發電概況及該分會的業務與活動。台灣分會由新會員林庭安代表報告，簡報內容如附錄三。各分會簡報摘述如下：

1. WiN Australia (由 Joanne Lackenby 簡報)：有 150 位會員。澳洲有 1 部研究用反應爐、2 部老舊的反應爐、1 座 synchrotron。活動可參閱 www.winaustralia.org。年度最主要活動為籌備今年的 WiN Global 年會。

2. WiN Bulgaria (由 Radka Ivanova 簡報)：有 163 位會員。保加利亞 Kozloduy 電廠原有 6 部機組，4 部待除役中， 2 部運轉中。多年來擬於新電廠 Belene 建造 2 部機組的計畫已確定取消，將改於 Kozloduy 增建 1 部機組。

3. WiN Czech (由 Larisa Dubska 簡報)：有 60 位會員。捷克之電力 35%來自核能；68%民眾支持核能。


林庭安(前左一)與理事長(立左四)及各分會報告人合影

4. WiN Europe (由 Irene Aegerter 簡報)：2012 成立，有 12 個 WiN 分會加上 WiN IAEA，WiN Poland 與 WiN UK 為新成員。舉辦多項國際與區域性活動以協助年輕女性進入核能相關行業；致力於加強與歐洲核能學會與(ENS)的合作。

5. WiN Germany (由 Irene Aegerter 代表簡報)：2008 年成立、有 224 位會員。德國的核電機組中，目前有 9 部運轉中、8 部停運中、14 部除役中，另有一鈾濃縮機構 Urenco。政府主張廢核，全國三分之二民眾反核。

6. WiN IAEA (由 Eva Gyane 簡報)：有 100 位會員。辦理年輕人相關活動，如女兒日等，以鼓勵年輕女性加入核能科技職場。籌備 WiN Global 2015 年年會，支助開發中國家核能女性出席 WiN Global 年會。

7. WiN Japan (由 Reiko Nunome 簡報)：有 250 位會員。日本有 50 部機，多部機組申請再起動。目前反核聲浪蔓延全國，WiN Japan 仍持續辦理很多溝通活動。

8. WiN Korea (由 Jae-Seon Lee 簡報)：有 463 位會員。韓國有 23 部運轉中核能機組，佔全國發電量 29%。另有 1 部進行試運轉，4 部施工中， 4 部規劃中。低放核廢料處置場已近完工。積極進軍海外市場。

9. WiN Malaysia (由 Zarina Masood 簡報)：馬來西亞尚無明確的新建核電廠計劃，本次係由 IAEA 贊助參加。

10. WiN Pakistan (由 Khalida Gill 簡報)：有 80 位會員。巴基斯坦今年共有 3 人與會，其中 2 人由 IAEA 贊助。除運轉中的恰希瑪核電廠之外，將興建新機組。

11. WiNSA (由 Margaret Mkhosi 簡報)：有會員 250 人。就 2013 年主辦 WiN Global 年會做綜合回顧，刻正規劃成立 WiN Africa。

12. WiN Sweden (由 Olga Ernandes 簡報)：1993 成立，有 403 位會員。瑞典有 10 部運轉中機組，2 部關閉。SFR 為低放射性廢棄物處置場，SFL 為長衰變期放射廢棄物處置場，Forsmark 正興建高放處置場。新政府再度提出廢核，希望以水力和再生能源提供全部電力。

13. WiN Switzerland (由 Helena Loner 簡報)：1995 成立，有 52 位會員。瑞士有 5 部運轉中機組，政府預計在 2035 年廢核，WiN Switzerland 向政府提出建言書。

14. WiN Taiwan (由林庭安 Kelly Lin 簡報)：我國之報告詳參附錄三。

15. UAE (由 Sezin Uzman 簡報)：刻正興建 4 部 APR-1400 機組，由韓電承建。85%民眾支持核電。

16. WiN UK (由 Miranda Kirschel 簡報)：有 430 個會員。英國核能工業在多年的沈默之後，近年有新的氣象。目前有 6 部 AGR、1 部 PWR 機組運轉中、14 部機組除役中/已除役，另將興建 5 部新機組。

17. US WiN (由 Kelly Semanco 簡報)：1999 年成立，有近 6500 個會員。美國由於經濟因素 2013 年有 4 部機停機、2014 年有 1 部機停止運轉，核能最大的挑戰是要比燃氣廠經濟。有 100 部運轉中機組、5 部施工中、14 部除役中；Watts Bar-2 將於 2015 年商轉、Vogtle-3 及 Summer-2 預計 2017 年商轉。低放射性廢棄物處置場 4 座，高放處置場在亞卡山計畫目前恢復審查作業。63%民眾支持核電。USWiN 每年舉辦一次全國性會員大會暨研討會，各分支組織有各自的活動，組織龐大、會員眾多。

(四) 會員大會與閉幕式(10月22日下午)

通常會員大會安排在第一天上午，今年是安排在閉幕之前。WiN Global 理事長作會務報告，今年的理事長/副理事長/執行理事選舉結果，在會員大會中通過。WiN chapter 今年增加至 33 個、會員增加至 4675 人，來自 105 個國家/chapters。今年 IAEA 支助 20 位參加，故約有 150 位來自 38 個國家/chapters 與會。會長請每個國家/chapters 起立接受鼓掌，其中以韓國 12 人為最大代表團，保加利亞 8 人團其次，中國馬璐女士所率 6 人代表團，也是陣容不小。至於 Park 理事長的會務報告內容，可參考本報告第 8~9 頁。理事長特別鼓勵大家踴躍投稿 WiN Global 的電子季報 WiNFO。

今年有 33 篇論文海報，經過評審之後選出 3 位得獎者，由今年 WiN Award 得獎人. Margaret Elcombe 頒獎後合影。

年會交棒：由澳洲分會會長(右二)等將會旗移交 IAEA 分會會長(左一)

理事長 Park 偕同大會主席向所有參與籌辦的單位與同仁致謝，並進行交棒儀式，將會旗由本次年會主辦國 WiN Australia 代表轉交明年年會接辦的 IAEA 分會會長 Eva Giana，象徵 WiN Global 年會的傳承。Eva 邀請大家踴躍出席2015年8月下旬於維也納舉行的第 23 屆年會，年會在大家熱烈掌聲中告一段落。

三、核能專題演講暨技術議題研討

主辦單位於年會第一天安排了三個場次的核能專題演講(Plenary Presentations)，每個場次各三位主講人，共有 9 場演講；第二天則將會場隔成兩間，同步進行技術議題研討(Concurrent Technical Sessions)，分 5 個議題，共 18 篇報告。除這些口頭報告外，亦有 33 篇論文壁報的發表。相關資料可參閱附錄四(會議手冊)。各場次專題演講與議題研討之內容重點擇要摘述如下。

(一) 核能專題演講 Plenary Presentations (10 月 21 日上午/下午) (擇要摘錄)

場次 I　Broader Considerations of Nuclear Technologies (10/21上午)

1. China's Nuclear Power Development; by Dr Lu Ma (馬璐), State Nuclear Power Technology Corporation (中國國家核電技術公司)

中國有 21 部運轉中核電機組，28 部施工中。國家核電技術公司(SNPTC) 成立於 2007 年，目的是做美國西屋 AP1000 機組的技術轉移，並將該機組擴大為本土 CAP1400。所技轉的四部機組中，第一部本土化程度為 55%，到第四部已提升到 70%。該公司有 1 萬名員工、其中 24%是女性，有 2%是高階主管。公司的口號是 C(confident) 、A(active) 、P(professional) ，呼應所設計的 CAP1400。中國核電發展的目標為 216 部機，一半以上的設備國產化，因此將來還要陸續建 160 多部機。馬璐接著播放以 Nuclear Women in SNPTC 為題的英文簡介影片，片中提到自 2002 年起中國已開始有核電廠女運轉員。

2. Australian Safeguards and Non-Proliferation Office; by Dr Jodie Evans, Australian Safeguards and Non-Proliferation Office (Australia)

Evans 介紹澳洲在核子保防方面的組織和任務，為了核子禁衍所負責的保防工作由此機構執行。世界上與澳洲進行核燃料/物料(包括鈾燃料買賣)相關合作的國家計24個，均簽有保防合約，其中與美國的合約涵蓋台灣。

3. The Security Dimension of Nuclear Technology; by Dr Jenny Nielsen, University of Queensland (Australia)

IAEA自1957年成立以來即推動核子禁衍，1968年提出NTP協定給發展核能的國家簽

署，1970年生效。澳洲是鈾礦生產國，對於鈾的料帳必須有清楚的交待，須遵守的規定有Nuclear Suppliers Group (NSG) Guidelines(1974) 、International Nuclear Fuel Cycle Evaluation (INFCE)、Comprehensive Test Ban Treaty (CTBT, 1996)、Fissile Material Cut-off Treaty (FMCT, 2002) 等。每兩年舉行一次的核能保安高階會議今年在海牙舉行，討論核能保安事宜，澳洲每年都會參加；在保安方面確保核子物料之安全、免受恐怖攻擊或惡意入侵。

場次 II　New developments in Nuclear & Radiation (10/21下午)

1. OPAL Multipurpose Reactor Past, Present and Future; by David Vittorio, Australian Nuclear Science and Technology Organization (Australia)
   ANSTO於2002年4月奉准興建OPAL，2006年11月起全功率運轉，2007年4月開始生產出售同位素產品。依規定運轉5年要停機大修並更新安全分析評估(SAR)。除了同位素生產之外，中子用在醫療與診斷、科研、工業上，如半導體的silicon NDT。OPAL是ANSTO的金雞母，可用率為98%。下次停機大修排在2018年。

2. ANSTO Nuclear Medicine; by Sarah Ballantyne, ANSTO Nuclear Medicine (Australia)
   OPAL是20MW的開池式輕水爐，從2006年運轉迄今8年，已經生產很多同位素藥物，其中最值得一提的是Mo-99，它是診斷心臟病、神經失調之藥物，以南非的SAFARI產量最大、其次就是ANSTO。澳洲在全球同位素藥物方面扮演重要角色。

3. Peptide Receptor Radionuclide Therapy (PRRT) Using 177Lu Octreotate; by Dr Elizabeth Bailey, Royal North Shore Hospital (Australia)
   介紹PRRT治療法，並說明使用鎦177、鎵68作為肝、脾之治療。

場次 III　Engaging with the Public, Government & Media on Nuclear (10/21下午)

1. Nuclear Communication Complexity: Peeling the Layers; by Nadia Levin, Australian Nuclear Science and Technology Organization (Australia)
   該計畫從隨機訪問路人開始，結果幾乎沒人知道ANSTO為何，經調查得知民眾對核能懼怕的原因，主要是認為核廢料很危險(70.2%)、擔心輻射對健康有害(52.8%)；至於認同核能對國家經濟則有貢獻(38.2%)、可提供可靠的電力(39.2%)、對環境有益(36.4%)。由此可知人們對並核能與輻射應用所知有限，必須加強溝通。

2. Energy for Humanity: Clean, Sustainable, Affordable Energy; by Dr Irene Aegerter, Cogito Foundation (Switzerland)

Aegerter介紹其子由最近推出的核能影片「潘朵拉的承諾」獲得靈感，在英國成立Energy for Humanity組織，推動使用清潔、永續、可負荷的能源。

3. How Can Community Support for the Nuclear Option be Achieved? by Ben Heard, Think Climate (Australia)

講者認為用「核能是必要之惡」等便宜行事的方法溝通，很難獲得民眾支持核能；必須使用正確的溝通方法，舉例如下：

- 必須讓人對核能有信心：雖然核能科技深奧複雜，仍須想辦法讓人了解。
- 資訊充足：對於壞消息必須儘速澄清，否則會發酵。了解才會支持。
- 給予正面的願景：提出核能美好的願景給民眾，人們才會有支持的熱忱。

(二) 技術專題研討 Technical Concurrent Session (10 月 22 日上午)

議題 I　Nuclear Design, Operations, Engineering and Maintenance (核電廠設計運轉維護)

1. Decommissioning Strategy of KHNP and Current Preparation; by Heeran Jeong

研究計畫的第一步乃了解美國(15部)、日本(1部)、德國(3部) 已完成除役的機組及其除役工作與費用。根據渠所收集之資料，美國之除役費用每部機組約US$734百萬元、估計韓國之除役費用為每部機組US$568百萬元。KHNP旗下最老的機組是古里1號機，雖然尚未屆齡，仍須及早著手擬定除役計畫。

2. OPAL I&C Systems; by Dr. Sam Harris

OPAL有兩個反應爐保護系統，此外尚有post accident monitoring system及reactor control and monitoring system，依據美國核管會(NRC)的NUREG 1431辦理。(註：在SNPTC擔任AP1000儀控設計的楊教授問了問題後，馬璐女士要求插播CAP1400之介紹影片，主要是介紹模組化之施工。)

3. Advanced Design Features and Passive Reactor Core Cooling Systems in NPP; by Duaa Aljilani, Jordan

約旦沒有核電廠，但有興趣啟動核電計畫。IAEA為核電廠安全訂有安全標準，約旦

在IAEA的輔導下，將會遵照有關規定辦理。福島事故後作者對反應爐的爐心冷卻系統特別關注，探討在失去交流電源時，非能動爐心冷卻系統將如何運作。

議題 II　Community Engagement, Education and Communication (核能教育與溝通)

1. Enhancing Human Resource Development for Nuclear Power Programme in Malaysia through PUSPATI TRIGA Reactor; by Dr. Zarina Masood

   馬來西亞雖然還沒有決定是否引進核能發電，藉著PUSPATI TRIGA反應爐的運轉，先了解發展核電需要那些人才。Reactor TRIGA PUSPATI (RTP) 是馬來西亞唯一的核反應爐，於1982年開始運行，其主要功能在於科研、製造同位素及訓練。

2. Dismantling the Public Distrust on Nuclear Power via Social Network Games; by Ms. Hyo Jeong Kim

   現在是網路時代，訊息傳播是一種分散式傳播，人人可以發送訊息，因此訊息傳播變成沒有時空限制。此外民眾看新聞也要看即時新聞，由於看不懂輻射的單位，且因為對核能不了解而產生恐懼；所以如果把核電廠用模擬(simulation)的方式做成遊戲(game)給大家玩，且用social network games的方式，大家玩熟了就會更了解核能發電，就像人們玩megapolis這類的遊戲而對大都會更加了解。

3. Developing a Nuclear Engineering Program at UNSW; by Prof John Fletcher

   Fletcher介紹澳洲新南威爾斯大學(UNSW)召募核工研究所學生及博士後研究生非常有彈性且條件優厚，並與倫敦Imperial College核工中心、ANSTO均有合作，可以把學生送去研習、培養實務經驗。

議題 III　Applications of Nuclear Techniques to Science and Research (核能技術科研)

1. Chemical Deuteration at the National Deuteration Facility; by Dr Anwen Krause-Heuer

   說明 D_2O 和 H_2O 的不同，D_2 和 C 元素之結合力比和 H_2 結合力強 10 倍。比較中子射線(neutron beam) 和 x 光之不同。此方法是用中子射線把 H-R-COOH 變成 D-R-COOH。

2. Could Neutron Research Provide Solutions for Modern Industrial Challenges? By Anna Paradowska, ANSTO

   ANSTO 的中子束實驗室 Bragg Institute 利用相連的研究用反應爐 OPAL 設置了許多

世界級的中子儀器設備提供科技研發與應用。這些儀器具有獨特的非破壞能力，可用來確定物質的特性並改進對各種複雜過程的了解。相關的實驗或測量可直接在工程組件、模型或試驗品上進行，而所得結果又可直接用於優化製程、改善產品可靠度、提升設計性能、降低生產成本、延長重要工程資產的壽命預測等。為了提升工業應用減小研究與工業的落差，該實驗室最近成立了一個技轉育成中心(Industrial Liaison Office)，嘗試將基礎研究的成果轉化為成商業的應用，已獲初步成果。

3. Environmental and Effluent Monitoring at Australia's Nuclear Research Reactor Site; by Emmy Hoffmann, ANSTO

ANSTO 位於雪梨近郊 Lucas Heights，早在 1959 年第一座研究用反應爐 HIFAR 臨界後即開始進行附近範圍的環境監測。HIFAR 在運轉近半個世紀後於 2007 年功成身退，由現代化的新研究用反應爐 OPAL 於 2009 年全面商轉後取而代之。此外，ANSTO 也運用 OPAL 及迴旋加速器生產多種核醫藥物，並負責包含加速器科學中心(CAS)等國家研究設施的營運。ANSTO 的環境與排放監測計畫包括：排放水在進入下水道前的檢測、煙囪排放的連續採樣與分析、附近地表水與地下水等環境介質的採樣與分析、體外(γ)輻射監測、完整氣象資料以及緊急應變所需的大氣排放模擬系統。近年來監測結果顯示：ANSTO 場區帶給附近居民的微量輻射劑量主要是來自製造核醫藥物所產生的惰性氣體排放，而非來自 OPAL。

議題 IV　Non-Proliferation, Security and Safeguards (核子保防與保安)

1. HEU Minimisation in Australia; by Therese M. Donlevy, ANSTO

早年就有研究用反應爐的國家都有用過的高濃縮鈾(HEU)需要處理，澳洲的 HIFAR 也不例外。從 1990 年代起，澳洲即開始以兩種方式進行 HEU 的減量工作：(1)境外再處理後廢料回運，(2)將與美國簽約下用於的 HEU 依外國研究反應爐用過核燃料回運計畫(FRRSNFA)回運美國。澳洲同意反應爐改用低濃縮鈾(LEU)以符合該回運計畫的要求。目前澳洲的新研究用反應爐 OPAL 已取代 HIFAR 並使用 LEU，所以也涵蓋在美國的回運計畫下。2012 年澳洲與美國 NNSA 的全球減少威脅倡議計畫合作進行 ANSTO 所貯存的 HEU 回運作業。

2. Nuclear Forensic Science at the Australian Nuclear Science and Technology Organization (ANSTO); by Kaitlyn Toole et al

核子司法鑑定學為利用核子或放射性相關證物的科學分析協助辦案的一門學科。位於 ANSTO 的核子鑑定研究設施(NFRF)為澳洲的核子鑑識中心，ANSTO 擁有獨特

的相關能力與資源，能提供核子鑑定分析以協助相關調查作業，包括處理放射性物質的設備、提供多元分析服務、具放射化學與鑑識科學專業的人力，以及各領域專業的數據解讀。NFRF 目前業務包括：與警方合作建立處理核汙染證物的能力、各種 signatures 的調查及辨識核燃料循環前端物質來源的應用，以及開發新型的輻射精密計時器(radiochronometers)。ANSTO 亦透過多項雙邊與國際合作，讓澳洲在全球核子鑑定的發展扮演逐漸重要的角色。

3. Radiation Detection for Border Security Applications; by Alison Flynn et al, ANSTO

輻射偵測技術在邊界保安與保防上扮演相當重要的角色。相關技術包含從被動偵測與放射性或核物料的識別，到應稅或可疑貨櫃的主動影像辨識等，種類繁多。ANSTO的偵測實驗室(Detector Lab)經由執行多種類的偵測業務以改善目前的偵測技術，並發展輻射偵測應用的新概念。主講人也介紹了該實驗室克正進行的放射性核種鑑定之運算法則的研發、背景輻射變化之製圖，以及μ介子斷層攝影術。

議題 V　Medical and Health Applications (核能在醫藥與衛生之應用)

1. Technical advance in radiation therapy of cancer - an example of liver cancer; by Dr Jinsil Seong

Seong表示做放射治療最重要是定位要精準，放射線之照射要集中，才能達到好的效果、病人才不致受罪。現在醫院的影像設備越來越好，使這項目標較以往容易達到。做放射治療的器官若是一直在動，就要偵視它的動態，才會照射得精準。她以肝癌為例做說明，照射是針對癌細胞，有3D影像可以看到它的準確位置、形狀與厚度。

2. The use of nuclear science and technology in advanced brain imaging; by Prof Richard Banati

腦部是否有阿茲海默症或腫瘤，有賴輻射科技作照相，用TSPO (18 kDa translocator protein) 作為影像記號(marker)，可以將腦部病灶顯示出來。核能科技對疾病之診斷和治療有很大貢獻。

四、參訪活動

澳洲在核子醫學與科技的應用領域表現非常傑出，除了國立澳洲大學、昆士蘭大學、新南威爾斯大學都有相關科系之外，還有多個世界知名核子醫學與科技相關的學術及研究機構，與數個政府成立的大型研究機構。這次在主辦單位WiNAustralia的安排下，我國3位與會代表於10月23日參觀了其中的澳大利亞核能科技組織ANSTO及其重要設施；林庭安於當晚飛至墨爾本，另參加了10月24日澳洲同步輻射中心Australian Synchrotron的參訪活動。

(一) 參訪澳洲國家核能科學技術組織 ANSTO (10 月 23 日)

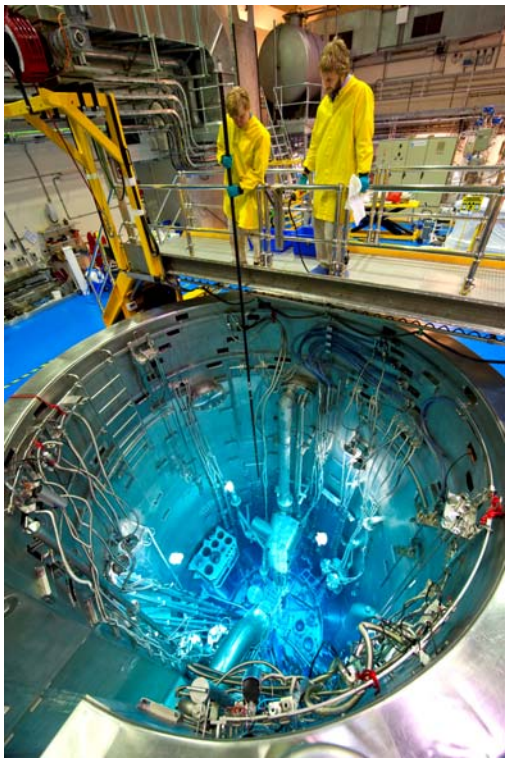
在雪梨Darling港之Four Points by Sheraton旅館前集合，搭上遊覽車，約1小時即抵達ANSTO。每位到訪者先核對護照，把所有東西分別鎖進置物櫃內才能入內參觀。我們一行約60人分成四組參觀了ANSTO的重要設施：布拉格研究所(Bragg Institute)、OPAL反應爐、HIFAR反應爐，以及加速器中心(Centre for Accelerator Science)等。

ANSTO簡介 位於雪梨西南部約40公里處的澳大利亞核能科學技術組織（Australian Nuclear Science and Technology Organization，ANSTO）為澳洲國家級核能研究機構，也為澳洲核能專家的主要聚集地。ANSTO佔地約20萬坪，擁有超過1,000名專業研究人員與職員。澳洲自1953年通過原子能法後即成立國家核能研發組織，於1987年轉型更名為ANSTO，目前隸屬於工業部(Commonwealth Minister for Industry)下，為一個法人組織，設有董事會，並由執行長負營運管理之責；主要發展世界級的核能相關科技與研究，並

在具有里程碑意義的設施上提供卓越的創新，同時也負責向澳洲政府、人民、工業界，與其他機構提供核能相關的專業意見、技術服務與產品。ANSTO設有布拉格研究所(Bragg Institute)、環境研究所、材料工程研究所、ANSTO 生命科學所、OPAL反應爐、HIFAR反應爐，以及加速器中心(Centre for Accelerator Science)等研究單位。提供的服務包含：健康服務、ANSTO礦物、矽品棒等材料或工程物件照射、高劑量照射與劑量計測、中子活化分析、活度標準實驗室、放射性射源區域保安計畫等。

布拉格研究所(Bragg Institute) 我們首先參觀與反應爐相連的中子束實驗室，主要儀器設備包括: 3座繞射儀、1座中子反射儀、1座中子散射儀，與2座冷中子三軸散射儀。有趣的是，ANSTO專家們依各儀器的中子束特性利用澳洲特有動物來幫這些儀器命名，像是針鼴鼠(繞)、無尾熊(繞)、蓬尾袋鼬(繞)、鴨嘴獸(反)、短尾矮袋鼠(散)、太攀蛇(三)等，而台灣國寶梅花鹿(SIKA)居然也出現在其中，原來當初這個冷中子三軸散射儀是國科會出資所建立，OPAL每年運轉340天，中華民國有主控權使用SIKA其中240天之實驗時間，提供國內各領域研究團隊使用。為了有效管理與運作這些中子束儀器，ANSTO於2002年創立布拉格研究所(Bragg Institute)，正是以發現布拉格曲線的澳洲英籍物理學家威廉・亨利・布拉格博士(William H. Bragg)而命名。

OPAL 反應爐 接著介紹Open Pool Australian Light-Water Reactor (OPAL)反應爐，OPAL是開池式清水型反應爐之縮寫，而opal(澳寶)原意為盛產於澳洲南部的珍貴礦產「蛋白石」。OPAL為使用低濃縮鈾(LEU)為燃料的研究用反應爐，所產生的能量只有20MW，主要用來生產放射性同位素、放射性照射，與中子束研究。OPAL於2007年開始運轉，取代興建於1958年的澳洲第一座研究用反應爐HIFAR（High Flux Australian Reactor）。隨後我們參觀了製作同位素藥物的設備。ANSTO提供全澳洲醫院高達80%的核子醫學藥物，幫助醫生診斷如癌症與阿茲海默症等疾病。導覽者介紹OPAL在工業上的用途，半導體業的材料矽品棒像溫泉煮蛋一樣放在水池中處理。OPAL在設計上都有考慮耐震、防止恐怖攻擊、防止飛行器撞擊等嚴格的安全要求。



OPAL 反應爐(攝影:Bragg Institute, ANSTO)

提到核能一定不能漏掉核安，OPAL的周圍有1.6公里的緩衝區，經特殊設計後能承受大型的地震與衝擊，反應爐上方長40米、寬30米的金屬網能防止恐怖攻擊利如飛機墜毀等對反應爐造成的衝撞。OPAL同時也擁有兩套獨立操作的控制系統，能在緊急情況下關閉反應爐、冷卻爐芯；反應爐建築也都使用加固型混凝土所建造，除了能防止反應爐遭受外力事故的影響，也能阻止發生事故時輻射外洩，因此不會帶給週遭居民安全上的問題。

HIFAR (High Flux Australian Reactor) 我們也參觀了HIFAR，10MW的HIFAR是個多用途的反應爐，作科研、核醫藥物、工業用及建造出更好的OPAL反應爐。HIFAR於2007/1/30停機、但仍需10年的時間來完成除役作業，除役費用約$50 million。目前爐心內的高濃縮鈾(HEU)燃料以全數移出，2016年將進行拆廠，以黃土(brown field)為整治目標。拆廠作業比照英國Harwell的DIDO反應爐，但時間更快。HIFAR運行50年，生產無數核醫藥物，產了中子束以研究物質結構、照射半導體業所用之矽品棒、供應工業用之放射性同位素，可謂功成身退。

加速器中心 (Centre for Accelerator Science) 最後我們參觀了加速器中心。ANSTO有4個加速器，分別為1MV, 2MV, 6MV及10MV。ANSTO運用核能來做多種環境相關的研究，例如溫室效應、放射性碳定年法（又稱碳定年，即利用自然存在的碳14同位素的半衰期來估算年代）、水文系統同位素分析（即推斷水源流向來保護未來的水資源供給）、空氣污染分析、能修復受汙染環境的綠色科技、預防害蟲殘害澳洲芒果等等，ANSTO表示他們擁有部分世界上最精密的儀器來執行這些研究。ANSTO頗以他們的技術水準為榮。茲簡述該中心4個加速器如下：

1. VEGA 加速器 (1MV)：此加速器可很有效率及精準地測定 14C 和放射性元素錒系之同位素。

2.SIRIUS Tandem 加速器(6MV)：它有 AMS、IBA 和離子照射設施，這 3 種離子源包括氫、氦和分析固體的 MC-SNICS 射源。

3. STAR Tandetron 加速器(2MV)：可做 IBA 和 AMS 分析，它有 3 個離子射源，包括 2 個 duoplasmatron 射源，1 個分析固體的射源。STAR 加速器有 3 個射線：多元素表面分析射線(IBA) 、分析 14C 的射線、高解析的深層分析射線(IBA)

4. ANTARES Tandem 加速器(10MV)：本加速器歷史最悠久、1991 年開始營運，包括 Heavy ion microprobe 射線、彈性後作力偵測射線、Actinide 射線、14C AMS 射線、10Be / 26Al / 36Cl AMS 射線等。

ANSTO 並不避諱對外開放參觀，每年約有 8,000 人至 ANSTO 參訪，在參訪期間都有研究人員陪同與講解，包括 OPAL 反應爐以及一系列中子束儀器的建設過程、工作原理與應用等，不僅有詳細的文字說明，還有解剖圖，其結構及原理讓人一目了然。

(二) 參訪澳洲同步輻射中心 Australian Synchrotron (10 月 24 日)

23 日晚庭安赴墨爾本，24 日參訪澳洲同步輻射中心 (Australian Synchrotron)。該中心隸屬 ANSTO，位於澳洲東南方的維多利亞州，距離澳洲第二大城市墨爾本只需 15 分鐘的車程。為了提升澳洲在國際學術上的地位與強化澳洲與國際科學界的關係，並使澳洲研究人員得以從事更有價值的研究，維多利亞州政府決定於 2001 年決定在澳洲八大名校之一的蒙納許大學(Monash University)旁建立國家同步輻射加速器，並於 2007 年正式開始運轉。除了 ANSTO 之外，澳洲的 5 個州政府及 25 所大學、澳洲聯邦科學與工業研究組織(CSIRO)、澳洲醫學研究機構(AAMRI)，甚至紐西蘭政府等都出資建立這座同步輻射加速器。

同步加速器為一種環型的粒子加速器，根據電磁學理論在環型磁場與電場的作用下，使以接近光的速度運行的帶電粒子束改變方向，在改變方向時會產生「同步加速器光源(synchrotron light)」。同步加速器是高能物理學家用來找尋基本粒子與探索宇宙本質的重要儀器，因科學家們逐漸體認到同步加速器光源的優異性，各國紛紛開始興建專門生產同步加速器光源的同步加速器，並嵌入特別的插件磁鐵使電子由一次偏轉進化成多次偏轉，光源亮度則能提高一千倍以上。因為發展迅速，同步加速器已成為許多研究領域不可或缺的研究工具，目前全世界約有 70 座實驗用同步加速器，而我國的同步加速器則完工於 1993 年並於同年啟用，比澳洲提早許多。澳洲同步輻射中心的研究範圍非常廣泛，涵蓋生物醫學、國防、環境科學設施、食品工學、法醫鑑識、製造業、礦物與自然資源的偵測與開採、藥劑學，與科學儀器的開發等等。

參、心得與建議

一、心得

本次赴澳洲出席全球核能婦女會年會獲益良多，感謝本會綜計處提供之出國員額及經費，使得本次公差得以順利進行。茲將重要心得摘錄如下：

1. 此次 WiN Global 理事會議的出席率偏低，尤其是西歐北歐及美洲的理事多人缺席，相較去年南非年會的超高出席率，形成強烈的對比。主要原因是連續兩年在南半球舉行，尤其今年在澳洲(無核電廠)，對歐美會員來說，旅程與交通費比一般高出許多。WiN Global 往後規劃年會地點，需加強考量地理位置與會員分佈的平衡，歐美地區的分會也應更積極的爭取主辦權。

2. 澳洲雖然沒有核電廠，但核能在生活上的運用既深且廣，這次 WiN 澳洲分會在只有 ANSTO 的協助下舉辦 150 人的國際型會議與技術參訪實屬不易。此外，ANSTO 對 OPAL 及其它核能設施開放的程度亦令人驚豔。在澳洲即使是反應爐，只要是公共設施都是人民納稅所建造，人民有權知道這些設施的建造過程、功能與作用，政府只需決定將哪些資訊公開，並制定嚴格的規範保證安全即可，令人印象深刻。

3. 今年正值 WiN Taiwan 慶祝成立 20 周年，我團特別準備由核能學會經費補助所訂製的紀念隨身碟分贈理事、部分會員代表及主辦年會的工作人員，分享我們的喜悅，更藉此自我激勵，邁向下一個 20 年。

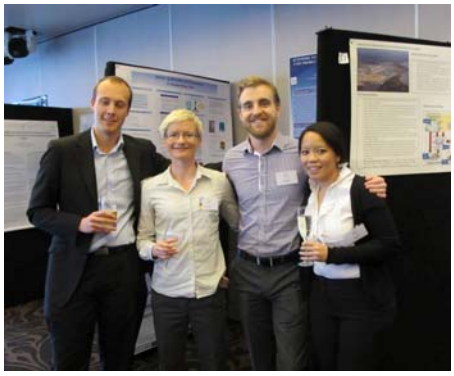
二、建議事項

1. WiN Global 成立迄今 22 年，現有正規會員 4700 人，遍及 105 個國家，有 33 個分會組織，若將各個分會的成員加總起來，會員超過 25,000 名，已發展成非常典型的大型國際網絡，成員遍及產官學研，在各個階層從事各種原子能科技相關作。建議我國核能界擬與他國新建國際交流或開發合作機會時，可善加運用此大型國際網絡，商請 WiN Taiwan 成員協助進行初步聯繫，或可達事半功倍之效。

2. 近幾年出席 WiN Global 年會，深切感受到美、韓、歐洲、南非、澳洲等主辦國對鼓勵女學生與職場新女兵的參與不遺餘力。我國 2011 年成立之台灣女科技人學會在短短三年內已推動多項業務與活動、主辦多場國內與國際女科技人研討會，更在國際女科技人連絡網中取得理事席位。建議我國核能界女性從業同仁對提攜國

內年輕女性多盡心力，亦可投入女科技人學會的行列，聯合女科技人的力量，奉獻所能、服務社會。

3. 我國於 WiN Global 成立之初即加入該國際組織，並隨即成立台灣分會且積極參與；自 1998 年至今一直保有一席執行理事。職於 2010 年起二度擔任執理一職，將於 2016 年屆滿，陳怡如理事亦將於一年後退休。期盼國內積極培育對國際事務與合作有興趣的年輕女性核能從業人員，並提供參加 WiN Global 年會的必要支助，從參與和服務中擴展國際視野、建立人脈，以延續我國在 WiN Global 的參與，確保 WiN Taiwan 多年來所建立的聲譽與地位。



附　錄

一、2014 WiN Global 年會議程 (3 頁)

二、2014 WiN Global 年會邀請函 (1 頁)

三、2014 WiN Global 年會我國分會簡報 (4 頁)

四、2014 WiN Global 年會會議手冊 (71 頁)

Conference Program

Monday 20th October	
0930-1530	Registration Open at 4 Points by Sheraton Hotel
0930-1130	Executive Meeting (WiN Executives only)
1130-1500	Board Meeting (WiN Board and Country Contacts)
1400-1630	Walking Tours of Sydney, led by WiN Australia Hosts
1630-1830	Sunset Harbour Cruise (Optional)

Tuesday 21st October		
0830-1700	Registrations Open at Dockside	
0900-1030	WiN-2014 Opening Ceremony *Conference Opening- Dr Se-Moon Park, WiN Global President* *Acknowledgement of Country – Ms Jasmin Craufurd-Hill, WiN Australia President* *VIP and Sponsor Acknowledgement* *Welcome on behalf of ANSTO – Dr Adi Paterson* *WiN Award Presentations – Dr Adi Paterson and Dr Se-Moon Park* *Conference Opening Keynote Address – Dr Erica Smyth*	
1030-1100	Morning Tea	
1100-1230	Session 1 Presentations - Broader Considerations of Nuclear Technologies	
	1100-1130	*CONFERENCE OPENING KEYNOTE ADDRESS* *Dr Lu Ma - State Nuclear Power Technology Corporation (China)*
	1130-1150	*Dr Jodie Evans – Australian Safeguards and Non-Proliferation Office (Australia)*
	1150-1210	*Dr Jenny Nielsen – University of Queensland (Australia)*
	1210-1230	*Panel Discussion*
1230-1330	Lunch & Judging of Poster Session	
1330-1500	Session 2 Presentations - New developments in Nuclear & Radiation	
	1330-1400	*David Vittorio - Australian Nuclear Science and Technology Organisation (Australia)*
	1400-1420	*Sarah Ballantyne – ANSTO Nuclear Medicine (Australia)*
	1420-1440	*Dr Elizabeth Bailey – Royal North Shore Hospital (Australia)*
	1440-1500	*Panel Discussion*
1500-1540	Afternoon Tea and Young Generation Networking Event	
1540-1700	Session 3 Presentations - Engaging with the Public, Government & Media on Nuclear	
	1540-1600	*Nadia Levin – Australian Nuclear Science and Technology Organisation (Australia)*
	1600-1620	*Dr Irene Aegerter – Cogito Foundation (Switzerland)*
	1620-1640	*Ben Heard – Think Climate (Australia)*
	1640-1700	*Panel Discussion*
1730-1930	Welcome Reception	

Wednesday 22nd October			
0830-1700	Registrations Open		
0900-1025	Concurrent Technical Sessions		
	0905-0925	*The role of the Nigerian Research Reactor in Human Capacity Development* *Edemanwayn Bassey Ita*	*Could neutron research provide solutions for modern industrial challenges?* *Dr Anna Paradowska*
	0925-0945	*Enhancing Human Resource Development for Nuclear Power Programme in Malaysia through PUSPATI TRIGA Reactor* *Zarina Masood*	*Chemical Deuteration at the National Deuteration Facility* *Dr Anwen Krause-Heuer*
	0945-1005	*Dismantling the public distrust on nuclear power via social network games* *Hyo Jeong Kim*	*A high performance neutron powder diffraction facility at TRIGA mark-II research reactor in Bangladesh* *Mst Sanjida Aktar*
	1005-1025	*Developing a Nuclear Engineering Program at UNSW* *Prof John Fletcher*	*ANSTO's Environmental Monitoring Program* *Emmy Hoffmann*
1025-1035	Conference Official Photograph		
1035-1100	Morning Tea		
1100-1240	Concurrent Technical Sessions		
	1100-1120	*Decommissioning strategy of KHNP and current preparation* *Heeran Jeong*	*Nuclear forensic science at the Australian Nuclear Science and Technology organisation (ANSTO)* *Kaitlyn Toole*
	1120-1140	*Flux screen design for NTD in the RA-10 project* *Dr Ana Cintas*	*Radiation Detection for Border Security Applications* *Alison Flynn*
	1140-1200	*Advanced Design Features and Passive Reactor Core Cooling Systems in NPP* *Duaa Aljilani*	*HEU Minimisation in Australia* *Dr Therese Donlevy*
	1200-1220	*Service and Maintenance of a Primary Side On-line Chemistry Monitoring System of KNPP and cooperation between KNPP and Energoservice Personnel* *Ralitza Penkova*	*Technical advance in radiation therapy of cancer - an example of liver cancer* *Dr Jinsil Seong*
	1220-1240	*Effect analysis to Technical Specification of improvement of MCR system in nuclear plant* *Tao Tang*	*The use of nuclear science and technology in advanced brain imaging* *Prof Richard Banati*
1240-1340	Lunch & Final Review of Poster Session		
1340-1500	Country Reports		
1500-1530	Afternoon Tea & Removal of Posters		
1530-1655	WiN Global General Assembly		
1655-1700	Conference Closing Ceremony & Presentation of Best Poster Award		
1900-2330	Gala Dinner - L'Aqua		

Thursday 23rd October	
0900-0930	ID checks and departure to ANSTO
0930-1700	ANSTO Site Visit
0900-1700	Australian Wildlife Zoo Visit

Friday 24th October	
1000-1530	Australian Synchrotron Visit
0900-1700	Additional Australian Wildlife Zoo Visits

Saturday 25th October	
0600-1830	Ranger Uranium Mine Visit

Locked Bag 2001
Kirrawee DC NSW
Australia 2232
winaustralia@gmail.com

13th August 2014

Dear Ms Jessie Chiu,

On behalf of WiN Australia and the WiN-2014 Conference Committee, it is my pleasure to invite you to present at the Women in Nuclear (Global) Annual Congress and to request your presence as a WiN-Global Executive at the Executive Meetings, Board Meetings and General Assembly that will be held in connection with the Congress.

This is the premier international event for women working in all applications of nuclear science and technology and presents a unique opportunity for members to network, exchange ideas, visit technical facilities and gain an understanding of new technologies and facilities around the world.

The overall programme will be composed of the WiN General Assembly, technical conference, workshops, gala dinner and both technical and cultural tours where global members can experience an overview of Australia.

Please don't hesitate to contact the Conference team or to contact me directly should you have any queries or require any assistance at any time and we greatly look forward to welcoming you to Australia in October.

Warmest regards,

Jasmin Craufurd-Hill
President - WiN Australia
Executive Board Member - WiN Global

WiN Taiwan

Kelly Lin
Assistant Manager
Nuclear Information Center

Summary of WiN Chapter

- Founded in 1994
- Local/Global members: 136/49
- Steering and Advisory Committee meets every 2~3 months; workgroup meetings
- Major activities in 4 categories:
  - Local/Global & other Conferences
  - Forums and Seminars
  - K-12 education activities
  - Others: website, E-newsletters

Please Note:

- WiN Taiwan/ANS-Taiwan Section Joint Annual Meeting
  - 11th WiN President/VP/Leading Group (2014-2016)
  - WiNners won 3 of 4 seats at ANS-TS election
  - WiN Taiwan 20th Anniversary Celebration

- New website under construction
- Forum commemorating 20th Annivesary in December

Nuclear Situation

- Nuclear Power Plants in Taiwan
  - Number of power reactors in operation: 6
  - Share of electricity from nuclear in 2013: 16.5%
  - Average capacity factor in 2013: 91.8%
  - Number of power reactors under construction: 2
- Research and Medical Facilities/Applications
  - Tsing Hua University Open-pool Reactor (THOR)
  - National Synchrotron Radiation Research Center (NSRRC)
  - Proton and Radiation Therapy Centers
  - Cyclotrons: INER Pharmaceuticals Manufacturing Center

WIN AUSTRALIA WOMEN IN NUCLEAR

Please Note:

- Challenges of Lungmen Plant
  - Referendum
  - Pre-op Testing and Re-inspection
  - Mothballing the Plant: “seal and save”
- Government Reform
  - AEC to become independent Safety Regulatory Authority
  - Ministry of Economic Affairs to become Ministry of Economy and Energy
  - INER to become IER under MOEE
  - To be finalized in 2015

WIN AUSTRALIA WOMEN IN NUCLEAR

Waste Management and Engaging with the Public

- Low-level waste: on-site storage, interim storage, final disposal (siting process)
- Spent fuel: on-site pools, dry storage, geological repository; reprocessing option open
- Public perception of nuclear changed drastically after Fukushima accident
- Forums of various subjects to improve public acceptance: energy mix, post-Fukushima safety improvement, risk communication, etc.
- 2014 Surveys: 56% favor scrapping Lungmen Plant; 35% support government decision of mothballing the plant
- National Energy Conference: January 2015

WIN AUSTRALIA WOMEN IN NUCLEAR

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Conference Program and

Proceedings

Join the conversation on social media – Facebook and Twitter – using the hashtag #WiNSyd2014

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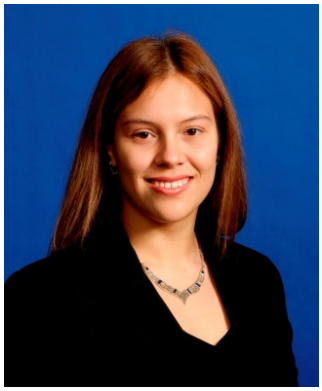

Dear WiNners and WiN-2014 Conference Participants,

It is with great pleasure, that on behalf of the members of Women in Nuclear Australia, I welcome you to the 22nd Annual Women in Nuclear Global Conference in Sydney, Australia.

Hosting our international colleagues in Australia for the first time is a defining moment for both WiN Australia and for me. Seeing our organisation flourish to the point where we are not only actively working to support our members but also promoting the development of expertise, embodies the spirit of WiN.

Such events do not occur without significant hard work and planning and I wish to specifically express my gratitude to the tireless Conference team of Dr Therese Donlevy, Janina Cooper, Kaitlyn Toole, Karyn Laxale and Dr Joanne Lackenby, to the Conference volunteers and the WiN Australia Executive, without whom this would never have been possible.

I also wish to thank our Major Sponsor ANSTO, whose commitment to the professional development of Australians through groups such as Women in Nuclear and Australian Young Generation in Nuclear, has been unwavering through the years.

Thankyou for choosing to join us in Australia for this wonderful event. I wish you a fantastic and enjoyable Conference and a safe return home from your travels in Australia.

Warmest regards,

Jasmin Craufurd-Hill
WiN Australia President
WiN Global Executive

Welcome from WiN Global President

Dear WiNners

It is my great pleasure to welcome you all to the 2014 WiN Global Annual Conference. It is a special year in the history of WiN; this is the first meeting to be held in Australia and we are very proud to have so many new members from this unique continent. So I thank WiN Australia for hosting our Conference and congratulate them on their growth.

Australia also holds a special place in the nuclear industry because of its rich uranium resources, we will hear more about this in the meeting.

Nuclear energy and radiation technologies remain as important today as they have ever been and we hope that during our Conference many new and important ideas will be discussed and important information exchanged. WiNers will also have the opportunity to network with each other to help achieve the objectives of WiN, to support each other and their work.

Finally, I also hope along the way we will have time to learn about Australian culture and nature, with some fun together, Australian-style!

A very warm welcome to everyone.

Dr Se-Moon Park
President WiN Global

WiN Award Winner – Dr Margaret Elcombe

Dr Margaret Elcombe is a world leader in the design, development, building and operation of neutron scattering instruments. She brings together particular nuclear scientific expertise with outstanding communication skills. Her recruitment to the fledgling Australian neutron scattering operation at HIFAR saw her commission two Triple Axis Spectrometers. The papers that arose from the experiments on these instruments provided the basis for some of Margaret's seminal research.

In the development of OPAL, Australia's open pool light water reactor, Margaret's profound knowledge of physics and neutron scattering was essential. She was a key member of an expert team for the implementation of the new neutron beam facilities, reviewing technical specifications, conducting cold source evaluations and ensuring regulatory requirements were met. The instruments established enabled ANSTO's Bragg Institute to lead Australia and contribute strongly to the global effort, in the application of neutron scattering and X-ray techniques to solve complex research and industrial problems.

As a pioneer of the science, made possible by nuclear reactors, Dr Elcombe has nurtured the careers of countless students and post-docs. She is of the highest international standing, is a role model to all scientists at ANSTO and a wise inspiration for young women scientists.

WiN Honorary Award Winner - Dr Gabriele Voigt

Dr. Gabriele Voigt has been working in the nuclear field for several decades. After obtaining a PhD in biology, Gabi became interested in the transfer of radioactivity in the environment and in living organisms. Her expertise in this area motivated her to investigate some of the consequences of the Chernobyl accident. Amongst other important work, she also carried out a radio-ecological evaluation of the Semipalatinsk test site in Kazakhstan. She became a well-recognized expert in radiation protection.

In 2002, Gabi joined the IAEA as the Director of the Agency's Laboratories at Seibersdorf and IAEA Headquarters and was tasked with streamlining the Laboratories' activities, which she carried out efficiently and effectively to the Director General's full satisfaction. After the reorganization of the Laboratories in 2010, Gabi became the Director of the Office of Safeguards Analytical Services in Seibersdorf and the Programme Manager of ECAS (Enhancing Capabilities of Analytical Services for Safeguards), with a €80 budget for constructing new safeguards laboratories.

Gabi has received several awards from the IAEA, the American Radiochemical Society and the World Nuclear Association in recognition of her outstanding professional work and leadership.

Gabi is the Vice-President of WiN IAEA and WiN Europe and a former Executive (now Board Member) of WiN Global.

Owing to her many years of professional experience and personal intuition, Gabi has been a mentor for a large number of men and women, in particular from the WiN membership. Although she is a busy IAEA Director, she will find time to meet with people who need her advice and guidance.

Gabi is due to retire from the IAEA at the end of 2014 and this award is an appreciation of her support for women, in Nuclear and beyond. With an unusual arrangement in her own immediate family (Gabi's husband Jochen has raised the two boys and taken care of the household, while Gabi has pursued her career), Gabi has always strived to support women, no matter whether they were in leadership positions or just starting their careers.

Gabi is a wonderful person, a great leader and a role model for all of us.

Conference Program

Monday 20th October	
0930-1530	Registration Open at 4 Points by Sheraton Hotel
0930-1130	Executive Meeting (WiN Executives only)
1130-1500	Board Meeting (WiN Board and Country Contacts)
1400-1630	Walking Tours of Sydney, led by WiN Australia Hosts
1630-1830	Sunset Harbour Cruise (Optional)

Tuesday 21st October		
0830-1700	Registrations Open at Dockside	
0900-1030	WiN-2014 Opening Ceremony *Conference Opening- Dr Se-Moon Park, WiN Global President* *Acknowledgement of Country – Ms Jasmin Craufurd-Hill, WiN Australia President* *VIP and Sponsor Acknowledgement* *Welcome on behalf of ANSTO – Dr Adi Paterson* *WiN Award Presentations – Dr Adi Paterson and Dr Se-Moon Park* *Conference Opening Keynote Address – Dr Erica Smyth*	
1030-1100	Morning Tea	
1100-1230	Session 1 Presentations - Broader Considerations of Nuclear Technologies	
	1100-1130	*CONFERENCE OPENING KEYNOTE ADDRESS* *Dr Lu Ma - State Nuclear Power Technology Corporation (China)*
	1130-1150	*Dr Jodie Evans – Australian Safeguards and Non-Proliferation Office (Australia)*
	1150-1210	*Dr Jenny Nielsen – University of Queensland (Australia)*
	1210-1230	*Panel Discussion*
1230-1330	Lunch & Judging of Poster Session	
1330-1500	Session 2 Presentations - New developments in Nuclear & Radiation	
	1330-1400	*David Vittorio - Australian Nuclear Science and Technology Organisation (Australia)*
	1400-1420	*Sarah Ballantyne – ANSTO Nuclear Medicine (Australia)*
	1420-1440	*Dr Elizabeth Bailey – Royal North Shore Hospital (Australia)*
	1440-1500	*Panel Discussion*
1500-1540	Afternoon Tea and Young Generation Networking Event	
1540-1700	Session 3 Presentations - Engaging with the Public, Government & Media on Nuclear	
	1540-1600	*Nadia Levin – Australian Nuclear Science and Technology Organisation (Australia)*
	1600-1620	*Dr Irene Aegerter – Cogito Foundation (Switzerland)*
	1620-1640	*Ben Heard – Think Climate (Australia)*
	1640-1700	*Panel Discussion*
1730-1930	Welcome Reception	

Wednesday 22nd October			
0830-1700	Registrations Open		
0900-1025	Concurrent Technical Sessions		
	0905-0925	*The role of the Nigerian Research Reactor in Human Capacity Development* *Edemanwayn Bassey Ita*	*Could neutron research provide solutions for modern industrial challenges?* *Dr Anna Paradowska*
	0925-0945	*Enhancing Human Resource Development for Nuclear Power Programme in Malaysia through PUSPATI TRIGA Reactor* *Zarina Masood*	*Chemical Deuteration at the National Deuteration Facility* *Dr Anwen Krause-Heuer*
	0945-1005	*Dismantling the public distrust on nuclear power via social network games* *Hyo Jeong Kim*	*A high performance neutron powder diffraction facility at TRIGA mark-II research reactor in Bangladesh* *Mst Sanjida Aktar*
	1005-1025	*Developing a Nuclear Engineering Program at UNSW* *Prof John Fletcher*	*ANSTO's Environmental Monitoring Program* *Emmy Hoffmann*
1025-1035	Conference Official Photograph		
1035-1100	Morning Tea		
1100-1240	Concurrent Technical Sessions		
	1100-1120	*Decommissioning strategy of KHNP and current preparation* *Heeran Jeong*	*Nuclear forensic science at the Australian Nuclear Science and Technology organisation (ANSTO)* *Kaitlyn Toole*
	1120-1140	*Flux screen design for NTD in the RA-10 project* *Dr Ana Cintas*	*Radiation Detection for Border Security Applications* *Alison Flynn*
	1140-1200	*Advanced Design Features and Passive Reactor Core Cooling Systems in NPP* *Duaa Aljilani*	*HEU Minimisation in Australia* *Dr Therese Donlevy*
	1200-1220	*Service and Maintenance of a Primary Side On-line Chemistry Monitoring System of KNPP and cooperation between KNPP and Energoservice Personnel* *Ralitza Penkova*	*Technical advance in radiation therapy of cancer - an example of liver cancer* *Dr Jinsil Seong*
	1220-1240	*Effect analysis to Technical Specification of improvement of MCR system in nuclear plant* *Tao Tang*	*The use of nuclear science and technology in advanced brain imaging* *Prof Richard Banati*
1240-1340	Lunch & Final Review of Poster Session		
1340-1500	Country Reports		
1500-1530	Afternoon Tea & Removal of Posters		
1530-1655	WiN Global General Assembly		
1655-1700	Conference Closing Ceremony & Presentation of Best Poster Award		
1900-2330	Gala Dinner - L'Aqua		

Thursday 23rd October	
0900-0930	ID checks and departure to ANSTO
0930-1700	ANSTO Site Visit
0900-1700	Australian Wildlife Zoo Visit

Friday 24th October	
1000-1530	Australian Synchrotron Visit
0900-1700	Additional Australian Wildlife Zoo Visits

Saturday 25th October	
0600-1830	Ranger Uranium Mine Visit

Conference Opening Ceremony Speakers

Dr Adi Paterson

Dr Adi Paterson commenced as Chief Executive Officer of the Australian Nuclear Science and Technology Organisation on 1 March 2009. Formerly General Manager of Business Development and Operations at the Pebble Bed Modular Reactor Company in South Africa, Dr Paterson holds a BSc in Chemistry and a PhD in Engineering from the University of Cape Town.

Throughout his career, Dr Paterson has been involved in creating, establishing and developing science and technology institutions. His focus is on the interface between public spending and practical innovations that create wealth and quality of life – putting science and technology to work.

In 2009 Dr Paterson became a Fellow of the Australian Academy of Technological Sciences and Engineering.

Dr Erica Smyth

Erica Smyth has almost 40 years experience in the mineral and petroleum industries. She was Principal Geologist for BHP Minerals Limited for 7 years, and then BHP-Utah Minerals International's Beenup Project Manager for 4 years, before moving to BHP Petroleum as their Manager Gas Market Development WA and later joined Woodside Petroleum Limited as General Manager – Corporate Affairs. She has been a professional company director since 2005. She has a Bachelor of Science from University of Western Australia and an Applied Master of Science from McGill University in Montreal, Canada. In 2008 she was awarded an Honorary Doctor of Letters from the University of Western Australia and in 2012 was elected as a Fellow of the Australian Academy of Technological Sciences and Engineering.

She is currently the Chair of Toro Energy Limited and the Diabetes Research Foundation of WA. She is also a Director of Emeco Holdings Ltd; the Australian Nuclear Science and Technology Organisation (of which she is Deputy Chair of the ANSTO Board), the Deep Exploration Targeting CRC, the Royal Flying Doctor Service (Western Operations), and the Harry Perkins Institute of Medical Research. The Chamber of Mines & Energy (WA), as part of the Women in Resources Award 2010, awarded Dr Smyth a Lifetime Achievement Award for her contribution to the industry and in 2013 she was included in the Women in Mining (UK) list of 100 Inspirational Women in Mining.

Plenary Speakers – Broader Considerations of Nuclear Technology

Dr Lu Ma

Madam Ma received her PhD degree in Engineering from Beijing University of Technology and holds an EMBA from University of Texas at Arlington. She is now Senior Vice President of State Nuclear Power Technology Corporation and Chairman of SNPTC–Westinghouse Nuclear Power Technical Services (Beijing) Company.

From 1993 to 2000, Madam Ma was General Manager of Energy Department of China National Technology Import & Export Corporation (CNTIC). From 2000 to 2007, she served as Vice President of CNTIC. In these roles, she led many major tender events including the bundled tender for gas turbines, tender for turbine generators of Three Gorges Project, and bundled tender for pumped storage power stations, and tender for China 3rd Generation Nuclear Power Technology Self-reliance Program Supporting Projects etc.

From 2007 to present, Madam Ma is the Senior Vice President SNPTC, responsible for international strategy, cooperation and business development, commercial issues and human resource. She also served as General Counsel from 2009 to 2012.

Dr Jodie Evans

Dr Evans completed a Science degree (with Honours) from the Australian National University in 1994. She then undertook a PhD at the same university, doing her research jointly between the Research School of Earth Sciences and the Department of Nuclear Physics. The majority of her thesis was written in the United States of America, while she was at home with young children and her husband undertook a Post-Doctoral research at Berkeley National Laboratory. Dr Evans completed her PhD after returning to Australia in 2001.

In 2003 Dr Evans joined the Department of Defence and worked as a nuclear analyst on Counter Proliferation issues in the Defence Intelligence Organisation. In 2012 Dr Evans moved across to the Australian Safeguards and Non-Proliferation Office (ASNO), located within the Department of Foreign Affairs and Trade, to work on nuclear safeguards and non-proliferation issues.

Dr Jenny Nielsen

Jenny Nielsen's research focuses on nuclear non-proliferation and disarmament issues, particularly the multilateral Non-proliferation Treaty (NPT) review process. Jenny is a Postdoctoral Research Fellow in the School of Political Science and International Studies

at the University of Queensland. Previously, she was a Research Analyst with the Non-proliferation and Disarmament Programme at the International Institute for Strategic Studies (IISS), a Programme Manager for the Defence & Security Programme at Wilton Park, and a Research Assistant for the Mountbatten Centre for International Studies (MCIS) at the University of Southampton. At MCIS, Jenny was tasked with the co-editing the 2004-2012 editions of the NPT Briefing Book. She holds a PhD from the University of Southampton which focused on U.S. nuclear non-proliferation policy vis-à-vis Iran in the 1970s.

Plenary Speakers – New Developments in Nuclear and Radiation

David Vittorio

David Vittorio has been working at ANSTO for over 14 years specialising in fuel management and operations management. David holds a Masters in Business Administration, Bachelor of Applied Science (physics) and Post Graduate qualifications in Energy Studies. David has lead key ANSTO projects including the management of two spent fuel shipments and conversion of the HIFAR Research Reactor from HEU to LEU fuel. He has also coordinated the planning for the commissioning of the OPAL Multipurpose Reactor as part of the Commissioning Operations Group. His interests in business management coupled with his experience in reactor operations led to his appointment as the OPAL Reactor Manager in 2010. As OPAL Reactor Manager, David has worked towards maximising the safety, reliability and availability of the OPAL research reactor with a view to delivering maximum benefit to its users. Today, the OPAL Research Reactor is recognised as being one of the world's most highly available and multipurpose research reactors.

Sarah Ballantyne

Sarah Ballantyne is an Executive Director of ANSTO Nuclear Medicine and has been on the Board since the formation of ANM in 2013. She is the Compliance and Quality Manager for ANSTO Nuclear Business (since 2011) and is also the Executive Officer for PETNET (since 2013). Sarah has been with ANSTO 7 years. Sarah has worked in the pharmaceutical industry for over 20 years in a range of operational roles with experiences in Production, Engineering, Quality, Safety and Environment. Sarah has a Bachelor of Engineering (Chemical) as well as a Master of Commerce in Industrial Relations.

Dr Elizabeth Bailey

Elizabeth Bailey is the Chief Nuclear Medicine Scientist at the Department of Nuclear Medicine, Royal North Shore Hospital. She has worked in the profession for more than 20 years and has extensive experience in all area of nuclear medicine, including PET and radionuclide therapy. She has a number of research interests, including V/Q SPECT, Cardiac Stem Cells in large animal models, the use of FET in brain tumour imaging, normal SUV ranges for ToF PET using FDG and [^{68}Ga]-Dotatate and FDG and CT patient dose ranges using low dose protocols. Elizabeth has developed and implemented the radionuclide therapy service at Royal North Shore Hospital, which now includes [^{177}Lu]-Octreotate, [^{131}I]-Rituximab and Radium-223 (Xofigo®). She has numerous publications, specifically in the area of V/Q SPECT, cardiac imaging, cardiac

stem cells and quantitation. She is the Immediate Past President of the Australian and New Zealand Society of Nuclear Medicine (ANZSNM) and the current chair of the Technologists Special Interest group.

Plenary Speakers – Engaging with the Public, Government and Media on Nuclear

Nadia Levin

General Manager, Government, International and External Relations Nadia Levin provides advice to ANSTO's Board, Chief Executive Officer and Executive team on strategic positioning and delivery of multi-channel engagement programs to reach and influence local and federal government, international counterparts, industry and community stakeholders.

Translating the impact of complex research and discovery conducted at ANSTO into compelling stories and shared experiences, Nadia and her talented and high performing group bring the incredible world of nuclear science and technology to communities, schools, policy and political decision makers and industry influencers. Interactive programs and campaigns ensure ANSTO's rich knowledge bank is accessible and open for opportunity, inspiring young Australians to ignite and maintain their fascination with the world of science and its possibilities.

Ms Levin is a member of the ANSTO's Executive Leadership Team and a Board member of the Synchrotron Light Source Australia.

Irene Aegerter

Irene Aegerter has earned a PhD in Physics and is a member of the Swiss Academy of Engineering Sciences (SATW). From 2004 -2014 she was Vice President of the Academy.

Her focus during her business career was to have a dialogue with women and students about technology, especially nuclear energy. She founded the organization Women for Energy in Switzerland in 1982 and, in 1992, founded the global network Women in Nuclear (WiN) and was WiN President 1992 - 1996. She was reelected to the Executive Board again in 2008 - 2014. WiN has more than 4500 members in nearly 100 countries. This shows that nuclear is not only a men's world. As Director of Communication of the Swiss Power Utilities from 1989-2000, she was leading the campaign against the Phase out of Nuclear in Switzerland. From 2000 - 2007 Irene was a member of the Federal Commission on Nuclear Safety. Safety in all aspects is her number one priority for nuclear energy. This is especially crucial, since the accident in Fukushima was due to the lack of containment venting, lack of hydrogen recombinators, lack of bunkered diesel

generators and too low Tsunami wall even though the probability of Tsunamis was known.

She is a devoted grandmother of 3 grandsons (20,18,10) and one granddaughter (7).

Ben Heard

Ben Heard's passion for sustainability is now over ten years old. It inspired a career change by way of a Masters in Corporate Sustainability Management at Monash University. He founded ThinkClimate Consulting after many years spent in large professional firms working on a range of climate, sustainability and stakeholder consultation challenges.

Ben wanted to bring a new approach with ThinkClimate, a nimble organisation that works tirelessly to meet their client's needs with specialist skills in research, analysis, and strategy development in sustainability and climate change. It's about building the thinking and processes to drive evidence-based sustainability decisions, for the good of your organisation and the world. Ben care deeply about our ecology and natural systems. He is also a modern environmentalist who loves humanity and believes in our collective potential.

Over the last three years, a range of organisations have benefited from their approach, including governments, large and small private organisations and members of the not-for-profit sector.

When not delivering projects, Ben enjoys teaching sustainability and climate change at Adelaide University and advocating further action on climate change through the deployment of nuclear power.

Technical Presentations – Applications of Nuclear Techniques to Science and Research

Could neutron research provide solutions for modern industrial challenges?

Anna Paradowska

Bragg Institute, Australian Nuclear Science and Technology Organisation, NSW, Australia

The OPAL research reactor at ANSTO has several world class neutron instruments available for science and engineering applications. The instruments have a unique non-destructive ability to determine critical properties of materials and improve understanding of various complex processes. These measurements can be carried out on real engineering components, mock-ups, or test samples with minimal preparation. All this information could provide direct impact into optimization of modern manufacturing processes, improved product reliability, enhanced design performance, reduced production cost, and extended life prediction on significant engineering assets. Our team has established a strong record in assisting Australian and international researchers and engineers in developing innovation and integrity across a wide range of engineering projects.

Recently, Bragg Institute established Industrial Liaison Office to enhance industrial engagement and minimize the gap between the research and industry. Transition from the fundamental research to commercial applications is not straightforward. The challenges and first successes will be shared and discussed.

Chemical Deuteration at the National Deuteration Facility

A.M. Krause-Heuer, N.R. Yepuri, T.A. Darwish, A.E. Leung, P.J. Holden

National Deuteration Facility, Bragg Institute, Australian Nuclear Science and Technology Organisation, NSW, Australia.

Molecular deuteration is an essential prerequisite in many ^{2}H (deuterium) NMR, infrared, mass spectroscopy, and neutron studies. The broad range of deuterated molecules synthesised by the National Deuteration Facility (NDF) has led to exciting opportunities for diverse characterisation studies. We have synthesized a range of deuterated organic and biomolecules for the investigation of complex systems in fields that include molecular electronics, structural biology, and biotechnology.

We are able to synthesise a variety of deuterated phospholipids (selectively deuterated at the tail or head group) with unsaturated or branched alkyl chains [1,2]. These selectively deuterated lipids significantly enhance contrast and simplify data analysis in neutron studies.

Chemical deuteration has facilitated a wide range of neutron studies at the Bragg Institute, ANSTO. Some examples include the study of the behaviour at the interface within functioning optoelectronic devices [3,4], and the localization of sugars in lipid membranes to give insights into cryoprotective mechanisms [5].

[1] Darwish, T. A.; Luks, E.; Moraes, G.; Yepuri, N. R.; Holden, P. J.; James, M. *J. Label Compd. Radiopharm.* **2013**, *56*, 520.

[2] Yepuri, N. R.; Holt, S. A.; Moraes, G.; Holden, P. J.; Darwish, T. A.; Hossain, K. R.; Valenzuela, S. M.; James, M. *Chem. Phys. Lipids* **2014**.

[3] Darwish, T. A.; Smith, A. R. G.; Gentle, I. R.; Burn, P. L.; Luks, E.; Moraes, G.; Gillon, M.; Holden, P. J.; James, M. *Tetrahedron Lett.* **2012**, *53*, 931.

[4] Smith, A. R. G.; Ruggles, J. L.; Cavaye, H.; Shaw, P. E.; Darwish, T. A.; James, M.; Gentle, I. R.; Burn, P. L. *Adv. Funct. Mater.* **2011**, *21*, 2225.

[5] Kent, B.; Hunt, T.; Darwish, T. A.; Hauß, T.; Garvey, C. J.; Bryant, G. *J. R. Soc. Interface* **2014**, *11*, 20140069.

A high performance Neutron Powder Diffraction facility at TRIGA Mark-II research reactor in Bangladesh

S. Aktar[a], I. Kamal[a], T.K. Datta[a], A.K.M.Zakaria[a], A. K. Das[a], S. Hossain[a], R. Berliner[b], W. B. Yelon[b] and S.M. Yunus[a]

[a] *Institute of Nuclear Science and Technology, Atomic Energy Research Establishment, Ganakbari, Savar, Dhaka.*

[b] *Instrumentation Associates, Durham, North Carolina, USA*

A neutron powder diffractometer has been installed at the radial beam port-2 of TRIGA Mark II Research Reactor of AERE, Savar, Dhaka, Bangladesh. The diffractometer is designed and equipped with modern technology like Popovici monochromator, Position Sensitive Detectors (PSD), Rotating Oscillating Collimator (ROC) etc. Doubly bent perfect single crystal focusing silicon monochromator is implemented for this instrument. To optimize the intensity and diffractometer resolution the monochromator is aligned for (115) reflection at a take-off angle of 97° yielding a wavelength of 1.5656 A. Before reaching the monochromator, incident neutron beam passes through an in–pile primary collimator where sapphire filter is inserted at the upstream to reduce fast neutron. The detection system is composed of 15 position sensitive detectors which are arranged parallaly and mounted vertically with preamplifiers, high voltage decoupling capacitors and 1-wide NIM Position Encoding Modules (PEM) to determine event positions in linear position sensitive proportional counters. The detector assembly within the shield can be placed at distance either 1.6m or 1.05m from the sample and PSD spans at those two positions are 20° and 30° respectively in a step size of 0.05°. A complete diffraction pattern is obtained by collecting data on two theta (2θ) axis ranging from 5° to 125°. The diffractometer is devoted for determination and refinement of crystalline and magnetic structure of technologically important materials like ferrites, perovskites, ceramics, alloys and superconductors.

Environmental and effluent monitoring at Australia's nuclear research reactor site

E. Hoffmann

Australian Nuclear Science and Technology Organisation (ANSTO), Sydney, Australia.

Monitoring of the local environment at the site of Australia's only nuclear research reactors at Lucas Heights, Sydney, commenced in 1959.

The Australian Nuclear Science and Technology Organisation (ANSTO, formerly the Australian Atomic Energy Commission) operated the HIFAR research reactor for almost 50 years, until it was permanently shut down in 2007. The modern OPAL reactor was then commissioned and commenced routine operations in 2009. ANSTO also produces a range of radiopharmaceuticals (both reactor and cyclotron-based) and operates a number of national research facilities including the Centre for Accelerator Science.

The environmental and effluent monitoring program including liquid and airborne emissions, environmental pathways, target nuclides and resulting dose will be discussed. The program includes: testing of liquid effluent discharges to sewer; continuous stack emission sampling; collection of local environmental media with an emphasis on surface water and groundwater; external gamma radiation; a comprehensive meteorology program and modelling of atmospheric emissions for emergency response.

The small contribution that ANSTO's operations make to the annual dose of nearby residents is largely due to noble gas emissions from production of nuclear medicine, rather than the OPAL research reactor.

Posters - Applications of Nuclear Techniques to Science and Research

Assessment of Trends in Freshwater Quality Using Environmental Isotopes and Chemical Techniques for Improved Resource Management

Nor Dalila Desa, Mohd Tadza Abdul Rahman and Kamarudin Samuding

Division of Waste & Environmental Technology, Malaysian Nuclear Agency.

Source of groundwater ought to be explored in a manner spread and protected so that the groundwater resource may well be fully used not just simply when the country faced the water crisis but also important for the function of the ecology. Due to rapid development on the Langkawi Island, the future water demand will increase. Groundwater will become extremely important as a supplementary source of water supply on the island when surface water availability is insufficient to meet the increased water demand. Therefore, a major reason for this study is to look into the trend of groundwater quality in Langkawi Island because of fear of groundwater contamination from point and non-point pollution sources. This study involved only technical aspect consists of isotope techniques as well as geological, hydro geological and hydro chemical approaches to identify evidence of pollution occurrence, the sources of pollutants and to assess changes in surface water and groundwater quality. Result of monitoring activities carried out initially showed that little changes in groundwater level and quality. From the study, the age of groundwater in that area is of sub-modern to modern (0.5 TU- 2.39TU) and quite sustainable.

Chemical Deuteration of Molecules for Structural Characterisation by Nuclear-Based Techniques

A. E. Leung, A.M. Krause-Heuer, N.R. Yepuri, T.A. Darwish, P.J. Holden

National Deuteration Facility, Bragg Institute, Australian Nuclear Science and Technology Organisation, Lucas Heights, NSW, Australia

Although deuterium (^{2}H) and hydrogen (^{1}H) exhibit similar chemical reactivity, the composition of their nuclei results in vastly different neutron scattering responses.[1] Thus, the exchange of hydrogen atoms for deuterium atoms is an effective tool for researchers to more effectively analyse molecules using neutron-based analytical techniques. The chemical deuteration team at the National Deuteration Facility (NDF) at the Australian Nuclear Science and Technology Organisation (ANSTO) performs hydrogen/deuterium exchange reactions in tandem with classical synthetic chemistry techniques to produce a range of known and novel compounds for neutron-based studies.

Current projects at the NDF have applications in forensic science, optoelectronics, surfactants, and biological binding studies. The NDF recently published the synthesis of perdeuterated phytanic acid (Figure 1) and several phytanic acid phospholipids, which are used in membrane-based biosensors due to their excellent chemical and mechanical stability and their capacity to form highly insulating bilayer membranes. Deuteration enabled characterisation of tethered bilayer lipid membrane models of phytanyl constituents on solid substrates using neutron reflectometry.[1]

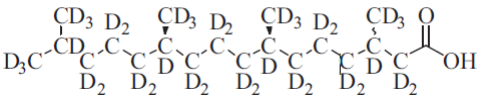

Figure 1. Perdeuterated phytanic acid.[1]

[6] [1] Yepuri, N. R.; Holt, S. A.; Moraes, G.; Holden, P. J.; Darwish, T. A.; Hossain, K. R.; Valenzuela, S. M.; James, M. *Chem. Phys. Lipids* **2014**.

Leaching Study in Immobilization of Radioactive Waste In Fly Ash- Zeolite Cement

Nesreen M. Samy

Hot Lab. Center, Atomic Energy Authority P.O. 13758, Cairo, Egypt

Fly ash-zeolite cement was synthesized from industrial by-product fly ash obtained from the thermal electric power station. The synthesis process is based on the hydrothermal-calcination-route of the fly ash. The microstructure was characterized by X-ray diffraction, FT infrared spectroscopy and surface area (BET-N_2). The efficiency of innovative matrices for immobilizing cesium and cobalt radionuclides is presented in this work. The aim of the present study is to investigate the possibility of solidifying exhausted synthetic fly ash zeolite cement, loaded with ^{137}Cs and ^{60}Co radionuclides. leaching behaviour of the radionuclides have been studied. The leachability index measured, These value indicated that both matrices studied can be classified as good solidify systems, and specially the fly ash zeolite cement matrix can be utilized as efficient materials for immobilizing cesium and cobalt radionuclides.

Modeling Physical Environmental Processes of Radio Nuclides Migration by means of Smooth Particle Hydrodynamics (SPH)

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Instituto Nacional de Investigaciones Nucleares, Carretera México Toluca SN, México.

Diffusion of radio nuclides in the environment (water, air and soil) is a very important research area because of its great impact. A correct description and understanding of this phenomenon is fundamental in order to analyse and prevent dispersion of this kind of waste and also to perform remediation alternatives to solve the problem. Although finite elements methods have been employed to model this processes, in many occasions, in cases of multiphase fluids with many components flowing through irregular structures with fractures and mobile boundaries, obtaining a solution with these traditional methods is complicated, being necessary to make simplifications or approximations. Inaccuracies due to these approximations could be significant because even small concentrations of radionuclides are considered as hazardous pollutants. As an alternative, the Smooth Particle Hydrodynamics methodology, known as SPH, has shown to be a very good option. SPH is a Lagrangian, meshless particle methodology which allows solving problems where mobile interfaces and complicated structures are present. Fundamental physical processes in the description of the system, such as diffusion, dilution and filtration, could be included in a natural way in SPH because this particle approximation of the fluid permits that each “particle”, or more property said each volume element of fluid, carry its individual information about velocity, mass, density and concentration. In this work, we present the results obtained by developing a numerical model based on SPH to analyze the main physical environmental processes involved in the radionuclide migration: fluid flow, diffusion, advection, dilution, filtration and radioactive decay. Comparison with analytical calculations show that this method represents an efficient and trustfully mechanism to analyse and predict migration of hazard pollutants in different scenarios.

[1] A.M. Tartakovsky, P. Meakin, T. D. Schibe, R. M. E. West, *Journal of Computational Physics* **222**, 654-672 (2007).

[2] J.J. Monaghan, Journal of Computational Physics **110**, 399 (1994)

Mutation breeding for salinity tolerance in bread wheat (*Triticum aestivum* L.)

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Wheat is the principal staple food crop of Pakistan and occupies 37 percent of total cultivated area [2]. Salt stress is one of the most prevalent abiotic stresses in the world that reduce plant growth. The material consisted of twenty five mutated lines from Kiran-95 and Bhittai. The check varieties were Kiran-95, Bhittai and NIA-Sunhari. Grain yield is a complex trait and highly influenced by many genetic factors and environmental fluctuations [1]. Results revealed that all the line/varieties were highly significantly different for yield and its components. The highest plot yield (300 g) was observed in line number 02, followed by the line 01, 08, 19 and 22 with plot yield 275 g. The aim of present experiment was to find out the existing varieties for high grain yield under saline environments.

[1] Ali, Y., Babar Mnazoor atta, Javed Akhter, Philippe Monneveux and Zahid lateef (2008). Genetic variability, association and diversity studies in Wheat (Triticum aestivum L.) germplasm. *Pak. J. Bot* . 40(5): 2087-2097, 2008.

[2] Hussain S, A.Khaliq, A. Matloob, M. A. Wahid and I. Afzal, (2013) Germination and growth response of three wheat cultivars to NaCl salinity. *Soil Environ.* 32(1): 36-43, 2013.

Real-time tracking of radioxenon plumes using NaI(Tl) Detector with rapid peak identification software

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A preliminary study was conducted at ANSTO to investigate the on-site impact of routine xenon emissions from the Medical Isotope Production Facility (MIPF). The production of Molybdenum-99 releases the inert noble gases xenon-135 (half-life 9.11h), xenon-135m (15.4m), and xenon-133 (5.25d) as transient puffs which are usually quickly dispersed. However the releases have occasionally been detected in other facilities on site containing sensitive detection equipment such as the whole body monitor and personal contamination monitors.

The aim of this study was to detect these emissions in the field and, if possible, measure dose rates in real-time under worst-case (low dispersion) conditions; also to verify modelled predictions of the resulting doses.

An ANSTO-developed portable detection system was used to track the xenon plume following a radioactive gas release from the MIPF during a period where stable conditions, i.e. low wind speeds, were expected. The stack emissions are continuously monitored using an on-line gamma detection system and the portable gamma detection system was able to rapidly identify the same radioxenon isotopes in the field. Dose rates were measured concurrently and a temporary increase in background radiation levels during releases were confirmed to be due to xenon isotopes.

Most current atmospheric plume models do not account for xenon being heavier than air, and it is hoped that these studies may help to inform and ultimately improve plume modelling for radioxenons.

Technical Presentations – Community Engagement, Education and Communication

The Role of the Nigerian Research Reactor in Human Capacity Development

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The Nigerian Research Reactor (NIRR-1) has served as a veritable tool in the development of human capacity for nuclear scientists, engineers and other stakeholders in the Nigerian nuclear industry. NIRR-1 was commissioned and operated in September 2004 and is situated at the Centre for Energy Research and Training (CERT) Saria, Nigeria. NIRR-1is used for Research – Neutron Activation Analysis, Education and Training. NIRR-1 has been used considerably to train the operators working at CERT – the research reactor, regulators working with the regulatory industry (regulators on attachment), student of high education institutes offing courses in reactor physics and nuclear science/engineering to enhance their knowledge and skills in various fields of science and technology. The installation of NIRR-1 brought rapid development of nuclear science and technology in the country. Your have been trained in different field of science in the centre giving rise to youth empowerment and self reliance which is very timely in the country due to the increase in level of insecurity and insurgency involving unemployed youth. This paper discussed the role of the Nigerian Research Reactor in Human Capacity Development in Nigeria and the socioeconomic impact makes in the country.

Enhancing Human Resource Development for Nuclear Power Programme in Malaysia through PUSPATI TRIGA Reactor

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Human resource development is critical in ensuring the successful implementation of nuclear power programme for a new-comer country. To this end, a research reactor can play an important role in developing or enhancing the capability and capacity of required human resource for the country.

The 1MW PUSPATI TRIGA Reactor (RTP), located at the Malaysian Nuclear Agency and operated since June 1982, has been playing this role although decision on the deployment of nuclear power as an energy source for Malaysia has not been made. The reactor is central in the development of expertise in neutronics, thermalhydraulics, reactor technology assessment, safety, security, safeguards, radiation protection and radioactive waste management. Expertise in regulatory and legal infrastructure was also developed in tandem with the requirement for supervision of a research reactor. In line with the possible future introduction of nuclear power in Malaysia, these efforts have been intensified and expanded.

Dismantling the Public distrust on Nuclear power via Social Network Games

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Despite historical catastrophic events of the Three Mile Island, and Chernobyl, the nuclear power energy industry has walked a prosperous path, until the notorious tsunami hit in Fukushima, Japan in March 2011. The nuclear power plant explosion in Fukushima shocked the entire world, and the distrust in nuclear power technology prevailed since. This international distrust on nuclear power technology, which resulted in a number of national declarations on reducing nuclear power facilities[1], is the foremost factor the nuclear power industry must face and overcome.

Here, a hypothesis is made that social network games on nuclear power plants may provide the best means to achieve such goal for two key factors: (1) it enables pleasurable and constant exposure to the subject, and hence enhancing the attitude towards the subject[1]; and (2) simulation games may play its role as instructional tool[2] on nuclear power technology. Inventing a social network game simulating nuclear power plant operation will grant a great chance of spreading amicable perceptions based on a better understanding of nuclear power technology.

[1] Robert B. Zajonc, *Attitudinal Effects of Mere Exposure* (Journal of Personality and Social Psychology June 1968 vol 9. No.2 Part 2)

[2] Rosemary Garris, Robert Ahlers, and James E. Driskell, *Games, Motivation, and Learning: A Research and Practice Model* (Simulation Gaming December 2002 vol. 33 no.4 p441-467)

Developing a Nuclear Engineering Program at UNSW

John Fletcher

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The Faculty of Engineering at the University of New South Wales is establishing a Nuclear Engineering program that includes undergraduate and postgraduate education and research training. The rationale for embarking on such an endeavour will be outlined. Existing UNSW teaching and research strengths in the nuclear sector are identified including Uranium mining, materials characterisation and modeling, energy markets and economics, power system operation, and life-cycle management. Challenges to the development of the program are identified including the undeniable need for funded and focused research programs in Australia in the nuclear area, student recruitment, and attracting new academic staff. The UNSW nuclear program will establish new links with the world-class Centre for Nuclear Engineering at Imperial College, London, and expand existing excellent relationships with the Australian Nuclear Science and Technology Organisation. As well as providing staff that can teach from an experienced background in nuclear operations, these two organisations provide much needed practical and research expertise in nuclear engineering, laboratory facilities, and access to the globally-integrated nuclear sector.

Posters – Community Engagement, Education and Communication

Changes in Correlation among Various Aspects Relating to Nuclear Power and Radiation Education in 2012-2013

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A radiation study experience, which included an hour of radiation measurement, was administered to a group of elementary-, middle-, and high-school students in South Korea. In order to analyze the effect of this intervention, a survey was used. In 2013, the number of students who participated in the study totalled 3,998 (100.0%) prior to the intervention and 3,914 (100.0%) after the intervention, which was higher than that of the 2012 participant group, which totalled 3,399 (100.0%) before the intervention and 3,157 (100.0%) after the intervention. The educational programs in both 2012 and 2013 resulted in a similar pattern, where acquisition of information and subjective knowledge were most strongly correlated before the intervention. After the intervention, however, necessity and attitude were most strongly correlated. In other words, when students were given education that stressed the necessity of radiation use and nuclear power generation, a change of attitude occurred. Education should be based on the idea that the average person's perception of scientific technology is formed within a system of emotionally grounded experiences [1]. As knowledge, perception, and attitude are all correlated with one another, education should be implemented so as to positively foster all these three aspects.

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Efforts of WIN Slovakia to inform General public

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The poster reflects the efforts of WIN Slovakia to inform General public in the most understanding way. We spread information during: Open Day VUJE, Inc., Daffodil Day, in the professional conferences and meeting with secondary school students. Our country is integrated in an international project Allegro so this information flow is very important. The project includes 4 central European countries with the support of France. The main objective of the project is the demonstration - GFR (gas fast reactor). The Allegro project is a part of the Strategic Energy Technology Plan (SET plan) presented by European Sustainable Nuclear Industrial Initiative (ESNII). The designed thermal power of ALLEGRO reactor is 75 MWth. Although this relatively low power makes licensing somewhat easier, the demonstration of the GFR technology assumes that the basic features of the 2400 MWth GFR reactor can be tested at Allegro. Therefore most of the main parameters of Allegro and the GFR2400 reactors must be similar. The preparatory work began in 2010. In May 2010 a memorandum of understanding was signed between: The Slovak Republic, the Czech Republic, Hungary and Poland. July 18th, 2013 Association V4G4 was established. It was presented to the public at the Hungarian Academy of Sciences. That is a legal entity of non profit organization. It will be legalized in the near future under Belgian or Slovakia authority. The work is divided among 4 Countries. They have made the working group. VUJE- Design & Safety Concept, Research Laboratory, UJV Rez - Technology, Research Laboratory (Helium technology) MTA-EK - Fuel Reprocessing and Research Laboratory, Material Research NCBJ laboratory (except fuel). The preparatory phase will last until 2018, construction work until about 2027, running around 2037. WiN Slovakia inform the general public about new technologies and necessity of nuclear energy.

[1] A.Kollarova and coll. VUJE, Inc. (2014) and coll.

Technical Presentations – Medical and Health Applications

Technical advance in radiation therapy of cancer: An example of liver cancer

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During recent 2 decades, radiation therapy has been facing a revolutionary change in technical development. Currently, 3-dimensional conformal radiotherapy is still useful as a baseline radiation therapy technology. More complicated one, intensity modulated radiotherapy (IMRT) and image guided radiotherapy have now entered into daily radiotherapy practice in clinic. However, more caution is required in clinical application of this advanced technology. While the ultimate goal is to achieve precision and accuracy, use of high end technology without appropriate monitoring and/or experienced hands often results in poorer outcome. In this regard, image guided radiotherapy (IGRT) in broader meaning is prerequisite; image-based target volume delineation, image-guided dose delivery, and finally, image-based outcome monitoring. Quality control (QC) in daily radiotherapy practice is also of utmost importance particularly with individual QC in high end technology. Current notion in radiotherapy of liver cancer is based on 2 revolutionary changes; one is conceptual change in radiotherapeutic coverage of volume from whole liver to local tumor area and the other is development of radiotherapy technology. More caution is required in applying high end radiotherapy technology on tumors in moving organ. Proper monitoring and control of organ motion are also important.

The use of nuclear science and technology in advanced brain imaging

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National Imaging Facility, University of Sydney (Brain and Mind Research Institute)

The 18 kDa translocator protein (TSPO), previously called the peripheral benzodiazepine receptor, is an ancient protein that is expressed in the brain in the wake of a broad range of injuries. The TSPO is now used as an imaging marker of "neuroinflammation" indicating active or progressive disease. TSPO expression is thus best interpreted as a nondiagnostic biomarker and disease staging tool that refers to histopathology rather than disease etiology. The therapeutic potential of TSPO as a drug target is mostly based on the current understanding that it is an outer mitochondrial membrane protein required for the translocation of cholesterol and thus regulates the rate of steroid synthesis.

The presentation will retrace the importance nuclear science and technology from the introduction of autoradiography to the use of high resolution positron emission tomography scanners. Nuclear techniques have allowed for the first time to study the brain's own immune defence cells (microglia, a type of specialised brain macrophages) and have helped to overturn a long-held belief that the brain was an immune-privileged organ without its own immune cells. This has far reaching consequences for the treatment of brain disease as varied as Alzheimer's disease or brain tumours all of which show a prominent involvement of microglia.

Posters – Medical and Health Applications

Brachytherapy of periorificial skin cancers of the face

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Management of periorificial facial skin cancers can be based on radiotherapy and/or surgery [1,2]. Tumor control, cosmetic and functional results are important endpoints in the treatment of these cancers. The aim of our study is to evaluate the therapeutic results of interstitial brachytherapy in the treatment of periorificial facial skin cancers.
We performed a retrospective analysis of 46 periorificial facial skin cancers treated with low-dose-rate interstitial brachytherapy in our department from December 2002 to November 2009. Tumor location was the nose in 18 cases, periocular in 10 cases and the lips in 18 cases. The median tumor size was 15 mm (5 – 32 mm). Histological type was basal cell carcinoma in 31 cases, squamous cell carcinoma in 13 cases and verruqous carcinoma in 2 cases. The median prescribed dose to the tumor was 71 Gy (65 – 74). After a median follow up of 52 months, two patients presented local recurrence that was managed by surgical excision. Major late complications were skin atrophy, hypopigmentation, telangiectasia and ocular dryness.

In conclusion, interstitial brachytherapy is an efficient and well tolerated treatment of periorificial skin cancers of the face. High-dose rate brachytherapy should be evaluated in the treatment of such locations in case of unavailability of iridium wires.

[1] M. Maalej, D. Hentati, M. Slimène, et al. Skin cancer in Tunisia : a retrospective study : 1379 cases and risk factors. Tunis Med 2007;85(9):728-33.

[2] C. Nasr. *La radiothérapie des cancers cutanés*. In : Maalej M, dir. Les cancers de la peau. Tunis : CPU ; 2012. p. 57-69.

Breast cancer in Tunisia: the tug-of-war continues…

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Breast cancer is the most frequent female cancer in Tunisia. Despite availability of early screening methods, the diagnosis is often made at an advanced stage.

In 1994, the standardized incidence was 16.7/100,000 women. The mean patient age was 50 years. The average size of the tumor was 49.5 mm. 7.2%, 48.9%, 18.5 % and 23.4% of tumors were respectively classified T1, T2, T3 and T4. Breast conservation was practiced in only 17.6% of patients [1].

In 2004, the standardized incidence increased to 28.5/100,000 women. The mean patient age was 51 years. The average tumor size decreased (40.8 mm). Tumor stage was T1 in 12.2% of cases, T2 in 46.9% of cases, T3 in 11.2% of cases and T4 in 24.7% of cases. 27.7% of patients had conservative treatment [2].

In 2011 (the year of Tunisian Revolution), despite the political and economic difficulties, the mean tumor size was still decreasing (27.3 mm) and breast conservation rate was increasing (38.5%).

Breast cancer incidence is progressively increasing in Tunisia. Diagnosis is done at an earlier stage due to early screening programs. Efforts must be continued in order to improve the management of this cancer and survival of patients.

[1] M. Maalej, H. Frikha, S. Ben Salem, J. Daoud, N. Bouaouina, et al. *Breast cancer in Tunisia: clinical and epidemiological study.* Bull Cancer 1999 Mar;*86*(3):302-6.

[2] M. Maalej, D. Hentati, T. Messai, L. Kochbati, A. El May, et al. *Breast cancer in Tunisia in 2004: a comparative and epidemiological study*. Bull Cancer 2008 Feb;95(2):E5-9.

Control of Unwarranted Radiation Exposures in Medical Applications

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Secondary Standard Dosimetry Laboratory, Atomic Energy Authority, Sri Lanka

Atomic Energy Authority (AEA) is the competent authority responsible for the regulation of all activities involving ionizing radiation in Sri Lanka. The AEA has established Secondary Standard Dosimetry Laboratory (SSDL) for implementation of radiation protection programme in the country to ensure the radiation safety of workers, public and environment. In the medical sector, this is achieved mainly through the regular inspections, therapy level dosimetry calibrations and radiation monitoring instrument calibrations.

The reference ion chamber & electrometer System in SSDL has been calibrated against the Radiation Standards at Dosimetry Laboratory of IAEA. The radiation standards of IAEA laboratory are traceable to the primary standards at BIPM.

This poster focused on services provided to enhance clinical medicine and healthcare in the country. SSDL Provide calibrations of therapy level dosimeters in terms of absorbed dose to water in a Co-60 beam and radiation monitoring instruments for measurement of ambient dose equivalent/rate, H*(10) for environmental monitoring instruments, personal dose equivalent Hp(10) for personal monitoring instruments & portable surface contamination monitoring instruments. Other than this SSDL provide QA/QC inspections to the hospitals which have diagnostic machines. Inspection mainly consist of the x-ray unit optimal performance and general safety provisions. Through these activities SSDL controls the unwarranted radiation exposures in medical application in Sri Lanka.

Detection of Radiation Induced Radicals in Crude Medicine Sterilized by Gamma Ray

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Medicine derived from plants are easily contaminated by microorganisms. In Asia these crude medicines have been used as foods. Ginseng is a common ingredient in soup. Radiation makes food safer by reducing the numbers of harmful bacteria and parasites. Public health agencies worldwide have evaluated the safety of food irradiation and found it to be safe. However consumers demand the labelling on package and also the exact detection method of radiation induced radicals of irradiated foods. Electron Spin Resonance (ESR) spectroscopy method is useful to detect the radicals directly. ESR spectroscopy method has already been applied for the international standard protocol of some irradiated specimens, such as the bone in fish and meats, cellulose contained in dried vegetables, and sucrose crystals in dried fruits. We have reported the radiation induced organic free radicals were detectable by ESR and proposed novel detection method of irradiated foods[1]. In the present study, we will report the radicals induced in gamma ray irradiated ginseng by ESR spectroscopy.

[1] M. Ukai and Y. Shimoyama, *Appl. Magn. Reson.* **24**, p1-11 (2003).

Implementation Of A Novel High Dose Rate Brachytherapy Planning Technique For Carcinoma Of The Cervix In Senegal: A Model For The Developing World

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[d]Overlook Medical Center, Summit, New Jersey;

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Senegal, a country in West Africa with nearly 13 million people, has one of the highest incidence rates of cervical cancer in the world. The vast majority of women do not have access to screening or treatment for the disease leading to presentation at advanced stages and to high mortality rates. Compounding this problem is the lack of radiation treatment facilities in Senegal and many other parts of the African continent. The Institute Joliot Curie Cancer Center in Dakar, Senegal is the only radiation therapy facility in the country and is a regional referral center for cervical cancer for Senegal and West Africa. Housing a Cobalt-60 teletherapy unit and a conventional simulator the clinic treats approximately 100 cervical cancer patients per year. Radiation therapy is given as both neoadjuvant treatment prior to definitive surgery and palliative treatment but not definitively because there is no access to brachytherapy. Radiating Hope, a non-profit organization whose mission is to provide radiation therapy equipment to countries in the developing world provided an high dose rate (HDR) afterloading unit to the cancer center for curative cervical cancer treatment. Here we describe the implementation of HDR brachytherapy in Senegal requiring a non-standard fractionation schedule and a novel treatment planning approach as a possible blueprint to providing this technology to other developing countries.

Improved radiolabeling of peptides with trivalent radiometals by addition of non-aqueous solvents: a pathway to kit-synthesis of radiopharmaceuticals for clinical application

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Clinical application of radiopharmaceuticals demands reproducible procedures, high radiochemical yields and high specific activities. We recently observed, that in the presence of acetone the labeling yields seem to increase compared to pure aqueous solution. The aim of this work is to investigate the effect of additional non-aqueous solvents in the reaction mixture, in synthesis efficacy of ^{68}Ga, ^{44}Sc and ^{177}Lu labeled radiopharmaceuticals.

^{68}Ga eluates were obtained from an EZAG generator, ^{44}Sc was obtained from a ^{44}Ti/^{44}Sc generator developed in University of Mainz and ^{177}Lu (n.c.a) was purchased from ITG Munich. Non-aqueous solvents were added to aqueous solutions containing DOTA- and NOTA-conjugated precursors such as octreotide derivatives. Labeling yields were analyzed by TLC and HPLC.

For almost all the non-aqueous solvents, labelling yields improved significantly for all the precursors selected and the radiometals investigated. When amounts of precursors are reduced from 40 to 10 or 4 µg, labelling yields are higher than 95% in case of ethanol mixtures, which represents significantly increased specific activities.

There is clear experimental evidence, that mixtures of aqueous and non-aqueous solvents significantly improve M(III) radiometal labeling efficacies. These findings could facilitating a wider application of M(III)-radiopharmaceuticals in routine clinical practice.

Non- destructive characterization of essential, toxic and radioactive elements in human placenta using energy dispersive x-ray fluorescence and low background gamma spectroscopy

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Pregnant women are exposed to essential, toxic and radioactive elements from the environment, food and water. The human placenta is a relevant tissue that indicates long term elements exposure to both mother and foetus [1]. 76 placental samples were collected from participants at the University hospital of the West Indies. The participants were interviewed on their average diet. A quarter of each placenta was oven dried at 60^{o}C for 96hrs before grinding. 3 grams of each sample was pelletized for handheld EDXRF analysis and 30g was placed in a round-box container to be analyzed with HPGe detector for 16hours. Eleven inorganic elements were detected by EDXRF. These elements were reported in order of increasing concentrations found in the body (As<Pb<Cd<Se<Cu<Br<Zn<Fe<Ca<S<K). The activity concentrations range for K-40 was 209 to 347 ± 28 Bq/kg and U-238 series was 2.2 to 9.1 ±1.2 Bq/kg. The Potassium concentrations obtained from EDXRF were in good agreement with the results obtained from gamma spectroscopy analysis. The results showed that maternal diet had a significant effect on the elemental concentrations in the placenta. EDXRF and Gamma spectroscopy are powerful non-destructive tools that can be used to characterize elements in human placenta. This data on placenta can also be used to model foetal exposure to essential and toxic elements.

[1] Iyengar, G.V. and A. Rapp. "Human placenta as a 'dual' biomarker for monitoring fetal and maternal environment with special reference to potentially toxic trace elements. Part 3: Toxic trace elements in placenta and placenta as a biomarker for these elements." *The Science of the Total Environment (*Elsevier) 280 (March 2001): 221-238.

Overcoming Radiation Protection Challenges in Paediatric Imaging - A collaborative approach

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Radiology practice is an established tool for medical diagnosis. In children it saves lives by diagnosis of diseases and injuries as well as reduction of need for surgical intervention. There are specific diseases unique to childhood therefore there is need for age appropriate care when performing radiological examinations.

Generally paediatrics have a higher sensitivity compared to adults thus more susceptible to radiation damage. Therefore there is a need to reduce exposure to radiation to lessen impact on life expectancy over which they may develop cancer from exposures to Ionizing Radiation. The challenges faced in paediatric imaging are mainly due to the fact that children lack co-operation and do not always understand a change in environment.
As a means of overcoming these challenges there is need to have child friendly dedicated paediatric centres equipped with specific equipment. The development of regulations and guides for paediatric imaging is essential in radiation protection. It is therefore of paramount importance that collaborative professional training and stakeholders awareness on paediatric imaging be conducted frequently. In this way recommendations to medical practitioners' board, regulatory authorities and facility management among other stakeholders can be made thus ensuring optimization of protection to paediatrics during radiological imaging.

[1] IAEA Safety Series Reports No.71 Radiation Protection in Paediatric Radiology (2012)
[2] IAEA Radiation Protection of Patients (RPOP),https://rpop.iaea.org
[3] The Alliance for Safety in Paedatric Imaging,www.gently.org

Technical Presentations – Non-Proliferation, Security and Safeguards

HEU Minimisation in Australia

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Like many countries having a research reactor dating from the fifties, Australia has had an inventory of high enriched uranium (HEU) in reactor fuel and other materials used for research projects. Since the mid-1990s Australia has worked to manage its HEU inventory by either sending spent fuel for reprocessing overseas, with future return of waste or sending US-obligated fuel to the US under the Foreign Research Reactor Spent Nuclear Fuel Acceptance (FRRSNFA) program for storage and disposal. In order to qualify for the FRRSNFA program Australia committed to converting its HIFAR reactor to low enriched uranium (LEU) fuel and repatriating all US obligated HEU fuel to the US. Since the OPAL reactor was designed to operate on LEU fuel and replaced HIFAR, it was included in the FRRSNFA program.

In 2012 Australia, in partnership with the US National Nuclear Security Agency, Global Threat Reduction Initiative conducted an HEU removal from ANSTO. This talk summarises Australia's previous spent fuel shipments and describes the key operational stages involved in the 2012 HEU Removal operation.

Nuclear Forensic Science at the Australian Nuclear Science and Technology Organisation (ANSTO)

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Nuclear Forensics Research Facility, Institute of Materials Engineering, Australian Nuclear Science and Technology Organisation, NSW, Australia.

Nuclear forensic science is "the scientific analysis of nuclear or other radioactive material, or of other evidence that is contaminated with radioactive material, in the context of legal proceedings, including administrative, civil, criminal or international law" [1]. ANSTO is home to the Nuclear Forensic Research Facility (NFRF), the central hub for nuclear forensics in Australia. ANSTO possesses the unique capabilities required to undertake nuclear forensic analyses in support of investigations including: facilities for handling radioactive material, access to a broad range of analytical services, staff with training and experience in fields ranging from radiochemistry to forensic science, and subject matter expertise for data interpretation. This presentation will describe the current activities of the NFRF including: partnerships with law enforcement to develop capabilities in the handling of contaminated forensic evidence, investigation of various signatures and their application to the provenancing of material at the front end of the nuclear fuel cycle, and the development of novel radiochronometers. The role ANSTO plays in Australia's contribution to the global development of nuclear forensics through bilateral relationships and engagement with international organisations will also be highlighted.

[1] International Atomic Energy Agency (2013) *Nuclear Forensics in Support of Investigations* Draft Implementing Guide IAEA: Vienna

Radiation detection for border security applications

A. Flynn, M. Reinhard and D. Boardman

Australian Nuclear Science and Technology Organistaion

Radiation detection techniques play an important role in border security and safeguards applications. Techniques range from the passive detection and identification of radioactive & nuclear materials through to the active imaging of cargo for dutiable and threat material. The Detector Lab at ANSTO carries out a diverse range of activities to improve current detection techniques and develop new concepts for radiation detection applications. This presentation will cover work on the development of radionuclide identifications algorithms, mapping variations in background radiation and muon tomography.

Posters – Non-Proliferation, Security and Safeguards

Evaluation of the Regulatory Framework

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Radiation Protection Authority Of Zimbabwe, Harare, Zimbabwe

Introduction

The paper is on the regulatory legislative framework of Zimbabwe that established the Radiation Protection Authority of Zimbabwe (RPAZ).

The principal objective of this paper is to ensure that the enabling Act Radiation Protection Act [15:15] is in full alignment with international safety standards and international agreements.

Methods

The Government of Zimbabwe invited the International Atomic Energy Agency (IAEA) to carry out an advisory mission to Zimbabwe (26-30 October 2009). After the assessment of the regulatory infrastructure, the IAEA recommended a revision of the Act to ensure full alignment with international safety standards and other international agreements.

The IAEA has been instrumental in the area of capacity building for the staff of RPAZ, a number of staff have been sponsored by the IAEA and the Government of Zimbabwe to attend various beneficial regional and international trainings and workshops in various areas and in particular drafting of regulations and nuclear law.

Discussion

The Act is undergoing amendment so as to correct some anomalies that were created when the present Act was drafted and promulgated. The memorandum of principles for the Radiation Protection Act amendment bill is in place and will soon be presented to Cabinet by the Office of the President and Cabinet.

The Act has placed certain powers and functions on RPAZ and such include;

"To define in regulations and authorisations the detailed obligations to be placed on those who possess radiation sources;"

As a result RPAZ through the parent Ministries has promulgated a number of regulations providing for matters which in terms of the Act are required to be prescribed for the safe and secure use of radioactive sources.

Nonproliferation, Safeguards And Nuclear Security Commitments For Brazil: The Role Of The Nuclear Regulatory Authority (CNEN)

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The international community seeks to balance the spread of the peaceful uses of nuclear energy for the benefit of all people with the guarantee of no misuse of this technology for proscribed purposes. In this direction, the existence of adequate international (such as the IAEA) and national organizations (mainly a Nuclear Regulatory Authority) is essential.

Nuclear issues are a crucial part of the foreign policy agenda of the States with consistent nuclear programs. In the case of Brazil, a well established interinstitutional coordination mechanism together with a consistent legal framework and skilled specialists are essential in order to promote a balance between the State´s objectives and international community efforts towards peace and security.

The objectives of this work are to present an overview of the commitments for Brazil in terms of nonproliferation, safeguards and nuclear security, and particularly, explain the roles of the Regulatory Authority (CNEN) in respect of those commitments.

TC project between IAEA and Azerbaijan Republic, Supporting the Preparation of the National Radiological Emergency Plan

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Ministry of Emergency Situations of Azerbaijan Republic.

Establishment of the requirements for an adequate level of preparedness for and response to a nuclear or radiological emergency in any State is essential element of safety for protection of health and minimization of danger to life and property. Existence and implementation of well-structured Nuclear Emergency Response Plan is a major requirement which helps each State to be prepared to any nuclear or radiological emergency situations and to mitigate their consequences. Azerbaijan Republic which is a Member of IAEA since 2001 has a special geographic location in terms of land and sea borders with States having nuclear facilities, nuclear technology, nuclear reactors and etc. At the same time in June 2010 within the framework of the IAEA regional project RER/9/100 EPREV mission of the IAEA assessment of emergency preparedness took place in Azerbaijan Republic. That mission indicated as a priority the need for a national plan on response to nuclear and radiological emergency situations. Due to these facts Ministry of Emergency Situations of Azerbaijan Republic decided to prepare not only radiological but also nuclear emergency response plan and appealed to IAEA assistance in this issue. The draft project was developed and submitted to IAEA. After approving by IAEA this TC project was successfully and fully implemented in 2 years (2011-2013) and the objectives have been achieved during and in the subsequent period at the national level. This project can be of greatest utility for nations having no nuclear or radiological emergency plans at place and at the same time it shows how IAEA through technical cooperation projects in cooperation with the State helps to build, strengthen and maintain the national capacities in the safe, peaceful and secure use of nuclear energy and technology.

Technical Presentations – Nuclear Design, Operations, Engineering and Maintenance

Decommissioning and Decontamination

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At the NPPs, research reactors and small facilities, production or use of radioactive materials involves the possibility of equipment and surfaces contamination.

There are fundamental causes that lead to the need of decontaminating, for example releasing materials and equipment from controlled areas to repair, replace or maintain them, and also to decommission a nuclear plant that has reached the end of This paper detailed the development of new technologies relating to decontamination of structural components and materials and decommissioning about equipment and a Regarding the equipment, it is an air cooling equipment located in the reactor building at NPP, the paper details the disassembly and decontamination, types of works and the selected methods for: place conditioning, operator´s conditions under ALARA, efficient cutting process, materials storage, decontamination and results process and DF importance.
Referring to the facility, the paper details the stages plan description for the decommissioning and decontamination, “Plant Storage and Treatment of Radioactive

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, Decommissioning of nuclear Facilities: Decontamination, Disassembly and Waste Management. TRS No.230, IAEA, Viena 1983.

Decommissioning Strategy of KHNP and Current Preparation

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After the Fukushima nuclear accident, the questions have been raised whether KHNP has a decommissioning technology and how well they have prepared for it. Korea has 23 nuclear power plants in operation and 5 units under construction. Kori unit 1, pressurized water reactor(PWR) type, has been operating its 10 year life extension till 2017 and another extension is under review. Life extension of Wolsong unit 1, pressurized heavy water reactor(PHWR) type, is still under review due to the influence of strengthened nuclear regulation since 2010. KHNP has been developing technical and business strategies for the future nuclear plant decommissioning. This presentation illustrates a general process of decommissioning from the permanent shutdown to the license termination, and fundamental decommissioning strategy of KHNP. It also provides detailed information concerning the current preparation status of decommissioning experience, R&D and the cost estimation. Lastly it presents KNHP's future plan.

Flux Screen Design for NTD in the RA-10 Project

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The Argentine National Atomic Energy Commission (CNEA) is the responsible for the design, construction and start-up of the new multipurpose research reactor, the RA-10 Project.

This new reactor will replace the RA-3 reactor in order to satisfy the increasing national and regional demands for radioisotopes.

The RA-10 is a 30 MW thermal power reactor, open-pool type with a compact core. A heavy water reflector tank surrounds the core. It provides a high thermal neutron flux adequate to house irradiation facilities [1].

The neutron transmutation doping of silicon (NTD) is one of the facilities under development for the RA10 project.

In order to obtain high quality semiconductor, commercial requirements of NTD include achieving high axial and radial uniformity in the silicon targets.
Axial uniformity is achieved locating a neutron screen around the Si ingot, obtaining a flat axial distribution of the dopant concentration.

For designing the screen, also known as flux flattener, the Monte Carlo code MCNP5 was used.

We have reached a satisfactory preliminary screen design after numerous iterations. The fluctuation in the axial distribution of the reaction capture rate ($^{30}Si(n,\gamma)^{31}Si$) is under ±1,5%, which is the required level by the semiconductor industry to accept the final product.

[1] H. Blaumann, A. Vertullo, F. Sánchez, F. Brollo and J. Longhino ”RA-10: A new Argentinian Multipurpose Research Reactor”. International Conference on Research Reactors: Safe Management and Effective Utilization Proceedings (2011), Rabat, Morocco.

Passive Reactor Core Cooling System

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Jordan Atomic Energy Commission, Shafa Badran- Amman, Jordan

This paper discusses most of design features and capabilities of the safety systems as it has been extensively studied in the Fukushima Daiichi accident, by the loss of power, the loss of cooling water flowing through the core and the loss of the ultimate heat sink. It also summarizes passive core cooling systems to remove decay heat from the reactor core in an emergency. It summarizes passive systems for cooling the containment and suppressing pressure and summarizes further technology options related to strengthening and venting containments, preventing hydrogen explosions, hardening instrumentation against radiation and cooling spent fuel.

Passive Reactor Core Cooling Systems is used to cool a reactor power without requiring AC electric power. Six variations are:

- Pressurized core flooding tanks (accumulators),
- Elevated tank circulation loops (core make-up tanks),
- Elevated gravity drain tanks,
- Passively cooled steam generator natural circulation,
- Passive residual heat removal (PRHR) heat exchangers,
- Passively cooled core isolation condensers (steam).

Passive Systems for Containment Cooling and Pressure Suppression:

- Containment pressure suppression pools
- Containment passive heat removal / pressure suppression systems
- Passive containment spray systems

Service and Maintenance of a Primary Side On-Line Chemistry Monitoring System of KNPP and co-operation between KNPP and Energoservice Personnel

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Primary Side On-Line Chemistry Monitoring System is installed in Kozloduy Nuclear Power Plant by Westinghouse. It continuously monitors important reactor coolant chemistry parameters (pH, dissolved oxygen, dissolved hydrogen and certain cations and anions). It provides information to the operational personnel and maintains optimal parameters for safe and reliable operation of the plant. This leads to equipment lifetime extension. The system consists of five modules – Sample Conditioning Rack, Neslab Chiller, Power Distribution Cabinet, Primary Side Sensor Panel and Primary Side Computer Panel, which are described in the presentation.

Energoservice is an external organization that supports the system. The support includes 24 hours on call personnel, periodic walk-downs on the equipment, repair and calibration activities, spare parts and cartridge delivery and incoming control in the presence of KNPP staff.

The responsibilities of KNPP personnel are to issue work orders, when a repair activity is needed, provides a representative from Automatic Chemical Control Laboratory, provides access to the premises in the Controlled Area.

[1] J. Balavage, Technical project Document for System Implementation, (2006).

[2] P. Penev, Operation Instruction for Primary Side On-Line Chemistry Monitoring System.

Effect analysis to Technical Specification of improvement of MCR system in nuclear plant

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Instrument and control system is one of the key comprehensive systems of Nuclear power plant. It is very important to keep the nuclear power plant operating safely and economically. China NPP Unit adopt advanced digital distributed control system (DCS), the main control room system is greatly improved in system equipment and general structure compared with the reference plant.

This paper analysis the effect to operating technical specification (OTS) of improvement of main control room system, and puts forward how to modify OTS. The paper can be the reference document for writing OTS, provides the exploitations for OTS and its base.

Posters – Nuclear Design, Operations, Engineering and Maintenance

Advanced Design Features for Safety Enhancement of the APR1400

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The Advanced Power Reactor 1400 (APR1400) is an evolutionary pressurized water reactor which has been developed under the Korean Next Generation Reactor (KNGR) project and has obtained the standard design approval in 2002. As of mid-2014, eight nuclear power plants (NPPs) are in preparation for operation or under construction, four in Korea (SKN 3&4, SUN 1&2) and four in UAE (BNPP 1,2,3&4), and four NPPs are in planning in Korea (SKN 5&6, SUN 3&4). Especially, SKN 3&4, the first construction NPPs for APR1400, are currently in the final stage to get Operating Licence.

The APR1400 has many benefits of evolutionary development such as ;

- Assurance of performance by the proven technology based on System 80+, OPR1000 experiences and R&D program,
- Cost effectiveness by uprating power level from 1,000 MWe to 1400 MWe
- Improved operability by use of compact workstation, fully digitalized technology and computerized procedure system,
- Enhanced safety by advanced new design features verified with experiments and tests.

The major advanced design features of the APR1400 to enhance safety are as follows;

- Safety Injection Systems (SIS) with Direct Vessel Injection, In-containment Refuelling Water Storage Tank (IRWST) and Fluidic Device in SI Tank,
- Shutdown Cooling System interchangeable with Containment Spray System,
- In-Vessel Corium Retention-External Reactor Vessel Cooling (IVE-ERVC) and Cavity Flooding System for Severe Accident mitigation and control,
- Safety Depressurization and Venting System (SDVS) with POSRV,
- Containment Hydrogen Management System
- Human-Machine Interface System (HMIS) and I&C Systems with full digital technology and defense against common mode failures,
- Main Control Room (MCR) with safety grade back-up display and control facilities for safe shutdown.

Comparison & Analysis of IEEE 344 and IEC 60980 standards for harmonization of seismic qualification of safety-related equipments

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The seismic qualification of safety related equipment in nuclear power plants (NPPs) should demonstrate equipment's ability to perform its safety function during and/or following a SL-2 seismic event (SSE). In addition, the equipment must withstand the effects of a number of SL-1 seismic events (OBE) without damage. IEEE 344 and IEC 60980 present the criteria for demonstrating that the Class 1E equipment can meet its performance requirement during such seismic events. Currently, IEEE 344 is mainly applied to NPPs in the United State whereas IEC 60980 is mainly applied in Europe.

Equipment suppliers and utilities have difficulties because of the different standards for seismic qualification. An equipment supplier exporting components qualified in one country to a country where the other standard applies may need to perform additional seismic qualification. Utilities attempting to modify an existing NPP (e.g. to up-rate power) constructed under one standard may encounter similar difficulties.

This paper surveys the similarities and differences between IEEE 344 and IEC 60980. The contents of IEEE 344 and IEC 60980 have some overlap, but in many cases significantly different topics. In addition, this paper considers how the two sets of standards may be used in a complementary fashion to be possible using one or the other standard area.

Conceptual Design of Nuclear Desalination for Kori Nuclear Power Plants in Korea

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Nuclear desalination is defined as production of potable water from sea water where nuclear reactor is used as the source of energy. It involves at least some degree of common or shared facilities, services, staff, operating strategies, seawater intake and discharge structures[1]. Korea Hydro & Nuclear Power Co. Ltd.(KHNP) is operating 23 commercial nuclear power plants(NPPs), and all these NPPs are located on coastal sites. Sea water reverse osmosis(SWRO) desalination could be the best candidate desalination process in Kori NPPs. Mixture(about 25 ℃) of warm turbine condenser discharge water and cool intake sea water can be used as feed water of SWRO process to enhance efficiency and stability. For the pre- and post-treatment of water in SWRO process some equipment, like purification equipment and waste water disposal equipment etc. in NPPs will be shared for economics and reducing additional site requirements. Water quality index like pH, conductivity, COD, turbidity, SS, temperature, concentration of Chloride etc. was measured monthly from October 2011 to September 2012 and considered as input variables. The total dissolved solids(TDS) concentration at Kori NPPs were around 35,000 mg· L-1. For passive coolant injection without power supply, a produced fresh water reservoir will be located at a higher elevation of the site. This nuclear desalination system is considered more economical compared to the other industrial water supply scenarios.

[1] International Atomic Energy Agency, Introduction of Nuclear Desalination, A Guidebook, TRS-400, Vienna (2000) p. 3.

Development of Severe Accident Analysis Code and Methodology in Korea

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Severe Accidents (SAs) of Nuclear Power Plants (NPPs) are hypothetical accidents beyond the scope of Design Basis Accidents (DBAs). In other words, SAs are core-melt accidents. They could lead to release fission products to the environment and they might be large impacts the public. So, it is crucial to evaluate and design appropriately for SAs in NPPs. Following the TMI-2 accident, extensive researches were carried out on SAs. Various integral codes for severe accident analyses were developed such as MAAP, MELCOR and ASTEC etc. Integral codes simulate the overall NPP response and cover almost relevant SA phenomena .The MAAP code, one of the integral codes, is widely used for design and safety studies of SA in Korea. But there might be a limitation for exportation of the NPP due to the intellectual property right. To have the competitiveness against popular SA integral codes and technical self-reliance for export without obligation, the project for the development of severe accident analysis code was launched in 2011 Korea by supported of the Korean government. The project consists of two phases for six years. The first step is development of the individual SA modules and the second step is construction of the integrated analysis code structure. During the first phase, development of the individual SA modules has been finished. Today, construction of integrated code is underway. After the completion of the project, Korea will acquire the original technology for SA analysis.

[1] KHNP-KAERI-FNC, Project plan for " Development of Severe Accident Analysis Code and Methodology" (KETEP, 2011)

[2] Bal Raj Sehgal, Nuclear Safety in LWRs , Severe Accident Phenomenology (Elsevier Inc., 2012) p 625-654

Economic Evaluation of Capital Cost, Operation and Maintenance Cost and Unit Production Cost of Kori Nuclear Desalination Plant in Korea

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After selection of the optimal conceptual design for Kori nuclear desalination plant, the economic feasibility was evaluated. In this study, 2 cases with different fresh water production capacity were studied(15,000 ㎥/day and 30,000 ㎥/day). The capital cost ranged 24.7* ~ 32.1 million dollars for 15,000 ㎥/day facility, and 44.5 ~ 59.3 million dollars for 30,000 ㎥/day facility. Operation and maintenance cost was analyzed by life cycle cost(LCC) with 4.5 % of discount rate. The life cycle cost analysis assumed two cases at 15 and 30 years. Assuming 15 year life cycle, the O&M cost was 36.5 million dollars for 15,000 ㎥/day facility, 71.2 million dollars for 30,000 ㎥/day facility. Assuming 30 year life cycle, the O&M cost ranged from 63.7 to 65.5 million dollars for 15,000 ㎥/day facility, from 123.3 to 128.8 million dollars for 30,000 ㎥/day facility. The unit production cost were 0.75 ~ 0.84 dollars at the life cycle of 15 years, 0.54 ~ 0.6 dollars the life cycle of 30 years for 15,000 ㎥/day. At 30,000 ㎥/day, the unit production cost were 0.71 ~ 0.79 dollars at the life cycle of 15 years, 0.51 ~ 0.57 dollars the life cycle of 30 years at 30,000 ㎥/day. These results indicate Kori nuclear desalination have economic merits compared with other district water rate.

(* : exchange rate : 1,011.8₩/$)

Ignalina Nuclear Power Plant Decommissioning

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Ignalina Nuclear Power Plant (INPP) contains two 1500 MW RBMK-type reactor units inherited from the former Soviet Union. Decommissioning of INPP is of an unprecedented nature and represents for Lithuania an exceptional financial burden not commensurate with the size and economic strength of the country; this has been internationally recognized [1]. In accordance with provisions of the Accession Treaty to the European Union, the last energy unit of the INPP was shut down on 31 December 2009 and the decommissioning of the INPP started. INPP decommissioning project is the first of this nature in the world taking into account that decommissioning and dismantling of power units with graphite-moderated channel-type RBMK type reactors has not been implemented. After performance of thorough analysis which encompassed economic, social, safety and know-how factors, the decommissioning strategy of immediate dismantling has been chosen [2]. Currently it is planned that the decommissioning of INPP will reach its final stage of “brown field” by the end of 2038. With respect to the complexity of the project, the efforts are made to ensure the safe and timely decommissioning of INPP while acquiring unique information and state-of-the-art knowledge that will bring common benefits for the sector.

[1] Treaty of Accession to the European Union 2003. Protocol No 4 on the Ignalina Nuclear Power Plant in Lithuania.

[2] Order of the Minister of Energy of the Republic of Lithuania on the Approval of the Final Decommissioning Plan of the INPP (2005; 2014).

The Influence of Nuclear Power Plant Operating on Phytoplankton Production

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The temporal variation and distribution of primary production was investigated to evaluate the influence of entrainment on phytoplankton production in cooling system and the effect of thermal discharge on the neritic waters off nuclear power plant. Size-fractionated (micro-, nano-, pico-size) primary production was measured using ^{14}C-method and the entrainment effect was measured by variation of specific production rate(assimilation number) after passing through the cooling system. Temporal variation of primary production showed the typical seasonal pattern of temperate region with the two peaks in spring and early summer. The contribution of large cells (micro-size, > 20 ㎛) to total primary production was higher than other groups. The contribution of small cells (nano- and pico-size, < 20 ㎛) was higher than that of micro-phytoplankton in offshore region. Primary production of phytoplankton was decreased after passing through the cooling system. Phytoplankton production was more influenced in high-temperature season. Reduced phytoplankton production was rapidly recovered by mixing with adjacent sea-water. This indicated that the cooling system of nuclear power plant had a negative effect and also influenced on primary production in discharge area, but these influence were very restrictive, less than 1 km from discharge mouth, on neritic waters off nuclear power plant.

The Installation of a New Cold Neutron Guide – Challenges Faced & Lessons Learnt

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The installation of a new cold neutron guide at the Australian Nuclear Science & Technology Organisation (ANSTO) during late 2012 was the first in-pile and primary shutter removal and replacement performed on the OPAL (Open Pool Australian Light water) Research Reactor since it first reached critically in 2006. One of the biggest challenges was the potential for significant dose rates from the irradiated components. The project was a success owing to the detailed planning, training and the involvement of Health Physics from the beginning.

As OPAL gets closer to 10 years of operation further projects will be undertaken to replace the in-piles and primary shutters of the other neutron guides to ensure the continued availability of neutrons for research. Consequently the lessons learnt from this first experience are critical to the effective planning and safe implementation of these future projects.

This poster will focus on the challenges faced and the lessons learnt, from a radiation protection and a project perspective, during the removal of the irradiated shutter and in pile guide and the installation of the new cold neutron guide.

Safety policy methods against Nuclear Power Plant Life Extension

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Currently, 437 nuclear power plants are in operation at 30 countries. Of these plants, 183 units have been operating beyond the design life called nuclear power plant life extension [1]. However, after the Fukushima nuclear accident, social demands for the nuclear safety have been increased. To meet these needs, Wolsong Unit 1 in Korea Hydro and Nuclear Power (KHNP) which is preparing the life extension, had carried out replacement of pressure tube, reinforcement of the steam generator moisture separator, and installation of the hydrogen detector, etc. These 27 safety improvement items have been qualified by safety regulations as well as the technical codes & standards (PSR, Periodic Safety Review, 2013). In addition, to prevent an accident by even disaster like the Fukushima accident, Wolsong Unit 1 in KHNP is performing the EU stress test [2], which is a targeted reassessment of the safety margins and functions of nuclear power plants under not only severe accidents but also extreme natural events. In the conclusion, above safety policy methods that are both the qualified safety improvement items and the EU stress test must be certainly accomplished to all nuclear power organization against nuclear power plant life extension in order to secure more comprehensive and systematic safety.

[1] IAEA Power Reactor Information System website (June, 2013).

[2] ENREG and the European Commission, *Declaration of ENSREG* (2011).

Site Selection and Evaluation for Nuclear Power Plant with respect to Nuclear Engineering

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As consumption for electricity soars with the rapid economic development worldwide, the pollution produced from burning of fossil fuel is heading towards the global warming which is in critical level. Also, the world's reserve of fossil fuels is drying out. Many countries are interesting in finding a reliable and sustainable energy. The revival of nuclear energy is highlighted in line with that demand. The use of nuclear energy must be safe; it shall not cause injury to people, or damage to the environment or property. In the siting of a nuclear power plant, the aim is to protect the plant against external threats as well as to minimize any environmental detriments and threats that might arise from it. There are many assessment parameters of the site selection in aspect of the nuclear engineering. The major assessment parameters are found in several guidelines and regulations from the IAEA, US NRC, and EPRI.

The various assessment parameters related to nuclear aspects can be categorized into three families:

- Atmospheric Extremes and Dispersion
- Exclusion Area and Low Population Zone
- Emergency Planning

The other parameters are no or slightly different from each other among the candidate sites.

[1] International Atomic Energy Agency, Site Evaluation for Nuclear Installations, Safety Standard Series No. NS-R-3, IAEA, Vienna (2003).

[2] US NRC Regulatory Guide 4.7, General Site Suitability Criteria for Nuclear Power Stations, Rev.2 (1998).

[3] EPRI Siting Guide, Site Selection and Evaluation Criteria for an Early Site Permit Application, Final Report (2002).

Status of Stress Test for Nuclear Power Plants in long term operation in KOREA

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In April 2013, Nuclear Safety and Security Commission(NSSC) of Korea announced the plan of implementing the stress test for long term operating nuclear power plants (Wolsong unit 1 and Kori unit 1) and published the guideline for the stress test. The guideline includes the evaluation method and items that is the impact on the safety of nuclear power plants(NPPs) due to the extreme natural disasters through the five evaluation areas specified.

Korea Hydro & Nuclear Power Co. (KHNP) carried out the stress test for the two nuclear power plants (Wolsong unit 1 and Kori unit 1) and submitted the stress test report of operator to the NSSC in July and December respectively in the same year. Those reports are being verified by regulator and civil inspectors.

Through the stress tests of the two NPPs, KHNP assessed the integrity and responsiveness of the structure, system and components in the extreme conditions of natural disasters. Also the arrival time was evaluated quantitatively to the limitation of coping strategies and the strategy minimizes human error and judgment errors were derived. As a result, the safety of the two NPPs can be sufficiently secured in the condition of extreme natural disasters if the several measures were implemented which were derived from the special safety inspection of NPPs after the Fukushima nuclear accident in addition to this stress test.

[1] KHNP, 2013, "Report on the implementation of the stress tests Wolsung unit 1 nuclear power plant.", Vol 7, pp 1~11

[2] KHNP, 2013, "Report on the implementation of the stress tests Kori unit 1 nuclear power plant.", Vol 7, pp 1~11

[3] NSSC, 2013, "Stress test for nuclear power plants in long term operation",pp1~5

[4] NSSC, 2013, " Stress test specifications",pp1~31

Studying Safety Assessment and Heat Transfer of the Reactor Pressure Vessel in Nuclear Power Plants using Different Composite Materials

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In this study, thermo-mechanical behavior of a pressure vessel for nuclear power plant having functionally graded material under the effect of a core radiation was studied. The functionally graded material is a class of composite material that the mechanical and thermal properties changes gradually changes in transverse direction.

The thermal and structural behavior was found by using analytical method, and by using Ansys Program; Coupled Field method. The analytical results were compared to computer aided design software by using (Ansys) where built in elements were used only, and another computer code MCNP code. The coupled thermoelastic analysis was carried out for determining the temperature, radial displacement, and radial and circumferential stress distributions of a classical cylinder, and later a reactor pressure vessel exposed to an inner moderator pressure, radiation and thermal loads.

For the solution, a critical region was analyzed. In order to certify our computational code, the temperature, radial displacement, radial stress, and circumferential stress distributions were also calculated using finite element (FE) method. It was concluded that the analytical results were in good agreement with the computational ones. The effect of thermomechanical loads on the temperature, displacement, and stress distributions will be discussed in detail. This is to present the analysis proposes for the thermal and structural Safety analysis of the pressure vessel using different composite materials, and to provide satisfactory results to design the reactor pressure vessels.

Poster Numbers

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1	Assessment of Trends in Freshwater Quality Using Environmental Isotopes and Chemical Techniques for Improved Resource Management
2	Chemical Deuteration of Molecules for Structural Characterisation by Nuclear-Based Techniques
3	Leaching Study in Immobilization of Radioactive Waste In Fly Ash- Zeolite Cement
4	Modeling Physical Environmental Processes of Radio Nuclides Migration by means of Smooth Particle Hydrodynamics (SPH)
5	Mutation breeding for salinity tolerance in bread wheat (Triticum aestivum L.)
6	Real-time tracking of radioxenon plumes using NaI(Tl) Detector with rapid peak identification software
Community Engagement, Education and Communications	
7	Changes in Correlation among Various Aspects Relating to Nuclear Power and Radiation Education in 2012-2013
8	Developing a Nuclear Engineering Program at UNSW
9	Efforts of WIN Slovakia to inform General public
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Medical and Health Applications	
11	Brachytherapy of periorificial skin cancers of the face
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13	Control of Unwarranted Radiation Exposures in Medical Applications
14	Detection of Radiation Induced Radicals in Crude Medicine Sterilized by Gamma Ray
15	Implementation Of A Novel High Dose Rate Brachytherapy Planning Technique For Carcinoma Of The Cervix In Senegal: A Model For The Developing World
16	Improved radiolabeling of peptides with trivalent radiometals by addition of non-aqueous solvents: a pathway to kit-synthesis of radiopharmaceuticals for clinical application
17	Non- destructive characterization of essential, toxic and radioactive elements in human placenta using energy dispersive x-ray fluorescence and low background gamma spectroscopy
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32	Site Selection and Evaluation for Nuclear Power Plant with respect to Nuclear Engineering
33	Status of Stress Test for Nuclear Power Plants in long term operation in KOREA
34	Studying Safety Assessment and Heat Transfer of the Reactor Pressure Vessel in Nuclear Power Plants using Different Composite Materials