

出國報告（出國類別：實習）

## 參加世界核能大學暑期機構課程

服務機關：台灣電力公司龍門核能發電廠

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派赴國家：加拿大

出國期間：105年6月27日~105年8月7日

## 行政院及所屬各機關出國報告提要

出國報告名稱：參加世界核能大學暑期機構課程

頁數 15 含附件：是否

出國計畫主辦機關/聯絡人/電話 台灣電力公司/陳德隆/(02)23667685

出國人員姓名/服務機關/單位/職稱/電話

黃日鉉/台灣電力公司/龍門核能發電廠/機械工程師/(02)24903550#3523

出國類別：1 考察2 進修3 研究4 實習5 其他

出國期間：105 年 6 月 27 日至 105 年 8 月 7 日 出國地區：加拿大

報告日期：105 年 9 月 7 日

分類號/目

關鍵詞：世界核能大學

內容摘要：(二百至三百字)

世界核能發電協會(World Association of Nuclear Operators, WANO)為培養新世代核能人才，提供會員公司獎學金，選派具有潛力之青年從業人員參加世界核能大學暑期學院(World Nuclear University Summer Institute, WNU-SI)。筆者由任職之台灣電力公司推薦，經 WANO 甄選後獲派參加 105 年 6 月至 8 月於加拿大渥太華舉辦之世界核能大學暑期學院課程。本報告概要介紹世界核能大學及暑期學院，以及 2016 年暑期學院之成員、課程設計及相關活動。並摘要說明為期六週之課程與活動、技術參訪之內容，及核能創新專題之成果。報告的結尾，則提出本次參加暑期學院之心得與建議。

本文電子檔已傳至出國報告資訊網 (<http://report.nat.gov.tw/reportwork>)

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## 壹、出國任務

### 一、緣起

世界核能發電協會(World Association of Nuclear Operators, WANO)為培養新世代核能人才，提供會員公司獎學金，選派具有潛力之青年從業人員參加世界核能大學暑期學院(World Nuclear University Summer Institute, WNU-SI)。筆者由任職之台灣電力公司推薦，經 WANO 甄選後獲派參加 2016 年於加拿大渥太華(Ottawa)舉辦之世界核能大學暑期學院課程。

### 二、目的

藉由參加世界核能大學暑期學院，與各國新世代人才交流，了解各國核能產業趨勢，並拓展國際視野，學習與各國學員針對各核能議題討論並合作，培養溝通協調能力以利於為本公司辦理各項業務工作。

### 三、行程

本次出國期間自 105 年 6 月 27 日至 105 年 8 月 7 日，共 42 天。任務為赴加拿大渥太華參加 2016 年世界核能大學暑期學院。主要上課地點位於渥太華蕭氏會議中心(Shaw Centre)，其中第三週為技術參訪行程。本次出國行程簡要如下表：

日期	地點	行程摘要
105/06/27	台北→溫哥華→渥太華	去程
105/06/28~105/07/09	渥太華	第一週及第二週課程
105/07/10~105/07/16	渥太華→薩斯堪通→渥太華	第三週核能設施技術參訪
105/07/17~105/08/04	渥太華	第四週至第六週課程
105/08/05~105/08/07	渥太華→溫哥華→台北	返程



蕭氏會議中心

## 貳、世界核能大學暑期學院簡介

### 一、世界核能大學

世界核能大學(World Nuclear University, WNU)為一推廣原子能和平用途之國際教育及研究組織，於 2003 年由 32 創始成員國與 4 個國際組織支持成立。

WNU 於世界各國提供一個國際性的教育及訓練課程，並由 WNU 協調中心組織規劃課程及行政聯繫工作。課程除了包含核能相關領域外，尤其著重於學員領導統御(Leadership)之建立。截至 2016 年，來自超過 60 個國家近 5000 學員已參加完成 WNU 課程。WNU 提供的課程包含暑期學院(Summer Institute)、鈾生產學院(School of Uranium Production)、一週短期課程(Short Course)、核能奧林匹亞(Nuclear Olympiad)、輻射技術學院(School on Radiation Technologies)及核能英文(Nuclear English)課程。

WNU 有 4 個主要支持機構，其中包含 2 個核能產業組織：世界核能組織(World Nuclear Association, WNA)及 WANO；以及 2 個國際組織：國際原子能總署(International Atomic Energy Agency, IAEA) 及經濟合作暨發展組織核能署(Nuclear Energy Agency of the Organization for Economic Cooperation and Development, OECD-NEA)，成立至今，其支持夥伴關係已觸及約 30 個國家，超過 40 個政府組織及的學術及產業機構。

### 二、世界核能大學暑期學院

WNU-SI 宗旨在於提供一個具全球性且完整的核能議題課程，並建立學員的領導統御、溝通、計畫及組織能力。

本屆 2016 年 WNU-SI 學員來自 31 個國家(如下表)，其專業背景亦相當廣泛，包含核能電廠、核能管制單位、核能研究實驗室、燃料製造、鈾礦開採、核能電廠除役、輻射應用醫藥、核子潛艦設計、研究所學生、律師及財務人員。此外，WNU-SI 學員在申請參訓前，均須符合以下要求：

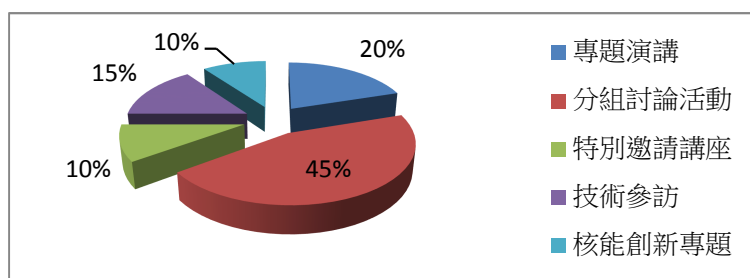
1. 目前任職於核能相關領域，並且擁有至少 3 年以上工作經驗。
2. 核能科學相關領域碩士以上(或 4 年以上核能工作經驗)。
3. 2 封推薦信內容須說明具領導潛力或專業學術上的優異。
4. 不超過 40 歲。
5. 流利的英語能力，必須能參與專業議題的討論。

區域	國家
亞洲及大洋洲	台灣、印尼、新加坡、蒙古、韓國、日本、孟加拉、斯里蘭卡、澳洲、中國
歐洲	英國、法國、土耳其、比利時、西班牙、瑞典、羅馬尼亞、亞美尼亞、愛爾蘭、烏克蘭、斯洛維尼亞、俄羅斯
北美洲	加拿大、美國、墨西哥
南美洲	古巴、阿根廷、巴西
非洲	肯亞、南非、剛果

### 參、課程紀要

本次 2016 WNU-SI 規劃 6 週的課程，並依課程形式可分成以下 5 大項：

1. 專題演講 2. 分組討論活動 3. 特別邀請講座 4. 技術參訪 5. 核能創新專題。



其中分組討論活動佔了最多的比重，WNU-SI 特別重視學員之間的交流，因此在分組討論活動中每個學員必須對特定的議題提出意見並且相互討論，並在討論過程中扮演不同角色，包含主席、記錄人及過程改善人(Process Improver)。因此，學員皆必須具備英文聽、說、讀、寫的溝通能力，是參加 WNU-SI 課程的基本要求。2016 WNU-SI 課程表及講師清單如附件一、二。

#### 一、專題演講與分組討論

2016 WNU-SI 專題演講由 31 個講師介紹共 43 個題目。每週專題演講主題如下：

第一週：全球核能現況

第二週：核能產業

第四週：核能安全、核能保安及核子保防

第五週：溝通、經濟與專案管理

除了課堂中不時有分組討論及任務出現外，每週的最後一天 WNU-SI 皆安排一個下午進行每週的系統課程複習(Systematic Lectures Review)，每位學員必須提出當週課程的重點，並分享自身與課程主題

相關的經驗。此外，WNU-SI 課程設計除了課堂演講外，還經常透過模擬實作來加深學員們印象，讓學員們從「做」中學習。

### 1. FOR-DEC 決策方法-Faber Fantasticus

FOR-DEC 是一種簡單且快速的決策方法，幫助我們在面對問題時如何做出正確的決定。字面上，FOR-DEC 即為以下個步驟的縮寫：

**Facts**：收集相關有用的資訊，列出所有目前發生的狀態。

**Options**：提出決定之多種選項。

**Risk & Benefits**：列出各種選項之優缺點。

- **(Re-think...)**：再次重複以上步驟。

**Decision**：作出決策。

**Execution**：執行決策。

**Check**：確認過程。

第一步驟必須盡可能地收集資訊以及了解現況，避免過度解讀其中某一項資訊。提出可能的解決方案，避免只有一種選擇而沒有其他替代方案。對提出的解決方案列出所有優缺點，尤其是可能發生較嚴重的風險，應該特別考慮。重複檢視以上的步驟，想想是否有所遺漏之處。再來做出決策，避免以投票做出決定，而且這個決策必須與執行者溝通清楚。執行者之間必須做好良好的溝通協調，而且避免在決策之前就開始動作。此外，在過程中必須對每個環節進行確認，確認收集或提出的意見必須是正確的。

Faber Fantasticus 是一個模擬組裝車廠的遊戲，經由遊戲過程訓練學員的溝通協調與決策方式。學員分為 4 個組裝廠、協調者及觀察者。協調者接受任務，須在有限的時間內調度 4 個組裝廠合作完成任務。第一輪遊戲開始，協調者卻接收過多任務，各組裝廠之間也為了爭取時間，不停要求其他組裝廠提供零件，造成場面非常混亂。觀察者提出改善方式，每次只執行一項任務，只有協調者能夠指揮各組裝廠，並且利用三向溝通，確認指令傳遞正確。此外，在執行前使用 FOR-DEC 決策方式選擇任務，再交給執行團隊執行。結果第二輪的得分大幅提昇。學員們皆能透過實作，體驗講師介紹的 FOR-DEC 決策方式。



## 2. 策略性溝通-模擬核能事故記者會

2016 WNU-SI 安排第五週參訪加拿大核能安全委員會 (Canada Nuclear Safety Commission, CNSC)，上午專題演講策略性溝通(Strategic Communications)，說明溝通能力對於核能從業人員的重要。溝通不僅是傳遞訊息，更重要的是語境(Context)的建立，包含周圍的環境、因果的脈絡。此外，成功的傳遞訊息可以從三個面向思考：邏輯、情感、值得信任的人(Logos, Pathos, Ethos)，即事情本身的邏輯，傳遞的方式或語調，以及誰來說明適當。

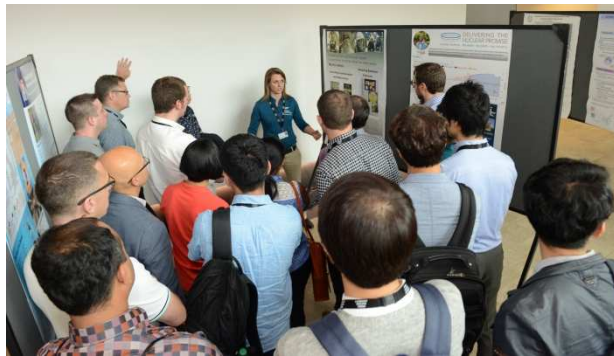
下午課程安排模擬電廠發生事故，並舉行說明記者會。學員們依自身實際工作背景分組，扮演不同角色：業主(電力從業人員)、管制單位(政府公務人員)、記者(研究單位人員)以及民眾(其他)。筆者參與業主角色，再分為發言人、運轉、工程設計、輻射防護等小組，以有限的資訊進行攻防推演，包含事故敘述、肇因分析、對環境影響以及採取行動，期間管制單位也會不時提出要求或澄清，如修復計畫。記者會開始，面對高舉反對標語的民眾，發言人先敘述過程，並說明業主的行動，並展現負責任的態度。多數的提問不會觸及細節的技術或運轉問題，大多關心外釋的輻射物質對環境影響。如何在過程中如何取得民眾的信任非常重要，其中一段本組發言人以感性的口吻，講述背自身負核能安全的壓力，並以安全運轉為己任，讓扮演抗議民眾的學員也為之動容。在與民眾溝通時，除了理性地說明事件本身，以貼近民眾的語言拉近與民眾的距離也相當重要。





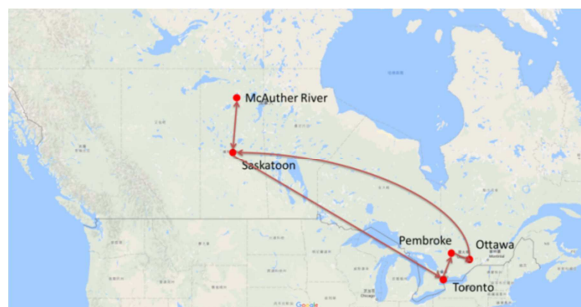
## 二、海報討論(Poster Session)

WNU-SI在課程前3個月便通知各學員準備一份A0大小海報簡報，內容包含學員們的專業領域，以及自己的工作任務。當課程開始，WNU-SI安排在各專題演講間之休息時間，讓學員們輪流介紹自己的海報，並且回答其他學員們或導師們的提問，藉此訓練學員視覺及口語的溝通技巧。每週以不同的主題分類，包含核能產業、核能安全、輻射應用、人力資源發展等，學員們可以在課餘時間或午餐時間交流討論。筆者選擇第二週主題核能產業，並向其他學員們介紹龍門電廠封存現況，簡報如附件三。



## 三、技術參訪(第三週)

加拿大在核能產業發展得相當完整，從供應鏈最源頭的鈾礦開採，到後端電廠除役均有相當的經驗。學員實際參訪核能設施，體驗現場工作環境，筆者雖然任職於核能電廠，但對其他核能設施，如鈾礦場、轉化廠，卻是第一次參訪，在台灣也沒有這些核能設施，因此筆者感到相當有興趣並認為此機會實屬難得。技術參訪行程簡要如下：



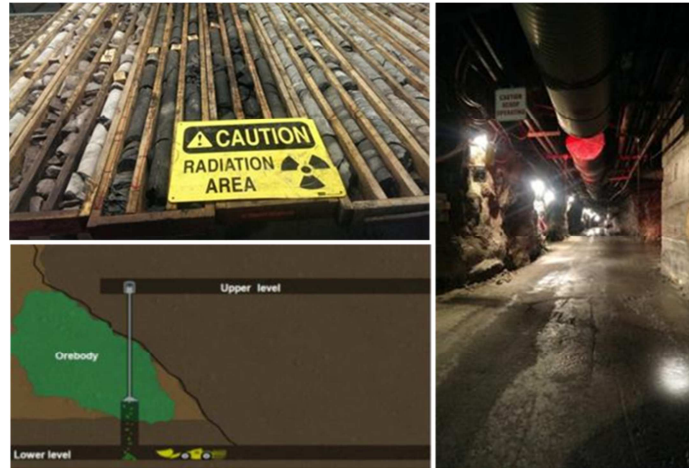
日期	行程	行程摘要
7/10	Ottawa→ Regina→Saskatoon	移動日，由 Ottawa 搭乘飛機至 Regina 再轉飛至 Saskatoon，當晚搭乘公車至住宿處。
7/11	Saskatoon→ McArthur River	搭乘 Saskatoon 當地小飛機至 McArthur River，再搭乘 Cameco 公司接駁車至麥克阿瑟河鈾礦坑參訪。當晚回 Saskatoon 住宿。
7/12	Saskatoon→ Toronto	移動日，由 Saskatoon 搭乘飛機至 Toronto，當晚參觀 Niagara 瀑布後回 Toronto 住宿。
7/13	Toronto→ Darlington	由 Toronto 搭乘接駁車至 Darlington 核能展示中心參訪，下午至 Darlington 核能發電廠參觀。當晚回 Toronto 住宿。
7/14	Toronto→ Port Hope→ Pembroke	由 Toronto 搭乘接駁車至 Port Hope 紀念公園聽取簡報，再參觀鈾轉化廠，當晚搭乘接駁車至 Pembroke 住宿處。
7/15	Pembroke→ Chalk River	由 Pembroke 搭乘接駁車至 Chalk River 核能實驗室聽取簡報，參觀 NPD 除役反應器，當晚回 Pembroke 住宿處參加 Chalk River 核能實驗室晚宴。

#### 1. 麥克阿瑟河鈾礦坑(McArthur River Mine)

麥克阿瑟河鈾礦坑由卡梅克公司 (Cameco) 及加拿大阿海法資源公司 (Areva Resources Canada) 共有，分別佔有 70% 及 30% 的股份。麥克阿瑟河鈾礦坑位於加拿大薩克其萬省北部，於 2000 年開始商業生產鈾礦，是現今世界上最大之高濃度鈾礦坑，預估藏有 345.2 百萬磅的鈾礦，平均濃度高達 15.8%。麥克阿瑟河鈾礦坑於 2012 年之鈾礦供給產量佔全世界 13% (全加拿大產量約占 15%，僅次於哈薩克 36%)，並於 2014 年創下 20.86 百萬磅產量之世界紀錄。每年的產量足以提供全美國 7% 之電力需求。

本次參訪實地進入至開採鈾礦現場，先搭乘電梯至鈾礦上方層 (地下 530 公尺)，再搭乘車輛至鈾礦下方層 (地下 640 公尺)。參觀時，工作人員實地操作機具挖礦並由現場領班對學員解說，讓筆者

及許多未進入過礦坑的學員均感到十分新奇。開採鈾礦分為 3 大步驟：1.由上方層往下鑽孔通過鈾礦至下方層。2.由下方層往上回挖鈾礦。3.回填水泥。此外，在鈾礦的四周以管路深入地層，管路內含冷媒，以冷凍法築成一道冰牆，防止地下水再開採鈾礦時流入地層造成結構鬆動。



## 2. 達林頓核能發電廠(Darlington NGS)

安大略電力公司(Ontario Power Generation, OPG)旗下之達林頓核能發電廠擁有 4 部 CANDU 機組，共輸出 3,524MW，位於多倫多城市東方 70 公里遠。其提供約 20% 之安大略省之電力需求，足以供給 2 百萬人生活用電。目前達林頓電廠正進行 4 部機組之更新計畫(Refurbishment Program)，預計由 2016 年 10 月開始進入執行階段(Execution Phase)本參訪行程上午至核能展示館參觀並聽取 OPG 董事長 Bernard Lord 簡報，下午分為 3 小組，分別參觀達林頓電廠之訓練中心、廢料管理中心及發電廠。

由於筆者任職於核能電廠，對其他營運中電廠狀況特別感興趣，因此選擇參觀發電廠內部。不同於本國擁有的 BWR、PWR 及 ABWR，加拿大設計的 CANDU 機組使用重水(D<sub>2</sub>O)作為爐心緩和劑及冷卻劑，且燃料棒為水平布置設計，燃料內 U<sup>235</sup> 濃度僅為天然鈾濃度，不須經過濃縮(Enrichment)過程，但因燃料燃耗低，爐心設計為不需停機即可於線上更換燃料。本次參觀電廠之控制室及汽機廠房，4 個機組共用 1 個控制室及廠房空間，電廠內部環境相當乾淨整潔，許多同為電廠工作人員的學員均表示相當讚賞。



### 3. 霍霍港鈾轉化廠(Port Hope Conversion Facility)

卡梅克公司所有的霍霍港鈾轉化廠為西方國家中 4 所鈾轉化廠之一。採礦而得的  $U_3O_8$  經過提煉(Refining)後產生的  $UO_3$  為鈾轉化廠之原料，再依不同使用目的將  $UO_3$  轉化為  $UF_6$  或  $UO_2$ 。霍霍港鈾轉化廠產能中， $UF_6$  佔了 80%，供給鈾濃縮(Enrichment)廠提高  $U^{235}$  濃度後，再轉化為  $UO_2$  並製成燃料後供輕水式反應器使用。其他 20% 產能為  $UO_2$ ，此未經過濃縮過程的  $UO_2$  (天然鈾濃度) 可直接製成燃料後供重水式反應器使用，如 CANDU 機組。



### 4. 核能展示電廠除役計畫(NPD Closure Project)

核能展示電廠(Nuclear Power Demonstration)是加拿大第一座反應器及 CANDU 反應器原型設計，輸出功率為 19.5MWe。位於首都渥太華東北方約 200 公里遠，1962 年開始營運，其主要目的為研究發展 CANDU 形式反應器，提供燃料、材料、組件及儀器之測試用。1988 年因 CANDU 發展成熟，達到其建造目標後停機。

雖然此研究用反應器已經停機多年，進入參觀時仍然比照營運電廠需著裝防護衣，離開時也需通過輻射劑量測量。現今除了反應爐內部燃料及未受污染的組件已經全部移除(包含控制室設備)，其

他管路及設備均仍留在廠內，目前 NPD 僅維持適當人力保存現況並維持監視，預計管制單位於 2018 年前核准最終除役計畫，若經核准將以水泥填封廠房內部所有空間，並於其上覆蓋土壤及植被。



#### 四、核能創新專題(Network for Nuclear Innovation)

核能創新專題的目的是為了讓學員能夠討論重要的全球核能議題，並且能夠提出新的觀點。核能創新專題排定於課程的尾聲，由學員們依個人志願選擇主題進行分組，7 項討論主題如下：

1. The possible solutions for the technical and economic challenges of the integration of nuclear and renewables in low carbon grid
2. The 4Rs – reduction, reuse, recycling and recovery – A case study in the nuclear industry
3. Initiating or expanding the use of nuclear energy
4. Nuclear safety regulators effectiveness
5. Contributing to the Harmony Programme
6. Leadership and employee development
7. An effective international verification system

確定分組後，學員們必須於課程最後一週星期一報告提案，簡單報告各組主題及預定完成目標，例如向公共媒體或國際會議投稿等，並由其他組別提出問題，藉由與其他組別學員討論，修正或加強報告內容。並於 2 天後提出 30 分鐘之專題成果發表，呈現的方式由各組創意發想，格式不拘，由於各組成員多來自不同專業、不同國家、不同文化，在各種想法衝擊下，產生各種精彩的呈現方式，例如以戲劇呈現職場情境、或是以模擬公聽會方式討論核能議題、甚至有以百萬大富翁方式與台下其他組員互動。堪稱是整個課程中最精彩的活動之一。

筆者選擇的主題為核能和諧計畫(Harmony Programme)：

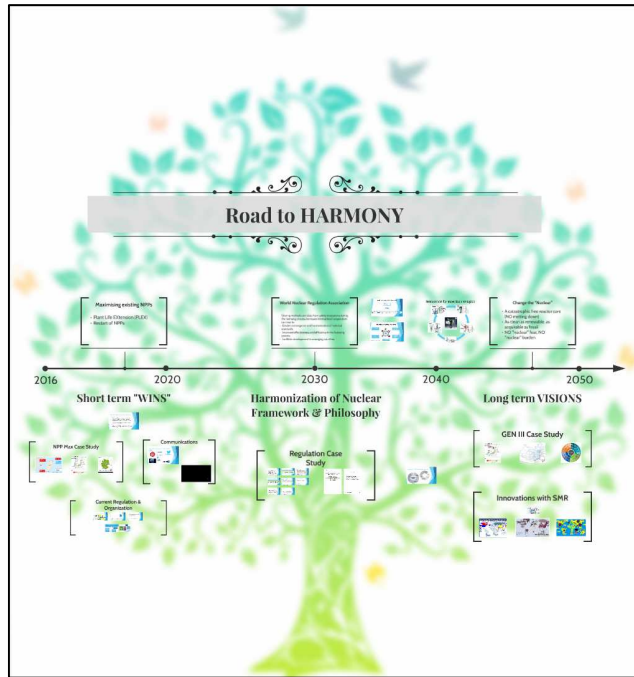
1. 核能和諧計畫的緣由是來自於國際能源總署(International Energy Agency, IEA)提出 2050 年前地球暖化必須小於 2°C 的情

況下，IEA 對各種能源方式的占比提出目標，其中除了增加風力、太陽能及水力發電的裝置容量外，核能也扮演了相當重要的角色。IEA 認為核能在 2050 年時必須達到全世界 17% 的能源占比，從 2014 年核能的發電量為 396GW，佔全球能源 11%，扣除掉 2050 年前退役共 150GW 的核能機組，還必須增加 680GW 的核能發電量，才能達到 17% 共 930GW 的目標。

2. 但是 IEA 所提出的目標內有一重要的前提，二氧化碳捕捉技術(Carbon Capture and Storage, CCS)必須發展成熟，其可將火力電廠排放的二氧化碳收集儲存於地質結構或生物吸收，預期約可使火力電廠減少 85%~90% 的碳排放。但是此技術是否能於預估期程內成熟仍是一項未知數。因此，為了補償 CCS 未能於預估時程內發展技術成熟，核能和諧計畫提出全球核能發電量，在 2050 年必須達到佔全球發電量 25% 的目標，必須興建 1000GW 的核能機組。
3. 本組學員來自台灣、英國、日本、韓國及中國。專業背景包含核能電廠、電力公司總部、鈾濃縮廠及核能研究單位。此外，本組另有一法國籍導師 Francois Perchet 協助學員們討論，導師並不直接參與討論，但會適時提出問題，幫助學員們思考並鼓勵學員提出解決方案。
4. 為了達成於 2050 年前興建 1000GW 的目標，本組將主題分為短程、中程及長程計畫。
  - i. 短程目標：2016~2020 年每年增加 10GW，共 50GW。在近五年內，我們認為應將重點放在短期治標方法 (Short-Term Wins)。福島事件過後，因為民眾反對核能，造成興建中核能電廠暫停，例如我國的龍門電廠，以及日本超過 50 部核能機組停機，這些都是在短期能夠努力的目標。由台灣與日本的個案研究發現，民意的影響非常重要，因此對民眾正確的溝通，傳遞核能的重要是目前的首要工作。
  - ii. 中程目標：2021~2025 年每年增加 25GW，共 125GW。由於各國核能法規的標準不一致，造成核能機組在各國進出口上的阻礙，這些核能法規的差異使得核能在發展的路上添增許多複雜度，並且耗費相當多的時間及成本，因此

在中期目標，希望能夠盡量減少各國核能法規的差異，以加速核能的發展。以日本 ABWR 為例，日本的核能法規依循 JSME，但為了要輸出 ABWR 至英國，必須做出許多設計變更以符合英國採用的 EN Standard 核能法規。本組一位任職於日立奇異的日本學員，自身參與緊急爐心冷卻系統(ECCS)的安全分析，便提出兩國法規在安全定義上的差異。因此，如何能夠讓各國的核能法規往標準化修正，是中程目標中的重要工作。達成這項目標必須有一跨國際組織主導這項工作，本組認為 IAEA 是一個相當適合的國際組織，並建議其下建立名為世界核能法規協會 (World Nuclear Regulator Association, WNRA)，對各國核能管制單位進行協調，提供一個平台，供各國分享核發執照時的方法、資料數據，將各國的核能法規朝標準化邁進，增加核發執照的效率。

- iii. 長程目標：2026~2050 年每年增加 33GW，共 825GW。在長程的目標中，我們認為對核反應器的設計創新發展，這些新一代的反應器，例如第四代反應器(Gen IV)、小規模模組反應器(Small Modular Reactor, SMR)，若能發展成功，將提供更多樣化的核能選擇，甚至翻轉民眾對核能的印象。例如球床反應器(Pebble Bed Reactor)不會發生燃料熔毀，民眾對核電廠的安全疑慮消弭，更可能消除人們對核電廠的恐懼。最後本組提出民眾支持、設計發展、政策方向等都是環環相扣，若是以技術直接消除人們疑慮，重返 1980 年代核能發展最顛峰的盛況仍是可期的。
- 5. 此外，本組利用 Prezi 網站製作簡報，用更生動活潑的簡報及影片報告和諧計畫，並上傳於網頁上，以期能讓更多的人瞭解和諧計畫，並支持核能發展，簡報如下連結：  
<https://goo.gl/oeKSSO>



核能創新專題-和諧計畫 Prezi 簡報

#### 肆、課餘活動

除了課堂上專業的討論外，WNU-SI 非常重視來自各國家間的文化交流，因此，安排了許多課餘活動，並要求學員們自行協調及安排內容。例如每週皆有一天的區域派對，歐洲、美洲、亞洲及非洲的學員準備來自自己國家的傳統食物或小吃，並提供一個輕鬆交流的場所。此外，學員們也利用 WNU-SI 的手機應用程式(APP)成立許多社團，例如慢跑、游泳社團等。

#### 伍、心得與建議

##### 一、面臨國際減碳趨勢，應審慎思考核能政策

在全球面臨氣候變遷之際，2015 年底在法國巴黎召開 UNFCCC 第 21 次締約國大會(COP 21)通過備受全球期待關注之「巴黎協定」(Paris Agreement)，這項普遍性協定的主要目的，是保持本世紀中全球氣溫升高不超過工業化前水準的 2°C。台灣因為自然資源不足，高達 97.5% 能源需由國外進口，在能源價格波動劇烈、全球減碳壓力漸增以及電力需求持續成長挑戰下，核能提供一種「安全」、「穩定」、「價格合理」之能源選項。

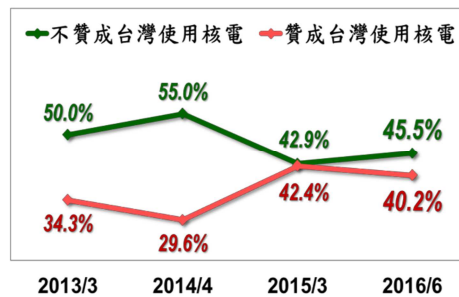
筆者於 6 個星期中與來自超過 30 個國家的學員交流，認為福島事件過後，各國仍對核能有所期待，包含目前正建造超過 20 部機組的中國、成功輸出核電的韓國。其中尤以日本特別值得我國借鏡，日本與我國同樣缺乏自產能源資源，約 84% 能源必須仰賴進口，但日本歷經福島



核災後並無廢除核電，反而在重新審視安全標準後，致力於重啟核電。日本政府多數反核的民意下勇於重啟核電，值得台灣借鏡與思考。

## 二、與民眾溝通為首要工作

1. 在日本發生福島核災事件之後，對全球的核能民意造成深遠的影響。於 2014 年國內反核聲浪高漲，高達 55% 民眾反對核能，僅 29.6% 支持核能，政府遂於 2014 年作出封存龍門電廠決定。因此，民眾對核能的支持度在核能發展的道路上是依相當關鍵的因素。政策常依附於民意的動向。世界各國在核能政策的修正，在歷史上也是屢見不鮮。目前 2016 年支持與反對核能的民意分別為 45.5% 及 40.2%，反對與支持的差距已大幅縮小，建議台電公司持續教育民眾正確的觀念，並拉近與民眾的距離，例如參訪核電廠，進而增加民眾的信賴感與支持度。



2016/7/29 Taiwan Mood Barometer Survey, TMBS

2. 建議台電公司在與民眾溝通前，先與員工溝通。身為核能工作者，所關心的不能只有工程專業問題，與民眾「溝通」更是一項重要責任。每個在核能領域的員工都是最好的宣傳者，以自身的經驗及專業給予身邊民眾正確的核能資訊，避免因為誤解而反對核能。因此建議台電公司對員工教育上，除了專業知識外，可以加強教育核能相關知識，例如世界核能趨勢、核廢料處置或輻射對環境影響等。透過此教育過程，除了能增加員工對核能的信心及身為核能工作者的成就感，並建立員工對民眾「溝通」的責任感。

## 三、做好封存龍門電廠，保留未來彈性選擇

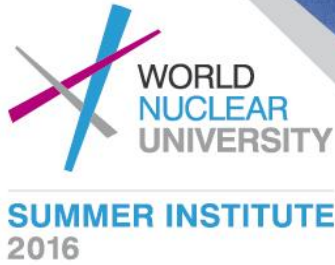
龍門電廠 2 部進步型沸水式(ABWR)機組，屬目前商用反應器中最先進之第三代改良型(Gen III+)，相較現今多數之壓水式(PWR)及沸水式(BWR)反應器，在安全、輻射防護及廢料減量等各方面均有長足進步。雖然龍門電廠已進入封存階段，但是未來在台灣面臨電力短缺之際，仍然是深具優勢的能源選項之一。因此，台電公司應持續做好龍門電廠之

封存工作，以保留台灣未來在能源上的一項選擇。

#### 四、持續培養國際視野及人際網絡(Network)

WNU-SI 課程中，導師們及主辦單位不斷地提醒學員 Network 的重要，並要求學員們在課程中及課餘活動時主動與人互動，包括同學、導師、講師或邀請講座(Invited Leader)。透過與其他人交流，開闊自己的視野，除了分享自身的專業知識及不同的文化想法，並且能建立起自身的人際網絡。許多電力公司或集團年年皆派員參加 WNU-SI 課程，以培養員工能力，建議台電公司持續派員年輕員工參與各類國際核能交流活動，建立國際交流管道並擴展自身國際視野。

此外，應善用網路工具與世界人才連結，例如 Facebook、Twitter 或 LinkedIn，這些網路工具除了分享生活上的吃喝玩樂，還可以提供很方便且無時差的討論交流空間，許多核能相關網路社群包含 WNN、NucNet Nuclear News、US WIN、NuclearInstitute YGN 等，皆提供相當豐富的核能相關資訊，加入這些社群可以即時幫助了解世界上的核能新知，並掌握國際趨勢。



The WNU Summer Institute aims to:

- a) Provide a global picture on the full spectrum of issues surrounding nuclear energy and to develop skills in leadership, communication, planning and organization.
- b) Offer quality education and nuclear training from the world's foremost experts and leaders in nuclear science, engineering and business enhanced by practical workshops, interactive platforms and a visit to nuclear facilities

22/07/2016

WNU Summer Institute 2016 Programme						
Week 1- Introduction and Global Settings						
Date	Start	End	Title	People	Category	Location
Tue 28 June	14:00	0:00	Check in Hotel Westin	All	Check in	Hotel Westin
	16:00	19:00	Fellows' registration	Lylah Davies (WNU) and interns	Registration	Shaw Centre Lobby Level 1
	19:00	21:00	Dinner	All	Social Event	Shaw Centre
Wed 29 June	8:30	9:00	Registration for late arrivals	Lylah Davies (WNU) and interns	Registration	Shaw Centre Lobby Level 1
	9:00	9:30	Welcome to the WNU Summer Institute 2016	Patricia Wieland (WNU), Mentors, Organizers	Introductions	Shaw Centre room 102
	9:30	10:30	Fellows self-introductions *	Fellows	Introductions	Shaw Centre room 102
	10:30	11:00	Networking and refreshments break			
	11:00	12:30	Fellows self-introductions (cont.) *	Fellows	Introductions	Shaw Centre room 102
	12:30	14:00	Lunch			
	14:00	14:45	Overview of 2016 SI - Objectives and Programme Working Groups dynamics and topics	Patricia Wieland (WNU)	Curriculum Presentation	Shaw Centre room 102
	14:45	15:00	What are your expectations? Envelope! *	All, interns	Introductions	Shaw Centre room 102
	15:00	15:45	Best practice from previous Fellows: how to make the most of your time at the SI	Lee Casterton (CNSC), Brady Balicki (Cameco) SI 2015 fellows	Curriculum Presentation	Shaw Centre room 102
	15:45	17:30	Getting acquainted with your Working Groups: extended self-introductions *	Working Groups A	Group Activity	Shaw Working Group rooms
	17:30	18:00	Industry Posters session preparation *	Industry posters authors	Poster Session	Shaw Colonel By Foyer
20:00	22:00	Dinner	All	Social Event	Shaw Colonel By Foyer	

\*Please refer to the Guidelines for more information.

Thur 30 June	8:50	9:00	Warm Welcome from World Nuclear University	Patricia Wieland (WNU)	Welcome	Shaw Thrillum Ballroom Level 4
	9:00	9:10	Warm Welcome from Canada	tbc	Welcome	Shaw Thrillum Ballroom
	9:10	9:50	World energy issues: the current situation and looking forward	Helmut Engelbrecht (World Nuclear Association)	Invited Leader Presentation	Shaw Thrillum Ballroom
	9:50	10:30	Strength through diversity: leadership in tomorrow's nuclear field	Janice Dunn Lee (IAEA)	Invited Leader Presentation	Shaw Thrillum Ballroom
	10:30	11:00	Networking and refreshments break			
	11:00	12:00	Panel discussion with invited leaders	All	Round Table	Shaw Thrillum Ballroom
	12:00	14:00	Lunch			
	14:00	15:00	Nuclear Fuel: demand and supply	Fletcher Newton (TENAM)	Curriculum Presentation	Shaw Centre room 102
	15:00	15:30	Networking break			
	15:30	16:30	COP 21: Progress made and the role of nuclear power	Malcolm Grimston (Imperial College Centre for Energy Policy and Technology)	Curriculum Presentation	Shaw Centre room 102
	18:40	18:40	Bus leaves to Museum	All	Transit	Westin Hotel
	19:00	22:00	Welcome reception - Buffet dinner and drinks	All	Social Event	Canadian Museum of History Voyager Salon
	Fri 01 July	22:00	22:10	Bus 1 leaves for Hotel	All	Transit
22:45		23:00	Bus 2 leaves for Hotel	All	Transit	Westin Hotel
8:50		9:00	Good Morning from Canada and What's up in WNN	Fellows	Group Activity	Shaw Centre room 102
Sat 02 July	9:00	9:30	Team building exercise preparation	Lylah Davies (WNU)	Group Activity	Shaw Centre room 102
	9:30	11:00	Team building exercise	Working Groups A	Group Activity	Shaw Working Group rooms
	Free time - Canada National day					
	8:30	10:00	Nuclear reactors: how they work	Claudio Almeida (ex-CNEN)	Curriculum Presentation	Shaw Centre room 102
10:00	10:30	Networking and refreshments break				
10:30	12:00	Overview of the nuclear fuel cycle and nuclear techniques	Alan Waltar (ex-PNNL)	Curriculum Presentation	Shaw Centre room 102	
12:00	13:00	Lunch				
13:00	14:00	Waste management: scientific and technical aspects	Tom Isaacs (ex-LLNL)	Curriculum Presentation	Shaw Centre room 102	
14:00	14:15	Networking break				
14:15	15:00	Waste management: societal aspects	Tom Isaacs (ex-LLNL)	Curriculum Presentation	Shaw Centre room 102	
15:00	18:00	Systematic lectures review on Global Setting *	Working Groups A	Group Activity	Shaw Working Group rooms	
19:00	21:00	Dinner (Karaoke night)	Working Groups A	Social Event	Shaw Centre Level 2 room 210	
Sun 03 July	Free time					

\*Please refer to the Guidelines for more information.

Week 2 - Nuclear Industry						
Mon 04 July	8:15	8:20	Coming up this week	Patricia Wieland (WNU)	Curriculum Presentation	Shaw Centre room 102
	8:20	8:30	Good Morning from Argentina and Brazil and What's up in WNN	Fellows	Group Activity	Shaw Centre room 102
	8:30	9:30	Invited Leader Presentation	Carl Marcotte (SNC-Lavalin Nuclear)	Invited Leader Presentation	Shaw Centre room 102
	9:30	10:00	Networking and refreshments break			
	10:00	12:00	Dealing with human errors	D. Schwalbe (Interpersonis)	Curriculum Presentation	Shaw Centre room 102
	12:00	13:00	Lunch			
	13:00	14:30	Communication in high risk environment	D. Schwalbe (Interpersonis)	Curriculum Presentation	Shaw Centre room 102
	14:30	15:00	Networking break			
	15:00	15:30	Introduction "Faber Fantasticus"	D. Schwalbe (Interpersonis)	Interactive Platform	Shaw Centre room 102
	15:30	17:00	Faber Fantasticus-1 <sup>st</sup> round	D. Schwalbe (Interpersonis) - 4 Groups	Group Activity	Shaw Working Group rooms
	17:00	17:30	Summary and feedback	D. Schwalbe (Interpersonis)	Interactive Platform	Shaw Centre room 102
Tue 05 July	8:20	8:30	Good Morning from Australia and Indonesia What's up in WNN	Fellows	Group Activity	Shaw Centre room 102
	8:30	09:30	Leadership development	Ken Ellis ( ex- WANO)	Curriculum Presentation	Shaw Centre room 102
	9:30	10:00	Networking and refreshments break			
	10:00	10:15	Introduction to Faber Fantasticus - 2 <sup>nd</sup> round	D. Schwalbe (Interpersonis)	Curriculum Presentation	Shaw Centre room 102
	10:15	12:00	Leadership in high risk environments	D. Schwalbe (Interpersonis)	Curriculum Presentation	Shaw Centre room 102
	12:00	13:00	Lunch			
	13:00	14:15	Faber Fantasticus - 2nd round	D. Schwalbe (Interpersonis) - 4 Groups		
	14:15	14:45	Networking break			
	14:45	16:00	Faber Fantasticus-3 <sup>rd</sup> round	D. Schwalbe (Interpersonis) - 4 Groups	Group Activity	Shaw Working Group rooms
	16:00	17:00	Summary and Feedback	D. Schwalbe (Interpersonis)	Curriculum Presentation	Shaw Centre room 102
19:00	23:00	Dinner with mentors (self organized)	Working Group A	Social Event		

\*Please refer to the Guidelines for more information.

Wed 06 July	8:20	8:30	Good Morning from Cuba and Mexico and What's up in WNN	Fellows	Group Activity	Shaw Centre room 102
	8:30	10:30	Review of previous day; Heuristics: How do humans make decisions?	D. Schwalbe (Interpersonis)	Curriculum Presentation	Shaw Centre room 102
	10:30	11:00	Networking and refreshments break			
	11:00	12:00	Structured Decisions: the FOR-DEC method	D. Schwalbe (Interpersonis)	Curriculum Presentation	Shaw Centre room 102
	12:00	13:00	Lunch			
	13:00	15:30	FOR-DEC training	D. Schwalbe (Interpersonis) - 4 Groups	Group Activity	Shaw Working Group rooms
	15:30	16:00	Summary and Feedback	D. Schwalbe (Interpersonis)	Curriculum Presentation	Shaw Centre room 102
	16:00	16:30	Group photo	All	Group Activity	Shaw Centre room 102
	16:30	17:30	Poster session on nuclear industry *	All	Poster Session	Shaw Colonel By Foyer
	17:00	18:00	Mini Forum on Waste management (self organized)*	Fellows	Mini Forums	Shaw Centre room 102
Thu 07 July	8:20	8:30	Good Morning from Sri Lanka and Bangladesh and What's up in WNN	Fellows	Group Activity	Shaw Centre room 102
	8:30	9:30	U Exploration, mining and milling, conversion	Cory Kos ( Cameco)	Curriculum Presentation	Shaw Centre room 102
	9:30	10:00	Networking and refreshments break			
	10:00	11:00	U enrichment	Salem Thyne (Urenco)	Curriculum Presentation	Shaw Centre room 102
	11:00	11:15	Networking break			
	11:15	12:15	Supply chain quality, vendor oversight and control of suppliers	Greg Kaser (World Nuclear Association)	Curriculum Presentation	Shaw Centre room 102
	12:15	13:30	Lunch			
	13:30	14:30	Current electricity generation in the world	Igor Piro (University of Ontario Institute of Technology)	Curriculum Presentation	Shaw Centre room 102
	14:30	17:00	Systematic lectures review *	Working Groups A	Group Activity	Shaw Working Group rooms
	17:00	18:00	Mini Forum on Reactor operation and maintenance (self organized)*	Fellows	Mini Forums	Shaw Centre room 102
Fri 08 July	8:20	8:30	Good Morning from USA and What's up in WNN	Fellows	Group Activity	Shaw Centre room 102
	8:30	9:30	Invited Leader Presentation	Mark Lesinski (CEO CNL)	Invited Leader Presentation	Shaw Centre room 102
	9:30	10:00	Networking and refreshments break			
	10:00	11:00	Advanced NPP design and small modular reactors	Glen Watford (GE Hitachi)	Curriculum Presentation	Shaw Centre room 102
	11:00	11:15	Networking break			
	11:15	12:15	Lessons learned from new NPP constructions	Greg Kaser (World Nuclear Association)	Curriculum Presentation	Shaw Centre room 102
	12:15	13:30	Lunch			
	13:30	14:30	Nuclear refurbishment	Aninda Ray (Amec Foster Wheeler Nuclear Canada)	Curriculum Presentation	Shaw Centre room 102
	14:30	17:00	Systematic lectures review *	Working Groups A	Group Activity	Shaw Working Group rooms
	17:00	17:30	Sum-up* of the first 2 weeks Feedback	Working Groups A	Group Activity	Shaw Working Group rooms
	20:00	23:00	Regional party - Americas and Oceania (self organized)	All	Social Event	
Sat 09 July	Free time					

\*Please refer to the Guidelines for more information.

Week 3 - Technical vist - Please check the website for updates!!						
Sun 10 July	05:30 06:50	05:30 06:50	Bus leaves to technical trip	All - PLEASE BRING PASSPORT		see WNUSI2016 website
	08:00 09:20	11:49 12:00	Flight to Saskatoon	All	Travel day	see WNUSI2016 website
	13:30	14:15	Lunch	All+ Cameco ex-SI fellows		Sheraton Hotel, Saskatoon
	14:15	15:15	The future is U	Tim Gitzel (Cameco)	Invited Leader Presentation	Sheraton Hotel, Saskatoon
Mon 11 July	7:00	7:00	Bus leaves for airport	All	Technical vist	Sheraton Hotel, Saskatoon
	10:30	15:30	Mine tour ( Key Lake mill, McArthur River mine, Cigar Lake mine)		Technical vist	Sheraton Hotel, Saskatoon
Tue 12 July	7:50	7:50	Bus leaves for airport	All	Technical vist	Sheraton Hotel, Saskatoon
	10:30	15:28	Flight to Toronto	All	Travel day	Hilton Garden Inn, Ajax, Toronto
Wed 13 July	tbc	tbc	Bus leaves	All		
	tbc	tbc	NPP In station; Nuclear Waste Management facility or Darlington Nuclear Training and Mock up Facility		Technical vist	Ontario Power Generation (OPG) Hilton Garden Inn, Ajax, Toronto
Thur 14 July	tbc	tbc	Bus leaves to Port Hope Fuel Services (see bus times in the website)			
	tbc	tbc	Conversion Facility: UO <sub>2</sub> and UF <sub>6</sub> production		Technical vist	Cameco Fuel Services, Port Hope Pembroke: Best Western Inn/Holiday Inn Express
Fri 15 July	tbc	tbc	Bus leaves to Canadian National Laboratory (CNL) (see bus times in the website)	All		
	tbc	tbc	NRU reactor, hot cells, waste storage			Chalk River Pembroke: Best Western Inn / Holiday Inn Express
	20:00	22:00	Chalk river tour and dinner	All + CNL ex -SI fellows	Social Event	Chalk River (tbc)
Sat 16 July	travel to Ottawa / free time					
Sun 17 July	Free time					

\*Please refer to the Guidelines for more information.


Week 4 - Safety, Security and Safeguards						
Mon 18 July	8:15	8:30	Coming up this week	Patricia Wieland (WNU)	Curriculum Presentation	Shaw Centre room 102
	8:20	8:30	Good Morning from Armenia and Slovakia, safety first and What's up in WNN	Fellows		Shaw Centre room 102
	8:30	9:30	Introduction to the 3S Scientific basis of radiological protection	Abel Gonzalez (ARN)	Curriculum Presentation	Shaw Centre room 102
	9:30	10:00	Networking and refreshments break			
	10:00	11:00	International safety regime and lessons learned from past radiological accidents	Abel Gonzalez (ARN)	Curriculum Presentation	Shaw Centre room 102
	11:00	11:15	Networking break			
	11:15	12:15	Emergency Response at Fukushima Daini Nuclear Power Station during the Great East Japan Earthquake and Tsunami	Naohiro Masuda (TEPCO)	Invited Leader Presentation	Shaw Centre room 102
	12:15	13:30	Lunch			
	13:30	14:30	Current Status and the Future of Fukushima Daiichi Nuclear Power Station	Naohiro Masuda (TEPCO)	Invited Leader Presentation	Shaw Centre room 102
	14:30	15:30	Table top exercise on radiological protection *	Abel Gonzalez Working Group A	Group Activity	Shaw Working Group rooms
	15:30	15:45	Answer to the table top exercise	Abel Gonzalez	Curriculum Presentation	Shaw Centre room 102
	15:45	16:00	Networking break			
	16:00	17:00	Improving Defense-in-Depth based on Lessons Learned from the accident at Fukushima Daiichi NPP	Akira Omoto (Tokyo Institute of Technology)	Curriculum Presentation	Shaw Centre room 102
	17:00	17:30	3S' Posters session preparation	3S' posters authors		Shaw Colonel By Foyer
	18:00	19:00	Mini Forum on Regulatory body activities (self organized)*	Fellows		Shaw Centre room 102

\*Please refer to the Guidelines for more information.



Tue 19 July	8:20	8:30	Good Morning from Romania and Ukraine, safety first and What's up in WNN	Fellows	Group Activity	Shaw Centre room 102
	8:30	9:30	Invited Leader Presentation	Peter Prozesky (WANO)	Invited Leader Presentation	Shaw Centre room 102
	9:30	10:00	Networking and refreshments break			
	10:00	11:00	Nuclear safety culture	Riccardo Chiarelli (WANO)	Curriculum Presentation	Shaw Centre room 102
	11:00	12:15	Case Study preparation	Working Group A	Group Activity	Shaw Working Group rooms
	12:15	13:30	Lunch			
	13:30	16:00	Case Study preparation	Working Group A	Group Activity	Shaw Working Group rooms
	16:00	18:00	Case Study presentations	Working Group A	Group Activity	Shaw Centre room 102
	19:00	21:00	Dinner	All	Social Event	Shaw Centre
Wed 20 July	8:20	8:30	Good Morning from South Korea, safety first and What's up in WNN	Fellows	News	Shaw Centre room 102
	8:30	9:30	Fundamentals of Security and Safeguards	Sukesh Aghara (ULowell)	Curriculum Presentation	Shaw Centre room 102
	9:30	10:00	Networking and refreshments break			
	10:00	11:00	Integrating Nuclear Security and Safeguards	Sukesh Aghara (ULowell)	Curriculum Presentation	Shaw Centre room 102
	11:00	11:15	Networking break			
	11:15	12:15	The trouble with justification: exploring the ethical dimensions of risk-inherent energy technology assessment	Gaston Meskens (SCK-CEN)	Curriculum Presentation	Shaw Centre room 102
	12:15	13:30	Lunch			
	13:30	15:00	The trouble with justification: exploring the ethical dimensions of risk-inherent energy technology assessment	Gaston Meskens (SCK-CEN)	Curriculum Presentation	Shaw Centre room 102
	15:00	15:30	Networking break			
	15:30	16:30	The road map for international NPP design standardization	Barry Kaufer ( World Nuclear Association)	Curriculum Presentation	Shaw Centre room 102
16:30	18:30	Poster session on 3S's	All	Poster Session	Shaw Colonel By Foyer	
Thur 21 July	8:20	8:30	Good Morning from Belgium and France, safety first and What's up in WNN	Fellows	Group Activity	Shaw Centre room 102
	8:30	9:30	Introduction to nuclear law	Christelle Drillat (IAEA)	Curriculum Presentation	Shaw Centre room 102
	9:30	10:00	Networking and refreshments break			
	10:00	11:00	R&D&I: Accelerator driven systems	Valeriia Starovoitova (Niowave, Inc)	Curriculum Presentation	Shaw Centre room 102
	11:00	11:15	Networking break			
	11:15	12:15	Development of human resources for new or expanding nuclear power programmes	Tom Mazour	Curriculum Presentation	Shaw Centre room 102
	12:15	13:30	Lunch			
	13:30	15:00	Pandora's promise	All	Video	Shaw Centre room 102
	15:00	15:30	Networking break	All		
	15:30	16:30	Discussion and Preparation of questions	Working Group A	Group Activity	Shaw Working Group rooms
16:30	17:30	Q&A video conference with Robert Stone	All, Robert Stone	Video Conference	Shaw Centre room 102	

\*Please refer to the Guidelines for more information.

Fri 22 July	8:20	8:30	Good Morning from Ireland and UK and safety first and What's up in WNN	Fellows	Group Activity	Shaw Centre room 102
	8:30	9:30	Invited Leader Presentation	Michael Binder (CNSC)	Invited Leader Presentation	Shaw Centre room 102
	9:30	10:00	Networking and refreshments break			
	10:00	11:00	Risk informed regulations, operations and decision making. Part I	Amir Shahkarami (CASE Global Partners, Inc)	Curriculum Presentation	Shaw Centre room 102
	11:00	11:15	Networking break			
	11:15	12:00	Risk informed regulations, operations and decision making. Part II	Amir Shahkarami (CASE Global Partners, Inc)	Curriculum Presentation	Shaw Centre room 102
	12:00	13:00	Lunch			
	13:00	16:30	Systematic lectures review*	Working groups A	Group Activity	Shaw Working Group rooms
	16:30	17:30	Feedback - Week 3 and 4 - Sum up*	Working groups A	Group Activity	Shaw Working Group rooms
	19:00	23:00	Regional party - Europe (self organized)	All	Social Event	
Sat 23 July	12:00	22:00	Rafting Day			Owl Rafting on the Ottawa River, Foresters Falls
Sun 24 July	Free time: Suggestion: Parliament building					

\*Please refer to the Guidelines for more information.

Week 5 - Effective Communications, Project Management						
Mon 25 July	8:00	8:00	Arrive at CNSC	All ( bring passport) 	10' walking transit	Westin Hotel to CNSC
	8:15	8:30	Welcome from CNSC	Marc Leblanc (CNSC)	Invited Leader Presentation	CNSC/ Public hearing room
	8:30	8:35	Coming up this week	Patricia Wieland (WNU)	Curriculum Presentation	CNSC/ Public hearing room
	8:35	10:00	Effective communications about nuclear energy	Scott Peterson (NEI)	Curriculum Presentation	CNSC/ Public hearing room
	10:00	10:30	Networking and refreshments break			
	10:30	11:15	Effective communications about nuclear energy	Scott Peterson (NEI)	Curriculum Presentation	CNSC/ Public hearing room
	11:15	12:30	Social media and instructions for teams to prepare for the afternoon session	Tara Young and Scott Peterson	Group Activity	CNSC/ Public hearing room
	12:30	13:30	Self-organized Lunch			CNSC
	13:30	14:45	Team preparation for scenarios	4 groups (regulators/ industry/ public+NGOs /press)	Group Activity	CNSC
	14:45	15:30	Simulation of a press conference on radiation release from a facility	4 groups (regulators/ industry/ public+NGOs /press)	Simulation	CNSC/ Public hearing room
	15:30	16:00	Networking and refreshments break			
		16:00	17:30	Simulation of a public meeting on announcement of a new nuclear facility		
	17:30	18:00	Review lessons learned and feedback from the fellows/mentors	All	Group Activity	CNSC/ Public hearing room
Tue 26 July	8:20	8:30	Good Morning from South Africa and Singapore and What's up in WNN	Fellows	Group Activity	Shaw Centre room 102
	8:30	9:30	Nuclear energy in new comer countries	Masahito Yoshimura (Hitachi-GE)	Invited Leader Presentation	Shaw Centre room 102
	9:30	10:00	Networking and refreshments break			
	10:00	11:00	Nuclear economics	Milton Caplan (MZConsulting)	Curriculum Presentation	Shaw Centre room 102
	11:00	11:15	Networking break			
	11:15	12:15	Nuclear project structuring and financing	Milton Caplan (MZConsulting)	Curriculum Presentation	Shaw Centre room 102
	12:15	13:30	Lunch			
	13:30	14:15	Nuclear Energy in India	Shah Nawaz Ahmad (World Nuclear Association - India)	Curriculum Presentation	Shaw Centre room 102
	14:15	14:30	Networking break			
	14:30	18:00	Case Study on project management: nuclear energy developments *	Network for Nuclear Innovations	Case Study	Shaw Working Group rooms
	19:00	21:00	Dinner with mentors (self organized)	All	Social Event	

\*Please refer to the Guidelines for more information.

Wed 27 July	8:20	8:30	Good Morning from China and What's up in WNN	Fellows	Group Activity	Shaw Centre room 102
	8:30	9:30	Presentation on the case study	Network for Nuclear Innovations	Case Study	Shaw Centre room 102
	9:30	10:00	Networking and refreshments break			
	10:00	11:00	Presentation on the case study	Network for Nuclear Innovations	Case Study	Shaw Centre room 102
	11:00	11:15	Networking break			
	11:15	12:15	Invited Leader Presentation	Laura Rockwood (VCDNP)	Invited Leader Presentation	Shaw Centre room 102
	12:15	13:30	Lunch			
	13:30	14:30	Transport of radioactive materials	Henri-Jacques Neau (WNTI)	Curriculum Presentation	Shaw Centre room 102
	14:30	15:00	Networking break			
	15:00	17:00	Manager's role in transport - solving issues	Network for Nuclear Innovations	Group Activity	Shaw Centre room 102
Thur 28 July	8:20	8:30	Good Morning from Japan and What's up in WNN	Fellows	Group Activity	Shaw Centre room 102
	8:30	9:30	Invited Leader Presentation	Ramzi Jammal (CNSC)	Invited Leader Presentation	Shaw Centre room 102
	9:30	10:00	Introduction to the Network for Nuclear Innovations	Patricia Wieland (WNU) and mentors	Curriculum Presentation	Shaw Centre room 102
	10:00	10:30	Networking and refreshments break	All		
	10:30	12:30	Network for Nuclear Innovations preparation	Network for Nuclear Innovations	Group Activity	Shaw Working Group rooms
	12:30	13:30	Lunch			
	13:30	13:30	Bus departure	Bring passport 	Transit	Shaw Centre
	14:00	15:30	Emergency response and monitoring	Group 1/ Group 2	Technical vist	Health Canada/CNSC
	15:30	16:15	Break and transit	All	Transit	Transit
16:15	17:45	Emergency response and monitoring	Group 2 /Group 1	Technical vist	CNSC/Health Canada	
Fri 29 July	8:20	8:30	Good Morning from Russia and Spain and What's up in WNN	Fellows	Group Activity	Shaw Centre room 102
	8:30	9:30	Development: top manager's role in corporate Rosatom	Kirill Komarov (Rosatom)	Invited Leader Presentation	Shaw Centre room 102
	9:30	10:00	Networking and refreshments break	All		
	10:00	12:15	Network for Nuclear Innovations preparation	Network for Nuclear Innovations	Group Activity	Shaw Working Group rooms
	12:15	13:30	Lunch			
	13:30	18:00	Network for Nuclear Innovations preparation	Network for Nuclear Innovations	Group Activity	Shaw Working Group rooms
	19:00	23:00	Regional party - Africa & Asia (self organized)	All	Social Event	
Sat 30 July	Free time Working group rooms will be available to prepare final projects.					
Sun 31 July	Free time Working group rooms will be available to prepare final projects.					

\*Please refer to the Guidelines for more information.

Week 6: Network for Nuclear Innovations – Summing Up						
Mon 1 Aug	8:15	8:20	Coming up this week	Patricia Wieland (WNU)	Curriculum Presentation	Shaw Centre room 102
	8:20	8:30	Good Morning from Turkey and What's up in WNN	Fellows	Group Activity	Shaw Centre room 102
	8:30	9:30	Network for Nuclear Innovations - Presentation of project plan			Shaw Centre room 102
	9:30	10:00	Networking and refreshments break			
	10:00	11:00	Network for Nuclear Innovations- Presentation of project plan	Network for Nuclear Innovations	Group Activity	Shaw Centre room 102
	11:00	12:00	Network for Nuclear Innovations preparation	Network for Nuclear Innovations	Group Activity	Shaw Working Group rooms
	12:00	13:00	Lunch			
	13:00	18:00	Network for Nuclear Innovations preparation	Network for Nuclear Innovations	Group Activity	Shaw Working Group rooms
	18:00	19:00	Mini Forum on Research and Development (self organized)	Fellows	Mini Forums	Shaw Centre room 102
Tue 02 Aug	8:20	8:30	Good Morning from Kenya and Congo and What's up in WNN	Fellows	Group Activity	Shaw Centre room 102
	8:30	9:30	Taking the Summer Institute back to work	Patricia Wieland (WNU)	Curriculum Presentation	Shaw Centre room 102
	9:30	10:00	Networking and refreshments break			
	10:00	12:00	Individual and group action plan and Feedback	All	Evaluations	Shaw Working Group rooms
	12:00	13:00	Lunch			
	13:00	18:00	Network for Nuclear Innovations preparation	Network for Nuclear Innovations	Group Activity	Shaw Working Group rooms
Wed 03 Aug	8:20	8:30	Good Morning from Mongolia and Mauritania What's up in WNN	Fellows	Group Activity	Shaw Centre room 102
	8:30	9:00	Network for Nuclear Innovations 1 presentation	Network for Nuclear Innovations	Group Activity	Shaw Centre room 102
	9:00	9:10	Q&A	All	Group Activity	Shaw Centre room 102
	9:10	9:40	Network for Nuclear Innovations 2 presentation	Network for Nuclear Innovations	Group Activity	Shaw Centre room 102
	9:40	9:50	Q&A	All	Group Activity	Shaw Centre room 102
	9:50	10:30	Networking and refreshments break			
	10:30	11:00	Network for Nuclear Innovations 3 presentation	Network for Nuclear Innovations	Group Activity	Shaw Centre room 102
	11:00	11:10	Q&A	All	Group Activity	Shaw Centre room 102
	11:10	11:40	Network for Nuclear Innovations 4 presentation	Network for Nuclear Innovations	Group Activity	Shaw Centre room 102
	11:40	11:50	Q&A	All	Group Activity	Shaw Centre room 102
11:50	13:30	Lunch				

\*Please refer to the Guidelines for more information.

	13:30	14:00	Network for Nuclear Innovations 5 presentation	Network for Nuclear Innovations	Group Activity	Shaw Centre room 102
	14:00	14:10	Q&A	All	Group Activity	Shaw Centre room 102
	14:10	14:40	Network for Nuclear Innovations 6 presentation	Network for Nuclear Innovations	Group Activity	Shaw Centre room 102
	14:40	14:50	Q&A	All	Group Activity	Shaw Centre room 102
	14:50	15:20	Network for Nuclear Innovations 7 presentation	Network for Nuclear Innovations	Group Activity	Shaw Centre room 102
	15:20	15:40	Q&A	All	Group Activity	Shaw Centre room 102
	15:40	15:50	Greetings from Sweden!	Fellows	Group Activity	Shaw Centre room 102
	15:50	16:00	Awards for distinguished participation	Lylah Davies (WNU)	Awards	Shaw Centre room 102
Thur 04 Aug	9:00	9:30	IAEA Technical cooperation programmes for nuclear development	Ana Caiado-Raffo (IAEA)	Invited Leader Presentation	Fairmont Castle, Canadian Theatre
	9:30	10:00	Looking forward: nuclear energy issues and opportunities	William Magwood (OECD/NEA)	Invited Leader Presentation	Fairmont Castle, Canadian Theatre
	10:00	10:30	Networking and refreshments break			
	10:30	11:00	Going to the next level	Agneta Rising (World Nuclear Association)	Invited Leader Presentation	Fairmont Castle, Canadian Theatre
	11:00	11:30	Nuclear safety in a global context	Jacques Regaldo (WANO)	Invited Leader Presentation	Fairmont Castle, Canadian Theatre
	11:30	11:45	Networking break			
	11:45	12:30	Round Table discussion and evaluation of the Summer Institute	P. Wieland (WNU), W. Magwood (OECD/NEA), A. Caiado-Raffo (IAEA), J. Regaldo (WANO), A. Rising (World Nuclear Association/WNU)	Round Table	Fairmont Castle, Canadian Theatre
	12:30	12:40	Break			
	12:40	13:30	Certificate ceremony	All		Fairmont Castle, Drawing room
	13:30	14:30	Lunch			Fairmont Castle, Drawing room
	18:45	19:00	Group Photo			Fairmont Castle, Laurier room
	19:00	23:45	Gala dinner	All	Social Event	Fairmont Castle, Laurier room
Fri 05 Aug	8:00	10:00	Networking breakfast	All		Hotel Westin
	12:00	12:00	Check out	All		Hotel Westin

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## 2016 WNU-SI講師名單

項次	講師	職務	組織/公司	國家	主題	類別	日期
1	Patricia Wieland	Head	World Nuclear University	英國	Welcome and Introduction to the WNU SI. Taking Summer Institute Back to Work.	課程介紹	2016/6/29
2	Brady Balicki	Lead	Cameco Corporation	加拿大	How to make most of your time at the WNU SI	專題演講	2016/6/29
3	Lee Casterton	Regulatory Program Officer	CNSC	加拿大	How to make most of your time at the WNU SI	專題演講	2016/6/29
4	Fletcher Newton		TENAM Corporation	美國	Nuclear Fuel: Demand and Supply	專題演講	2016/6/30
5	Helmut Engelbrecht	Head	World Nuclear Association	英國	Why do People Want Nuclear Energy	邀請講座	2016/6/30
6	Malcom Grimston	Professor	Imperial College, London	英國	COP 21: Progress Made and Role of Nuclear Power	專題演講	2016/6/30
7	Janice Dunn Lee	Deputy Director General	International Atomic Energy Agency	奧地利	Building Tomorrow's Nuclear Leadership	邀請講座	2016/6/30
8	Michael Binder	President	CNSC	加拿大	Warm Welcome from Canada. Excellence in Nuclear Regulation.	邀請講座	2016/6/30
9	Lylah Davies	Project Officer	World Nuclear University	英國	Team Building Exercise Preparation. Awards for Distinguished Participation.	課程介紹	2016/7/1
10	Tom Isaacs	Retired	ex-LLNL	美國	Waste Management: Scientific and Technical Aspects. Waste Management: Social Aspects.	專題演講	2016/7/2
11	Alan Waltar	Retired	ex-PNNL	美國	Overview of the Nuclear Fuel Cycle and Nuclear Techniques	專題演講	2016/7/2
12	Caludio Almeida	Retired	Ex-IAEA and ex-CNEN	巴西	Nuclear Reactors: How They Work	專題演講	2016/7/2
13	Daniel Schwalbe	Director	Interpersonis	德國	Dealing with Human Errors. Communication in High Risk Environment. Introduction to Faber Fantasticus.	專題演講	2016/7/4
14	Carl Marcotte	CEO	SNC Lavalin	加拿大	Canada's Role in the Evolving Nuclear Landscape	邀請講座	2016/7/4
15	Ken Ellis		ex-WANO	加拿大	Global Perspective. Dimensions of Leadership.	專題演講	2016/7/5
16	Cory Kos	Manager	Cameco Corporation	加拿大	Uranium Exploration, Mining, Milling and Conversion	專題演講	2016/7/7
17	Salem Thyne		Urenco	美國	Uranium Enrichment	專題演講	2016/7/7
18	Igor Pioro	Professor	University of Ontario Institute of Technology	加拿大	Current Electricity Generation in the World	專題演講	2016/7/7
19	Greg Kaser		World Nuclear Association	英國	Supply Chain Quality, Vendor Oversight and Control. Lessons Learned from New NPP Constructions.	專題演講	2016/7/7
20	Mark Lesinski	CEO	Canadian Nuclear Laboratories	加拿大	The Lab, An Example and Some Thoughts	邀請講座	2016/7/8
21	Glen Watford	Chief Engineer	GE-Hitachi	美國	Advanced NPP Design	專題演講	2016/7/8
22	Aninda Ray	Senior Nuclear Engineer	Amest Foster Wheeler Nuclear Canada	加拿大	Nuclear Refurbishments	專題演講	2016/7/8

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23	Rachelle Girard	Director Investor Relations	Cameco Corporation	加拿大	Overview of Cameco Operations	邀請講座	2016/7/10
24	Les Yesnik	General Manager	Cameco Corporation	加拿大	Cigar Lake - World's Highest Grade Uranium Deposit	參訪介紹	2016/7/11
25	Daley McIntyre	Superintendent	Cameco Corporation	加拿大	Key Lake - World's Largest Uranium Milling Operation	參訪介紹	2016/7/11
26	Craig Lapointe	Technical Specialist	Cameco Corporation	加拿大	Key Lake Mill Operations (part of main presentation)	參訪介紹	2016/7/11
27			Cameco Corporation	加拿大	McArthur River - World's Largest High-Grade Uranium Mine	參訪介紹	2016/7/11
28	Don Jarron	Director	Ontario Power Generation Nuclear	加拿大	OPG Waste Management	參訪介紹	2016/7/13
29	Glenn Jager	President and CNO	Ontario Power Generation Nuclear	加拿大	What Makes OPG Unique	參訪介紹	2016/7/13
30	Dietmer Reiner	Senior Vice President	Ontario Power Generation Nuclear	加拿大	Darlington Refurbishment Program	參訪介紹	2016/7/13
31	Len Clewett	Executive VP and CNO	Ontario Power Generation Nuclear	加拿大	An overview of the Canadian Regulatory Framework	參訪介紹	2016/7/13
32	Darryl Godfrey	Manager	Cameco Corporation	加拿大	Overview of UO2 Production at the Port Hope Facility	參訪介紹	2016/7/14
33	Glenn Case	Senior Technical Advisor	Canadian Nuclear Laboratories	加拿大	Port Hope's nuclear history and initiatives to cleanup	參訪介紹	2016/7/14
34	Jeremy Whitlock	Senior Scientist	Canadian Nuclear Laboratories	加拿大	Splitting Atoms, Canadian Style	參訪介紹	2016/7/15
35	Naohiro Masuda	Managing Executive Officer	Tokyo Electric Power Corporation	日本	Emergency Response at Fukushima Daini NPP. Status of Fukushima Daiichi NPP.	邀請講座	2016/7/18
36	Akira Omoto	Professor	Tokyo Institute of Technology	日本	Learnings from Fukushima Dai-ichi Accident	專題演講	2016/7/18
37	Abel Gonzalez		Autoridad Regulatoria Nuclear	阿根廷	What are your expectations (envelope exercise). Scientific Basis of Radiological Protection. Safety Regime and Lessons Learned from Past Accidents.	專題演講	2016/7/18
38	Peter Prozesky	CEO	WANO	英國	Leadership Courage	邀請講座	2016/7/19
39	Riccardo Chiarelli		WANO	英國	Nuclear Safety Culture	專題演講	2016/7/19
40	Gaston Meskens	Professor	University of Ghent	比利時	The trouble with justification: exploring the ethical dimensions of risk inherent energy technology assessment	專題演講	2016/7/20
41	Barry Kaufer		World Nuclear Association	英國	Roadmap for International NPP Design Standardization	專題演講	2016/7/20
42	Sukesh Aghara	Professor	University of Lowell, MA	美國	Fundamentals of Security and Safeguards. Integrated Nuclear Security and Safeguards.	專題演講	2016/7/20
43	Valeriia Starovoitova		Niowave Inc.	美國	R&D&I: Accelerator Driven Systems	專題演講	2016/7/21



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44	Tom Mazour	Retired	ex-IAEA and ex-NE	美國	Dev. of human resources for new or expanding NPP	專題演講	2016/7/21
45	Christelle Drillat	Legal Officer	IAEA	奧地利	Introduction to Nuclear Law	專題演講	2016/7/21
46	Amir Shahkarami	President and CEO	CASe Global Partners and ex-Exelon	美國	Risk Informed Regulation, O&M, Decision Making - Part 1. Risk Informed Regulation, O&M, Decision Making - Part 2.	專題演講	2016/7/22
47	Scott Peterson	Senior Vice President	Nuclear Energy Institute	美國	Strategic Communications. Digital Strategy.	專題演講	2016/7/25
48	Marc Leblanc		CNSC	加拿大	Commission Tribunal Process	專題演講	2016/7/25
49	Shah Nawaz Ahmad	Senior Advisor	World Nuclear Association	印度	Nuclear Energy in India	專題演講	2016/7/26
50	Masahito Yoshimura		Hitachi-GE	日本	Prospects of Nuclear Development in the Future	邀請講座	2016/7/26
51	Milton Caplan	President	MZ Consulting and ex-AECL	加拿大	Nuclear Economics. Nuclear Project Structuring and Financing.	專題演講	2016/7/26
52	Henry-Jacques Neau	General Secretary	World Nuclear Transport Institute	英國	Transporting Radioactive Materials	專題演講	2016/7/27
53	Laura Rockwood	Executive Director	Vienna Center for Disarmament and Non-Proliferation	奧地利	Nuclear Non-proliferation Regime and IAEA Safeguards	邀請講座	2016/7/27
54	Ramzi Jammal	Executive Vice-President	CNSC	加拿大	CNSC Licensing Process	邀請講座	2016/7/28
55	Richard Tennant	Emergency Management	CNSC	加拿大	Emergency Preparedness and Response	專題演講	2016/7/28
56	Ana Claudia Raffo-Caiado	Director	IAEA	奧地利	The IAEA's Technical Cooperation Programme	邀請講座	2016/8/4
57	Jacques Regaldo	Chairman	WANO	英國	Nuclear Safety in a Global Context	邀請講座	2016/8/4
58	Agneta Rising		World Nuclear Association	英國	Going to the Next Level	邀請講座	2016/8/4
59	William Magwood	Head	OECD/NEA	美國	Looking forward: Nuclear Energy Issues and Opportunities	邀請講座	2016/8/4
60	Kirill Komarov	President	Rosatom	俄羅斯	Video Message on Looking to the Future of Nuclear Power	邀請講座	2016/8/4



# DEFERRAL STATUS of LUNGMEN NUCLEAR POWER PLANT

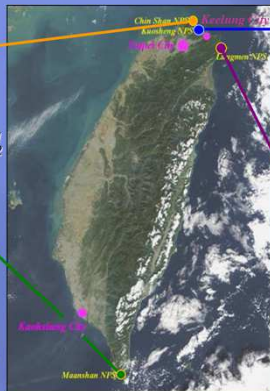
Jih-Hsuan Huang Taiwan Power Company, Taiwan

## Introduction

There are two 1350 MWe Advanced Boiling Water Reactors (ABWR) under construction at Lungmen, near Taipei. Construction began in 1999 with intention of 2004 completion. However, in April 2014 in response to political discord the government said that unit 1 would be mothballed once safety checks were complete, and construction of unit 2 would be halted.



**Chinshan NPS**  
GE BWR-4 636 MWe x2  
Commercial Dec-1978 Unit1  
Jul-1979 Unit2



**Kuosheng NPS**  
GE BWR-6 985 MWe x2  
Commercial Dec-1981 Unit1  
Mar-1983 Unit2



**Maanshan NPS**  
Westinghouse PWR  
951 MWe x2  
Commercial Jul-1984 Unit1  
May-1985 Unit2



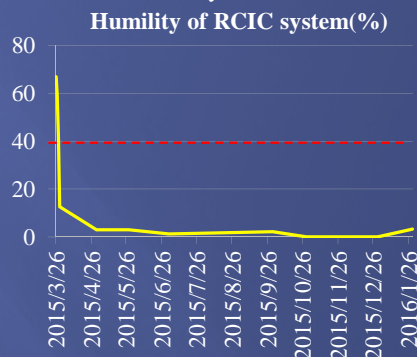
**Lungmen NPS**  
GE ABWR  
approximately 1,350 MWe x2  
Under Construction

## Layup Planning and Preparation

- Strategy
  1. Optimization of layup cost and management
  2. Enhance nuclear propaganda to the public actively
  3. Re-start up preparation
- Experiences and References
  1. Shimane-3, Watts Bar and Bellefonte experiences
  2. Experienced experts suggestion (GEH, MHI)
  3. EPRI guidelines and other publication
- WANO-TC TSM

## Dry Layup

- Reactor Core Isolated Cooling System
- Main Generator System
- Main Turbine System



## Wet Layup

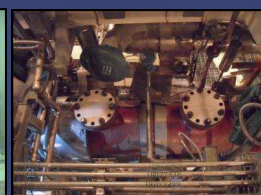
- RPV head off to prevent components from corrosion
- Keep the reactor water level at about normal water level for surveillance tests and monitor the quality of reactor water to meet the chemical composition criteria.
- For the interior wall of RPV above normal water level, we analyze and monitor to meet the chloride content less than 70mg/m<sup>2</sup> for the layup criteria.
- Reactor Internal Pumps operated periodically
- RHR, HPCF System Surveillance Test

## In Service

- Keep HVAC related systems in service for each building to maintain components at dry condition.
- Control Rod Drive Pump supplies continuous purge flow to avoid FME entering Control Rod Drive Mechanism and Reactor Internal Pump from reactor.

## Disassembly Layup

- Circulating sea water pump
- Main steam line relieve valve
- The removed components are stored with good conditions in Onsite Drum Storage Facility.



## Conclusion

- It is a political issue that makes future uncertain and postpone the rest of the schedules. Unit 1 and 2 will be suspended and preserved in the near future, which will cause a great impact on the economy and future energy policy in Taiwan.
- The pre-operational tests and systems safety inspection completed successfully on July 31, 2014.
- Lungmen Nuclear Power Plant learned from foreign deferral experiences and references to develop “Lungmen Layup Program” under regulatory requirements.
- Lungmen Nuclear Power Plant has formally entered into deferral state on July 1, 2015.
- Layup for Lungmen plant is to retain a reliable energy option with acceptable cost for the future.

### System layup prerequisite

