

## 出國報告（出國類別：訓練）

### 參加第 32 屆除役與放射性廢料管理課程

服務機關：行政院原子能委員會

姓名職稱：林繼統簡任技正

派赴國家：英國

出國期間：105 年 7 月 3 日至 7 月 8 日

報告日期：105 年 9 月 20 日

# 摘 要

第 32 屆除役與放射性廢料管理訓練課程於 105 年 7 月 4-8 日假英國劍橋大學辦理，課程由英國 Informa 公司主辦，課程內容包括歐洲核能設施除役現況、除役作業、除污、拆除、輻射特性調查(characterization)、低/中階廢料處理、高階廢料處理、廢料包裝(package)、深層地質處置等。

本課程每年開辦一次，至今已 32 屆，相當受核能界肯定，所聘講師 20 餘位來自產官學界，層面廣泛，其在各領域均已工作多年，經驗豐富；學員 20 餘位，主要來自英國與歐洲其他國家，其所屬單位含括設施業者、管制單位與研究單位等。

課程講授內容著重實務，內容淺顯，適合初從事除役與廢料處理工作人員，建議考量持續派員參加此訓練課程。

關鍵字：除役、放射性廢料

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## 壹、目的

筆者於 2016 年 4 月奉派駐法國代表處並支援經濟合作與發展組織 (Organization of Economic Cooperation and Development, OECD) 之核能署 (Nuclear Energy Agency, NEA)，從事除役相關工作，應所屬單位-輻射防護與放射性廢料管理組 (Division of Radiological Protection and Radioactive Waste) 建議，赴英國參加除役與放射性廢料管理訓練課程，以順利推動相關工作。

## 貳、出國行程

本訓練課程於 105 年 7 月 4-8 日假英國劍橋大學舉辦，筆者就近於巴黎駐處出發，行程概要如下表：

日期	行程	摘要
7/3-4	法國巴黎—英國倫敦—劍橋	往程
7/4-8	英國劍橋	參加課程
7/8	英國劍橋—倫敦—法國巴黎	返程

## 參、過程紀要

訓練課程於 7 月 4-8 日進行，課程表詳如附件一，參加學員名冊如附件二。

課程由歐洲核能現況談起，歐洲能源政策主要有三面向考量，分別是供應安全 (Security of supply, availability/ uninterrupted)、價格(Competitiveness, affordability)、環保 (Sustainability, lowest possible negative impact on environment)，此三面向考量猶如三腳凳，缺一不可，且須平衡兼顧，核能即符合此考量，故普遍為歐洲多國採用；目前核能約佔 1/3 發電比率，近年比率雖略降，惟預估至本世紀，核能仍將繼續提供電力，在此同時，核廢料持續的產生，核電廠等設施陸續屆齡，面臨除役，故除役與廢料處理是未來重要議題。

目前歐洲核能機組約 208 座，其中 129 座運轉中，89 座停機，3 座已完成除役，預估到 2025 年，停機機組將再增加 50 座，到 2050 年，除役市場約 1230 億歐元；研究用反應器部分，全數 140 部中，103 部已停機，其中 71 部已拆除，20 部除役中，7 部採安全暫存(Safe Enclosure)；核燃料廠部分，全數 121 座中，48 座關廠停機，31 座除役中，13 座已拆除。綜上，包含 3 座核能機組在內，共 90 座已完全除役拆除，另 120 座核設施(其中 67 座為核能機組)除役中。

核電廠除役作業分為 8 階段，分別是 1.規劃(Initial Planning), 2.核燃料移出 (Defueling), 3.輻射強度調查 (Characterization), 4.除污 (Decontamination), 5.拆卸 (Dismantling), 6.廢料處理(Waste Management), 7.廠房拆除(Demolition), 8.廠區復原(Site Clearance)。其中難度較高作業為反應器內部組件拆解，目前技術有 4 種，1.Plasma Arc Cutting，優點是切除快速，缺點是工作人員劑量高；2.Abrasive Water Jet Cutting，有成功應用案例，但其產生的二次廢料之處理費用高；3.Mechanical Cutting，是目前最可靠，成本效益高，風險低的方法；4.MDM，可利用於螺栓等內部小組件之拆除。

核設施除役不是像一般工廠拆廠，只要把設備管路移出，廠房拆除即可，因核設施內有輻射，設備必須除污後才能移出，進行除役作業前，必須先調查設施內輻射分布狀況，以評估工作人員劑量及廢料量，因此輻射強度調查(Characterization) 可說是除役之基本與關鍵工作。輻射強度調查前須先收集相關資料，包括電廠運轉日誌(log books)、取樣紀錄(previous sampling results)、保健物理紀錄(HP Surveys)等，以了解核設施運轉以來之輻射狀況，再進一步建立取樣計畫，以獲取精確之輻射分布資訊；取樣方式必須考量統計之隨機與客觀性，除平面取樣外亦須進行深度取樣以獲取完整之輻射分布資訊，取樣後之分析作業亦須力求準確。

除役過程包括除污作業，除污主要目的有 4 項，1.降低背景輻射以減少工作人員劑量，2.避免拆除過程中造成污染擴散，3.組件物料回收再利用，4.降低廢料等級(降低廢料處理費用)。

除污方式有很多，決定於 1.想達到的結果(Desired End Point)，2.待除污表面種類(Type of Surface to be Decomtaminated)，3.污染程度(Radiological Conditions, Nature and Extent of Contamination Present)，4.安全與環保(Safety and Environmental Impact)，5.二次污染(Likely Nature and Volume of Secondary Waste Arising)，6.廢料處置方式(Disposal Route)，7.整體除役成本效益評估(Cost Benefit to the Total Decommissioning Process)，必須多方面綜合考量，才能獲得最佳選擇。

目前除污方式大致分為 4 類，1.清洗/擦洗(Washing/Swabbing)，2.化學除污(Cheical)，3.機械式除污(Mechanical)，4.開發中新技術(Emerging Technology)；其中清洗是最簡單方式，但經常因污染表面粗糙，污染物沉積於粗糙間隙而難以清洗乾淨，故須借助化學除污，以化學溶劑將污染物溶解後帶離污染體，但化學除污經常伴隨大量液體二次廢料，且對物件內面(Internal surface)或孔隙(Porous surface)表面之除污效果

不佳，且化學溶劑可能具毒性與腐蝕性等缺點；機械式除污包括真空吸塵 (Vacuuming)、括除(Scrubbing)、膠膜吸附(Strippable coating)、蒸汽除污(Steam cleaning)、高壓水注(High pressure water jetting)、磨砂(Abrasive decontamination)等；開發中新技術包括應用雷射(Laser ablation)、微波(Microwave scrubbling)等，目前還在試驗階段。

除役最終目的是要恢復廠區土地供再利用，因此系統設備組件等之拆卸是必要程序，有時是為了某場所空間之除污而須將該場所內物件進行拆卸以移除；拆卸過程伴隨切割，因此會有粉塵吸入(inhalation)、噪音(noise)等輻射防護以外之工安防護問題；系統設備組件之拆卸首先考量以卸螺栓方式(Unbolting)進行，必要時進行切割(cutting)。拆卸方式須因時因地制宜，無法一應概全，惟應綜合考量工安、輻安、廢料減量與成本等因素，最佳選則原則是簡單與可靠。

國際原子能總署依放射性廢料之半衰期與活性強度，將其分類成豁免 (EW, exempt waste)、極短半衰期 (VSLW, very short lived waste)、極低階 (VLLW, very low level waste)、低階 (LLW, low level waste)、中階(ILW, intermediate level waste)、高階(HLW, high level waste)等六類，英國之分類標準為  $4 \text{ GBq}(\alpha)/\text{ton}$  且  $12 \text{ GBq}(\beta \gamma)/\text{ton}$  以下者為低階廢料，以上但無明顯發熱者(not significantly heat generating) 為中階廢料，至於用過核燃料或其經再處理所產生之高輻射強度液態/玻璃固化廢料屬高階廢料。其處置方式各有不同，其中半衰期長且活性強度最高之高階廢料採深層地質處置方式，其次中階廢料採中層地質處置方式，低階廢料採淺層地質處置方式，極低階廢料採填土掩埋處置方式，極短半衰期廢料採貯存方式讓其自然衰減。

廢料管理計畫應有全面多方為考量，諸如：廢料來源、技術問題(放射線種類、物理、化學性質等)、廢料處理、包裝(packaging)、化驗(assaying)、文件(appropriate sentencing of waste)等。英國針對放射性廢料管理策略最高原則是避免廢料產生



(prevention)、其次分別是減量(minimization)、再利用(reuse)、再回收(recycling)、最後才是處置(disposal)。

英國有關低階放射性廢料管理策略可參考除役管理局(Nuclear Decommissioning Authority, NDA)2016年2月出版之UK Strategy for the Management of Solid Low Level Waste from the Nuclear Industry 報告。

英國有關中階放射性廢料管理政策依據是2002年環境部提出之放射性廢料安全管理(Managing Radioactive Wastes Safely)，其中清楚明列4項原則，1.志願性(volunteerism)，指有關處置場或中期貯存設施之選址必須基於地方政府同意。2.否決權(veto)，指地方政府有權於過程中否決並退出參與。3.地方政府利益(community benefits)，指地方政府應於參選過程即獲得補助，獲選後另有補助。4.參與權(partnership)，指除役單位與地方政府間關係應公開與對等。

廢料處理(treatment)方式很多，諸如：壓縮(supercompaction，可減少約20%體積)、焚化(incineration，可減少約5%體積)、除污(decontamination，可降低廢料活度進而降低廢料等級，減少處置成本)。

英國有關廢料處置成本(英鎊/立方米)，豁免(120)，極低階(VLLW, 400)，低階(LLW, 4000)，中階(ILW, 30000)。

廢料型式不一(物理、化學形態)，為便於貯存、運送與處置，同時考量安全，建立深層屏障(multiple barrier containment)，對廢料進行包裝(packaging=container+waste form，包含容器與固化體)。

英國負責廢料管理的單位是Radioactive Waste Management，其使命就是廢料管理與提出最終地質處置場所，其針對低與高產熱廢料包裝要求，分別於2012年8月與2016年2月出版相關報告，Geological Disposal: Generic Specification for waste packages

containing low heat generating waste, Geological Disposal: Generic Specification for waste packages containing high heat generating waste.

核分裂產生巨大能量，雖為人類提供了電力等滿足，其分裂產物所具有之高輻射強度與超長半衰期也對人類科技提出巨大挑戰。如何處理這些廢料，大概有五種可能，1.靜觀其變(Do nothing), 一直貯放著直到千萬年，放射線衰竭，廢料威脅解除；2.等待更好解決之道(wait in hope)；3.分離與轉化(Partition and Transmutation)；4.處置(disposal)；5.轉他國或地區(pass it on)，前二者將現在問題留給後代處理，為不負責任做法，第三項效益不高，現在各國公認最佳處置方式是深層地質處置，使之隔絕於生物圈(biosphere)外，至少 10 萬年內。

用過核燃料之放射性活度來源主要分為 2 類，分別是 1.分裂產物與活化產物(fission and activation products)，2.錒系元素與其蛻變子核(actinides and daughters)；其活度大小與隨時間衰減速率不同，前 100 年，活度主要來自前者，後 100 年則來自後者。

用過核燃料等高階核廢料以深層地質方式處置，其所處地質條件在數萬年時間長度考量下，無法 100%確認其地質變動所導致地下水入侵，與隨之放射性物質之流出處置場外。

可能影響深層地質處置安全的因素有三種，分別是 1.氣候變遷(climate change)，2.地層變動(tectonic process and events)，3.人類活動(activities of people)。氣候變遷可能導致 1.海平面變化，隨之影響地下水流徑與其化學性質，2.地下水與表層水之混合(groundwater and surface water mixing)，導致地下水氧含量變化與氧化還原電位(redox potential)變化等，3.冰河地區岩石應力(rock stress in glaciated areas)，4.地層新構造運動(neotectonics)，5.生物圈(biosphere)等。地層變動的影響在選擇場址時要將其列入考慮，例如為居地層活躍之日本，相對瑞典與芬蘭，其地層活動較低。

因此一適合之深層地質處置場所應具備下列條件，1.地層穩定，2.地下水流量低且與表層水混流小，3.地下水存在久遠且穩定，4.對氣候變遷不敏感，5.熱穩定的岩石-水系統(thermally stable rock-water system)，6.適合處置場開挖施工之地質，7. 處置場無通往地表之途徑(lack of fast transport pathways from the repository to the surface)，8.核種播遷以擴散為主(diffusion-dominated radionuclide movement)，9.可逸氣(ability to disperse gas)。

課程結束後並頒發結業證書如附件三，交換名片如附件四。

## 肆、心得與建議

- 一、核能設施自 1960 年代建造發展至今，諸多設施已陸續停止運轉並規劃進行或已完成除役，預期未來進行除役機組數將快速增加；另隨著核能的利用，放射性廢料持續產生，各國均積極進行廢料處置規劃；本訓練課程針對除役與放射性廢料管理領域，邀請各國產官學專家授課，內容深入淺出，兼具理論與實務，對初入此領域工作人員助益甚大，且此課程已辦理 32 年，顯見深受肯定，爰建議派員參訓。
- 二、我國已設定 2025 年達成非核家園目標，目前運轉中核一、二、三廠將於 40 年運轉執照到期後停機展開除役工作；除役工作期長達 25 年且工程龐大複雜，如何作好規劃並落實執行，達成將廠區土地復原的目標，過程中除清除所有污染物，減少廢料，避免造成後代負荷，同時要降低除役工作人員劑量與環境保護，此任務挑戰不小，除國內核能從業人員同心協力外，外國已完成或進行除役之經驗，不論業主或與管制單位，均值得我國借鏡參考。
- 三、隨著除役工作展開，意謂用過核燃料的處理工作也迫在眉睫，不論是中期貯存或終期處置，都必須有完整的策略；不只高階廢料，中低階廢料的處置也必須儘速提出對策，特別是蔡總統於今(105)年 8 月 1 日前往蘭嶼，代表政府向原住民道歉時曾特別關切蘭嶼核廢料儲存問題；因此有關廢料管理問題，亦是本會當務之急；如同除役工作，廢料管理不論執行或管制，他山之石，可以攻錯，外國之經驗值得參考借鏡。

## 伍、附件

附件一、課程表

附件二、學員名冊

附件三、結業證書


附件一、課程表

## 32nd Annual Decommissioning & Radioactive Waste Summer School

Combining In-Depth Technical Knowledge With Operational Industry Experience



an Informa business

Day One - Monday 04 July 2016	
12:30 - 1:00 Registration Derek Taylor, Professor In Geo-Energy, University of Nottingham	
1:00 - 1:10 Chairman's Introduction	 <p>Derek Taylor, Professor In Geo-Energy, University of Nottingham</p>
An overview of decommissioning and radioactive waste management	
1:10 - 1:55 Nuclear energy and radioactive waste management in the European Union	 <p>Borislava Batandjieva-Metcalf, Policy Officer, European Commission</p>
<ul style="list-style-type: none"> <li>• The EU energy policy: why nuclear?</li> <li>• The role of nuclear energy in Europe</li> <li>• The EURATOM Treaty</li> <li>• Quantities of waste in the EU</li> <li>• EU legislation on waste</li> <li>• Results of EB surveys on public opinion on the EU</li> </ul>	
1:55 - 2:10 Overview of decommissioning in Europe	 <p>Derek Taylor, Professor In Geo-Energy, University of Nottingham</p>
<ul style="list-style-type: none"> <li>• The future of decommissioning activities</li> <li>• Recent developments</li> </ul>	
2:10 - 2:50 IAEA perspectives on decommissioning, remediation and radioactive waste management	 <p>Andrew Orrell, Section Head, Waste and Environmental Safety, International Atomic Energy Agency</p>
<ul style="list-style-type: none"> <li>• Mandate and functions of the IAEA</li> <li>• How the IAEA provides assistance to its Member States</li> <li>• International safety standards for decommissioning, radioactive waste management and remediation</li> <li>• Application of the international standards for safety</li> <li>• Present and future activities of the IAEA in decommissioning, radioactive waste management and remediation</li> <li>• Update on IAEA activities carried out under the Nuclear Safety Action Plan (Fukushima Action Plan)</li> <li>• Future trends and issues for decommissioning, remediation and radioactive waste management</li> </ul>	
2:50 - 3:00 Tea break	
Engaging the stakeholder: Identifying opportunities for collaboration	
3:00 - 3:40	

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**Waste management from a local stakeholder perspective - the Scandinavian view**

- Experiences from the participation of local stakeholders
- Examining the waste management view in Sweden
- Identifying the opportunities for more efficient and anchored management of waste
- A candid approach to lessons learned from Sweden



**Marie Berggren,**  
Head of Unit,  
Osthammar Municipality

3:40 - 4:10

**Public & Stakeholder Engagement Forum**

Discuss how you would tackle some of the key stakeholder challenges as presented through the eyes of the public, councils and nuclear operators. Examine solutions to help facilitate the relationship between the different groups.

4:10 - 4:15

**Close of Day One**



**Derek Taylor,**  
Professor in Geo-Energy,  
University of Nottingham

4:15 - 4:45

**Optional walking tour of Cambridge**

Taking part in the walking tour gives you the chance to see some of the most breathtaking sights Cambridge has to offer including a look at the famous King's College Chapel

**Day Two - Tuesday 05 July 2016**

**Considerations in the decommissioning process: strategy, risk management, contracts and financing**

9:00 - 9:40

**Decommissioning nuclear power plants**

- An overview of the major activities of decommissioning projects
- Techniques and processes for dismantling reactors
- Future outlook for decommissioning



**Joseph Boucau,**  
Director, Decommissioning and Dismantling  
Business Development,  
Westinghouse Electric Company

9:40 - 10:20

**The NDA's strategy for decommissioning and clean-up of the UK's civil public sector nuclear sites**

- Understanding the role of the NDA
- Exploring NDA Strategy and delivering outcomes
  
- Future challenges



**Matthew Clark,**  
Strategy Implementation Manager,  
NDA

10:20 - 10:40

**Morning tea**

10:40 - 11:20

**Nuclear decommissioning contracts**

- Contract structures - past, present and future
- The NDA's Tier 1 and Tier 2 contracts - understanding and allocating risks
- The issues that cause disputes



**Chris Chesterman,**  
Associate,  
Borges Salmon LLP

11:20 - 12:00

**Decontamination processes and techniques**

- Identifying decontamination processes

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- Practical application of decontamination procedures
- Developing decommissioning techniques



Nick Brown,  
Senior Project Manager and Technical  
Consultant,  
Nuvia Ltd

12:00 - 1:00

Lunch

1:00 - 1:40

Examining nuclear costs and financing for decommissioning

- Type of decommissioning costs
- Analysing the challenges of long-term provision of funding
- Evaluating the importance of estimating costs
- Identifying the future of finance for decommissioning projects



Martyn Jenkins,  
Managing Director,  
Enkom Consulting

1:40 - 2:20

Dismantling techniques and methods

- Dismantling techniques
- Cutting methodologies
- Project references and lessons learned
- Conclusions



Nick Brown,  
Senior Project Manager and Technical  
Consultant,  
Nuvia Ltd

2:20 - 2:40

Afternoon tea

2:40 - 2:40

Working Group

Decommissioning Workshop

Work in groups to tackle key issues presented by a decommissioning problem. Delegates will have to take into account costs, technical processes and site obstacles. At the end of the session, delegates will be asked to feedback to the group on their thoughts.



Lorimer Fellingham,  
Manager, Site Remediation Services,  
Nuvia Ltd

4:30 - 4:40

Close of Day Two

4:40 - 5:10

Punting

Enjoy taking part in a relaxing activity with other delegates and speakers. Try your hand at steering the boat or sit back, relax and soak in the beautiful sights of Cambridge.

### Day Three - Wednesday 06 July 2016

Focus on global decommissioning & waste projects

9:00 - 9:45

Regulation at nuclear sites

- Regulatory philosophy
- International standards
- Challenges of regulation



William Turner,  
ONR Principal Inspector - Nuclear Safety  
Radioactive Waste,  
Office for Nuclear Regulation

9:45 - 10:30

An update from Germany: the status and developments in decommissioning

- Analysing current nuclear situation in Germany
- Lessons learned from past and present decommissioning projects in Germany
- Examining the current challenges and future opportunities



Przemyslaw Imielski,  
Radiological Protection Officer,  
Gesellschaft für Anlagen- und  
Reaktorsicherheit (GRS)

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10:30 - 10:45

Morning tea

10:45 - 11:30

Case Study

**Decommissioning Sellafield**

- Background to the Sellafield site
- Overcoming the challenging environment
- Progress with high hazards plants remediation
- Development of an Integrated site strategy for Sellafield
- Transition Into Waste Retrieval and future outlook



**Adil Sardardeen,**  
Special Assistant to the Chief Decommissioning  
Officer,  
Sellafield Ltd

11:30 - 12:15

Case Study

**Decommissioning kept simple - a Dounreay experience**

- Decommissioning principles
- Organisational culture changes
- Simple technologies
- Decommissioning examples



**Steve Beckitt,**  
Project Director,  
Dounreay Site Restoration Ltd

12:15 - 1:15

Lunch

1:15 - 1:55

Case Study

**Decommissioning of the Dragon Reactor**

- A brief history of the Dragon Reactor
- Decommissioning to date
- Waste Management and ALARP
- Future challenges



**Mike Jones,**  
Radiation Protection Advisor,  
Magnox Winfrith

1:55 - 2:25

Case Study

**Spent fuel storage, disposal and licensing in the U.S**

- Evolution of the waste confidence decision
- Resolving the licensing and disposal dilemma
- Storage and disposal of spent fuel outlook



**Andrew Orrell,**  
Section Head, Waste and Environmental Safety,  
International Atomic Energy Agency

2:25 - 2:35

Afternoon tea

**Understanding waste hierarchy**

2:35 - 3:35

**Understanding the management of low level (LLW) and intermediate level (ILW) waste**

- Exploring LLW and ILW
- Evaluating the developments in managing LLW and ILW
- Assessing the disposal opportunities



**Lorimer Fellingham,**  
Manager, Site Remediation Services,  
Nuvia Ltd

3:35 - 4:30

Working Group

**RADIOACTIVE WASTE WORKSHOP: EIA for waste storage and disposal site**

Delegates will be asked to work in groups to negotiate and agree on the scope and content of an EIA for either a waste storage/disposal site or for a new reactor site

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4:30 - 5:00

Close of Day Three

**Day Four - Thursday 07 July 2016**

**Management of wastes: characterisation, transport, remediation and geological disposal**

9:00 - 9:30

**Defining characterisation**

- Assessing the importance of the characterisation process
- Developing best practice remediation guidance



Richard Hunter,  
Waste Characterisation Services Manager,  
LLW Repository Ltd

9:30 - 11:00

**WORKSHOP: characterisation of waste**

You will be asked to assess information provided on potential sampling and analysis scenarios in order to make recommendations as to the best options available. The scenarios, although fictional, are heavily based on real life problems that have been presented to LLWR. The information shall provide outlines undertaken within the facilities, maintenance regimes, provenance available etc.



Richard Hunter,  
Waste Characterisation Services Manager,  
LLW Repository Ltd

11:00 - 11:10

Morning tea

11:10 - 12:10

**UK radioactive waste transport, from very LLW to ILW**

- Overview of UK radioactive waste logistics requirements and related regulations
- Tackling national and international transport politics and perception
- Radioactive "Disposal" Waste Package operational experiences
- Radioactive "Treatable" Waste Package operational experiences



Marc Flynn,  
Logistics Services Manager (RAMTUC  
Chairman),  
LLW Repository Ltd

12:10 - 1:10

Lunch

1:10 - 2:10

**Radioactive land remediation and final site clearance**

- A case study of a large scale radioactive land remediation project
- Waste management options in relation to radioactive land remediation
- An overview of UK and International nuclear site final clearance and deicensing, with examples
- Site End States for nuclear sites



Paul Atyeo,  
Decommissioning Project Manager,  
Magnox

2:10 - 3:10

**INTERACTIVE EXERCISE: remediation of radioactive land**

Delegates will be split into groups to develop a plan for remediation of radioactive land, taking into consideration issues such as regulations, funding and technical processes.



Paul Atyeo,  
Decommissioning Project Manager,  
Magnox

3:10 - 3:20

Afternoon Coffee

3:20 - 4:20

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**Geological disposal of radioactive wastes**

- Understanding the objectives of deep geological disposal of long-lived waste
- Identifying alternative repository systems for different waste types
- Outlining the key issues in safety demonstration
- Exploring the future international scene



**Tim McEwen,**  
Geological Consultant,  
McEwen Consulting

4:20 - 5:00

**Exploring the Swedish radioactive waste management system**

- Current activities for management of higher level radioactive waste
- Repository developments



**Borje Torstenfelt,**  
Director, Waste Management and  
Decommissioning,  
SKB Sweden

5:00 - 7:00

**Close of Day Four**

7:00 - 7:00

**Gala dinner**

Enjoy your last evening at the Summer School with a four course meal. Dress to Impress!

**Day Five - Friday 08 July 2016**

**Disposal and packaging of radioactive wastes**

9:30 - 10:15

**Disposal and recycling of redundant equipment**

- Post operational clean out of redundant plant and equipment
- Practical experiences gained since 2006 at Devonport Royal Dockyard
- Metallic component recycling efficiencies
- Lessons learnt and the future workload



**Scott Tucker,**  
Health Physicist (Nuclear Infrastructure  
Directorate),  
Babcock International Group

10:15 - 11:00

**Packaging higher activity waste for geological disposal**

- Geological disposal and status of the UK programme
- Waste package specifications for Higher Activity Waste
- Disposability Assessment process for waste packaging
- Managing Innovation in waste packaging



**Brian Southgate,**  
Waste Package Specification and Guidance  
Manager,  
Radioactive Waste Management Limited, NDA

11:00 - 11:15

**Morning tea**

11:15 - 11:45

**Radioactive waste management and decommissioning in Finland**

- Understanding the general framework
- Current waste management activities
- Repository development in Finland



**Henri Niittymäki,**  
Inspector,  
STUK - Radiation and Nuclear Safety Authority

11:45 - 11:55

**Discussion session**

11:55 - 12:00

**Chairman's closing remarks**

12:00 - 12:00

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附件二、學員名冊

# Decommissioning & Radioactive Waste Management Summer School

Monday 4<sup>th</sup> - Friday 8<sup>th</sup> July 2016

Cardiffville, UK

## LIST OF ATTENDEES

ROMAN ANDREEV	PUBLIC INSTITUTION CENTRAL PROJECT MANAGEMENT AGENCY
PAUL ATYED	MIGROZ
BOISLAWA BATAKOJEVA- METCALF	EUROPEAN COMMISSION
STEVE BEKITT	DOURNEY SITE RESTORATION LTD
JESPER BERNHILT	AB SVAPO
HANS BERGGREN	OSTYARNAR MUNICIPALITY
TOMY BIRCH	CAPEHURST NUCLEAR SERVICES LTD
JOSEPH BOJICAU	WESTINGHOUSE ELECTRIC COMPANY

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JUDITH LEE	NERVA INSTITUTE OF NUCLEAR SAFETY
MIGEL LI	JT SAFETY CONSULTANTS LTD
JAYTONG LIN	OECD NEA HAD
TIM McEWEN	MC EWEN CONSULTING
HELEN MILBURN	OFFICE OF NUCLEAR REGULATION
PETER MOLIN	AB SVAPO
GWENDOLYNE NEWTON	MOD
HENRI RUTTYMACKI	STUK - RADIATION AND NUCLEAR SAFETY AUTHORITY
ANDREW ORRILL	INTERNATIONAL ATOMIC ENERGY AGENCY
GEORGIUS PASKEVICIUS	PUBLIC INSTITUTION CENTRAL PROJECT MANAGEMENT AGENCY
KEVIN PAVICEVIC	NERAS - ONDRAP

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MATTHEW CLARK	NDA
BENEDICTE DEFAUT	CAPEHURST NUCLEAR SERVICES LTD
DAVID EWING	CAPEHURST NUCLEAR SERVICES LTD
LOUISIER FEILDINGHAM	NERVA LTD
KAROL KUPIN	LLP BERGOTTORF LTD
STEVE DEFFERTY	CANDORAL UK LTD
RICHARD HUNTER	LLP BERGOTTORF LTD
PRZEMYSLAW JABLONSKI	GESELLSCHAFT FÜR WILGEN- LÖD REAKTORSCHEMERT (GWS)
FRITZ JENSEN	BRIGH CONSULTING
JOHN JONES	BRIGH CONSULTING

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DEAK TAYLOR	UNIVERSITY OF NOTTINGHAM
NOPIE TORSTENSELT	SKB SWEDEN
WES TOMMERSO	MINISTRY OF DEFENCE
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附件三、結業證書

**KNect365**  
Energy

**The 32<sup>nd</sup> Annual  
Decommissioning & Radioactive  
Waste Management Summer  
School**

THIS IS TO CERTIFY THAT

**Jihong Lin**

OF

**OECD NEA RAD**

ATTENDED THE ABOVE NAMED COURSE ON

**4<sup>th</sup> – 8<sup>th</sup> July 2016  
Christ's College, Cambridge, UK**

**Operations Manager:**

**Nishali Patel**



**Date:**

**8<sup>th</sup> July 2016**



附件四、交換名片



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