

行政院所屬各機關因公出國人員出國報告書
(出國類別：開會)

參加 2010 年台美民用核能合作委員會議

服務機關：台灣電力公司

出國人 職稱：處長

姓名：李清山

出國地區：美國

出國期間：99 年 11 月 14 日至 11 月 20 日

報告日期：100 年 1 月 10 日

行政院及所屬各機關出國報告提要

出國報告名稱：參加 2010 年台美民用核能合作委員會議

頁數 48 含附件：■是□否

出國計畫主辦機關/聯絡人/電話：台電公司

出國人員姓名/服務機關/單位/職稱/電話：

李清山/台電公司核能後端營運處/處長/02-2368-3419

出國類別：1 考察2 進修3 研究4 實習5 開會

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分類號/目

關鍵詞：用過核子燃料、放射性廢棄物營運

內容摘要：(二百至三百字)

原能會謝主委得志率原能會、物管局、核研所、清華大學、駐美代表處及本公司等單位計 17 人，參加 2010 年 11 月 15-17 日在美國召開之台美民用核能合作會議，會中雙方交換過去一年來在核能電廠營運與管制、技術研發及核廢棄物管理方面之經驗與發展等資訊，並就雙方核能合作項目之執行情形進行分組討論。其中美方報告其新核能機組計畫、美國核電廠運轉安全管制等現況與展望以及用過核子燃料長程貯存技術研發構想；職於會中報告「台灣核能發電現況與展望」與「台電公司放射性廢棄物營運現況」，並參加分組討論第二分組關於雙方在放射性廢棄物營運合作議題之討論。另，參訪 Idaho National Laboratory (INL) 之核能教育與研究設施，以瞭解美國為擴大核能永續利用，在人才培育及新一代核反應器研發之現況與未來發展。

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1. 2010 年台美民用核能合作會議議程
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出國目的

每年舉辦一次的台美民用核能合作會議，2010 年會議於 11 月 15 日至 17 日在美國愛達荷佛斯(Idaho Falls)附近之愛達荷國家實驗室(Idaho National Laboratory, INL)舉行。職於會議期間報告「台灣核能發電現況與展望」與「台電公司放射性廢棄物營運現況」，並參加分組討論第二分組關於雙方在放射性廢棄物營運合作議題之討論。

另外，職亦與雙方參加本次會議人員於 11 月 15 日參訪 INL 之核能教育與研究設施，以瞭解美國為擴大核能永續利用，在人才培育及新一代核反應器研發之現況與未來發展。

壹、行程

一、台美雙方代表團名單

本(2010)年度會議，我方由原能會謝副主委得志率原能會、物管局、核研所、清華大學、駐美代表處及本公司等單位計 17 人參加，名單如下：

行政院原子能委員會：謝副主任委員得志、物管局邵副局長耀祖、
輻防處劉副處長文熙、核管處龔科長繼康、
綜計處林科長耿民、侯科長榮輝

核能研究所：邱副所長太銘、蔡副研究員光福、羅副研究員彩月、
李副研究員春林、林副研究員家德、
洪副研究員煥仁

清華大學：錢教授景常、李教授敏

駐美代表處：經濟組 莊世明；科技組 黃俊源

台電公司：李處長清山

美方代表包含國務院、核能管制委員會、能源部及所屬國家實驗室、美國在台協會台北辦事處等單位計 22 人與會，名單如下：

姓 名	單位及職稱
Dr. Alex R. Burkart	Deputy Director, Office of Nuclear Energy, Safety and Security, U.S. Department of State
Scott W. Hansen	American Institute in Taiwan
Christine Martin	Office of Nuclear Energy, Safety and Security, U.S. Department of State
Thomas R. McIlvain	Senior Advisor, Office of the Coordinator for Threat Reduction Programs, U.S. Department of State
Dr. Chuan Fu Wu	Acting Deputy Assistant Secretary, Office of Project Management, Office of Environmental Management, U.S. Department of Energy
Lee Hwa Gebert	Office of International Nuclear Energy Policy & Cooperation, U.S. Department of Energy
Jeffrey Williams	Deputy Director, Office of Used Fuel Disposition Research and Development, U.S. Department of Energy
William Rhodes	National Nuclear Security Administration
Maria Holleran Rivera	Office of International Emergency Management and Cooperation, National Nuclear Security Administration
William Ruland	Director, Division of Safety Systems, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission
Danielle Emche	Office of International Programs, U.S. Nuclear Regulatory Commission
Harold MacFarlane	Deputy Associate Laboratory Director, Idaho National Laboratory
Dr. Steven Bakhtiar	Nuclear Materials Characterization Department Manager, Idaho National Laboratory
Dr. Patricia Paviet-Hartmann	Nuclear Science & Technology Directorate, Idaho National Laboratory
Dr. William Geist	Safeguards Science & Technology, Los Alamos National Laboratory
Robert Finch	Global Security Engagement and International Safeguards, Sandia National Laboratories
Dr. Hong-Nian Jow	Global Security Engagement and International Safeguards, Sandia National Laboratories

Dr. Soon S. Kim	Lawrence Livermore National Laboratory
Dr. David Diamond	Brookhaven National Laboratory
Dr. Paul Dickman	Argonne National Laboratory
Annie Winterfield	Pacific Northwest National Laboratory
Amanda Rynes	Idaho National Laboratory

二、行程

時 間	行 程
11 月 14-14 日	台北→洛杉磯→鹽湖城→愛達荷佛斯(Idaho Falls)
11 月 15~ 17 日	參加 2010 年台美民用核能合作會議、參訪 INL 之核能教育與研究設施、討論核廢棄物管理合作議題
11 月 17 日	愛達荷佛斯→鹽湖城→洛杉磯
11 月 18 日	隨團拜會我駐洛杉磯辦事處
11 月 18 ~ 20 日	洛杉磯—台北

貳、工作內容

本次台美民用核能合作會議係假愛達荷佛斯(Idaho Falls)附近之愛達荷國家實驗室(Idaho National Laboratory, INL)舉行，由 INL 協助相關技術參訪與場地安排等事宜，各天議題與行程詳如附件 1，分述如下：

一、參訪 INL 核能教育與研究設施

本次參訪設施包括 INL 的先進能源研究中心(Center for Advanced Energy Study, CAES)、材料與燃料研究(Material and Fuel Complex, MFC)、先進測試反應器(Advanced Test Reactor, ATR)與一號實驗滋生反應器(Experimental Breeder Reactor-1, EBR-1)等 4 個地點，分述如下：

(一) 先進能源研究中心(CAES, 參如圖 1)

先進能源研究中心為 INL 與愛達荷州內的三個主要學術研究機構：Boise 州立大學、愛達荷州立大學、與愛達荷大學共同經營的研究中心，研究重點在於核子科學與工程、先進材料、碳管理、生質能、能源政策、模型與模擬等領域。該中心自豪的是全館採用環保概念，已獲得美國能源與環境設計頂尖組織(Leadership in Energy and Environmental Design, LEED)的認證，符合所謂「綠色永續建築」的要求。

該中心的副主任 Harold McFarlane 博士代表歡迎本代表團，在簡短致詞後，參訪成員即分成兩組，輪替進行參訪，一組聽取該中心核材料解析能力現況(以「Nuclear Material Characterization Dept. Capabilities」為題)與 CAES 核燃料循環研究的國際學研合作(以「How to stimulate Nuclear Fuel Cycle Research innovation applicable to domestic and global nuclear energy studies」為題)的現況，另一組則參觀該中心先進視覺研究室的 3D 電腦輔助視覺環境(CAVE)。

美方在簡報如何激勵核燃料循環研究創新應用於國內和全球核能界時表示：全球運轉中核電廠有 435 座，建造中有 28 座，規劃建造有 222 座。美國核電使用佔 20%，104 座核電廠年產 2,000 噸用過核子燃料，到 2050 年將累積產生 150,000 噸用過核子燃料。美國

用過核子燃料和高放射性廢棄物分別貯存於境內 40 餘州。當世界傾向核能復甦時，美國預估於 2030 年時，其國內用電將成長 30%，核能必需伴隨著其他能源成長之需求，用過核子燃料乾式貯存在核燃料循環中將扮演重要之角色。

INL 已結合數間優秀美國大學創立核能科技院 (Institute for Nuclear Energy Science and Technology-I-NEST)，其目的係合作訂定 INL 長期核能研究發展策略，該策略將包括下列 4 個研究和教育中心：

- 核燃料與物料
- 太空核能科技
- 核燃料循環
- 核能安全和證照。

INL 先進能源研究中心的策略和投資計畫白皮書，在技術方面將建立世界級的放射化學、熱力學、動力學、熱化學整合試驗等領域。在教育方面將進行長期學習，交換教授、科學家，擴展核燃料循環合作院校。

在 CAVE 展示方面，CAVE 是先進的展示系統，可將現場探測的資料，透過視覺處理與投影系統，直接投射在 3D 空間，讓數據直接與現場環境結合，使用者可透過特殊的觀測頭盔或特殊眼鏡，觀察探測數據在實際地理位置的分佈情形。參訪時該系統展示了幾個 3D 圖像，例如地球地震活動、先進測試反應器與潛在碳封存場址。以地球的地震活動記錄為例，透過 3D 的地球視覺模型，使用者可以直接看到地球各地的地震點(歷史紀錄)分佈，並可以直接利用手部或頭部動作，拉近觀察數據所呈現的影像細節。另一個範例：以雷射雷達系統(簡稱 LiDAR)掃瞄愛達荷州的 Malad 峽谷地形，並據以建立一個 3D 模型，顯示峽谷立在河旁的岩石表面，可讓研究人員以任何高度與角度，以斷面的方式觀察峽谷表面下的內部構造，例如水流、蝕刻、沈積、洞穴等所有與碳封存有關的重要線索。如此一旦該峽

谷被選為碳封存的場址，則相關研究人員甚至於民眾立刻就能夠得到場址的詳細資訊，除了做為研究用平台外，對於公眾溝通也有助益。此種直接將原先死板數字化的數據，生動地展現在現場位置的模型的能力，令人印象深刻。



圖 1. 愛達荷國家實驗室先進能源研究中心(CAES)

(二)材料及燃料研究設施(MFC)

INL 的 Materials and Fuels Complex (簡稱為 MFC)有下列幾項重要設施：包括分析實驗室(Analytical Laboratory)、燃料處理設施(Fuel Conditioning Facility, FCF)、燃料製造設備(Fuel Manufacturing Facility, FMC)、熱室檢驗設備(Hot Fuel Examination Facility, HFEF)、太空及安全電力系統設施(Space and Security Power Systems Facility)及暫態反應爐測試設施(Transient Reactor Test Facility)。MFC 計畫主要針對核能發電技術開發創新性之解決方案，包括核燃料發展、分離技術探討、照射後檢驗及快速反應爐之開發等，

MFC 同時也支援國土安全部(Department of Homeland Security) 的訓練活動及美國太空總署(NASA)之太空核能研究及其它商業應用研究等。

分析實驗室配置有熱室、套手箱及模具實驗室及相關設施，用於研究核燃料及材料特性、環境取樣分析及其它檢驗工作。FCF 設有兩個相接的大型熱室及一個實體模型區域，配備有大型機械手臂及各式自動化設施，主要應用於用過核子燃料之處理、遙控設備發展、模型接收及其相關應用研究，同時，配合實驗之需要，熱室內亦設有除污及維護區域。

FMF 設有安全極高的燃料貯藏空間及套手箱等設施，主要用於接收、貯存、操作及檢測可分裂材料之特性，並支援先進核燃料之應用研究。HFEF 提供照射後及照射中期之檢驗能力，其熱室、Transuranic glove box 及一個小型反應爐則應用於探討中子放射圖譜(neutron radiograph)及材料之照射研究。

午餐時，INL 特別安排該實驗室之文化資源管理辦公室(Cultural Resource Management Office) Hollie Gilbert 小姐為大家介紹愛達荷國家實驗室區域內史前和國家歷史文化遺產及其對應之保護措施，並提供若干在該區域發現之一些先民使用過古物供大家觀賞，讓大家對於美國除了重視高科技之發展外，亦十分重視文化資源之保護，留下深刻且美好的印象。

(三)先進測試反應器(ATR)

先進測試反應器(ATR)位於 INL 的西南區，是 INL 目前僅有三座運轉中反應器中的一座，主要之任務為支援美國能源部之各項交辦任務，研究在密集中子與加碼射線照射下，對於反應器材料與燃料的效應；預期在核能復甦的情勢下，該反應器也將繼續扮演新反應器設計、測試與驗證上的主要實驗場地，尤其是照射後燃料或材料的實驗。ATR 也同時接受少部分國外政府、研究人員與商業公司的委託，進行中子照射測試。美方於 ATR 的主要解說人員為 INL 之 Don Miley 先生與在該反應器廠工作的 Caleb Robison 先生，分隊帶

領解說 ATR 的相關設施。

ATR 雖然早於 1967 年開始運轉，但仍被認為是世界上科技最先進的幾個核能測試反應器之一，尤其在於可提供反應器運轉週期之內，固定或變化的中子通量下的照射服務。ATR 運轉功率相當高，為 250 MW，但實際運轉仍須視客戶的要求，在一定的功率下運轉。

ATR 的主要設計特色如下：

- 測試位置多：共有 77 個測試位置。
- 中子通量高：熱中子可達 $1E15$ n/cm²-sec，快中子可達 $5E14$ n/cm²-sec，並可有不同的快/慢中子通量比率(0.1 到 10)。
- 固定軸向功率分佈：以轉動的控制滾筒(drum)取代垂直的控制棒。
- 功率傾斜能力；同一個運轉週期內可進行不同功率的實驗。
- 個別實驗控制，也可同時進行不同測試條件的實驗，可應付頻繁的實驗變更。
- 爐心組件每十年更換，每次可更換所有爐內設備。
- 可因應燃料開發與材料測試要求，進行加速測試。

ATR 一般每年約運轉 75%的時間，燃料週期平均為 7 週，每次停機約 1 到 2 週。運轉以來已進行過數次的反應器與廠區變更作業，測試能力也隨之加強，運轉特性與可靠度也均有提升，例如可快速在軸向移進或移出實驗材料，以模擬反應器起動與其他暫態條件，讓測試需求者可在一個 ATR 運轉週期內即模擬數千次的反應器運轉週期，相關的反應器保護儀控系統也已經昇級到比較可靠的數位系統。ATR 的運轉績效也相當優異，從 1980 年平均每年 11 次非預期停機，到數年前(2004 年時)已進步到 1 年僅 1 次。

(四) 一號實驗滋生反應器(EBR-1, 參如圖 2)

當初設計 EBR-1 的目的並不是用來產生電能，而是驗證科學家費米(Enrico Fermi)的核燃料滋生理論：這一理論闡明核反應器會生產比其所消耗更多的核燃料，並證實建立一個滋生反應器是可行

的。但 EBR-1 安裝了由核反應爐(產生熱)、熱交換器(進行一次側與二次側熱交換)、蒸汽產生器(產生高溫蒸汽)、渦輪發電機、控制室、輸配電線路等所組成的產生電力之系統，當時的工程師利用這間控制室來控制反應器內連鎖反應的啟動與停止，並控制發電設備的運作，使 EBR-1 維持穩定的核反應與發電狀態。

EBR-1 的架構與目前運轉中的核電廠架構相近，只是運轉中的核電廠的規模比 EBR-1 大多了。EBR-1 廠址外，也同時展出在 1950 年代美國所研發的核能動力飛機的兩個原型反應器。

EBR-1 為世界上第一次成功完成核能發電的地點，此歷史時刻為 1951 年 12 月 20 日。EBR-1 對於核能發電而言，具有獨特意義的歷史地位，目前已成為 INL 的歷史遺產。



圖 2. 我國代表團參觀一號實驗滋生反應器(EBR-1)

三、2010 年台美民用核能合作會議

本次會議分為一般議程與分組討論兩部份。首先進行一般議程部份，就雙邊過去一年的核能發展做綜合性介紹，接著依據討論議題及主管單

位的不同，分為三組，進行分組討論。

(一) 一般議程

首先安排兩國代表的簡報，我方由謝副主委代表致詞，並由原能會林耿民科長、核研所邱太銘副所長與職分別簡報我國核能管制現況、核能研究所研究現況、「台灣核能發電現況與展望」與「台電公司放射性廢棄物營運現況」等議題。美方則由能源部、核管會與國務院之代表各自簡報新核能機組計畫、能源部用過核子燃料營運、環境管理現況(主要為核設施除役與環境復育現況)、核能安全管理、與核子保安高峰會(Nuclear Security Summit)等議題，其概要分述如下：



圖 3. 2010 台美民用核能合作會議會場

1. 新核能機組計畫

美國現有 104 部核能機組運轉中，維持 90%以上的發電容量因數，績效良好。在歐巴馬政府領導之下，仍然是美國能源政策裡重要的項目之一，而美國政府的一些激勵措施：例如 2005 年能源政策法

訂定的「核能 2010 目標(NP2010)」(推動由政府與工業界分攤核能電廠興建成本，並克服技術、法規與組織上的障礙，為興建新核能機組鋪路)與貸款保證等激勵措施，將有助於美國重啟擴大使用核電。

美方簡報中也提及美國研議中的幾個新核能機組型式，例如以輕水式反應器為基礎的小型模組化反應器(Small Modular Reactor, SMR)、下一代超高溫核能熱應用等，也提及從海水中提取鈾元素的展望。另，2010 年初美國能源部成立了「藍帶」(Blue Ribbon)委員會，重新檢討美國用過核子燃料營運政策，預計在 2011 年 7 月提出政策研究報告草案，2012 年 1 月向總統提出正式報告。

美國新核能機組的推動現況如下：

- 早期場址許可：目前核管會已核准 4 個早期場址許可，包括 Clinton、Grand Gulf、North Anna sites 與 Vogtle。
- 建廠與運轉執照申請：有 30 個新反應器建廠與運轉執照申請中。Areva 與 USEC 也已提出新鈾濃縮廠興建執照的申請。
- 反應器設計認證：已有兩種設計獲核管會通過，即進步型沸水式反應器(ABWR)與西屋的 AP1000，核管會目前也正在審查另三種新設計：ESBWR、EPR 與 APWR 及一件設計修改 (AP1000)。
- 新電廠訂單：4 個建廠訂單已進行議約程序中，另有 9 個電力公司下單採購大型組件。
- 建廠：田納西州 TVA 恢復 Watts Bar 2 號機的建廠工作，也恢復 Bellefonte 1 號機與 2 號機的建廠許可。另 LES 鈾濃縮廠也開始運轉。
- 財務激勵措施：Vogle 電廠已獲得能源部的有條件貸款保證，另有 3 個核能電力公司選擇協商有條件貸款保證。而貸款保證的上限值已提議在 2011 年增加到 540 億美元。另外 Eagle Rock 濃縮廠也獲得核准有條件貸款保證。

2. 核能安全管制

美國核管處核反應器管制署處長 William Ruland 先生簡報美國核能安全管理現況，概要如下：

- 推動國際管制審查服務(International regulatory review service, IRRS)。
- 執照更新相關之通用環境影響評估(GEIS)與通用老化管理經驗(GALL)兩本報告的更新。
- 圍阻體事故壓力考量於安全注水泵淨正吸水頭(NPSH)計算問題的因應及目前處理導引草案與審查的現況。
- ECCS 系統管路內部出現氣體累積，可能造成安全泵損壞，與空泡標準之設立；NRC 已針對所有電廠回報處理情形(包括在高點設置排氣裝置、進行空泡監測等)進行審查，並將在明年初提出暫行視察指引 2515/177。
- H. B. Robinson 事件的管制現況：該電廠於 2010 年 3 月 28 日發生跳機且安全注水因為電氣纜線故障而動作，顯示組件失效若再加上運轉員誤失，就可能導致跳機衍生事件、喪失直流電匯流排、喪失反應器冷卻水泵的組件冷卻水、電氣隔離不當等類似三哩島事故的先導事件。
- PWR 電廠泵濾網在 LOCA 事故下可能堵塞的處理現況：已有超過 2/3 的壓水式反應器已有效處理此議題，但槽內效應仍在處理中。另外 BWR 業主團體也正在進行測試與分析，準備應用 PWR 的經驗。

(二) 合作案分組討論

分組討論部份援例分為反應器管制與管制法規相關研究、廢棄物管理與環境復原、及先進核能科技三組，平行進行年度合作議題進度檢討與新增項目討論。各組總結摘要如下：

1. 第 1 分組：反應器管制與管制法規相關研究：

第一分組內容主要係針對核子反應器設施管制及相關法規與

程式應用等議題，由美方之核能管制委員會(NRC)核子反應器管制室(Office of Nuclear Reactor Regulation)安全系統處(Division of Safety System)處長 William H. Ruland 與我方原能會(AEC)核能管制處龔繼康科長擔任共同主席。

Ruland 處長首先報告 2009 年 3 月美國有 27 座核電廠向 NRC 報告除役基金有短少的情形，NRC 要求這些核電廠提供回應計畫 (response plan)，目前僅有一座核電廠完成改善，其餘核電廠實施改善中。Ruland 處長建議因台美雙方各有核能應用技術議題持續進行中，雙方應繼續交流以分享技術與經驗，此舉有利雙方更有效地進行核能應用。例如：我方可提供龍門電廠施工測試經驗與美方 NRC 審照經驗進行交流，有助於國內進行新建核電廠審照作業與安全數位儀控更新作業，並回饋我方新建核電廠之經驗給美方參考。

本分組會議就原先的 22 個項目進行討論，我方新增議題 4 項 (AE-NR-TP-BN-C19 PRA 數位儀控的應用；AE-NR-JJ4 龍門電廠運轉完備視察；IN-AE-NR-A10 運用 RADTRAD 程式評估輻射效應；AE-NR-S48 原能會與 NRC 合作協定定期檢視)，美方新增議題 1 項 (美國 NRC 與原能會在 Integrated Regulatory Review Service 的合作)、及由第 3 分組合併至此分組之 1 項 (TP-BN-C22 Reliability Modeling of Digital Instrumentation & Control Systems)，經雙方討論後，同意第 1 分組共增加下列 5 項合作項目，合計同意續進行 25 個合作項目(詳如附件 2)：

- 數位儀控 PRA：項目 C19 (亦將項目 C22 併進來)，規劃與 BNL 的朱宗倫博士合作。
- NRC 派員觀察龍門電廠運轉前視察：列入編號 JJ4 項目。(但題目要改，避免 Joint inspection 的字眼)
- 輻射外釋後果分析程式 RADTRAD：編號 A10
- 新 TECRO-AIT 議約事宜(Arrangement)

• 管制資訊需求包括：

- i. Information exchange of nuclear reactor power up-rating
- ii. AEC will provide the NRC with the information of containment accident pressure (CAP) credit
- iii. AEC/NRC cooperation on IRRS (International regulatory review service)
- iv. 如何處理興建中電廠的安全文化，並區隔運轉中電廠的安全文化。

第 1 分組的合作項目中編號 IN-TP-AE-NR-B1 “Participation in the USNRC Program of Thermal-Hydraulic Code Applications and Maintenance Research (CAMP)” 乙項，我方係由本公司核安處與核研所共同參與，美方由 USNRC 參與。台美雙方針對該項合作議題之協議，預定於 2011 年 2 月完成簽署更新，在此之前，雙方工作階層將續進行技術資訊交流。

第 1 分組的其他結論如下：

- (1) 我國物管局(FCMA)將於明年 3 月份向 NRC 提出有關於 2011 年 7 月舉辦研討會(workshop)的建議書，研討會主題為「美國德州低放廢料處理與設施之興建」。
- (2) NRC 第二區的視察員(預計為 Scott Freeman 與 Bob Haag)將會於 2011 年 3 月 7 日該週抵達台北，準備參與龍門電廠起動前測試的視察與討論工作。
- (3) 我國原能會(AEC)在龍門電廠燃料裝填之前，將會進行緊急應變演習。若燃料裝填預期可順利於 7 月之前完成，則該項演習將會提前在燃料裝填之前或 7 月之前舉行，若燃料裝填延到 8 月之後，則演習將安排在 7 月或 8 月舉行。
- (4) NRC 將回報 AEC 有關功率提昇與執照更新申請案的審查經驗，以及兩者審查期程重疊時如何處理的相關議題。

- (5) AEC 願意告知 NRC 有關中華民國政府組織改造的的進度。
- (6) AEC 將透過電子郵件，提供 NRC 有關圍阻體事故壓力(簡稱 CAP)採納的技術資訊。
- (7) AEC 與 NRC 將尋求在「國際管制審查服務」(簡稱 IRRS)方面的合作機會。
- (8) AEC 將告知 NRC 有關強化內部安全文化的進展，並做為範本，繼續擴充至建廠場址，也將與台電公司合作，考量交流此領域進一步的資訊。

2. 第 2 分組：廢棄物管理與環境復原：

有關「廢棄物管理和環境復育」討論方面，由原能會物管局邵耀祖副局長與美國能源部 Jeff William 先生共同主持。本分組共新增下列 3 項合作案 (詳如附件 3)：

- Classification, Volume Reduction of TRU Radwaste (核研所提案)：

交流有關 TRU 放射性廢料減容與降級技術的經驗與資訊。美方人員 Los Alamo 國家實驗室(LANL)的 William Geist 博士將協助確認美方的聯絡人。

- Contaminated Soil Remediation (核研所提案)：

交流有關污染土壤整治的經驗與資訊。INL 的 Patricia Paviet-Hartmann 博士將會協助確認 INL 與 LANL 在此議題的聯絡人。

- Behavior of Used Nuclear Fuel Storage System (美方提案)：

交流有關用過核子燃料延長貯存研發的經驗與資訊。Jeffrey Williams 先生將提供美國延長貯存研究方案的資訊，並鼓勵我國參與延長貯存合作專案(Extended Storage Collaboration Project，簡稱 ESCP)。

另，第 2 分組的合作項目中編號 TP-EM-DD22 “ Planning for Decommissioning” 乙項，我方係由本公司核後端處參與，美方由

能源部參與，考量本公司已向原能會申請核一廠運轉執照更新許可，核二、三廠亦將規劃辦理，雙方經討論後同意現階段暫時結束本項合作議題。

本次第 2 分組討論後，本公司核後端處參與之合作議題計有下列 4 項(詳如附件 3):

- AE-NR-X1 “Transport and Disposal Practices of Irregular Waste Forms (我方由原能會物管局及本公司核後端處參與，美方由 USNRC 參與): 在本合作項目下，物管局及本公司預定於 2011 年派員參訪美國德州 Andreas 低放射性廢棄物最終處置場，以觀摩學習該州政府及業者對低放射性廢棄物最終處置場之安全管制與公眾溝通之作法與經驗。
- AE-TP-EM-DD12 “Public Participation” (我方由原能會物管局及本公司核後端處參與，美方由能源部參與): 在本合作項目下，雙方同意俟美國能源部之「藍帶」(Blue Ribbon)委員會於 2012 年 1 月向總統提出美國用過核子燃料營運政策檢討報告後，再研議相關之合作活動。
- TP-IN-NE-DD19 “Geological Repository Sciences” (我方由核研所及本公司核後端處參與，美方由能源部參與): 在本合作項目下，我方表示本公司用過核子燃料最終處置計畫後續之地質調查及技術發展係以花岡岩為主，美方表示將提供桑迪亞國家實驗室(Sandia National Laboratory, SNL)關於深地層處置之研究報告供本公司參考。
- TP-IN-NE-DD29 “Used Nuclear Fuel Extended Storage” (我方由原能會物管局、核研所及本公司核後端處參與，美方由能源部參與):本項為前揭美方提案之新增合作項目之一，美方將提供美國延長用過核子燃料貯存研究方案的資訊供我方參考，並鼓勵我國參與延長貯存合作專案(Extended Storage Collaboration Project，簡稱 ESCP)。

3. 第 3 分組：先進核能科技：

第 3 分組主要討論議題包括保健物理、能源安全技術支援、同位素生產及應用研究、反應爐應用研究、核物料之基礎研究及安全管制等議題，由美方 AIT 代表 Lee Hwa Gebert 與我方核研所邱太銘副所長共同主持。

本分組討論後，共有 3 項新增議題(詳如附件 4)：

- Physical Protection of Nuclear Material：

AIT 同意明年派員至台灣，訪問台灣之核設施，並考慮台灣方面亦派員至美國訪問其核設施。

- Training in Implementation of New physical protection Standards and Guidance：

AIT 及 TECRO 同意進行相關訓練課程之安排。

- Explore opportunities related to DOE Engineering Innovation Hub for Modeling and Simulation Program

繼續建立與美國國家實驗室之合作，接受我方研究所學生來美實習計畫，

四、拜會我駐洛杉磯辦事處

2010 年 11 月 18 日本代表團順道拜訪我國駐洛杉磯台北經濟文化辦事處，由代表處龔中誠處長接待，就駐外工作及核能管制與民眾溝通等議題交換彼此的工作經驗；代表團利用中午時間，也與代表處副處長與科技組秘書呂學祥先生就駐洛杉磯辦事處的僑務與領務等工作，駐外工作對於年輕人在外交能力、溝通協調與應變等能力的考驗，以及原能會面對各項民眾關切議題、核能設施興建場址的溝通與協調、核能與放射物料管制等經驗交換意見。



肆、心得與建議

2010 年台美民用核能合作會議在美方細心的籌備及我方主辦單位原子能委員會的充分協調與整合下圓滿結束。雙方共發表 11 篇報告，交換雙方關切之核能議題的最新資訊與進展；在「反應器管制與管制法規相關研究」的合作方面，本年度新增 5 項合作項目，合計同意續進行 25 個合作項目；在「放射性廢棄物管理與環境復育」的合作方面，本年度新增 3 項合作議題，合計同意續進行 15 個合作項目；在「先進核能科技」的合作方面，本年度新增 3 項合作議題，合計同意續進行 24 個合作項目，未來雙方合作將更形密切。

從此次會議中美方代表提出有關美國未來核電發展之報告，以及參訪 INL 國家實驗室研發設施，顯示美國為擴大無碳之核能發電之利用，持續積極進行新一代核反應器與先進核燃料循環技術之研發，並育核能科技人才，設立在 INL 之先進能源研究中心(CAES)藉由與鄰近大學機構之合作，以建立世界級的放射化學、熱力學、動力學、熱化學整合試驗等領域，並在教育方面將進行長期學習，交換教授、科學家，擴展核燃料循環技術研發之合作機構，就是美國為擴大核能永續利用所作研發與人才培育投資的典範之一。

另，美國能源部於 2010 年 3 月宣布終止雅卡山用過核子燃料最終處置場計畫並成立「藍帶」(Blue Ribbon)委員會，以重新檢討美國用過核子燃料營運政策，預定於 2011 年 7 月提出報告草案並廣徵各界意見後，預定於 2012 年 1 月向美國總統提出正式報告與建議，亦即修訂後之美國用過核子燃料最終處置政策最快在 2012 年始能定案。據此，美國能源部負責用過核子燃料與高放射性廢棄物營運計畫之官員 Mr. John Kessler 於本次會議中表示：經過此次政策之修訂，美國如欲啟動新的用過核子燃料最終處置計畫恐將費時數十載，故在美國電力研究院(Electric Power Research Institute, EPRI)之倡議下，結合美國能源部、核管會及電力公司等開始研究美國延長用過核子燃料貯存之方案，擬建議：

透過台美民用核能合作會議所建立之相關管道與機制，適時請美方提供前揭能源部「藍帶」委員會產生之美國用過核子燃料最終處置政策檢討評估報告以及延長用過核子燃料貯存研究方案之相關資訊，供規劃評估本公司用過核子燃料長程營運策略之參考。

附件 1 2008 年台美民用核能合作會議議程

American Institute in Taiwan (AIT) and Taipei Economic and Cultural Representative Office (TECRO) Joint Standing Committee in Civil Nuclear Cooperation (JSCCNC) Meeting

November 15-17, 2010

Attire for day of tour: Sturdy shoes with closed-toe and closed-heel are required. Recommend comfortable clothing for cold temperatures. Must wear long, natural fiber slacks (cotton) due to the sensitivity of INL personnel contamination monitors and their ability to read naturally occurring radon, which is attracted to synthetic fiber (i.e., polyester).

Monday, Nov. 15, 2010

AmeriTel Inn, 645 Lindsay Blvd

- 08:00 Pick up guests from hotel, foreign visitors must have passports and visas in hand, drive to Willow Creek Building (WCB) INL Transportation WCB, 1955 N. Freemont Ave
- 08:15 Process visitor's passports, sign INL tour log Sandra Tomchak & Don Miley Tomchak, Foreign Visits & Assignments Office, (208) 526-2575 Miley, INL Tours, (208) 526-5523
- 08:35 Depart for Center for Advanced Energy Studies (CAES) INL Transportation CAES, 995 University BLVD
- 08:45 Arrive at CAES, INL Welcome Harold McFarlane Deputy Associate Laboratory Director, Nuclear Science & Technology, (208)526-3256

- 09:00 Group One “Nuclear Material Characterization Dept. Capabilities” Steven Bakhtiar Nuclear Materials Characterization Department Manager, (208)533-7463
“How to stimulate Nuclear Fuel Cycle Research innovation applicable to domestic and global nuclear energy studies” Patricia Paviet-Hartmann Nuclear Materials Characterization, (208)533-7816
- 09:00 Group Two CAVE Demonstration Keith Wilson Center for Advanced Modeling and Simulation, (208) 526-8228
- 09:30 Group Two “Nuclear Material Characterization Dept. Capabilities” Steven Bakhtiar Nuclear Materials Characterization Department Manager, (208)533-7463
“How to stimulate Nuclear Fuel Cycle Research innovation applicable to domestic and global nuclear energy studies” Patricia Paviet-Hartmann Nuclear Materials Characterization, (208)533-7816
- 09:30 Group One CAVE Demonstration Keith Wilson Center for Advanced Modeling and Simulation, (208) 526-8228
- 10:00 Walking tour of CAES Harold Blackman CAES Director, (208) 526-0245
- 10:45 Depart CAES for Materials and Fuels Complex (MFC) INL Transportation

MFC, INL Site

- 11:30 Arrive at MFC Complex Don Miley INL Tours, (208)526-5523
Visitors process through security main gate; tour log and all-area TLDs provided by INL Tours
Note: Electronic devices must be left on the bus
- 11:40 Break into groups; Tour Hot Fuel Examination Facility Don Miley & James Magnan Magnan, HFEF, (208) 533-7900

MFC L&O Conference Room

12:15 Hosted lunch with INL Cultural Resources Overview Hollie Gilbert INL Cultural Resources Office (208)526-2189

Lunch catered by MFC Cafeteria Debra Morgan INL Hospitality Specialist (208) 526-0168

1:30 Depart for ATR Complex INL Transportation

ATR Complex, INL Site

1:50 Arrive at ATR Don Miley Visitors process through security main gate; tour log and all-area TLDs provided by INL Tours

Note: Electronic devices must be left on the bus

Advanced Test Reactor

2:10 Break into groups, Tour ATR Don Miley/Caleb Robison

2:50 Depart for EBR-1 INL Transportation

Experimental Breeder Reactor-1, INL Site

3:00 Tour EBR-1 Don Miley

4::00 Depart for Idaho Falls.INL Transportation

AmeriTel Inn, 645 Lindsay Blvd

5:00 Arrive hotel

6:00 Depart for Wasabi/Whitewater Grill INL Transportation

Wasabi/Whitewater Grill, 335 River Parkway

- 06:10 TECRO hosted dinner
- 08:00 Depart for hotel INL Transportation

Tuesday, Nov. 16, 2010

AmeriTel Inn, 645 Lindsay Blvd

- 08:30 Pick up visitors, transport to EROB INL Transportation
Engineering Research Office Building (EROB), 2525 N. Freemont
Avenue, CR 15908:45 Arrive at EROB Julia Townsend INL Tours,
(208) 526-2192
- 09:00 Greetings and Introductions Scott Hansen, AIT
- 09:05 Greetings and introductions Der-Jhy Shieh, TECRO/AEC
- 09:10 Opening Remarks Alex Burkart, AIT/DOS
- 09:30 Opening Remarks Der-Jhy Shieh, TECRO/AEC
- 09:50 U.S. Department of Energy Programs Supporting Nuclear Power
Deployment
Harold McFarlane, DOE/NE
- 10:15 Overview of Civil Nuclear Programs in Taiwan Keng-Ming Lin,
AEC
- 10:45 Break
- 11:00 Review of current major activities at INER Tai-Ming Chiu, INER
- 11:30 Used Nuclear Fuel Disposition Research and Development Program
Jeffrey Williams, DOE/NE
- 12:00 Current status of Taipower's Radioactive Waste Management Projects
Chin-Shan Lee, TPC
- 12:30 Lunch

Lunch provided by 3's Company Debra Morgan

- 1:30 Office of Environmental Management Projects Chuan Wu, DOE/EM
- 2:00 Overview of U.S. Safety and Regulatory Issues William Ruland, NRC
- 2:30 Performance of Nuclear Power Plants in Taiwan Chin-Shan Lee, TPC
- 3:15 Break
- 4:00 Nuclear Security Summit Tom McILvain, DOS/ISN/TR
- 4:30 Discussion
- 5:00 Depart for Hotel INL Transportation

AmeriTel Inn, 645 Lindsay Blvd

- 6:00 Depart for Dinner INL Transportation
Cellar, 3520 East 17th Street, Ammon
- 6:15 Dinner hosted by AIT
- 8:00 Depart for hotel INL Transportation

Wednesday, Nov. 17, 2010

AmeriTel Inn, 645 Lindsay Blvd

- 08:30 AIT and TECRO participants walk from hotel to Hilton (Weather Permitting)

Hilton Garden Inn, 700 Lindsay Boulevard, Idaho Falls

- 09:00 AIT-TECRO JSCCNC Meeting Working Groups

Working Group I: Matters Pertaining to Reactor Regulation and
Regulatory Research

Co-chairs: William Ruland, NRC

Dr. Jec-Kong Gone

Working Group II: Matters Pertaining to Waste Management and Environmental Restoration

Co-chairs: Jeff Williams, DOE/NE, and Hong-Nian Jow, SNL

Mr. Yao-Tsu Shao

Working Group III: Advanced Nuclear Technology

Co-chairs: Lee Gebert, DOE/NE

Dr. Tai-Ming Chiu

12:30 Lunch

Lunch provided by HiltonDebra Morgan

1:30 Resume Technical Working Groups

3:00 Closing Plenary: Working Group Reports and Closing Remarks

附件 2 台美民用核能合作案第 1 分組合作議題

四 -1、Group I：Reactor Regulation and Regulatory Research

Discussion Summary of Working Group I

Matters Pertaining to Reactor Regulation and Regulation Research

Working Group I began this year's meeting with 22 items. After the presentations and meeting and discussing, NRC and AEC agreed two items were completed and should be closed and five new items were added. Working Group I ended with 25 items.

The next AEC/NRC bilateral exchange is planned for May of 2011 and will be held in Rockville, MD.

Commitments

1. AEC and NRC will continue to support and pursue the signing of the Arrangement for cooperation, which should be completed with the signature of TECRO by mid-December. CSARP and CAMP agreements will be implemented through this Arrangement and should be finalized by February 2011.
2. FCMA will send a proposal to NRC in March for a workshop to occur in July of 2011. The topic of the workshop will be low level waste and the construction of the facility in Texas.
3. AEC would like to send an assignee to the NRC, Office of Research regarding the application and practical use of the RADTRAD code. AEC will send the work proposal and staff resume for NRC to formally consider and form a plan.
4. Inspectors from NRC Region II (Scott Freeman and Bob Haag) will visit Taipei the week of March 7, 2011 to consult with and prepare for pre-startup testing inspections. Plans are for Mr. Freeman and Mr. Haag to return with 3-5 other staff in mid to late 2011, depending on when the fuel loading will occur, in order to observe the pre-startup inspections prior to fuel loading.

5. AEC will have an offsite emergency preparedness exercise at Lungmen prior to fuel loading. If fuel loading occurs prior to July, the exercise will occur before July and before fuel loading. If fuel loading is delayed until after August, the exercise will still occur in July or August.
6. NRC will report back to AEC about NRC experience reviewing power up-rates and license renewal submittals and issues with potential overlap.
7. AEC has plans to send their staff to NRC PRA fire protection courses. AEC will send the course requests to NRC.
8. AEC and NRC will continue exchanging CNS reports for peer review. AEC just sent theirs to NRC in November and NRC will send their recent report soon.
9. NRC will provide AEC with updated documents for streamlined license renewal process for research and test reactors.
10. AEC will keep NRC informed about the ongoing reorganization.
11. AEC will provide NRC with the technical information about containment accident pressure credit via email.
12. AEC and NRC will explore cooperation possibilities regarding the IRRS.
13. AEC will keep NRC informed about next steps for enhancing internal safety culture as a model for expanding to construction sites and working with Taipower and future information exchange in this area will be considered.

Approved :

William H. Ruland
AIT Representative

Jec-Kong Gone
TECRO Representative

Item	B
Project Name	<u>THERMAL HYDRAULIC AND KINETICS</u>
Reference No.	IN-TP-AE-NR-B1
Subject	Participation in the USNRC Program of Thermal-Hydraulic Code Applications and Maintenance Research (CAMP)
Coordinators	TECRO: 邱太銘 Tai-Ming Chiu, INER;; 翁炯立 Tung-Li Weng, TPC AIT: Danielle Emche, NRC
Personnel	TECRO: 王仲容 Jong-Rong Wang, INER;; 江授全 Julian S. Chiang, TPC AIT: Jeff Dehn, NRC
Timing	2005-2009
Site	NRC (Washington, D.C.) and INER (Lungtan, Taiwan)
Objective	To join the code application and maintenance program for TRACE
Resource	TECRO will contribute US\$35,000 per year for five years, through AIT, to CAMP.
Status	On-going
Remarks	<p>(1) Dr. Shih-Kuei Chen of TECRO passed the invitation information from USNRC to join the CAMP program and to support the development of TRACE code.</p> <p>(2) A meeting organized by AEC with relative experts from Taipower and INER concluded that it was worth to participate in the program, and the agreement could be started from the beginning of 2005. During the first year, only one code assessment report will be provided.</p> <p>(3) The agreement will be modified and translated. With necessary administrative work, it is planned that both parties will sign the agreement by the end of 2004.</p> <p>Dec. 2004 (1) The updated agreement has been translated into Chinese for reference. The English version has been signed by both. The updated agreement has been translated into Chinese for parties on December 13, 2004.</p> <p>(2) The first payment of agreed contribution from TECRO (US\$3,5000 per year) has been sent through AIT to the CAMP program by the end of December 2004.</p> <p>April 2005 (1) TECRO and AIT signed the agreement of the CAMP program in November 2004.</p> <p>(2) Taipower will provide one code assessment report annually from the year of 2006.</p> <p>April 2005 Dr. Tsing-Tyan Yang of INER assigned Dr. Jan-Ru Tang to be the technical contact person for the TRACE related work of INER. Dr. Tang started to organize the project.</p> <p>May 2005 Started ISO for the TRACE related work.</p> <p>June 2005 A work plan was prepared for review.</p> <p>Dec. 2005 Taipower is planning a project for code assessment starting from the year of 2006.</p> <p>Jan. 2006 A project was initiated by INER entitled "Applications and Maintenance of NPP T/H Safety Analysis Code TRACE." This is a two-year project and the project manager is Prof. Chun-Kuan Shih (ckshih@ess.nthu.edu.tw) of National Tsing-Hua University.</p>

March 2006	The technical contact person of INER was changed from Dr. Jan-Ru Tang to Dr. Jong-Rong Wang (jrwang@iner.gov.tw).
March 2006	Two graduate students attended NRC training workshop on TRACE. Chris Murray, Joseph Staudenmeier (USNRC) et al. taught the students using TRACE/SNAP.
April 2006	Taipower has been in process of the project for code assessment.
June 2006	Taipower began to sponsor a four-year project on RELAP3-MOD5 applications and maintenance program. Project investigators were Professor Chunkuan Shih and Professor Min Lee from National Tsing-Hua University.
Aug. 2006	Failed in conversion from the input files for RELAP and TRAC to those for TRACE.
Sep. 2006	Started to model the Kuosheng and Lungmen NPPs by TRACE. Stopped modeling Kuosheng, started to model the Maanshan NPP by TRACE.
Oct. 2006	Prof. Chun-Kuan Shih attended Autumn 2006 CAMP Meeting, and reported: "STATUS REPORT ON TRACE APPLICATIONS IN TAIWAN". Using the PIPE component to model Lungmen RPV and Maanshan PZR by TRACE
Dec. 2006	Modeled Maanshan PZR control system
Jan. 2007	Ran four Maanshan startup tests with TRACE PZR model
Feb. 2007	Started building up Maanshan SG model
March.2007	Started modeling Lungmen RPV with VESSEL component Started modeling Lungmen suppression pool
April 2007	Taipower has sponsored a four-year project on Relap5/Mod3 application and maintenance program. Project investigator was Finished modeling and verification of Maanshan PZR model.
May 2007	Attended Spring 2007 CAMP Meeting, two papers presented: (1)Yi-Hsiang Cheng, Chunkuan Shih, Jong-Rong Wang, "Status Report on CAMP Activities in Taiwan" (2)Yi-Hsiang Cheng, Jong-Rong Wang, Chunkuan Shih, "Modelling and Verification of Pressurizer Model for Maanshan Nuclear Power Plant"
June 2007	Started modeling hot channel module
July 2007	Studied on pump modeling with TRACE/SNAP Studied on output from TRACE and SNAP
Aug. 2007	Studied on suppression pool modeling of Chinshan and Kuosheng. CAMP activity Report at ROCAEC international cooperative program seminar
Sep. 2007	Shu-Ming Yang Attended TRACE/SNAP workshop. Studied on using APTPLOT for output processing.
March. 2008	Run three Maanshan startup tests with TRACE Maanshan Plant model.
May 2008	One conference papers were published: "Benchmark calculations of pressurizer model for Maanshan nuclear power plant using TRACE code", Proceedings of the 16th International Conference on Nuclear Engineering (ICONE 16), May 11~15, 2008, Orlando, Florida, USA
May 2008	Prof. Chun-Kuan Shih(施純寬) and Jong-Rong Wang(王仲容)

June 2008	<p>attended Spring 2008 CAMP Meeting, and reported:</p> <ol style="list-style-type: none"> 1. "CAMP related activities in Taiwan" 2. "Modeling and verification with TRACE code for Maanshan PWR" <p>Chris Murray and Joseph Staudenmeier (USNRC) attended Spring 2008 CAMP Meeting, and reported:</p> <ol style="list-style-type: none"> 1. "Status of NRC Code Development" 2. "TRACE Code Development Status" <p>INER received TRACE 5.09 code and user's manual from AIT.</p> <p>Two topical reports were completed:</p> <ol style="list-style-type: none"> 1. "Modeling and verification with TRACE code for Maanshan PWR", Annals of nuclear energy (paper submission). 2. "TRACE Analysis of Maanshan PWR for Turbine Trip Test", ANS 2008 Winter Meeting and Nuclear Technology Expo, Grand Sierra Resort & Casino, Reno, Nevada, November 9~13, 2008.
July 2008	<p>Ran the partial loss of flow(PLOF) case with TRACE Maanshan Plant model.</p>
Aug. 2008	<p>Studied on Lungmen Plant modeling with TRACE.</p> <p>Two topical reports were completed:</p> <ol style="list-style-type: none"> 1. "Benchmark calculations of pressurizer model for Maanshan nuclear power plant using TRACE code", Nuclear engineering and design. (paper submission) 2. "USE TRACE CODE TO ANALYZE ABWR/BWR SUPPRESSION POOL TRANSIENT UNDER ATWS'S MSIV CLOSURE SITUATION", INER report.
Oct. 2008	<p>Over the past year, following activities are carried out:</p> <ol style="list-style-type: none"> 1. Building input deck of RELAP5/3D of code of Kuosheng Nuclear Power Station of Taiwan Power Company. The plant employs a General Electric designed Boiling Water Reactor (BWR/IV). The input deck includes reactor coolant system, major components of balance of plant. The control systems include in the input deck are: pressure regulator system, recirculation flow control system, and feedwater control system. The input deck is used in simulating three power tests, which are: 100% power Generator Load Rejection, 96% power Main Steamlines Isolation Valves Full Isolation, and 68% Power Recirculation Pump Trip. The simulated results are compared the results of power test. One mistake of RELAP5/3D related to the initial position of valves during steady state initialization is identified. 2. Building input deck of RELAP5/Mod3.3 of code of Lungmen Nuclear Power Station of Taiwan Power Company. The plant employs a General Electric designed Advanced Boiling Water Reactor (ABWR). The input deck includes reactor coolant system, almost all the major components of balance plant. The input deck has been successfully initialized to a steady state. The deck is used to simulate selected transients in the Final Safety Analysis Report (FSAR) of the station. Two mistakes of RELAP5/Mod3.3 code are identified. One mistake is related to the specification of the boundary conditions of heat structure. The other mistake is related to the model options of turbine model. 3. The results of 6SB2C and 6LB1A tests of FIST facility are used to assess the RELAP5/Mod3.3, RELAP5/3D and RELAP5/3DK code.

Achievements from 2005 to 2008 (TRACE)	<p>The simulated results of these codes are compared with the experimental results. The results of this study will be submitted to the Nuclear Regulatory Commission of the United States at the end of year as one of the contributed report.</p> <ol style="list-style-type: none"> 4. The RELAP5/Mod3.3, RELAP5/3D, and RELAP5/3DK code are used to analyze the large break loss of coolant accident of the Pressurized Water Reactor (PWR) of Maanshan Nuclear Power Station of Taiwan Power Company. The plant employs a Westinghouse designed three-loop PWR. The results of these codes will be compared in detail. The results of this study will be submitted to the Nuclear Regulatory Commission of the United States at the end of year as one of the contributed report. 5. Attended the Fall 2007 CAMP meeting held in Bethesda, Maryland from November 7 ~ November 9, 2007.
	<p>The activities planned for next year</p> <ol style="list-style-type: none"> 1. Building RELAP5/Mod3.3 input decks for Chanshan and Kuosheng Nuclear Power Station of Taiwan Power Company. The former station employs BWR/IV system and the later station employs BWR/VI system. 2. Incorporate control system into the input deck of RELAP5/Mod3.3 and RELAP5/3D for Lungmen Nuclear Power Station. The deck will be used to simulate the upcoming power tests of the station. The results of pretest calculations can provide guidance to operators. 3. Detail study of the 3-D effects in the downcomer region of PWR during loss of coolant accident using RELAP5/3D code.
	<p>Jong-Rong Wang (王仲容) attended Fall 2008 CAMP Meeting, and reported:</p> <ol style="list-style-type: none"> 1. “Modeling and Transient Simulation of the Lungmen ABWR with TRACE Code” 2. “TRACE Analysis of Maanshan PWR for Loss of Flow Event”
	<p>Received TRACE V5.0 Patch Release 1 from NRC (Released in Oct. 2008)</p> <p>Nov. 2008 Nuclear Power plant models with TRACE –</p> <ol style="list-style-type: none"> 1. Maanshan PWR TRACE model has been built and verified. 2. Lungmen ABWR TRACE model has been built and verified. <p>Papers –</p> <p>Dec. 2008</p> <ol style="list-style-type: none"> 1. Chunkuan Shih, Shu-Ming Yang, Yi-Hsiang Cheng, Jong-Rong Wang, “STATUS REPORT ON TRACE APPLICATIONS IN TAIWAN”, CAMP 2006 Fall Meeting. 2. Yi-Hsiang Cheng, Jong-Rong Wang, Chunkuan Shih, “Status Report on CAMP Activities in Taiwan”, CAMP 2007 Spring Meeting. 3. Min Lee, Chunkuan Shih, “Code Assessment Maintenance Program Related Activities in Taiwan” CAMP 2007 Fall Meeting. 4. The Input Files Introduction of PARCS, Hao-Tzu Lin, Jong-Rong Wang, Shu Chun Chen, Chunkuan Shih, INER-5859R, 2008.

5. USE TRACE CODE TO ANALYZE ABWR/BWR SUPPRESSION POOL TRANSIENT UNDER ATWS'S MSIV CLOSURE SITUATION, Fei Jan Tsai, Jong-Rong Wang, Hao-Tzu Lin, Chunkuan Shih, INER-5703R, 2008.
6. Modeling and verification with TRACE code for Maanshan PWR, Jong-Rong Wang, Hao-Tzu Lin, Chunkuan Shih, Yi-Hsaing Cheng, INER-PC-0118R, 2008.
7. Jong-Rong Wang, Hao-Tzu Lin, Yi-Hsiang Cheng, Wei-Chen Wang, Chunkuan Shih, "TRACE MODELING AND VERIFICATION OF MODEL USING MAANSHAN PWR START-UP TESTS", Annals of nuclear energy, 2008. (paper accepted)
8. Yi-Hsiang Cheng, Jong-Rong Wang, Hao-Tzu Lin, Chunkuan Shih, "Benchmark Calculations of Pressurizer Model for Maanshan Nuclear Power Plant using TRACE Code", Nuclear Engineering and Design, 2008. (paper submission)
9. Yi-Hsiang Cheng, Chunkuan Shih, Jong-Rong Wang, Hao-Tzu Lin, "A study of steam-water countercurrent model in TRACE code", Applied Thermal Engineering, 2008. (paper submission)
10. Yi-Hsiang Cheng, Chunkuan Shih, Jong-Rong Wang, Hao-Tzu Lin, Benchmark Calculations of Pressurizer Model for Maanshan Nuclear Power Plant using TRACE Code, ICONE16-48603, Proceedings of the 16th International Conference on Nuclear Engineering, May 11-15, 2008, Orlando, Florida, USA.
11. Chunkuan Shih, Jong-Rong Wang, Hao-Tzu Lin, Wei-Chen Wang, CAMP related activities in Taiwan, 2008 SPRING CAMP MEETING, Pisa, ITALY, May 28~30, 2008.
12. Jong-Rong Wang, Chunkuan Shih, Hao-Tzu Lin, Wei-Chen Wang, Modeling and verification with TRACE code for Maanshan PWR, 2008 SPRING CAMP MEETING, Pisa, ITALY, May 28~30, 2008.
13. Jong-Rong Wang, Hao-Tzu Lin, Yi-Hsiang Cheng, Wei-Chen Wang, Chunkuan Shih, TRACE Analysis of Maanshan PWR for Turbine Trip Test, ANS 2008 Winter Meeting and Nuclear Technology Expo, Grand Sierra Resort & Casino, Reno, Nevada, Nov. 9~13, 2008.
14. Jong-Rong Wang, Hao-Tzu Lin, Yung-Shin Tseng, Yi-Hsiang Cheng, Chunkuan Shih, Wei-Chen Wang, TRACE Analysis of Maanshan PWR for Loss of Flow Event, CAMP Fall Meeting 2008, November 5-6, 2008.
15. Jong-Rong Wang, Hao-Tzu Lin, Yung-Shin Tseng, Yi-Hsiang Cheng, Chunkuan Shih, Wei-Chen Wang, Modeling and Transient Simulation of the Lungmen ABWR with TRACE Code, CAMP Fall Meeting 2008, November 5-6, 2008.

Jan. 2009

A one year project 'Research and Applications of NPP Safety Analysis Codes' started, the project leaders are Professor Bau-shei Pei (白寶實教授) and Professor Chunkuan Shih (施純寬教授) of NTHU. There conference papers were completed:

1. "MAANSHAN PWR LOSS OF FLOW TRANSIENTS ANALYSIS WITH TRACE", Proceedings of the 17th International Conference on Nuclear Engineering (ICONE17). (paper submission)

	<p>2. "TRACE ANALYSIS OF LOSS OF FEEDWATER FLOW EVENT IN LUNG MEN ABWR", 2009 International Congress on Advances in Nuclear Power Plants (ICAPP'09). (paper submission)</p> <p>3. "TRACE ANALYSIS OF MSIV CLOSURE DIRECT SCRAM EVENT IN LUNG MEN ABWR", American Nuclear Society: 2009 Annual Meeting. (paper submission)</p>
Feb. 2009	Started study on Lungmen startup test analysis with TRACE mode
July 2009	Both NRC and AEC have willing to continue the CAMP cooperation for next period. The Agreement extending process is underway.
July 2009	Jong-Rong Wang(王仲容) et al. published two conference paper: (1) A study of steam-water countercurrent flow model in TRACE, Proceedings of the 17th International Conference on Nuclear Engineering, ICONE17, July 12-16, 2009, Brussels, Belgium. (2) Maanshan PWR Loss of Flow Transients Analysis with TRACE, Proceedings of the 17th International Conference on Nuclear Engineering, ICONE17, July 12-16, 2009, Brussels, Belgium.
July 2009	One SCI paper was accepted: (1) Benchmark Calculations of Pressurizer Model for Maanshan Nuclear Power Plant using TRACE Code, Nuclear Engineering and Design. (2009/7/15 accepted)
Aug 2009	One conference paper was completed: (1) TRACE MODELS AND VERIFICATIONS FOR LUNG MEN ABWR, American Nuclear Society: 2009 Winter Meeting, November 15-19, 2009 Washington, DC Omni Shoreham Hotel.(paper submission)
Aug 2009	NRC sent the new version of TRACE to INER Jong-Rong Wang. Besides, Jong-Rong Wang et al. solve the TRACE coupled PARCS problems by the new version of TRACE.
Oct. 2009	【JSCCNC】 NRC request the ABWR Trace Deck from AEC, but not necessary for this time.
Dec. 2009	Shu-Chuan Chen worked on the development of the Lungmen TRACE coupled PARCS model. She discussed the TRACE coupled PARCS problems with Dr. Thomas J Dowar, Yunlin Xu, and Andrew Ward. They suggested Shu-Chuan Chen build up MAPTAB.edt to solve the problems. Shu-Chuan Chen finished the file: MAPTAB.edt, but it still failed in the TRACE coupled PARCS.
Jan, 2010	One SCI paper was completed:

	<p>(1) TRACE MODELS AND VERIFICATIONS FOR LUNG MEN ABWR, Annals of Nuclear Energy.(paper submission)</p> <p>Two conference papers were completed:</p> <ul style="list-style-type: none"> · Reactivity Modeling in MSIV Closure Transient of Lungmen ABWR with TRACE, ASME-AIT-UIT 2010 Conference, Sorrento, Italy, May 16-19, 2010. (paper accepted) · TRACE MODELING OF CHINSHAN NPP BENCHMARK TEST, ASME-AIT-UIT 2010 Conference, Sorrento, Italy, May 16-19, 2010. (paper accepted)
Feb. 2010	<p>Shu-Chuan Chen still worked on the development of Lungmen TRACE coupled PARCS model. She still discussed the TRACE coupled PARCS problems with Dr. Thomas J Dowar, Yunlin Xu, and Andrew Ward. She modified the PMAXS files of reflectors in order to solve the problems. But it still failed in the TRACE coupled PARCS.</p>
March. 2010	<p>Started building up IIST(Institute of Nuclear Energy Research Integral System Test) Facility TRACE model.</p> <p>One conference paper was completed:</p> <ol style="list-style-type: none"> 1. TRACE Analysis of MSIV Closure Direct Scram Event for Lungmen ABWR , ICAPP, 10 San Diego, California, USA, June 13-17, 2010. (paper accepted)
April 2010	<p>Shu-Chuan Chen still discussed the TRACE coupled PARCS problems with Dr. Thomas J Dowar, Yunlin Xu, and Andrew Ward. They told her the GenPMAXS code (version 6) will be released.</p> <p>One conference paper was completed:</p> <p>TRACE Analysis of Feedwater Pump Trip Event for Lungmen ABWR , NUTHOS-8, Shanghai, China, October 10-14, 2010. (paper submission)</p>
May 2010	<p>Chun-Yu Chen and Shu-Chuan Chen attended ASME-AIT-UIT 2010 Conference, and reported:</p> <ol style="list-style-type: none"> 1. Reactivity Modeling in MSIV Closure Transient of Lungmen ABWR with TRACE, ASME-AIT-UIT 2010 Conference, Sorrento, Italy, May 16-19, 2010.

	<p>2. TRACE MODELING OF CHINSHAN NPP BENCHMARK TEST, ASME-AIT-UIT 2010 Conference, Sorrento, Italy, May 16-19, 2010.</p>
<p>June 2010</p>	<p>Jong-Rong Wang and Shuming Yang attended Spring 2010 CAMP Meeting, and reported:</p> <ol style="list-style-type: none"> 1. Status of CAMP Activities in Taiwan. <p>Jong-Rong Wang and Hao-Tzu Lin submitted the NUREG/IA paper to NRC Dr. Calvo in May 2010. Then this paper was accepted in June 2010.</p> <ol style="list-style-type: none"> 1. Assessment of the TRACE Code Using Transient Data from Maanshan PWR Nuclear Power Plant, NUREG/IA-0241, June 2010. <p>One conference paper was published:</p> <ol style="list-style-type: none"> 1. TRACE Analysis of MSIV Closure Direct Scram Event for Lungmen ABWR , ICAPP, 10 San Diego, California, USA, June 13-17, 2010. <p>One conference paper was accepted:</p> <ol style="list-style-type: none"> 1. TRACE Analysis of Feedwater Pump Trip Event for Lungmen ABWR , NUTHOS-8, Shanghai, China, October 10-14, 2010.
<p>July 2010</p>	<p>Four conference papers were accepted:</p> <ol style="list-style-type: none"> 1. TRACE Modeling and Its Verification Using an IIST SBLOCA Experiment, American Nuclear Society: 2010 Winter Meeting, November 7–11, 2010 • Las Vegas, Nevada • Riviera Hotel. 2. TRACE Analysis of 1 RIP and 3 RIPs Trip Transients for Lungmen ABWR, American Nuclear Society: 2010 Winter Meeting, November 7–11, 2010 • Las Vegas, Nevada • Riviera Hotel. 3. TRACE Analysis of Loss of Flow Events in Maanshan Nuclear Power Plant, American Nuclear Society: 2010 Winter Meeting, November 7–11, 2010 • Las Vegas, Nevada • Riviera Hotel. 4. TRACE Modeling of Kuosheng BWR/6 Startup Tests, American Nuclear Society: 2010 Winter Meeting, November 7–11, 2010 • Las Vegas, Nevada • Riviera Hotel.
<p>Aug. 2010</p>	<p>Chian-ying Chang discussed the TRACE coupled PARCS problems</p>

	of PBTT, MSLB , and Lungmen with Andrew Ward (PARCS Research Group, University of Michigan).
Sep. 2010	Jong-Rong Wang et al. worked on the development of Maanshan and Lungmen TRACE LOCA model.
Nov. 2010	AEC and NRC reached a common consensus on draft Agreement The renewal of CAMP Agreement would be signed after the "AEC-NRC AIT/TECRO Arrangement" signed. The interactions between working levels should keep going before signature completed. CAMP should be signed by February 2011 in tandem with CSARP.

附件 3 台美民用核能合作案第 2 分組合作議題

Discussion Summary of Working Group II

Waste Management and Environmental Restoration

TECRO-AIT JSC Meeting on Civil Nuclear Cooperation

November 17, 2010

1. Number of working items been discussed in Group II: 15
2. Closed items: 2
 - IN-ANL-G32, “Spent Fuel Management”
 - TP-EM -DD22, “Planning for Decommissioning”
3. Merged 2 items : DD18 to be merged into J4
 - IN-EM-DD18, “Fuel Basin Cleaning”
 - IN-ANL -J4, “Information transfer on decontamination and dismantling of research nuclear facilities”
4. 3 New items :
 - IN-EM-DD27, “TRU Waste Management “
 - IN-EM-DD28, “Contaminated Soil Remediation “
 - TP-IN-NE-DD29, ” Used Nuclear Fuel Extended Storage “
5. Number of working items after the meeting: 15
6. Highlights:
 - Item FC-NR-G34, “Peer Review of National Report of Taiwan for the Joint Convention on the Safety of Spent Fuel Management and on the

Safety of Radioactive Waste Management” , FCMA provided the draft National Report (2nd version) by CD-ROM to Jeff Williams of DOE for peer review.

- Item AE-SNL-G35,” Information and Data Management System for SNF Interim Dry Storage Facility”, Mr. Robert Finch provided a draft report of the Phase I Study to TPC . The final report will incorporate TPC’s comments and be delivered to FCMA and TPC by January 2011.
- Item AE-NR-X1, “Transport and Disposal Practices of Irregular Waste Forms”, FCMA and TPC plan to visit Texas Commission on Environmental Quality and Waste Control Specialists to collect the license review experiences and public acceptance activities on Andrews LLRW disposal site in 2011. FCMA will contact with NRC in March of 2011.

Approved :

Jeffrey Williams

Yao- Tsu Shao

AIT Representative

TECRO Representative

Project Name	LOW LEVEL RADWASTE TREATMENT & DISPOSAL
Reference No.	AE-NR-X1
Subject	Transport and Disposal Practices of Irregular Waste Forms
Coordinators	TECRO: 邱賜聰 Syh-Tsong Chiou, FCMA; 李清山 Chin-Shan Lee, TPC AIT: Danielle Emche, NRC
Personnel	TECRO: 林善文 Shan-Wen Lin,, FCMA; 彭永昌, TPC AIT: Shawn Smith, NRC
Timing	2008-2011
Site	Taiwan
Objective	To share US experiences on the transport and disposal practices of large components (reactor pressure vessel, steam generators, motors), GTCC waste and class A waste.
Resource	All necessary traveling and living expenses shall be born by FCMA.
Status	On-going
Remarks	<p>Oct. 2007 FCMA will invite 1-2 NRC/DOE experts to Taiwan in 2008 to carry out 1 week workshop on transport and disposal practices of large components.</p> <p>Jan. 2008 FCMA will send the proposal for workshop to NRC before the end of March.</p> <p>August 2008 No activity in this period.</p> <p>Oct. 2008 FCMA will send the proposal for workshop to NRC in next fiscal year.</p> <p>Oct. 2009 【JSCNC】 FCMA will send the proposal for a workshop on “Transport and disposal practices of irregular waste forms” to NRC in the first half of 2010. Through discussion in TECRO-AIT Joint Standing Committee Meeting, Hsien-Shiow Tsai (蔡顯修), TPC, is added to be a member of the coordinator and 彭永昌, TPC, is added to be a member of personnel.</p> <p>Sep. 2010 FCMA and TPC plan to visit the Texas Commission on Environmental Quality and Waste Control Specialists to collect the license review experiences and public acceptance activities on Andrews LLRW disposal site in 2011.</p>

Item	DD
Project Name	<u>EM PROJECT</u>
Reference No.	AE-TP-EM-DD12
Subject	Public Participation
Coordinators	TECRO: 李清山 Chin-Shan Lee, TPC/邱賜聰 Syh-Tsong Chiou, FCMA AIT: Chuan-Fu Wu
Personnel	TECRO: 史簡 Chien Shih, TPC/邵耀祖 Kenneth Shao, FCMA AIT: Leroy Stewart (DOE/RW)
Timing	1995~2020
Site	Taiwan
Objective	Exchange experiences
Resource	TPC or AEC will provide funding.
Status	On-going
Remarks	<p>Explore opportunities for U.S. experts to visit Taiwan to discuss subject matter to a broader audience. TECRO coordinator changed to M.H. Lin.</p> <p>1998 On-going. No activity during the period. Please change TECRO Coordinator from F.H. Chen to M.H. Lin.</p> <p>1999 AIT will review information available on public participation within DOE and share with TECRO during 1999.</p> <p>Dec. 2000 TECRO will request AIT to visit Taiwan in December to discuss future plans for this project.</p> <p>July 2001 Dr. Ouyang (AEC Senior Vice President), Mr. Lin (NBMD Director, TPC) and Dr. Lee (AEC International Affairs) visited the WIPP Repository. Public participation is an issue discussed.</p> <p>Oct. 2001 Dr. Wu of DOE visited TPC to discuss public outreach strategies for the TPC's LLRW Program. Primary focus was on the EIS public meetings.</p> <p>Nov. 2003 In 2004, TECRO will invite AIT experts to discuss the public participation issues.</p> <p>Nov. 2004 Dr. Wu suggests that AIT (DOE WIPP and YMP projects) offer to share public outreach experience with TECRO. Mr. Chin-Shan Lee, Mr. Michael Lin and Dr. Ruoh-Tsann Lee will discuss TECRO's needs. AIT and TECRO will also consider participation by NRC, based on NRC's experience in public outreach (and subject to availability of resources).</p> <p>Jan. 2005 A dialogue was initiated by TECRO side to plan for a coming discussion meeting in Taiwan.</p> <p>March 2005 A plan for the coming discussion meeting, possibly connected with early November AIT-TECRO meeting, is still being organized by TECRO.</p> <p>Nov. 2005 Project will continue.</p> <p>April 2006 A plan for the coming discussion meeting is still being organized by TECRO.</p> <p>July 2006 The plan of inviting U.S. experts to visit Taiwan is postponed to early 2007.</p> <p>Nov. 2006 TPC will invite US experts in spring, 2007. TPC or AEC to cover</p>

	expenses.
July 2007	The plan of inviting U.S. experts to visit Taiwan is temporarily pending due to the shortage of budget.
Sept. 2007	The plan of inviting U.S. experts to visit Taiwan will not be executed this year. TPC will consider the necessity and budget conditions to decide the appropriate time.
Jan. 2008	The plan of inviting U.S. experts to visit Taiwan is temporarily pending. TPC will consider the necessity and budget conditions to decide the appropriate time.
Nov 2008	Mr. Leroy Stewart of AIT will send a local county public perception report on Yucca Mountain project to Mr. Yao-Tsu Shao 邵耀祖 at FCMA by December 2008.
Oct. 2009	The plan of inviting U.S. experts to visit Taiwan is temporarily pending. TPC will consider the necessity and budget conditions to decide the appropriate time.
Oct. 2009	【JSCCNC】 Mr. Leroy Stewart of DOE sent a CD-Rom “ NYE County Nevada Community Protection Plan” to FCMA for reference on Oct. 26, 2009. AIT and TECRO both agree to keep ongoing.
Oct. 2010	Given the facts that Taiwan’s low-level radioactive waste disposal program has been further delayed , public acceptance is the most important issue in Taiwan. TPC will invite experts from DOE to visit Taiwan at appropriate time, to share public participation experience .
Nov 2010	Agree to defer until the completion of the Blue Ribbon Commission Report which is expected to be available on or before January 2012.

Item	DD
Project Name	EM PROJECT
Reference No.	TP-IN-NE-DD19
Subject	Geological Repository Sciences
Coordinators	TECRO: 李清山 Chin-Shan Lee, TPC , 邱太銘 Tai-Ming Chiu, INER AIT: Jeff Williams, DOE
Personnel	TECRO: 彭桓沂 Huan-Yi Peng, TPC 莊文壽 Wen-Shou Chuang, INER AIT: Robert Finch, SNL
Timing	2005~2020
Site	To be determined
Objective	(1) To investigation of geological media, disposal site evaluation and performance assessment of disposal site (2) Verification and validation of the performance assessment models with the data of engineering barrier system (EBS) and geological media.
Resource	
Status	On-going
Remarks	
1998	(1) Training site to be determined (2) Plans have been made for INER to fund WIPP to provide course at INER in December, 1998. INER would like to send one staff member to the U.S. to obtain three months of training in Performance Assessment of HLW disposal at Yucca Mountain. (3) AIT and TECRO will organize a workshop on developing a comprehensive strategy for a deep geological repository in Taiwan. This will include understanding Taiwan's program needs and matching U.S. capabilities. (4) AIT will share information concerning the conducting of the test and analysis addressing transportation and storage of nuclear materials. Future opportunities for cooperation to be identified.
March 1999	No activities in this period.
Oct. 1999	Four members of Taiwan Nuclear Society will attend DOE's International Conference on Geological Repository in Denver, Colorado October 31~November 3, 1999.
Oct. 2000	Initial meeting held to discuss the formation of an International Center for Geological Science and Technology.
April 2001	Two members of Taiwan attended the second meeting of the International Center for Geological Repository Science and Technology (ICGRST) held at Las Vegas.
April 2001	Three members of Taiwan attended the 9th International High-Level Radioactive Waste Management Conference (IHLRWM) held at Las Vegas.
May 2001	One INER staff visited SNL and WIPP for technical discussions on performance assessment of the geological repository.
July 2001	One INER staff visited SNL, WIPP and YMP for technical discussions on performance assessment of the geological repository and disposal technology.
Aug. 2001	Third meeting to discuss the formation of the ICGRST, and workshop

Jan. 2002	and discussion of two possible tasks related to URL's and TSPA. Four ITRI-ERL staff visited SNL, WIPP for technical discussion on applications of geostatistics for site characterization and information integration.
May 2002	INER organized a workshop on the integration between PA and site investigation for spent fuel repository, and invited two experts from SNL to be instructors.
Dec. 2002	AIT will coordinate meetings, discussions or visits upon TECRO's request.
Feb. 2003	INER and SNL both came to an agreement of collaboration in the field of SNF repository research. SNL will help review the preliminary PA report to be prepared by INER in April. SNL experts will then join the workshop to be organized in Taiwan to discuss the review comments and to talk about the integration technology between PA and SC in that field.
Feb. 2003	One INER staff attended Waste Management'03 conference in Tucson and visit Lawrence Livermore National Laboratories for technique discussion on total system performance assessment of geological repository and attend advanced training course of GoldSim.
March 2003	One INER staff attended 10 th International High-level Radioactive Waste Management Conference and visit Yucca Mt. as well.
April 2003	April 15, INER provide performance assessment report to SNL for technique document review. At the end of April, one SNL expert came to Taiwan to discuss the review comments and talk about the integration technology between Performance Assessment (PA) and Site Characterization (SC). ICP kick-off meeting be discussed in advanced as well.
May 2003	Industrial partnerships and commercialization of LLNL provided the EQ3/6 package to INER for the performance assessment regarding the chemical of waste forms and rock/water interactions.
June 2003	Two INER staff visited SNL, GAI (Golder Association Inc.), and MSCI (Monitor Scientific) for technique discussion on total system performance assessment of geological repository and attend advanced training course of GoldSim.
July 2003	Two experts from MSCI organized a workshop about system analysis and engineer barrier system to transfer the technique of long term disposal
Aug. 2003	The kick-off meeting was held for Taiwan ICP technology transfer of geologic repository science and performance assessment.
Sept. 2003	One expert from GAI held a workshop in Taiwan. The workshop was based on the contract between INER and GAI to introduce the use of GoldSim software.
May 2004	Drs. Randy Robert and Hong-Nian Jow of SNL visited ERL and organised a workshop on the application of nSIGHT code.
Aug. 2004	Ms. Shu-Jun Chang of INER visited WIPP for technical discussion of environmental monitoring in Aug. 2004.
Nov. 2004	AIT will invite TECRO to attend the 11th International High-Level Radioactive Waste Management Conference (IHLRWM) held at Las Vegas in September, 2005. AIT will also invite TECRO to attend the Waste Management Conference which will be held in Tucson, March 2005.

June 2005	No activities since Nov. 2004.
Nov. 2005	Project will incorporate TP-DE-G30. Also, the subject title shall be changed to Geological Repository Sciences. AIT will invite TECRO to attend the 11th IHLRWM conference to be held in Las Vegas in May, 2006. AIT will also invite TECRO to attend the Waste Management Conference which will be held in Tucson, March 2006.
Nov. 2005	Both sides agreed that TP-DE-G30 is merged into TP-IN-RW-DD19.
Dec. 2005	On Dec. 21, Dr. Hong-Nian Jow of SNL visited TPC. The two parties shared the information about the current status of TPC's spent fuel disposal program and Yucca Mountain Spent Fuel Disposal Program.
March 2006	1. INER and EEL proposed to initiate a cooperation program for technology transfer for final disposal of spent nuclear fuel from SNL through Industrial Cooperation Program. The proposal has been delivered to and will be reviewed by Office of Executive Committee for Industrial Cooperation Program, Ministry of Economic Affairs. 2. Dr. Shin-Jon Ju and Dr. Min-Chuan Kuo plan to visit SNL for technology and experience exchange of safety assessment of radioactive waste final disposal in June 2006.
June 2006	Drs. Shin-Jon Ju and Ming-Chuan Kuo of INER visited SNL during June 9 to 16, 2006. Several topics were discussed with the experts of SNL, including the integration of biosphere code, AMBER, with GoldSim, application of GDPM macro of FEHM code in a single fracture system, Yucca Mountain Project TSPA Scheme and uncertainty and sensitivity analysis techniques.
Sep. 2006	Drs. Hong-Nian Jow and Jeff Smith of SNL visited Taiwan to participate in the kick-off meeting of ICP Technology Transfer for the Phase II program on the final disposal of spent nuclear, which was held at FCMA on September 29, 2006.
Nov. 2006	On-going
Feb. 2007	Dr. Hong-Nian Jow of SNL visited INER to discuss the agenda of the training courses of second phase SNF ICP program proposed on March 2007.
March 2007	Drs. Hong-Nian Jow, Rick Beauheim, Sean McKenna, Randy Roberts and Bill Arnold of SNL visited INER for implementation of SNF ICP Phase II technology transfer program. The scopes of discussion included "Data Interpretation using nSIGHTS code", "Groundwater flow model by FEHM code", "Conceptual Model Development Methodology" and "Field Test Planning and Design".
June 2007	Drs. Hong-Nian Jow, Ji-Woong Han, Joe Schelling, Patrick Mattie of SNL visited INER to implement the second training courses of technology transfer for spent nuclear fuel disposal under ICP phase 2 program.
Oct. 2007	Dr. Bill Arnold, Sean McKenna, and Dr. Hong-Nian Jow visited INER to conduct a workshop on Fracture Network Simulation and FEHM flow and transport. Dr. Hong-Nian Jow, SNL was assigned as AIT personnel.
March 2008	As part of the work scope for the ICP technology transfer project on phase 2 spent nuclear fuel management and final disposal, Sandia completed the review of INER's technical progress draft report for

April 2008	CY2006-2007 on Taiwan spent nuclear fuel final disposal program, and held a discussion meeting with INER in March 2008.
April 2008	Dr. Hong-Nian Jow of SNL visited FCMA to participate the closeout meeting of SNF ICP Phase II technology transfer program.
April 2008	The ICP tech transfer project was successfully completed on schedule at the end of March 2008. Sandia attended the project closeout meeting held in Taipei on April 17, 2008.
Nov. 2008	Mr. Leroy Stewart of AIT (DOE/RW) provided TECRO a CD-ROM of Yucca Mountain Repository License Application.
Oct.2009	【JSCCNC】 Both sides agree to add Objective (2) : Verification and validation of the performance assessment models with the data of engineering barrier system (EBS) and geological media.
Oct.2010	As part of its study program on spent fuel disposal, TPC plans to establish a small- scale laboratory for conducting testing on potential host rock characteristics in 2012, YMP related experience would be taken into account for reference.
Nov.2010	TECRO has expressed interest in geological disposal in granite. Robert Finch will provide a recent SNL report on deep borehole disposal and check on the availability of additional recent reports on generic disposal concepts.

Group	Group II Waste Management and Environmental Restoration
Item	TP-IN-NE-DD29
Project Name	<u>USED NUCLEAR FUEL EXTENDED STORAGE</u>
Subject	Behavior of UNF storage system
Coordinator	TECRO: 邱賜聰 Syh-Tsong Chiou, FCMA ;李清山 Chin-Shan Lee, TPC , 邱太銘 Tai-Ming Chiu, INER AIT: Jeffrey Williams, DOE
Personnel	TECRO: 劉文忠 Wen-Chung Liu, FCMA;邱顯郎,TPC 莊文壽 Wen-Shou Chuang, INER AIT: Jeffrey Williams, DOE
Objective	Share Experiences and Information on used fuel disposition research and development.
Budget resource	Each Party shall be responsible for necessary traveling and living expenses of its staff.
Co-operation Type	visiting, information exchange etc.
Benefits	Share experiences and information on extended used fuel long term storage research and development.
Remarks	Mr. Jeffrey Williams will provide information on the US extended storage cooperation program. Taiwan is encouraged to participate in the Extended Storage Collaboration Project (ESCP).

附件 4 台美民用核能合作案第 3 分組合作議題

Discussion Summary of Working Group III

Advanced Nuclear Technology

Item Summary for Group III

Topical areas include health physics, technical safety support, radioisotope production and applications, advanced reactors, basic research, physical protection and safeguarding of nuclear materials.

Number of items in discussion	25
Closed items	2
Items moved to Group I	2
Proposed new items	3
Pending items for next year's discussion	1

There is one presentation made by the AIT side.

Confidence-Building Measures: Nuclear Forensics Initiative by William Rhodes of DOE/NNSA.

AIT will confirm an appropriate coordinator on the “Health Physics” topics.

AIT and TECRO intend to reach agreement on a Statement of Intent Regarding Nuclear and Radiological Incident Response and Emergency Management Capabilities.

TECRO will contact the coordinator directly on the AIT side for “Radioisotope Productions and Applications” topic.

On the Advanced Reactor topics:

- o TECRO proposes new item for potential cooperation in DOE Engineering Innovation Hub for Modeling and Simulation Program .

Approved:

Lee Hwa Gebert

AIT Representative

Tai-Ming Chiu

TECRO Representative