

蔡春鴻理事長致詞

梁政務委員、各位貴賓、核能界及核能學會的各位朋友，

大家早！

首先本人要代表核能學會竭誠歡迎大家來參加「用過核燃料管理策略研討會」，尤其是遠道從國外來的貴賓，謝謝各位對研討會的支持！

大家都知道，台灣自有的能源非常缺乏，能源進口的比例已超過 99%，如何在兼顧能源安全、經濟發展與環境保護的情況下，選擇適當的能源加以有效利用，一直是國內產官學研各界努力的議題。從 2005 年京都議定書生效以來，如何因應全球暖化和溫室氣體排放減量又變成各國政府的施政重點。今年稍早歐盟已經率先提出要在 2020 年的二氧化碳排放比 1990 年減少 20%(如果國際協議達成共識，還可能提升至 30%)；日本新任的鳩山首相在 9 月底更提出要比 1990 年減少 25%；11 月間中國大陸和美國也分別宣示將於 2020 年達成比 2005 年下降 40~45%與 17%的減碳目標（其中中國大陸是以每千元 GDP 的二氧化碳排放密度為單位，其他國家則是以二氧化碳的排放總量為單位），12 月 7 日在丹麥哥本哈根的世界氣候變遷大會前後，世界各國也都紛紛宣示了減碳的決心，因此未來的生活型態邁向低碳家園，已經是必然的趨勢。

反觀國內，一般民眾和社會各界，對於全球氣候變遷的嚴重性和節能減碳的生活規範也都已經有深切的覺醒。在今年 4 月全國能源會議召開之後，政府已參照會議的結論，及去年發佈的節能減碳政策，擬定出低碳施政的目標和具體的行動方案，同時又將計畫統合成 16 項旗艦整合方案，其中的「核能發電合理使用評估方案」、「能源國家型科技計畫方案」、「全方位能源科技人才培育方案」等均和未來核能的長期發展有密切的關係。

然而各位也都知道，經過核四廠興建過程的紛紛擾擾和過去 8 年「非核家園」的政治環境，要得到國會和民眾對核能的支持，仍然必須比過去付出更大的心力。剛剛提到民眾對於節能減碳的認知，當然是有助於增加民眾對於無碳的核能的接受度，另一方面來說，以國內運轉中核一、二、三廠 6 部機組的運轉記錄看來，近年來均呈現相當穩定安全運轉的狀態，自動急停及異常事件等績效指標表現良好，且近兩 (96.97) 年平均容量因數(產能利用率)均達到 89%，創下歷年最佳的紀錄。這些運轉績效對於增加民眾對核能安全的信心更是讓民眾接受核能最重要的條件。

除了核能安全之外，妥善處理核廢料的問題也是民眾普遍關切的。在低放射性廢棄物最終處置方面，經濟部預定於 99 年 6 月辦理地方公投，惟公投門檻過高，須 50%出席投票及 50%同意票，且地方政府並無配合辦理地方公投之意願，故地方公投過關能否確實有很高的難度。不過目前幾個核電廠都

設置有安全的貯存庫，加上近年來各廠廢料減量和減容的部份有很顯著的成效，要貯存未來運轉期間產生的低放射性廢棄物短期間不是問題。至於在用過核燃料處置方面，目前各核電廠所產生的用過核燃料，均安全地貯存在廠內用過燃料池中；但核一、二廠因水池容量不足，已規劃興建乾式貯存設施，卻又引發地方民眾可能將永久就地存放的疑慮及抗爭。以長程的策略來看，由於用過核燃料仍存有 95%的可用資源，國際間除採行長期貯存與直接最終處置的方式外，日本、法國等則採行再處理，以回收鈾資源供循環再利用。美國在歐巴馬總統上台後，已停止 Yucca Mountain 的計畫，同時也在檢討長程的用過核燃料處理或處置策略，在這種情況下，我國如何掌握未來可能發展的情勢，重新檢討未來的用過核燃料管理策略，應當是我們核能界全體同仁必須正視的議題。我們前面講到的能源政策，除了從全球暖化碳減量的面向，除了從國家安全、從經濟發展的面向之外，還有一個是社會正義、世代正義的面向，核廢料是一個長期要解決的問題，但是從世代正義的角度，我們這一代的核能從業人員仍然必須積極正視這個問題。

各位貴賓、各位核能界的朋友，核能學會作為國內各核能相關單位及從業人員技術交流暨意見整合的平台，我們特別在今天召開會員大會的機會，籌辦了這場「用過核燃料管理策略研討會」，除了邀請多位旅居國外對此項議題有豐富經驗的專家，分別就不同的角度進行專題演講之外，也特別邀請各位朋友一齊共同來進行這個議題的討論，希望藉由這個年度的聚會，能為

我國未來用過核燃料管理的策略，例如境外再處理的可行性、高放廢棄物之最終處置規劃、以及國內人力及資源的有效整合等項目，透過討論得到共識，並且規劃出明確的建議，提供給政府與民間部門作為參考。而下午時段，在會員大會之後，本學會下設的 5 個學術委員會也將分別就核能安全、核燃料與材料、核反應器水化學、放射性廢棄物管理及醫學應用等領域進行專題學術演講及討論，盼望經由這一整天的學術活動，讓政府與民間、國內與國外等相關學者專家有更充分的互動和交流。

最後，我代表核能學會再次感謝梁政務委員、各位貴賓及所有出席人員的共襄盛舉，也感謝參與研討會籌備工作同仁的努力，以及相關單位對籌辦經費的大力支持，預祝本次研討會順利成功，也祝大家身體健康、事事如意，謝謝各位！

梁政務委員啟源致詞

大會主席核能學會蔡理事長、各位貴賓、以及各位核能界的先進、專家、學者們，大家早！

今天，非常榮幸能參加國內核能界涵蓋產、官、學、研四個領域一年一度舉辦的盛會暨用過核燃料管理策略研討會。

今年 10 月聯合國政府間氣候變遷專家小組(IPCC)指出，亞太地區是天災高頻率的地區，全球 70% 重大災害，包括颱風、海嘯都發生在此，總結主因是全球暖化所造成。

台灣人口占全球的千分之三，但台灣所排放的 CO₂，卻占全球的百分之一；廿世紀全球氣溫上升 0.74 度，台灣平地溫度卻上升 1.2 度，導致台灣已成為全球暖化、氣候變遷的重災區，今年 8 月莫拉克颱風來襲，阿里山雨量暴增到 2,965 毫米，造成海拔二千公尺的阿里山遊客中心淹水高達二公尺，空前的天災令人震撼，國人應該認知在地球暖化的影響下，台灣未來將面臨和莫拉克颱風相同，甚至破壞力更大的颱風，故必需下決心有所對應。

就如同剛才蔡理事長所言，政府為了面對這項嚴峻的挑戰，今年 4 月召開全國能源會議，邀集國內各領域專家學者凝聚共識，共同研商解決之道，並由經建會、經濟部、國科會及原能會等部會參照會議結論，擬定出國家低碳施政目標，範圍涵蓋五大主軸，包括：健全能源法規、能源科技研發、輔導低碳產業、營造低碳社會及改善能源結構，總計提出 16 項旗艦整合方案。7 月份各部會已提出具體行動方案，分年編列預算逐步落實，期能朝兼顧經濟永續發展、重視環境保護、穩定能源供應、提高能源效率、拓展能源

產業等五個面向，引領國家、產業與民眾走向優質化的經濟體系與生活環境邁進。

綜觀世界主要國家能源政策的制訂，為降低 CO₂ 排放量，最直接有效的作法，就是減少化石能源的使用，積極發展再生能源，而選擇發展低成本、且能源自主性高的無碳核電，更是抑減溫室氣體的利器。台灣能源匱乏，再生能源的發展受限於地理環境與天候條件，大幅增長不易；因此要有效減低溫室氣體排放，因應 2012 年後京都議定書、及日前哥本哈根世界氣候變遷大會的宣示，參考日韓大陸等鄰近國家的作法，重新思考核電的價值，並逐步落實推動，乃是當前台灣極為重要的課題。

未來在 16 項能源旗艦整合方案中，有 6 項與核能發展息息相關，包括：推動能源基本法、能源政策環評、規劃長期電力開發與結構調整、建立核能合理使用評估機制、推動能源國家型科技計畫及科技人才培育等，均需請原能會、經濟部，及國科會出面廣邀核能界先進參與推動。舉例來說，(1)核能重生已是世界趨勢，因此應協助產學研界參與國際核能合作計畫，與世界接軌；(2)為因應未來可能形成賣方市場的情勢，應善用國內機械、電子、資訊、化工、材料、產業的優勢，輔導建構國內核能產業體系，並建構國際及兩岸核能合作平台，形成更緊密的市場伙伴關係，以塑造核能產業有利發展環境；(3)參照國外作法妥善處理核廢料，提高民眾信心，建立國內共識。

就如同蔡理事長先前致詞提到，台灣無論要擴大使用核電、或進一步發展核能產業，核廢料的妥善解決絕對是無可避免的。多年來的經驗顯示，社會大眾對用過核燃料，以及低放射性廢棄物，這兩者的區別，觀念仍然是相當混淆，也普遍存在著「別擺放在我家後院」的心態，這也是造成政府各相關單位在推動低放射性廢棄物最終處置場選址方面處處碰壁的原因，仍然需

要核能界的朋友多秉持耐心，加強與民眾溝通，同時也盼望能參考其他國家成功溝通的經驗，提高民眾信心，以建立國內共識。

今天上午的研討主題「用過核燃料管理策略」，能邀集到國內外學者專家共聚一堂，發表各地區的經驗，激盪出最適合台灣未來發展的藍圖，是相當重要的，也希望經過熱烈討論後的共識，能提供政府擬訂相關政策的參考。

最後，預祝大會圓滿成功，並祝福各位身體健康、萬事如意。謝謝！

2009 用過核燃料管理策略研討會暨

中華民國核能學會第 28 屆第 2 次會員大會暨第 5 屆原子能安全績優獎頒獎典禮議程

會議日期：2009 年 12 月 16 日（星期三） 會議地點：核能研究所國際會議廳及會議室

時 間	內 容
08:30~08:50	會員及貴賓報到
08:50~09:00	開幕典禮 <ul style="list-style-type: none"> ■ 主席致歡迎詞 (蔡理事長春鴻) ■ 貴賓致詞 (梁政務委員啓源)
09:00~10:40	專題演講：(各 20 分鐘) 1. 美國能源部對用過核燃料管理策略現況(朱嚴斯台) (美國能源部放射性廢棄物管理局前局長) 2. 台灣用過核燃料管理策略之個人見解(卓鴻年) (前美國 Sandia 國家實驗室核廢料經理) 3. 大陸之現況與未來(王駒) *1 (北京地質研究院副院長) 4. 日本核燃料循環後端營運之現況與未來趨勢(蔡助山) *2 (東京大學核子工程與管理研究所教授) 5. 歐洲之現況與未來(黃穎) *3 (法商亞瑞華股份有限公司經理)
10:40~10:55	休 息
10:55~12:30	中心議題討論：「用過核燃料管理策略」 [引言]：台灣之用過核燃料管理策略 (物管局 黃局長慶村) 主席：蔡理事長春鴻 來賓：朱嚴斯台(美國能源部放射性廢棄物管理局前局長) 卓鴻年(前美國 Sandia 國家實驗室核廢料經理) 鄧希平(輻射防護協會董事長) 陳昭義(經濟部)、劉宗勇(環保署)、蔣本基、李敏(學者專家)、 黃慶村(管制單位)、徐懷瓊(營運單位)等
12:30~13:30	午 餐
13:30~13:40	理事長致詞
13:40~13:55	頒獎： 1. 核工獎學金 2. 朱寶熙紀念獎
13:55~14:15	會務報告、財務報告、議題討論
14:15~14:30	休 息
14:30 16:30	分組學術活動： A. 放射性廢棄物管理學術委員會—060 館國際會議廳 B. 核反應器水化學委員會及核燃料與材料委員會—060 館 311 會議室 C. 核能安全委員會—060 館 315 會議室 D. 醫學應用委員會—060 館 307 會議室

*1 由核能研究所化工組組長莊文壽代為宣讀。

*2 由清華大學工程與系統科學系主任李敏教授代為宣讀。

*3 由輻射防護協會董事長鄧希平教授代為宣讀。

A. 放射性廢棄物管理學術委員會－060 館國際會議廳

會議日期：2009 年 12 月 16 日（星期三）

會議地點：核能研究所 國際會議廳

主席：召集人 黃慶村

12/16 14:20~16:20	<ul style="list-style-type: none">● 題目：台灣高放射性廢棄物處置地質調查技術 主講人：工研院能資所 林鎮國副組長● 題目：GoldSim 程式在用過核燃料最終處置之應用 主講人：核研所化工組 張福麟先生● 題目：用過核燃料深層地質處置包封容器壽命對核種外釋率之影響 主講人：核研所化工組 朱信忠博士
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B. 核反應器水化學委員會及核燃料與材料委員會－(060 館 311 會議室)

會議日期：2009 年 12 月 16 日（星期三）

會議地點：核能研究所 060 館 311 會議室

主席：召集人 葉宗洸、賴玄金

12/16 14:20~16:20	<p>水化學委員會</p> <ul style="list-style-type: none">● 題目：台電 BWRs/PWRs 水化學控制最適化進展 主講人：台灣電力公司 核發處化學組 朱方組長● 題目：國內 BWR 核反應器水質改善及可能之管理趨勢 主講人：核能研究所 化學組 溫冬珍組長● 題目：功率提昇狀態下核一、二廠加氫水化學防蝕效益的變化 主講人：國立清華大學 工程與系統科學系 葉宗洸 副教授 <p>核燃料與材料委員會</p> <ul style="list-style-type: none">● 題目：先進核反應器結構材料受輻射損傷影響研究 主講人：開執中教授● 題目：沸水式反應器壓力邊界異材銲道腐蝕疲勞行為研究 主講人：黃俊源博士● 題目：182 合金焊道之應力腐蝕破裂敏感性之研究 主講人：蔡文達教授
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C. 核能安全委員會—(060 館 315 會議室)

會議日期：2009 年 12 月 16 日（星期三）

會議地點：核能研究所 060 館 315 會議室

主席：召集人 陳宜彬

12/16 14:20~16:20	<ul style="list-style-type: none">● 題目：龍門核電廠數位儀控安裝及測試現況 主講人：台電公司龍門核電廠李家光經理● 題目：核能電廠地下管線問題探討 主講人：原能會核管處方鈞技正● 題目：核能電廠安全系統管路氣體聚集之議題討論 主講人：核能研究所核工組張欽章博士● 題目：壓水式電廠圍組體集水坑濾網改善之規劃 主講人：核能研究所核工組胡相宸工程師● 題目：核能電廠興建與運行的輔助利器-工程用模擬器的製作與應用 主講人：清華大學能環中心梁國興博士
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D. 醫學應用委員會—(060 館 307 會議室)

會議日期：2009 年 12 月 16 日（星期三）

會議地點：核能研究所 060 館 307 會議室

主席：召集人 林武智

12/16 14:20~16:20	<ul style="list-style-type: none">● 題目：急性肝衰竭國際診療概況介紹 主講人：台大內科李宜書教授● 題目：The Current Status and Future Prospective of Global Liver Transplantation 主講人：台大外科李伯皇教授● 題目：肝癌新正子掃描製劑初報 主講人：台大核醫部曾凱元主任● 題目：Synthesis of 5-[¹²³I]iodoarabinosyl Uridine and 3-[¹⁸F]-FLT Analog for Probing the HSV-1 Thymidine Kinase Gene and Cell uptake Assay 主講人：清華大學原子科學院俞鐘山教授● 題目：Re-188 標定藥治療肝癌之評估 主講人：成大內科林錫璋教授● 綜合討論：輻射應用與核醫研發肝功能與肝癌診療之可行策略研究
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2009 用過核燃料管理策略研討會

專題演講

Margaret S.Y. Chu

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SUMMARY

Margaret Chu holds a B.S. degree from Purdue University in chemistry and a PhD from the University of Minnesota in physical (quantum) chemistry. Her entire career has been devoted to promoting safe nuclear energy and nuclear fuel cycle. She has the rare combination of abilities to create a vision, formulate strategies as well as implement the necessary pragmatic tactics. She has extensive experience in successfully managing large, multidisciplinary projects, and in negotiating with customers, regulators and stakeholders. Currently she provides consulting services to domestic and international clients in nuclear waste management, nuclear fuel cycle analysis, nuclear security analysis, R&D strategy, market analysis, organizational effectiveness, and management strategy.

Margaret served as the Director of Office of Civilian Radioactive Waste Management at the Department of Energy (DOE) between March 2002 and February 2005. Margaret was nominated by President Bush to this Assistant Secretary level position in November of 2001 and confirmed by the Senate in March of 2002. She received the Secretary's Gold Award, Department of Energy's highest honorary award in January 2005.

At this DOE position, Margaret had the responsibility to lead and implement the management and disposal of U.S.'s spent nuclear fuel and high-level waste into a deep geologic repository at Yucca Mountain in Nevada. Her responsibilities included Congressional budget request, interfacing and communicating with the congress, regulators, and stakeholders; providing strategic as well as tactical directions, resolving issues under difficult and frequently conflicting constraints. In her three years leadership position, Margaret provided a strong sense of mission to the 2000 people in the program, recruited and retained new key personnel, established an integrated disposal strategic plan and schedules, resolved the long-standing intractable technical problems, and provided renewed confidence with the scientific oversight groups. She successfully requested the highest annual budget (\$577 M) from the Congress in program's history. Furthermore, the morale of the project people greatly improved under her clear and high-integrity personal style as evidenced by several in-house surveys.

Before her DOE experience, Margaret had a twenty-one-year distinguished career at Sandia National Laboratories. She was the first female awarded the title of "Distinguished Member of Technical Staff" in the Lab. Her leadership, management skills and technical expertise were instrumental in the successful certification of the first operating deep geologic nuclear waste repository in the world, the Waste Isolation Pilot Plant (WIPP) for the disposal of U.S. defense transuranic waste. At Sandia, she also led highly successful R&D programs on nuclear waste and environmental remediation for the DOE. She received the highest award of recognition for achievement from Lockheed Martin – the management company of Sandia National Laboratories -- the NOVA Award.

WORK HISTORY

(1) M.S. Chu+Associates, LLC, Albuquerque

Position Held: President

M.S. Chu+Associates, LLC

1333 Camino Cerrito SE

Albuquerque, NM 87123

Date of Employment: March 2005 - Present

Summary of Responsibilities:

Providing consulting services in the areas of nuclear waste management, nuclear fuel cycle options analysis, radiation detection policy and analysis in homeland security applications, non-proliferation policy analysis, R&D strategy, organizational effectiveness, market analysis and management strategy. She also assisted in the preparation of several major proposals for management and operations contract competitions at DOE sites. Clients include Lockheed Martin, GE, Areva, Canberra, Sandia National Laboratories, Idaho National Laboratories, Washington Group International, and Japan Nuclear Waste Management Organization (NUMO).

Active participation in international scene: conducted workshops on nuclear waste management in Beijing, China, and in Tokyo, Japan. Reviewed Intermediate Waste Management license application analysis for Korea. Serves as a member of the International Board of Counselors at NUMO of Japan.

(2) Department of Energy, Washington DC

Position Held: Director of Office of Civilian Radioactive Waste Management (OCRWM),

Department of Energy, Washington DC

Date of Employment: March 2002 – February 2005

Responsibilities include preparing for the licensing and subsequent operation of the world's first geological repository for the disposal of high-level waste and spent nuclear fuel at Yucca Mountain in Nevada. Manage a total of 2,000 federal and contractor employees. Her accomplishments include:

- Received the Secretary's Gold Award, Department of Energy's highest honorary award, in January 2005.
- Contributed to the successful siting of Yucca Mountain Repository through Congressional Joint Resolution in July 2002
- Increased the program budget by 60% to \$577M/year since FY02, and developed roadmap for major life-cycle cost reduction.
- Recruited a new team of leadership, resulted in a renewed sense of mission to the program and successfully transformed the program from a science project to a disciplined operational-ready nuclear project.
- Completed Draft License Application (5,000 pages) in November 2004.
- Resolved long-standing key technical issues with the NRC.
- Issued record of decision for Nevada Rail Line as part of readiness for transportation of radioactive waste.

- Established a Science and Technology Program for long-term continuous technology improvements.
- Significantly enhanced credibility and trust with regulators and external scientific oversight groups.

(3) Sandia National Laboratories, Albuquerque, NM

Position Held: Director of Nuclear Waste Management Program Center, Sandia National Laboratories

Date of Employment: 1998-2002

Summary of Responsibilities, Accomplishments and Results:

As Director of the Nuclear Waste Management Center, she provides the vision and develops strategy and directions for the Center. She led and managed close to 200 professional staff ranging from technicians to Ph.D with a budget of about \$ 60 M. The mission of the Center was to conduct R&D in providing integrated solutions to global nuclear energy problems.

The Nuclear Waste Management Center at Sandia is a recognized international leader in the application of performance assessment and decision analysis techniques to global nuclear issues. Projects in the Center included Waste Isolation pilot Plant (WIPP), Yucca Mountain, Hanford tank waste, DOE Nuclear Materials Management, Sealed Source management, and chemical and biological agent decontamination. The Center also conducts technical collaborations with international partners including Japan, Korea, Taiwan, Sweden, Switzerland, Germany, Canada, and Hungary.

Dr. Chu had a reputation for taking personal interests in encouraging staff to pursue new and innovative ideas. An example was the development of the anti-anthrax solutions. This project was initiated a few years before 9/11 and only Dr. Chu recognized the potential applications and the innovation involved in the idea. She provided this project with much-needed financial and managerial support and her personal attention. This idea was eventually successfully developed, tested, and commercialized just in time when the anthrax incidents took place in late 2001. The formulation was best known for its role in helping clean up contaminated buildings following a series of mailings of anthrax powder to recipients in DC, New York and Florida in 2001. Now the formulation is used by many first responder organizations in state and municipal governments, US military, as well as commercial applications such as mold control. This has become one of the top technology transfer success stories at Sandia National Labs.

In June 1998, Dr. Chu was awarded the Nova Award by the Lockheed Martin (LM) Corporation – the highest award at LM – for the leadership she provided to the WIPP team to its success.

Position Held: Senior Manager, WIPP Deputy Manager and Technical Integration Department (1995-1998), Sandia National Laboratories

Dr. Chu was hand picked by Sandia management to take a critical role in completing the Compliance Certification Application (CCA) for the Waste Isolation Pilot Plant (WIPP). Her main responsibility was to integrate all technical activities performed by experimentalists, modelers and regulatory analysts of the WIPP project for a timely and successful submission of the CCA. There was over 100 professional staff with a budget of about \$ 50M. Her responsibilities included planning, issue identification, issue resolution and resource management under many conflicting requirements and constraints. She worked and negotiated closely with the DOE and EPA to identify solution options and prioritize work within Sandia.

The nature of the responsibility required high-level strategic thinking, creative solutions, in-depth technical knowledge, teamwork and integrity. Due to the high cost of R&D activities, she used a “Systems Prioritization” methodology to prioritize R&D activities based on their “values added” to the safety of the repository. The WIPP was successfully certified by the EPA in May of 1998 as the world’s first deep geologic repository for nuclear waste.

Position Held: Manager, Environment Risk Assessment and Waste Management Department (1991-1995), Sandia National Laboratories

Supervised about 25 professional staff with a budget of \$ 3M conducting research and development for environmental remediation and management of nuclear, chemical and mixed wastes. Accomplishments include:

- Developed innovative remediation technologies such as electro-kinetic remediation of heavy metals and septic tank remediation.
- Initiated and implemented the DOE Disposal Workshop to screen and evaluate DOE sites for their capabilities to dispose of mixed waste. This workshop successfully integrated ideas and resolved challenges from DOE/HQ, DOE sites, 22 States, and the EPA.
- Successfully completed the voluminous inventory database for mixed waste from all DOE sites under the Federal Facility Compliance Act within the mandated 180 days.

Positions Held: Project Leads (1980-1991), Sandia National Laboratories

Since 1980, Dr. Chu functioned as project leaders in many projects in the waste management, environmental and nuclear R&D areas. She developed extensive expertise in risk assessment, performance assessment as applied to waste disposal, environmental remediation, and nuclear reactor safety. Her expertise in modeling of contaminant transport, source term evaluation and exposure analysis, coupled with her in-depth understanding of regulatory rules made her stand out as a star at Sandia. She demonstrated herself as a self starter and had a reputation of providing innovative solutions to complete projects on time and within budget. In 1986, she was awarded the title of “Distinguished Member of Technical Staff” – the first female awarded this honor at Sandia Labs. Her accomplishments are:

In the Waste Management area:

- Supporting the development of NRC’s technical rules (10 CFR 60) and EPA’s environmental standards (40 DFR 191) for disposal of high-level nuclear wastes.
- Developing a performance assessment methodology for low level nuclear waste for U.S. NRC

- Assessing performance of the Greater Confinement Disposal facilities for orphan wastes for the U.S. DOE
- Assessing performance of the Waste Isolation Pilot Plant for the disposal of transuranic waste.
- Developing a site ranking system for mixed radioactive and hazardous waste sites for DOE defense mixed waste.

In the nuclear reactor area:

- Performed systems analysis and concept evaluation of the multi-mega watt space reactors
- Performed criticality and shielding analysis of reactors using finite-element as well as Monte Carlo codes

CITIZENSHIP: U.S.

PROFESSIONAL ACTIVITIES AND AFFILIATIONS

International Board of Counselors, Nuclear Waste Management Organization of Japan (NUMO)
(2006 – Present)

Science & Technology Peer Review Committee, Idaho National Laboratory (2007-2009)

Member of Interim Storage of Nuclear Waste: Nuclear Energy Study Group of American Physical Society (2006)

U.S. representative of International Association of Environmentally Safe Disposal of Radioactive Materials (EDRAM, 2001-2005)

Executive Board Member, Waste Management Education & Research Consortium (WERC/DOE) (1998)

Member of American Chemical Society

Member of American Nuclear Society

Member of American Association of the Advancement of Science

Member of Iota Sigma Pi

Member of Phi Lambda Upsilon

Member of American Chinese Engineers and Scientists Society

PUBLICATIONS AND PRESENTATIONS

-- Over 50 publications including journal articles, technical reports, and conference papers

-- Invited/keynote speakers at many U.S. and International forums and conferences

AWARDS AND HONORS

Department of Energy: Secretary's Gold Award, 2005

Lockheed Martin Nova Award, June 1998

Performance Awards (numerous), Sandia National Laboratories,

Distinguished Member of Technical Staff Award, Sandia National Laboratories, 1986

Current Strategy for the Management of Spent Nuclear Fuel in the U.S.

Margaret S.Y. Chu, Ph.D.
M.S. Chu + Associates, LLC
Albuquerque, New Mexico USA
The Chinese Nuclear Society Annual Meeting
December 16, 2009

In the U.S., nuclear energy supplies about 20% of the electricity needs and spent nuclear fuel and high-level wastes are stored at 121 commercial and government sites in 39 states. The Nuclear Waste Policy Act was enacted by the U.S. Congress in 1982 and it established a process for the siting, construction and operation of a deep geologic repository for the permanent disposal of spent nuclear fuel and high-level waste. In 1987, the Congress selected the Yucca Mountain site in Nevada as the site for site characterization, and extensive scientific and engineering studies have been conducted since then. In June of 2008, the Department of Energy submitted the license application to the Nuclear Regulatory Commission seeking license for the Yucca Mountain repository.

In January of 2009, the Obama administration and the Department of Energy announced that Yucca Mountain repository would not be a solution for the U.S. spent nuclear fuel. Instead, the Department of Energy will seek alternatives that involve long-term innovative solutions for the management of spent nuclear fuel.

This presentation discusses the current policy and strategy from the Department of Energy, and their potential implications to the nuclear energy development in the U.S.



Dr. Hong-Nian Jow
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Dr. Jow has been recognized for his strong team work attitude, pragmatic and customer focus approach to the successful completion of projects. He has broad experience in the nuclear industry and at a national laboratory in reactor safety, radiation protection, and the safe and secure management of the backend of nuclear fuel cycle. In addition to his technical and management experience, Dr. Jow has an extensive experience in working with international partners, in particular, in the East Asia region (China, Japan, South Korea, and Taiwan).

Received B.S. degree in Physics from National Tsing Hua University in Taiwan, M.S. degrees in Physics and Health Physics from University of Pittsburgh, PA, and Ph.D in Nuclear Engineering from M.I.T.

Summary Biography:

Consultant, sole proprietor of *Jow International*, 2009-present:

Major activities included:

- Provide consultant services to national laboratories and private companies in the US.
- Invited by China Nuclear Power Engineering (CNPE) and China Institute of Atomic Energy (CIAE) to give a lecture on spent nuclear fuel management and HLW disposal in September 2009.

Department Manager at Sandia National Laboratories (Albuquerque, New Mexico, 2006-2008):

Major contributions included:

- Project manager for the successful completion of two geologic repository technology transfer projects to research institutes of a foreign country
- A lead instructor for a US-China emergency preparedness workshop for nuclear fuel cycle facilities
- Made significant contributions to a NNSA funded project in the engagement with East Asia region countries in the security and safety of nuclear fuel cycle.
- Invited to provide technical support to the successful inception and organization of a non-government level East Asia forum on Radioactive Waste Management (EAFORM) and

contribute to the success of expanding the EAFORM original member institutes in Japan, South Korea and Taiwan to include member institutes in China

Department Manager at Sandia National Laboratories (Albuquerque, New Mexico, 1994-2005):

Dr. Jow managed a group of technical staff to develop performance assessment models and support the two geologic repository programs in the US: the Waste Isolation Pilot Plant (WIPP) and the Yucca Mountain Project. Major contributions included:

- Contributed to the successful licensing (Compliance Certification Application) and opening of the WIPP site and beginning receiving TRU waste in March of 1999.
- Contributed to the successful site recommendation for the Yucca Mountain Project in 2002.
- Managed a DOE/RW science and technology program to develop innovated radionuclide absorbing materials (radionuclide getter materials) for geologic repository.
- Lead organizer for two successful US-China workshops on radioactive waste management (1999 and 2005) for the US DOE.
- Successfully complete several geologic repository technology transfer projects to the research institutes in Taiwan.

Other Work Experience at Sandia National Laboratories (Albuquerque, New Mexico, 1988-1994):

- Manager of Radiation Protection Department (1991-1994): managed a group of technical staff and technologists and provided operational radiation protection support to all radiological facilities (research reactors, accelerators, pulsed power, hot cells, radiochemistry labs, etc.) at Sandia.
- Member of Technical Staff (1988-1991): contributed to the development of software and performance analyses for the severe reactor accident research program (NUREG-1150) at Sandia.

Yankee Atomic Electric Company (Framingham, MA, 1978-1981 and 1984-1987):

Senior radiological engineer, performed radiological safety analyses for nuclear power plants.

University of New Mexico (Albuquerque, NM 1994-1997):

Adjunct Professor of Chemical and Nuclear Engineering Department and taught two graduate level courses.

Other International Experience

- Lead technical support to the US DOE/RW international program for bi-lateral meetings between the US and China and between the US and Taiwan from 2000 to 2008.
- Hosted several IAEA fellows visit to Sandia in the technical field of radioactive waste disposal from the following countries: Brazil in 2001 and 2002, Egypt in 2003 and 2004, and Slovakia in 2005.
- Served as a member of international technical experts for an IAEA technical co-operation project, visited Chernobyl NPP and reviewed its waste management program, February 17-21, 2003.

- Lead organizer for bi-lateral workshops between the US DOE/RW and China in topics related to management of spent nuclear fuel and radioactive waste disposals.

Publications

More than thirty journal papers, technical reports and conference presentations.

Personal Information and Professional Societies:

USA citizen; excellent reading, writing, and speaking skills in both English and Chinese. Certified Health Physicist by American Board of Health Physics since 1982. Members of Institute of Nuclear Materials Management (INMM), American Geophysical Union (AGU), and Health Physics Society (HPS).

Strategy for the Taiwan Nuclear Fuel Management: A Personal View

By: Hong-Nian Jow, Ph.D

Jow International

Albuquerque, NM, USA

The Chinese Nuclear Society Annual Meeting, December 16, 2009

Institute of Nuclear Energy Research, Lungtan, Taiwan

ABSTRACT

In order to address the global climate changes and energy security, many countries have begun actively developing new energy technologies to reduce the uses of fossil fuels. These include solar, wind, geothermal, bio-fuels, nuclear energy, and others. New nuclear power plants are under construction in Asia and Europe, more than two dozens of new construction licenses are being submitted in the US, and many developing countries, including the oil-rich countries in the Middle East, are serious considering uses of nuclear energy as part of their future energy plan. This phenomenon has been dubbed the so-called 'nuclear renaissance'.

In Taiwan, there has been a series of events related to nuclear energy since President Ma took office in May 2008: (1) the sustainable energy policy guidance passed in June 2008, (2) the 3rd National Energy Conference in 2009, and (3) the Former Premier Liu's commitment to nuclear energy. These events reaffirm that nuclear energy is an important integral part of Taiwan sustainable energy policy to reduce CO² emission.

As Taiwan going forward with nuclear energy as a part of the sustainable energy policy, Taiwan should develop a clear strategy for the long term spent nuclear fuel management as an important integral part of the Taiwan long term nuclear energy policy. With this strategy, Taiwan government would be able to articulate to the Taiwan public an integrated nuclear energy policy and that Taiwan government has a path forward to address the backend of nuclear fuel cycle.

In this presentation, I will offer some personal thoughts on the Taiwan spent nuclear fuel management strategy.

王驹简历

1. 姓 名: 王 驹
2. 出生年月: 1964.12.11
3. 工作单位: 核工业北京地质研究院
4. 职 务: 副院长, 主管科技项目和国际合作
5. 学 位: 工学博士
6. 职 称: 研究员级高级工程师, 博士生导师
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12. 简 历

1980.9-1984.7 南京大学地球科学系, 学士;

1984.9-1987.9 核工业北京地质研究院学习, 地球化学专业, 硕士;

1988.1-1991.12 核工业北京地质研究院学习, 地球化学专业, 博士。

1984—1993 核工业北京地质研究院工作, 从事铀矿地质研究

1993—2008 核工业北京地质研究院工作, 历任环境保护研究中心副主任、主任、院总工程师, 从事核废物地质处置研究

2008—至今 核工业北京地质研究院工作, 任副院长, 从事核废物地质处置研究和科研管理工作。同时, 任高放废物地质处置项目负责人。

13. 主要科研工作经历

- 2001—今 从事高放废物地质处置研究和国际合作项目, 任国际原子能机构技术合作项目“中国高放废物地质处置工程设计、场址评价、核素迁移和性能评价研究”项目主任; 任放射性废物管理专项项目“高放废物地质处置甘肃北山预选区选址、场址评价和地质处置技术研究”项目总负责人(2002-2004, 2005-2006, 2007-2010)。
- 1998.1—1998.7 在日本 JNC 东海事业所从事核废物地质处置研究。

- 1996--2000 从事高放废物地质处置研究和国际合作项目，主持项目“高水平放射性废物处理处置技术研究”；任国际原子能机构技术合作项目“高放废物处置库选址和场址特征评价研究”项目主任（1999.1-2000.12）。任三废专项项目“高放废物地质处置甘肃北山预选区深部地质环境初步研究”项目总负责人（1999-2001）。
- 1994--1995 从事中低放废物处置研究，组织实施并参加“中低放固体废物西北处置场场址评价研究”项目。
- 1993--1995 从事核废物地质处置研究，参加“我国高放废物地质处置研究”；主持“我国高放废物处置库甘肃北山预选区地质稳定性研究”课题。
- 1991--1992 从事铀资源研究，主持“我国南方花岗岩外带型铀矿成矿规律及靶区优选”项目
- 1988--1991 从事铀矿和铀资源研究，参加国家重点攻关项目“我国碳硅泥岩型金铀矿床成矿规律及远景预测”；主持“碳硅泥岩型金铀矿床成矿富集地球化学研究”。
- 1984--1987 从事铀矿地质研究，主持“辽东连山关铀矿床成因研究”课题。

14. 主要学术任职：

国际岩石力学学会放射性废物处置委员会主席，
 中国地质学会环境地质专业委员会副主任委员；
 中国地学哲学研究会副理事长；
 中国辐射防护学会常务理事；
 中国矿物岩石地球化学学会地球科学认识论方法论专业委员会主任委员。《Journal of Rock Mechanics and Geotechnical Engineering》杂志编委；
 《地质论评》杂志编委；
 《原子能科学技术》杂志编委；
 《地质与勘探》杂志编委；
 《铀矿地质》杂志编委；
 《国外铀金地质》杂志编委；
 《中国岩石力学与工程》杂志编委；

15. 专著及论文

共出版专著 3 部，译著 3 部，发表文章 72 篇。

乏燃料管理及高放废物地质处置：大陸之現況與未來

王 驹

核工业北京地质研究院，北京，100029

摘要 如何安全管理和最终处置放射性废物是一个与核安全同等重要的问题，是建设和谐社会和确保核能工业可持续发展和环境保护的重大问题。在过去的三十年中，大陆在中低放固体废物处置、中放废液处置和高放废物地质处置研究等方面均取得了显著进展。对于中低放固体废物，在处置场选址和场址特性评价、处置场设计和安全评价等方面已获得重要成果，已建成西北处置场和广东北龙处置场。

据估计，大陆目前运行的11个核电机组每年约产生370吨乏燃料（即用過核燃料）。根据2007年10月国务院批准的《核电中长期发展规划(2005-2020年)》中的核电规模，大陆到2020年投入运行的核电装机容量将达到4000万千瓦，在建装机容量1800万千瓦。以此为基础计算，所有这些反应堆全寿期最终共将产生82,630吨乏燃料。如果大陆核电规模达到100 GW，则所有这些核电站产生的乏燃料总量将达到138,070 tHM。目前，大陆核电站的乏燃料暂存在核电站的乏燃料储存水池中。其中，大亚湾核电站的一部分乏燃料已经通过公路运输运走，目前暂存在容量为550tHM的中央湿法贮存设施中。大陆采用闭合核燃料循环的策略，开展了乏燃料后处理的研究开发。一座最大通过量可达400 kgHM/d的后处理中间试验工厂也在建设之中。目前正在讨论建设一座大型商用后处理厂。大陆拟对乏燃料后处理产生的高水平放射性液体废物进行玻璃固化，然后再进行最终地质处置。

2003年大陆发布《中华人民共和国放射性污染防治法》，其第四十三条中明确规定“高水平放射性固体废物实行集中的深地质处置”，这从国家层次明确了深地质处置的地位。2006年国家原子能机构、科技部和国家环保部联合发布《高放废物地质处置研究开发规划指南》，明确了深地质处置开发的主要技术路线和开发的总体设想。2007年，国务院批准《核电中长期发展规划(2005-2020年)》，明确提出2020年建成大陆高放废物地质处置地下试验室的目标，从而使高放废物地质处置研究进入了新的阶段。大陆高放废物深地质处置规划分为3个阶段，即1) 实验室研究开发和处置库选址阶段（2009—2020），其目标是，完成各学科领域实验室研究开发任务，初步选出处置库场址并完成初步场址评价，确定地下实验室场址，完成地下实验室的可行性研究，并建成地下实验室；2) 地下现场试验阶段（2021—2040），其目标是，完成地下实验室现场试验，完成场址详细评价，并最终确

认处置库场址，掌握处置库建造技术，完成处置库设计和可行性研究；3）处置库建设阶段（2041—本世纪中叶），其目标是，2050年前后建成处置库，开展示范处置，并开始接受高放废物。地质处置库处置的对象是玻璃固化块、超铀废物和部分乏燃料，处置库为竖井—坑道型，候选围岩为花岗岩，位于饱和带中。经过全国筛选对比，已初步选定甘肃北山地区为重点预选区，该区人口稀少、交通方便、土地无耕种价值、动植物资源贫乏、矿产资源稀缺和经济发展缺乏基础等适宜废物处置的社会经济条件和气候干燥、地处戈壁、地形平缓、地壳稳定、地表水不发育、地下水贫乏、花岗岩体完整、岩体工程质量优良和工程地质条件适宜等有利条件。至2008年已施工完毕6口深钻孔（北山1、2、3、4、5、6号孔），建立了较为系统的场址评价方法，开展了地质研究、水文地质实验、地应力测量、钻孔电视测量、钻孔雷达测量等实验，获得了大量深部地质环境参数。已确定使用膨润土作为处置库的回填材料，对膨润土的矿物学、土力学、物理力学性质和高温膨胀特性以及THMC耦合条件下的行为等进行了研究，目前正在建造大型膨润土Mock-up装置。已获得一批放射性核素在花岗岩和膨润土上的吸附、扩散数据，建立了模拟处置库温度、压力和氧化还原条件的实验装置。高放废物地质处置场址评价、放射性核素地球化学行为、回填材料研究和环境影响评价研究正在深入进行，并与国际原子能机构和欧盟等国际组织和法国、德国、比利时和瑞典等国开展了卓有成效的合作。

关键词：乏燃料、高放废物、地质处置、地下实验室、场址评价。

* 由核能研究所化工组组长莊文壽代為宣讀。

Curriculum Vitae

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Dr. Jor-Shan Choi is a Professor for the Global Center-of-Excellence (G-COE) Program of the Department of Nuclear Engineering and Management at the University of Tokyo (Todai), Japan. His areas of interests include non-proliferation, nuclear fuel cycle and technologies, proliferation-resistant technologies, international safeguards, international and regional cooperation on peaceful use of nuclear energy. Before joining Todai, Dr. Choi worked for Lawrence Livermore National Laboratory (LLNL) in California, USA for 21 years, involving in developing corrosion-resistant material for long-term spent fuel containers; nuclear non-proliferation and proliferation-resistant fuel cycle technologies; fissile material safety, security and disposition; development of advanced small reactors and novel fuel material (nitride fuel and long-life particle fuel), etc.

Dr. Choi was a Science Fellow at the Center for International Security and Cooperation (CISAC) at Stanford University in 1995-96. He worked at the International Atomic Energy Agency (IAEA) in Vienna from 1998-2001. Prior to joining LLNL in 1987, Dr. Choi had 13 years of industrial experience working for Bechtel. He has a PhD in Nuclear Engineering from the University of California at Berkeley. He is also a registered Professional Engineer (PE) in California.

EXPERIENCE *Brief Highlight:*

- Tokyo University** Project Professor, Global COE/Go-NERI Program: nuclear energy sociology; (3/08 – present) Non-proliferation; Internationalization of nuclear fuel cycle; and International/Regional cooperation to harmonize nuclear energy technology and society in global nuclear energy renaissance.
- LLNL** Application of structural amorphous metal (SAM) coating for spent fuel package;

(2/87 – 3/08) Development of nitride-based fuel for small and space nuclear reactors; Proliferation resistance and physical protection (PR&PP) working group; Fuel-cycle analysis; HEU transparency and blend-down monitoring; Non-proliferation; Additional Protocol; Atoms for Peace; Safety and security at fuel cycle facilities.

IAEA Management of Plutonium, HEU, DU; Partitioning and transmutation; International (7/98 – 7/01) working group on nuclear fuel cycle options.

UC Berkeley: Taught a graduate course on “Nuclear fuel cycle and radioactive waste management”; (9/96 – 7/98) Contributed to the National Academy of Science’s STATS Study on “Nuclear Wastes”; Program leader for LLNL on the Campus-to-Lab (CLC) program at the Center for Radioactive and Toxic Waste Management (CRTWM), Nuclear Engineering, UC Berkeley, on the technical and institutional aspects of radioactive waste management.

CISAC Stanford: Science Fellow, East Asian nuclear energy/security cooperation, studying “A Regional (9/95 – 9/96) Compact for the Peaceful Use of Nuclear Energy: East Asia;”

Industry: 13 years of experience in nuclear industry, working for Bechtel Power Corp., Quadrex (4/74 – 2/87) Corp., and Bechtel National Inc., before joining LLNL in 1987.

* 由清華大學工程與系統科學系主任李敏教授代為宣讀。

AREVA CV

**This article is prepared by
AREVA Recycling NC Business Unit**

OPTIMIZING USED FUEL MANAGEMENT THROUGH RECYCLING

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ABSTRACT

Recent surveys performed in the USA and in Europe have clearly showed that providing a sound solution to used fuel management enhances the support to nuclear energy. By lowering the demand for natural uranium and effectively treating waste, Recycling constitutes a real plus for nuclear energy. It allows a responsible use of the great energy potential still contained in used fuel. For example, recycling eight LWR used fuel assemblies allows producing two fresh recycled fuel assemblies, representing 25% of uranium savings and covering the yearly electricity needs of 200,000 consumers¹. The management of ultimate nuclear waste is a sensitive subject that crystallizes many concerns. Recycling is a responsible answer to these concerns meeting the stakes of several stakeholders including the Utilities, Waste Agencies, the Governmental Bodies and the Public.

AREVA has implemented recycling capabilities associated with an optimized ultimate waste management with the so-called Universal Canister Strategy. This strategy based on recycling and waste conditioning standardization by using a single type of package for long lived waste, allows a reduction of the final waste volume by 5 and the long term radiotoxicity by 10, compared to the direct disposal. This ultimate waste consists mainly in fission products and structural assembly parts. The Fission Products are incorporated into a stable borosilicate glass matrix and conditioned in the UC-V (Universal Canister for Vitrified waste) ensuring stability and containment during a very long period (over than 100 000 years). The structural assembly parts - hulls and end fittings – are compacted and conditioned in UC-C (Universal Canister for Compacted waste).

The UC strategy rationalizes the global waste management from reception and storage of waste to final disposal. On-site handling, transport operations, and geological disposal selection, design and construction are indeed facilitated thanks to the singleness of packaging with smaller volumes and reduced thermal constraints. The resulting costs are therefore optimized.

In addition, this strategy is suitable to bring additional time for making decision and for implementing final repository through a safe and simplified interim storage. Indeed, the related interim storage facilities are currently licensed for about 100 years.

This solution contributes also to non proliferation. The ultimate waste (Vitrified and Compacted Waste) do not contain IAEA-safeguarded fissile materials. In addition, recycling plutonium in MOX fuel consumes roughly one third of the plutonium (single recycling) and significantly degrades the isotopic composition and thus the potential weapon attractiveness. Existing Recycling facilities have been designed and constructed to satisfy all relevant national and international standards for the safekeeping of nuclear materials.

¹ Based on the average yearly household consumption in Europe, and considering a typical PWR fuel type

The Recycling facilities and the separated fissile materials are safeguarded both by EURATOM and the IAEA.

The efficiency of this Safeguard scheme applying to recycling has been demonstrated through more than 40 years of experience, notably in France.

The Recycling solution proposed by AREVA, including the Universal Canister Strategy features predictable and competitive economics; the related fuel cycle economics is indeed comparable to direct disposal but with cost uncertainties much reduced.

Many Countries have opted for, or are considering Recycling as the way to optimize their fuel management while bringing a responsible solution to radioactive waste. The paper will endeavor to analyze the merits of such a strategy tackling technical and economical aspects, as well as Public acceptance.

* 由輻射防護協會董事長鄧希平教授代為宣讀。

分組學術活動

A. 放射性廢棄物管理學術委員會



林鎮國簡歷

- ◆ 用過核子燃料最終處置計畫—潛在母岩特性調查
 - 協同主持人：2002~2004；計畫主持人：2005~2010
- ◆ 低放射性廢棄物最終處置第一階段工作顧問服務(第一次工作變更)計畫
 - 地球化學分項負責人：1999~2000
- ◆ 經歷：
 - 美國猶他大學—化學與燃料工程系博士(1996)；
 - 工研院能資所(1997)—正研究員兼副組長(2006/04)
- ◆ 研究領域：放射性廢棄物深地層處置、CO₂地質封存。
- ◆ 軟體開發：
 - PhaseChem (Eh-pH 穩定相圖繪製軟體)；CO₂Depth (CO₂最佳封存深度評估軟體)
- ◆ 儀器開發：
 - ChemWish (Chemical and Hydraulic Exploration Marlinespike for Groundwater Isolated in a Borehole)：孔內封塞水質監測、取樣及水力試驗儀器
- ◆ 近期文章：
 - Lin, CK (2008) Algorithm for determining optimum sequestration depth of CO₂ trapped by residual gas and solubility trapping mechanisms in a deep saline formation, Geofluids, 8, 333-343.
 - 林鎮國(2007)，二氧化碳的儲存，科學發展，2007年5月，413期，pp28-33。
 - 林鎮國、張育德(2006)，用過核子燃料深地層處置之化學環境適合性探討，台灣原子能論壇

台灣高放射性廢棄物處置地質調查技術

工研院能資所 林鎮國

摘要

台灣電力公司參考過去研究結果建議：花崗岩質岩體應做為我國用過核子燃料深層地質處置之優先調查對象，因此集中深地層特性調查技術之發展重點於花崗岩質技術發展測試區。期能透過各項技術的集中發展與整合性驗證，加速建置與驗證各項技術能力，取得測試區的地質特性參數與建構初步地質概念模式，供驗證功能安全評估能力，以完備現地調查至功能評估之整體流程的初步技術能力驗證，順利達成近程工作目標：於 2009 年提出「我國用過核子燃料最終處置初步技術可行性評估報告」。除了進行地表地質調查、岩石定年分析外，總計在測試區完成約 500 點重/磁力探測、16 km 地電組剖面探測、3000m(6 孔)地質鑽探、及地球物理/水文地質/地球化學/現地應力等各式孔內探測作業，順利取得重要地質特性參數，並透過整合性的資料解析，建構測試區地質剖面與構造帶概念模式，成功建置 500m 深度之花崗岩質岩體的特性調查及資料解析技術，其產出結果將結合功能安全評估技術，用以完整說明我國由地質調查至功能安全評估之整體流程的執行能力，已具備「初步技術」的可行性。

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1981~1985 逢甲大學水利系學士

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1988~1992 萬鼎公司工程師，派駐核研所參與用過核燃料長程處置計畫

1992~1995 台北市捷運局高級規劃師，潛盾隧道施工規劃

1995~1996 高考分發經濟部水資會助理工程司，水文資訊彙編

1996~2004 核研所助理研究員，用過核燃料長程處置計畫功能安全評估

2004~至今 核研所副研究員，用過核燃料長程處置計畫功能安全評估；低放處置
相關研究計畫主持人

GoldSim 在用過核子燃料最終處置之應用

核能研究所 張福麟

摘要

用過核子燃料最終處置場之評估，需藉由一整合系統連結互相獨立之各子系統程式而成，本研究以 GoldSim 程式為整合平台，整合核能研究所用過核子燃料處置之近、遠場核種傳輸子系統分析程式 INPAG-N 與 INPAG-F。說明如何建立動態連結之技術，將 INPAG-N 與 INPAG-F 連結至 GoldSim 系統程式中，並進行演算。由分析成果可知，GoldSim 程式不但成功的連結 INPAG-N 與 INPAG-F 程式，並將原僅能進行定率式之子系統分析程式，提升至可進行機率式分析之性能。

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Dissertation: Study on the Turbulence in Aerated Stirred Tank

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Concentration: Moving Boundary Layer, Analytical, Numerical

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B.S., CED, National Cheng-Kung University, Taiwan, 1973

Occupation:

Associate Scientist: Institute of Nuclear Energy Research, Taiwan, 1986 - Present

Teaching Assistant: CED, National Taiwan University, Taiwan, 1982-1986

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Experiences:

1. Performance and Safety Assessment for Low-Level Radwaste and Spent Nuclear Fuel Disposal
2. Plant Design and Construction for Low-Level Radwaste Incineration and Melting
3. Plant Design and Construction for Uranium Recovery from Phosphoric Acid Solutions
4. Simulation of GS Process for Deuterium Production from Sea Water

用過核燃料深層地質處置包封容器壽命對核種外釋率之影響

核能研究所 朱信忠

摘要

本文以機率方式進行用過核燃料深層地質處置核種外釋率及人體劑量率之評估分析，並以 Kolmogorov-Smirnov Statistical Test (KS-Test) 技術，針對不同包封容器壽命下所得之人體劑量率峰值及劑量率峰值發生時刻之 CCDF 分佈曲線進行差異性分析。從 CCDF 分佈曲線之上、下限值來看，包封容器壽命分別為 100 年、1,000 年、10,000 年、100,000 年等四種情況的結果並無太大差異。KS-Test 的結果顯示：從劑量率峰值之分佈來看，包封容器壽命 100 年者與 1,000 年者之結果並無差別，與 10,000 年者之結果才稍微有明顯的差異；包封容器壽命 1,000 年者與 10,000 年者及包封容器壽命 10,000 年者與 100,000 年者之結果其差異也不是非常強烈。從 KS-Test 的結果來看，包封容器壽命在用過核燃料深層地質處置中的角色主要是延緩核種的外釋時刻，而非降低核種外釋率及人體劑量率。

分組學術活動

B. 核反應器水化學委員會及

核燃料與材料委員會

朱方簡歷

1981 年美國 Wayne State University 取得化學碩士學位，1983 年進入臺電後長期從事 corrosion prevention and water chemistry optimization in nuclear power plant，現任職核發處核能化學組長。

臺電 BWRs/PWRs 水化學控制最適化進展

核發處核能化學組長 朱方

Abstract

臺電核一二三廠依據 EPRI BWR/PWR Water Chemistry Guidelines 內唯一「強制性」要求, 已建立以保護電廠資產(例如 Structure Material Integrity, Steam Generator Tube Integrity, Fuel Failure Free 等)為首要目標且兼顧輻射場劑量抑低之策略性水化學計畫(Strategic Water Chemistry Plan)。該計畫內容是動態的, 隨著電廠水化學控制最適化過程而更新。本篇報告說明 BWR/PWR 水化學控制為什麼需要最適化(Optimization)及其關鍵參數(ECP, pH 酸鹼值), 並從 ECP 及 pH 酸鹼值控制看臺電 BWR/PWR 水化學最適化控制策略的形成與進展。

臺電 BWRs 水化學最適化控制部份介紹核一、二廠目前 IGSCC Mitigation Program (包括 IGSCC mitigation effectiveness evaluation) 以及 HWC 後 plant performance 變化(包括乾井管路 Dose Rate、FW Fe、RW Cu) 與大修時再循環管路得以 Inspection Relief 的附帶效益。核一、二廠功率提昇(→1.7% MU → 3% S)後, 飼水注氫需求量是否有變化亦值得注意。與國際接軌(參加擁有 46 部機組會員的 BWR chemistry monitoring and assessment program) 亦有助於臺電 BWRs 策略性水化學計畫更新參考。最後, 勾勒核一、二廠未來 Possible IGSCC mitigation improvements。

臺電 PWRs 水化學最適化控制部份介紹核三廠一次側 Improved RCS Li-B control program、shutdown chemistry control optimization、以及 Zn injection project 的挫折。二次側偏重於 steam generator sludge pile management program。

另從水化學控制角度看幾項有趣的 Environmental Assisted Cracking Mitigation Topics ; ❶ Corrosion Fatigue of Stainless Steel in Low ECP BWR/PWR Environment ❷ IASCC mitigated by HWC ❸ PWR PWSCC Chemical Mitigation

溫冬珍簡歷

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經歷：

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 - (1)TRR 水質改善計畫
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 - (3)複合吸附劑研製計畫
 - (4)海水提鈾計畫
- 2.核能研究所副研究員
 - (1)反應器水化學計畫主持人
 - (2)輻射劑量抑低計畫主持人
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核能研究所化學組組長

國內BWR核反應器水質改善及可能之管理趨勢

核能研究所 化學組 溫冬珍

摘要

國內沸水式反應器自商業運轉迄今已逾三十年，反應器爐水及相關系統冷卻水之控制及管理歷經多年的改善，世界核能發電者協會(WANO)之化學指標值從民國80年至85年大幅度的自0.42提升為0.27，爐水導電度也自早期的0.120 ~ 0.20 μ S/cm下降至近幾年的0.075~0.12 μ S/cm;影響材質劣化及爐水導電度變化較顯著的Cl⁻與SO₄⁼含量也逐步在掌握之中。86年開始WANO將化學績效指標修正且強化以提升整體性之營運績效，從化學指標之提昇顯示多年來從事水質改進之努力，獲得相當具體的成效；雖然從指標中證明國內BWR電廠各機組之水質環境已有相當程度的改善，但仍有多項變數值得電廠關切且有待逐步克服。

核一、二廠爐水水質早期從原能會管制的角色適時監督外，台電公司也積極委託工材所、清華大學及核研所等單位協助探討解決水化學面臨的共同相關問題，加上電廠多方面密切的配合，使爐水近年來已逐漸開始步入較穩定的階段。本篇報告為核研所自85年後參與核能一、二廠於機組起動、運轉及大修等不同時期及階段之水質改善工作，其中包括(1)爐水氯離子、硫酸根離子、硼酸根離子...等鑑定及肇因分析、評估，(2) 垢及氧化膜之模擬測試、鑑定分析，(3)水質監測系統之測試及建立，(4)除礦系統改善、應用及樹脂規範建立，(5)加氫水化學水質評估，(6)化學除污程序改善及清洗建議，(7)電廠突發性水質異常肇因探討及(8)水質精進技術諮詢...等。除此之外並以國外目前推動、實施較普遍且具正面效益的水化學控制方式與國內實際現況加以比較，客觀性的提出今後可能需要面臨的調整方向及可採行的因應措施；而參酌累積多年經驗的看法，或許可作為從事研究方向及電廠應用的參考。

葉宗洸簡歷

1. *Current Position, e.g.*

Prof. Yeh is an associate professor at the Department of Engineering and System Science, National Tsing Hua University.

2. *Professional Career, e.g.*

Prof. Yeh has been involved in R&D of Nuclear Engineering for more than 14 years. He is specialized in corrosion mitigation and water chemistry of light water reactors.

3. *Professional Education, e.g.*

He received a Ph.D. degree in nuclear engineering from Pennsylvania State University, U.S.A. in 1994.

功率提昇狀態下核一、二廠加氫水化學防蝕效益的變化
**The Impact of Power Uprate on the Corrosion Mitigation Effectiveness of
Hydrogen Water Chemistry in Kuosheng and Chinshan Boiling Water
Reactors**

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The approach of power uprate has been adopted by the utilities of light water reactors in the past few decades in order to increase the power generation efficiency of nuclear reactor. The power uprate strategy is apparently applicable to the three nuclear reactors in Taiwan as well. Among the three types of power uprate, measurement uncertainty, stretch power uprate, and extended power uprate, a deliberate and thorough evaluation is required before a final decision and an optimal selection can be reached and determined. One practical way of increasing the reactor power is to deliberately adjust the fuel loading pattern and the control rod pattern and thus to avoid replacing the primary coolant pump with a new one of larger capacity. The power density of the reactor will increase with increasing power, but the mass flow rate in the primary coolant circuit (PCC) of a light water reactor will slightly increase (usually by less than 5%) or even remain unchanged. Accordingly, an uprated power would induce higher neutron and gamma photon dose rates in the reactor coolant but pose a minor or no effect on the mass flow rate of the primary coolant.

The radiolysis product concentrations and the ECP values differ largely in the PCC of a BWR. It is very difficult to measure the water chemistry data directly at various locations of an actual reactor. Thus the impact of power uprate on the water chemistry of a BWR operating under HWC can only be theoretically evaluated through computer modeling. In this study, the DEMACE computer code was modified to investigate the impact of power uprate on the water chemistry upon a fixed mass flow rate in the primary coolant circuit of the Kuosheng BWR.

Simulations were carried out for $[H_2]_{FWS}$ ranging from 0.0 to 2.0 parts per million and for power levels ranging from 100% to 120%. The responses of water chemistry and ECP to HWC at some selected locations in this BWR under different uprated power levels were successfully evaluated. Our analyses indicated that a particular uprate percentage would tend to promote a more oxidizing coolant environment for the structural components and therefore lead to downgraded HWC effectiveness on ECP reduction and corrosion mitigation. An 8% uprate percentage led to a poorer HWC efficiency at most of the evaluated locations of this BWR. In contrast, the HWC efficiency could be slightly improved at 20% power uprate for most of the evaluated locations of this BWR. A comparison between the Kuosheng BWR and the Chinshan BWR was also carried out in this work. In summary, the impact of power uprate on the water chemistry in the primary coolant circuit of a BWR is expected to vary from location to location and from plant to plant due to different degrees of radiolysis and physical dimensions.

Keywords: Boiling water reactor, power uprate, hydrogen water chemistry, electrochemistry corrosion potential



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Experiences:

- Associate Professor, Department of Nuclear Engineering, 1986-1990
- Professor, Department of Nuclear Engineering, 1990-1995
- Head, Nuclear Reactor Division, Nuclear Science and Technology Development center, 1991-1996
- Professor, Department of Nuclear Engineering and Engineering Physics, 1995-1997
- Director, Nuclear Science and Technology Development Center, 1996-1998
- Director, Center for Electron Microscopy, 1997-
- Director, Advanced Instrumentation Center, 2003-2004
- Chairman, Department of Engineering and System Science, 2004-2007
- Search Committee for the university president, 2000-2001
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先進核反應器結構材料輻射損傷影響研究

開執中 教授

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新一代先進型核反應器設計的宗旨是要能達到高效率，安全可靠及永續性。以解決人類未來對能源的需求並同時達到降低溫室氣體排放，保持地球環境的重要目標。

先進型核反應器要達到高效率的要求必須在更高溫、高輻射及高腐蝕的環境下運轉，因此對於結構材料的挑戰要比輕水式核反應器更為嚴酷。許多甚至是超過目前已有的 ASME-CODE 的規範之外的條件。因此如何選擇適當的材料，做為核反應器內外組件的結構材料變得非常重要，也是必須要解決的重大問題。

本篇報告將探討中子輻射損傷對結構材料影響的機制，並且以過去研究的成果為例，深入淺出論述未來在先進型核反應器結構材料的研究方向與目標。

黃俊源簡歷

1981~1985 成功大學冶金及材料工程系

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**CORROSION FATIGUE BEHAVIOR OF DISSIMILAR METAL
WELDMENTS
IN HIGH TEMPERATURE WATER ENVIRONMENTS**

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ABSTRACT

Corrosion fatigue behavior of the dissimilar metal weldment, Alloy 52-A508, under a simulated BWR coolant condition was studied. Fatigue and corrosion fatigue crack growth rates of the dissimilar metal weldments were observed to increase with crack extension under the nominal constant ΔK loading mode. It can be accounted for by a decrease in the crack closure effect and an increase in the tensile residual stress with the weld depth. The crack closure effects in the weld were proved to decrease with the crack increment measured by the strain gauges in front of the crack tip. Finite element analysis on the welding residual stress was performed. The trend of analytical results agreed well with that of the residual stress measurements obtained by a hole-drilling strain gauge method. The tensile residual stress increased with the weld depth in the weld and turned into compressive stress when the crack went into A508 base metal.

Keywords: Corrosion fatigue crack growth rate, residual stress, crack closure, dissimilar metal weldment.

蔡文達簡歷

學歷：

- 學士 台灣 成功大學冶金及材料工程系 (1975/6)
- 碩士 美國 威斯康辛大學密爾瓦基分校材料科學系 (1979/8)
- 博士 美國 俄亥俄州立大學冶金工程系 (1983/3)

經歷：

- 博士後研究 美國俄亥俄州立大學方丹那防蝕研究中心 (1983/3~8)
- 副教授 成功大學材料系 (1983~1987)
- 教授 成功大學材料系 (1987~迄今)
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主要成果：

主持具有特色的「耐蝕材料及電化學」研究室，是國內材料電化學，特別是在腐蝕與防蝕領域，最專業與突出的學術研究單位。歷年來研究成果相當可觀，總計已有200篇的學術期刊論文發表，其中有SCI論文有156篇。在2000 ~ 2008期間所發表的SCI論文平均每篇被引用次數達9.0次。在2005 ~ 2009（迄今）其間共發表SCI論文共有59篇；在國內學術期刊也發表9篇論文；總計近五年來(2005 ~ 迄今) 在國內外學術期刊共發表學術論文70篇。另外，發明專利核准1件；建教合作15件，國科會產學合作計畫1 項，國際學術合作計畫2 件。

182 合金焊道之應力腐蝕破裂敏感性研究

國立成功大學材料系 蔡文達教授

摘要

The environmentally-assisted cracking (EAC) behavior of Alloy 182 weld in 0.05 M hydrochloric acid solution was investigated by employing slow strain rate testing (SSRT) technique. The potentials applied during SSRT at a strain rate of $8.3 \times 10^{-7} \text{ s}^{-1}$ were controlled at cathodic, active-to-passive transition, passive and transpassive potential regions, respectively. The experimental results showed that Alloy 182 was most susceptible to cracking in 0.05 M hydrochloric acid solution under cathodic polarization condition. In the active-to-passive transition as well as in the transpassive potential regions, the weld also suffered EAC. However, in the passive potential region, the weld was immune to EAC. The strain-rate-dependent EAC behavior was observed in 0.05 M hydrochloric acid solution at an applied potential of $-50 \text{ mV}_{\text{SCE}}$ (in the active-to-passive transition region). The results indicated that hydrogen-assisted cracking (HAC) participate in the cracking process under anodic polarization condition.

分組學術活動

C. 核能安全委員會

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學歷	1989~1991,美國 DREXEL 大學機械碩士 1977~1979,台灣工業技術學院電子工程技術系畢業.
經歷	<ol style="list-style-type: none"> 1. 91 年至今,台電公司龍門核能電廠儀控經理. 2. 82 年~91 年台電公司核能發電處儀電課主管儀控業務. 3. 72 年~82 年,台電公司第一核能發電廠儀控股長
文章發表	<ol style="list-style-type: none"> 1. Chia-Kuang Lee, The Network Architecture and Site Test of DCIS in Lungmen Nuclear Power Station. American Nuclear Society, 1995. 2. 李家光, 龍門數位儀控工場檢查/現場檢查及現況. 第一屆台日核能安全技術研習會, Jan. 2007. 3. Chia-Kuang Lee, Horng-Wen Chang and Tung-Ming Wu, The DCIS Testing in the Lungmen Nuclear Power Plant. American Nuclear Society, April 2009. 4. Chia-Kuang Lee, Kin W. Wong, Digital System Validation Testing in the Lungmen Project. American Nuclear Society, April 2009.

龍門核能電廠數位儀控安裝與測試現況

龍門核能電廠儀控經理 李家光

龍門核能發電廠位於台灣東北角之貢寮鄉共有二部機組每部機組發電容量為 135 萬瓩，目前正在施工中，龍門核電廠的數位儀控系統(簡稱 DCIS)發展作業分成核能蒸汽供應系統(NSSS)、一般支援系統(BOP)、汽機控制系統(TG)及核能廢料(Radwaste)四個主要部分。主要 DCIS 廠家包括美國的 GE、NUMAC、DRS、Invensys、GEIS;日本的三菱(MHI)、日立(Hitachi);另外西班牙 Tecnatom 負責人因工程及 Inabensa 負責主控室盤面、遙控停機盤與模擬器盤設計等，DCIS 由上述七家大型的數位儀控廠家所設計製造,並整合而成，DCIS 採用全數位整合的分散式控制系統,其架構與傳統的類比設計不同，簡報將介紹 DCIS 系統之安裝與測試現況。為了說明安裝與測試,首先簡介 DCIS 之架構與設計概念(包含人機界面,軟體及硬體)，由於龍門核電廠之主控制室與傳統電廠有極大的不同，所以主控制室之佈置與測試亦會在簡報中介紹，DCIS 設計之後廠家開始設備製造,設備製造完成後之廠家接收測試(FAT)費時 2 年完成，FAT 之測試計畫亦會在簡報中介紹，接收後設備運至工地由台電執行安裝，安裝後進行嚴謹與詳細的現場測試,現場測試時間長達 3 年以上，分為三階段執行，分別為施工後測試,試運轉測試,啟動測試。上述的施工/現場測試規劃、現況、偏差處理將在簡報中介紹，最後對龍門核電廠之儀控系統作一總結。

方鈞簡歷

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- 4.專長領域：
 - 1982~1986：台電公司核三廠核能工程師（運轉值班）
 - 1987~1993：原子能委員會核能研究所助理研究員（參與核能電廠整體可靠度計畫）
 - 1993~1999：原子能委員會核能研究所助理研究員/副研究員（參與核能電廠安全度評估計畫）
 - 1999~2001：原子能委員會核能研究所副研究員（參與 TRR-II 計畫）
 - 2001 迄今：原子能委員會核能管制處核三廠專案小組技正（駐廠視察員、運轉人員執照測驗考官）

核能電廠地下管線問題探討

原子能委員會技正 方 鈞

摘 要

美國核能電廠之地下管線，經運轉多年後，因埋在泥土中，容易生鏽腐蝕造成破管洩漏，且發生洩漏之後，不易查覺。地下管線之洩漏，目前雖尚未發生影響核能安全之事件，但其影響有環境中之輻射污染（氡污染）及其他非輻射污染、系統之正常運作。

美國工業界及核能電廠，對於地下管線之策略，是分析風險、研擬檢測/修復/更換計劃，美國管制單位對於地下管線則偏重於現行法規/規範/標準之適用性及監管實務之檢討。目前原能會對地下管線之管制，僅限於含放射性液體之地下管路，未來美國工業界及管制單位提出之地下管線相關報告，將有助於檢視國內核能電廠地下管線之情況。

張欽章簡歷

- (1) 於 1994 年獲得美國任色列理工學院(RPI)機械工程學系之博士學位
- (2) 目前服務於核能研究所核子工程組，為簡任副研究員兼副組長
專長為雙相流沸騰熱傳實驗與分析、汽機性能分析
近年來主要從事於核電廠運轉效能提昇之工作，如功率提昇及汽機環路性能測試與評估

核能電廠安全系統管路氣體聚集之議題討論

核能研究所 張欽章

摘 要

鑑於多年來核能電廠一再發生安全系統因管路氣體聚集而影響到設備操作的實例，使得美國核管會(USNRC)關心是否在不同的電廠有未瞭解的設計、組態、與運轉方面的問題。因此 USNRC 於 2008 年 1 月發佈 GL2008-01 要求電廠在九個月內評估其 ECCS、DHR、以及 Containment Spray 等安全系統之請照基準(Licensing Basis)、設計(Design)、測試(Testing)、與改正行動(Corrective Actions)，以確保這些系統內的積氣量不會危及系統的運轉性。若發現有積氣可能影響系統時，電廠需說明採取的做法。在我國原子能委員會(AEC)也同樣要求國內三座核電廠就安全系統管路氣體聚集之處理提出說明。

胡相宸簡歷

胡相宸博士於 1995 年獲得美國加州大學洛杉磯分校(UCLA)機械、航太暨核子工程學系之博士學位，畢業後曾服務於加州大學(UCLA)、聯合訊號航太公司 (Allied Signal Aerospace)、洛克維爾科學中心(Rockwell Science Center)等知名機構，從事熱傳、流體力學、微機電、熱聲能轉換、新能源開發相關的工作，發表超過 20 篇以上的論文和專業報告，並提出國際知名的熱流控制理論 "Kelly-Hu Mechanism" 用於流場不穩定性的分析和系統控制，目前胡相宸博士服務於核能研究所。

壓水式電廠圍阻體集水坑濾網改善之規劃

核能研究所 胡相宸

摘要

核三廠一、二號機圍阻體再循環集水坑濾網改善計畫主要是針對美國核能管制委員會 (United States Nuclear Regulatory Commission, USNRC) 發佈之 Generic Safety Issue, GSI-191 及 Generic Letter, GL 2004-02, 所指壓水式核能電廠圍阻體內再循環集水坑濾網堵塞的安全議題和事項, 提出解決方案以滿足原子能委員會的要求。此事項係指當核電廠在發生圍阻體內管路破裂事故時, 圍阻體內部現有材料遭受大量由破管處流出之水或蒸汽破壞, 所產生破損物質累積在圍阻體再循環集水坑濾網上, 導致安全相關泵 (如餘熱移除泵、圍阻體噴灑泵...等) 喪失淨正吸水頭 (Net Positive Suction Head, NPSH) 而無法自再循環集水坑取水注入爐心, 進而造成爐心熔毀的嚴重事故, 而其解決方案即為核電廠必須對現存圍阻體再循環集水坑濾網進行評估與改善, 核三廠預定分成兩階段來完成 GSI-191 相關安全議題的改善。

梁國興簡歷

一、基本資料

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二、教育背景

學位	學校	就讀科系	學程
博士	美國麻省理工學院	核子工程	1988,9-1991,6
碩士	國立清華大學	核子工程	1980,9-1982,6
學士	國立清華大學	核子工程	1976,9-1980,9

三、工作資歷

服務單位	職稱	任期
核能研究所	荐任助理研究員	1982年7月-1991年6月
核能研究所	荐任副研究員	1991年7月-1998年12月
核能研究所	簡任副研究員	1999年1月-2005年12月
核能研究所	簡任研究員	2006年1月-2008年10月
台灣清華大學	研究員	2009年1月-
上海交通大學	教授	2009年1月-

四、工作經驗

多年研發工作之主要專長領域包括(1) 認證級安全分析技術之研發與應用，(2) 核能電廠系統動態模擬與分析技術之研發與應用。自1995年至2008年負責執行之計畫項目共計12項，總計畫經費共計2億2千餘萬(新台幣)。各項計畫及經費如下：

項目	計畫名稱	計畫經費	期程
1	核四廠起動測試暫態模擬與分析	750萬/ 台電委託計畫	2008-2009
2	核四廠電廠配套系統模式建立與運轉模擬-飼水系統轉速分析與評估	750萬/ 台電委託計畫	2007-2008
3	用過核燃料中期乾式儲存熱傳認證分析技術建立與應用	1200萬/ 台電委託計畫	2006-2008
4	核能電廠整廠系統動態模擬技術建立與應用-核二廠工程用模擬器製作	1600萬/ 台電委託計畫	2005-2008
5	核四廠終期安全報告(FSAR)LOCA與圍阻體平行計算	1000萬/ 台電委託計畫	2005-2008

6	核四廠工程用模擬器製作與應用	3000 萬/ 政府施政計畫	2003-2006
7	核四廠飼水斷管水流沖放認證分析	1400 萬/ 台電委託計畫	2004-2005
8	核能電廠失水事故分析技術之法制化研究	4200 萬/ 台電委託計畫	2001-2005
9	壓水式電廠大破口爐水流失事故保守模式分析技術建立	2600 萬/ 政府施政計畫	1998-2002
10	核三廠停機期間異常事件應變準則之熱流安全分析	3000 萬/ 台電委託計畫	1998-2001
11	反應器大修熱流分析技術研究與發展	2000 萬/ 政府施政計畫	1994-1997
12	核一、二廠大修爐心替代冷卻認證分析	700 萬/台電委託計畫	1995-1996

五、獲獎項目

1997 年獲頒行政院甲等傑出研究獎

六、學術論著

自 2000 年共發表 SCI 學術期刊論文 12 篇

Development and Application of a Dual RELAP5-3D Based Engineering Simulator for ABWR

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Abstract

For any innovated plant design, the designed paper plant can be converted into a computer as a digital plant with advanced simulation techniques before being constructed into a real plant. A digital plant, namely engineering simulator, can be applied for (1) verification of system design and system integration, (2) power test simulation, (3) plant transient and accident analyses, (4) plant abnormal and emergency procedure development and verification, (5) design change verification and analysis, etc.. An advanced engineering simulator was successfully developed for the LungMen Advanced Boiling Water Reactor (ABWR) plant to support various applications before and after commercial operation. This plant specific engineering simulator was developed based on two separate RELAP5-3D modules synchronized on a commercial simulation platform, namely 3-Key Master. On this Advanced LungMen Plant Simulation (ALPS) platform, major plant dynamics were simulated by two separate RELAP5-3D modules, one for reactor system modeling and the other for Balance of Plant (BOP) system modeling. Moreover, major control systems as well as ECCS (emergency core cooling system) were all simulated in great detail with built-in tasks of this commercial simulation platform. Different from real time calculation on training simulator, precision of engineering calculation is intentionally kept by synchronizing modules based on the most time-consuming one. During synchronization, each module will check its' own converge criteria in each small time advancement. This plant specific advanced ABWR engineering simulator has been successfully applied on (1) licensing blowdown analysis of Feed Water Line Break (FWLB) for containment design; (2) phenomena investigation of low pressure ECC injection bypass during FWLB; (3) analysis of FW pump performance during power ascending; and (4) verification of plant vendor's pretest calculations of each startup test.

Key words: Engineering Simulation, Dual RELAP5-3D, Plant Dynamic, ABWR

分組學術活動

D. 醫學應用委員會

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EDUCATION

1974- 1981 M.D., Department of Medicine, College of Medicine, National Taiwan University, Taipei, Taiwan

1991- 1995 Ph.D., Graduate Institute of Clinical Medicine, College of Medicine, National Taiwan University, Taipei, Taiwan

1998-1999 Research Fellow, Dana Farber Cancer Institute, Boston, Massachusetts, U.S.A.
Visiting Scientist, Division of Bioengineering and Environmental Health,
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POSITIONS

1980-1981 Internship, National Taiwan University Hospital

1983-1988 Residency, Department of Internal Medicine, National Taiwan University Hospital

1988-1989 Chief of Division of Digestive Diseases, Lo-Tung Po-Ai Hospital, I-Lan, Taiwan

1989-now Attending Physician, Department of Internal Medicine, National Taiwan University Hospital, Taipei, Taiwan

1996-1999 Adjunct Associate Professor, Department of Internal Medicine, College of Medicine, National Taiwan University

1999-2004 Clinical Assistant Professor, Department of Internal Medicine, College of Medicine, National Taiwan University

2004-2006 Clinical Associate Professor, Department of Internal Medicine, College of Medicine, National Taiwan University

2006-now Associate Professor, Institute of Biotechnology, College of Bioresources and Agriculture, National Taiwan University

AWARDS

1991-1993 Young Investigator Award, Academia Sinica, Taipei, Taiwan

2002 Award of Medical Research, The New Century Health Care Promotion Foundation, Taipei, Taiwan

2003 Teaching Award for Excellence in Medical Education, National Taiwan University Hospital

2003 Award for Excellent Publication in the Memory of Dr. Tsung-Ming Tu, Formosan Medical Association

MEMBERSHIP OF ACADEMIC SOCIETIES

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EDITORIAL ACTIVITIES

Editorial Board: Journal of Gastroenterological Society of Taiwan

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PUBLICATIONS

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characterization of small cells in adult cartilage and bone marrow. *J Formos Med Assoc* 2004 ;103:264-273.

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62. Chen CH, Yang PM, Huang GT, Lee HS, Sung JL, Sheu JC. Estimation of seroprevalence of hepatitis B virus and hepatitis C virus in Taiwan from a large-scale survey of free hepatitis screening participants. *J Formos Med Assoc* 2007;106:148-155.
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急性肝衰竭國際診療概況介紹

台大醫院內科 李宣書教授

「急性肝衰竭」指最嚴重的急性肝炎造成的肝衰竭，死亡率高達 8 成。這時的肝組織呈現 massive 或 submassive hepatic necrosis。臨床上的定義及使用名稱仍然分歧，但是原則上是指嚴重的急性肝炎後，陸續發生了黃疸及肝性腦病變 (hepatic encephalopathy) 等症狀。幾乎所有肝疾病皆可能併發急性肝衰竭，例如各種肝炎，如病毒性肝炎 (A、B、C、D、E 型)、黃熱病及其他病毒感染、酒精性肝炎、藥物 (acetaminophen, tetracycline, halothane, isoniazid, methyldopa, monoamine oxidase inhibitors...) 及毒物 (amanita phalloides) 性肝炎、代謝性肝病 (急性妊娠脂肪肝病變、威爾遜氏病、雷氏症候群)、肝動脈結紮或栓塞、肝靜脈阻塞 (Budd-Chiari syndrome) 等。其發生原因世界各地區互有異同。亞洲地區大多與病毒性肝炎有關，例如台灣與香港皆為 B 型肝炎的好發區，急性肝衰竭 80~90% 與 B 型肝炎有關，例如發生於慢性肝炎併急性發作時，以及化學療法造成 B 型肝炎病毒的再活化近來也受到重視。其次藥物性肝炎也不能忽視，尤其肺結核流行在全世界似有再興起之勢，抗結核藥物引起之急性肝衰竭需要及早因應。美國近來做了一個集合美國 17 個醫學中心急性肝衰竭病例的前瞻性的研究中發現 acetaminophen 中毒比率由以前的 20% 增加為目前的 39%，另外 13% 為 idiosyncratic drug reactions，其中較多者為 isoniazid、trimethoprim/sulfa、phenytoin、disulfiram、propylthiouracil，少數為草藥及治療 AIDS 之藥物。病毒性肝炎引起者佔 12%，其中 A 型肝炎 4%，B 型肝炎 8%。

急性肝衰竭的治療包括支持性治療、合併症治療、特殊藥物治療 (例如干安能用於 B 型肝炎，acetylcysteine 用於 acetaminophen 中毒)、血漿置換術、洗肝機 (例如 MARS)、以及肝臟移植。肝臟移植是最有效的治療，但是必須接受終生的免疫抑制劑治療。如何判斷一個病人必定要肝移植，否則無法存活；或是這個病人可以不必肝移植也可恢復，因此免去終生使用抗排斥藥物？這個問題一直是臨床醫師最想知道的，以便給與病人最適切的醫療。現今世界上被提過的此種指標有 King's College criteria、Clichy criteria、及一般加護病房常用的 APACHE II scoring system。但美國的 ALF Study Group 的數據顯示 King's College criteria 及 APACHE II scoring system 的預測準確性並不夠好。準確性高的預測指標在臨床上相當重要，但是目前仍缺少大家公認準確的指標，仍需大家繼續努力。

李伯皇簡歷

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國立台灣大學醫學院	中華民國	醫學院	醫學士
國立台灣大學	中華民國	臨床醫學研究所	醫學博士
美國匹茲堡大學醫學院	美國	外科器官移植部	研究員

主要經歷：

服務機關	服務部門	職稱
台大醫學院附設醫院	外科部	主任
台大醫學院附設醫院	外科部	主治醫師
台大醫學院	外科	主任
台大醫學院	外科	教授
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台大醫學院外科教授
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財團法人義大醫院總執行長
義聯集團醫學及生物科技發展委員會主任委員
財團法人義大醫療體系執行長

專長：

肝膽外科、器官移植、一般外科

學位、獎狀及榮譽記錄：

1. 民國 81 年 獲青杏醫學獎
2. 民國 82 年 獲台灣醫學會優秀論文獎
3. 民國 84 年 獲台北市醫師公會杏林獎
4. 民國 84 年 獲國際外科學院優秀論文獎
5. 民國 86 年 獲台灣醫學會高天成教授紀念演講獎
6. 民國 75 年 3 月 獲頒博士學位證書(博字第 0465 號)
7. 民國 63 年 12 月 獲頒高考及格證書(醫師及建設人員公共衛生醫師)
8. 民國 68 年 12 月 獲頒原子能委員會醫用游離輻射防護結業證書
9. 民國 89 年 3 月 獲頒台大生物技術核心技術核心實驗室課程結業證書
10. 民國 88 年 3 月 獲頒台大醫院第一期主管研究班結業證書
11. 民國 94 年 11 月 獲頒台大醫院臨床肝臟移植團隊服務特殊優異獎

12. 民國 96 年 7 月 獲頒有庠基金會傑出教授獎
13. 民國 97 年 1 月 香港大學醫學院訪問教授
14. 民國 98 年 1 月 國立成功大學醫學院外科客座教授

重要事蹟：

現任學會工作：

1. 國際消化外科醫學會(International Society of Digestive Surgery) 執行委員會執行委員兼副主席(2000~2004,2006~2008)
2. 台灣外科醫學會理事長
3. 台灣醫學會理事
4. 台灣消化系外科醫學會榮譽理事
5. 台灣移植醫學會榮譽理事
6. 國際肝膽移植雜誌編輯委員
7. 亞洲外科醫學會理事長(2009~2011)

經歷重要校內職務：

1. 校務會議代表
2. 醫學院院務會議代表
3. 台大醫學院學術整合委員會委員
4. 醫學院教師升等審查委員
5. 台大醫院器官移植管理委員會委員
6. 台大醫院主治醫師評審委員會委員
7. 台大醫院學術發展委員會委員
8. 台大外科醫療研究發展委員會主委
9. 台大外科教學訓練委員會委員
10. 台大外科人才儲備委員會委員
11. 台大外科空間管理委員會委員

經歷校外重要工作：

1. 財團法人醫策會醫學中心及醫院外科品質評鑑委員
2. 健保局高科技醫療審查醫師
3. 台北市醫師公會會員代表
4. 健保局全民健康保險醫療服務審查委員

經歷重要學術審查工作：

1. 國科會學門召集人
2. 台灣外科醫學會雜誌主編
3. 香港研究資助局 (Research Grant Council of Hong Kong) 聘任外審委員 (External referee)
4. 國衛院癌症研究組肝癌術後輔助治療委員會委員
5. 國衛院 BC 型肝病論壇--肝癌共識小組專家學者

The Current Status and Future Prospective of Global Liver Transplantation

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Liver transplantation has been one of the most effective treatments for end stage liver disease since Prof Thomas E Staz performed the first clinical liver transplantation in 1963. The refinement of surgical procedures, development of immunosuppressant and organ preservation, and improvement of critical care made liver transplantation progression with good outcome.

The bottleneck of liver transplantation is critical shortage of organ. The donation rate in Europe and American usually over 15 per million population. In Taiwan the donation rate is around 6 per million population. To resolve organ shortage living related liver transplantation becomes an important option not only in Taiwan but also in Asian countries. For the organ sharing and promote the organ donation, the government established Taiwan organ registry and sharing center(TORSC) in March 2002 hoping to improve this discrepancy which is similar to UNOS in US. This organization improves the organ sharing and donation in these years.

To alleviate the urge for organ demand (bio)-artificial liver and hepatocyte cell therapy are under development with slow progress.

Over the last 10 years, the number of both deceased donor liver transplantation and living donor liver transplantation increased dramatically in Asia especially in China. Over three- fourth of countries have their policy for organ allocation. But still around 50% of the countries does not have a national center for organ allocation. For international collaboration it is necessary to have unified patient-oriented system or MELD system in the future.

In summary, liver transplantation has become a routine procedure to treat end-stage line diseases. Through the expansion of donor sources and donor allocation more patients got benefit from transplantation. I believe hepatocyte transplantation will have its role in the transplantation program in future.

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學歷 (Education)	<ul style="list-style-type: none"> • 1975 台北醫學院醫學系醫學士 • 1979 Johns Hopkins Medical Institutions, School of Public Health and Hygiene, Master of Science 	
經歷 (Work Experiences)	<ul style="list-style-type: none"> • 1979-1981 台大醫院放射線科主治醫師 • 1981-2003 長庚醫院核子醫學科主治醫師(1982-2002 主任) • 2003-2009 台大醫院核子醫學部主治醫師、主任 	
專長 (Expertise)	<ul style="list-style-type: none"> • 核子醫學 • 分子造影 	

肝癌新正子掃描製劑初報

台大醫院核子醫學部 曾凱元主任

關鍵詞：肝細胞癌，氟-18 去氧葡萄糖正子斷層掃描， $[^{18}\text{F}]$ Fluorocholine 正子斷層掃描

^{18}F -FDG 是截至目前為止臨床上使用最為廣泛的正子掃描製劑，其機轉乃針對癌症細胞對於葡萄糖代謝增加的特性。然而，正常肝細胞也會吸收某種程度的 ^{18}F -FDG，而肝癌細胞攝取量因分化之差異，由而影響攝取量及診斷的準確性與臨床應用的範疇。診斷率約在 50-60%之譜。因此， ^{18}F -FDG PET Scan 並非肝癌診斷的首選。

香港 Dr. Garrett Chi-Lai Ho 的團隊，曾利用碳-11 標記的 acetate 作肝細胞癌 PET Scan，初步有不錯的結果，然而，同樣的方法在國內台北榮總的嚐試卻無法得到相同的結果，其原因並不清楚。而且，由於碳-11 半衰期只有 20 分鐘，無法普及，也不能運送給其他醫院使用。

在 2006 年 11 月 Eur J Nucl Med Mol Imaging 法國團隊一篇初步報告中(Talbot JN et. al.)， ^{18}F -FCH ($[^{18}\text{F}]$ Fluorocholine) PET/CT 比傳統的 ^{18}F -FDG PET/CT 對於肝癌的診斷有較高的敏感度。自 2005 年 10 月我們的正子中心設立迴旋加速器暨正子製劑合成系統以來，我們逐步合成了 F-18 FDOPA，F-18 FLT。今年，我們依據 Iwata R. et. al.之合成方法加以修改，在有經驗的顧問薛晴彥的指導下，合成 F-18 F-choline 並完成必要的品管測試。

在台大醫院研究倫理委員會與衛生署核可之下開始進行人體試驗，提出初步報告。希望未來透過肝癌 choline 代謝增加的特性，配合 ^{18}F -FDG 設計一套可能的正子掃描流程以提升正子掃描在肝癌診斷、追蹤之臨床價值。

俞鐘山簡歷



一、基本資料：

簽名：

身分證號碼	U	1	2	0	5	0	2	5	6	7	填表日期：	2009 / 08 / 13
中文姓名	俞鐘山				英文姓名	Yu Chung-Shan						
						(Last Name)		(First Name)		(Middle Name)		
國籍	台灣				性別	<input checked="" type="checkbox"/> 男 <input type="checkbox"/> 女		出生日期	1966年12月31日			
聯絡地址	30043 新竹市光復路二段 101 號清大醫環系											
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傳真號碼	03-5751922					E-mail	csyu@mx.nthu.edu.tw					

二、主要學歷 由最高學歷依次填寫，若仍在學者，請在學位欄填「肄業」。

學校名稱	國別	主修學門系所	學位	起訖年月(西元年/月)
海德堡大學	德國	化學系	博士	自 1994 / 9 至 1999 / 4
清華大學	台灣	原子科學所	碩士	自 1989 / 9 至 1991 / 6
淡江大學	台灣	化學系	學士	自 1985 / 9 至 1989 / 6

三、現職及與專長相關之經歷 指與研究相關之專任職務，請依任職之時間先後順序由最近者往前追溯。

服務機構	服務部門/系所	職稱	起訖年月(西元年/月)
現職：清華大學	生醫工程與環境科學系	副教授	自 2008 / 8 至 迄今
經歷：清華大學	生醫工程與環境科學系	助理教授	自 2003 / 8 至 2008 / 7
經歷：中央研究院	化學所	博士後研究	自 1999 / 10 至 2003 / 7
經歷：台北榮民總醫院	核子醫學部	研究助理	自 1993 / 7 至 1994 / 3
			自 ___ / ___ 至 ___ / ___

四、專長 請自行填寫與研究方向有關之學門及次領域名稱。

1. 醫學化學	2. 醣質科學	3. 正子藥物	4.
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五、學術著作：

I. 期刊論文 (2003-present)

No.	Paper	IF ¹	JR ² & TC ³	Affiliation
J1	Tzu-Sen Yang, Yujia Cui, Chien-Ming Wu, Jem-Mau Lo, Chi-Shiun Chiang, Wun-Yi Shu, Chung-Shan Yu , Kuo-Ning Chiang, and Ian C. Hsu*, Determining the Zero-Force Binding Energetics of Intercalated DNA Complex Using Single Molecule Approach, <i>ChemPhysChem</i> , 2009 , <i>10</i> , 2791-2794 (SCI)	3.5	JR = 2/32 = 6%	NTHU
J2	Li-Wu Chiang, Si-Der Pan, Jem-Mau Lo, Chung-Shan Yu * "Triflic acid-promoted formylation of ceramide in dimethyl foramide." <i>Chin. J. Chem. Accept.</i> (SCI) (Granted by NSC-96-2113-M-007-028-MY2)			NTHU
J3	Chi-Shiun Chiang, Ching-Fang You, Li-Wu Chiang, Shao-Wei Chen, Jem-Mau Lo, Chung-Shan Yu * "Comparison of bioactivities of 5-fluoro, 5-iodo, 5-iodovinyl, and 5-fluorovinyl arabinosyl uridines against SR-39 TK-transfected murine prostate cancer cells" <i>Chem. Pharm. Bullet.</i> 2008 , <i>56</i> , 109-111. (SCI) (Granted by NSC-96-2113-M-007-028-MY2)	1.623	JR = 48/125	NTHU
J4	Chi-Shiun Chiang, Ching-Fang You, Li-Wu Chiang, Shao-Wei Chen, Jem-Mau Lo, Chung-Shan Yu * "Comparison of bioactivities of 5-fluoro, 5-iodo, 5-iodovinyl, and 5-fluorovinyl arabinosyl uridines against SR-39 TK-transfected murine prostate cancer cells" <i>Chem. Pharm. Bullet.</i> 2008 , <i>56</i> , 109-111. (SCI) (Granted by NSC-96-2113-M-007-028-MY2)	1.623	JR = 48/125	NTHU
J5	Jem-Mau Lo, Li-Wu Chiang, Shao-Wei Chen, Zhi-Wei Fu, Kai Pei, Chung-Shan Yu * "Recent advances in solution-phase derived synthetic libraries and rapid bioassays on microtiter plates" Invited review paper. <i>Chemistry Today Chim. Oggi.</i> 2007 , <i>25</i> , 46-50. (SCI) (Granted by NSC 95-2113-M-007-039)			NTHU
J6	Chien-Hung Yeh, Si-Der Pan, Shao-Wei Chen, Zhi-Wei Fu, Li-Wu Chiang, Chung-Shan Yu * "An improved method for synthesis of ceramide for constructing α -galactosyl ceramide analogs." <i>J. Chin. Chem. Soc. Taipei.</i> 2007 , <i>54</i> , 1375-1378. (SCI) (Granted by NSC_95-2113-M-007-039)			NTHU
J7	Yu, C.-S.* ; Wang, R.-T.; Chiang, L.-W.; Lee, M.-S. "Synthesis of 4',4'-C-diaminomethyl nucleoside derivative as a building block for constructing libraries via amide bond formation." <i>Tetrahedron Lett.</i> 2007 , <i>48</i> , 2979-2982. (SCI) (Granted by NSC 94-2113-M-007-005)	2.625	JR = 20/56 TC = 2	NTHU
J8	Yu, C.-S.* ; Wang, H.-Y.; Chiang L.-W.; Pei, K. "Synthesis of rhamnosyl trisaccharide repeating unit to mimic the antigen determinant of <i>Pseudomonas syringae</i> lipopolysaccharide." <i>Synthesis</i> , 2007 , 1412-1420. (SCI) (Granted by NSC 94-2113-M-007-005)	2.470	JR = 23/56	NTHU
J9	Lin, K.-I.; Chiang, L.-W.; Wu, C.-H.; Chen, S.-W.; Yu, C.-S.* . "Synthesis of 5-radioiodoarabinosyl uridine analog for probing HSV-1 thymidine kinase gene." <i>J. Chin. Chem. Soc. Taipei.</i> 2007 , <i>54</i> , 563-568. (SCI) (Granted by NSC 94-2113-M-007-005).			NTHU
J10	Yu C.-S.* ; Wu, C.-H.; Chiang, L.-W.; Pei, K.; Hsu, Z.-K. "Synthesis of (<i>E</i>)-5-(2-fluorovinyl)arabinosyl uridine analog as a potential probe for HSV-1 thymidine kinase gene" <i>Synthesis</i> , 2006 , 3835-3840 (SCI). (Granted by NSC 94-2113-M-007-005)	2.257	JR = 23/56 TC = 3	NTHU
J11	Yu, C.-S.* ; Chiang, L.-W.; Wu, C.-H.; Wang, R.-T.; Chen, S.-W.; Wang, H.-Y.; Yeh, C.-H. "Synthesis of 5-radioiodoarabinosyl uridine	2.478	JR = 26/87 TC = 4	NTHU

	analogs for Probing HSV TK gene: An unexpected chelating effect” <i>Nucl. Med. Biol.</i> 2006 , <i>33</i> , 367-370 (SCI). (Granted by 93-2113-M-007-038)			
J12	Yu, C.-S.* , Wu, C.-H.; Chiang, L.-W.; Wang, R.-T.; Wang, H.-Y.; Yeh, C.-H., Lin, K.-I. “Synthesis of (<i>E</i>)-5-(2-radioiodovinyl)arabinosyl Uridine Analog for Probing HSV-1 Thymidine Kinase Gene” <i>Chemistry Letters</i> 2005 , <i>34</i> (10), 1390-1391 (SCI). (Granted by NSC 93-2113-M-007-038)	1.48	JR =47/128 TC = 4	NTHU
J13	Yu, C.-S.* ; Oberdorfer, F. “Synthesis of a Novel Aldehyde: 4- <i>O</i> -methyl-5-formylmethyl-2'-deoxyuridine Derivatives” <i>Nucleosides, Nucleotides Nucleic Acids</i> 2003 , <i>22</i> (1), 71-84. (SCI)		TC = 3	Heidelberg
J14	Yu, C.-S.* ; Zeisler, S.; Eisenbarth, J.; Weber, K.; Runz, A.; Oberdorfer, F. “Synthesis of 5-(2-radiohaloethyl)- and 5-(2-radiohalovinyl)-2'-deoxyuridines. Novel Types of Radiotracer for Monitoring Cancer Gene Therapy with PET” <i>J. Labelled Compd. Radiopharm.</i> 2003 , <i>46</i> , 1-19 (SCI)		TC = 8	Heidelberg

*:通訊作者; 1: SCI Impact Factor (2007); 2: Journal Ranking; 3: Times Cited

II. 期刊論文 (before 2003)

- J15. **Yu, C.-S.**; Niikura, K.; Lin, C.-C.*; Wong, C.-H*. “The Thioglycoside and Glycosyl Phosphite of 5-Azido Sialic Acid: Excellent Donors for the α -Glycosylation of Primary Hydroxy Groups” *Angewandte Chemie* **2001**, *40*, 86-88. [IF = 10.031, JR = 4/124 (3%), TC = 44]
- J16. **Yu, C.-S.**; Oberdorfer, F.* “Synthesis of (*E*)-5-[2-(tri-*n*-butylstannyl)viny] substituted 2'-deoxyuridine derivatives for use in halogenation and radiohalogenation reactions” *Synlett* **2000**, 86-88. [IF = 2.763, JR = 16/56 (28%), TC = 11]
- J17. **Yu, C.-S.**; Oberdorfer, F.* “Synthesis of 4-*O*-methyl-protected 5-(2-hydroxyethyl)-2'-deoxyuridine derivatives and their nucleophilic fluorination to 5-(2-fluoroethyl)-2'-deoxyuridine” *Synthesis* **1999**, 2057-2064. [IF = 2.257, JR = 23/56 (43%), TC = 7]

III. 期刊論文 (審稿中)

- J18. Li-Wu Chiang, Jia-Rong Chen, Wen K. Yang, Chung-Shi Yang, Li-Chen Wu and **Chung-Shan Yu** Unusual bioactivities of 5-fluoro, 5-iodo and 5-iodovinyl arabinosyl uridines against HSV-1 TK-transfected murine sarcoma cells. Manuscript submitted. (SCI) (Granted by NSC-96-2113-M-007-028-MY2).

IV. 國內期刊 (中文著作)

- J19. Chiang, L.-W.; Lo, J.-M.; **Yu C.-S.***, “Synthesis of Radiolabeled Nucleoside Analogs for Probing Cancer Gene Therapy” *Chemistry* (The Chem. Soc., Taipei), **2006**, *64*, 179-190 (Review Article in Chinese). (Granted by NSC 94-2113-M-007-005).

V. 會議論文

- P1. Huang, H.-L.; Liao, K.-W.; Chang, K.-H.; Huang, C.-W.; Chiang, L.-W.; Chen-S.-W. ; **Yu, C.-S.*** *Synthesis of glycopytosphingosine analogs for constructing libraries for targeting cancer. IUPAC 5th International Symposium on Novel Materials and Synthesis (NMS-V) 19th International Symposium on Fine Chemistry and Functional Polymers (FCFP-XIX) 3rd Symposium on Power Sources for Energy Storage and their Key Materials (PS-III) October 18-22, 2009 (invited speaker). (Granted by NSC-96-2113-M-007-028-MY2).*
- P2. Chen, S.-W.; Chiang, L.-W.; Huang, H.-L.; **Yu, C.-S.*** *Combining a solution-phase derived library with in-situ cellular bioassay for discovering prodrugs for HSV TK. 1st Annual World Congress of iBio-2008, Hangzhou, China, 17-21 May 2008 (plenary speaker). (Granted by NSC-96-2113-M-007-028-MY2).*

- P3. Chiang, L.-W.; Wu, C.-H.; Wang, R.-T.; Wang, H.-Y.; Yeh, C.-H.; **Yu, C.-S.*** *Development of gene probes. Synthesis of radioiodo and radioiodovinyl arabinosyl uridine analogs* **229th American Chemical Society Spring Meeting**; San Diego 13-17 March. **2005**, 229, U165-U165. SCI (Granted by NSC 93-2113-M-007-038).
- P4. Yang, T.S.; Cui, Y.J.; Lo, J.M.; Wu, C.M.; Chiang, C.S.; **Yu, C.S.**; Hsu, I.C. * *Single molecule approach to detect DNA double-strand break by Auger electrons*. *Biophysical Journal* 229A-229A Suppl. S, JAN **2007** (SCI). (Granted by NSC-96-2113-M-007-028-MY2).
- P5. **Chung-Shan Yu***, Ren-Tsong Wang, Li-Wu Chiang, Kai Pei, Ho-Lien Huang, and Ming-Hsun Lee. *Synthesis of 4',4'-C-diaminomethyl nucleoside derivative as a building block for constructing libraries via amide bond formation*. **233th American Chemical Society Spring Meeting**; Chicago 25-29 March. **2007**. (Poster Presentation) (Granted by NSC-96-2113-M-007-028-MY2).
- P6. **Chung-Shan Yu***, Chien-Hung Yeh, Li-Wu Chiang, Si-Der Pan, and Kai-Hsiang Chang. *An improved method for synthesis of ceramide for constructing alpha-galactosyl ceramide analogs*. **233th American Chemical Society Spring Meeting**; Chicago 25-29 March. **2007**. (Poster Presentation) (Granted by NSC-96-2113-M-007-028-MY2).
- P7. **Chung-Shan Yu***, Heng-Yen Wang, Li-Wu Chiang, Shao-Wei Chen, and Chen-Tze Pan. *Synthesis of rhamnosyl trisaccharide repeating unit to mimic the antigen determinant of Pseudomonas syringae lipopolysaccharide*. **233th American Chemical Society Spring Meeting**; Chicago 25-29 March. **2007**. (Granted by NSC-96-2113-M-007-028-MY2).
- P8. **Chung-Shan Yu***, Heng-Yen Wang and Li-Wu Chiang. *Synthesis of rhamnosyl trisaccharide repeating unit to mimic the antigen determinant of Pseudomonas syringae lipopolysaccharide*. **ICCEOCA-1 post-conference of 1st international conference on cutting edge organic chemistry in asia**. **2006**, Oct. 21-24, Hsinchu Taiwan. (Granted by NSC 95-2113-M-007-039).
- P9. **Chung-Shan Yu***, Chien-Hung Yeh, Li-Wu Chiang. *Synthesis of amide-bond nucleoside analogs for construction of libraries to develop HSVtk gene probes efficiently*. **2nd Symposium of biomedical imaging and radiological sciences**. Taiwan Sept. 24, **2006**. Taipei Taiwan. (Granted by NSC 95-2113-M-007-039).
- P10. **Yu, C.-S.***; Chiang, L.-W.; Wu, C.-H.; Wang, R.-T.; Wang, H.-Y.; Yeh, C.-H.; Hsu, Zhi-Kai *Synthesis of (E)-5-(2-fluorovinyl)arabinosyl uridine analog as a potential probe for HSV-1 thymidine kinase gene* **SNM 53rd Annual Meeting**; San Diego 3-7 June. **2006**. (Granted by NSC 94-2113-M-007-005).
- P11. Chien-Hung Wu (吳建宏), Li-Wu Chiang (姜豐武), Kai Pei (裴鏞), Zhi-Kai Hsu (許智凱) and **Chung-Shan Yu (俞鐘山)*** *Synthesis of (E)-5-(2-fluorovinyl)arabinosyl uridine analog as a potential probe for HSV-1 thymidine kinase gene* Chinese Chemical Society annual meeting November 19-20, 2005, Kaoshiung, Taiwan. (Granted by NSC-94-2113-M-007-005).
- P12. Li-Wu Chiang (姜豐武), Chien-Hung Wu (吳建宏), Ren-Tsong Wang (王仁聰), Chien-Hung Yeh (葉建宏), Shi-Ting Huang (黃詩婷), **Chung-Shan Yu (俞鐘山)*** *Development of gene probes. 1. Synthesis of radioiodo arabinosyl uridine analog* Chinese Chemical Society annual meeting November 25-26, 2004, Taichung, Taiwan. (Granted by NSC 93-2113-M-007-038).
- P13. Chien-Hung Wu (吳建宏), Li-Wu Chiang (姜豐武), Heng-Yen Wang (王姮雁), Shao-Wei Chen (陳勁緯), **Chung-Shan Yu (俞鐘山)*** *Development of gene probes. 2. Synthesis of 5-(2-radioiodovinyl) arabinosyl uridine analog* Chinese Chemical Society annual meeting November 25-26, 2004, Taichung, Taiwan. (Granted by NSC 93-2113-M-007-038).

六、近三年內執行之研究計畫（請務必填寫近三年所有研究計畫）

計畫名稱及編號	計畫內擔任之工作	起迄年月	補助或委託機構	執行情形	核定經費總額(含人事費及管理費)
發展可快速篩選抗腫瘤之液相分子庫技術以作為新一代活體正子斷層掃描造影劑 NSC-98-2113-M-007-012	主持人	98/08/01 ~ 99/07/31	國科會	進行中	1,400,000
長庚清華合作計畫補助經費	主持人	98/1/01 ~ 98/12/31	清華大學	進行中	650,000
長庚清華合作計畫補助經費	主持人	96/10/01 ~ 97/12/31	清華大學	結案	650,000
發展醣脂體合成以作為藥物運輸載具 NSC-96-2113-M-007-028-MY2	主持人	96/08/01 ~ 98/07/31	國科會	結案	2,723,000
清大拔尖計畫前期作業院補助經費	主持人	95/08/01 ~ 95/12/31	清華大學原科院	結案	500,000
抑制肝癌細胞之岩藻醣合成酶之分析方法之建立 NSC- 95-2113-M-007-039-	主持人	95/08/01 ~ 96/07/31	國科會	結案	1,527,000
發展基因探針以監測癌症基因治療：正子放射藥物研發與藥物活性分析系統之建立(3/3) NSC-94-2113-M-007-005	主持人	94/08/01 ~ 95/07/31	國科會	結案	1,965,000
發展基因探針以監測癌症基因治療：正子放射藥物研發與藥物活性分析系統之建立(2/3) NSC 93-2113-M-007-038-	主持人	93/08/01 ~ 94/07/31	國科會	結案	2,128,600
發展基因探針以監測癌症基因治療：正子放射藥物研發與藥物活性分析系統之建立(1/3) NSC 92-2119-M-007-071-	主持人	92/08/01 ~ 93/07/31	國科會	結案	3,880,800

Synthesis of 5-[¹²³I]iodoarabinosyl Uridine and 3-[¹⁸F]-FLT Analog for Probing the HSV-1 Thymidine Kinase Gene and Cell uptake Assay

Li-Wu Chiang^a(姜豐武), Ho-Lien Huang^a(黃鶴聯), Jen-Tzung Chen^b(陳振宗), Wu-Chi Lin^b(林武智) and Chung-Shan Yu^{a*}(俞鐘山)

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Tumor cells transfected with herpes simplex virus thymidine kinase gene have been intensively applied to the field of gamma ray tomography via imaging of its substrate. Here we described the synthesis of 5-[¹²³I]iodoarabinosyl Uridine ([¹²³I]IaraU) and [¹⁸F]FLT and the in-vitro uptake in HSV-TK transfected cancer cells.

[¹²³I]IaraU was produced by 5-step synthesis from uridine. Prepare of the tin precursor has been described in early reference. Labeling the precursor with Na[¹²³I]I, [¹²³I]IaraU was obtained in 10% radiochemical yield.

[¹²³I]IaraU was studied for their accumulation with time-course in vitro of three fibrosarcoma cells, NG4TL4, NG4TL4-tk, NG4TL4-sr39tk.

No significant cell uptake for [¹²³I]IaraU was found. Inhibition experiment using [¹²³I]IaraU in conjugation with GCV, FLT, FIAU, FaraU, and IVaraU also did not show significant inhibition effect.

By contrast, [¹⁸F]FLT showed rational uptake and inhibition assay also demonstrated the fluoro nuclide could serve as a rational probe for HSV-TK.

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1. K. I. Lin, L. W. Chiang, C. H. Wu, S. W. Chen, C. S. Yu, Synthesis of 5-Radioiodoarabinosyl Uridine Analog for Probing the HSV-1 Thymidine Kinase Gene, *Journal of the Chinese Society*, **2007**, *54*, 563-568
2. C. S. Chiang, C. F. Yu, L. W. Chiang, S. W. Chen, J. M. Lo, C. S. Yu, Comparison of Bioactivities of 5-Fluoro, 5-Iodo, 5-Iodovinyl, and 5-Fluorovinyl Arabinosyl Uridines against SR-39 TK Transfected Murine Prostate Cancer Cells, *Chem. Pharm. Bull.*, **2008**, *56*, 109-111
3. C.S. Yu, L. w. Chiang, C. H. Wu, R. T. Wang, S. W. Chen, H. Y. Wang, C. H. Yeh, Synthesis of 5-radioiodoarabinosyl uridine analog for probing HSV-1 thymidine kinase gene: an unexpected chelating effect, *Nuclear Medicine and Biology*, **2006**, *33*, 367-370
4. C.S. Yu, C. H. Wu, L. W. Chiang, R. T. Wang, H. Y. Wang, C. H. Yeh, K. I. Lin, Synthesis of (E)-5-(2-Radioiodovinyl)arabinosyl Uridine Analog for Probing HSV-1 Thymidine Kinase Gene, *Chemistry Letters*, **2005**, *34*, 1390-1391

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Medical College National Taiwan University 1976~1983

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June 1988~February 1990 Acting Chief of Division of Gastroenterology
March 1990~June 1993 Medical Director, Outpatient Clinical
March 1990~June 1993 Deputy Director, Department of Emergency Medicine
August 1995~July 2000 Chief, Division of Gastroenterology
August 1998~July 2004 Deputy Director, Department of Graduate Institute of Clinical
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August 2004~July 2007 Chairman, Department of Internal Medicine
August 2000~ present Professor, Department of Medicine

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June 2001~ present Consultant, Medical consultant for Center of
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June 2002~ present Consultant, Bioresource Collection and Research
Center, Food Industry Research and Development
Institute.
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Institute of Nuclear Energy Research.

National Committees

May 1992~resent	Education Committee, Endoscopy Society of Taiwan.
October1992~December 1996	Editorial Board, Emergency Medicine and Critical Care Society of Taiwan.
January1998~December 2003	Editorial Board, Gastroenterological Journal of Taiwan.
May 1995~April 2004	Executive Board, Endoscopy Society of Taiwan.
May 2001	Representative to Japan for Society of Gene Therapy and Vaccination of Taiwan.
April 2006~ present	Executive Board, Taiwan Society of Internal Medicine.
January 2008~ present	Executive Board, Taiwan Society for Hepatoma Therapy

Refereed Papers (Since 2006)

1. Luo TY, Shih YH, Chen CY, Tang IC, Wu YL, Kung HC, Lin WJ, **Lin XZ***. Evaluating the potential of 188Re-ECD/Lipiodol as a therapeutic radiopharmaceutical by intratumoral injection for hepatoma treatment. *Cancer Biother Radiopharm.* 24;535-541,2009.
2. Wu IC*, Shiesh SC, Kuo PH, **Lin XZ***. High oxidative stress is correlated with frailty in elderly Chinese. *J Am Geriatr Soc.* 57;1666-1671,2009.
3. Tasi HM, Chuang CH, **Lin XZ**, Chen CY. Factors relating to the short term effectiveness of percutaneous biliary drainage for hilar cholangiocarcinoma. *World J Gastroenterol.* 15:5206-5210, 2009.
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5. Wu HW, **Lin XZ**, Hwang SM, Lee GB*. The culture and differentiation of amniotic stem cells using a microfluidic system. *Biomed Microdevices.* 11:698-707,2009.
6. Tseng HY, Lee GB*, Lee CY, Shih YH, **Lin XZ***. Localized heating of tumors utilizing injectable magnetic nanoparticles for hyperthermia cancer therapy. *IET Nanobiotechnol.* 3:64-54,2009.
7. Chuang TF, Lee SC, Liao KW, Hsiao YW, Lo CH, Chiang BL, **Lin XZ**, Tao MH*, Chu RM*. Electroporation-mediated IL-12 gene therapy in a canine cancer model. *Int J Cancer.* 11:698-707,2009.
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9. Tasi HM, Shan YS, Lin PW, **Lin XZ**, Chen CY. Clinical and Imaging Characteristics Relating to Surgical Outcomes of Perforated Appendicitis. *Hepatogastroenterology.* 55:127-132, 2008.
10. Drake P, Cho HJ, Shih PS, Kao CH, Lee KF, Kuo CH, **Lin XZ**, Lin YJ*. Gd-doped iron-oxide nanoparticles for tumour therapy via magnetic field hyperthermia. *J Mater Chem.* 17:4914-4918, 2007.

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12. Chang YC, Tsai HM, **Lin XZ**, Chang CH, Chuang JP. No debridement is necessary for symptomatic or infected acute necrotizing pancreatitis: delayed, mini-retroperitoneal drainage for acute necrotizing pancreatitis without debridement and irrigation. *Dig Dis Sci.* 51:1388-95, 2006.
13. Tsai HM, Shan YS, Lin PW, **Lin XZ**, Chen CY. Clinical analysis of the predictive factors for recurrent appendicitis after initial nonoperative treatment of perforated *appendicitis*. *Am J Surg.* 192:311-6, 2006.
14. Syu MJ, Nian YM, Chang YS, **Lin XZ**, Shiesh SC, Chou TC. Ionic effect on the binding of bilirubin to the imprinted poly(methacrylic acid-co-ethylene glycol dimethylacrylate). *J Chromatogr A.* 1122:54-62, 2006.
15. Chang YC, Nagasue N, Chen CS, **Lin XZ**. Simplified hepatic resections with the use of a Chang's needle. *Ann Surg.* 243:169-72, 2006.
16. Shiesh SC, Chou TC, **Lin XZ**, Kao PC. Determination of C-reactive protein with an ultra-sensitivity immunochemiluminometric assay. *J Immunol Methods.* 311:87-95, 2006.
17. Yao CL, Feng YH, **Lin XZ**, Chu IM, Hsien TB, Hwang SM. Characterization of Serum-Free Ex Vivo-Expanded Hematopoietic Stem Cells Derived from Human Umbilical Cord Blood CD133 Cells. *Stem Cells Dev.* 15:70-78, 2006.

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2. Shan YS, Zuchini R, Tasi HW, Huang SC, Huang CH, Lee GB, Huang CF, **Lin XZ**. Non-Anatomical Liver Resection by Magnetic Fine Needle Array in an Alternating Magnetic Field. *3rd International Kobe Liver Symposium on HCC with an International Liver Cancer Association(ILCA) Scientific Session.* 2009, Kobe, Japan.
3. Zuchini R, Luo TY, Shin YH, Chen CY, Tang IC, Wu YL, Kung HC, Lin WJ, **Lin XZ**. Rhenium-188 ECD/Lipiodol as a Therapeutic Radiopharmaceutical for Hepatoma Treatment. *3rd International Kobe Liver Symposium on HCC with an International Liver Cancer Association(ILCA) Scientific Session.* 2009, Kobe, Japan.
4. Huang SC, Tsai HW, Huang CH, Zuchini R, Lo Ch, **Lin XZ**, Lee GB. Liver Resection Using High Frequency Electromagnetic Thermotherapy. *11th International Congress of the IUPESM.* 2009, Munich, Germany.
5. Wu IC, Shieh SC, Kuo PH, **Lin XZ**. Frailty is Correlated with High Oxidative Stress. *XIX th IAGG World Congres.,* 2009, Paris, Francais.
6. Zuchini R, Huang CH, Huang SC, Shih YH, Tsai HW, Huang CF, Lee GB, **Lin XZ**. Magntic fine needles and iron oxide particles in an alternating magnetic field for hepatoma treatment. *44th Annual Meeting Of The European Association For The Study Of The Liver.* 2009, Copenhagen, Denmark.

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8. **Lin XZ**, Tseng HY, Huang SC, Lee GB. Magnetic nanoparticles and needles for cancer therapy. *The 7th International symposium on nano-biomedical engineering*. 2008, Tainan, Taiwan.
9. Huang SC, Huang CH, **Lin XZ**, Lee GB. High frequency electromagnetic thermotherapy for cancer treatment. *The 13th International conference on biomedical engineering*. 2008, Singapore.
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11. Tseng HU, Lee CY, Shih YH, **Lin XZ**, LeeGB. Hyperthermia Cancer Therapy Utilizing Superparamagnetic Nanoparticles. *IEEE NEMS*. 2007, Thailand.

National Conference Papers (Since 2006)

1. Wang MR, Chiu CH, Cheng LC, Huang CC, Hong JW, Cheng M, **Lin XZ**. Mechanical property of porcine rectum tissue and its deep penetration test. *Biomedical Engineering Society 2009 Annual symposium*. 2009, Taipei, Taiwan.
2. Huang CH, Huang SC, Tsai HW, Lo CJ, Chen CY, Huang CF, Lee GB, **Lin XZ**. Bloodless liver resection using high frequency electromagnetic thermotherapy. *Biomedical Engineering Society 2009 Annual symposium*. 2009, Taipei, Taiwan.
3. Wu IC, **Lin XZ**, Liu PF, Tsai WL, Shiesh SC. Testosterone Deficiency and Frailty in the Elderly. *International Conference on Geriatric Syndrome*. 2009, Taipei, Taiwan.
4. ShanYS, Zuchini R, Tsai HW, Huang SC, Huang CH, Lee GB, Huang CF, **Lin XZ**. Electromagnetic thermal liver resection using conformational fine needle array in a high frequency alternating magnetic field. *Asian Pacific Digestive Week*. 2009, Taipei, Taiwan.
5. Chang S, Zuchini R, Huang CH, Tsai HW, Huang SC, Lin CP, Chen CY, Lee GB, **LinXZ**. Electromagnetic thermoablation to treat thrombocytopenia in cirrhotic and hypersplenic rats. *Asian Pacific Digestive Week*. 2009, Taipei, Taiwan.
6. Shan YS, Zuchini R, Tasi HW, Huang SC, Huang CH, Lee GB, Huang CF, **Lin XZ**. Non-Anatomical Liver Resection by Magnetic Fine Needle Array in an Alternating Magnetic Field. *The 2nd Annual Meeting of the Taiwan Liver Cancer Association*. 2009, Kaohsiung, Taiwan.
7. 吳易謙, 謝淑珠, 郭柏秀, 白惠文, 張家銘, **林錫璋**. 老人衰弱與高氧化壓力相關. 台灣老年學暨老年醫學會第十屆第一次年會暨學術研討會. 2009, 台北, 台灣.
8. 吳立偉, 黃志豪, 施映霞, 蔡弘文, 李國賓, **林錫璋**. Electromagnetic thermotherapy using fine needles and iron oxide nanoparticles for rat hepatoma treatment. 2009 年第 39 屆台灣消化系聯合學術演講年會. 2009, 台北, 台灣.
9. 程俊嘉, 李瑞成, 李貞宜, 陳明華, 施映霞, **林錫璋**. 質譜組織影像分析法搜尋 Thioacetamide 誘導之大鼠肝纖維化蛋白生物標記. 2008 年第 38 屆台灣消化系內視鏡醫學會聯合學術演講年會. 2008, 台北, 台灣.
10. 邱彥程, 李貞宜, 曾皓瑜, 施映霞, 李國賓, **林錫璋**. 磁性奈米顆粒應用於癌症治療-動物實驗. 2008 年第 38 屆台灣消化系內視鏡醫學會聯合學術演講年會. 2008, 台北, 台灣.

11. 施映霞, 羅彩月, 陳健祺, 蔡宏名, 陳炯瑜, 李碧芳, **林錫璋**. 銻-188 治療肝腫瘤之療效評估. 2007 年生物醫學工程科技研討會暨國科會醫學工程學門成果發表會. 2007, 台中, 台灣.
12. 李貞宜, 曾皓瑜, 施映霞, 黃聖傑, 李國賓, **林錫璋**. 超順磁氧化鐵用於高週波感應加熱器以治療癌症動物之研究. 2007 年生物醫學工程科技研討會暨國科會醫學工程學門成果發表會. 2007, 台中, 台灣.
13. Chen MH, Shih YH, Lu HC, Lee CY, Ou HY, Hung SM, Tsai HM, Chang YC, Chang SH, **Lin XZ**. From animal models to preclinical experiments of pancreatic islet transplantation for diabetes mellitus. *The 2nd International Meeting on Microsensors and Microsystems*. 2006, Tainan, Taiwan.

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1. Kan P, Chang KY, Hsieh MF, **Lin XZ**. 溫度敏感性生物活性物質緩釋傳遞系統. *Taiwan Patent No. I297275*. (June 2008~December 2022.)
2. Chang KY, Yeh MH, Hsieh MF, Kan P, Jan YY, Jan SH, **Lin XZ**. Thermosensitive biodegradable copolymer. *2008 Intellectual property office certificate of grant of patent GB2408510*. (June 2008~December 2022.)
3. Chang KY, Yeh MH, Hsieh MF, Kan P, Jan YY, Jan SH, **Lin XZ**. Thermosensitive biodegradable copolymer. *The United States Of America Patent US.7,179,867*. (May 2007~May 2026.)
4. Lee SY, Lin SM, **Lin XZ**, Huang SJ. Air supply device for the protective clothing. *Taiwan Patent No. I262283*. (September 2006~August 2025.)
5. Chang KY, Yeh MH, Hsieh MF, Kan P, Jan YY, Jan SH, **Lin XZ**. Thermosensitive biodegradable copolymer. *Taiwan Patent No. I247017*. (January 2006~ December 2023.)

Technology Transfer (Since 2006)

1. Lee SY, Lin SM, **Lin XZ**, Huang SJ. Air supply device for the protective clothing. National Cheng Kung University transfer ADDA corporation. (15 August 2006)

銻 188 同位素為基礎的肝癌治療

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銻 188 放射性同位素有許多優點，而適用於腫瘤之治療，如以釋放高能量之 β 射線為主，射程長、半衰期短，易於輻射安全管控。肝癌一直是世人致命的病患，因此以銻 188 作為放射同位素藥物，以治療不同時期、不同嚴重程度的肝癌是醫學界努力的目標。

相對於以往用在甲狀腺癌治療的 ^{131}I ， ^{131}I -lipiodol 亦用於肝癌之治療，銻 188 的半衰期短，85% 以 β 線為主，因此不需隔離設備，住院 1-2 天是為了腫瘤的血管注射。

鈷 90 的治療近年在台灣亦快速發展。但它仰賴反應器 (reactor) 生產必須進口，銻 188 可以由購得之射源產出器 (generator) 在現地製造，兩者價格據估差異百倍。鈷 90 治療在台灣的發展，有許多值得借鏡之處，可以提供銻 188 治療應用的實現。

銻 188 在國際核能開發總署 (IAEA) 之主導下，2002 年起在第三世界國家進行肝癌治療之研究。一共有 5 個國家，185 位病患接受治療，條件最重要的是不能開刀的肝癌，排除 Child-Pugh Class C 的病患。使用 ^{188}Re -HDD-lipiodol 185 MBq (5 mCi) 劑量作測試，再以治療標準射源追加，經由 5-F 肝動脈導管注射治療。在 4 年追蹤時間，中位存活期約 1 年，腫瘤大小變化、 αFP 濃度其差異，統計學上是有意義的，而且無任一病人有嚴重副作用。

台灣有關銻 188 的臨床經驗，以 1999 年經驗在高雄長庚醫院執行的防止動脈再度狹窄為主。當時核能所的謝栢蒼博士、丁幹博士均參與研究工作。臨床試驗與世界其它中心比起來是一致的，但沒有明確的效果。銻 188 用在肝癌治療方面，台灣一直以核能所羅彩月、林武智、沈立漢博士為主。台北榮總核醫學科的王世楨主任曾和他們一起發表過動物肝癌的治療。以 0.1 ml 7.4 MBq ^{188}Re -EDC/lipiodol 打入肝動脈，腫瘤得到最高的劑量，從 1 hr、24 hr 及 48 hr 均如此。但其次為腎臟、膀胱。銻 188 亦可做成 microsphere 直接注射肝腫瘤，其結果為 80% 的老鼠 (12/15) 活過 60 天，但只有 26.7% (4/15) 控制組活過 60 天，其

差異有意義。分佈劑量肺只佔 1.78% 而已。今年度本人與羅博士等人發表 ^{188}Re -ECD/lipiodol 直接注射肝癌之研究，在生體分佈的研究，24 小時、48 小時後藥物均可滯留於肝癌，60 天的存活率為 62% 與 20%，完全治癒率為 38% 對 0%。其結果顯示 ^{188}Re -ECD/lipiodol 是令人樂觀可以期待的。

銻 188 的臨床應用有其重要的意義，核能所的研究經驗已累積至相當的程度；鈈 90 的上場更使台灣醫療界對放射線同位素肝癌的治療有打破成規，整合新團隊、新伙伴關係；而官方對核子醫學的管理也已逐漸更有信心和經驗，銻 188 在台灣醫療界用來治療肝癌，現在是萬事俱備，正是升火待發的好時機。

廠內乾式貯存之安全性

台電公司核能電廠用過核子燃料目前存放於用過核子燃料池中。未來將比照歐、美等核能先進國家作法，進行第2階段的乾式貯存。

乾式貯存設施在國際上已有20年以上的使用經驗，安全沒有問題。



美國麻州洋基洛伊(Yankee Rowe)核電廠
乾式貯存設施



美國巴利沙帝斯(Palisades)核電廠
乾式貯存設施



用過核子燃料3階段營運方式

第1階段：水池冷卻

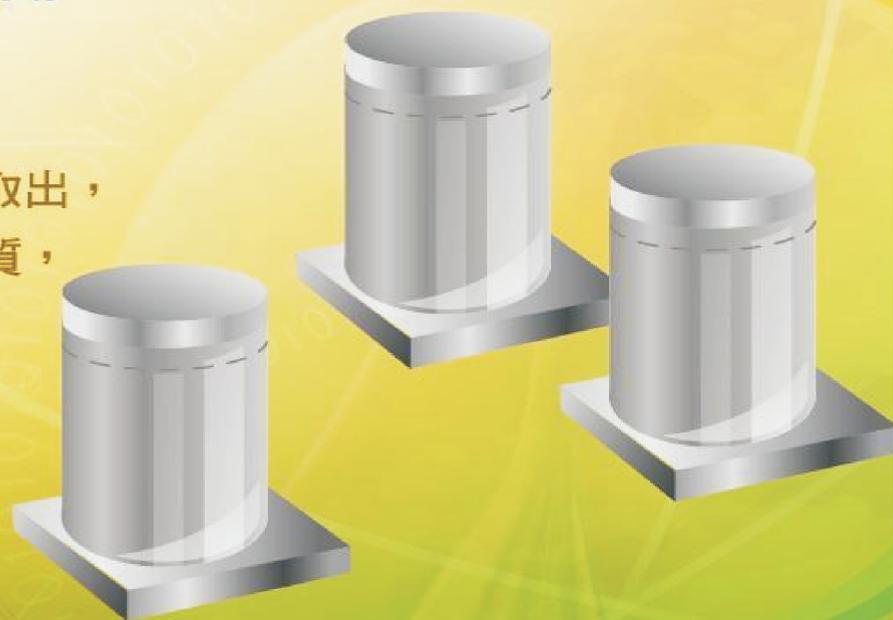
用過核子燃料有殘餘的熱量及輻射，必須先存放在核能電廠內的專用貯存水池中冷卻。

第2階段：乾式貯存

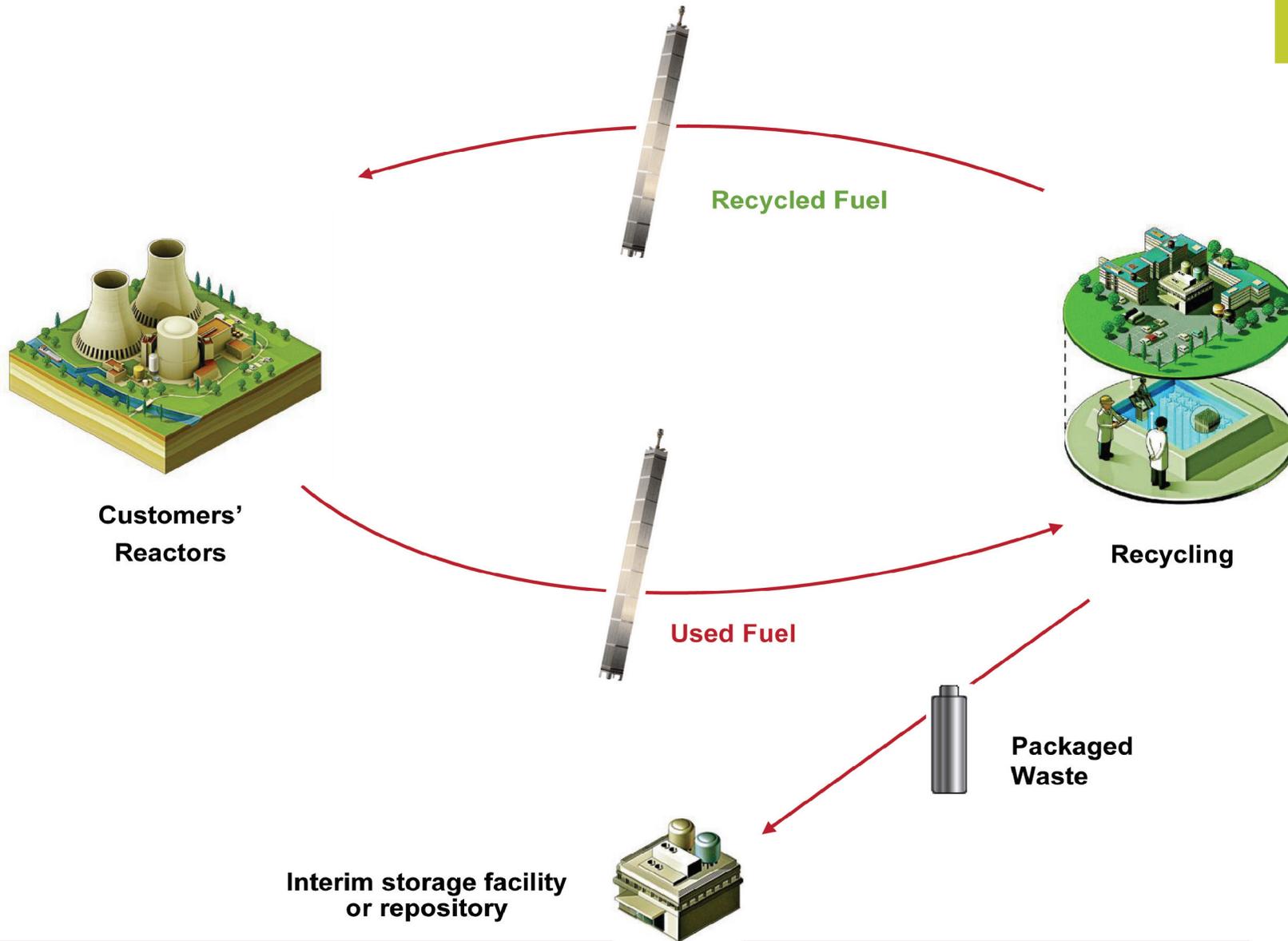
用過核子燃料在水池中經多年冷卻，殘餘熱及輻射已大幅降低，可移到在電廠內興建的乾式貯存設施進行乾式貯存。

第3階段：最終處置

在乾式貯存期間，可以將用過核子燃料取出，進行再處理以回收鈾與鈾等可利用的物質，或運到深層地質處置場做永久處置。



Recycling nuclear fuel

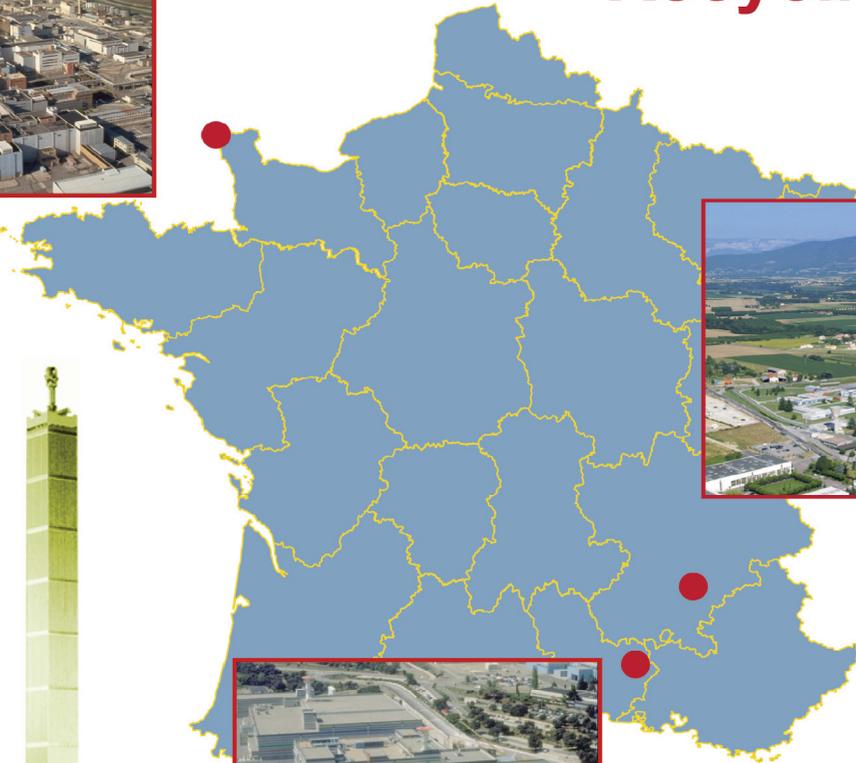


Completion of a comprehensive Recycling Tool



La Hague

» 25 000 tHM treated



Romans



MELOX

» More than 5500 MOX and 4000 ERU FAs fabricated