107年 年報
行政院原子能委員會
Atomic Energy Council, Executive Yuan

AEC 2018
ANNUAL REPORT

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主委的話

Words from the Minister and Chairman

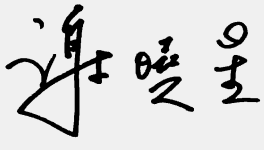
原能會做為一個核能安全的主管機關，對於機關的施政主軸，一直秉持著要做好「核安守護」及「核廢處理」的安全監督工作，為全民的安全把關；我一直認為核能安全是社會大眾關注的問題，所以我站在社會大眾的角度來思考這個問題，希望藉由資訊公開、多元參與、共同監督，來擴大社會各界參與和溝通，爭取民眾的信任並讓人民對原能會的施政有感！

107 年大家最關注的焦點，莫過於核一廠 1 號機的運轉執照在 12 月進入除役階段。然而，核一廠內用過燃料棒仍然放在用過燃料池中，所以在過渡期間，原能會仍會比照運轉中核電廠進行管制，來確保用過燃料棒存放的安全性。另外也要求台電公司積極與新北市政府溝通，好讓乾式貯存設施可以順利運作，使核一廠早日進入實質除役。

回顧 107 年原能會的工作，除了堅守輻射、核能安全外，也首次在每年例行的核安演習，採取現場發布議題狀況，來深化無預警演練；另外執行輻射工作場所及輻射源的安全檢查，以確保作業場所、從業人員、民眾及環境的輻射安全；此外，也新增 5 個全國輻射自動監測站，使總站數達到 51 站，讓全國輻射偵測網絡更綿密；還有持續推動原子能科技在民生應用層面上的研發，包括核電廠除役前運轉安全、核廢料處理／處置、核醫藥物與放射醫材、綠能科技等相關技術。

未來面對核二廠的除役及輻安、核安管制工作，原能會仍將秉持嚴格執行核能安全管制監督的職責，不會有絲毫懈怠，並會持續落實資訊公開、多元參與以及共同監督。另強化核災緊急應變機制、積極面對核電廠除役及核廢料的問題，確實做到「全民的原能會」、「核安的守護者」。

主任委員



As the competent authority for nuclear safety, the Atomic Energy Council (AEC) endeavors to effectively safeguard nuclear safety and regulate nuclear wastes management. By adhering to these policy guidelines, AEC undertakes to fulfill its role as the safety gatekeeper for the whole nation. I have always considered nuclear safety as a major issue of the public concerns; therefore, I have taken the perspective of the public as my own in approaching this concern. Through information disclosure, variety participation and joint supervision, AEC expects to expand the scope of participation and the level of communication from all areas of society. AEC strives to gain the public trust and their recognition of AEC administration.

The focal point of public concern in 2018 was that the Chinshan Nuclear Power Plant Unit 1 entered the decommissioning phase in December, following the expiration of its operation license. However, the spent fuel rods of the Chinshan Nuclear Power Plant remain in the spent fuel pools. Therefore, during the transitional phase, AEC will carry out relevant regulation as that applied in an operating power plant, so that the storage safety of spent fuel rods can be ensured. In addition, AEC has also requested Taiwan Power Company to actively communicate with New Taipei City Government to facilitate the smooth operation of dry storage facilities, whereby Chinshan Nuclear Power Plant can enter the "actual decommissioning" sooner.

In review of AEC work in 2018, AEC remained its commitment to nuclear and radiation safety. In particular, AEC work in 2018 included the following: in the annual nuclear emergency exercise, AEC did not announce scenario issues until the inception of the exercise, which was the first time an exercise of this kind adopted this particular approach and its purpose was to deepen the realistic intensity of the exercise. AEC also conducted safety inspections on radiation facilities and radioactive sources, so that the radiation safety of related facilites and their employees, as well as the public and the environment, could be ensured. Furthermore, AEC set up additional five environmental radiation monitoring stations, increasing the total number of monitoring stations to 51 nationwide and enhancing a national network of radiation monitoring. AEC continued to promote the research and development of atomic energy technology in terms of its application in improving people's lives; the areas of such application covered the operation safety of nuclear power plants before decommissioning, the treatment and disposal of nuclear waste, nuclear medicine and radiological medical devices and green energy technology.

In the future, AEC will remain dedicated to the decommissioning of Kuosheng Nuclear Power Plant and the regulation of radiation and nuclear safety, relentlessly and tirelessly carrying out AEC duties. AEC will also continue to maintain information disclosure, variety participation, and joint supervision. Furthermore, AEC will strengthen nuclear emergency response mechanisms and take an active approach towards nuclear power plant decommissioning and nuclear wastes, so as to honor the ideals of the "AEC of the People" and service as the "Guardian of Nuclear Safety."

Minister and Chairman

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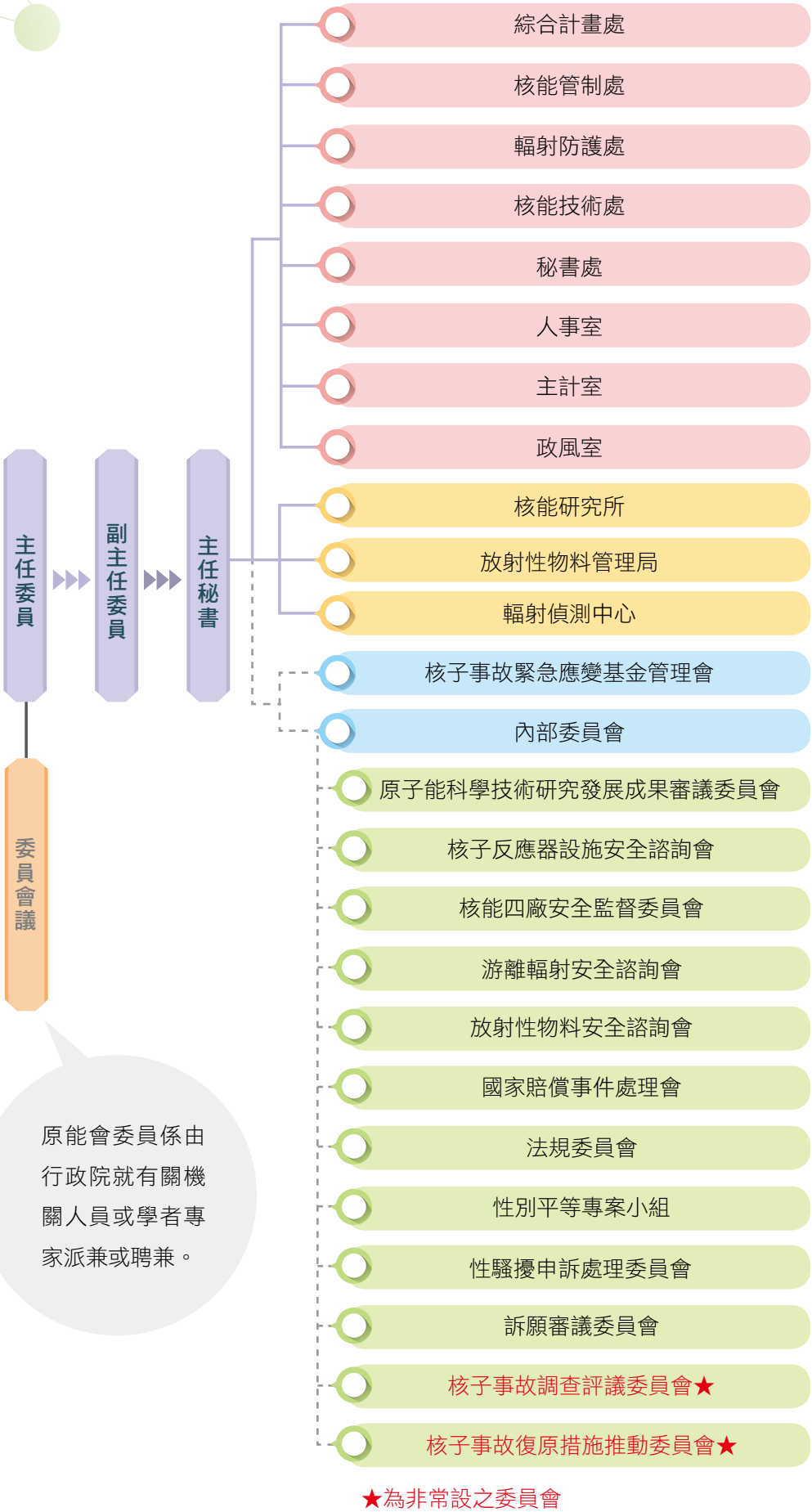
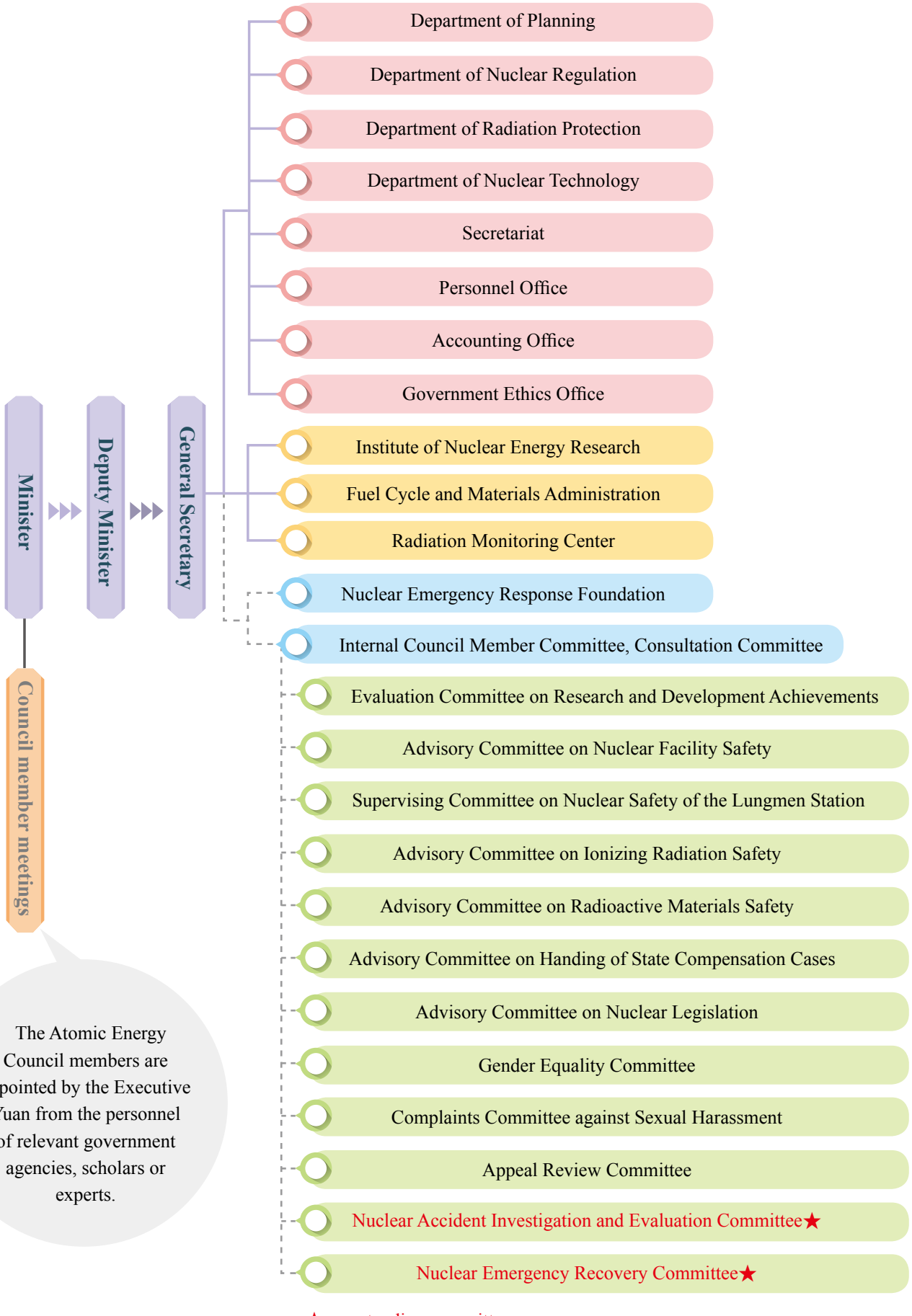
貳 組織架構
Organizational Structure



★為非常設之委員會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Advisory Committee on Handing of State Compensation Cases
Advisory Committee on Nuclear Legislation
Gender Equality Committee
Complaints Committee against Sexual Harassment
Appeal Review Committee
Nuclear Accident Investigation and Evaluation Committee★
Nuclear Emergency Recovery Committee★
The Atomic Energy Council members are appointed by the Executive Yuan from the personnel of relevant government agencies, scholars or experts.
★non-standing committee

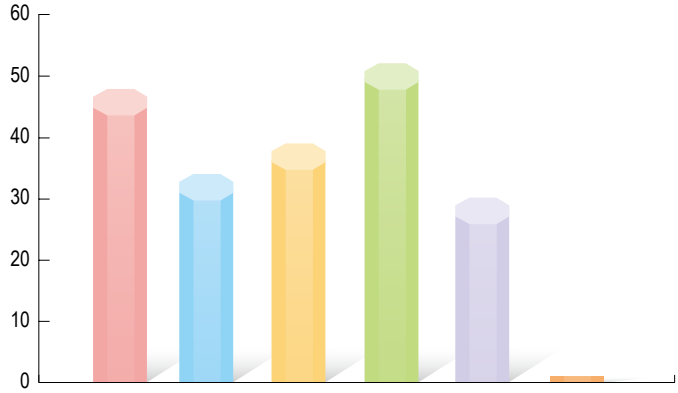
參

人力與經費

Manpower and Budget

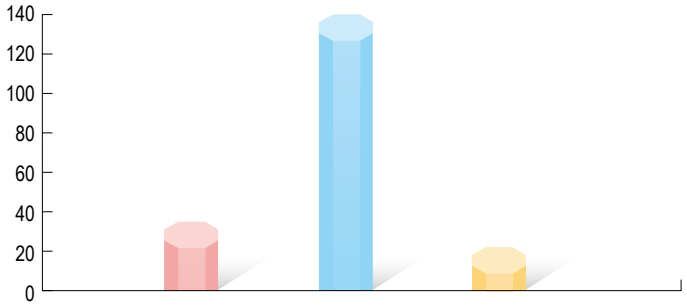
行政院原子能委員會

107 年度職員（含聘用人員 7 人）業務性質分配



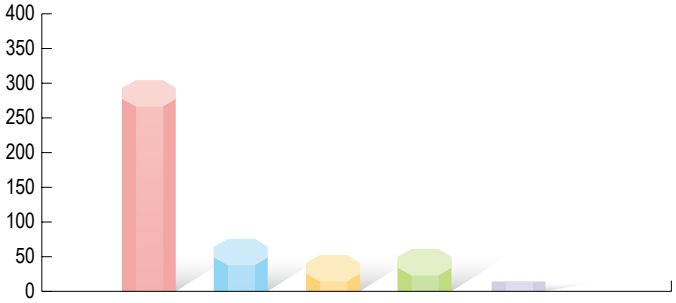
一般行政	48 人（23.53%）
原子能科學發展	34 人（16.67%）
游離輻射安全	39 人（19.12%）
核能設施安全管制	52 人（25.49%）
原子能技術應用	30 人（14.71%）
核能管制技術研究	1 人（0.49%）
合計：204 人	

107 年度職員官等分配



簡任人員	35 人（17.8%）
薦任人員	140 人（71%）
委任人員	22 人（11.2%）
合計：197 人	

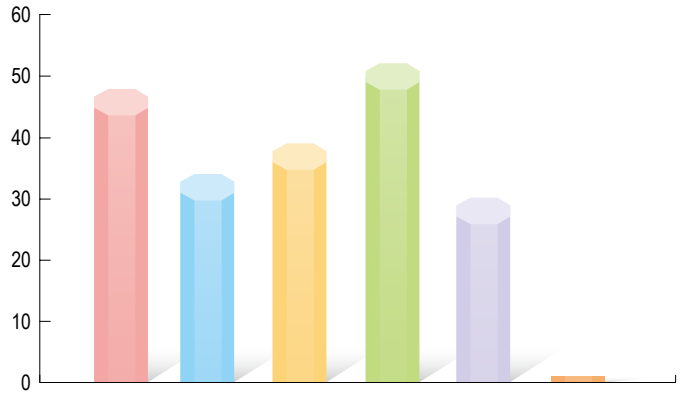
107 年度經費支用概況



一般行政	303,928 千元（59.53%）
原子能科學發展	76,949 千元（15.07%）
游離輻射安全防護	54,514 千元（10.68%）
核能設施安全管制	60,477 千元（11.84%）
核子保安與應變	14,722 千元（2.88%）
合計： 510,590（千元）	

The Atomic Energy Council

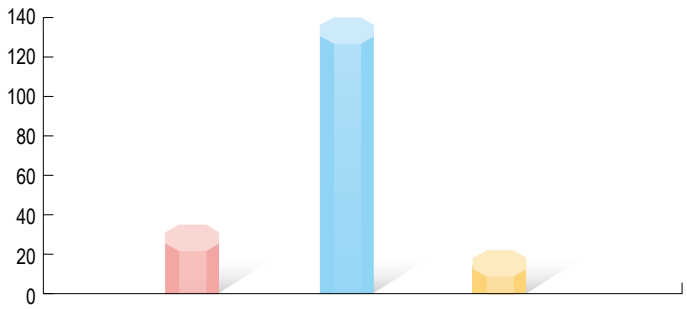
2018 Human Resources Breakdown (Including seven contract staffers)



- General administration 48 (23.53%)
- Atomic energy science development 34 (16.67%)
- Ionizing radiation protection 39 (19.12%)
- Nuclear installation safety control 52 (25.49%)
- Nuclear technology applications 30 (14.71%)
- Research on Nuclear Safety Control 1 (0.49%)

total: 204

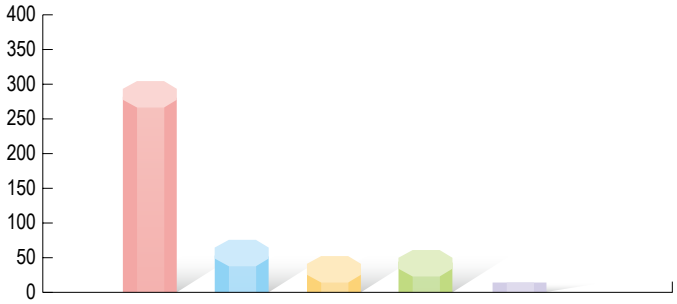
2018 Employee Ranking Breakdown



- Senior Rank Personnel 35 (17.8%)
- Junior Rank Personnel 140 (71%)
- Elementary Rank Personnel 22 (11.2%)

total: 197

2018 Budget/Expenditure Allocation



- General administration 303,928 (59.53%)
- Atomic energy science development 76,949 (15.07%)
- Ionizing radiation protection 54,514 (10.68%)
- Nuclear installation safety control 60,477 (11.84%)
- Nuclear technology applications 14,722 (2.88%)

total: 510,590 (Unit: Thousand NTD)

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重要施政成果

Important Governance Outcomes

一、務實國際核安管制合作與經驗交流

為吸取國際相關經驗，順利我國非核家園政策的推動與執行，原能會持續深耕於美、日兩國雙邊國際合作交流，於 6 月 19 日至 21 日在台北舉行的「第 4 屆台日核能管制資訊交流會議」，與日本原子力規制廳就核安文化、緊急應變、除役與核廢料管制等議題進行交流，台日雙方代表在會議中除分享有關核能安全、電廠除役、核子事故緊急應變及除役廢棄物外釋等管制作法與經驗外，亦就未來雙方在核電廠除役管制資訊交流的議題進行討論；另外日方一行人也在 6 月 21 日至核一廠參訪電廠除役相關設施，包括用過核燃料乾式貯存場，以了解我國除役相關工作之準備近況。

11 月 5 日至 7 日亦於美國薩凡納河國家實驗室（Savannah River National Laboratory, SRNL）舉行「台美民用核能合作會議」，這項會議自 1985 年開始就輪流由台灣及美國辦理，至今已邁向第 34 年。我方由原能會綜計處王重德處長率原能會暨所屬機關、清華大學及駐美代表處等單位之代表出席，與美方來自國務院、核管會、能源部及所屬國家實驗室等單位的代表，就核電廠營運及除役安全管制、核廢料安全管制、緊急應變管理和民眾防護行動等議題進行經驗分享交流；會後我方也參訪薩凡納河國家實驗室（SRNL），了解該實驗室有關核設施除役、核廢棄物管理等經驗與作法。

▲ 第 4 屆台日核能管制資訊交流會議與會單位代表合照
Delegates at the 4th AEC-NRA Nuclear Regulatory Information Exchange Meeting

A. Engaging in international cooperation and exchanges on nuclear safety

In order to draw on the experience of the international community and successfully carry out the Nuclear-Free Homeland Policy, the Atomic Energy Council (AEC) has committed to deepening bilateral cooperation and exchanges with the United States and Japan. For this reason, in the 4th "AEC-NRA Nuclear Regulatory Information Exchange Meeting" held on June 19th – 21st in Taipei, AEC and NRA (Nuclear Regulation Authority, Japan) exchanged practices and views on nuclear safety culture, nuclear emergency preparedness and response, the decommissioning of nuclear power plants (NPPs), and the decontamination and release of decommissioning waste. In addition, delegates from both sides also discussed future information exchanges regarding the management of NPP decommissioning. After the meeting on June 21st, the Japanese delegates also visited related decommissioning facilities in the Chinshan Nuclear Power Plant, including its dry storage facilities for spent nuclear fuel, to learn about our work on the preparation for decommissioning.

The 2018 "TECRO-AIT Joint Standing Committee Meeting on Civil Nuclear Cooperation" was held in the US Savannah River National Laboratory (SRNL) on November 5th – 7th, marking its 34th year this year; the Meeting is held in Taiwan and the US on an annual rotational basis. Led by Director General Chung-Der Wang of the AEC's Department of Planning, the Taiwan delegation comprised representatives from the AEC and its affiliated organizations, National Tsing Hua University (NTHU), and TECRO (the Taipei Economic and Cultural Representative Office in the U.S.). The US delegation consisted of officials from the Department of State, the Nuclear Regulatory Commission, the Department of Energy (DOE), and the DOE National Laboratories. Delegates from both sides exchanged their experiences and views on NPP operation and decommissioning regulation, radioactive waste regulation, nuclear emergency preparedness and response management, and public protective action. After the meeting, the Taiwan delegates also visited SRNL to gain insights from its practices on the decommissioning of nuclear facilities and radioactive waste management.

▲ 2018 台美民用核能合作年會與會單位代表合照
Delegates at the 2018 TECRO-AIT JSC Meeting on Civil Nuclear Cooperation

二、「即時資訊　全民參與」原能會溝通服務新視界

面對資訊快速傳播的時代，社會大眾對原子能安全的要求日趨殷切，因此原能會瞭解資訊快速公開、民眾積極參與的重要性，所以藉由管制資訊立即公開或回應以及健全全民監督機制，以使政策的推動順遂。

（一）即時資訊

1. 原來我們一直都在　原能會的即時訊息

隨著網際網路的崛起，我們迎接了一個多采多姿的資訊時代。為強化原能會對假訊息或重大爭議事件的回應通報機制，除訂定回應作業程序外，並在官網「最新消息」項下建制專區，以快速提供大眾關切議題的說明資料，現已為新聞媒體獲取原能會即時資訊的來源之一；107 年原能會輿情回應件數為 93 件，佔行政院所轄部會回應總件數之 8.2%。

▲ 原能會官網最新消息專區
"What's New" on the AEC website

2. 資訊透明　落實資訊公開及溝通

為使社會大眾瞭解核能設施放射性物料管制現況，落實資訊公開透明，原能會每月上網公開各核能設施低放射性廢棄物產量表、各貯存庫貯存量現況表、蘭嶼貯存場營運管制表、核電廠以外小產源放射性廢棄物產量表、核研所低放射性廢棄物貯存現況表等 5 種管制動態資訊。

另依據各核電廠放射性廢液處理設施之運轉數據，每季彙整統計與核算安全評鑑報告；彙整年度檢查成效，完成各核能設施放射性廢棄物管制年報、固化放射性廢棄物年產量減量率，以及用過核子燃料乾式貯存設施興建管制相關之安全檢查報告及訪查活動等相關資訊；且針對處置計畫，提出低放射性廢棄物最終處置計畫半年執行成果報告及審查報告、用過核子燃料最終處置計畫執行成果報告及年度工作計畫等。相關資訊均公開於原能會網站供各界參閱。

B. "Real-time information for public participation": AEC's new vision of communication and service

In the era of rapid information dissemination, the public demand for atomic energy safety is continuously increasing. AEC sees the importance of speedy disclosure of information and its relation to the active participation of the public. Therefore, AEC strives to promptly disclose regulatory information, respond to concerns thereof, and improve the supervision mechanism of the public to effectively promote related policies.

1. Real-time information

a. Real-time information on the AEC website

The advent of the internet has ushered in a multi-faceted information age. In order to strengthen the response and notification mechanism in handling fake news and major controversial incidents, AEC has not only set up response procedures, but also created a designated space under "What's New" on our website to quickly provide explanatory information on issues of public concern. This channel has become one of the sources for the press and media to access real-time information from AEC. In 2018, AEC issued 93 responses to public opinion, accounting for 8.2% of the total responses issued by all the ministries and councils under the Executive Yuan.

b. Information transparency through the disclosure of relevant data and publications

In order to facilitate the public's understanding of current regulatory activities of radioactive materials in nuclear facilities, as well as to meet the objective of information transparency, AEC publishes five low-level radioactive waste management review data sheets on its website: nuclear power plants' low- level radioactive waste monthly production status; nuclear power plants low-level radioactive waste storage status; Lan-yu storage site status; small producers' low-level radioactive waste monthly production status; and low-level radioactive waste storage status of the Institute of Nuclear Energy Research.

Other relevant information on regulatory activities available on the AEC website includes: Quarterly Reports on Safety Assessment of each liquid radioactive waste treatment facility in nuclear power plants; Annual Reports on low-level radioactive waste management of each nuclear power plant and Annual Reduction Ratio of Solidification Radioactive Waste; Safety Inspection Reports on the Construction of Dry Storage Facilities for Spent Nuclear Fuel, as well as relevant information on public

▲ 核一廠乾式貯存設施訪查活動
Public observation of the dry storage facility in Chinshan Nuclear Power Plant.

3. 開放監督　強化公眾參與除役乾貯安全管制

原能會迄今已辦理 14 次「核一廠用過核燃料乾式貯存設施訪查活動」，邀請新北市政府及石門區里長、地方代表及環保團體參加，實地訪查並聽取與會代表建言。107 年 3 月 20 日為強化公眾參與安全管制監督，特於台電公司核一廠辦理用過核子燃料乾式貯存設施統合演練作業期間，再次邀請新北市政府等代表，實地觀摩演練作業，以增進管制資訊公開透明。

觀摩訪查活動分別由台電公司及原能會物管局簡報「核一乾貯統合演練辦理情形」及「核一乾貯計畫現況及統合演練管制作業」，並請出席代表前往乾式貯存設施，實地訪查混凝土護箱運送作業演練。代表們對乾貯作業技術及人員認真演練均表示肯定，並期能順利推展乾貯作業。原能會秉持讓民眾安心、放心的信念，將持續推動公眾參與，做好公眾溝通。除定期公開核一廠乾式貯存設施興建安全管制相關檢查報告外，訪查活動資訊，亦公開登載於原能會網站。

4. 推動地方民眾參與蘭嶼地區環境輻射平行監測活動

原能會於 6 月 5 日至 6 日連續第 8 年辦理蘭嶼地區環境輻射平行監測作業，邀請蘭嶼當地民眾、台東縣環保局及地方政府等共同參與，一同進行蘭嶼各部落之環境取樣作業，以落實資訊公開、民眾參與及第三方驗證取樣偵測分析。

為使參與人員瞭解取樣作業流程，假台電公司蘭嶼貯存場會議室進行取樣作業說明會，並由參與民眾指定地點進行採樣，分別採集六個部落的農產品、土壤、水樣及草樣等環境試樣各 3 份，委由經財團法人全國認證基金會（TAF）認證的清

visit activities; Biannual Execution and Review Reports on the Final Disposal Plan for Low-Level Radioactive Waste; Execution Reports and annual work plan on the Final Disposal Plan for Spent Nuclear Fuel.

c. Open supervision to strengthen public observation in dry storage safety control during the decommissioning period

Up to now, 14 public observations of the dry storage facility in Chinshan Nuclear Power Plant (NPP) have been held by AEC since May 2011. Officials from New Taipei City Government, village chiefs of Shimen District, and representatives from local communities and environmental groups were invited to take part in on-site visits and give their suggestions. To enhance public observation in the supervision of safety control, as well as to increase the transparency of safety control information, officials and representatives from New Taipei City Government and other groups were invited to observe the integration drill of the dry storage facility in Chinshan NPP on March 20, 2018.

In this visit, Taiwan Power Company (TPC) and AEC gave presentations on the "Conduct of Integration Drill on Dry Storage Facility" and the "Current Situation of the Dry Storage Program in Chinshan NPP and the safety control of the Integration Drill," respectively. Representatives then proceeded to the dry storage facility to observe the transportation drill of concrete storage casks. The representatives gave positive feedback regarding both the dry storage technology and the hard work of the personnel carrying out the drill. They also expressed their good wishes for the smooth running of the dry storage operation. To enhance the confidence of the public, AEC remains committed to promoting public observation and communicating with the public in a timely manner. In addition to periodically disclosing relevant inspection reports on the construction and safety control of dry storage facility in Chinshan NPP, AEC also publishes the information about the public observation on its website.

d. Promoting the participation of local residents in the Environmental Radiation Parallel Monitoring Activity in Lanyu Area

On June 5th – 6th, 2018, AEC held the Environmental Radiation Parallel Monitoring Activity in Lanyu Area for the eighth consecutive year. To meet the objectives of information disclosure, public participation, and environmental radiation sampling and analyzing by third-party, Lanyu residents, officials from the Environmental Protection Bureau of Taitung County, and local governments were invited to take part in the environmental sampling processes in Lanyu's tribes.

華大學原子能科學中心執行分析工作，另分送樣品至原能會輻射偵測中心及台電公司放射試驗室進行比對驗證。

試樣分析結果報告除由清華大學原科中心寄送各參與單位外，原能會亦公開於官方網站。自 100 年起歷年的蘭嶼環境試樣分析結果，均在背景劑量變動範圍內，沒有發現輻射異常。

5. **擴大公眾參與重大核安管制案件**

原能會本於資訊公開原則，對於核電廠重大審查案件，審查期間於官網公布相關管制說明與資訊，另視案件進度辦理公開說明會，107 年計完成「核二廠 2 號機 107 年 3 月 28 日機組急停事件安全管制作業地方說明會」、「核二廠 2 號機燃料廠房護箱裝載池設備修改案現場施工查訪」等 2 案，除蒐集公眾意見外，亦使外界能夠更加瞭解案件審查辦理情形，以強化核電廠管制作業。

（1）核二廠 2 號機 107 年 3 月 28 日機組急停事件安全管制作業地方說明會

原能會為與社會溝通，使地方鄉親及公民團體進一步瞭解核二廠 2 號機 107 年 3 月 28 日發生機組急停事件之管制狀況，於 5 月 31 日假萬里區公所辦理「核二廠 2 號機 107 年 3 月 28 日機組急停事件安全管制作業」地方說明會。原能會除說明事件肇因及強化措施之審查與現場查核之相關安全管制作為，並與在場之地方人士及公民團體就其關心議題進行意見交換與溝通說明。

▲ 蘭嶼環境輻射平行監測作業前說明會
Briefing session before the Environmental Radiation Parallel Monitoring Activity in Lanyu Area

▲ 蘭嶼環境輻射平行監測參與人員合照
Participants of the Environmental Radiation Parallel Monitoring Activity in Lanyu Area

▶ 蘭嶼環境輻射平行監測活動—採集水樣
Collecting water samples in the Environmental Radiation Parallel Monitoring Activity in Lanyu Area

▶ 蘭嶼環境輻射平行監測活動—採集草樣
Collecting grass samples in the Environmental Radiation Parallel Monitoring Activity in Lanyu Area

To facilitate the participants' understanding of the sampling processes, a briefing session was held in the meeting room of TPC's Lanyu Storage Site. The participants then chose the sampling locations and collected three sets of samples comprising agricultural produce, soil, water, and grass samples in each of the six tribes. One set of samples was sent to the Nuclear Science and Technology Development Center (NSTDC), NTHU, which was accredited by the Taiwan Accreditation Foundation (TAF), for analysis. The other two were sent to AEC Radiation Monitoring Center and TPC Radiation Laboratory for validation.

The analysis results were sent to each of the participating group by NTHU-NSTDC and published on the AEC website. Since 2011, no abnormal radiation has been detected in the environmental samples collected in Lanyu area. All data and the derived radiation doses are within the variation range of background radiation.

e. Enhancing public involvement on important issues related to nuclear safety

AEC maintains an open and transparent environment in its reviewing process. During the reviewing period of important NPP safety related issues, AEC provides regulatory information and progress on its website, AEC also holds public meetings to collect feedbacks from the general public. Two public meetings were held in 2018, including "regulatory measures on Kuosheng Nuclear Power Plant Unit 2 automatic shut down event on March 28, 2018", and "design change request of cask loading pool of Kuosheng Nuclear Power Plant Unit 2". These public meetings serve the purposes of soliciting public opinions and providing update information to the general public about the process and important issues being reviewed by the AEC, and in turn strengthening the nuclear safety regulation.

（2）核二廠 2 號機燃料廠房護箱裝載池設備修改案現場施工查訪

原能會於 8 月 15 日邀請公民團體，以及新北市政府、萬里區公所及金山區公所等地方政府相關人員，赴核二廠進行「核二廠 2 號機燃料廠房護箱裝載池設備修改案」施工作業現場查訪，首先由台電公司就施工作業進行說明，再由電廠人員陪同查訪人員赴護箱裝載池現場實地查看施工現況，最後原能會再針對公民團體及地方政府之關切事項進行座談，使地方政府及公民團體可更瞭解護箱裝載池設備修改情形。

（二）全民參與

1. 值得我們共同參與　原子能的知識傳播

配合不同族群、不同年齡層對核能與輻射科普知識的需求，建立客製化友善的知識傳播環境刻不容緩。原能會藉由與台北市立大學合作，在台北市、新北市及屏東市辦理新住民核災應變防護與輻射量測體驗課程或參訪活動，藉由新住民種子教師輔以母語說明及大手牽小手親子共學等方式，積極建立與新住民的互動管道，讓更多婆婆媽媽們願意跨出家庭走入群體，除能傳遞原子能知識，促進參與平等外，我們更相信學習讓彼此更緊密連結。

▲ 核二廠 2 號機燃料廠房護箱裝載池設備修改案現場施工查訪—查看施工現況
Inspection of design change request in cask loading pool of Kuosheng Nuclear Power Plant Unit 2

▲ 核二廠 2 號機燃料廠房護箱裝載池設備修改案現場施工查訪—座談交流
Panel discussion during the inspection of the design change request in cask loading pool of, Kuosheng Nuclear Power Plant Unit 2

(1) The public meeting for Automatically Shutdown of Kuosheng Nuclear Power Plant Unit 2 on March 28, 2018

In order to communicate with society and facilitate the understanding of public and civic groups on this issue, AEC held a public meeting on May 31st. AEC explained the cause of the event and provided information regarding to enhancement of regulatory activities in the meeting.

▲ 核二廠 2 號機 107 年 3 月 28 日機組急停事件安全管制作業地方說明會—原能會說明及意見交流
Explanation and opinion exchange at the public meeting on "Automatically Shutdown of Kuosheng Nuclear Power Plant Unit 2 on March 28, 2018"

(2) Inspection of Design Change Request in Cask Loading Pool of, Kuosheng Nuclear Power Plant Unit 2

On August 15th, AEC invited representatives from civic groups and local government including New Taipei City Government, Wanli District Office, and Jinshan District Office to an inspection of "design change request in cask loading pool of Kuosheng Nuclear Power Plant Unit 2". TPC first gave a briefing on the design change request, and then accompanied the participants to the cask loading pool for an inspection. Finally, AEC conducted a panel discussion on issues of concern to the representatives from civic groups and local governments, so that they could better understand the design change request of the cask loading pool.

2. Public participation

a. Public participation in the dissemination of atomic energy knowledge

Building a customized and friendly environment for knowledge dissemination that can meet the needs of different ethnic and age groups for nuclear energy and radiation science is imperative. For this reason, AEC cooperated with the University of Taipei and offered workshops and activities on nuclear emergency response and protective action, and radiation measurement to new immigrants in Taipei City, New Taipei City, and Pingtung City. New immigrant spouses were encouraged to leave the confinement of their homes and attend the workshops and activities conducted in their native languages by new immigrant seed-teachers. Adopting the parent-child co-learning method, these events served as a platform for interaction with new immigrants. Not only did they facilitate the dissemination of atomic energy knowledge and allow equal participation, but they also provided an environment wherein participants could feel more connected with each other.

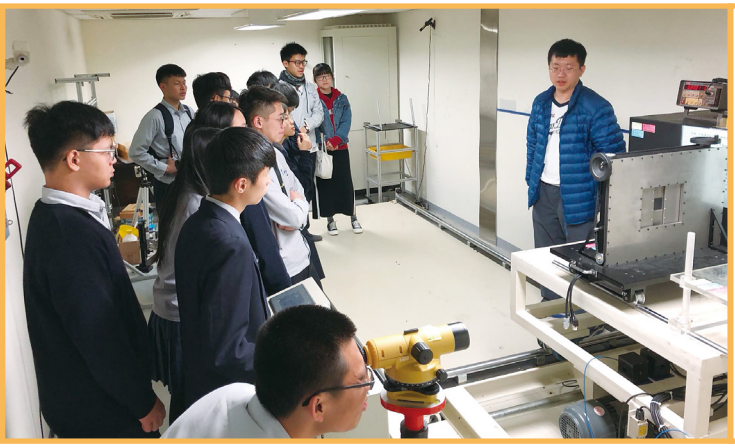
▲ 科學園遊會中的闖關遊戲及「動手量輻射」的研習課程
Challenge games in the Science Fun Fair; "Hands-On Radiation" activity

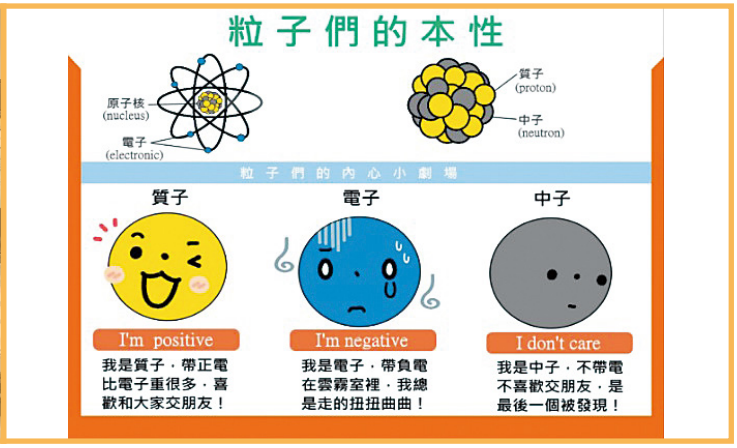
此外持續推動原子能科普教育，將足跡深入台灣各縣市，107 年與國立臺灣科學教育館合作，辦理基隆市、彰化縣、南投縣及屏東縣科學園遊會、第 58 屆中小學科展科學博覽會及參與該館「科學環境市集」館慶活動，另受國立自然科學博物館邀請，參加車籠埔斷層保存園區「冬至進補、就要科普」活動，透過原子能電子遊戲介紹輻射基礎知識，並藉由「動手量輻射」的體驗，讓學童實際量測環境中的輻射，使原子能知識的學習更富趣味性。

為提升高中、職學生對原子能科普的興趣，安排 5 場「核災應變民眾防護暨輻射安全研習活動」，透過授課、參訪原子能有關設施、實地操作輻射偵測儀器及體驗輻射防護衣的穿戴等，讓參加的師生對原子能民生應用與防護留下深刻印象。另積極經營「輻務小站」粉絲頁，並與財團法人國家實驗研究院、科技部科技大觀園、國立臺灣科學教育館及台大風險與政策研究中心等科普推廣相關社群媒體結盟，以共享科普資源，擴大傳播效能。

2. 推動核子事故民眾防護多元宣導

為鼓勵更多民眾實際參與疏散演練，原能會配合地方政府規劃辦理「核電廠緊急應變計畫區內核子事故民眾防護行動逐里疏散演練」，落實民眾核安防護教育，107 年辦理 35 場次，計 3,475 人參與。另辦理園遊會 5 場，以簡淺易懂的遊戲方式建立民眾的防災意識，參與民眾約 2,800 人。





▲ 研習營學生參觀國家標準游離輻射實驗室及「輻務小站」趣味貼文圖片
Students from the workshops visiting the National Radiation Standard Laboratory: A post with fun facts on "Radiation Station"

AEC's commitment to promoting atomic energy science education is also witnessed in different parts of Taiwan. In 2018, AEC cooperated with the National Taiwan Science Education Center (NTSEC) and organized the Science Fun Fair in Keelung City, Changhua County, Nantou County, and Pingtung County, as well as the 58th National Primary and High School Science Fair. AEC also attended the "Science Marketplace" to celebrate NTSEC's anniversary. Invited by the National Museum of Natural Science, AEC participated in the "Science for Winter Solstice" event at the Chelungpu Fault Preservation Park, which provided a fun way for schoolchildren to learn about atomic energy. For example, students learned the basics of radiation through electronic games and measured environmental radiation doses in the "Hands-On Radiation" activity.

To increase high school and vocational school students' interest in atomic energy science, AEC organized five "Workshops on Nuclear Emergency Response and Public Protective Action, and Radiation Safety." Through lessons, visiting atomic energy facilities, operating radiation detection devices, and putting on radiation protective clothing, teachers and students who attended the workshops gained a good understanding of the civil application and protective action of atomic energy. AEC also undertakes to reach the public through its "Radiation Station" Facebook page. In addition, AEC has formed alliances with the National Applied Research Laboratories, the Sci-Tech Vista of the Ministry of Science and Technology, the National Taiwan Science Education Center, and the Risk Society and Policy Research Center of National Taiwan University for sharing their online science resources to effectively disseminate scientific knowledge.

3. 製作核子事故應變指南及災防包

原能會結合在地化資訊完成「核子事故應變指南」，內容包括核子事故訊息通知、掩蔽做法、碘片服用時機、接獲疏散通知準備事項，及減少輻射曝露做法等，民眾可透過手冊連結 QR code 及 APP，獲取原能會網站相關資訊。另於原能會臉書及緊急應變計畫區 9 處公所辦理災防包設計圖樣票選活動，計 3,414 人參與，製作之災防包將併同「核子事故應變指南」，於 108 年 6 月前發放給緊急應變計畫區內住戶，以讓民眾平時備妥災害準備，配合政府執行應變工作。

4. 「守護工程品質的輻射作業」辦理放射線照相檢驗業輻射安全防護管制宣導活動，落實業者自主管理

工業界廣泛利用各種儀器和技術，從事非破壞檢測工作，俾及早發現產品內在或潛在的缺陷，以提昇產品設備的安全性及可靠度，放射線照相檢驗（RT）就是其中一種檢測方法。

放射線照相檢驗是指「以具有穿透能力的射線（如 X 射線、加馬射線）穿透試件，再達於底片或螢幕等介質，生成影像並經研判，以瞭解試件品質」，常運用於核電廠、石化或鋼鐵工業所使用之壓力容器與管線焊道品質的檢驗。

▲ 核子事故應變指南
Guidelines for nuclear emergency response

▲ 災防包票選
Public vote on the emergency response kit

▶ 辦理防災園遊會並透過臉書直播
Emergency response fun fair; A live broadcast on Facebook

b. Promoting public protective actions in nuclear emergencies

To encourage wider public participation in evacuation drills, as well as to enforce nuclear safety education to the public, AEC coordinated with local governments in planning and carrying out the "Village-Based Evacuation Drill of Public Protective Actions in Emergency Planning Zones (EPZs) During Nuclear Emergencies." Thirty-five drills were conducted in 2018 with 3,475 residents taking part in these drills. In addition, five fun fairs were organized which were attended by 2,800 people. The fairs' easy-to-play games were designed with the goal of raising public awareness about emergency response.

c. Guidelines for nuclear emergency response and emergency response kit

AEC compiled a brouchure of "Guidelines for Nuclear Emergency Response" with localized information, covering areas of nuclear emergency alert, sheltering in place, the timing as to when to take iodine tablets, a checklist for actions required when an evacuation order has been issued, and measures that could be taken to reduce radiation exposure. Relevant information is available on the AEC website, which can be accessed via the QR code provided in the Guidelines, as well as AEC's app. AEC also arranged a public vote on the design of an emergency response kit via its Facebook page and the nine district and village offices in the EPZs, and received 3,414 votes. When completed, the emergency response kit, together with the "Guidelines for Nuclear Emergency Response", will be handed out to EPZ households before June 2019, so that the public can be better prepared in an emergency response.

原能會為提升放射線照相檢驗業輻射安全自主管理能力，落實輻射安全文化，並與業界相互交流，於 12 月 14、18 及 21 日在雲林麥寮、新北市、高雄市辦理 3 場「107 年度放射線照相檢驗業輻射安全防護管制宣導會」，邀請放射線照相檢驗業之負責人、輻射防護人員及工作人員計 230 人參加，原能會提供了「非破壞照相檢驗 X 光機安全操作使用程序」、「GPS 在放射性物質運送車輛之運用」、「放射線照相檢驗業輻射安全管理」等課程，希望提升業界工作人員之輻射安全防護及自主管理能力，避免劑量異常事件發生，並強化射源運送保安功能，杜絕射源遭竊遺失情事發生。

▲ 於麥寮台塑園區舉辦之放射線照相檢驗業輻射安全防護管制宣導會
The Radiation Safety Promotion Conference for the RT Industry held in Formosa Plastics Mailiao Petrochemical Park

d. "Radiographic testing in ensuring project quality": promotional events on radiation safety and protection for the self-management of the radiographic testing industry

Industries apply a variety of instruments and techniques to perform non-destructive testing, so that internal or potential flaws can be detected early and the safety and reliability of products and equipment can, in turn, be ensured and increased. One such technique is radiographic testing (RT).

RT refers to "utilizing penetrating radiation, such as X-rays or gamma rays, to pass through the object being tested and reach a film or screen, on which an image is then formed. Based on the image, the quality of the tested object can be determined." RT is a well-established method often applied in the nuclear industry, the petrochemical industry, or the steel industry in the testing of pressure vessels and pipeline welds.

To enhance the self-management capacity of the RT industry on radiation safety, to promote radiation safety culture, and to exchange views with the industry, AEC held three conferences entitled: "Radiation Safety Promotion Conference for the RT Industry, 2018" in Mailiao Township, Yunlin County, New Taipei City, and Kaohsiung City on December 14th, 18th, and 21st, respectively. A total of 230 executives, radiation protection personnel, and radiation workers from the RT industry were invited to attend the conferences. Through the three lectures: "Safety and Operational Procedures for Non-Destructive Testing X-Ray Equipment", "The Application of GPS in Vehicles Used for Transporting Radioactive Materials" and "Radiation Safety Management in the RT Industry," AEC aims at achieving the following three goals: increasing facility operatives' self-management capability on radiation safety and protection in the RT industry; preventing incidents of over-exposure to radiation; and enhancing safety and security regarding the transportation of radioactive sources and safeguarding against the theft or loss of radioactive sources.

▲ 放射線照相檢驗業輻射安全防護管制宣導會報到
Sign-in at a Radiation Safety Promotion Conference for the RT Industry

三、切實監督核電廠安全

（一）核一廠除役管制作業

核一廠 1 號機運轉執照已於 107 年 12 月 5 日屆期，我國核電廠除役，依規定須將放射性污染物質予以拆除並妥善管理，除役之進程大致可分為過渡、拆廠、最終狀態（環境輻射）偵測，以及廠址復原等階段。在除役過渡階段，核一廠之核子燃料仍在反應爐內無法立即退出，為確保燃料安全，原能會依國際間類似核一廠除役機組的管制作法，仍比照運轉中電廠之品質標準，進行相關管制，同時亦持續執行各項視察作業，督促台電公司進行核電廠之除役工作。

原能會本於安全管制職責，針對核電廠除役期間安全管制已制定相關規定與措施，並持續精進我國核電廠除役安全管制之原則，近期參考國際間核電廠除役管制有關法規及經驗回饋，依我國管制實務需求，精進國內現有除役安全管制，針對核一廠除役相關管制作為包括法規檢視及技術文件之審查，分述如下：

1. 精進我國核電廠除役管制法規

原能會於 107 年度針對除役管制法規原法律授予之立意、除役許可申請與審核程序、運轉執照屆期與除役許可核發之銜接、除役期間現場作業安全管制、終止除役後廠址之管制程序等方面，進行全面檢視，並已於 107 年 11 月 16 日完成「核子反應器設施管制法施行細則」及「核子反應器設施除役許可申請審核辦法」之條文修正，並將前述辦法更名為「核子反應器設施除役許可申請審核及管理辦法」。

除役相關法規修正內容，係依據我國核電廠管制實務，明定當核子反應器設施運轉執照屆期之次日起，即進入除役期間，以順利銜接運轉執照屆期與除役許可核發兩者間之時序。此外，修正條文亦重新敘明除役許可申請應備文件與其檢送期限、除役計畫應載明事項，及除役期間核子燃料安全、環境輻射安全、放射性氣液體排放與放射性廢棄物管理等管制措施。

參酌國外核電廠除役管制技術經驗及法規，目前已初步完成檢討國內除役管制相關規範，強化核電廠除役之安全管制作業，由於國際先進國家對核電廠除役法規亦仍持續推演增修中，原能會將持續掌握各國管制脈動和經驗，適時精進我國核電廠除役管制措施，提升除役作業之安全，達成環境永續發展之目標。

C. AEC's endeavor to effectively supervise nuclear power plant safety

1. Regulatory Activities for decommissioning on Chinshan Nuclear Power Plant

The operating license of Chinshan Nuclear Power Plant Unit 1 expired on December 5, 2018. According to the R.O.C. regulations governing decommissioning of nuclear facilities, all radioactive contaminants must be dismantled and properly managed. The process of decommissioning can be divided into four phases: the transitional phase, the dismantling phase, the final site survey of environmental radiation phase, and the site restoration phase. For Chinshan Nuclear Power Plant, nuclear fuels still remain in the reactor without quick removing-out solution during the transitional phase. To ensure nuclear fuel safety, AEC will adapt to international regulatory practices applied to the decommissioning of nuclear facilities similar to Chinshan Nuclear Power Plant. All the pertinent regulatory quality standards for an operating power plant will hereby be applied before nuclear fuels are removed from the reactor vessel. AEC will also continue to conduct inspection on Chinshan NPP and oversight TPC's activities with regard to decommissioning.

To fulfil AEC's duties concerning safety regulation, AEC have adapted safety-related regulations and measures to govern NPP decommissioning planning and execution. With the aim to enhance the regulatory safety regulation on NPP decommissioning, AEC have reviewed pertinent laws and regulations governing NPP decommissioning in other countries, as well as experiences and feedback so as to improve Taiwan's decommissioning regulations to better meet the practical demands on safety requirements. The reviews of regulations and technical documents with regard to the decommissioning of Chinshan Nuclear Power Plant are stated as follows:

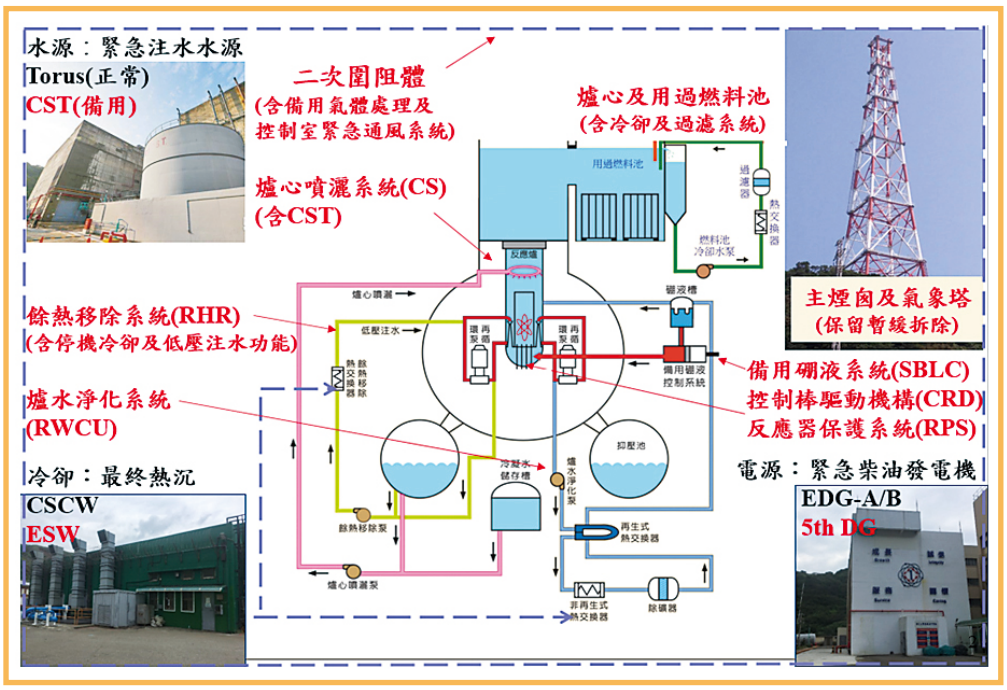
a. Enhancing the regulations governing NPP decommissioning

In 2018, AEC conducted a comprehensive review on multiple issues which include: 1) the purposes of legislation stipulated for decommissioning regulations; 2) applications for nuclear reactor facility decommissioning permits and the corresponding review process; 3) the transition between expiration of operating licenses and issuance of decommissioning permits; 4) regulations concerning on-site activities during the decommissioning period; and 5) Deregulation process after decommissioning is completed. Two amendments included the "Enforcement Rules for the Implementation of Nuclear Reactor Facilities Regulation Act" and the "Regulations for the Review and Approval of Applications for Decommissioning Permits of Nuclear

2. 核一廠除役過渡階段安全分析報告與技術規範審查作業

核一廠進入除役後，反應爐內核子燃料尚無法移出，為強化反應爐內核子燃料之安全，原能會於核一廠除役計畫審查期間，即要求台電公司須就核一廠運轉期間終期安全分析報告（Final Safety Analysis Report, FSAR）及技術規範（Technical Specifications, TS）進行修訂，以強化暫存於反應爐內核子燃料之安全作業依據基礎，並列為除役計畫重要管制事項。

台電公司於 106 年 12 月 1 日提出核一廠除役過渡階段燃料移出爐心前之安全分析報告及技術規範（Pre-Defueled Safety Analysis Report/Technical Specification, PDSAR/PDTS），以作為除役期間電廠安全基準文件，其內容架構依循運轉期間 FSAR 及 TS 格式，並考量除役期間反應爐內仍有核子燃料之安全管制需求進行內容調整修訂。原能會接獲台電公司提出之 PDSAR 及 PDTS 報告，即進行程序審查，並由原能會各局處及會外學者專家共同組成審查專案小組，於 107 年 1 月 25 日展開實質審查，經 2 回合之審查提問答覆及召開 3 次審查會議，原能會審查專案小組所提之審查意見，台電公司均完成澄清說明，並修正 PDSAR 及 PDTS 報告，原能會於 107 年 11 月 30 日完成審查作業，同意台電公司所提 PDSAR/PDTS 修改申請案。



▲ 核一廠除役過渡階段前期重要系統及設備

Reactor Facilities" were finalized and became effecitve on November 16, 2018. The latter one was renamed as the "Regulations on the Permit Application and the Management for the Decommissioning of Nuclear Reactor Facilities".

Amendments to decommissioning-related regulations are based on the regulatory practices of nuclear power plants in Taiwan. The provisions specify that the decommissioning period of a nuclear reactor facility begins on the next day after the expiration of its operating license. The amended provisions also clarify the requirements of applications for decommissioning permits, including the following: 1) required documents and the deadline for submission; 2) contents included in the decommissioning plan; 3) measures with regard to nuclear fuel safety, environmental radiation safety, radioactive gas and liquid waste release, and radioactive waste management during the decommissioning period.

After referring to the technologies and regulations of nuclear reactor facility decommissioning in other countries, AEC completed the preliminary review of NPP decommissioning-related regulations in Taiwan. In order to ensure decommissioning safety and achieve the goal of environmental sustainability, AEC will continue to evaluate the progress of changes on regulations in other countries and enhance the safety-related regulatory activities on NPP decommissioning in Taiwan.

b. Review on the safety analysis reports and the technical specifications applied during the transitional phase of Chinshan Nuclear Power Plant

In the early decommissioning stage of Chinshan Nuclear Power Plant, the nuclear fuels are remained in the reactor vessel. To ensure and enhance the safety of spent fuels, AEC required TPC to revise the Chinshan Nuclear Power Plant Final Safety Analysis Report (FSAR) and Technical Specifications (TS) during the review of the Chinshan Nuclear Power Plant decommissioning plan. These documents not only serve as the basis for the ensuring and enhancing of the safety of the nuclear fuels temporarily stored in the reactor but also are important regulatory contents in the decommissioning plan.

TPC submitted the Pre-Defueled Safety Analysis Report/Technical Specification (PDSAR/PDTS) of Chinshan Nuclear Power Plant on December 1, 2017. AEC organized a review team comprising specialists from AEC and experts from academia, and started the review process on January 25, 2018. Two sessions of questions and answers and three review meetings were held during which TPC provided clarifications and explanations in response to all of the review opinions from the review panel, as well as revised the PDSAR/PDTS. AEC completed the review and approved the application for the revised PDSAR/PDTS from TPC on November 30, 2018.

核子燃料移出反應爐前，為確保燃料安全，原能會將依國際間類似核一廠除役機組的管制作法，仍比照運轉中電廠之品質標準，進行核安、輻安、保安、核子保防、廢料管理等之管制，同時亦會持續執行駐廠及專案團隊視察，以確認台電公司依規定執行相關安全作業。未來原能會將嚴格監督台電公司落實核一廠安全基準文件規定要求，維持相關安全系統設備功能，以確保反應爐內核子燃料之安全。

（二）核二廠 2 號機再起動管制作業

1. 核二廠 2 號機第 25 次大修後機組初次臨界申請審查

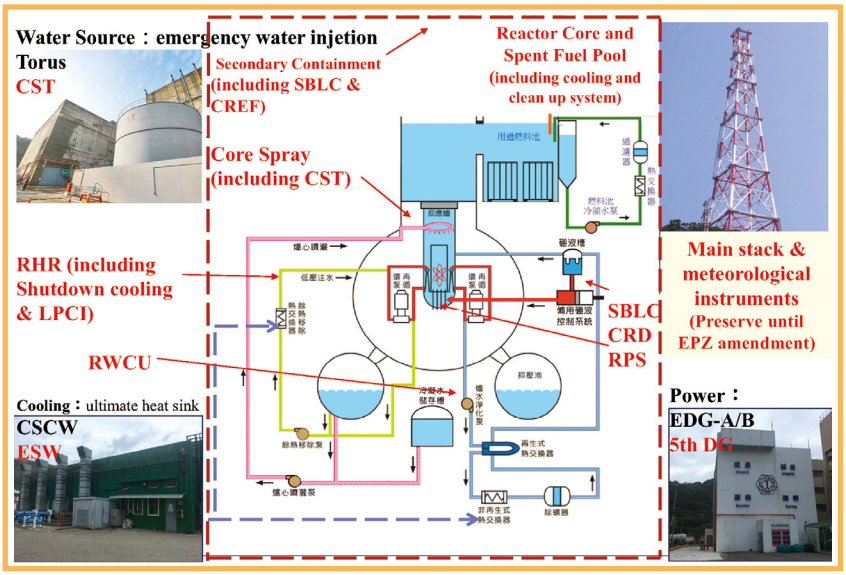
台電公司於 107 年 2 月 5 日依「核子反應器設施管制法」及「核子反應器設施停止運轉後再起動管制辦法」規定提出核二廠 2 號機第 25 次大修後機組初次臨界申請。原能會因考量機組處於長時間未起動運轉，為使本案之管制更為周延完備，由原能會核管處、輻防處及物管局分別針對核能安全、輻射安全及廢棄物營運管理等三個面向進行審查及現場查核，再審慎檢視機組整體性維護成效。其中核能安全管制部分，更另聘請具有電氣／儀控、機械／熱流、核工／燃料及結構等各領域專家學者，與原能會同仁共同組成核安專案視察團隊，從儀電設備、機械管路、核燃料、重要安全設備測試（偵測）試驗及現場設備配置、地震監測、起動規劃及品保作業與人員訓練、廠務管理及廠內輸配電鐵塔塔基等各個面向進行嚴格審查及現場查核，以確認機組整體性維護成效可符合起動運轉之要求。

原能會於 107 年 3 月 5 日完成台電公司核二廠 2 號機再起動運轉申請案審查，確認核二廠 2 號機現場狀態符合起動運轉之要求後，基於尊重立法院決議，於 107 年 3 月 15 日赴立法院完成核二廠 2 號機再起動運轉之專案報告，並確認機組狀態符合起動要求，於 107 年 3 月 20 日同意核二廠 2 號機第 25 次大修後機組初次臨界申請。並就相關審查情形與審查結論撰寫完成「核二廠 2 號機第 25 次大修後機組初次臨界申請審查總結報告」，於原能會官網公開，供大眾檢視。

2. 核二廠 2 號機 107 年 3 月 28 日機組急停後再起動申請案審查

台電公司核二廠 2 號機於 107 年 3 月 28 日 13 時 25 分升載過程中，因功率振盪中子偵測系統（Oscillation Power Range Monitor, OPRM）訊號動作，引動安全保護系統運作使機組急停。對於本次核二廠 2 號機急停事件，台電公司於 107 年 4 月 9 日依據「核子反應器設施停止運轉後再起動管制辦法」第 18 條規定提送急停事件之綜合檢討報告。為此原能會聘請具有電氣／儀控、核工及熱流等各領域 6 位專家學者，與原能會核管處同仁共同組成專案小組。專案小組除針對

AEC will adapt international regulatory practices applied on decommissioning of nuclear reactor facilities similar to Chinshan NPP to ensure the safety of the spent fuels before their removal from the reactor. Regulations with regard to nuclear safety, radiation safety, nuclear security, nuclear safeguards, and waste management are carried out by AEC. Meanwhile, resident inspection and project team inspection will continue to be conducted in order to ensure the compliance of TPC in abiding by safety-related procedures and regulations. In the future, AEC will supervise that TPC to complies with the requirements of the documents with regard to maintaining of safety-related systems and equipment functions so that the safety of the nuclear fuels in the reactors can be ensured.



▲ Important systems and equipment during the initial transitional phase of Chinshan Nuclear Power Plant decommissioning

2. Regulations concerning the restart of Kuosheng Nuclear Power Plant Unit 2

a. Review of the criticality application for Kuosheng Nuclear Power Plant Unit 2 after its 25th rerfueling outage

In accordance with the "Nuclear Reactor Facilities Regulation Act" and the "Regulation Act Governing the Restart of Nuclear Reactor Facilities after Shutdown," TPC submitted the criticality application for Kuosheng Nuclear Power Plant Unit 2 after its 25th outage on February 5, 2018. With the consideration that the Unit 2 had not been restarted to operate for a long time, AEC organized a review team and conducted on-site inspection on nuclear safety, radiation safety, and nuclear waste operation and management, respectively. In terms of safety regulation, a nuclear safety inspection team was formed, which comprised both AEC's staff and domestic experts in relevant fields, such as electrical engineering, instrument and control, mechanical engineering, thermal hydraulics, nuclear engineering, nuclear fuel and structure engineering. In order to ensure the requirements of restart, the inspection team conducted a rigorous review and on-site inspections from a wide range of

▲ 核二廠 2 號機第 25 次大修後機組初次臨界申請審查會議
The review meeting on the first criticality application for Kuosheng Nuclear Power Plant Unit 2 after its 25th refueling outage

▲ 核二廠 2 號機 107 年 3 月 28 日機組急停後再起動申請案審查會議
The review meeting on the application for a restart of Kuosheng Nuclear Power Plant Unit 2 after a scram on March 28, 2018

台電公司就本次急停事件所提出綜合檢討報告進行審查外，並赴核二廠查核相關設備狀況及後續強化措施之改善情形。經專案小組從事件肇因及改善措施等各方面，進行綜合檢討報告審查與現場查證結果，確認台電公司已確實釐清事件肇因並完成相關必要之改善措施，於 107 年 6 月 5 日同意台電公司核二廠 2 號機 107 年 3 月 28 日機組急停後起動申請案。並就相關審查情形與審查結論撰寫完成「核二廠 2 號機 107 年 3 月 28 日機組急停事件審查報告」，於原能會官網公開，供大眾檢視。

（三）加強國際合作，促進經驗交流

核電廠除役技術日新月異，各國核能安全管制機關亦不斷精進該國之安全管制技術，為使國內核電廠除役安全管制技術與國際接軌，原能會近年來辦理多項國際核電廠除役研討會，邀請美國與日本等具有除役經驗國家的專家學者，就除役期間關鍵議題，進行技術交流與經驗分享，並開放國內產、官、學界及民眾參與，以增進對除役技術深度之瞭解，確保除役作業能在安全的前提下順利完成。

107 年 5 月 21 日辦理「核能電廠除役期間廠址劑量評估程式（RESidual RADioactivity, RESRAD）」專題演講，邀請美國阿岡諾國家實驗室專家，針對 RESRAD 程式概述及其發展與應用、關鍵參數物理意義、案例探討等進行說明，接續在 22 日至 25 日辦理 RESRAD 程式參數設定及模擬等課程講授，並搭配上機案例實作演練。7 月 31 日至 8 月 1 日，舉辦「2018 核能電廠除役管制研討會」，邀請美

perspectives included electrical instruments, mechanical piping, nuclear fuel, testing of critical safety equipment, on-site equipment configuration, seismic monitoring, restart planning, quality assurance and personnel training, facility management, and the structure of internal power transmission and distribution towers.

AEC completed the review of the application from TPC for a restart of Kuosheng Nuclear Power Plant Unit 2 on March 5, 2018 and decided that the Kuosheng Nuclear Power Plant Unit 2 met the safety requirements to restart. Based on the resolution from the Legislative Yuan, AEC delivered a special report of this issue to legislators on March 15, 2018, and approved the application on March 20, 2018. The review report and the process for reviewing of this issue had been published on AEC's website.

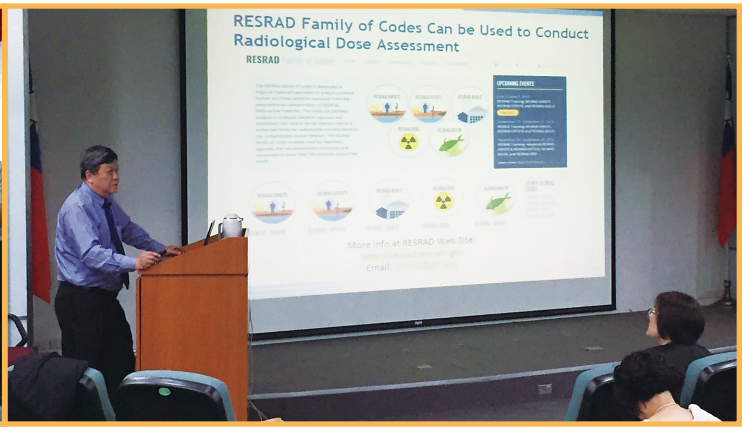
b. Review on the application for a restart for Kuosheng Nuclear Power Plant Unit 2 after a scram on March 28, 2018

During the power increasing period after the restart of Kuosheng Nuclear Power Plant Unit 2 on March 28, 2018, a reactor protection safety system was triggered by the Oscillation Power Range Monitor (OPRM), and resulted in a scram of Kuosheng Nuclear Power Plant Unit 2. TPC submitted a report on the investigation of this issue to the AEC in accordance with Article 18 of the "Regulation Governing the Restart of Nuclear Reactor Facilities after Shutdown" on April 9, 2018. Subsequently, AEC organized a task force consisted of six specialists and academia experts in relevant fields, including electrical engineering, instrument and control, nuclear engineering, and thermal hydraulics. The task force conducted a review on the investigation report of this issue submitted by TPC, and conducted on site inspection at the Kuosheng Nuclear Power Plant, as well as evaluated the follow-up reinforcement measures. During the review process, TPC had clarified the cause of the incident and taken necessary improvement measures. Consequently, TPC's application for the restart for Kuosheng Nuclear Power Plant Unit 2 due to the scram was approved by AEC on June 5, 2018. The review report and the process for reviewing of this issue had been published on AEC's website.

3. Enhancing international cooperation and promoting exchange of experience

NPP decommissioning technology is advancing rapidly, and nations around the world are striving to enhance their regulatory measures on nuclear safety. AEC organized series of international workshops and conferences on the issue of nuclear reactor facility decommissioning in the past few years. Professionals and academia experts from countries with experience in NPP decommissioning, such as the United

▲ 「核能電廠除役期間廠址劑量評估程式（RESRAD）」專題演講—大合照
Participants in the keynote speeches on the "RESidual RADioactivity (RESRAD) Assessment During the NPP Decommissioning Period"



▲ 「核能電廠除役期間廠址劑量評估程式（RESRAD）」專題演講
Keynote speech on the "RESidual RADioactivity (RESRAD) Assessment During the NPP Decommissioning Period"

國核管會（Nuclear Regulatory Commission, NRC）具有除役經驗之專家，就除役安全管制相關之議題進行交流與討論。107 年 9 月 11 日至 12 日舉辦「2018 台日核電廠除役技術交流研討會」，邀請日本原子力除役研究會（Association for Nuclear Decommissioning Study）專家學者，就日本核電廠除役現況等多項議題，分享除役實務經驗，原能會亦於會中分享我國核電廠除役安全管制現況，並與日本專家學者作深入的討論。

藉由邀請國際專家學者來台，除能就核電廠除役相關議題進行交流討論外，更能夠汲取先進國家除役安全管制面與實務執行面的經驗，得以強化我國核能安全管制專業知能，對未來除役安全管制的周延性與品質有相當的助益。

▲ RESRAD 程式機上案例演練
Exercise activity using the RESRAD model

▲ 2018 核能電廠除役管制研討會
2018 NPP Decommissioning Conference

▲ 2018 核能電廠除役管制研討會—美國核管會講師與學員討論問題
Discussion between a USNRC speaker and participants in the 2018 NPP Decommissioning Workshop

▲ 2018 台日核電廠除役技術交流研討會
2018 Sino-Japanese Workshop on NPP Decommissioning Technology

States and Japan, were invited by AEC to exchange expertise and share their experiences on key issues faced during the decommissioning period. These workshops and conferences were also available to participants from industry community, other government departments, academia, and general public.

Experts from US Argonne National Laboratory were invited to a workshop and provided updated information on the issues of "RESidual RADioactivity (RESRAD) Assessment during the NPP Decommissioning Period," covering areas such as the model, development and application of RESRAD, key parameters and physical significance, and a case study on May 21, 2018. Follow-up lectures on parameter setting and simulation of the RESRAD model, as well as had on activities using the model, were delivered on May 22-25, 2018. The "2018 NPP Decommissioning Workshop" was held between July 31 and August 1, 2018, and the experts with decommissioning experience from United States Nuclear Regulatory Commission (USNRC) shared regulatory issues on decommissioning safety, as well as exchanged opinions with the audience. The "2018 Sino-Japanese Workshop on NPP Decommissioning Technology" was held on September 11-12, 2018 and experts from Association for Nuclear Decommissioning Study (ANDES) of Japan shared their experiences of NPP decommissioning in Japan. AEC also shared the current status of NPP decommissioning in Taiwan and engaged in an in-depth discussion with the experts from Japan.

By inviting international experts to Taiwan, AEC not only provided opportunities to discuss on issues related to NPP decommissioning, but also for learning the experiences of NPP decommissioning from other countries. It would strengthen the regulatory knowledge of nuclear safety in Taiwan and be helpful for decommissioning safety regulation in the future.

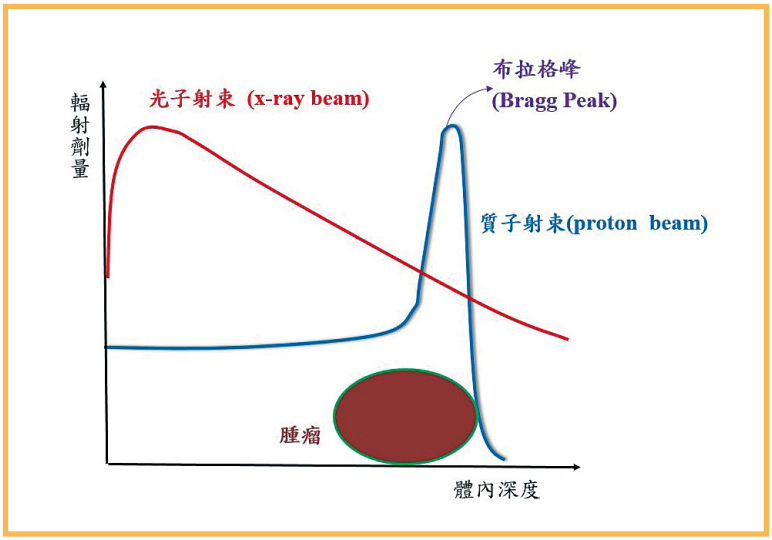
四、嚴密輻射防護安全管理

（一）「最新輻射醫療技術的應用與輻射安全管制」執行質子治療設施的輻射安全審查，提升民眾輻射醫療品質

1. 質子治療設施在癌症病人治療的效益及其輻射安全管制

近年來國際間以質子取代光子射束治療癌症病人，這是因為質子具有布拉格峰的物理特性，就好比深水炸彈一般，只將射束集中在靶區（癌細胞）上，可以大大降低對於正常組織的傷害。

原能會針對質子治療設施之管理機制，主要透過「多重的審核、多重的檢查」策略，以督促醫院注意輻射安全問題，加以確保民眾及工作人員輻射安全，提升病患醫療品質。林口長庚醫院於 98 年 4 月向原能會申請安裝我國第一部質子治療設施，在歷經審查、建造及試運轉後，103 年 6 月取得使用許可證，開始治療病人。



◀ 光子及質子射束在體內不同深度與劑量關係圖
A comparison of different depth and dose distributions of photon beams vs. proton beams

2. 我國質子治療設施新建發展及 107 年原能會的審查管制現況

107 年原能會完成高雄長庚醫院質子治療設施加速器及第一間治療室試運轉報告審查及檢查，並核發使用許可證；完成臺北醫學大學附設醫院質子治療設施輻射安全評估報告審查，同意設施建造安裝；完成林口長庚醫院質子治療設施第五間射束實驗室試運轉計畫審查，同意進行試運轉。另台大癌醫中心質子治療設施正在建造中，原能會將在安裝期間進行輻射安全管制及檢查。

D. Rigorous management of radiation safety and protection

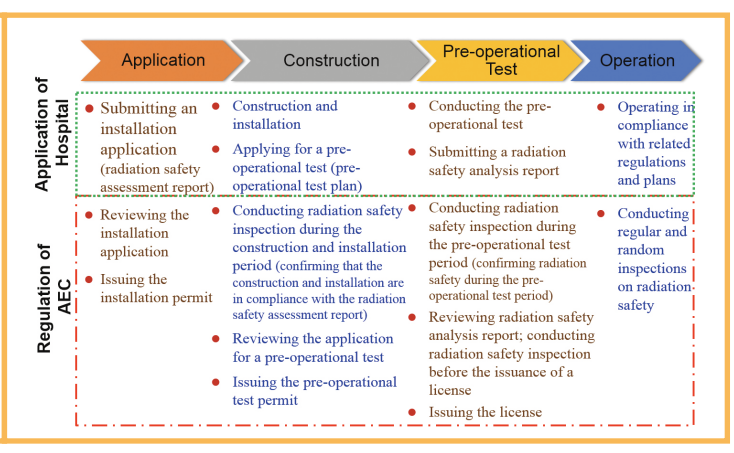
1. "Latest application of radiation in medical science and regulation of radiation safety": a review on radiation safety in proton therapy facilities to increase the quality of radiological medical services

a. The effectiveness of proton therapy facilities in cancer treatment and regulation of radiation safety

In recent years, international communities have witnessed a trend towards the use of proton beams instead of photon beams in cancer treatment. The physical proton property known as Bragg Peak means that a proton beam can give off a concentrated energy in depth, akin to a depth charge, and accurately reach a targeted site (cancerous cells), which significantly reduces damage to non-cancerous tissue.

AEC's administrative mechanism governing proton therapy facilities adopts the strategy of "Multiple Reviews; Multiple Inspections" so that hospitals would be supervised to value the importance on radiation safety and undertake to ensure the safety of the public and radiation operatives, which, in turn, increases the quality of medical services received by patients. In April 2009, Linkou Chang Gung Memorial Hospital (CGMH) submitted an application to AEC for the establishment of the first proton therapy facility in Taiwan. After the review process, construction, and the pre-operational test, the facility was granted a license and began patient treatment in June 2014.

▲ 質子治療設施管理機制



▲ The administrative mechanism governing proton therapy facilities

▲ 高雄長庚醫院質子治療設備
The proton therapy facility at Kaohsiung CGMH

未來原能會將持續藉由研究計畫精進管制人員訓練，並收集國內外最新資訊，以確保質子治療設施之管制品質，保障民眾之輻射安全。

（二）「確保放射性物質應用的輻射安全」嚴密管制放射性物質應用，保障人員及環境的輻射安全

1. 我國放射性物質的應用與輻射安全管制

密封放射性物質因會持續釋出游離輻射，所以輻射安全管制及保安措施管理也為原能會重點工作之一。

目前工業界使用的密封放射性物質，多屬輻射危害性較低的「登記備查類」射源，例如以 β 射線或 γ 射線穿過物質後強度的變化來測量紙張及鋼板厚度的測度計；紡織業測棉紗密度的密度計；以及利用 γ 射線測定如熔煉爐中鋼液高度、石油槽內油量或是瓶裝飲料內容量的液位劑，以進行商品品質管理。

為加強設施經營者對密封放射性物質的管理，以及火災等意外事故之應變處理，原能會於 107 年規劃辦理「多數量密封放射性物質設施經營者輻射安全專案檢查」，針對領有原能會核發 15 張以上工業用密封放射性物質證照之 36 家設施經營者，查核其輻射作業自主管理現況，包括確認密封放射性物質使用場所之安全管理、查核料帳、檢視輻射防護計畫內容是否符合輻射作業現況、瞭解業者輻射作業自主管理與檢查情形，另原能會檢查同仁輔以法規宣傳及管制作為之建議，以提升各業者執行輻防安全自主管理之能力。

b. The construction and development of proton therapy facilities in Taiwan and the status of AEC regulatory review in 2018

In 2018, AEC completed a review on the pre-operational test report on Kaohsiung CGMH's proton beam accelerator and first treatment room, conducted relevant inspections, and issued a license. AEC also concluded a review on the radiation safety assessment report for the proton therapy center at Taipei Medical University Hospital, and approved the construction and installation application for the center. AEC further completed a review on the pre-operational test plan for the fifth beam laboratory of the Proton and Radiation Therapy Center at Linkou CGMH, and approved the application for the pre-operational test. Furthermore, the construction of the Radiation Science and Proton Therapy Center of the National Taiwan University Cancer Center is underway, during which AEC will carry out regulation and inspections on radiation safety.

In the future, AEC will undertake to advance the training of regulatory personnel through research projects and gather the latest information, both domestically and internationally, so that the quality of regulation on proton therapy facilities and public radiation safety can both be ensured.

2. "Ensuring radiation safety on the use of radioactive materials": stringent regulation on the use of radioactive materials to safeguard radiation safety for both people and the environment

a. The application of radioactive materials and the regulation on radiation safety in Taiwan

Due to the fact that sealed radioactive sources continue to emit ionizing radiation, regulation on radiation safety and security measures remains one of AEC priority tasks.

Currently, most sealed radioactive sources used in industries are of low radiation hazard potential, which require only registration with the competent authority. For example, beta and gamma radiations are used in thinkness gauge to measure the thickness of paper and steel plates, and in densitometers to measure the density of yarn in the textile industry, both by detecting changes in intensity of radiation being passed through the material. Gamma radiation is also used in liquidometers to detect the level of molten steel in a smelting furnace, oil mass in an oil sump, and volume in bottled drinks for quality management.

To strengthen facility operators' capability in the management of sealed radioactive sources and in response to emergencies or accidents such as fire, AEC planned and conducted the "Radiation Safety Inspection Project on Facility Operators of Multiple

2. 107 年原能會在放射性物質管制之成果與效益

107 年執行「多數量密封放射性物質設施經營者輻射安全專案檢查」，原能會逐一視各受檢單位輻防管理措施之實際執行情形，以建立原能會與受檢單位在輻防管制之共識，並要求受檢單位之管理階層重視輻射防護管理與強化自我檢查程序，強化受檢單位自主管理之機制，落實輻防人員或輻防管理人員之權責，透過檢查過程，受檢單位可了解自主檢查程序是否存有盲點或未注意事項。

此外，專案檢查完成後，原能會將各受檢單位待改進或建議事項分別函送 36 家業者，以期各設施經營者可確實或落實輻射防護自主管理能力，確保人員及環境的輻射安全。

▲ 設施經營者簡報
A facility operator presentation

▲ 輻射作業場所查核（一）
On-site inspection on radiation practice (1)

▲ 輻射作業場所查核（二）
On-site inspection on radiation practice (2)

▲ 書面資料查核（一）
Document review (1)

▲ 書面資料查核（二）
Document review (2)

Sealed Radioactive Sources" in 2018. Inspections were carried out on 36 facility operators, which have obtained more than 15 licenses for sealed radioactive sources in industrial use issued by AEC with regard to their respective self-management status regarding radiation practice. Areas of inspection include: confirming the safety management of facilities using sealed radioactive sources, checking material inventories, assessing whether the current situation of radiation practice is in accordance with the radiation protection plan, and understanding how facility operators perform self-management and relevant checks and inspections in radiation practice. In addition, AEC inspectors also provided regulatory recommendations and took the opportunity to promote related laws and regulations, with the goal of enhancing facility operators' capability in carrying out self-management of radiation safety and protection.

b. The outcome and effectiveness of AEC regulation on radioactive materials in 2018

AEC conducted the "Radiation Safety Inspection Project on Facility Operators of Multiple Sealed Radioactive Sources" and evaluated facility operators on their respective execution over radioactive protection and management measures in 2018. These inspections were conducive to consensus building between AEC and the inspected entities regarding radiation protection and regulation. The executives of the inspected entities were requested to value the importance on radiation protection and management, and enhance self-inspection procedures. They are also advised to strengthen their respective self-management mechanisms and put in place duties and responsibilities of radiation protection personnel and administrators. Through the inspection process, inspected entities also gained a good understanding of whether there were any blind spots regarding self-inspection procedures or any matters that they were previously unaware of.

After the completion of the inspection project, AEC further sent the respective inspection results with regard to areas for improvement and recommendations to the 36 facility operators, in the hope of building and enhancing their self-management capability in radiation protection and, in turn, ensuring radiation safety of people and the environment.

▲ 檢查後檢討會議
Review meeting after inspection

五、強化輻災應變與整備能量

（一）核子保安管制之強化

1. 完成核電廠保安計畫審查

4 月完成核一、二、三廠保安計畫內容修訂之審查，本次內容修訂係依據國際最新核子保安規定與原能會管制要求，強化我國核電廠保安設施與作業程序。

2. 執行核電廠無預警動員測試

為確保核電廠與台電公司緊急應變組織動員之應變時效性，訂定「107 年核能電廠緊急應變無預警動員或通訊測試演練計畫」，並執行核三廠無預警通訊測試及核一廠無預警動員測試，各廠緊急應變組織回應與召回之時效性均符合測試標準。

3. 強化核電廠資通安全防護

要求台電公司參考美國法規，從技術、操作及管理等三方面落實關鍵數位資產之資安防護，並定期視察。另邀請美國能源部國家核子保安局來台辦理核設施資安風險管控訓練課程，強化資安防護。此外，因我國執行核設施資安防護績效良好，受邀參加首屆核能網路安全論壇（NTI Cyber-Nuclear Forum）（本次初始會議計 7 位各國專家受邀出席），會議目的在討論各國合作及交流機制，以增進核設施資通安全，並討論 108 年召開論壇會議之方式與優先議題。

4. 辦理輻射災害風險管理與犯罪偵查研習會

10 月 26 日假中央警察大學辦理「輻射災害風險管理與犯罪偵查研習會」，各機關單位計 75 人參與。課程包括組織內部威脅情境分析與防制策略、輻射犯罪偵查標準作業程序之研擬等，並安排主題技術參訪及綜合座談等多元方式，進行交流互動，參與人員獲益良多。

5. 規劃除役核電廠核子保安與緊急應變管制

執行「核子事故緊急應變法規對除役中核能電廠之適用性與管制實務研究」與「除役中核能電廠之核子保安管制要求與國際實施現況研究」等計畫，檢討除役期間現行法規之適用情形，進行相關管制措施調整之研究，以做為未來除役管制的參考。

E. Strengthening the capability in radiological emergency response and preparedness

1. Strengthening nuclear security regulation

a. Review of the NPP security plans

The review on the revision of security plans for the Chinshan, Kuosheng and Maanshan Nuclear Power Plants was concluded in April. The revision was conducted in accordance with the latest international nuclear security requirements and AEC's regulatory requirements, with the aim to enhance NPP security systems and operational procedures in Taiwan.

b. Unannounced emergency mobilization drills

To ensure the timeliness of mobilization by TPC and NPPs in an emergency, AEC had enacted the "2018 Plan for Unannounced Emergency Mobilization Drill or Communication Tests in NPP"; An an unannounced communication test and an unannounced emergency mobilization drill were conducted in the Maanshan Nuclear Power Plant and the Chinshan Nuclear Power Plant, respectively.

c. Enhancing the regulations of NPP cyber security

TPC was required to be in place, by referring to related regulations, the protection system for NPP cyber security of critical digital assets by means of technical, operationl and management controls. AEC performs periodic cyber security inspections. Experts from the U.S. Department of Energy's National Nuclear Security Administration were invited to Taiwan to conduct a training workshop on cyber security risk management and control in nuclear facilities, with the goal of strengthening the protection of NPP cyber security. In addition, due to Taiwan's sound performance in nuclear facilities' cyber security, AEC were invited to attend the first NTI (the Nuclear Threat Initiative) Cyber-Nuclear Forum (a total of 7 experts worldwide were invited to attend the steering meeting). The objectives of the meeting were to discuss international cooperation and information exchange mechanisms to enhance nuclear facilities' cyber security, while discussing the mode and priority agenda of the 2019 forum.

d. Organizing the workshop on the risk management of radiation emergencies and the crime investigation related to radiation

The "Workshop on the Risk Management of Radiation Emergencies and the Crime Investigation Related to Radiation" was held in the Central Police University

（二）年度核安演習之規劃與執行

107 年核安第 24 號演習於核一廠及鄰近地區舉行，分兵棋推演及實兵演練二階段實施，由中央與地方政府、國軍及民眾協力完成，總參與人數計 7,897 人。本次演習規劃階段即邀請民間團體參與，並於演習評核組中增列民間團體觀察員，以及邀請民間團體及評核委員組成無預警狀況設計小組，以提升公信力及增加演練強度。另為促進核子事故應變整備國際交流，邀請國際外賓來訪觀摩演習，包含美國核能管制委員會、法國核能安全署及輻射防護暨核能安全研究所、日本原子力規制委員會，與歐盟、義大利等相關駐台機構等共 23 人。

1. 兵棋推演

於 8 月 10 日辦理兵棋推演，為深化無預警狀況演練，於核子事故中央災害應變中心前進協調所，首次以現場發布議題狀況的方式進行推演，呈現真實氛圍；透過功能分組 (輻災救援組、支援調度組、疏散撤離組、醫療衛生及收容安置組等四個分組) 討論，強化跨單位協調合作與狀況處置，並擴大地方局處層級人員參與功能分組，即時掌握支援調度需求；另模擬召開記者會，對外說明災情搶救情形及事故現況，釐清外界疑慮。

▲ 核子事故中央災害應變中心前進協調所演練
Exercise at the Forward Coordination Post, National Nuclear Emergency Response Center

▲ 分組討論
Discussion at a functional unit

on October 26th, and was attended by 75 people from different agencies and departments. Workshop sessions included insider threat analysis and control strategy, and the formulation of standard operating procedures used in the crime investigation related to radiation. Topical technical visits and panel discussions were also arranged, providing multiple opportunities for participants to exchange views and interact with each other, whereby they could be benefited from the workshop.

e. Planning regulations on nuclear security and emergency response in decommissioning NPPs

Two projects were undertaken: the "Study on the Applicability and Regulatory Practice of Nuclear Emergency Response Regulations in Decommissioning NPPs" and the "Study on Regulatory Requirements for Nuclear Security and the Current Situation of International Practice in Decommissioning NPPs," in which the applicability of current laws and regulations used during the decommissioning period was reviewed and the adjustment of relevant regulations and measures was studied, so that the results could be used for future reference in the regulation of decommissioning NPPs.

2. The planning and implementation of the annual national nuclear emergency exercise

The 2018 Nuclear Emergency Exercise was carried out in two phases: a tabletop exercise and a full-scale exercise in the Chinshan Nuclear Power Plant and its surrounding areas. A total of 7,897 people from the central and local governments and the military, as well as civilians, participated and collaborated in the Exercise. Members of the public were invited to take part during the planning of the Exercise, and observers from local communities were invited to the assessment panel in the Exercise. In addition, both civilians and the assessment panel were invited to form a team to devise unannounced emergency scenarios to increase the credibility and intensity of the Exercise. Furthermore, to promote international exchanges in the field of nuclear emergency response and preparedness, 23 international guests from the Nuclear Regulatory Commission of the US, the Nuclear Safety Authority and the Institute for Radiation Protection and Nuclear Safety of France, the Nuclear Regulation Authority of Japan, and the European Economic and Trade Office, the Italian Economic, Trade and Cultural Promotion Office in Taipei, and other representative offices in Taiwan, were invited to observe the Exercise.

▲ 災防告警細胞廣播訊息服務（CBS）發送
Emergency alert notification issued via CBS

▲ 無人機輻射偵測示範演練—設備裝載
A drone drill for radiation detection: loading the device

2. 實兵演練

為驗證核電廠緊急應變組織成員召回之時效性，先於 9 月 8 日（週六）非上班時間至核一廠執行無預警動員測試。藉由該項測試，惕勵應變人員之警覺性，核一廠各應變人員皆於指定時間內完成報到集結。

另於 9 月 14 日至 15 日（週六）執行廠內及廠外各項演練，包括：核一廠機組搶修，演練過程中臨時發布 4 項突發狀況，檢驗電廠人員應變能力；於核一廠鄰近 3 所國中小同時執行預防性疏散至接待學校；首次於假日執行海灘關閉與旅客勸離示範演練；台北榮總及淡水馬偕醫院同時執行輻傷醫療救護；以無人機執行輻射偵測及災情勘查；首次於新北市全區以中英文內容發送核子事故演習之災防告警細胞廣播訊息（CBS）；另安排履帶機動橋搭建、陸域輻射偵測數據即時回傳、環境檢測作業及交通路障排除等抽演項目，由無預警狀況設計小組勾選決定，並適時宣布演練時間、地點，以深化各單位狀況應變處置能力。

（三）輻災應變機制與能量之精進

1. 完備輻射災害應變整備規範

為強化核子事故緊急應變效能，推動「核子事故緊急應變法」修正作業，加重台電公司平時整備之責任、引入經濟部能量，整合運用防救災資源，並以風險分級擴大應變整備區域範圍，修正草案已於 107 年 5 月函送立法院審議；另配合行政院防制假訊息危害政策，於 107 年 12 月增訂「核子事故緊急應變法」第 31 條之 1 有關散布假消息罰則修正條文，業經行政院院會議通過，並於 12 月 17 日與災害防救法第 41 條修正草案等 7 個法案一同函送立法院審議。另外，為使

a. Tabletop exercise

The tabletop exercise took place on August 10th at the Forward Coordination Post, National Nuclear Emergency Response Center. To deepen the realism and intensity of the exercise, scenario issues were not announced, for the first time in an exercise of this kind, until the inception of the exercise. The functional unit approach was adopted, and discussions within and between the units (the radiation emergency response unit, the support and dispatch unit, the evacuation unit, and the medical treatment and shelter placement unit) proceeded in order to enhance the coordination and cooperation between units, as well as the disposition of the situation. Personnel from local governments at the bureau and division level also joined functional units to ensure real-time access to the demands for support and dispatch. A simulated press conference was also held to provide information on rescue efforts and emergency status, as well as to clarify the public's doubts and concerns.

b. Full-scale exercise

In order to verify the timeliness of the recall of NPP emergency response teams, an unannounced emergency mobilization drill was first performed at the Chinshan Nuclear Power Plant on September 8th, a Saturday and a holiday, wherein all response personnel of the Chinshan Nuclear Power Plant reported back within the designated time. This drill also served to prompt the response personnel to stay alert.

Various on-site and off-site drills were conducted on September 14th and 15th (Saturday). Urgent repairs and emergency maintenance were performed on Chinshan Nuclear Power Plant units as a result of the four random emergency scenarios announced during the exercise, which served to verify the NPP personnel's capabilities in emergency response. The preventive evacuations were carried out simultaneously to move student from the three adjacent junior high schools and primary schools near the Chinshan Nuclear Power Plant to reception schools. A demonstration drill was conducted on a holiday, the first time in a drill of this kind, for a beach closure wherein tourists were advised to leave the vicinity. Medical treatment for radiation injuries was performed in the Taipei Veterans General Hospital and Mackay Memorial Hospital, Tamsui Branch at the same time. Drone missions were undertaken for radiation detection and disaster reconnaissance. An emergency alert notification of the nuclear emergency exercise in both Chinese and English, the first time in a drill of this kind, was issued via the cell broadcast system (CBS) across the entire area of New Taipei City. In addition, few random drills, such as building an armored vehicle launched bridge, real-time data transmission of territorial radiation

中央災害應變中心於核子事故發生時，進行民眾防護行動之應變決策更加周延，於 5 月增訂「核子事故民眾防護行動應變與決策參考指引」供依循。而因應災害防救現行實務做法，完成「輻射災害防救業務計畫」檢討修正，經 11 月行政院中央災害防救會報會議核定後，於 12 月函頒實施，使輻射災害應變整備規範面更加完備。

2. 強化中央與地方輻射災害聯防作業

持續透過輔導、訓練、演練三面向，充實基層輻射災害防救職能，並藉由與地方政府攜手合作，強化輻射災害聯防作業，增進國家整體輻災防救能量。配合行政院執行地方政府災害防救與全民防衛動員計畫審查及業務訪評，輔導 22 縣市政府依其轄區內災害潛勢特性落實各項輻射災害整備工作；另結合地方政府辦理之各類救災訓練、講習及研討會進行輻射災害應變實務教育訓練，讓地方政府第一線應變人員熟悉輻射防護要領及知能，以提升處理輻射災害的能力，並維護自身安全，107 年共辦理 27 場次訓練，計 2,361 人參訓；本年另與桃園市政府共同辦理民安 4 號輻射災害應變演習，協助情節設計並出動輻射應變技術隊參與演練，提供專業技術諮詢與支援，以強化中央與地方聯防機制。

3. 精進輻災應變實務課程

為增進第一線應變人員及業務承辦人員對輻射災害應變機制與防救措施之瞭解，於北、中、南、東區共辦理 4 場次之「地方政府輻射災害防救講習」，計有 234 人參與。課程內容除講授輻射應變原則與技術外，另增加輻射儀器量測活動與輻

▲ 高雄輻化災防救研討會講授輻射災害應變課程
Lesson on radiological emergency response in a radiological and chemical disaster response workshop in Kaohsiung

▲ 輻射應變技術隊參與桃園市政府輻射災害應變演練
Our Radiological Emergency Response Team(RERT) participating in Taoyuan City Government's radiological emergency response drill

detection, environmental testing operations, and the removal of road barriers, were selected by the emergency scenario devising team, while the time and place of these drills were announced timely, serving to strengthen relevant units' capabilities in scenario response and disposition.

3. Advancing the mechanism and capacity in radiological emergency response

a. Refining the regulations for radiological emergency response and preparedness

To enhance the effectiveness of nuclear emergency response, the revision of the "Nuclear Emergency Response Act" was undertaken in terms of augmenting TPC's duty regarding emergency preparedness, incorporating the Ministry of Economic Affairs' capacity, integrating and utilizing emergency relief resources, and expanding the area of response and preparedness on the basis of risk assessment. The draft of the "Nuclear Emergency Response Act" was amended by a wide range and was submitted to the Legislative Yuan for consideration in May 2018. Furthermore, in concert with the Executive Yuan's policy in curbing threats from fake news, Paragraph 1 of Article 31 of the "Nuclear Emergency Response Act" was amended in December 2018 to include penalty of the dissemination of fake news; it was passed in the Cabinet meeting. The amendment draft was sent to the Legislative Yuan on December 17th. In addition, the "Reference Guidelines for Decision Making on Public Protective Actions in a Nuclear Accident" was issued in May to helpthe Central Disaster Emergency Operation Center to make a more comprehensive and thorough decision on public protective actions during nuclear emergency. Also, the review on the "Radiological Disaster Relief Operations Plan" was updated and included the current practices in disaster prevention and response. Following its approval by the Central Disaster Prevention and Response Council of the Executive Yuan in November, the Plan was promulgated in December.

b. Strengthening the cooperation between central and local governments in radiological emergency preparedness and response

AEC committed to raising local governments' competence in radiological accident prevention and response viacontinuous counselling, training and drills, while strengthening cooperation by working with local governments to increase overall national capabilities in radiological accident prevention and response. Under the coordination of the Executive Yuan, AEC conducted a review of plans for local government disaster response and civil defense mobilization, as well as carried out

▲ 地方政府輻射災害防救講習之輻射偵檢儀器實作課程
Hands-on activities using radiation detection instruments in a Local Government Radiological Emergency Response Training Workshop

▲ 地方政府輻射災害防救講習之輻射災害應變處理桌上演練課程
Tabletop exercise on responding to a radiological emergency in a Local Government Radiological Emergency Response Training Workshop

射災害應變處理之桌上演練等實作課程，透過動手操作與災害現場的處置模擬演練，深化應變人員對輻射災害的第一線應變要領。

4. 加強科技防災推動合作

與國家災害防救科技中心簽署合作備忘錄，共同推動輻災應變科技研發與應用，並將現有輻災應變圖資整合於國家災害情資網，提供事故決策所需完整資訊。

▲ 與國家災害防救科技中心簽署合作備忘錄
The signing of an MoU with the National Science and Technology Center for Disaster Reduction

visits and evaluations. AEC also counselled 22 cities and counties nationwide to put in place various preparedness measures for radiological emergency based on the localized disaster potential and characteristics. AEC further worked with local governments to organization various training sessions, workshops and seminars on radiological emergency response practices and radiation safety and protection to ensure that the first responders of local governments are well trained and educated. There were 27 training sessions took place in 2018 with 2,361 participants. Additionally, the Radiological Emergency Response Team (RERT) attended the All-out Defense Mobilization and Disaster Prevention Exercise (Min-An No.4) hosted by Taoyuan City in 2018, to carry out a drill on radioactive materials retrieved from a transportation accident. The RERT provided professional technical consultation and support to reinforce the cooperation mechanism of central and local governments in radiological emergency response.

c. Advancing the training on radiological emergency response

To facilitate better understanding of the first responders and radiological emergency response and rescue measures related staffs, four "Local Government Radiological Emergency Response Training Workshops" were held in Northern, Central, Southern, and Eastern Taiwan, with 234 participants. In order to improve first responders' expertise of radiological emergency response, lessons on the principles and techniques of radiological emergency response were offered as well as practical classes, including implementation activities using radiation detection instruments and tabletop exercises of a radiological emergency.

d. Strengthening cooperation in promoting disaster prevention with science and technology

AEC has signed a memorandum of understanding (MoU) with the National Science and Technology Center for Disaster Reduction to promote the research, development and application of science and technology in radiation disaster response. AEC also integrated the information regarding existing radiation disaster response with the national disaster information network to provide more comprehensive information for decision-making in an emergency.

5. 納入在地意見以規劃核子事故民眾防護行動

台電公司依法每 5 年提報「核能電廠緊急應變計畫區內民眾防護措施分析及規劃檢討修正報告」，依現有人口分布以及既有路網，模擬災害情境下所需疏散時間，並提出交通改善行政管制措施。原能會邀請專家委員及相關機關共同審查，完成該檢討修正報告之審查，並撰寫評估報告，併台電公司之報告於 107 年 7 月 30 日公布於原能會官網，作為地方政府修訂核子事故區域民眾防護計畫參考。另於 5 月 18 日辦理核子事故民眾防護措施之疏散交通規劃地方座談會，要求台電公司參考與會民眾意見，進行疏散效益評估，未來俟台電公司完成評估報告，將再邀請相關部會、地方政府與民意代表及地方人士代表等研商討論，俾確保民眾權益。

6. 提升輻射災害檢測分析備援能量

為強化緊急時期輻射檢測分析之能量，分別委請陽明大學及屏東科技大學建置放射性分析備援實驗室，107 年各項軟硬體設施已完成規劃建置，並皆取得全國認證基金會（TAF）之實驗室認證，有效擴增我國輻射檢測能量。

e. Incorporating voice by local communities into the transportation plan for evacuation in a nuclear emergency

In compliance with legal requirements, TPC submits the "the Review on the Analysis and Planning of Public Protective Actions in NPP Emergency Planning Zones" every five years. In the Report, TPC proposes administrative control measures for traffic improvement by simulating evacuations in disaster scenarios and recording the time taken for evacuations based on existing population distribution and road networks. A joint review committee comprising experts invited by AEC and officials from relevant authorities was formed; it completed the review on the revised report. An evaluation report was composed and released on our website on July 30, 2018, along with TPC's report; they served as a reference for local governments to revise public protective action plans in NPP emergency planning zones. Moreover, a local forum on transportation plan for evacuation in the event of a nuclear emergency was held on May 18th, during which TPC was requested to to conduct an evaluation on the effectiveness of evacuation. Once the TPC evaluation report is completed, reviewers from relevant ministries and councils, local governments, elected representatives, and local representatives will be invited for further consideration and discussion, so that the public's rights and interests can be ensured.

f. Improving capacity of radiation detection and analysis for a radiological accident

To enhance the overall capacity of radioactivity analysis in radiological accidents, AEC established two backup laboratories cooperated with National Yang-Ming University and National Pingtung University of Science and Technology. The facilities, both hardware and software, were completed. Both laboratories have been certified by the Taiwan Accreditation Foundation (TAF) in 2018 and would provide efficient and reliable radioactivity analysis services to meet public expectations.

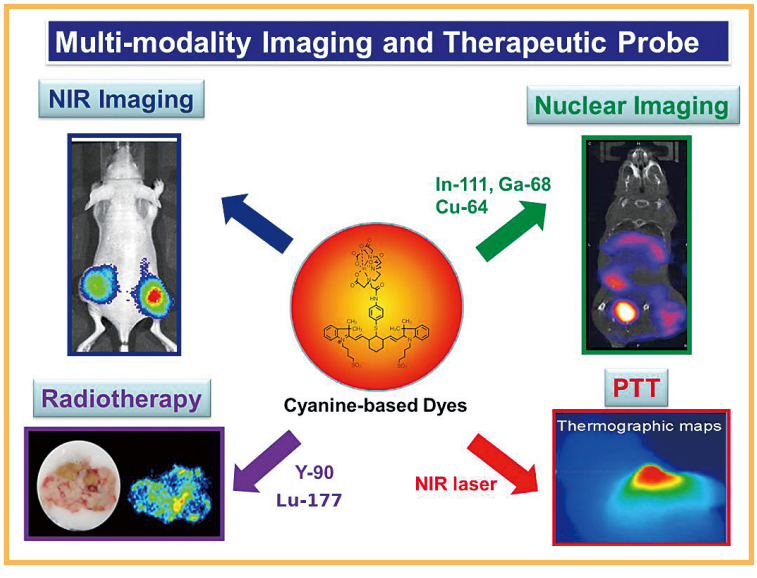
六、精進原子能科技研發

（一）多功能花菁染料基質之腫瘤診療探針開發

根據國人十大死因統計，惡性腫瘤連續三十幾年蟬聯首位，而全球每年約新增1千多萬人罹患癌症，隨著癌症患者持續增加，相關藥物的開發已是各國生技製藥產業重要的一環，而早期診斷與合併治療更是未來對癌症治療發展的趨勢。

核研所開發的「多功能花菁素染料基質之腫瘤診療探針」（DOTA-NIR790）為單一分子，對於各類器官的腫瘤均能產生藥物聚積的特性，使藥物能順利累積在我們欲診斷或治療的部位。應用於腫瘤功能性影像診斷上，臨床常見有深層腫瘤的單光子掃描（SPECT）及淺部腫瘤的近紅外螢光造影（NIRF），兩者各有所長。本探針可合併上述2種影像來診斷癌症，並依造影需求能螯合多種放射性同位素，如銦-111（In-111）、鑥-177（Lu-177）、鎵-67（Ga-67）等，可用於單光子電腦斷層掃描造影；螯合鎵-68（Ga-68）、銅-64（Cu-64）等，可用於正子電腦斷層造影（PET）；螯合釓（Gd），則可用於非放射之核磁共振造影（MRI），多重造影技術搭配使用，可提升腫瘤診斷之精準度。

至於針對腫瘤治療方面，本探針除原本之花菁染料主體具備光熱特性，可藉之達到癌症光熱治療目的外，亦可標誌治療用同位素鑥-177（Lu-177）、釔-90（Y-90）等進行腫瘤進接放射治療，未來更朝向鍵結化療藥物發展，達到單一藥物合併多重治療功效，以期提升腫瘤治癒率。



◀ 多功能花菁染料基質之腫瘤診療探針（DOTA-NIR790）發展淺力
Development potential of theranostic probes (DOTA-NIR790) for multimodality imaging, radiotherapy, and photothermal therapy

F. Advancing the research and development of atomic energy technology

1. The development of theranostic probes (DOTA-NIR790) for multimodality imaging, radiotherapy, and photothermal therapy

According to the statistics on the top 10 causes of death in Taiwan, malignant tumors have been the leading cause of death for over 30 years in a row. Globally, more than 10 million people are diagnosed with cancer every year. With the continuous rise in the number of cancer patients, the development of related drugs for cancer treatment has become an important area in the biotechnology and pharmaceutical industries worldwide. Early diagnosis and combined treatment, in particular, will be the trend for the future development of cancer treatment.

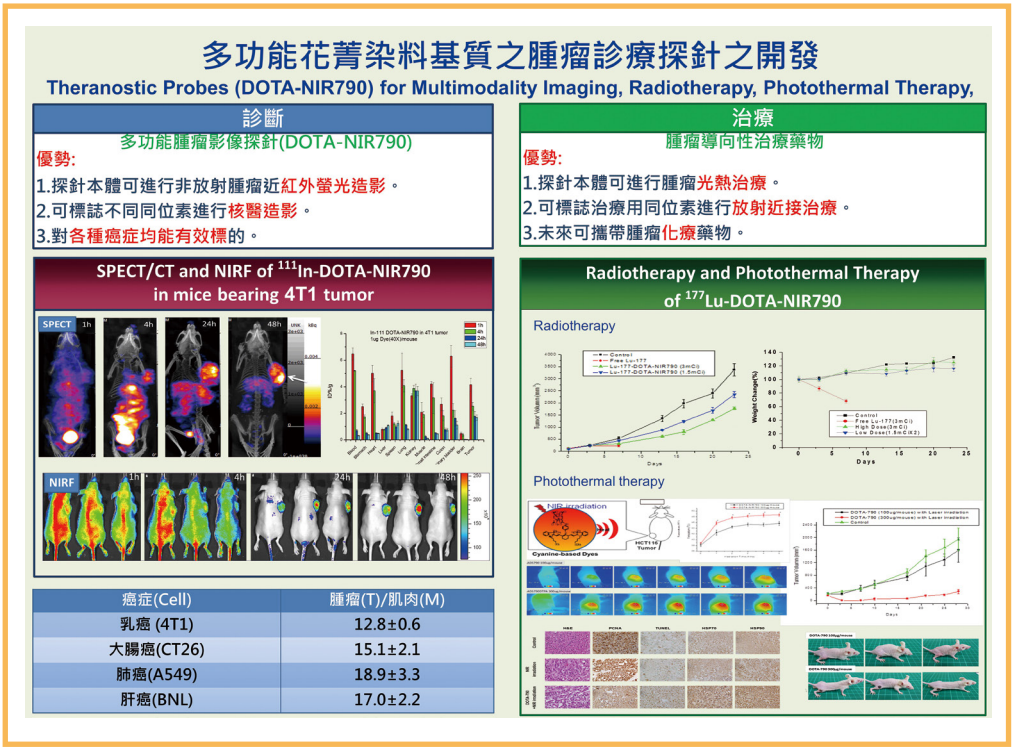
The "theranostic probes (DOTA-NIR790) for multimodality imaging, radiotherapy, and photothermal therapy", developed by AEC's Institute of Nuclear Energy Research (INER), are single-molecule probes that can be applied to tumors in various organs where drugs can accumulate in the targeted diagnostic or treated location. For functional imaging used in tumor diagnosis, two common clinical practices are as follows: single photon emission computed tomography (SPECT) used for deep-tissue tumors and near-infrared fluorescence (NIRF) imaging used for subcutaneous-tissue tumors. Both have their own advantages. Said probes can combine the above two imaging methods for cancer diagnosis; depending on imaging requirements, they can chelate a variety of radioisotopes, such as indium-111 (In-111), lutetium-177 (Lu-177) and gallium-67 (Ga-67), in single photon emission computed tomographic imaging; gallium-68 (Ga-68) and copper-64 (Cu-64) in positron emission tomographic (PET) imaging; and gadolinium (Gd) in non-radioactive magnetic resonance imaging (MRI). The combined usage of multiple imaging techniques can increase accuracy in tumor diagnosis.

As for tumor treatment, the photothermal property of cyanine-based dyes used in the probes serves to achieve the goal of photothermal tumor therapy. In addition, the probes can also apply for labeling with therapeutic isotopes for further radiotherapy of cancer, such as lutetium-177 (Lu-177) and yttrium-90 (Y-90). In the future, the development of chemotherapy drugs with chemical bonds will serve to achieve the objective of single drugs combined with multiple treatment effects, whereby the cure rates for tumors can be improved.

As verified by animal experimentation conducted by INER, the DOTA-NIR790 can target various types of tumor, such as breast cancer, colon cancer and liver cancer, with

經核研所動物實驗證實，DOTA-NIR790 運用在許多不同類別的腫瘤標誌上，如：乳癌、大腸癌、肝癌等，確實具有良好的腫瘤／肌肉聚積比（tumor/muscle ratio），我們可以分別在單光子掃描與近紅外螢光的影像中看見，腫瘤部位呈現明顯的熱區，與正常組織產生強烈的影像對比，表示本探針能有效地標地及累積於腫瘤，亦能產生良好的功能性影像。另將探針以不同濃度注射至腫瘤進行光熱治療或搭配不同輻射劑量的 Lu-177 進行放射治療，並在治療的過程中進行造影，從影像中我們可以看見，與實驗對照組相比，隨著治療的天數增加，腫瘤體積確實有減小的趨勢，顯示本探針應用於腫瘤治療之發展潛力。

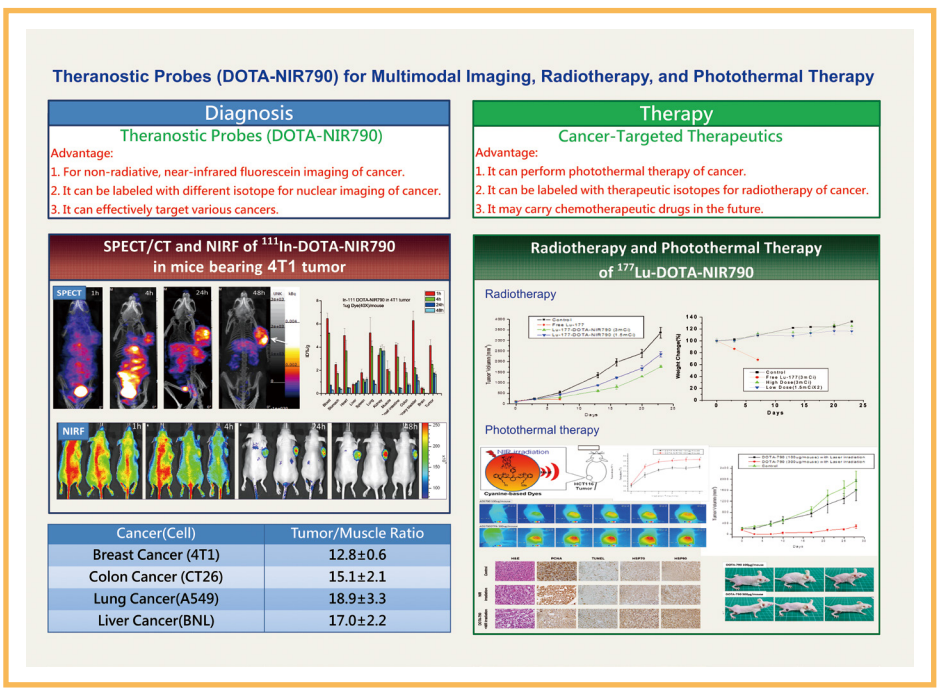
由於癌症的各種診斷、治療模式均有不同的優點及限制，核研所開發之 DOTA-NIR790 具「可運用於近紅外螢光及核子醫學影像診斷能力」與「光熱治療或同位素標的放射治療」等 2 大特點，使癌症的診斷與治療，在方式的選擇上能更具彈性且多樣化，另該探針亦於 107 年第十五屆國家新創獎，獲得生技製藥組「學研新創獎」，為核研所的新藥生技研發帶來鼓勵，促進實現個人化醫療及精準醫學的目標。



▲ 多功能花菁染料基質之腫瘤診療探針（DOTA-NIR790）之腫瘤影像診斷與治療效果

a good tumor/muscle ratio. As shown separately in both the imaging of SPECT and NIRF, the tumor region is reflected as a thermal zone; the imaging of the tumor region presents a sharp contrast to that of non-cancerous tissue, indicating that the probes can effectively target and accumulate in the tumor location and generate good functional imaging. Furthermore, the imaging generated during the process of photothermal treatment, which was carried out by injecting probes of different concentrations into tumors or during the process of radioactive therapy, conducted by combining probes with different radioactive doses of Lu-177 clearly shows the following: compared with the control group, the size of the tumor shows a trend of diminishing as the number of days in treatment increases, indicating the development potential of the application of said probes in tumor treatment.

Different diagnostic and treatment methods of cancer have different advantages and limitations. DOTA-NIR790 developed by INER has two features: "the application in near infrared fluorescence imaging and nuclear medicine imaging for diagnosis" and "the application in radiotherapy and photothermal therapy", which provide a variety of flexible and diversified modes for choice in cancer diagnosis and treatment. Furthermore, it was awarded the 15th National Innovation Award in the Academic Research Category of the Biotechnology and Pharmaceutical Division in 2018. The Award is an encouraging recognition of INER's efforts in new drug research and development in biotechnology, whereby the realization of personalized medicine and precision medicine can be fostered.



◀ Tumor diagnostic imaging and treatment effects of theranostic probes (DOTA-NIR790) for multimodality imaging, radiotherapy, and photothermal therapy

（二）核研所助台廠進軍國際市場—卷對卷複合型電漿模組化鍍膜系統及產品

核研所與台灣廠商合作，研發出新型電漿技術鍍製頂級隔熱紙，技術追上國際市場水準，但成本只要 1/3，目前正申請台灣及新加坡玻璃綠建材認證，全力搶占東南亞及全球隔熱紙市場。

台灣在隔熱紙市場大多生產中低階產品，礙於技術、品質無法提升，始終難以在國際上競爭。台灣最大隔熱紙廠商東鏘工業公司找上核研所，希望協助其開發頂級隔熱紙生產技術，雙方經 2 年合作研發，成功開發出獨步全球的卷對卷複合型電漿模組化鍍膜系統，該量產設備預計於 109 年開始商業運轉，並將生產台灣業界唯一的頂級熱反射型隔熱紙 T70 系列產品。

熱反射型 T70 隔熱紙系列，是一種符合國際公認的頂級隔熱產品，紅外光阻隔率達 87.2%（阻隔太陽紅外光熱源），室內仍保有可見光穿透率達 73%（透視度極高），室外可見光反射率 8.92%（無光害），室內可見光反射率 9.92%（鏡面反射低），紫外光阻隔率近 100%（完全保護室內人員及家具），太陽能總隔熱率 55% 以上（達國際頂級品隔熱性能）。該款產品性能與國際大廠同級品相當，價格卻更加經濟實惠，符合一般民眾需求，直接貼合於建築玻璃，除節省室內空調負荷外，並保有足夠的光線，減少照明，讓家居舒適清爽，且節能減碳。

目前該產品已分別張貼在核研所 013 館、立法院二館四樓、南崁兆豐銀行及中央大學節能屋等西曬大樓窗戶進行場域測試，在可見光穿透率 70% 以上的高透視度下，空調節電可高達 20% 以上，室內舒適度極佳。

▲ 卷對卷複合型電漿模組化鍍膜系統
Roll-to-roll hybrid plasma modular coating system

▲ 熱反射型 T70 系列產品
T70 series heat-reflective products

2. INER supporting Taiwanese firms to enter the international markets: roll-to-roll hybrid plasma modular coating system and products

In cooperation with a Taiwanese firm, INER has developed a new type of top-end window film using plasma coating. Catching up with international levels, the manufacturing cost of the technology is only 1/3 that of others. An application for the Green Building Certification of Taiwan and the Singapore Green Building Council Certification for the technology is currently in progress, with the aim of winning over a substantial share of the Southeast Asian and global window film markets.

In the window film market, Taiwanese firms mostly produce medium and low-end products. Limited by a lack of capability to improve technology and quality, Taiwanese manufacturers have not yet been able to compete internationally. Top Colour Film Ltd., the largest window film manufacturer in Taiwan, sought assistance from INER in developing a top-end manufacturing technology for window film. After two years of cooperation in research and development, the "roll-to-roll hybrid plasma modular coating system", a world-leading technology, was successfully developed. Mass production equipment is scheduled to start commercial operation in 2020 to produce T70 series, the only top-end heat reflective window film in Taiwan.

The T70 series heat-reflective window film is an internationally recognized top-end product. It can block 87.2% of infrared rays (blocking the infrared heat from the sun), allows 73% of visible light penetration indoors (high transparency), reflects 8.92% of outdoor visible light (zero light pollution), reflects 9.92% of internal visible light (low surface reflection), blocks close to 100% of ultraviolet rays (100% protection of people and furniture inside a building), and achieves over 55% of total solar energy rejection (reaching internationally recognized top-end heat-shielding performance standards). The performance of T70 series products is on a par with that of equivalent products from leading global firms with an absolute bargain on the price, making it affordable to the public. They can be directly affixed to building glass, which not only allows a reduction of air conditioning load, but also maintains sufficient natural light to save on lighting costs, both for a more comfortable home environment and lower carbon emissions.

財團法人成大研究發展基金會
NCKU Research & Development Foundation

9. 玻璃測試總表(Glass Data)

測試項目	測試結果	備註
1. 可見光穿透率(380nm～780nm) (visible light transmittance)	73.00	
2. 可見光反射率(380nm～780nm) (visible light reflectance)	8.92	
3. 日光穿透率(300nm～2500nm) (solar radiation transmittance)	38.17	
4. 日光反射率(300nm～2500nm) (solar radiation reflectance)	40.95	
5. 日光輻射熱取得率 SHGC(夏) (solar heat gain coefficient)	0.4477	
6. 日光輻射熱取得率 SHGC(冬) (solar heat gain coefficient)	0.4350	
7. 遮蔽係數 Sc(夏) (Shading Coefficient)	0.5146	
8. 遮蔽係數 Sc(冬) (Shading Coefficient)	0.5000	
9. 紫外線穿透率(300nm～380nm) (UV transmittance)	0.00	
10. 總熱傳係數 U W/m²-K(夏) (thermal transmittance)	5.492	
11. 總熱傳係數 U W/m2-K(冬) (thermal transmittance)	5.194	
12. 紅外線阻隔率 (780nm～2500nm) (100- Infrared direct transmittance)	87.20	
13. 總太陽能量阻隔率 (Total Solar Energy Rejection)	55.23	

▲ T70 產品張貼於建築玻璃之性能認證測試（成大綠建材隔熱性能檢測實驗室量測數據）
Performance certification test conducted on T70 series products when being affixed to building glass (laboratory testing data for heat shielding performance by the Y.S. Sun Green Building Research Center at National Cheng Kung University

▲ 性能驗證測試，左上為核研所 013 館，右上為立法院二館四樓，左下為南崁兆豐銀行，右下為中央大學節能屋
Performance verification test. Top left: Building 013 at INER; Top right: 4th floor of Building 2 at the Legislative Yuan; Bottom left: Nankan Branch of Mega International Commercial Bank; Bottom right: the Energy Saving Building at National Central University

由於產品獨特創新的高性價比生產技術已達國際水準並履獲國內外大獎肯定。106 年獲得第 14 屆國家新創獎，107 年獲得 2018 年台北國際汽機車 5 聯展配件類創新產品獎評選的銅牌獎，同時榮獲 2018 年美國航太權威媒體「美國國家航空暨太空總署技術摘要雜誌」（NASA Tech Briefs）主辦的 Create The Future Design Contest 開創未來設計競賽的機械與自動化類榮譽獎及百大科技獎。

（三）整合綠能的好幫手—隨插即用之能源作業系統（Energy Operating System, EOS）

1. 能源作業系統

就像電腦作業系統掌理電腦軟、硬體周邊一樣，能源作業系統監測、控制微電網系統內的分散式再生能源、儲能設備、負載及配電相關設施。能源作業系統以通

▲ 得獎實績。自左而右為第 14 屆國家新創獎、NASA Tech Brief 的 Create the Futere 競賽獎、2018 汽配展銅牌獎 Awards. From left to right: the 14th National Innovation Award, the 2018 NASA Tech Briefs' Create the Future Design Contest Awards, and the 2018 Taipei AMPA bronze medal

The T70 series products have been affixed to the windows of west-facing buildings at Building 013 at INER, 4th floor of Building 2 at the Legislative Yuan, Nankan Branch of Mega International Commercial Bank, and the Energy Saving Building at National Central University, all of which are undergoing a field test. With 70% of visible light transmittance (high transparency), over 20% of energy can be saved on air-conditioning, and a comfortable indoor environment can be maintained.

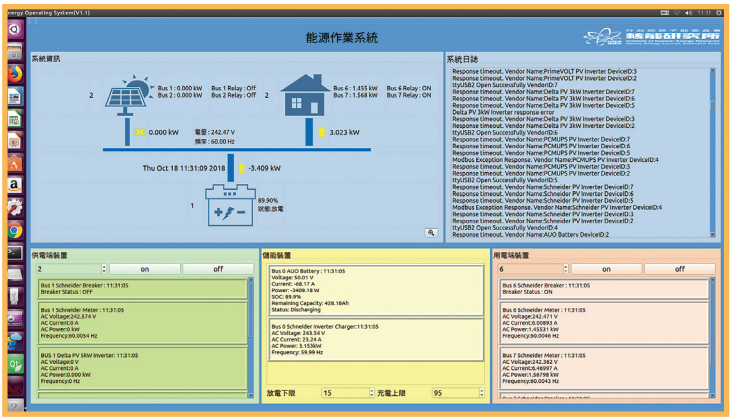
With its unique innovation, a high price-performance ratio, and an internationally recognized manufacturing technology, T70 has won a number of awards, both internationally and domestically. It won the 14th National Innovation Award in 2017 and the Taipei AMPA bronze medal of the Innovative Products Awards in the accessories category in 2018. It was also awarded an Honorable Mention in the Manufacturing/ Robotics/Automation category for the 2018 Create the Future Design Contest held by NASA Tech Briefs, a leading aviation and aerospace publication, and R&D 100 Awards.

3. Integrating green energy with the plug-and-play energy operating system (EOS)

a. Energy Operating System

Similar to a computer operating system that manages computer software and hardware resources, an energy operating system monitors and controls the distributed renewable energy, energy storage equipment, load and distribution-related facilities

用的 USB 介面與微電網設備通訊連結，可簡化微電網系統通訊連結與電力線建構，縮短建置獨立電網所需時程，進而提升再生能源之使用率。

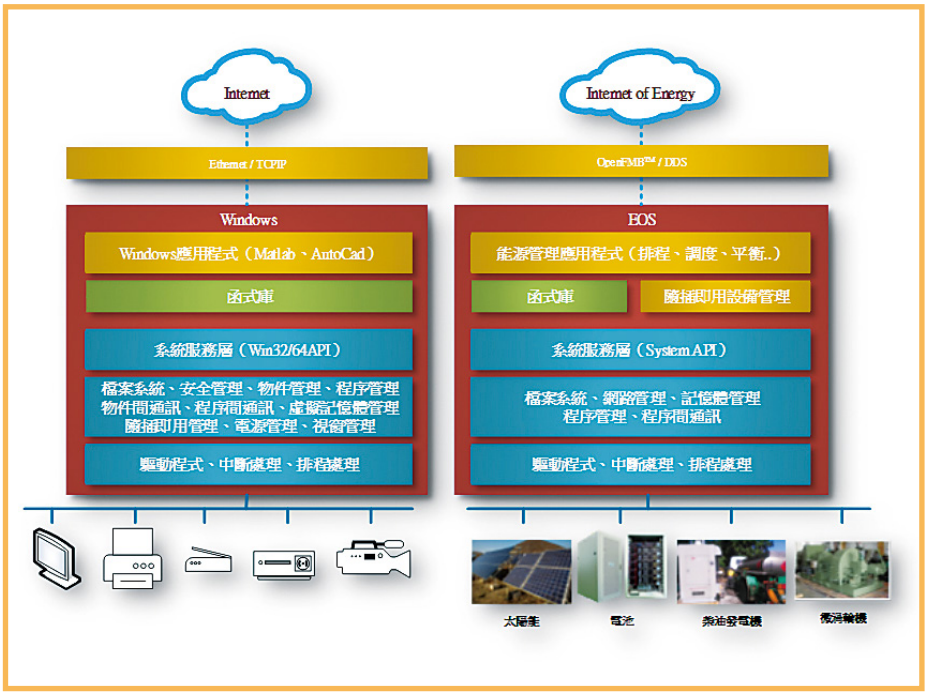


▲ EOS 內發配電相關設施的操作人機畫面
Man-machine operating interface for power transmission and distribution-related equipment within the EOS

2. 能源作業系統的特點

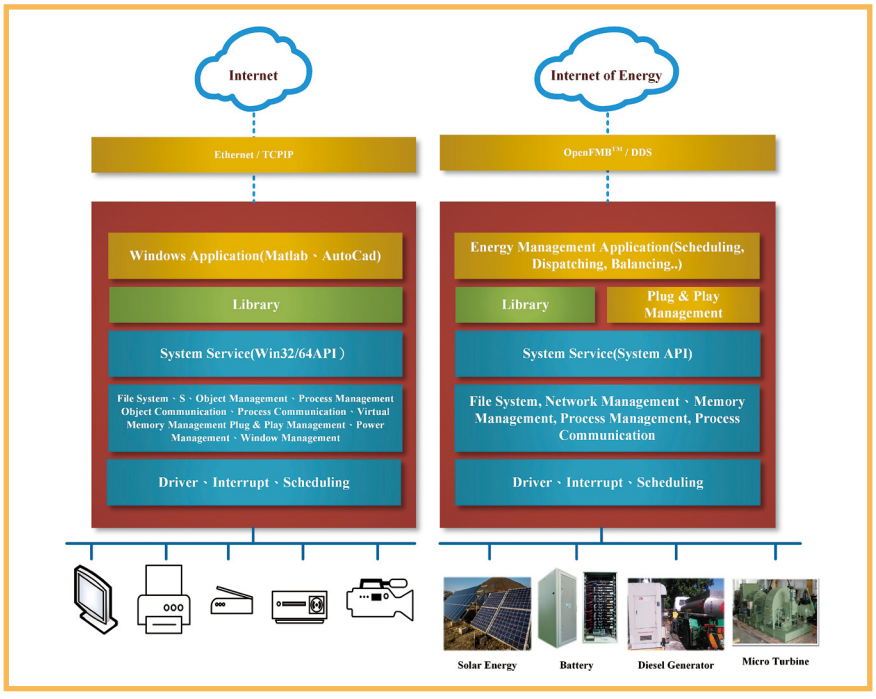
（1）隨插即用：微電網設備透過信號轉換後的 USB 介面與 EOS 相連，就像電腦外接 USB 滑鼠／鍵盤／隨身碟一樣，自動偵測辨識後，即可加入電網系統運作。當部分設備需要維修，關閉並拔除後，EOS 系統亦會偵測，架構改變後也不需手動設定或關機重開。

（2）自動組態：EOS 透過內建之組態偵測／設定功能，自動辨識連結設備類別屬性，包括分散式再生能源、儲能設備、負載及配電設施等，分門別類，各司其職。



▲ 電腦作業系統（Windows）與能源作業系統（EOS）之對比

in a microgrid system. The energy operating system connects and communicates with the microgrid system through a universal USB interface, which simplifies the communication connection and cable configuration of the microgrid system, thereby shortening the time required for building an independent power grid, as well as increasing the utilization of renewable energy.



▲ Comparison between a computer operating system (Windows) and an energy operating system (EOS)

b. Features of the energy operating system

(1) Plug and play: Similar to a mouse, keyboard and flash drive that are connected to a computer through a USB interface, the microgrid device is connected to EOS through a USB interface following the conversion of its signal. Upon automatic detection and identification, it is incorporated into the operating system. EOS will also detect when a certain piece of equipment needs to undergo repair or maintenance after it is switched off and removed. There is also no need to manually reset or restart when the structure has been changed.

(2) Automatic configuration: The built-in function of configuration detection/setting enables EOS to automatically identify the property of a device and connect to it, including distributed renewable energy, energy storage equipment, load and distribution facilities, each with their own function and usage.

(3) Independent grid energy management: EOS can adjust to the specifications and structure of a piece of equipment in the independent grid system, while

（3）獨立電網能源管理：EOS 配合獨立電網系統設備規格與架構，即時監測電力供需狀態，確保供需兩者間保持穩定平衡，並考量再生能源利用率及用戶最大用電需求，使電力品質、綠能優先使用及用戶需求等條件皆能滿足。

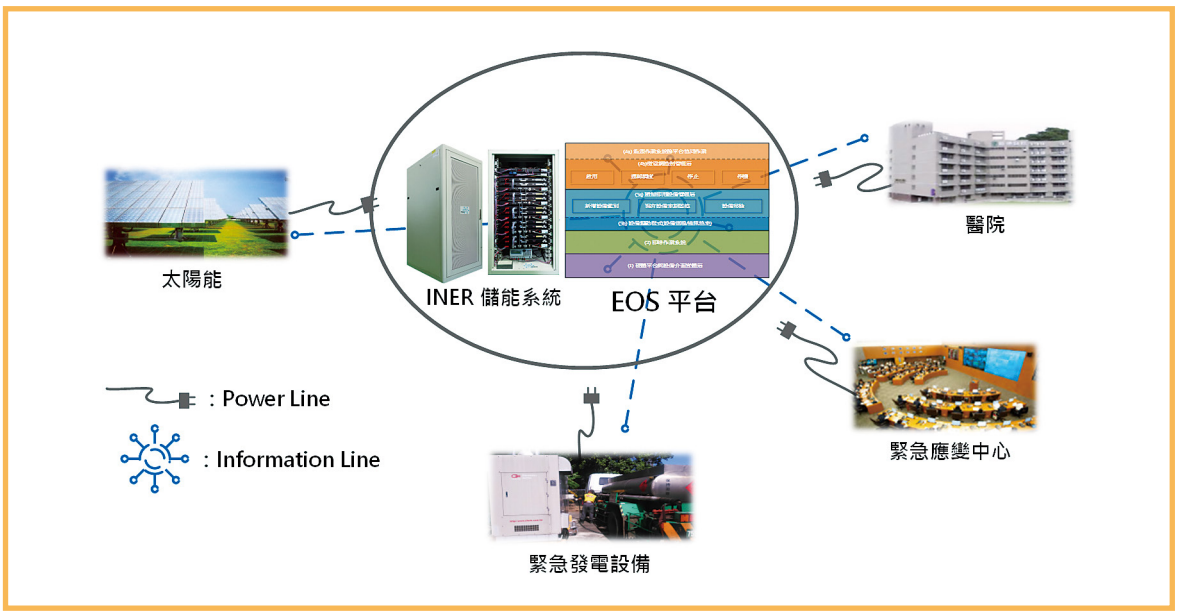
（4）運作模式（獨立／併網）切換：EOS 具備獨立（孤島）與併網兩種運作模式，並確保獨立電網能平順地在孤島與併網模式間進行切換且能穩定運作。

（5）能源聯網：數個 EOS 系統在電力配線條件許可情況下，可透過安全性高之 EOS 聯網功能，彼此協同合作，展現螞蟻雄兵的力量。

3. 能源作業系統的應用情境

（1）獨立運轉模式：A. 建置於電網基礎建設較不完善國家的偏鄉家庭或社區型用戶，以獨立（孤島）運作模式運作，白天或太陽能發電充足時，自發自用，多餘電力進行儲能充電；夜晚或太陽能發電不足時，以儲能系統供電，減緩缺電困擾。B. 於災區醫院或緊急應變中心，結合現有再生能源及緊急發電設施，快速建置救災型微電網系統，在市電尚未修復期間，提供必要之用電。

（2）併網運轉模式：建置於有電網基礎建設之社區、大樓、小型工廠等，當再生能源和儲能設備無法應付自發自用，則由市電負擔部分負載，維持供需平衡；若自發自用有多餘電力，回饋電網，降低電費支出或售電。



▲ 救災型微電網系統
Emergency-oriented microgrid system

monitoring the status of power supply and demand in a real-time manner to ensure stable balance between supply and demand. The utilization of renewable energy and users' demand for maximum power are also taken into consideration to satisfy the following criteria: power quality, priority on using green energy, and user requirements.

(4) Operation mode (independent/grid-connected) switching: EOS operates in both the independent (island) and grid-connected modes; it is ensured that the independent grid can switch smoothly between the island and grid-connected modes and operate stably.

(5) Energy networking: When the conditions of power wiring permit, several EOSs can collaborate with each other through the highly secured EOS networking, demonstrating the effect of synergy.

c. Application scenarios of the energy operating system

(1) The independent operation mode: (A) EOS can be installed in rural households or households in communities in countries with less developed grid infrastructure. The independent (island) mode can be used during the day or when solar power is sufficient to generate power for self-use. The excess power can be stored in energy storage, which can then be used to supply power during the night or when solar power is insufficient, mitigating the impacts of power shortage. (B) EOS can be installed in disaster-stricken hospitals or emergency response centers; it can incorporate existing renewable energy and emergency power generation facilities to promptly build an emergency-oriented microgrid system, while supplying the needed power before the restoration of municipal electricity.

(2) The grid-connected mode: EOS can be installed in communities, multi-storey buildings, small-scale factories, etc., with the existing power grid infrastructure. When renewable energy and energy storage equipment are insufficient for self-use, part of the load can be borne by the municipal grid to maintain the balance between supply and demand. If there is excess electricity after self-use, it can be transmitted to the power grid, whereby electricity bills can be reduced or sales from electricity can be generated.

4. Developing Taiwan's first technology for the planning of NPP decommissioning that has been approved by the competent authority

The Chinshan Nuclear Power Plant is the first NPP facing decommissioning in Taiwan. The operation licenses of its two units expired and will expire in December 2018

（四）發展國內首次且獲得主管機關認可之核電廠除役規劃技術

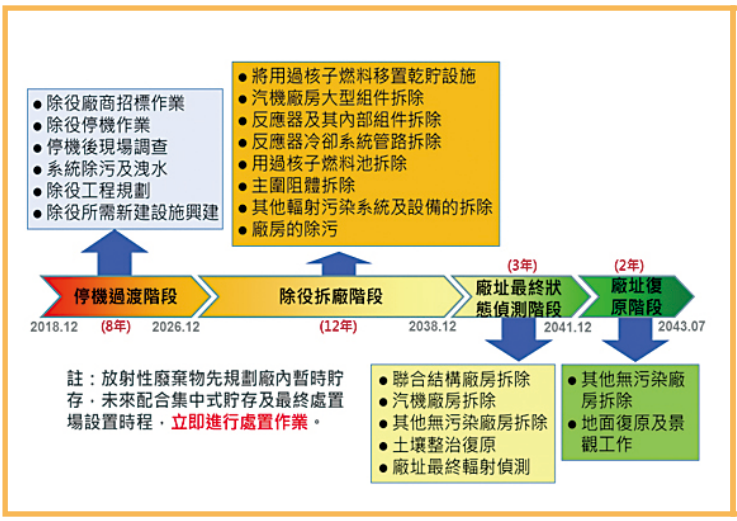
核一廠為我國首座面臨除役的核電廠，兩部機組運轉執照之有效期，將分別於107年12月與108年7月屆滿後陸續展開除役。核研所自102年起配合國家政策，積極參與核一廠除役規劃與申照工作，依據核子反應器設施除役計畫導則完成「核一廠除役計畫」，並發展以下關鍵技術：

1. 除役工作排程規劃

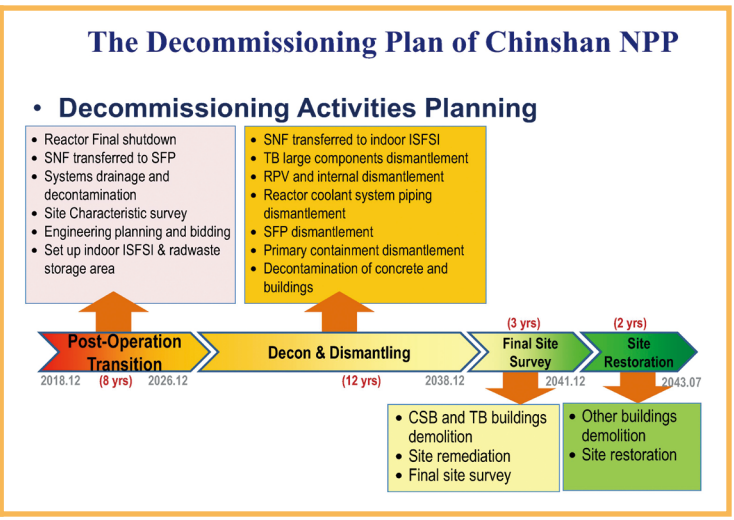
核一廠除役作業規劃依法規要求採拆除方式進行，在取得主管機關核發之除役許可後，於25年內完成除役作業。除役各階段預定工作時程規劃，主要分成四個階段，依序為：停機過渡階段（8年）、除役拆廠階段（12年）、廠址最終狀態偵測階段（3年）及廠址復原階段（2年）。

2. 3D工程模擬與視覺輔助技術

完成核電廠除役所需之系統、結構與組件3D工程模擬，並結合輻射量測數據與工程視覺輔助技術的應用，透過完整且準確的工程參數，建立國內第一個核電廠數位模型資料庫與除役資訊管理系統，以提供作為執行核電廠除役之除污、拆除、放射性廢棄物安全管理及人員訓練等之依據。



▲ 除役作業規劃



▲ Decommissioning Activities Planning

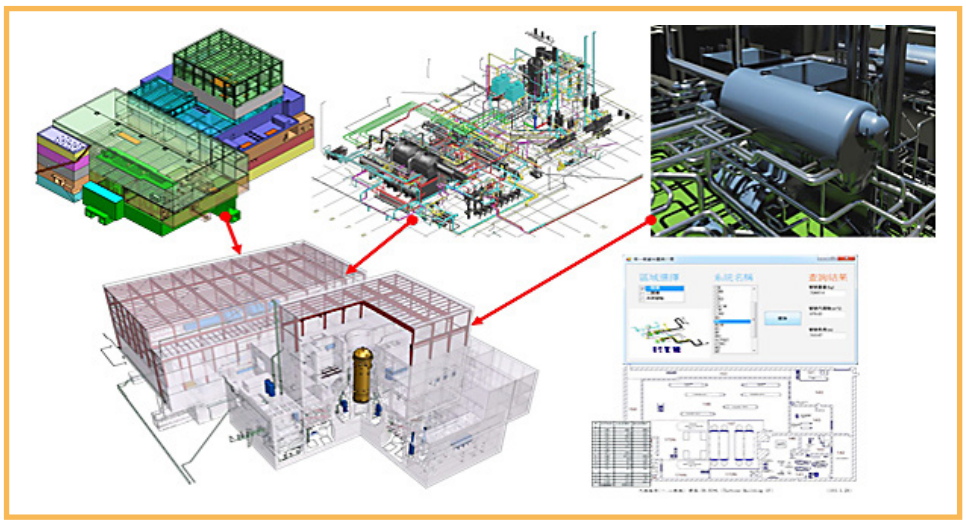
and July 2019, respectively, after which the decommissioning period begins. In line with national policies, INER has been proactively participating in the decommissioning planning and permit application for the Chinshan Nuclear Power Plant since 2013; it has completed "the Chinshan Nuclear Power Plant Decommissioning Plan" based on the guidelines for nuclear reactor facility decommissioning plans, and developed the following key technologies:

a. Schedule planning for decommissioning

According to regulations governing NPP decommissioning, the Chinshan Nuclear Power Plant is required to be dismantled during its decommissioning period. The work needs to be completed within 25 years after the issuance of the decommissioning permit by the competent authority. The decommissioning process can be primarily divided into four phases, each with its predefined work and timeline: the shutdown and transitional phase (8 years), the decommissioning and dismantling phase (12 years), the final site survey phase (3 years), and the site restoration phase (2 years).

b. 3D engineering simulation and visual aid technology

The 3D engineering simulation of the system, structure and components required for NPP decommissioning is completed. Taiwan's first NPP digital model database and decommissioning information management system have been built through the incorporation of radiation measurement data and the application of visual aid technology, as well as the compilation of complete and accurate engineering parameters, which then provide the basis for decontamination, demolition, radioactive waste safety management, and personnel training during NPP decommissioning.



▲ 3D 工程模擬與視覺輔助技術
3D engineering simulation and visual aid technology

七、落實放射性物料管理

（一）依法行政　完備放射性廢棄物管制法規體制

物管局與時俱進，積極檢討增修放射性物料管制法規，107 年已修訂 1 項主管法律、1 項法規命令及 6 項行政規則，嚴密管制規範符合實際需求。

配合行政院組織改造，並遵循國際核能基本安全原則，原能會將改制為核能安全委員會，專司核能安全管制，物管局配合啟動「放射性物料管理法」修正為「放射性物料管制法」，以完備核廢三法架構中之管制法。107 年修法納入放射性物料設施品質保證、廢棄物設施除役及最終處置計畫提報程序等管制規定，以強化安全管制效能。修法作業至今已完成資訊公開及公眾參與程序，並經原能會法規委員會議審議，未來將配合組織改造進程，報行政院送請立法院審議。

考量違規裁處罰鍰符合比例原則，完成研訂「違反放射性物料管理法第二十九條第一項之罰鍰裁量基準」，以期減少裁罰爭議及提升行政效率。此外六項導則與規範的增修，提供業者撰提相關安全分析報告的依循，並有助於提升審查效能。

（二）提升安全　嚴密管制蘭嶼低放貯存場營運安全

依據總統府原住民族歷史正義與轉型正義委員會第 5 次委員會議之決定，邀集經濟部、原民會、台電公司，於 107 年 7 月 31 日召開「蘭嶼核廢料貯存場設置真相調查後續應辦有關遷場及補償事項討論會議」，督導台電公司切實辦理蘭嶼貯存場遷場與損失補償事宜。並於 7 月 19 日函請行政院國家永續發展委員會「非核家

▲ 放射性廢棄物法規體系圖

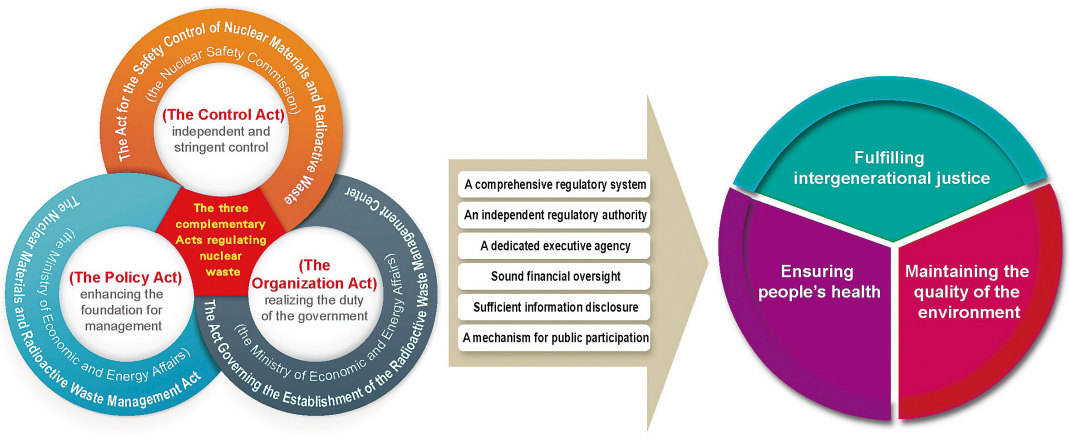
G. Implementing a radioactive materials management system

1. Refining the regulations and framework for radioactive waste control

Keeping up with the times, the Fuel Cycle and Materials Administration (FCMA) has been proactively reviewing and amending the regulations for radioactive materials. One piece of legislation, one regulation order, and six directions were revised in 2018, stringently ensuring that regulation meets actual needs.

In line with the organizational reform of the Executive Yuan and in conformance with the basic principles of international nuclear energy safety, AEC will be renamed the Nuclear Safety Commission and be solely in charge of nuclear safety regulation. Accordingly, FCMA activated the process of modifying "The Nuclear Materials and Radioactive Waste Management Act" to "The Nuclear Materials and Radioactive Waste Regulation Act", refining the regulation act in the framework of the three acts governing nuclear waste. In 2018, provisions on regulation, such as quality assurance of radioactive material facilities, waste facility decommissioning, and procedures for submitting final disposal plans, were included in the revised act to enhance the effectiveness of safety regulation. To date, the revision has undergone the processes of information disclosure and public participation, and was reviewed at AEC legal affairs committee meeting. In the future, the revision will be submitted to the Executive Yuan to deliver to the Legislative Yuan for deliberation, based on the timeline of the organizational reform.

Taking into consideration the principle of proportionality that a penalty should fit the violation, the "Fine Determination Criteria for Violation of Paragraph 1 of Article



▲ Regulatory framework governing radioactive waste

▲ 主任委員視察蘭嶼貯存場
Minister and Chairman Hsieh inspected the Lanyu Storage Site

▲ 提升蘭嶼貯存場營運安全實施計畫示意圖

園推動專案小組」優先討論蘭嶼貯存場遷場及集中式中期貯存場議題，並列管台電公司辦理蘭嶼貯存場遷場之執行進度。

原能會對於蘭嶼貯存場安全至為重視，主任委員於 7 月 26 日視察蘭嶼貯存場。原能會亦要求台電公司加強與蘭嶼地方政府及民眾溝通，並妥善重裝準備作業，俾使重裝作業順遂推展，以提升貯存安全及做好遷場前置作業。蘭嶼鄉公所於 8 月 6 日同意放行容器運送並配合開箱作業指派人員監督，將可順遂重裝作業之執行。

107 年 9 月、10 月執行蘭嶼貯存場重裝容器製程品保專案檢查及重裝整備作業進度專案檢查，要求台電公司務必於開蓋重裝作業前，完成設備建置、人力整備、作業程序書建立等相關整備作業。未來重裝作業期間，原能會將嚴格管制重裝作業安全，以確保蘭嶼居民安全與環境品質。

（三）邁向非核　落實放射性物料安全管制

台電公司規劃將龍門電廠 1,744 束核子燃料運往國外燃料廠家進行處理，以求核子燃料資產最大價值。原能會為核能安全主管機關，負責核子燃料運作之安全管制，尊重經濟部及台電公司之決定。

核子燃料屬國際核子保防物料，原能會為確保燃料運送安全，經嚴密審查後，核備台電公司「核子燃料運送計畫」與「核子燃料安全管制計畫」、「龍門核電廠核子燃料外運廠區作業計畫」，並於 107 年 4 月 26 日同意核子燃料輸出申請。原能會成立檢查專案小組及應變小組，派員全程嚴格監督核子燃料運送，以確保安全。

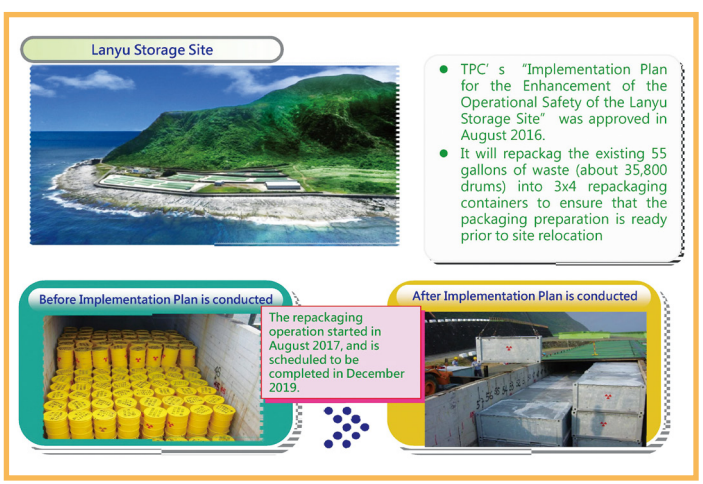
29 of the Nuclear Materials and Radioactive Waste Management Act" was expected to reduce disputes and improve administrative efficiency. In addition, the revision of six guidelines and directions provides industry operators with guidance on the compilation of relevant safety analysis reports and helps improving the effectiveness of the review.

2. Stringent regulation of the operational safety of the Lanyu low-level radioactive waste storage site

According to the decision of the 5th committee meeting of the Presidential Office Indigenous Historical Justice and Transitional Justice Committee, the Ministry of Economic Affairs, the Council of Indigenous Peoples, and TPC were invited to convene the "Review Meeting for Site Relocation and Compensation following the Truth Investigation on the Setup of the Lanyu Storage Site" on July 31, 2018. At the meeting, TPC was urged to effectively and fully carry out the relocation and loss compensation of the Lanyu Storage Site. A letter was delivered to the "Nuclear-Free Homeland Task Force" of the National Council for Sustainable Development under the Executive Yuan on July 19th for it to give priority to discuss the issues of Lanyu Storage Site relocation and centralized interim storage site, as well as monitor TPC's execution progress in managing the relocation of the Lanyu Storage Site.

AEC greatly values the importance on the safety of the Lanyu Storage Site. On July 26th, AEC Minister and Chairman Hsieh inspected the Lanyu Storage Site. AEC also requested TPC to enhance communication with both the local government and residents of Lanyu, while properly preparing for the repackaging operation to smoothly carry out the operation, whereby storage safety can be increased and the preparatory work for site relocation put in place. The Lanyu Township Office agreed to release the transportation of repackaging containers to Lanyu Storage Site on August 6th; it has designated personnel to monitor container inspections, which further contributes to the smooth running of the repackaging operation.

In September and October 2018, AEC conducted the inspection project on process quality assurance for Lanyu Storage Site repackaging containers and on the preparatory progress for repackaging, wherein TPC was requested to complete related preparatory work, such as equipment building,



▲ Schematic diagram of the implementation plan for increasing the operation safety at the Lanyu Storage Site

台電公司於 7 月及 9 月完成 2 批次共 400 束核燃料外運作業，在原能會全程監督作業安全管制之下，安全運往國外燃料廠家進行處理。

原能會要求台電公司依據國際原子能總署的「核物料和核子設施實體防護核子保安規範」規定，謹守核子物料運送作業保密措施，另持續要求台電公司落實三級品保自主管理，加強工安、輻安、核子保防及核子保安等管制措施，以確保核子燃料運送作業安全。

原能會為全民的原能會，核安的守護者，核子燃料完成外運前，原能會實施龍門電廠駐廠視察，持續執行核子燃料貯存設施定期及不定期檢查，以確保貯存安全。

（四）步步為營　督促推動用過核子燃料最終處置

原能會為督促台電公司切實執行用過核子燃料最終處置計畫，要求台電公司應於處置計畫第一階段「潛在處置母岩特性調查與評估」工作完成後，於 106 年提出「我國用過核子燃料最終處置技術可行性評估報告」（SNFD 2017 報告），做為第一階段性的工作目標，並須經國際同儕審查，以確保處置技術符合國際水平。

台電公司於 106 年底提出 SNFD 2017 報告送原能會審查，經原能會邀集國內工程地質、地震工程、土木工程、核子工程、輻射防護、材料科學及功能安全評估等領域專家學者，參照「高放射性廢棄物最終處置及其設施安全管理規則」相關要求，審查其處置技術可行性，相關報告均已上網公開，以強化落實資訊公開透明。

▲ 核子燃料外運原能會應變小組
AEC rapid response task force for nuclear fuel outbound transportation

▲ 核子燃料貨櫃吊運作業
Nuclear fuel container handling

manpower preparation, and operation manual compilation prior to the inception of the repackaging operation. During the repackaging period, AEC will carry out rigorous control on the safety of the repackaging operation to ensure both the safety of Lanyu residents and the quality of the environment.

3. Effectively carrying out regulation of the safety of radioactive materials for a nuclear-free homeland

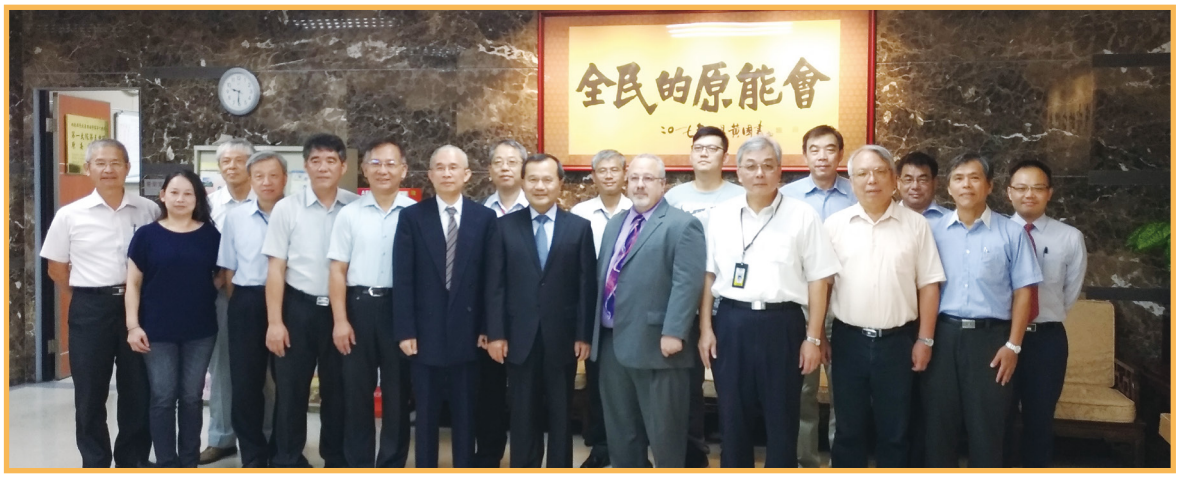
TPC plans to ship 1,744 bundles of nuclear fuel from the Lungmen Nuclear Power Plant back to its manufacturer abroad for further handling to maximize the value of nuclear fuel assets. As the competent authority over nuclear safety, we are responsible for the safety regulation of nuclear fuel operations, and respect the decisions of the Ministry of Economic Affairs and TPC.

Nuclear fuel is material under international nuclear safeguards. To ensure fuel safety during transportation, AEC conducted a rigorous review on the "Nuclear Fuel Transportation Plan", the "Nuclear Fuel Safety Regulation Plan," and the "Operational Plan for the Outbound Transportation of Nuclear Fuel from the Lungmen Nuclear Power Plant" submitted by TPC; all the plans were filed for recordation. AEC approved the application for the shipment of nuclear fuel on April 26, 2018, and subsequently set up an inspection task force and a rapid response task force, designating personnel to carry out rigorous supervision during the entire course of nuclear fuel transportation, so as to ensure safety. A total of 400 bundles of nuclear fuel were shipped in two batches in July and September by TPC. Under AEC supervision and safety regulation during the entire process, they were safely transported to the fuel manufacturer overseas for further handling.

AEC request that TPC comply with International Atomic Energy Agency's "Nuclear Security Recommendations on Physical Protection of Nuclear Materials and Facilities", and strictly adhere to the confidentiality measures regarding nuclear material transporation. AEC also consistently requests TPC to fully carry out self-management of three-tier quality assurance and strengthen regulation in terms of occupational safety, radiation safety, nuclear safeguards and nuclear security, so as to ensure the safe transportation of nuclear fuel.

As the guardian of nuclear safety, AEC stand with all citizens. Before the shipment of nuclear fuel is completed, AEC will carry out on-site inspections on the Lungmen Nuclear Power Plant, and continuously conduct both regular and random inspections on nuclear fuel storage facilities to ensure storage safety.

原能會為周延審查技術能力並提升審查效能，分別於 107 年 3 月邀請德國 TUV 機構專家、7 月邀請美國核管會（NRC）兩位專家、11 月邀請 6 位來自日本原子力研究開發機構（JAEA）、電力中央研究所（CRIEPI）、原子力發電環境整備機構（NUMO）等核廢料處置之專家學者，召開三場次之技術研討會議，邀集國內外學者專家進行技術交流，以強化 SNFD 2017 報告之品質與水準。SNFD 2017 報告經五回合的技術審查後審結，原能會要求台電公司切實依照審查委員及國際同儕審查意見，進行檢討修正並反饋於 10 月底提報之「用過核子燃料最終處置計畫書」（2018 年修訂版），以強化最終處置計畫第二階段「候選場址評選與核定階段」（2018 ～ 2028 年）之技術建置工作。



▲ 邀請美國核管會辦理技術研討會議
Experts from the US Nuclear Regulatory Commission attending the technical conference

▲ 邀請日本研究機構專家辦理技術研討會議
Experts from research institutes and agencies in Japan attending the technical conference

4. Urging and promoting the step-by-step management of final disposal of spent nuclear fuel

To urge TPC to strictly carry out the final disposal plan for spent nuclear fuel, AEC requested TPC to submit "The Technical Feasibility Assessment Report on the Spent Nuclear Fuel Final Disposal" (the SNFD 2017 report) in 2017 after the completion of "Potential Host Rock Characterization and Evaluation" during the first stage of the disposal plan; this served as the objective of the first stage. Furthermore, the SNFD 2017 report must undergo international peer review to ensure that the disposal technologies meet international standards.

TPC submitted the SNFD 2017 report at the end of 2017 for AEC review. AEC invited experts and academics in various fields in Taiwan, including: engineering geology, earthquake engineering, civil engineering, nuclear engineering, radiation protection, materials science, and functional safety assessment, to review the feasibility of disposal technologies with reference to relevant requirements specified in the "Regulations on the Final Disposal of High Level Radioactive Waste and Safety Management of the Facilities." All relevant reports have been made available online to strengthen the principle of information disclosure and transparency.

To develop more comprehensive review skills and capabilities, as well as increase review effectiveness, AEC invited experts with expertise in nuclear waste disposal to hold three technical conferences in March, July and November 2018, respectively: some from Germany's TÜV Rheinland Group, two from the US Nuclear Regulatory Commission (NRC), and six from the Japan Atomic Energy Agency (JAEA), the Central Research Institute of Electric Power Industry (CRIEPI), and the Nuclear Waste Management Organization of Japan (NUMO). At the conferences, domestic and international experts and academics gathered for technical exchanges, whereby the quality and standard of the SNFD 2017 report were enhanced. After five rounds of technical review, the review on the SNFD 2017 report was concluded. AEC requested TPC to fully refer to the review opinions of both the review committee and international peers, and conduct relevant review and revision. The results shall be incorporated into "the Final Disposal Plan for Spent Nuclear Fuel", which was to be submitted at the end of October (2018 revision), so that the technical implementation work of the second stage of the final disposal plan: "Candidate Site Investigation and Confirmation Stage" (2018~2028) can be enhanced.

▲ 自來水公司淨水廠
TWC water purification plant

▲ 自來水樣
Tap water samples

八、強化環境輻射監測

（一）民生供水及市售飲用水輻射加強監測計畫

國人對於飲用水之輻射安全日益關心，輻射偵測中心為確保國人飲用水之輻射安全，定期採取台灣自來水公司所屬淨水廠及臺北自來水事業處所屬給水廠之飲用水樣品，並至消費市場購買各品牌瓶裝水試樣進行放射性含量分析。

自 107 年起輻射偵測中心與台灣自來水公司協調，由原來的 26 所淨水廠擴大至 203 個淨水廠進行飲用水放射性含量調查，加上臺北自來水事業處所屬 10 個給水廠及金門縣政府所屬 3 個淨水廠總計 216 個淨水廠，以保障國人飲用水放射性方面之安全；107 年各類飲用水放射性含量分析結果皆符合法規規定，無輻射安全顧慮，國人可以安心飲用。

所有分析結果均刊載於「台灣地區放射性落塵與食品調查」半年報中，並同時公布於原能會網站上供外界查詢及下載。

（二）強化南部地區食品輻射檢測能量

當國內外發生核子事故或輻射意外事件時，必須檢測民生相關的大量流通商品與生活環境用水等樣品，為解決我國目前放射性分析能量不足問題，輻射偵測中心協助屏東科技大學建制輻射災害放射性分析備援實驗室，培育輻射度量及檢測技術之實務操作人員，加入核安食品檢驗以提升輻射污染事故的處理與分析能量，該實

▲ 礦泉水
Mineral water

▲ 水樣分析
Water sample analysis

H. Strengthening environmental radiation monitoring

1. Reinforcing the monitoring of radiation in household water and drinking water commodities

Public's concern of radiation safety in drinking water is increasing. To ensure radiation safety in drinking water in Taiwan, Radiation Monitoring Center (RMC) regularly takes drinking water samples from water purification plants of both the Taiwan Water Corporation (TWC) and the Taipei Water Department, and purchases bottled water under various brand names from consumer markets to conduct radioactive content analyses.

RMC has coordinated with TWC to expand the scope of measuring for radioactive content in drinking water, originally taking water samples from 26 water purification plants in the past to 203 plants since 2018. Adding 10 water purification plants from the Taipei Water Department and 3 water purification plants under Kinmen County Government, the total number of water purification plants under the task of radioactive analysis reaches 216, whereby radiation safety in drinking water for citizens can be secured. According to the analysis results, the radioactive contents in the samples taken from various drinking water sources in 2018 were all within regulatory limits; they do not pose any threat to radiation safety in drinking water for the public.

All analysis results have been published in the Semi-Annual Report on "Radioactive Fallout and Food Survey in Taiwan"; they are also available on AEC website for the public to search and download.

驗室於 107 年 6 月完成全國認證基金會（TAF）認證，未來藉由基金會進行放射性分析能力試驗、監督評鑑等督考機制達到品質優化之保證。

另外為強化地方政府衛生單位對於食品輻射檢驗能力，亦邀集南部地區台南市、高雄市及屏東縣等衛生局共同參與輻射偵測中心舉辦之「純鍺半導體偵檢器加馬能譜分析系統」實務訓練，並舉行二場研討會，共同投入食品放射性核種之檢驗，未來若有輻射災害事件亦可協助大量市售食品之放射性含量檢測。

（三）全國環境輻射監測設施的新作法

輻射偵測中心肩負全國各項環境輻射偵測工作，在核設施周圍及各地區設置環境輻射監測設施，確實維護國民及環境的輻射安全。

▲ 純鍺半導體偵檢器加馬能譜分析系統實務訓練課程實作及樣品前處理
Practices and sample pretreatment in the training workshop on the “Application of High Purity Germanium Gamma-ray Spectrometer”

2. Strengthening the capacity for food radioactive analysis in the southern Taiwan

In the event of a nuclear or radiation accident, whether in or near Taiwan, it becomes imperative to collect samples from a large number of household-related consumer commodities and environmental water for testing. To solve the issue of insufficient capacity for radioactive analysis in southern Taiwan, RMC assisted National Pingtung University of Science and Technology in building a backup laboratory for radioactive analysis of radiation hazards to cultivate practical operatives possessing radiation measurement and detection skills. These operatives can then join the workforce for the detection of nuclear contamination in food, thus increasing the capacity in handling and analyzing a radioactive contamination incident. The backup laboratory obtained accreditation from the Taiwan Accreditation Foundation (TAF) in June 2018. In the future, its quality will be optimized via tests, supervision, and appraisal of its capabilities in radioactive analysis conducted by TAF.

To strengthen the capabilities of the health bureaus of local governments in radiation detection in food, RMC also invited health bureaus in Tainan City, Kaohsiung City, and Pingtung County to take part in its training workshop on the "Application of High Purity Germanium Gamma-ray Spectrometer". RMC also held two conferences on the tests of radionuclides in foods to expand assistance in high-volume radioactive content detection in marketed foods in a radioactive accident.

3. New practices for nationwide environmental radiation monitoring

RMC is responsible for various tasks in environmental radiation surveillance. It has set up environmental radiation monitoring facilities around nuclear facilities and in various regions to ensure the radiation safety of people and the environment.

To advance the practices in environmental radiation monitoring facilities in Taiwan, the "Setup Guidelines for Environmental Radiation Monitoring Facilities" was formulated on January 10, 2018. In the Guidelines, monitoring facilities are classified into three types based on the monitoring objectives: basic, standard and enhanced. The basic type refers to real-time environmental radiation monitoring stations, which are suitable for monitoring environmental background radiation in Taiwan. The standard type consists of not only real-time environmental radiation monitoring stations, but also aerosol suction machine, and fallout collector, etc., to perform radioactive detection of atmospheric particulate matter and fallout around nuclear facilities. The enhanced type includes those of the basic and standard types and high-volume aerosol suction that can rapidly sample at least 500 liters per minute for early detection of global radioactive fallout.

為精進全國環境輻射監測設施的做法，於 107 年 1 月 10 日增訂「環境輻射監測設施設置要點」，依監測目標將監測設備分為基本型、標準型及加強型三類。基本型包含環境輻射即時監測站，適用於臺灣地區環境背景輻射偵測；標準型除了環境輻射即時監測站外，增設空浮微粒抽氣裝置、乾濕沉降取樣裝置等設備，執行大氣中懸浮微粒及落塵的放射性偵測，使用於核設施周圍環境輻射監測；加強型則再增加高容量抽氣設備，每分鐘可快速抽取至少 500 公升以上的空氣，及早監測來自境外放射性落塵。

為確保資源有效運用及監測設施全天候 24 小時穩定運作，並利於後續管理及儀器設備之維護，監測設施的設置原則為：

1.未具有核設施（指核子反應器設施、放射性廢棄物處理、貯存或最終處置設施）之臺灣各直轄市及縣市，以設置 1 至 2 站基本型監測設施為原則；必要時可設置標準型監測設施。

2.具有研究用核子反應器及放射性廢棄物處理、貯存或最終處置設施之直轄市及縣市，在距離核設施 5 公里內，以設置 2 至 4 站基本型監測設施為原則；必要時可設置標準型監測設施。

3.具有動力用核子反應器設施之直轄市及縣市，在距離核子反應器設施 15 公里內，以設置 5 至 7 站監測設施為原則；其中監測設施至少 2 站為標準型監測設施，另因應核事故之可能發生，至少設置 1 站加強型監測設施。

4.考量台灣鄰近區域國情，若境外有發生核事故之虞，因應實際應變狀況，可擇離島或南北大城市設置標準型監測設施，必要時可改為加強型監測設施。

◀ 標準型環境輻射監測設施之監測設備配置圖
Layout of monitoring equipment in a standard-type environmental radiation monitoring facility

To ensure the effective utilization of resources and the stable operation of monitoring facilities 24/7, as well as to facilitate subsequent management and maintenance of instruments and equipment, monitoring facilities are set up in compliance with the following principles:

a. For municipalities, counties and cities where there are no nuclear facilities (referring to nuclear reactor facilities, radioactive waste processing, storage or final disposal facilities), the recommended guideline for monitoring facility setup is one to two basic-type monitoring facilities, or standard-type facilities if necessary.

b. For municipalities, counties and cities where there are nuclear reactor facilities for research purposes or radioactive waste processing, storage or final disposal facilities, the recommended guideline for monitoring facility setup is two to four basic-type monitoring facilities within five kilometers of nuclear facilities, or standard-type facilities if necessary.

c. For municipalities, counties and cities where there are power generation nuclear reactor facilities, the recommended guideline for monitoring facility setup is five to seven monitoring facilities within 15 kilometers of nuclear reactor facilities, with at least two standard-type monitoring facilities and one enhanced-type monitoring facility, due to the possibility of a nuclear emergency.

d. Taking into consideration the situations in neighboring countries and the possibility of a nuclear emergency beyond the borders, the recommended guideline is to set up standard-type monitoring facilities on offshore islets or in municipalities in Northern and Southern Taiwan, depending on actual response conditions, or enhanced-type monitoring facilities if necessary.

To effectively utilize resources to ensure the environmental radiation safety of the public, five monitoring facilities were set up in the following locations in 2018 as per the Guidelines: Pengjia Islet (Agincourt), Shihmen Reservoir, National Tsing Hua University, Lanyu Weather Station, and Huangtan, Wanli District next to the Kuosheng Nuclear Power Plant. The number of environmental radiation monitoring stations in Taiwan subsequently increased to 51, while several basic-type monitoring stations were adjusted to standard-type or enhanced-type ones.

為有效運用資源確保民眾之環境輻射安全，107 年依據要點新增彭佳嶼、石門水庫、清華大學、蘭嶼氣象站及核二廠旁萬里區磺潭等 5 個監測站，使全國環境輻射監測站數達 51 站，並調整若干基本型站點為標準型或加強型等環境輻射監測設施。

環境輻射自動監測系統 107 年執行現況

類別	設置地點	編號	監測設施類型	環境監測站	乾濕沉降裝置	抽氣機	高容量抽氣機	設置情型
核一廠	石門國中	1	標準型	●	▲	●		調整
	石崩山	2	標準型	●	▲	●		調整
	茂林社區	3	加強型	●	▲	●	▲	調整
核二廠	野柳	4	標準型	●	▲	●		調整
	大鵬	5	加強型	●	▲	●	▲	調整
	磺潭	6	標準型	▲	▲	▲		新增
核三廠	恆春氣象站	7	加強型	●	▲	●	▲	調整
研究用	石門水庫	8	基本型	▲				新增
	清華大學	9	標準型	▲	▲	●		新增
貯存設施	蘭嶼氣象站	10	標準型	▲	▲	▲		新增
離島	彭佳嶼	11	基本型	●				新增

說明：符號「●」原有設備；符號「▲」新增設備；「空白」表示不須設置

（四）國民輻射劑量調查之先期研究

日常生活環境中，存在著感受不到的游離輻射，世界各處都無可避免，然而因為地理環境與生活條件不同，各國的國民輻射年平均劑量差異頗大。如美國與日本評估年平均劑量大約 6 毫西弗，而英國大約 2.7 毫西弗，聯合國統計全球平均年劑量 3 毫西弗。台灣在民國 86 年統計國人年輻射劑量大約 2.4 毫西弗。

由於各國國民輻射劑量來源可分為天然與人造兩方面，天然的輻射源來自地面及建材微量的鈾、釷系列放射性同位素、氡氣、食品飲水中的鉀同位素以及來自太空的宇宙輻射。人造輻射主要來自醫療檢查的應用以及消費產品的輻射。因為台灣

Status of the environmental radiation monitoring system in 2018

Category	Setup location	Number	Type of monitoring facility	Environmental monitoring station	Fallout collector	Aerosol suction	High-volume aerosol suction	Setup status
Chinshan Nuclear Power Plant	Shih Men Junior High School	1	Standard type	●	▲	●		Adjusted
	Shibeng Mountain	2	Standard type	●	▲	●		Adjusted
	Maolin Community	3	Enhanced type	●	▲	●	▲	Adjusted
Kuosheng Nuclear Power Plant	Yehliu	4	Standard type	●	▲	●		Adjusted
	Dapeng	5	Enhanced type	●	▲	●	▲	Adjusted
	Huangtan	6	Standard type	▲	▲	▲		Newly added
Maanshan Nuclear Power Plant	Hengchun Weather Station	7	Enhanced type	●	▲	●	▲	Adjusted
Research Nuclear Reactor Facilities	Shihmen Reservoir	8	Basic type	▲				Newly added
	National Tsing Hua University	9	Standard type	▲	▲	●		Newly added
Waste Storage Facility	Lanyu Weather Station	10	Standard type	▲	▲	▲		Newly added
Offshore Islet	Pengjia Islet	11	Basic type	●				Newly added

Note: " ● " refers to existing facilities; " ▲ " refers to newly added facilities; a blank cell indicates setup not required.

4. A pilot study on people's exposure to radiation in Taiwan

Ionizing radiation cannot be felt but it exists in our daily lives. It cannot be avoided anywhere on the globe. However, due to different geological environments and living conditions, the average annual radiation exposure between nationals of different countries varies greatly. For instance, the average annual radiation exposure per person in the United States and Japan is 6 milli-sievert (mSv); for UK nationals, it is 2.7 mSv. According to the United Nations statistics, the average annual radiation exposure per person worldwide is 3 mSv. Based on the 1997 statistics, the national average annual radiation exposure per person in Taiwan is 2.4 mSv.

多居住於鋼筋混泥土房舍，導致體外輻射較國外高，但是氡氣造成的體內曝露則較其他國家低。美國的調查結果則顯示近年醫療檢查中，使用電腦斷層的檢查大幅增加，是造成醫療輻射劑量最主要的輻射來源。

輻射偵測中心 107 年初步調查發現，地表體外輻射劑量及食品飲水造成的體內輻射與之前相比變化不大；國際航線飛航人次則大幅增加四倍有餘；室內氡氣因氣密窗與空調的使用，平均濃度大約增加一倍；醫療輻射的單項劑量統計如電腦斷層，依近年國內文獻也呈現上升的趨勢。後續將參照 107 年先期研究之結果，持續調查評估國內各類輻射來源對國人造成的輻射劑量。

Sources of radiation exposure include natural and man-made ones. Natural radiation sources come from the minute traces of radioisotopes of uranium and thorium series and radon emitted from both the ground and building materials, potassium isotopes from foods and drinking water, and cosmic radiation from space. Man-made radiation mainly comes from the application of medical examinations and consumer products. Most houses and buildings in Taiwan are made of reinforced concrete structures; as a result, the level of external radiation is relatively higher than that of other countries, but the level of internal exposure to radon is lower. Recent U.S. surveys show that the major source of radiation in medical radiation exposure comes from CT scans, which results from a significant increase in medical examinations using CT scans.

A preliminary investigation by RMC in 2018 found the following: the levels of external radiation from the terrestrial and internal radiation from food and drinking water did not change much from that of previous periods; the number of people taking international flights increased by more than four times; the average concentration of indoor radon approximately doubled as a result of the increased use of airtight windows and air conditioning; according to recent literature in Taiwan, single dose statistics from medical radiation, such as CT scans, also showed an upward trend. Based on the results of the preliminary investigation in 2018, RMC will continue to investigate and evaluate the Taiwanese nationals' radiation exposure to various types of radiation sources.

伍

大事紀

Chronicle of Events

January

01.10
訂定「環境輻射監測設施設置要點」，並自即日起開始實施。
The "Setup Guidelines for Environmental Radiation Monitoring Facilities" was formulated and made effective immediately.

01.19 、 01.26
辦理聽取核電廠工作人員對原能會管制作業建言之查訪作業。
AEC conducted an onsite inspection and held a meeting for communication with the staff from NPP in each operating NPPs.

01.22
修正發布「放射性物料設施設計修改及設備變更申請審核作業規範」。
The "The Review Guide for Design Amendment and Equipment Change on Nuclear Materials and Radioactive Waste Facilities" was revised and promulgated.

01.24 、 03.09 、 04.09
核定核一廠、核二廠、核三廠保安計畫。
The security plans of the Chinshan, Kuosheng and Maanshan Nuclear Power Plants were approved.

01.26
法國在台協會 Guillaume Roy 副主任等一行訪會。
A visit by Mr. Guillaume Roy, Deputy Director of the French Office in Taipei (Bureau Français de Taipei), along with his colleagues.

February

02.01
辦理年終記者會，向外界說明原能會施政成果及未來業務主軸。
AEC held a year-end press conference, in which our achievements in administration were cited and key features of future operations were outlined.

02.05 | 03.20
執行「核二廠 2 號機第 25 次大修後再起動」審查作業，完成審查後同意再起動之申請。
AEC completed the review of the application from TPC for the restart of Kuosheng Nuclear Power Plant Unit 2 after its 25th outage and approved the restart application.

02.27
原能會委員參訪核研所研發設施。
AEC council members visited the research and development facilities of the Institute of Nuclear Energy Research (INER).

March

03.02 、 04.28 、 05.16
執行「107 年度第 1 次核三廠、核一廠及核二廠不預警視察」。
AEC conducted first unannounced inspections at each operating NPPs in 2018.

03.12
完成 106 年下半年「臺灣地區放射性落塵與食品調查半年報」。
The "Semi-Annual Report on Radioactive Fallout and Food Survey in Taiwan" of the second half of 2017 was completed.

3 March

03.13	會同輻防處至清華大學同位素館執行取樣平行監測計畫，總共取樣 13 件，3 月 21 日完成報告提送輻防處。 Along with the Department of Radiation Protection, AEC inspectors visited the Isotope Division, Nuclear Science and Technology Development Center of National Tsing Hua University to carry out a parallel sampling and monitoring program. A total of 13 samples were taken, and the report was completed and submitted to the Department of Radiation Protection on March 21st.
03.13	召開放射性物料安全諮詢會第 1 次會議。 The first meeting of the Radioactive Materials Safety Advisory Board was convened.
03.16 ｜ 03.28	辦理 4 梯次「原能會 106 年度個案管制計畫期末查訪會議」。 Four sessions of the "2017 AEC Annual Meeting on Case Control Plan" were conducted.
03.20	邀請新北市政府、區公所、地方及環保團體代表參加「核一廠乾式貯存設施訪查活動」之統合演練作業。 Officials from New Taipei City Government and district offices and representatives from local and environmental groups were invited to take part in a "Visit to Chinshan Nuclear Power Plant Dry Storage Facility" and observe an associated integration drill.
03.28	邀請核能專家辦理德國放射性廢棄物管制技術研討會，分享德國除役放射性廢棄物處理與貯存實務、室內乾式貯存設施及最終處置計畫發展現況。 Nuclear experts were invited to hold the Workshop on Safety Regulation of Radioactive Waste in Germany and to share their practices in the treatment and storage of radioactive waste from decommissioning, as well as the development status of indoor dry storage facilities and final disposal plans.

4 April

04.02	「輻射應變技術隊」參與桃園市之 107 年民安 4 號演習。 AEC "Radiation Emergency Response Technical Team" took part in the Min-an No. 4 exercise hosted by Taoyuan City.
04.03 ｜ 05.14	執行「核三廠 1 號機第 24 次大修作業視察」及同意再起動之申請。 AEC conducted inspection during the refueling outage (EOC-24) of Maanshan NPP unit 1 and issued the restart approval.
04.04 ｜ 05.13	為「2018 桃園農業博覽會」綠能零碳之展示，核研所協助提供微電網電力轉換設備及雙向電力控制等技術。 INER provided microgrid power conversion equipment and bidirectional power control and other technologies to the "2018 Taoyuan Agriculture Expo" to support its exhibition on green energy and zero carbon.

04.09 | 06.05
執行「核二廠 2 號機 107 年 3 月 28 日機組急停事件」審查作業，完成審查後同意再起動之申請。
AEC completed the review of the application from TPC for the restart of Kuosheng Nuclear Power Plant Unit 2 after a scram on March 28, 2018 and approved the restart application.

04.10
人事行政總處審查核能安全委員會組織法草案。
The Directorate-General of Personnel Administration reviewed the draft of the Organization Act of the Nuclear Safety Commission.

04.11 | 04.15
核研所技術移轉廠商以核研所協助開發之頂級隔熱紙產品參加「2018 年台北國際汽車零件配件展」之創新產品獎競賽，榮獲配件類銅牌獎。
A manufacturer, a transferee of a technology transfer with INER, entered the "2018 Taipei AMPA" Innovative Product Awards contest with the entry of top-end window film that INER assisted in developing. It won the Bronze Medal in the accessories category.

04.12
核研所與台經院共同召開「台灣有機太陽能電池產研協會」成立大會，並舉辦「有機與鈣鈦礦太陽能電池產業化研討會」，以推廣太陽能電池產業，促進產學研之交流與整合。
INER and the Taiwan Institute of Economic Research jointly convened the inaugural meeting of the "Taiwan Organic Solar Cell Industry Research Association", and organized the "Industrialization of Organic and Perovskite Solar Cells Conference" to promote the solar cell industry and facilitate exchanges and integration among industry, academia, and research institutes.

04.16 | 04.18
核研所、亞洲核能結構完整性協會及龍華科技大學共同主辦第 12 屆亞洲核能結構完整性國際研討會（ASINCO-12），並增加核後端除役及用過核燃料處置結構安全技術專題。
INER, the Asian Society for Integrity of Nuclear Components, and Lunghwa University of Science and Technology jointly held the 12th International Workshop on the Integrity of Nuclear Components (ASINCO-12), wherein the keynotes of the decommissioning of back-end nuclear facilities and structural safety technology for spent nuclear fuel disposal were added to its agenda.

04.23
協助北部備援實驗室（陽明大學食品檢驗分析實驗室）取得財團法人全國認證基金會（TAF）之游離輻射領域測試實驗室認證。
AEC assisted the northern backup laboratory (National Yangming University Food Testing and Analysis Laboratory) to be certified as an ionizing radiation testing laboratory from the Taiwan Accreditation Foundation (TAF).

04.25
完成 106 年台灣地區環境輻射監測年報並於官網公開。
The "2017 Annual Report on Environmental Radiation Monitoring in Taiwan" was completed and published on AEC website.

4 April

04.27 召開第 16 屆第 1 次「游離輻射安全諮詢會」。
The first session of the 16th "Ionizing Radiation Safety Advisory Board" was convened.

04.29 舉辦 107 年度第 1 次「輻射防護專業測驗及操作人員輻射安全證書測驗」。
The 1st "Certification Examination for Radiation Protection Personnel and Radiation Operators on Radiation Safety" in 2018 was held.

04.30 發布我國「106 年度全國輻射工作人員劑量統計年報」。
The "2017 Annual Statistical Report on Occupational Radiation Exposure in Taiwan, Republic of China" was published.

5 May

05.10 辦理 107 年低放處置計畫專案視察作業及用過核子燃料最終處置計畫專案視察作業。
The 2018 inspection project on the disposal plan for low-level radioactive waste and the final disposal plan for spent nuclear fuel were carried out.

05.17 核研所舉辦「原子能委員會委託研究計畫成果發表會」，邀請產、學、研界合作夥伴出席，參加人數計 463 人。
INER organized the "Presentation of Results from Research Projects Commissioned by AEC". Partners from industry, academia, and research institutes were invited to attend the event; there were 463 participants.

05.18 辦理核子事故民眾防護措施之疏散交通規劃地方座談會，並要求台電公司參考與會民眾意見，進行疏散效益評估。
AEC held a local forum on evacuation and traffic planning as a public protective action in the event of a nuclear emergency, during which TPC was requested to refer to participants' opinions to evaluation on the effectiveness of evacuation.

05.21 | 05.25 邀請美國阿岡實驗室專家辦理「核能電廠除役期間廠址劑量評估程式（RESRAD）」訓練課程。
AEC invited experts from the US Argonne National Laboratory to conduct "RESidual RADioactivity (RESRAD) Assessment during the NPP Decommissioning Period" training course.

05.25 「核子事故緊急應變法」修正草案經立法院第 9 屆第 5 會期第 14 次院會會議決定，交付教育文化委員會審查。
The draft amendment of "Nuclear Emergency Response Act" was submitted to the Legislative Yuan.

05.28 | 05.31 執行核三廠核子保安暨緊急應變整備年度視察。
AEC performed annual inspection on nuclear security and nuclear emergency response and preparedness at Maanshan Nuclear Power Plant.

May

05.29 | 05.30 、08.09 | 08.10	辦理二梯次地方政府「純鍺半導體偵檢器加馬能譜分析系統實務訓練」，協助高雄市、台南市及屏東縣食品衛生單位輻射檢測作業。 Two sessions of local government "Training Workshops on Application of High Purity Germanium Gamma-ray Spectrometer" were held to assist the food and health authorities of Kaohsiung City, Tainan City and Pingtung County in their respective radiation detection practices.
05.30	辦理 106 年度放射性廢棄物最終處置計畫執行成效評核會議。 The 2017 appraisal meeting on the effectiveness of the execution of the final disposal plan for radioactive waste was held.
05.31	公告「放射性物料管理法部分條文修正草案」於眾開講平台。 The "Draft of Partial Amendments to the Nuclear Materials and Radioactive Waste Management Act" was published on the National Development Council Platform for Public Consultation.
05.31	訂定發布「核子事故民眾防護行動應變與決策參考指引」。 The "Reference Guidelines for Decision Making on Public Protective Actions in a Nuclear Accident" was promulgated.
05.31	辦理「核二廠 2 號機 107 年 3 月 28 日機組急停事件安全管制作業」地方說明會。 AEC held the public meeting for "Regulatory measures on the automatic shutdown event of Kuosheng NPP Unit 2 on March 28, 2018".

June

06.04	協助南部備援實驗室（屏東科技大學災害防救科技研究中心放射性分析備援實驗室學）取得財團法人全國認證基金會（TAF）食品檢測認證及通過能力試驗程序，10 月 11 日開始對外服務。 RMC assisted the backup laboratory in the southern region (Backup Laboratory for Radioactive Analysis of Radiation Hazard of the Disaster Prevention and Mitigation Technology Research Center, National Pingtung University of Science and Technology) to obtain accreditation in food testing from the Taiwan Accreditation Foundation (TAF), while passing capacity test procedures. The laboratory began service to the public on October 11th.
06.04 | 06.08	薦派新進人員乙名，赴國際原子能總署維也納總部見習。 A new recruit was recommended and appointed to the headquarters of the International Atomic Energy Agency (IAEA) in Vienna for an internship.
06.05	邀請蘭嶼居民及團體代表參與「107 年度蘭嶼地區環境輻射平行監測活動」。 Lanyu residents and community representatives were invited to participate in the "2018 Environmental Radiation Parallel Monitoring Activity in Lanyu Area".
06.11 | 06.15	邀請美國專家舉辦「2018 核設施資安風險管控訓練」。 U.S. Experts were invited to conduct a workshop about "Information Security Risk Management and Control in Nuclear Facilities".

6 June

06.13	辦理 107 年核子事故南部輻射監測中心人員再訓練，包含各單位人員共 52 員。 The 2018 southern region radiation monitoring center personnel re-training on nuclear emergencies was conducted. A total of 52 people from various units attended the re-training.
06.15	辦理「107 年放射性廢棄物處理設施運轉人員測驗」。 The "2018 Examination for Operators of Radioactive Waste Treatment Facilities" was held.
06.15、08.17、09.21	執行「107 年度第 2 次核三廠、核一廠及核二廠不預警視察」。 AEC conducted second unannounced inspections at each operating NPPs in 2018.
06.19 | 06.20	召開第 4 屆台日核安管制資訊交流會議。 The 4th AEC-NRA Nuclear Regulatory Information Exchange Meeting was held.
06.21 | 06.22	應經濟合作暨發展組織核能署（OECD/NEA）邀請，派員赴日本分享我國反應器監管程序（Reactor Oversight Process）的管制經驗。 OECD/NEA invited AEC's senior staff to attend a workshop in Japan for Reactor Oversight Process and to share AEC's regulatory experience.
06.26 | 06.28	辦理與美國核管會之雙邊技術交流會議。 AEC held the 2018 AEC-NRC Bilateral Technical Meeting.
06.28	國際原子能總署於該署網站公布 2017 年全球核子保防實施總結報告，宣告我國連續第 12 年為「所有核物料均用於核能和平用途」國家。 IAEA published the Safeguards Statement for 2017 on its website, declaring R.O.C. as a country where "all nuclear materials have been used in peaceful nuclear activities" for 12 consecutive years.
06.28、09.14、09.20	視察核二廠、核一廠、核三廠核子保安及反恐演練。 AEC has conducted inspections on nuclear security and anti-terrorism drills at Kuosheng, Chinshan and Maanshan Nuclear Power Plants respectively.
06.30	發布我國「106 年游離輻射應用與管理統計」年報。 The "2017 Annual Statistical Report on Application and Management of Ionizing Radiation in Taiwan, Republic of China" was published.

July

07.12	完成石門水庫及清華大學環境輻射監測站的設置，全國監測站數達 49 座。 The setup of environmental radiation monitoring stations in Shihmen Reservoir and National Tsing Hua University was completed; the number of monitoring stations in the country increased to 49.
07.19	英國在台辦事處處長 Catherine Nettleton 女士訪會。 Catherine Nettleton, Representative of the British Office Taipei, visited AEC.
07.24	邀請美國核管會（NRC）專家來台辦理「2018 用過核燃料處置技術研討會」。 Experts from the U.S. Nuclear Regulatory Commission (NRC) were invited to Taiwan to hold the "2018 Technical Workshop on Spent Nuclear Fuel Disposal."
07.24 ｜ 07.29	受邀參與國立臺灣科學教育館及台中市政府共同辦理之「第 58 屆中小學科展科學博覽會」。 AEC was invited to take part in the "58th National Primary and High School Science Fair", jointly organized by the National Taiwan Science Education Center (NTSEC) and Taichung City Government.
07.25 、 08.08 ｜ 08.09	於空勤總隊台中基地辦理空中輻射偵測實作訓練；於核能三廠鄰近海域，辦理 107 年核子事故南部輻射監測中心海上輻射偵測及取樣實作演練。 Practical training workshop on aerial radiation monitoring took place in the National Airborne Service Corps' Taichung Base. The 2018 marine radiation monitoring and sampling exercise of the southern region radiation monitoring center for nuclear emergencies took place in the neighboring waters of the Maanshan Nuclear Power Plant.
07.26	原能會謝主委視察蘭嶼貯存場。 AEC Minister and Chairman Hsieh pay an oversight visit the Lanyu Storage Site.
07.29 ｜ 08.03	日本公益財團法人日本分析中心（JCAC）來台辦理「環境樣品放射性分析技術交流研討會」。 The Japan Chemical Analysis Center (JCAC), a public interest group, conducted the "Technical Workshop on the radioactive analysis of environmental samples" in Taiwan.
07.30	核定公布核一廠、核二廠、核三廠緊急應變計畫區內民眾防護措施分析及規劃檢討修正報告。 The "Revised Reports of the Review on the Analysis and Planning of Public Protective Action in NPP Emergency Planning Zones" of the Chinshan, Kuosheng and Maanshan Nuclear Power Plants were respectively approved and published.

7 July

07.31 邀集經濟部、原民會、台電公司召開「蘭嶼核廢料貯存場設置真相調查後續應辦有關遷場及補償事項討論會議」。
07.31 The Ministry of Economic Affairs, the Council of Indigenous Peoples, and TPC were invited to convene the "Review Meeting for Site Relocation and Compensation following the Truth Investigation on the Setup of the Lanyu Storage Site".

07.31 | 08.01 邀請美國核管會專家辦理「2018 核能電廠除役管制研討會」。
AEC invited experts from the US NRC to conduct "2018 NPP Decommissioning Workshop".

8 August

08.01 | 08.02 與美國國家核子安全局（NNSA）共同舉辦 Cs-137 射源保安及替代方案研討會。
A Workshop on "Risk Reduction Strategies for the Security of Radioactive Cesium-137" was jointly held by AEC and the U.S. National Nuclear Security Administration (NNSA).

08.06 | 08.10 執行「107 年度核三廠核能安全總體檢」專案視察。
AEC conducted "Post Fukushima Safety Enhancement" inspection at Maanshan NPP in 2018.

08.09 臺北高等行政法院完成審理 105 年度針對台電公司低放處置執行不力開立之三級違規行政訴訟案，宣判本會勝訴。
The Taipei High Administrative Court concluded the administrative litigation trial case regarding a Level III violation of TPC as a result of its poor conduct in handling low-level radioactive waste disposal, and granted a winning suit to AEC.

08.10 於核二廠模擬操作中心辦理 107 年核安第 24 號演習兵棋推演。
The tabletop exercise of the 2018 Nuclear Emergency Exercise was carried out in the Simulation Operation Center of the Kuosheng Nuclear Power Plant.

08.13 、 08.15 執行「核二廠 2 號機燃料廠房護箱裝載池設備修改案」現場施工視察及邀請公民團體查訪現場施工現況。
AEC conducted site visit to the Kuosheng NPP unit 2 design change request on cask loading pool with commissioners and citizen groups representatives.

08.14 輻射偵測中心通過國家游離輻射標準實驗室「第七次輻射偵測儀器校正能力試驗」之 3 項劑量率測試項目。
The Radiation Monitoring Center passed three tests on dose rates in "The 7th Proficiency Testing in Calibrating Radiation Monitoring Instruments" by the National Radiation Standard Laboratory.

08.15	核研所以「EOS-Energy Operating System」及「RollnCoat」為題，申請 2018 年全球百大科技研發獎（R&D 100 Awards），經獨立評審會議審定，分別在資訊／電子領域及機械／材料領域獲選進入最後決選。 INER entered the 2018 R&D 100 Awards competition with the entries of "EOS-Energy Operating System" and "RollnCoat", which were placed by an independent panel of judges on the finalists' lists in the IT/Electrical category and the Mechanical Devices/Materials category, respectively.
08.16	輻射輻射偵測中心規費收費標準第二條及第三條修正條文，行政院於 107 年 8 月 14 日修正發布施行，生效日為 107 年 8 月 16 日。 The amendment of Articles 2 and 3 of Fee-charging Standards for the Radiation Monitoring Center was promulgated by the Executive Yuan on August 14, 2018, and made effective on August 16, 2018.
08.16 ｜ 08.17 、 09.21 、 10.19 、 11.14 、 11.19	針對花蓮、台中、台南、北部地區石材及瓷磚等建築材料進行放射性檢測，檢測結果均正常。 Radioactive detection testing was carried out on building materials such as stones and tiles from Hualien, Taichung, Tainan and Northern Taiwan; no radioactive abnormalities were detected.
08.16 ｜ 09.19	辦理 7 梯次「原能會 107 年度個案管制計畫期中查訪會議」。 Seven sessions of the "2018 AEC Interim Meeting on the Case Control Plan" were conducted.
08.23	8 月 23 日召開放射性物料安全諮詢會第 2 次會議，報告「龍門電廠（核四）核子燃料外運作業安全管制」。 The second meeting of the Radioactive Materials Safety Advisory Board was convened on August 23rd, wherein FCMA staff delivered a report on "Safety Control of the Outbound Transportation of Nuclear Fuel from the Lungmen Nuclear Power Plant".
08.24	召開第 16 屆第 2 次「游離輻射安全諮詢會」。 The second session of the 16th "Ionizing Radiation Safety Advisory Board" was convened.
08.27	邀請中研院廖俊智院長以「能源永續與碳循環」為題蒞核研所演講，並安排參訪纖維酒精及生質精煉研發成果，以及再生能源與核醫藥物等設施。 Dr. James C. Liao, President of Academia Sinica, was invited to INER to give a speech entitled "Sustainable Energy and Carbon Cycles". He was also accompanied to see research results in cellulosic ethanol and biorefinery, and to visit facilities which conduct research in renewable energy, nuclear medicine, etc.

August

08.28

修正及發布「放射性污染建築物事件防範及處理辦法」。
The "Regulations for Prevention and Management of Incidents Concerning Radioactively Contaminated Buildings" was revised and promulgated.

08.28 | 08.31

依據台美民用核能合作工作項目，協助美國能源部核子保安局在高雄辦理大港倡議區域性工作國際研討會，參加人員包括泰國6位、越南6位、原能會5位及高雄海關5位。
In accordance with the TECRO-AIT Joint Standing Committee on Civil Nuclear Cooperation program, RMC assisted the U.S. Department of Energy's National Nuclear Security Administration to hold the Megaports Initiative Regional Workshop in Kaohsiung. Six attendees from Thailand, six from Vietnam, five from AEC and five from the Kaohsiung Customs participated in the workshop.

08.29

行政院訴願會駁回台電公司訴請原能會核定低放處置浮動時程之訴願案，決定維持原處分。
Regarding TPC's appeal in which AEC is requested to give approval to the unfixed timeline for low-level radioactive waste disposal, the Appeals Committee of the Executive Yuan dismissed the appeal and upheld the original administrative disposition.

08.30

修正發布「低放射性廢棄物貯存設施安全分析報告導則」。
The "Standard Format and Content for the Safety Analysis Report of Low Level Radioactive Waste Storage Facilities" was revised and promulgated.

September

09.03

於羅馬尼亞布加勒斯特舉行之「Bucharest 2018 Symposium on Microgrids」微電網國際年會，核研所以「Energy Management System and Resilient Control of Distribution Feeder with Microgrid Technology」海報，獲最佳海報獎。
INER's "Energy Management System and Resilient Control of Distribution Feeder with Microgrid Technology" won the Best Poster Award in the Bucharest 2018 Symposium on Microgrids held in Romania.

09.05

行政院訴願會就台電公司所提原能會106年度開立低放處置執行延宕裁罰三千萬罰鍰之訴願案，決定維持原處分，駁回台電公司訴願。
Regarding TPC's appeal on a penalty fine of NT$30 million as a result of a delay in executing low-level radioactive waste disposal issued by AEC in 2017, the Appeals Committee of the Executive Yuan dismissed the appeal and upheld the original administrative disposition.

09.10

辦理「107年核安第24號演習實兵演練登場」記者會，向媒體說明演習之地點、項目、動員人力及特點。
AEC held a press conference on the "Launch of a Full-Scale Exercise of the No. 24 Nuclear Emergency Exercise", detailing the locations, list of activities, manpower to be mobilized and features of the exercise to the press and media.

09.11 | 09.15
派員赴奧地利與國際原子能總署共同召開「2018 年核子保防業務協調會議」。
Delegates were appointed to attend the "2018 Coordination Meeting on Nuclear Safeguards", jointly held by AEC and IAEA in Austria.

09.11 | 09.12
邀請日本原子力除役研究會專家學者辦理「2018 台日核電廠除役技術交流研討會」。
AEC invited experts from ANDES of Japan to conduct "2018 Sino-Japanese Workshop on NPP Decommissioning Technology".

09.12
通過本年度資訊安全管理制度（ISMS）追蹤查核，維持 ISO 27001 證書持續有效。
AEC has passed this year's Continuing Assessment of the information security management system (ISMS); the validity of our ISO 27001 certification is maintained.

09.12
蘭嶼氣象站標準型環境輻射監測設施完成建置及上線，全國環境輻射監測站達 50 座。
Standard-type environmental radiation monitoring facilities were set up and began operation in Lanyu Weather Station; the number of environmental radiation monitoring stations in the country increased to 50.

09.14
完成 107 年上半年「臺灣地區放射性落塵與食品調查半年報」。
The "Semi-Annual Report on Radioactive Fallout and Food Survey in Taiwan" of the first half of 2018 was completed.

09.14 | 09.15
於核一廠及鄰近地區舉行 107 年核安第 24 號演習。
A full-participation exercise of the 2018 Nuclear Emergency Exercise was taken place in the Chinshan Nuclear Power Plant and its neighboring areas.

09.19
原能會全球資訊網取得「無障礙標章 2.0 版」認證，可讓身障朋友瀏覽網站時更為方便。
AEC's website has obtained the certification for "Accessibility 2.0 Conformance Level A", making it easier to browse for users with disabilities.

09.26
核研所「RollnCoat: Roll-to-Roll Hybrid Plasma Modular Coating System for High-Performance Thermal Control Films」技術，獲美國航太權威媒體「美國國家航空暨太空總署技術摘要雜誌（NASA Tech Briefs）」主辦的「開創未來（Create the Future）」技術評選，於「Robotics/Automation/Manufacturing」類別脫穎而出，技術獲國際同儕肯定。
INER technology "RollnCoat: Roll-to-Roll Hybrid Plasma Modular Coating System for High-Performance Thermal Control Films" was recognized by international peers and awarded in the Robotics/Automation/Manufacturing category for the 2018 Create the Future Design Contest held by NASA Tech Briefs, a leading aviation and aerospace publication.

9 September

09.27 訂定發布「低放射性廢棄物貯存設施再評估報告審查導則」。
The "Standard Review Plan for Evaluation Reports on Low-level Radioactive Waste Storage Facilities" was promulgated.

09.27 | 09.29 核研所於「2018 台北創新技術博覽會」獲得 6 面金牌、5 面銀牌、8 面銅牌，共 19 個獎項。
INER was awarded six Gold Medals, five Silver Medals and eight Bronze Medals (a total of 19 medals) in the "2018 Taiwan Innotech Expo".

10 October

10.05 | 10.08 核研所提供 15 項技術展品參加第二期能源國家型科技計畫辦公室舉辦之「NEP-II 總期程期末成果展」。
INER provided 15 technology exhibits to the "Presentation of Project Results from NEP-II" held by the NEP-II Program Office.

10.08 核研所與美國德州西南研究院（Southwest Research Institute, SwRI）簽署合作備忘錄（MOU），雙方可就放射性廢棄物處置技術、核設施除汙與除役技術等進行技術交流。
INER signed a memorandum of understanding on cooperation with the U.S. Southwest Research Institute (SwRI) to conduct technical exchanges in areas such as radioactive waste disposal technology and nuclear facility decontamination technology.

10.11 | 11.30 執行「核二廠 1 號機第 26 次大修作業視察」及同意再起動之申請。
AEC conducted inspection during the refueling outage (EOC-26) of Kuosheng NPP unit 1, and issued the restart approval.

10.13 與臺北市立聯合醫院仁愛院區共同舉辦「107 年度輻射屋居民聯歡會」。
The "2018 Gathering of Residents of Radioactively Contaminated Buildings" was jointly held by AEC and Taipei City Hospital Renai Branch.

10.18 人事行政總處研商「國家龍潭原子能科技研究院設置條例草案」會議。
The Directorate-General of Personnel Administration held a consultation meeting on the "Draft of the Act Governing the Establishment of the National Longtan Institute of Atomic Energy Science and Technology".

10.18、10.22、10.26、10.29 於北、南、中、東區辦理「地方政府輻射災害防救講習」。
"Local Government Radiological Emergency Response Training Workshops" were held in Northern, Southern, Central, and Eastern Taiwan.

10 October

10.25	核二廠磺潭社區監測站完成建置及上線，全國環境輻射監測站增加至 51 座。 The monitoring station in the Huangtan Community around the Kuosheng Nuclear Power Plant was set up and began operation; the number of environmental radiation monitoring stations in the country increased to 51.
10.25 、 11.07 、 12.01	執行「107 年度第 3 次核三廠、核二廠及核一廠不預警視察」。 AEC conducted third unannounced inspections at each operating NPPs in 2018.
10.26	辦理「輻射災害風險管理與犯罪偵查研習會」。 The "Workshop on the Risk Management of Radiation Emergencies and the Crime Investigation Related to Radiation" was held.
10.31	與國家災害防救科技中心簽署合作備忘錄，推動輻射災害防救相關科技研發與應用。 AEC has signed a memorandum of understanding on cooperation with the National Science and Technology Center for Disaster Reduction to promote the research, development and application of science and technology in radiation disaster response.

11 November

11.05 | 11.07	出席於美國薩凡納河國家實驗室舉辦之 2018 年台美民用核能合作年會。 AEC led a delegation to attend the 2018 TECRO-AIT Joint Standing Committee Meeting on Civil Nuclear Cooperation held in the U.S. Savannah River National Laboratory.
11.06	邀請日本核廢料處置之專家學者來台，辦理「2018 年台日高放射性廢棄物最終處置技術研討會」。 Nuclear waste disposal experts and academics from Japan were invited to Taiwan to conduct the "2018 High-Level Radwaste Final Disposal Seminar in Taiwan".
11.07 | 11.08	執行核一廠緊急應變整備年度視察。 AEC has performed annual inspection on nuclear emergency response and preparedness at Chinshan Nuclear Power Plant.
11.10	舉辦 107 年度第 2 次「輻射防護人員證書測驗及操作人員輻射安全證書測驗」。 The 2nd "Certification Examination for Radiation Protection Personnel and Radiation Operators on Radiation Safety" in 2018 was held.
11.12 | 11.14	國際原子能總署來台與本會共同召開「2018 年核子保防料帳與補充議定書申報作業研習會」。 IAEA came to Taiwan to hold the "2018 Seminar on the Declaration of Nuclear Materials Accounting and Supplementary Protocol" with AEC.

11 November

完成 2017 年版「用過核子燃料管理安全與放射性廢棄物管理安全聯合公約」國家報告書，並請美國能源部同儕審查後上網公開。

11.13 The 2017 National Report for the "Joint Convention on the Safety of Spent Fuel and Radioactive Waste Management" was completed and published online after being peer reviewed by the U.S. Department of Energy.

11.15 瑞典貿易暨投資委員會台北辦事處代表 Håkan Jevrell 先生訪會。
A visit by Mr. Håkan Jevrell, Representative of the Swedish Trade & Invest Council.

修正發布「核子反應器設施管制法施行細則」及「核子反應器設施除役許可申請審核及管理辦法」。

11.16 AEC revised and issued "Enforcement Rules for the Implementation of Nuclear Reactor Facilities Regulation Act" and "Regulations on the Permit Application and the Management for the Decommissioning of Nuclear Reactor Facilities".

輻射偵測中心經食品藥物管理署審查，獲得食品放射性檢測認證，並於 12 月 4 日取得證書。

11.16 The Radiation Monitoring Center was accredited for food radioactivity testing by the Taiwan Food and Drug Administration, and was granted the Accreditation Certificate on December 4th.

11.17 | 11.18 受邀參與國立臺灣科學教育館辦理之「科教館科學環境市集」活動。
AEC was invited to participate in the "NTSEC Science Marketplace" organized by the National Taiwan Science Education Center.

11.21 | 12.03 執行「核一廠 1 號機進入除役管制專案視察」。
AEC conducted inspection on Chinshan NPP unit 1 for safety preparation of decommissioning activities.

於北、中、南區舉辦 3 場「輻防雲端裡有我，便捷服務帶著走— 2.0 版輻射源進出口簽審系統暨輻射防護服務業宣導說明會」。

11.27 | 11.29 Three briefing sessions on Version 2.0 "Permit Application for the Import and Export of Radiation Sources and for the Promotion of Radiation Protection Service Industry" were conducted in Northern, Central and Southern Taiwan.

11.28
訂定發布「違反放射性物料管理法第二十九條第一項之罰鍰裁量基準」。
The "Fine Determination Criteria for Violation of Paragraph 1 of Article 29 of the Nuclear Materials and Radioactive Waste Management Act" was promulgated.

11.29
核研所辦理「2018 液流電池與儲能產業應用論壇」，邀請國內產、學、研共 70 餘人參加。
INER held the "2018 Forum on the Application of the Flow Battery and Energy Storage Industry", and invited over 70 attendees from industry, academia and research institutes.

11.29 、 12.05 | 12.06 、 12.10
執行核二廠核子保安暨緊急應變整備年度視察。
AEC performed annual inspection on nuclear security and nuclear emergency response and preparedness at Kuosheng Nuclear Power Plant.

11.30
舉辦 107 年面對媒體應對研習活動，以提升同仁面對媒體訪問及危機新聞處理技巧。
The 2018 workshop on interaction with, and response to, media was held to enhance our colleagues' skills in dealing with media interviews and handling news of crises.

11.30
完成核一廠除役過渡階段安全分析報告及技術規範審查作業。
AEC completed the review and approved the application from TPC for the revised PD-SAR/PDTS of Chinshan NPP.

11.30
執行 107 年度輻射污染建築物居民醫療服務諮詢及後續醫療照護計畫，完成 705 位輻射屋居民健康檢查。
The "2018 Medical Consultation and Subsequent Medical Care Program for residents of radioactively contaminated buildings" was carried out, providing health examinations to 705 residents of radioactively contaminated buildings.

11.30
核研所「多功能花菁染料基質之腫瘤診療探針開發」技術產品，獲社團法人國家生技醫療產業策進會主辦之第 15 屆國家新創獎。
INER technology "Theranostic Probes (DOTA-NIR790) for Multimodality Imaging, Radiotherapy, and Photothermal Therapy" was awarded the 15th National Innovation Award by the Institute for Biotechnology and Medicine Industry.

11 November

11.30

完成 107 年台灣海域輻射監測方法研究計畫之樣品分析，另與中山大學、農委會漁業署及水試所、海洋委員會、環保署等機構合作，全年取回台灣各海域及沿岸海水 202 件、海產物 79 件、岸沙 62 件、河沙 9 件、海底沉積物 5 件，總計 350 件，均未測出放射性異常狀況。

The analysis of 2018 samples for the Study Plan for Radiation Monitoring Methods in Taiwan Waters was completed. In addition, the Radiation Monitoring Center collaborated with National Sun Yat-sen University, the Fisheries Agency and the Fisheries Research Institute of the Council of Agriculture, the Ocean Affairs Council, and the Environmental Protection Administration; they acquired 350 samples from various waters and coastal areas of Taiwan for the year. Among them were 202 seawater samples, 79 samples of marine products, 62 coastal sand samples, 9 river sand samples and 5 bottom sediment samples. The results show that no radioactive abnormalities were detected in these samples.

12 December

12.01

建立輻射偵測中心及物管局入口網頁，強化附屬機關形象。

The respective portals webpage of the Radiation Monitoring Center and the Fuel Cycle and Materials Administration were set up to enhance the image of AEC affiliated agencies.

107.12.03 | 108.01

執行「核三廠 2 號機第 24 次大修作業視察」。

AEC conducted inspection during the refueling outage (EOC-24) of Maanshan NPP unit 2.

12.04

12 月 4 日召開放射性物料安全諮詢會第 3 次會議，報告「我國用過核子燃料最終處置技術可行性評估報告（SNFD2017）審查作業。

The third meeting of the Radioactive Materials Safety Advisory Board was convened on December 4th, wherein FCMA staff delivered a report on the review of the "Technical Feasibility Assessment Report on Spent Nuclear Fuel Final Disposal" (SNFD 2017).

12.07

函送台灣自來水公司 107 年第 4 季「台灣地區自來水試樣放射性分析結果」共計 64 件水樣；107 年含市售包裝水採樣共 393 件，分析結果全部符合法規限值。

The 2018 fourth-quarter "Results from the Radioactivity Analysis of Water Samples in Taiwan Area" (a total of 64 water samples) were sent to the Taiwan Water Corporation. For the entire year, a total of 393 water samples, including commercially available packaged water samples were tested and the results were all within regulatory limits.

12.11

召開第 51 次核子設施類輻射防護管制會議。

The 51st Session on "Radiation Protection and Regulation for nuclear facilities" was convened.

12.14

召開第 16 屆第 3 次「游離輻射安全諮詢會」。

The third session of the 16th "Ionizing Radiation Safety Advisory Board" was convened.

12 December

12.14	「輻射災害防救業務計畫」修正草案經行政院中央災害防救會報核定後函頒實施。 The draft of revised "Radiological Disaster Relief Operations Plan" was approved by the Central Disaster Prevention and Response Council of the Executive Yuan, and was subsequently promulgated.
12.14 、 12.18 、 12.21	於北、中、南區舉辦 3 場「107 年度放射線照相檢驗業輻射安全防護管制宣導會」。 Three "2018 Promotion Conferences for Radiation Safety and Protection of the RT Industry" were conducted in Northern, Central and Southern Taiwan.
12.17	配合行政院防制假訊息危害政策，增訂「核子事故緊急應變法」第 31 條之 1 有關散布假消息罰則修正條文，業經行政院院會議通過，與災害防救法第 41 條修正草案等 7 個法案一同函送立法院審議。 According to the Executive Yuan's policy in curbing threats from fake news, Paragraph 1 of Article 31 of the "Nuclear Emergency Response Act" was amended to include penalty of the dissemination of fake news. The amendment had passed at the Cabinet meeting and sent to the Legislative Yuan along with 7 other bills including the amendment of Article 41 of "Disaster Prevention and Response Act".
12.18 ｜ 12.20	執行核一廠核子保安年度視察。 AEC has performed annual inspection on nuclear security at Chinshan Nuclear Power Plant.
12.18 ｜ 12.21	執行「107 年度核二廠核能安全總體檢」專案視察。 AEC conducted "Post Fukushima Safety Enhancement" inspection at Kuosheng NPP in 2018.
12.18 ｜ 12.22	執行「107 年度核一廠核能安全總體檢」專案視察。 AEC conducted "Post Fukushima Safety Enhancement" inspection at Chinshan NPP in 2018.
12.22	修正及發布「放射性物質與可發生游離輻射設備及其輻射作業管理辦法」。 The "Administrative Regulations for Radioactive Material and Equipment Capable of Producing Ionizing Radiation and Associated Practice" was revised and promulgated.
12.22 ｜ 12.23	受邀參與國立自然科學博物館辦理之「冬至進補、就要科普」活動。 AEC was invited to attend the "Science for Winter Solstice" event organized by the National Museum of Natural Science.
12.31	完成 2.0 版「全國輻射源進出口簽審通關資訊系統」建置。 The Version 2.0 "Permit Application for the Import and Export of Radiation Sources and Customs Information System" was established.

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