Introduction to

AEC

The Atomic Energy Council

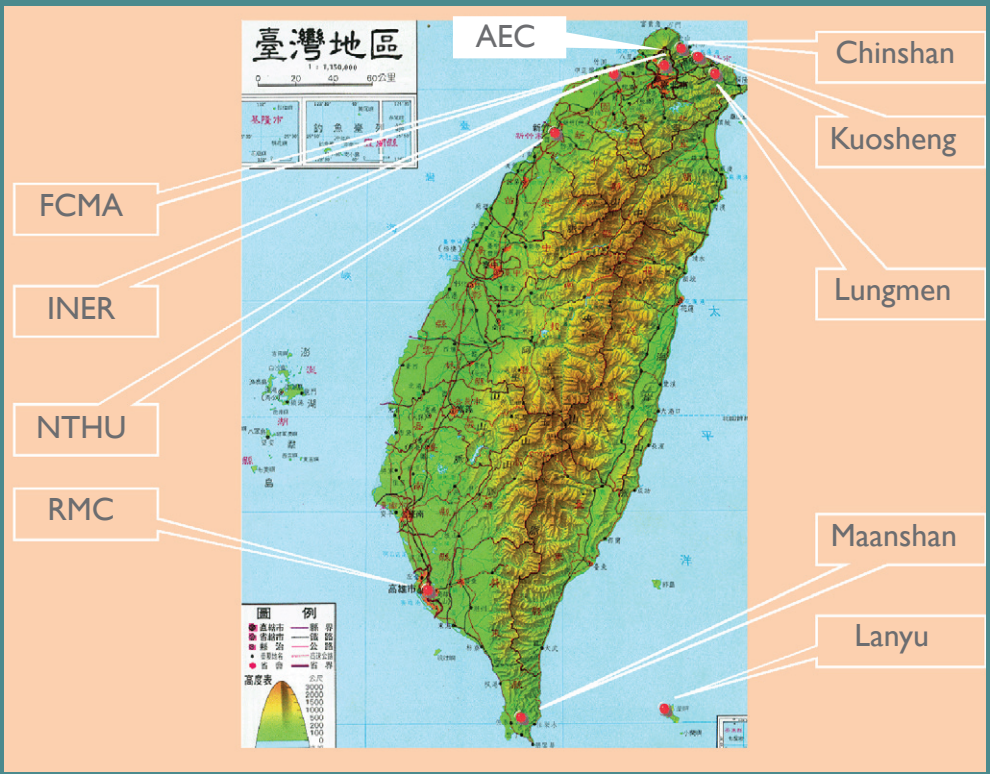
Enhancing Nuclear Safety and
Radiation Protection to
Help Building a Sustainable Low-Carbon Society

AEC

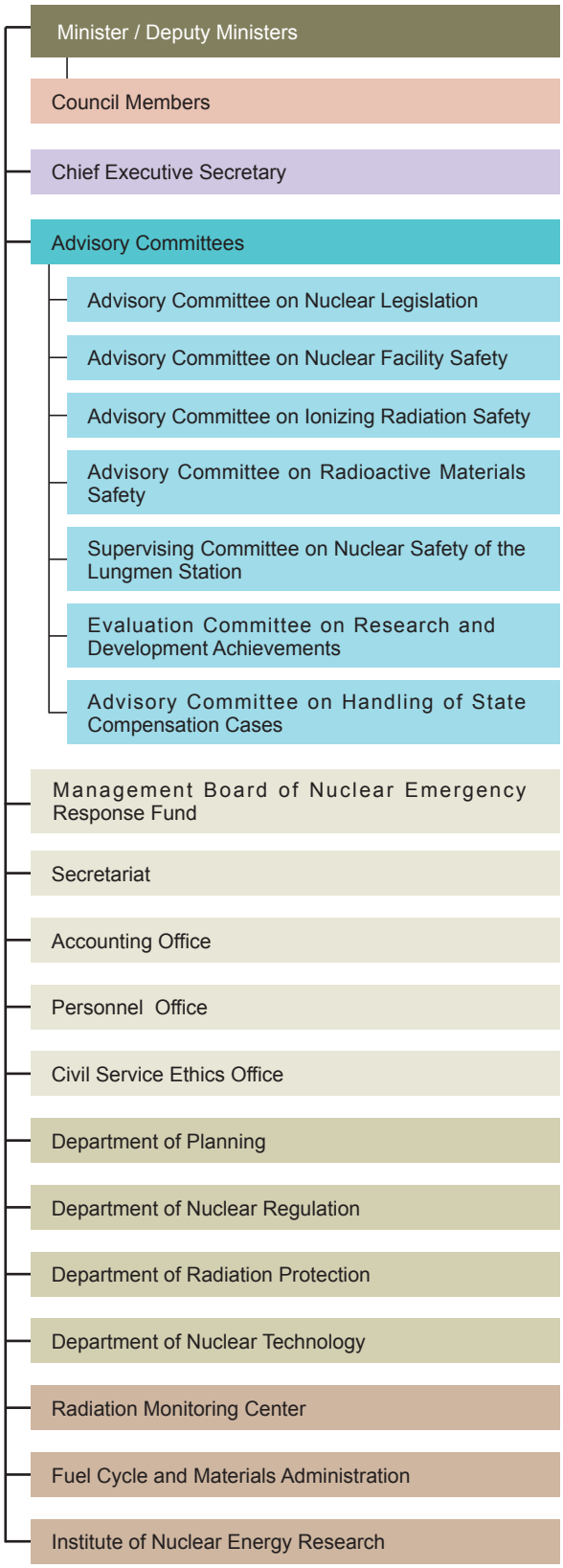
As the country's nuclear safety regulator, the AEC takes responsibility for ensuring nuclear safety and radiation protection, so the public can have a peace of mind to benefit from the peaceful applications of atomic energy.

History

The Atomic Energy Council (AEC) was founded in 1955 at the ministerial level under the Executive Yuan. Its original mission was to foster peaceful applications of atomic energy, and to coordinate international cooperation on nuclear energy. In 1961, the Tsing Hua Open-pool Reactor (THOR) built by the National Tsing Hua University reached its first criticality. Then, the Atomic Energy Act was enacted in 1968 and the Institute of Nuclear Energy Research (INER) was founded in the same year.



Organizational Structure



In 1974, the Taiwan Radiation Monitoring Station (TRMS) was established under the AEC. In 1978, the state-owned power utility Taiwan Power Company (TPC) connected its first nuclear power plant to the grid and started its commercial operation. Three years later, the Radwaste Administration (RWA) was formed under the AEC aimed to regulate radioactive waste management. The TRMS and the RWA were then renamed as the Radiation Monitoring Center (RMC) and the Fuel Cycle and Materials Administration (FCMA), respectively, in 1996. In 1999, the AEC issued a construction permit to the TPC for its fourth nuclear power (Lungmen) project.

Now with six nuclear power units in operation, two advanced boiling water reactor units under construction, and other peaceful applications of nuclear and radiation technology expanding in great pace, AEC's most important mission has long been shifted to reactor safety regulation, radiation protection, radwaste administration, environmental monitoring and R&D for technology development and other civilian nuclear applications.

MANDATE	YEAR
Atomic Energy Act	1968, 1971
Nuclear Damage Compensation Act	1971,1977,1997
Ionizing Radiation Protection Act	Jan. 2002
Nuclear Materials and Radioactive Waste Management Act	Dec. 2002
Nuclear Reactor Facilities Regulation Act	Jan. 2003
Nuclear Emergency Response Act	Dec. 2003
Act on Sites for Establishment of Low Level Radioactive Waste Final Disposal Facility	May 2006

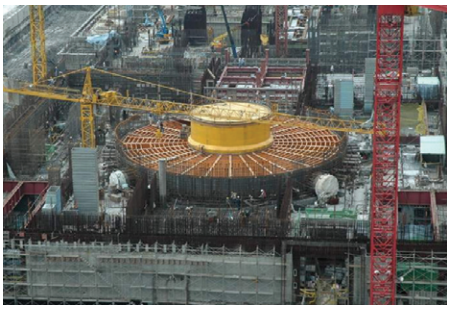
Human Resources and Budget (2009)

	Manpower	Budget (NTD)
AEC HQs	181	361M
FCMA	38	68M
RMC	41	61M
INER	971	2,967M

General Description On Regulation

Licensing and enforcement for the safety of nuclear materials, facilities and installations are the first-line responsibilities of the AEC. These include licensing, inspection, and other regulatory actions for nuclear power plants and research reactors, radioactive sources and ionizing equipment capable of producing ionizing radiation, as well as for nuclear reactor operators and radiation protection personnel. These responsibilities are split between the Nuclear Regulation Department and the Radiation Protection Department within the AEC. Regulatory activities for safe management of radioactive waste fall under the responsibilities of the FCMA and are described in a separate section.

Licensing and Enforcement for Reactor Safety



Licensing

Typical and of utmost importance in licensing is for the construction and operation of nuclear power plants. Project feasibility study and budget allocation are of sole responsibility of the Ministry of Economic Affairs, while the Environmental Protection Administration evaluates environmental impact assessment for environmental concerns and the AEC reviews site selection reports for safety considerations. A two-step licensing review process is followed for the issuance of construction, fuel loading, and start-up permits, before an operating license is issued. Taking the Lungmen Project as an example, a construction permit was issued following a Preliminary Safety Analysis Report (PSAR) being satisfactorily reviewed in March 1999. By the completion of plant construction, the PSAR has been updated into a Final Safety Analysis Report (FSAR). The TPC will use the FSAR together with the pre-operation test results to apply for the issuance of a fuel loading permit. An operating license will be given after a detailed review on the FSAR and start-up test results by checking the fulfillment of licensing requirements.

As plant operators play a key role in their dynamic responses to normal operations and anomalies, their qualification and ability are crucial for nuclear safety. Plant operators and senior operators are required to pass stringent tests, including written examination, plant walk-through and simulator operation, before they are allowed to work at the main control room of the plant.

The operating license of the first (Chinshan) nuclear plant in Taiwan has been issued for over 30 years. According to ‘‘Regulation on the Review and Approval of Applications for Operating License of Nuclear Reactor Facilities’’, timeliness of application for license renewal (LR) is from 5 to 15 years before the expiration of the operating license. Upon receipt of an LR application for the Chinshan plant in July 2009, the AEC has organized a taskforce to review, which will take about two years.

Inspections and Enforcement

While safety evaluations aim at compliance between licensing documents and safety requirements, inspections concentrate on whether the work and performance on the scene meet the design requirements set forth in the licensing documents. Resident inspections, outage inspections, and team inspections as well as ten-year periodic safety review afford stringent and independent enforcement measures upon licensee of nuclear power plants. Resident inspectors are assigned to check daily operation and selected surveillance tests in operating power plants. Periodic outage inspections are performed to assure the quality of maintenance work during each unit outage. Team inspections are typically conducted for special tasks with corresponding teams of experts.

In addition, unannounced night-shift inspections are conducted frequently at each plant. Examples abound in regulatory actions (including plant shutdowns) upon licensee to secure safety.

These regulatory efforts have been rewarded by performance improvement of the nuclear plants. Over the past ten years, average capacity factor of all six units has increased steadily from 75% to about 90%, the annual average number of reportable events per unit dropped from over 20 to 2, and the average number of automatic scrams per unit per year decreased from over 2 to well below 1.

The inspections and enforcement of Lungmen project started in 1999 with one resident inspector monitoring daily activities of the construction work. To enhance the regulatory effectiveness, the number of the resident inspectors has doubled since September 2002. Periodic inspection is conducted about every three months. The concerned scope and areas of the inspections are dependent on the nature of the construction stages, i.e., design, fabrication, installation, pre-operational test and startup test, and operating license issuance stages. For items that require special evaluation, experts outside the AEC were invited to join the inspection team for special taskforce. Quality inspections of contractors/vendors are

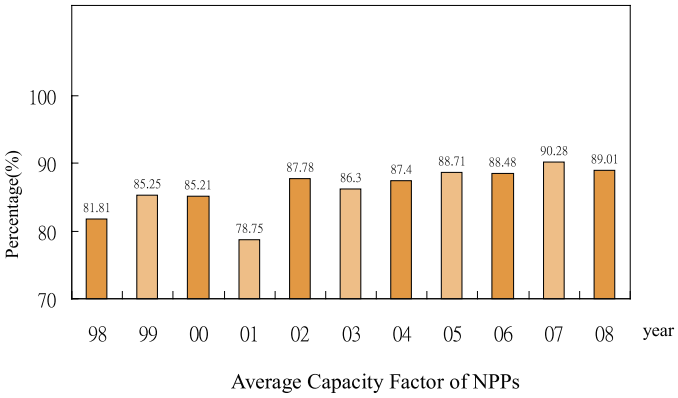
also implemented by AEC staff to ensure that the fabrication quality of the major equipment such as RPV, RIP, FMCRD, and RCCV meets the design requirements.

Other Major Activities

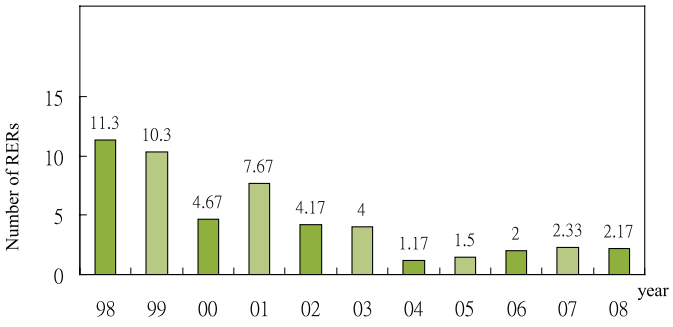
Reactor Oversight Process/Significance Determination Process The AEC has posted the performance indicators (PI) of nuclear power plants and significance determination process (SDP) evaluation results of inspection findings on its website since 2004 and 2006, respectively. Inspectors conduct inspection and initial screening of findings. The "PRA Model Based Risk Significance Evaluation Tool" (PRiSE) developed by the INER is used for risk significance estimation and justification. Currently all of the performance indicators and inspection findings are in green, indicative of no safety concerns.

Installation of Automatic Seismic Trip System (ASTS) The disastrous Chi-Chi earthquake (M=7.3) occurred on September 21, 1999 prompted the AEC to request the installation of an automatic seismic trip system at each of TPC's six existing nuclear units to further ensure plant safety. Installations and tests were completed in November 2007, and the systems have been put in service since then.

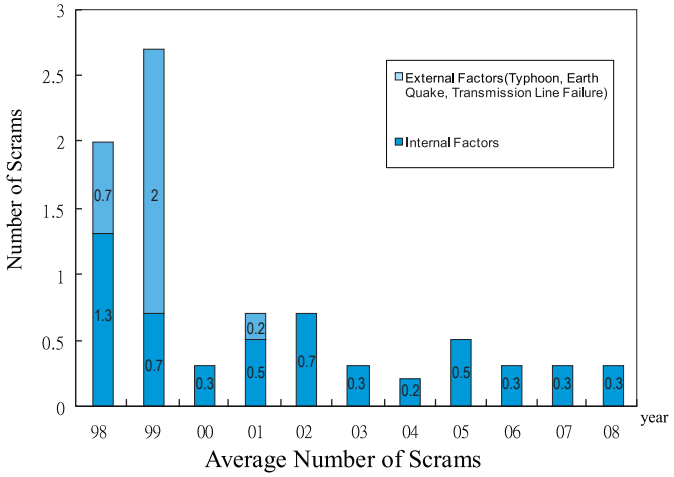
Power Uprate of Operating Nuclear Power Plants Taipower has launched a power uprate project for its three nuclear power plants. The adopted power uprate is the measurement uncertainty recapture (MUR) type, which was first implemented at the Kuosheng plant in 2007, with an uprate of about 1.7 % per unit. Chinshan unit 2 and Maanshan unit 2 were completed in 2008, resulting in a power increase of 6 MWe and 12.4MWe, respectively. Similar tasks for Chinshan unit 1 and Maanshan unit 1 were also finished most recently.



Average Capacity Factor of NPPs



Average Number of RERs



Average Number of Scrams

Protecting Workers and the General Public from Ionizing Radiation

Goal of Radiation Protection

The integral goal of ionizing radiation protection in Taiwan is two-fold: to reasonably control the applications of ionizing radiation in domestic medical, agricultural, academic and industrial sectors to attain the welfare of our people, and to prevent possible detriment of ionizing radiation, thereby protecting the health and safety of radiation workers and the general public. As such, licensing for radioactive material and equipment capable of producing ionizing radiation for the various applications constitutes another utmost important task of the AEC, while site survey, operator certification and annual inspections provide means to enforce radiation safety.

Control of Radiation Sources

The Ionizing Radiation Protection Act (IRPA), enforced as of February 2003, stipulates the control of radiation sources and its associated practice. As of February 2009, about 24,000 registrations and permits were issued for the use of radioactive material and equipment capable of producing ionizing radiation in various applications, and over 8,800 certificates were issued to radiation protection personnel. In order to raise the level of radiation safety and security, a cradle-to-grave radiation sources tracking system has been established in the AEC to strengthen the control of radiation sources. Each licensee is responsible for reporting source information to the tracking system through an online Internet system. Other measures such as conducting annual inspection of radiation sources used in industry, research, universities and hospitals, and establishing national exposure dose database for occupational workers, were taken to protect the public, workers and the environment.

E-Trade Facilitation Project

In streamlining application procedures on import/export permits, reducing application time and cost and enhancing national competitive edge, the AEC launched the “Facile Trade Network Project”, or “FT Network” for short, in 2006. As the first phase of the FT Network implementation, the “Import/Export Licensing Review System” and the “Radiation Protection Control System” were brought online for use in October 2007. These two systems covered more than 90% of the online application services to replace traditional paper application work. It provides 24-hours-a-day import/export application service all year round. As most of the applications can be accomplished in a few minutes, the systems greatly improve the efficiency of import/export service and the ability to verify the ownership and use of radiation sources.

Medical Exposure Quality Assurance Program

In recent years, medical exposure accounts for a large portion of general public exposure. As such, the medical exposure quality assurance program becomes a strong focus in the AEC. The Program is optimizing patient doses and follows good administrative procedures. All hospitals are required to submit a Medical Exposure Quality Assurance Procedure emphasizing on training and quality management to the AEC for review and approval. The Procedure will enable personnel to get best image quality and direct radiation dose targeted accurately to the tumor. The AEC has been working with the Department of Health to promote the Medical Exposure Quality Assurance Program since 2003. So far, linear accelerators, Cobolt-60 Teletherapy machines, Remote After-loading Brachytherapy machines, Gamma Knife, CyberKnife and Tomotherapy machines are included in this Program. With regard to diagnostic equipment, Mammography X-ray equipment has been added into the regulation of quality assurance since July 1, 2008. The AEC has conducted an annual inspection of the facilities to assure that the quality assurance and machine standard are being met.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Safeguarding our Environment

The AEC takes charge of nation-wide environmental monitoring on natural and man-made ionizing radiation through its affiliated Radiation Monitoring Center (RMC). A monitoring network, established in 1991, is equipped with real-time instrument installed at dozens of sampling stations located at city parks, country wilderness, as well as offshore islands of the Taiwan Area. Readings on area exposure rates of gamma radiation are transmitted through data network to RMC's computer center and the Internet website. Natural radioactivity from cosmic and terrestrial sources as well as man-made radioactivity sampled upon fallouts in air, water and soil are analyzed at the RMC laboratory and published regularly for public information. For over thirty years since the founding of the Center, no radiation anomaly has been detected, good news to all habitants.

In the vicinity of nuclear power plants, research reactors, and the low-level radioactive waste interim storage facility in Lanyu, public health and safety are secured with coordinated AEC efforts to monitor regional radiation levels, public dose assessments, cumulative effects by radionuclides, abnormal waste discharge events and effectiveness of radiation protection measures. Programs on personnel dose reduction, radioactive waste reduction, and national policies on waste disposal are ongoing efforts in safeguarding our environment.

Protecting the public from radioactive material contamination of foodstuffs and construction material are of increasing importance. The AEC monitors both domestic and imported foodstuffs on a periodic basis. Monitoring equipment is also installed at major steel mills in Taiwan for this purpose.

Safe Management of Radioactive Waste and Nuclear Materials

The administrative target for radioactive waste is to assure nuclear safety and the minimum generation of radioactive waste, to promote public acceptance and to manage radioactive waste in an environmentally sustainable manner. The Nuclear Materials and Radioactive Waste Management Act, enacted in 2002, replaced all administrative orders governing licensees over the past two decades. The act sets regulatory requirements for all licensing and enforcement activities for the treatment and storage of radioactive waste, as well as repository construction, operation, closure, and institutional control. The AEC with its affiliated FCMA is the regulatory authority. Details of FCMA's functions and regulatory activities can be found at http://gamma1.aec.gov.tw/fcma.

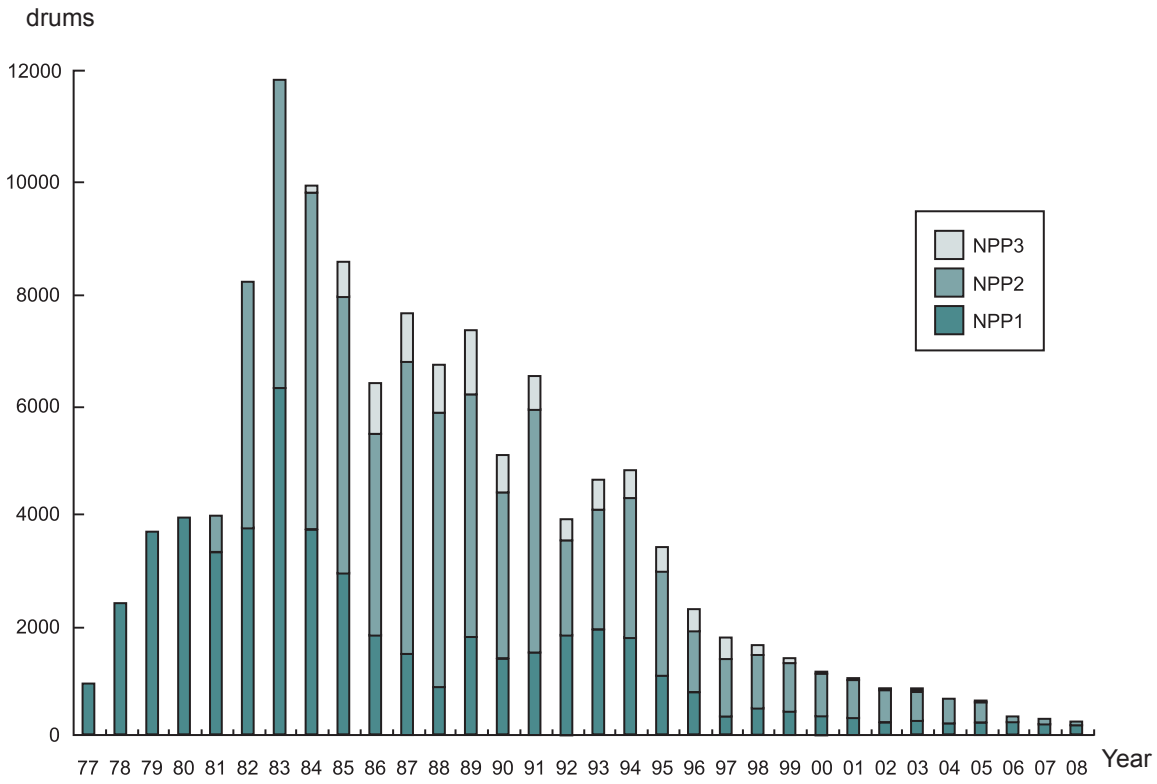
Low-Level Radioactive Waste

More than 90 percent (by volume) of low-level radioactive waste (LLRW) generated in Taiwan has been produced by the three nuclear power plants, while hospitals, research institutes and industry alike accounted for the remaining amount. Since the FCMA launched a volume reduction strategy program in 1990, the TPC has drastically reduced its annual output of solidified LLRW from a high of nearly 12,000 200-liter drums in 1983, to 253 drums in 2008. This accomplishment could not have been realized without successful implementation of the High Efficiency Solidification Technology (HEST) developed by INER.

The Lanyu storage facility has been providing interim storage for solidified LLRW since 1982 and reached its full capacity in 1996. The TPC has carried out the inspection, repairing, and repacking of rusty or damaged drums at the site since 2007. In addition, modern air-conditioned, automated and well-shielded storage facilities have been constructed at each nuclear power plant to accommodate all anticipated LLRW.

The AEC inspects LLRW management at nuclear facilities and reviews related monthly operation reports. Results have shown that there have been neither waste liquid releases nor industrial accidents in the LLRW treatment and storage facilities at the three nuclear power plants, INER, the Lanyu storage site or TPC's Volume Reduction Center (VRC) during the last several years.

The Act on Sites for Establishment of Low Level Radioactive Waste Final Disposal Facility, promulgated in May 2006, requires that a candidate site be determined through a referendum. Following its announcement of three potential sites in August 2008, the Ministry of Economic Affairs (MOEA) further published in March 2009 a site selection committee's report for public comment. The report recommended two of the three potential sites as "recommended candidate sites" to be located in Nantien village of Taitung County



and Donguiyu Islet of Pescadores. The MOEA is expected to make a formal announcement on the recommended candidate sites by the end of 2009, taking into consideration of the comments received. A final "candidate site" will be determined through a referendum held at the counties where these "recommended candidate sites" are located. The county-level referendum is being planned for mid-year of 2010.

Spent Nuclear Fuel

On-site dry storage before final disposal has been recognized as a favorable option for the spent nuclear fuel management. An application for constructing a spent fuel dry storage facility at Chinshan plant was submitted by the TPC in March 2007. After rounds of review by a technical review team, the FCMA accepted the application and issued a construction license in December 2008.

A long-term investigation plan has been undertaken by the TPC for over two decades to select suitable geological formations of preferred characteristics for a final repository of spent nuclear fuel. Preliminary results show that some potential host rocks in certain regions of Taiwan are worth further investigation. To further comply with the Nuclear Materials and Radioactive Waste Management Act of 2002, the TPC submitted a final disposal plan on spent nuclear fuel which was reviewed and approved in July 2006. A preliminary report on technology feasibility study will be submitted to the AEC at the end of 2009 as the next step.

Radioactive Waste Clearance

According to the Ionizing Radiation Protection Act, radioactive sources could be exempted from regulatory control if their radiation was below a certain level. The FCMA has promulgated Regulations on Clearance Levels for Radioactive Waste under the Nuclear Materials and Radioactive Waste Management Act, providing a risk-informed basis for the release of solid materials in the short term and those resulting from the future decommissioning of Taiwan's nuclear power plants.

Advancement of Radioactive Waste Management

According to amended regulations, all radioactive waste must undergo volume reduction and stabilization prior to long-term storage to decrease the amount of radioactive waste in storage. The FCMA also implemented comprehensive safety and performance reviews for all existing radioactive waste treatment facilities at the nuclear plants in 2008.

In addition, the FCMA has started on establishing a personnel qualification system for radioactive waste management, qualifying not only regulatory staff but also facility operators. The corresponding regulation was promulgated in April 2009, with sunset clauses to cease current practices in two years.

Preparing for Emergencies

An emergency response system is the last line of defense for nuclear safety. According to the Nuclear Emergency Response Act promulgated in 2003, central and local governments as well as facility operators are mandated to assemble a swift response to minimize the impact on the local community and the environment in the event that an emergency arises at any nuclear facility in Taiwan.

In order to carry out emergency response action effectively upon the occurrence or possible occurrence of a nuclear accident, the AEC shall activate the National Nuclear Emergency Response Center (NNERC) and the Radiation Monitoring and Dose Assessment Center (RMDAC), the Ministry of Defense shall activate Nuclear Emergency Support Center (NESC), and the local government shall activate the Regional Nuclear Emergency Response Center (RNERC). The nuclear reactor facility licensee is responsible for setting up a dedicated Nuclear Emergency Response Unit and activating the Nuclear Emergency Response Organization within the facility.

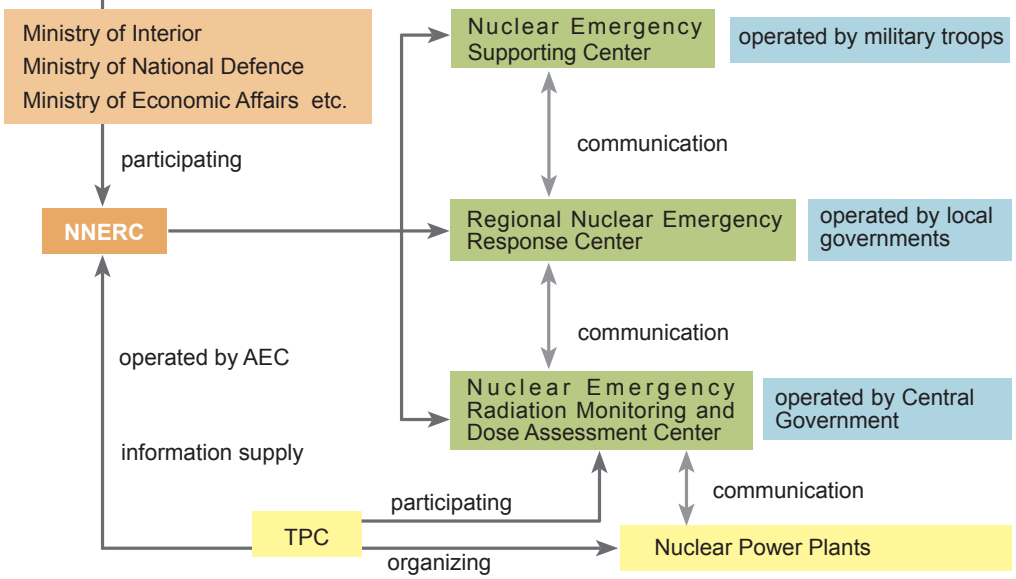
The AEC consults each designated agency to lay down the Emergency Response Basic Plan and the Nuclear Emergency Public Protective Action Guides. According to the Emergency Response Basic Plan, the AEC periodically selects an Emergency Planning Zone (EPZ) and conducts full-scale off-site exercise while the TPC conducts on-site emergency response

exercises at each plant annually. For safety and protection of the public, the AEC adopts a policy to pre-administer stable iodine of 2-day dose to every resident in the EPZ.

Nuclear security is to protect the nuclear power plant from intruders who wish to damage or destroy it in order to harm people and the environment. The AEC requires each plant to establish and maintain its physical protection system to protect against radiological sabotage. Furthermore, each plant should submit a site security plan including the following main items for AEC's approval：

(1) Security organization and personnel training,
(2) Physical barriers,
(3) Access controls,
(4)Communication requirements,
(5)Testing and maintenance of security related devices or equipment,
(6)Contingency planning and event reporting, and
(7)Liaison with law enforcement authorities.

Organization of National Nuclear Emergency Response Center (NNERC)



To assure plant security, the AEC conducts annual comprehensive security inspections on each plant, and also requires each plant carry out periodical anti-terrorism drills.

To make the public better understand the performance of emergency response preparedness and physical protection systems of the operating nuclear power plants, a color coded indicators, using green,white,yellow,and red to signify the various safety concerns, has been developed and partly shown on AEC's website.

A 24/7 Nuclear Safety Duty Center has been in operation since February 2004. During normal situation the Center monitors the operating conditions of the ncuelar power plants and the environmental radiation in the whole Taiwan area through the integrated system. While in the occurrence or possible occurrence of nuclear accidents or other significant radiation release events, the Center will be immediately converted as the pivotal center to activate the emergency response unit of the AEC, and start up the emergency response mechanism.

The Center also serves as a single reporting channel for any abnormal event including nuclear and radiological accidents, and as an inter-ministerial communication gateway within the framework of national disaster prevention.

Research and Regulatory Support

While the AEC devotes great efforts to the reactor safety regulation, radiation protection, environmental monitoring and radwaste administration, radioactive material and ionization-producing equipment, it is critically important that the regulatory practices are of sound scientific and technical basis. Research support is, therefore, one area of strong emphasis assigned by the Council to its affiliated research arm, the INER. Probabilistic risk analysis (PRA) studies, thermal-hydraulic test programs, equipment dedications and qualifications, root-cause technologies, instrument calibration techniques for radiation measurements, and waste reduction and processing technologies are among the top priorities of its endeavor in supporting AEC's regulatory efforts. In 2008, the nuclear regulatory technology support center was established directly under the Director-General's command with dedicated personnel to further delineate its support functions and enhance its capabilities.

As the sole national institute for nuclear science and technology studies, INER's primary R&D objectives, aside from the above research activities in supporting AEC's regulatory practices, are maintaining nuclear safety, innovating environment and energy technologies, and promoting nuclear technology in civilian applications. INER's major research areas include nuclear energy, new/renewable energy, radiopharmaceuticals and plasma technology. All these R&D projects operate in close matrix with eleven functional divisions.

To comply with the energy policy of the government, the INER has initiated an integrated energy research program using our nuclear technologies, consisting of several projects, to develop new/renewable and eco-friendly energy technologies with lower cost and high efficiency. The goal of the program is to fulfill the national requirement on CO_2 reduction, to reserve energy sources, and to foster new energy technologies in the country. Major projects in this program include small/medium size wind turbine system, high concentration photovoltaic system, cellulosic ethanol technology, and fuel cells.

For promoting nuclear technology in civilian applications, research activities are focused on radiopharmaceuticals and their applications. The purposes in developing these radiopharmaceuticals are to study diagnosis, radiation therapeutic technology and the molecular image technique for domestic health care. Currently, more than 15 radiopharmaceuticals were formulated, approved by the Department of Health, and produced through current Good Manufacturing Practice (cGMP).

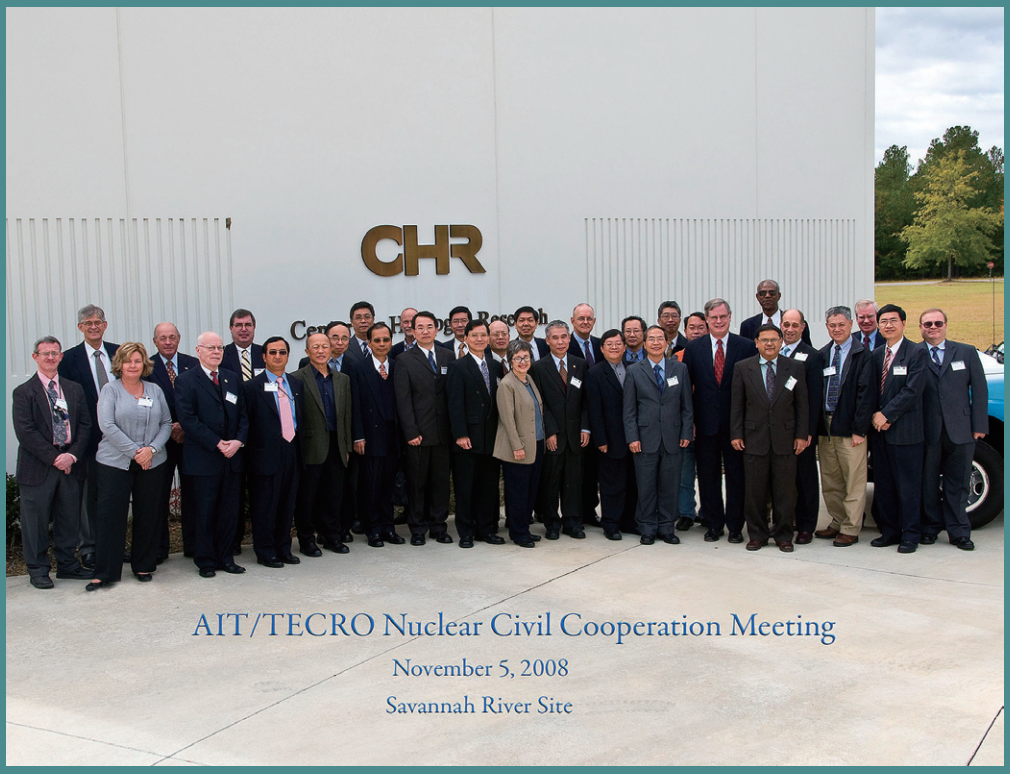
As a national research institute, the INER possesses a strong research team composed of nearly 500 talented researchers with graduate degrees. In the future, the INER is determined to actively meet the severe domestic challenges in energy and environmental areas. Through the use of research results, the INER aims to bring welfare to the people as well as feedback to the society and the country. For more information, please visit INER's website, http://www.iner.gov.tw.

Personnel Training and Expert Advice

The AEC provides its staff with systematic training to maintain their professional capability up to date for meeting ever-increasing regulatory challenges. For example, a course of 12-24 weeks on PWR, BWR or ABWR technology and simulator training is a requisite for resident inspectors at nuclear power plants; advanced technology training courses are followed to enhance the regulatory capability of the inspectors. In addition, selected staff members are dispatched to regulatory agencies and research institutes in nuclear advanced countries for on-the-job training. The AEC also invites experts outside the Council in relevant fields of expertise to serve as advisors in various in-house committees. Five advisory committees were created within the AEC to help ensure the quality of its regulatory practices on issues related to reactor safety, ionizing radiation safety, new construction of nuclear power plants, radioactive materials safety, and nuclear legislation. Members of these committees meet frequently to help the AEC resolve issues in related areas. In addition, the Advisory Committee on Handling of State Compensation Cases was formed in 2002 to provide expert opinions on AEC's handling of such cases should they arise. Another committee has also been set up for evaluating research and development achievements.

Communication

Communication is a very important mechanism for effective regulation. Periodic nuclear reactor regulatory meetings are held between the regulator and the operator to enhance reactor safety. Meetings with stakeholders are also held whenever new laws are enacted, regulations promulgated or policies announced. For public outreach, the AEC holds press conferences periodically to inform the general public, through media, of major activities such as regulatory decisions, inspection results, etc. To intensify guarantees for nuclear power safety, the AEC is making strides to strengthen transparency and public oversight mechanisms. New projects are under way for public education and awareness on nuclear safety, radiation protection, waste management and atomic technology applications. A newly revised AEC website was launched in June 2009 which has made information browsing and retrieval more user-friendly.



International Cooperation

It has been widely recognized by the international community that nuclear has no national borders. There is growing international cooperation in nuclear infrastructure, safety regulation and R&D to enhance the safety of nuclear activities. The AEC has long had sound cooperative relationship with nuclear advanced countries such as France, Japan, and USA in various aspects of nuclear programs, and continued information exchange on waste management developments with Finland, Sweden and Switzerland. The Council also takes part in some of the cooperative activities and training seminars sponsored by the OECD's Nuclear Energy Agency and the International Atomic Energy Agency (IAEA), and will continue to seek opportunities for such participations. In the area of international nuclear safeguards, the IAEA conducts safeguards inspections in Taiwan following the spirit of the United Nation's Nuclear Non-Proliferation Treaty and an Additional Protocol established between Taiwan and the Agency.

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A Word from the Minister

At the AEC, not only must we persist in honesty, uprightness, and act in compliance with the laws, but also be ready and enthusiastic to serve the public. Let's work with our greatest efforts for the sustainable development of our nation as well as for the protection of the Mother Earth.

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