行政院所屬各機關因公出國人員出國報告書

參加「危險物及其對環境暨法律上之衝擊研討會」

服務機關：行政院原子能委員會輻射偵測中心
出國人員　職　稱：副主任
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出國地點：約旦
出國期間：91 年 5 月 10 日　91 年 5 月 18 日
報告日期：91 年 7 月 30 日

目　　　錄

（頁碼）

一、前言

約旦國家之民防部（Civil Defense Directorate）職司其國內緊急救難事宜，由於約旦鄰接以色列與巴勒斯坦，位處中東最緊張、敏感的地帶，因此，民防部在約旦政府中之地位甚為重要。

本次大會係因民防部考慮到萬一有核、生、化意外事故發生時，緊急救難系統當如何建立？因此於本年 5 月 11 日 16 日在首都安曼召開此次「危險物及其對環境暨法律上之衝擊研討會」（National Seminar on Hazardous Material---Environmental & Legislative Dimensions），討論議題包含了技術及立法等廣大的層面。參加人員則包含了約旦本國之能源部、衛生部、軍方、民防、學界、環保等機構之代表，此外，亦邀請了台灣、美國、法國、瑞士、沙烏地阿拉伯等國外專家參與，以助其迅速建立必要的防護體系。

約旦與我國雖無邦交，但甚為友好，此次籌備會負責人 Dr. Ayman Khalil 透過網際網路之搜尋，認為本中心在輻射偵測上之經驗應對其有所幫助；另方面，透過其與「台灣國際法研究會」會長謝淑媛博士之交誼，請求我外交部協助派員參加，幾經協調，終於選派謝博士、本人、物管局林善文技正及工研院環境與安全衛生技術發展中心楊致行副主任等四人代表台灣與會，成為此次大會上人數最多的外國代表團。

二、行程：

日期	行程	工作內容
5 月 10~11 日	高雄→吉隆坡→安曼	去程
5 月 12 日	安曼	參加會議
5 月 13 日	安曼	參加會議
5 月 14 日	安曼	參加會議
5 月 15 日	安曼	參加會議
5 月 16~18 日	安曼→吉隆坡→高雄	回程

三、研討會紀要

約旦是個小國，在其境內並無核能電廠，有關輻射的從業人員及經驗甚為有限，放射性廢棄物之主要來源是醫院、工業、研究單位所產生的廢棄物及廢射源，此次會議的主題係首次舉辦，因此大會安排每位演講人員一個小時時間，以充分討論，會議時程表如附錄一。研討會開幕典禮於 11 日早上在 Amra Hotel 國際會議廳舉行，典禮由約旦民防部長主持，我國駐約旦商務代表沈代表國雄亦應邀致詞，各國使節及媒體亦應邀出席。茲選擇部份演講內容提出摘要報告。

（一） 本人此次發表的題目為"Environmental Radiation Monitoring in Taiwan"，在演講過程中，因慮及其並未有實際的經驗，故特別針對輻射偵測的設備及方法詳加解釋，並攜帶一些簡便的儀器，例如 TLD，膠片配章，手提式輻射偵檢器等在現場展示，彼等甚感興趣。此外，亦佐以大量的圖片，說明我們在台灣的一些實際經驗，包括：

1. 放射性落塵的偵測
2. 食品及飲水中放射性含量的偵測
3. 自然背景輻射的調查
4. 核設施環境輻射之監測
5. 環境輻射監測網路系統
6. 核子事故緊急應變計畫

全文如附錄二。

物管局林善文技正所發表之題目為「Safety Regulations

and Disposal Technologies of Radioactive Waste in Taiwan」。鑑於約旦境內並無核電廠，因此簡報之重點擺在低放射性廢棄物之管理，尤其是小產源放射性廢棄物之管理，並著重最終處置之法規、處置技術與小坵嶼之輻射劑量評估等方面。簡報內容包括以下部分：

1.前言：介紹我國核能發電概況、放射性廢棄物管理組織架構、放射性廢棄物分類、高放射性廢棄物管理概況、低放射性廢棄物管理概況、小產源放射性廢棄物管理概況。

2.低放射性廢棄物處置技術：介紹處置策略(濃縮與保存、稀釋與排放)、目前主要處置方法(淺地層掩埋、深地層處置、海床下處置、海床上處置)、先進國家處置場介紹(美國、法國、日本、瑞典、德國) 。

3.我國低放射性廢棄物處置安全法規：輻射安全目標、廢棄物分類、廢料體品質標準、選址準則、安全分析報告導則、運輸。

4.我國低放射性廢棄物處置推動情形：

5.小坵優先調查候選場址之處置概念設計與功能評估技術(地下水流評估、核種傳輸評估與劑量評估)。.

6.結論：提出我國低放射性廢棄物處置「境內優先」原則與成功必要條件，並對約旦之小產源廢棄物之管理提出建言。

工研院環安中心楊副主任致行所發表的題目是「The Management of Hazardous Material in Taiwan」，楊副主任以其在台灣十餘年來在有害廢棄物之實務經驗，對台灣有害廢棄物的

管理作了詳盡的介紹，其內容包括下列部分：

1 我國有害廢棄物立法與法規之一般原則

2. 簡介我國有毒化學物質管制法(Toxic Chemical Substance Control Act)

3. 我國有害廢棄物之管制與法規

4. 工業有害廢棄物的實務－案例分析

5. 不明有害廢棄物與物質之問題

6. 結論與建議

（二） 美國 Nevada Technical Associates 之 Dr. Robert Holloway 發表"Radiological Monitoring in the Vicinity of the Nevada Test Site", Dr. Holloway 以一實際的照片圖說明在某次地下核爆時，放射性雲團衝出地面的情況，令人印象深刻，亦直接說明了本次大會的主題：不論事前的防範如何週延，仍要做最壞的打算！比較我國目前在核能電廠周圍之環測計畫，發現目前我們的作法不論是分析項目、使用儀器、評估方法等皆甚為相近，對於本中心多年來所建立之偵測技術亦倍感信心。

（三） 法國大師級之 Jean-Jacques Salomon 教授，是巴黎 Technologie et Societe, Conservatoire National des Arts et Metiers 名譽教授，其所發表"Industrial Risks and Environment: French Legislation, Institutions & Policy-Making"，談工業與環境風險。

環境保護與工業污染防治可追溯至拿破崙一世時代第

1810 號帝國法命，儘管在工業革命之各種技術過程採取許多措施，二十世紀仍只有在最後 25 年污染防治才得到顯著效果，但 1975 年以後的工業產品亦幾乎加倍成長。1987 年 7 月 22 日法國頒布相關法令，考慮技術風險之預防、設立風險管理組織、預防意外事件之發生與減輕意外事件後果(在城鎮與鄉間之發展計畫內，使用警報與各種資訊通知民眾)。近年來，在國家立法中並考慮了風險之預防與管理。

在風險管理方面，法國成立了工業及環境風險國家研究所（National Institute for Industrial Environment and Risks, INERIS），負責經濟活動導致的健康、個人安全、財產及環境之風險，並協助產業調整這些目標。INERIS 除處理重大危機(如 Erica 海難、Blanc 山隧道意外事故、Danube 河污染意外事件)之風險評估, 並成立預防風險計畫(Plan of Preventing Risks)，負責工業區附近民眾之諮詢與教育，教導民眾意外事故發生時之處理措施，2000 年已有 2550 各鄉鎮加入此計畫，預計 2005 年時可增加到 5000 個。

因為預防的失敗而見證到意外事故的發生，Salomon 教授在其演講中提出了三個評論：

1. 即便是可控制的人工系統，仍可能發生意外。

因為人與機器之間的界面不可能完全無誤，三哩島事故，車諾比爾事故皆是例子。此外，有時候技術專家們已經注意到某些潛在的問題，但因為各種因素而被扭曲、掩蓋了，包括歷史、文化、競爭、官僚作風、行政體系、權勢、規則、制度---

-等。

2.決策過程中，民眾參與的重要性：

一個社會裡如果沒有充分的言論自由，人人只知附和、遵從，則高度的危險很可能潛藏其中。因此，民主、多元的社會仍是較可取的制度。但是個人與公眾的利益是難免相衝突的，且一旦採取公眾參與的決策模式，常常就不能僅考慮技術層面，經濟、社會、政治等的因素都必須包含在內。

一個卓越的決策過程應包括三個層次：多方面的知識，專家的意見及做成決定。在此過程中，科學家的角色只是提供先進的知識並提供其證明。如果所提出的建議有所爭論，則只能由決策者依照各方面的資訊來做成決定。

3.球員兼裁判的問題（一個法國的經驗）

法國為追求重大公共政策更客觀、透明化的決策過程，避免球員兼裁判的質疑，曾經在 Mr. Michel Rocard 擔任總理時，任命了一個特別諮詢委員會，直屬總理，委員會由十二名德高望重的知名人士組成，包括科學院院士、律師、資深工程師、生物學家、醫生、海軍上將、社會學家…..等。委員會的主要任務是思考有關核能、化學、石油、交通乃至各種新科技在工業化後可能帶來的危險，並提供其建議。任命當時，一個重大的議題正是法國政府決定設置二個深層處置的放射性廢料最終處置場，而遭到當地居民的強烈抗爭。

委員會除供總理諮詢外，也可以自行進行研究，並享有一

項特權：即委員會在將其建議提報總理及政府之相關部門後（例如十天），即可以公開發表。

此一設計，尤其是逕行發表的權利，對於行政部門及工業界所造成的壓力十分巨大，可以想見。而且雖然委員會自認是以超然的立場運作，其建議難免會與既定的政策相違背，漸漸地被認為是"Trouble maker"，而終於在歷經幾任總理後，被廢止了。

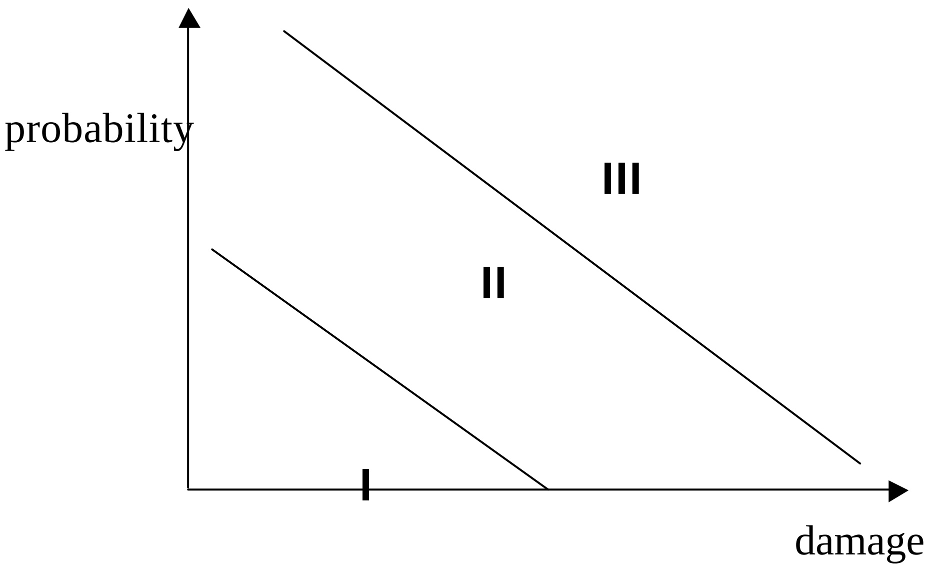
Dr. Salomon 是社會科學資深教授，曾任上述諮詢委員會之主席，亦曾受聘至 MIT 任教，其演講及思考的內容頗富哲理，已不僅是技術的範疇，頗值得深思，僅摘錄二句如下，並附全文如附錄三。

In any society, the acceptable risks are always the politically accepted risks.

Public trust and confidence is not a one-way street. DOE must trust the public before it can expect the public to trust it. By the same token, the public and its representives must be held to a standard of behaviour that is trustworthy.

（四） 瑞士的 Dr. Alain Pasche 發表"Swiss Experience in HAZMAT Management"，瑞士工業發達，相對地，其在工業安全方面的法令也相當完備。Dr. Pasche 以下圖說明瑞士有關法令的基本精神。所考慮者主要為此項工業可能造成的傷害（damage）及其機率（probability），若此二項參數之座標是在 I 區內，則此項工業是絕對核准設立。若是在III區內，則此項

工業絕對不准設立。若是在 II 區內，則由主管機關裁量之，聞之似乎頗有道理。



但在會後，本人問他若是要興建一座核能電廠，則其 damage **及** probability **當如何定義？**Dr. Pasche **答道：此圖並不適用於核能工業！瑞士目前亦有核能電廠，但是在多年以前興建的，目前他們想要興建放射性料的最終處置場，也是遭受到當地居民強烈的阻力！**

四、心得與建議：

（一） 以往出國，大都是前往美、日等國考察或參加學術會議，基本上都是抱持著前往先進國家學習的態度，此次竟是受邀前往講授我們的經驗，直有受寵若驚之感，而因約旦方面誠懇的邀請及尊重的態度，也讓我們倍感珍惜，事前頗花了一番精神準備, 卻也因教學相長, 對於本中心過去的一些成果，做了一次整理。

（二） 我國緊急救難的職責屬於消防署及地方之消防局，然而其救難範圍仍以消防為主，有關於核、生、化等重大意外，因涉及專業技術，並未包含在內。據瞭解，目前我國關於化學災害之緊急救難及善後處理，是由環保署委託工研院化工所辦理，國軍化學兵則在必要時支援。核災部分，目前我國「核子意外事故緊急應變計畫」是由原子能委員會主導，地方政府及國軍化學兵亦皆參與其中，每年皆進行聯合演習一次，準備可謂亦頗充分。唯原能會部分主要的人力及技術皆來自核研所，目前我國正積極推動政府再造，組織及人力的精簡是必然的趨勢，若將來核研所不再隸屬原能會時，則類似環保署與工研院間的委辦關係，似乎也是一種可行的模式。

（三） 啟程前，適蘭嶼原住民發動強烈抗爭，要求政府將放射性廢料貯存場遷移，行政院游院長、經濟部林部長都到達蘭嶼與居民溝通，並允諾成立「蘭嶼放射性廢料貯存場遷場推動委員會」及「蘭嶼社區總體營造委員會」二個委員會，以處理本案。但是在人人都不願把廢料擺在自家後院的心理下，貯存場將何去何從，著實令人擔憂。

另一方面．在中東地區，巴勒斯坦人以人肉炸彈報復以色列，以色列則發動軍事攻擊，包圍巴勒斯坦的指揮總部，雙方情勢可謂劍拔弩張，而約旦正是所謂巴勒斯坦難民營的所在地。此次會議期間，大會亦安排全體人員參觀約旦之上議院，並與議長會面，談話中，議長的話題主要仍是以、巴之間的問題，而其困難度看來更甚於廢料的問題！法國的 Dr. Salomon 則勉以只有繼續不斷的溝通與努力，才有和平的可能；而彼此間的互信必須由雙方本身各自做起！

我想廢料的困境是舉世皆然，但也只有以更大的耐心來溝通及化解，期待外界環境的改變。另一方面，民主需與法治相輔相成，世界上仍有成功的廢料貯存場案例，彼所依據的法律及技術的基礎為何？我們必須在立法及安全技術兩方面都充分準備，再藉由民主與法治的程序，溝通與公權力多管齊下，以執行此一必要的公共政策。

附錄　二

Environmental Radiation Monitoring in Taiwan

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Introduction:

Chemical, biological and nuclear accident are always considered as the major hazard to the human. For nuclear accident, radiation is especially of great concern to the public. Therefore, environmental radiation monitoring is becoming an important issue of the government. In Taiwan, the Radiation Monitoring Center (TRMC) is a branch of the Atomic Energy Council （AEC） ,Executive Yuan, R.O.C. It is responsible for the environmental radiation surveillance and related fields in Taiwan. Its environmental radiation monitoring programs can be categorized into two parts: surveillance of natural ionizing radiation and surveillance of man-made ionizing radiation. For natural ionizing radiation, surveillance programs are mainly to establish the radiation baseline data. For man-made ionizing radiation, surveillance programs include the radioactive fallout surveillance, the environmental radiation monitoring around the nuclear facilities and surveillance of radioactivity in foodstuffs. This article summarizes the relevant programs carried out in Taiwan in the past years.

Sources of Environmental Radiation:

To do the environmental radiation monitoring, we should understand where the environmental radiation comes from. The sources of environmental radiation are often subdivided as natural and man-made radiation. The natural environmental radiation includes:

1. Cosmic radiation which comes from the outer space.
2. Terrestrial gamma radiation which comes from the ground.
3. Naturally occurring radioactive isotopes, such as
   (1) U, Th series in soils and building materials.
   (2) ^{40}K which exists in everything containing K element.
   (3) Radon and its decay products.

The natural environmental radiation contributes the major radiation dose received by human. However, human have lived in this natural radiation environment for thousand of years.

For the man-made environmental radiation which we are concerned about, it comes from :

(1) The radiofallout due to nuclear explosion or nuclear accident such as Chernobyl accident.

(2) The nuclear facilities such as the nuclear research reactor, the nuclear power plants, the radwaste storage site, etc.

(3) Industrial and medical usage. It has existed in many different fields of our living.

Method and Instrumentation:

Since radiation can not be seen with our eyes, it can only be detected with proper instruments. The environmental radiation can be monitored with instruments directly or by sampling and measuring the radioactivity in the samples.

To measure the radioactivities in the environmental samples, there are some basic principles:

(1) Sampling: Take samples from the critical pathway. The samples should be representative of the material under consideration.

(2) Concentration: In most cases, the dadioactivities of environmental samples are quite low, samples should be concentrated first. Concentration methods include ashing, filtration, precipitation, extraction and chemical separation and purification….etc.

(3) Detection: After proper pretreatment, samples can be counted to evaluate its radioactivity. Detectors include gas-filled detector, liquid scintillation counter, γ-ray spectrometry…..etc. The most common is γ-ray spectrometry. The block diagram is shown as Fig. 1. It is a non-destructive method. Samples are put into the containers and then counted by the detectors. The γ-ray spectrum will then be accumulated as shown in Fig. 2. Each peak corresponds to a specific gamma radiation. The computer software for analyzing the γ-ray spectrum have been well developed and commercialized. It is not difficult to set up the whole system.

To measure the environmental radiation with instrument directly, the instrument should be sensitive enough. It is difficult to measure the α and β radiation, due to their short range in the air.

One method that is often used is to measure the accumulated radiation dose with thermoluminescent dosimeter (TLD). Because of its small-size, easy-handling and reusableness, it is widely used in the measurement of personal and environmental radiation.

Examples of Environmental Radiation Monitoring in Taiwan

1. Radioactive fallout surveillance

The first step of environmental radiation monitoring in Taiwan was conducted on the monitoring of radioactive fallout from the atmospheric nuclear weapon tests. Radiofallout means the air dust that are contaminated by the nuclear explosion or the nuclear accident. It descended gradually from the atmosphere and deposited on the ground. The purposes for the radioactive fallout surveillance are :

1. to check whether radioactive contamination occurred or not,
2. to identify the influence of increased levels of radiation,
3. to take appropriate measures for radioactive fallout.

To monitor the radiofallout, the radioactive particulates in the air are collected by air samplers with filter paper. Dry and wet precipitation are collected with water tray, gummed film and rain water method. Samples are collected by the weather stations at six main cities around the country, and then sent to TRMC for analyzing. Gross β activity and γ -ray spectrometry are carried out for each sample.

As the Chernobyl accident occurred on April 26, 1986, the radiofallout surveillance program had magnified its effectiveness. Figure 3 shows the γ -spectrum of an air filter sample which we collected at May 16, 1986.[1] The sample volume is 2650 m^3 air and the counting time is 80,000 seconds. The radionuclides of ^{131}I, ^{132}I, ^{103}Ru, ^{106}Ra, ^{134}Cs, ^{137}Cs------had been found in this sample. These radionuclides are fission products that hadn't been found in the background spectra in Taiwan. Comparing the sampling date and the date of Chernobyl accident, we understood it was from the accident. However the activities were very low and could not be related to any radioactive hazard.

2. Monitoring of radioactivity in the foodstuffs and drinking water[2]

After the Chernobyl accident, many places in the Europe were contaminated with radioactivity. So were the foodstuffs produced from these places. Milk power and dairy products were the most concerned about, because the radioactivity in these foodstuffs may be concentrated.

The European Economic Community (EEC) first proposed a regulation limit for the import foodstuffs. Many countries such as U.S, Japan and Taiwan --- soon adopted the same regulation. The limit is :

"The sum of concentration of ^{134}Cs and ^{137}Cs should be less than 370 Bq/kg."

The regulation checked the concentration of ^{134}Cs and ^{137}Cs only. Because they are the representative radionuclides of fission products and the half life of ^{137}Cs is as long as 30 years.

The monitoring procedures is quite simple. Samples are checked randomly both from the Customs and bought from the markets. For each sample,300g of sample was put into a container and then counted by a detector for γ -ray spectrometry for ten minutes.

In 1986, after the Chernobyl accident, ten samples exceeding the regulation limit were found. Since then, no samples exceeding the regulation has been found again.

Besides the surveillance of imported foodstuffs, Ten major foodstuffs and drinking water are sampled and analyzed the radioactivities every half year to evaluate the radiation dose through food ingestion for the population in Taiwan.

3. Surveillance of natural radiation [3]

A study of Taiwan's natural background radiation was carried out by (1) in-situ measurement, (2) soil sampling and (3) rock sampling. For the in-situ measurement, the whole island of Taiwan was divided into 153 regions by considering the population distribution, soil characteristics, types of rocks and transportation conditions. Each region represents a population of at least 3×10^4. A survey meter equipped with cylindrical NaI(Tl) detector was used. School playground or public squares were preferred for measuring. The survey meter readings were taken at 1 m height above ground. At each measuring site, five locations nearby were chosen. At each location, 10 readings were recorded. The measured results are shown in fig. 4.

For soil and rock samples, 8 kinds of soil and 13 kinds of rocks were sampled. The number of sampling sites are 40 for soil and 209 for rocks, respectively. After sample preparation, each sample was put into a container and sealed for 1 month, and then measured with Ge detector. The specific radioactivities of ^{232}Th, ^{238}U and ^{40}K were calculated by the peak area of

583.1 KeV (^{208}Tl, 30%), 609.4 KeV (^{214}Bi, 45%) and 1460.8 KeV (^{40}K, 10.7%), respectively. The contents of naturally occurred radionuclides in rocks varied considerably. The exposure rates at 1 m height above ground were then calculated using the appropriate conversion factors. The relationship between the in-situ measurement and the calculated exposure rates were in good agreement.

Figure 5 is a map from Radiation Atlas published by the Commission of the European Communities. It is a summary of natural radiation surveillance in many European countries. Moreover, recently there are some studies that conduct the wide area surveillance with an airborne gamma ray spectrometry in a helicopter !

4.The environmental radiation monitoring around the nuclear facilities[4]

Currently, the nuclear facilities in Taiwan include three nuclear power plants with six reactors in total, one research reactor and one radwaste storage site. According to the “Safety Standard for Protection Against Ionizing Radiation” issued by the Atomic Energy Council R.O.C, an environmental radiation monitoring system is required to set up in the vicinity of each nuclear facility to assess the induced population dose and the level of radioactive contamination. The regulatory guide for the environmental radiation monitoring of nuclear facilities was first developed in 1989 and revised in 1992. The environmental radiation monitoring of each nuclear facility were carried out by the facility owner and TRMC independently. Take the nuclear power plant (NPP) for example :

The fundamental objective of monitoring is to ensure the health and safety of the public around the NPPs and to confirm that the environmental radiation doses are below the dose limits for the public. The specific goals are summarized as follows.

(1) To calculate and assess the radiation doses received by the public.

(2) To surely understand the cumulative effects of radionuclides in the environment.

(3) To assess the impact of abnormal release of radioactive materials from the NPPs.

(4) To verify the safe operations of the NPPs and maintain the release of the radioactive materials below regulation limits.

(5) To provide the accurate information of the environmental radiation to the public.

The scope of the monitoring program covers terrestrial and coastal (marine) areas. The critical pathway can be shown as Fig. 6. The terrestrial samples include direct radiation, atmosphere, fresh water, vegetation, soil, and agricultural products. In coastal areas, the samplings include marine products, sea-water and beach sands. The details of the monitoring items and numbers of samplings are listed in Table 1. The monitoring results serve as the base for the assessment of radiation doses received by the public. Moreover, the results will surely help us understand the cumulative effects of radionuclides released from NPPs.

Monitoring methods include the measurements of environmental radiation dose and the radioactivity analyses of samples. For the former method, both the thermoluminescent dosimeter (TLD) and the high pressure ionization chamber (HPIC) are used. The latter methods include gross-beta counting, analyses of tritium activity, analyses of gamma ray spectrometry, radiochemical analyses of specific radionuclides, etc. Germanium (Ge) detectors were used to determine the radioactivity of gamma emitters, where the radionuclides of interest are ^{54}Mn, ^{58}Co, ^{60}Co, ^{131}I and ^{137}Cs. Figure 7 and Fig. 8 Show some of the typical results of our experience.[5]

5. The environmental radiation monitoring network

With the development of computer, the real-time remote radiation monitoring has become possible.

An environmental radiation monitoring network has been developed by TRMC in 1991. This network includes real-time monitoring instruments installed around nuclear power stations and at major cities for the measurements of gamma radiation. It has the function of continuous automatic radiation monitoring in the environment. The data collected are transmitted to TRMC via the telephone network.

The central computer in TRMC collects the data of each local computer of this network hourly. In case of abnormal situation, the local computer will change the sampling rate and send the data to TRMC immediately. The processing functions of the central computer are listed below:

1. Call up: The central computer can call the local monitoring post one by one according to the preset schedule. The monitoring post then send the measured data to the monitoring center.
2. Display: The measured data are displayed on a displaying board of the local monitoring post that is open to the public.

3.Alarm: As the exposure rate exceeds the alarm level, the central computer will receive the successive data from the local computer and send a signal to the alarm system.

4.Reset: The central computer can reset the time, measuring frequency and alarm level of the local monitoring post.

5.Data processing: The central computer has other functions such as database management, analysis and display, etc.

With this system, we have participated in the project of " Nuclear Transparency in the Asia Pacific " held by the Cooperative Monitoring Center in the U.S Sandia National Laboratory. (http://www.cscap.nuctrans.org/)

6. Nuclear accident emergency preparedness planning:

(1) Organization

The "National Nuclear Accident Emergency Preparedness Plan（NNAEPP）" was promulgated as a preventive and preparatory measure against any severe nuclear accident that may happen. The "National Nuclear Emergency Management Committee （NNEMC）", as composed of Chairman of AEC and Ministers of relevant ministries of the cabinet in R.O.C, is charged with the overview of off-site nuclear emergency management and preparedness.

In order to effectively carry out the off-site emergency preparedness action, NNEMC shall be organized immediately by relevant government agencies including the AEC, the Ministry of interior, Ministry of Defense, Ministry of Economic Affairs, Ministry of Transportation and Communications, Department of Health, Department of Police, Taiwan Power Company, etc. The following units have been established under the NNEMC: Near-site Directing and Coordinating Center, Crisis Directing Center, Supporting Center, and Media Relations. The goal is to unite each institution's capabilities to protect the health and safety of the public. The organization system is shown as Figure 9.

(2) The missions of NNEMC and its established organizations

a. NNEMC:

This unit is in charge of reporting to head of state and executing decisions on public evacuation, issuing evacuation orders, setting up the Supporting Center and Crisis Directing Center, dispatching manpower and materials needed in evacuation, monitoring and assessing off-site radiation intensity, publishing nuclear accident news, decision making on major policies related to nuclear accidents, issuing recovery orders, and issuing exercise orders.

b. Near-site Directing and Coordinating Center:

This center is composed of AEC and TPC personnel and subdivided into technical group, radiation monitoring team and general affair group that takes on the responsibility of collecting and submitting accident information, assessing the accident consequences and radiation dose, and monitoring and controlling the off-site radiation and contamination.

c. Crisis Directing Center:

This center is composed of units of the local governments responsible for informing and helping the public to evacuate, arranging accommodations and providing medical care.

d. Supporting Center:

This center is composed of military units responsible for providing vehicles, carrying out evacuation in affected areas, and establishing temporary communications network, traffic controlling and safeguarding.

e. Media Relations Office:

This office is composed of AEC and TPC personnel responsible for issuing and updating news on up-to-date nuclear accident conditions and the preparedness measures recommended by NNEMC.

Summary

It has been more than 20 years since the operation of nuclear power generation in Taiwan. The environmental radiation monitoring is an important part of the so-called “Nuclear Safety”. The environmental radiation monitoring of each nuclear facility is carried out by the owner and the TRMC independently.

Most of our regulation and monitoring program followed the guide of international authorities such as the ICRP and the IAEA. We also quoted some of the practical guides from the U.S and Japan.

For the past years, we have established the baseline data of natural ionization radiation in Taiwan and have carried out the environmental radiation monitoring around the nuclear facilities quarterly. A national exercise on nuclear accident emergency preparedness planning was carried out every two year.

The measuring results show that the radiation dose of the public was contributed mostly from the natural and the medical radiation. However, most people are still very afraid of the hazard of radiation. Therefore, it is necessary to keep carrying out a thorough environmental radiation monitoring program in the future.

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Fig 1. Block Diagram of a Gamma-Ray Spectrometry System.

Fig 2. Germanium Detector Pulse Height Spectrum.

Fig 3. Gamma-ray Spectrum of the Airborne Dust after the Chernobyl Accident.

Fig4.   Terrestrial Gamma Radiation in Taiwan.

Fig. 5 A Map from Radiation Atlas Published by the Commission of the European Communites.

Fig 6. Radiation Exposure Pathways to Man.

Fig. 7   Variation of Direct Radiation Dose Rates Around the Maanshan NPP.

Fig. 8   Concentration of Radionuclide in the Soil Sample.

participating

Fig.9 Organization System of National Nuclear Accident Handling Committee in Taiwan.

Table 1. Program for the environmental surveillance around the Maanshan NPP.

Monitoring Category	Sample	Sampling Frequency	Analysis Frequency	Sampling Location
Direct Radiation	TLD	Quarterly	Accumulated Dose/Quarter	17
	HPIC	Continuous	Continuous Dose Rate	5
Atmosphere	Airborne Particulate	Weekly	Gross Beta/Week, Gamma/Month	3
	Fallout	Monthly	Gross Beta/Month, Gamma/Month	1
	Water Vapor	Monthly	Tritium/Month	3
Vegetation	Grass Sample	Quarterly	Gross Beta/Quarter, Gamma/Quarter	4
			Tritium/Quarter	3
	Hsianshih Tree	Quarterly	Gross Beta/Quarter, Gamma/Quarter, Tritium/Quarter	1
Water	Drinking Water	Quarterly	Gross Beta/Quarter, Tritium/Quarter	3
	Ground Water	Quarterly	Gross Beta/Quarter, Tritium/Quarter	2
	Pond Water	Quarterly	Gross Beta/quarter, Tritium/Quarter	1

	Sea Water	Quarterly	Gross Beta/Quarter, Gamma/Quarter, Tritium/Month	5
	Sea Water*	Weekly	Gross Beta/Month, Gamma/Week Tritium/Month	1
Produce and Marine Products	Goat Milk	Monthly	Gamma/Month, Iodine-131/Month	2
	Chicken	Biannually	Gamma/Half-year	1
	Duck	Biannually	Gamma/Half-year	1
	Rice	Biannually	Gamma/Half-year, Strontium-90/Year	1
	Sweet Potato	Biannually	Gamma/Half-year	1
	Vegetable	Quarterly	Gamma/Quarter	2
	Onion	Annually	Gamma/Year	1
Sea Food	Sea Fish	Quarterly	Gamma/Quarter	1
	Seaweed	Annually	Gamma/year, Strontium-90/Year	1
	Shellfish	Annually	Gamma/Year	1
Cumulative Effect	Soil	Biannually	Gamma/Half-year	3
	Beach Sand	Quarterly	Gamma/Quarter	5
	Sediment	Annually	Gamma/Year	4

*Seawater collector was installed nearby the NPP’ s cooling water vent.