行政院原子能委員會
Atomic Energy Council

Radiation Protection in Taiwan

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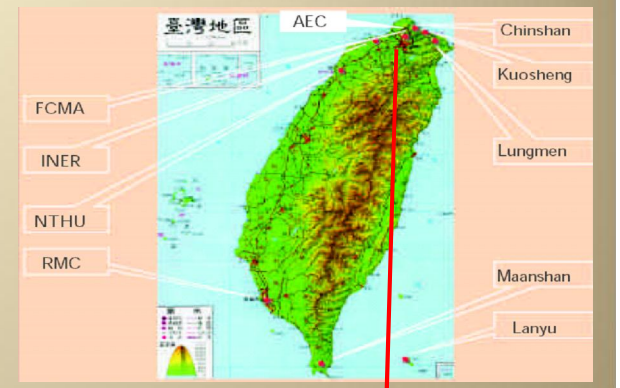
Outline

- Background
  - Department of Radiation Protection
  - Radioactive Sources in Taiwan
- Highlights
  - Regulation of radiation workers and radiation management
  - Audit and Control of High Risk Radioactive Sources
  - Computerized Monitoring
  - Establishment of radioactivity detection system
  - Medical Exposure Quality Assurance Program
  - Re-evaluation of Nuclear Safety and Radiation Protection System

Department of Radiation Protection (DRP)

- responsible for protection against ionizing radiation arising from working places of nuclear facilities, medical and non-medical institutions.
- to protect workers, the general public, **patients** and the environment.
- to issue licenses, and inspect nuclear installations and activities related to radiation.



AEC
(Atomic Energy Council)

- Department of Planning
- Department of Nuclear Regulation
- **Department of Radiation Protection**
- Department of Nuclear Technology
- Radiation Monitoring Center
- Fuel Cycle and Materials Administration
- Institute of Nuclear Energy Research

AEC

DRP (Department of Radiation Protection)

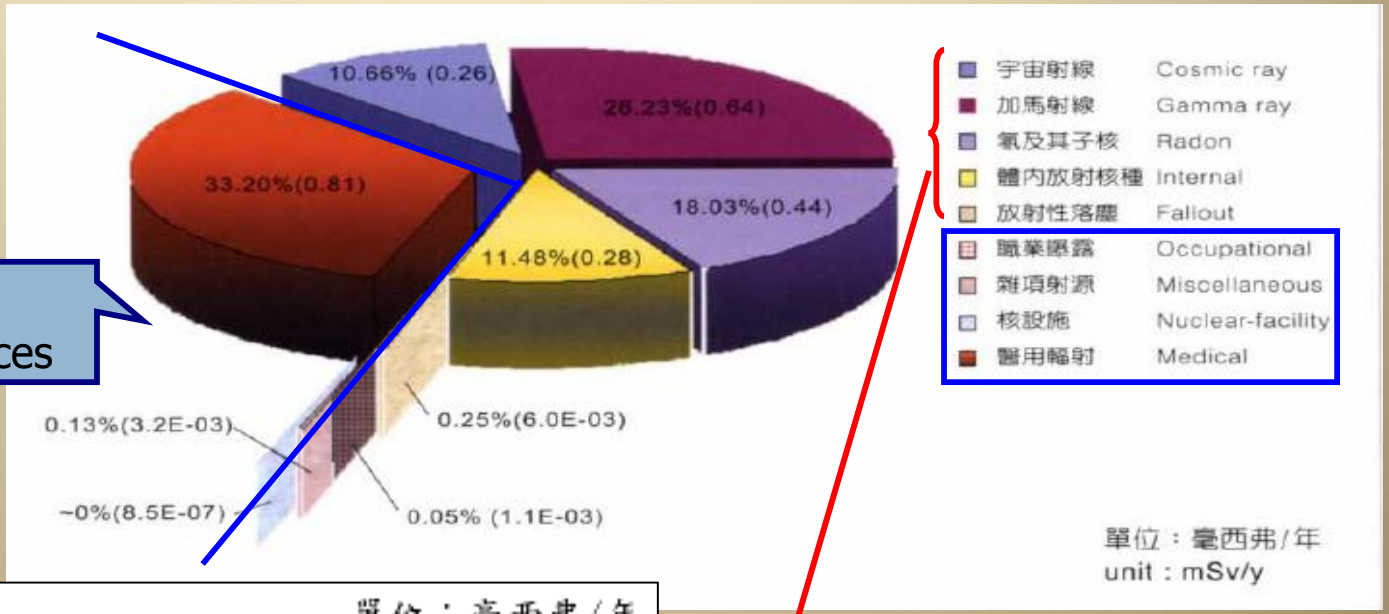
1st Section	Rules and Regulations
2nd Section	Nuclear Facilities and Environmental Monitoring
3rd Section	Industrial Radiographers
4th Section	Hospitals
5th Section	Non-Hospital Facilities

INER (Institute of Nuclear Energy Research)

Support of inspection, collection and receiving of radioactive materials for centralized storage

WWW.AEC.GOV.TW

Effective Dose per Individual in Taiwan



man-made radiation sources

單位：毫西弗/年

類別		UNSCEAR	美國	英國	日本	臺灣
體外輻射	宇宙輻射	0.36	0.28	0.25	0.38	0.26
	地表及建物	0.41	0.28	0.35	0.29	0.64
	小計	0.77	0.56	0.60	0.67	0.90
體內輻射	氡 等	1.26	2.0	1.30	0.41	0.44
	鉀40等	0.36	0.39	0.30	0.40	0.28
	小計	1.62	2.39	1.6	0.81	0.72
合 計		2.4	3.0	2.2	1.48	1.62

UNSCEAR：聯合國原子輻射效應科學委員會

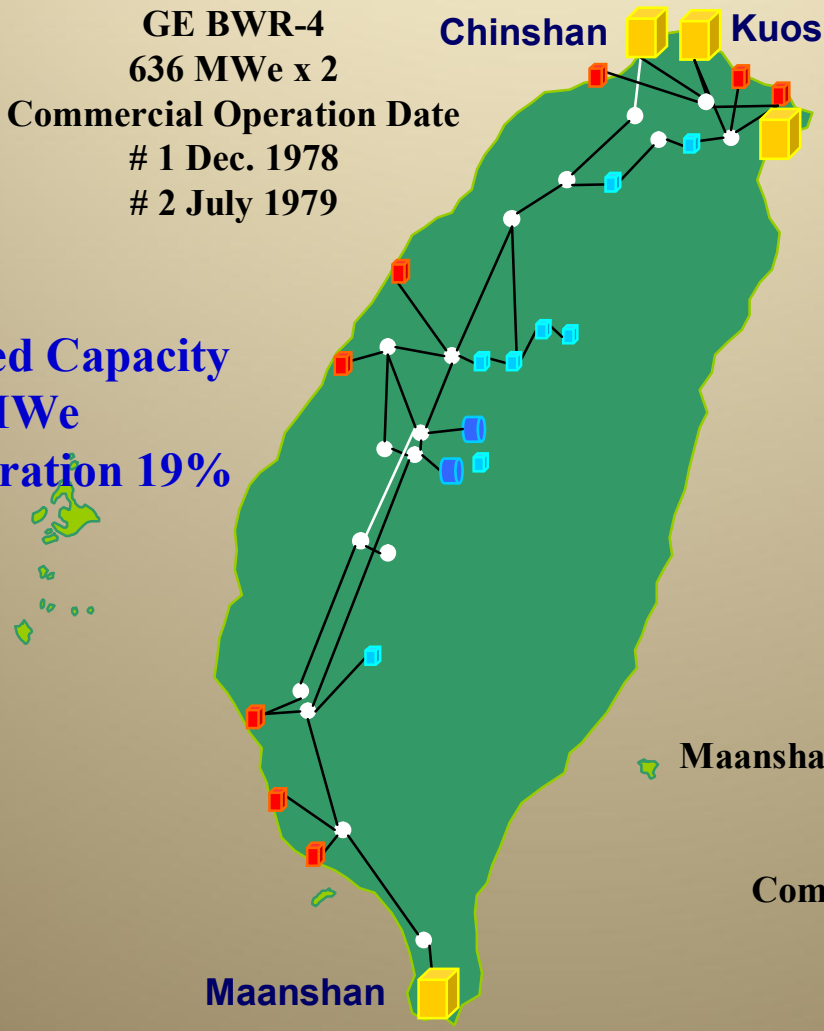
Individual Dose in Taiwan avg. 2.44 mSv/y

Individual Annual Dose from Natural Radiation

Nuclear Power Plants in Taiwan

Chinshan Nuclear Power Plant (1st)
GE BWR-4
636 MWe x 2
Commercial Operation Date
 # 1 Dec. 1978
 # 2 July 1979

Kuosheng Nuclear Power Plant (2nd)
GE BWR-6
985 MWe x 2
Commercial Operation Date
 # 1 Dec. 1981
#2 Mar. 1983

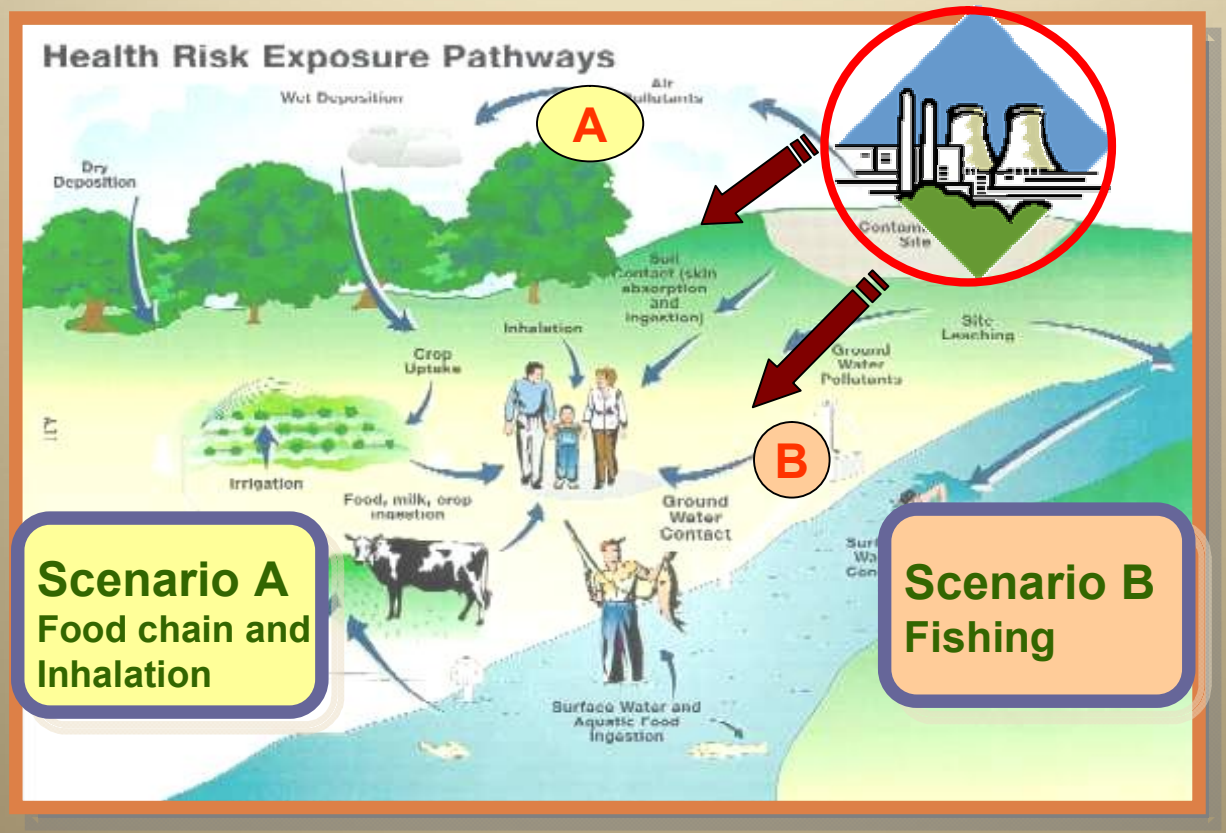


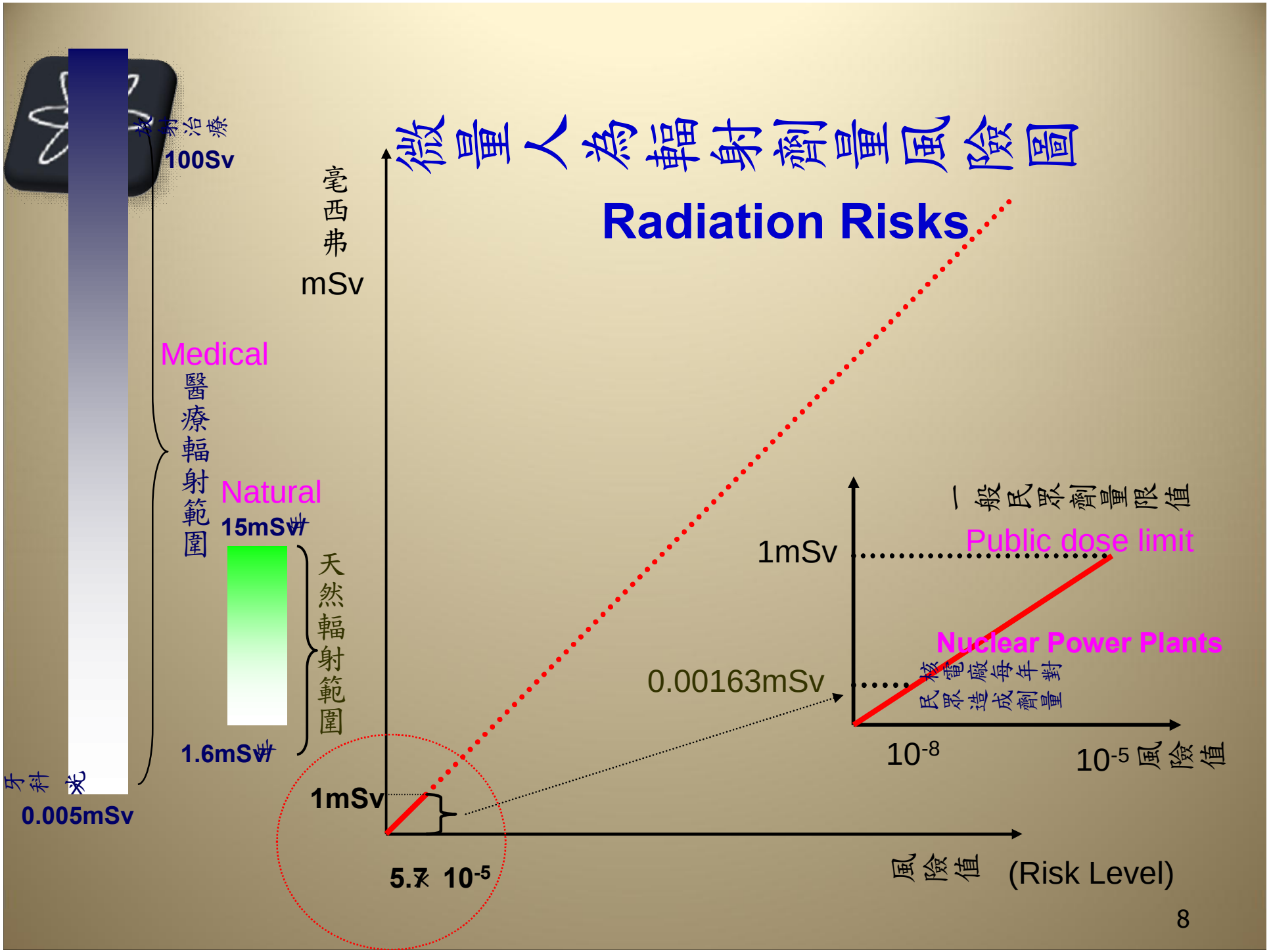
Lungmen Nuclear Power Plant (4th)
GE ABWR 1350 MWe x2
90.5% complete

Nuclear Installed Capacity
5,144 MWe
Electricity generation 19%

Maanshan Nuclear Power Plant (3rd)
WH PWR
951 MWe x 2
Commercial Operation Date
 # 1 July 1984
#2 May 1985

Monitoring Public Exposure



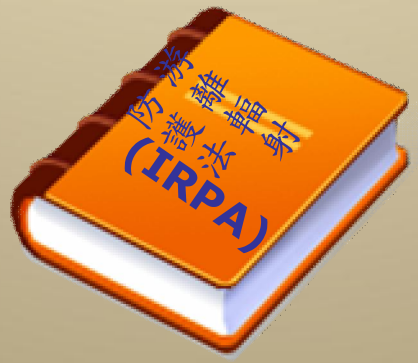

放射治療
100Sv
Medical
醫療輻射範圍
Natural
15mSv
天然輻射範圍
1.6mSv
牙科光
0.005mSv
微量人為輻射劑量風險圖
Radiation Risks
毫西弗
mSv
1mSv
5.7 10-5
風險值
(Risk Level)
一般民眾劑量限值
1mSv
Public dose limit
Nuclear Power Plants
核電廠每年對民眾造成劑量
0.00163mSv
10-8
10-5 風險值

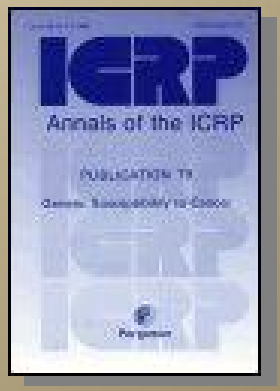
Regulation of Users and Workers

	TYPE	Numbers (data collected on 2013.01.22)		
		TOTAL	MEDICAL	NON-MEDICAL
MATERIAL LICENSE	PERMIT	571	136	435
	REGISTERED	3,436	282	3,154
EQUIPMENT LICENSE	PERMIT	536	176	360
	REGISTERED	24,385	17,699	6,686
RADIATION WORKERS		46,546		

Ionizing Radiation Protection Act

- Effective on Feb. 2003
- In compliance with ICRP-60　IAEA-115 report

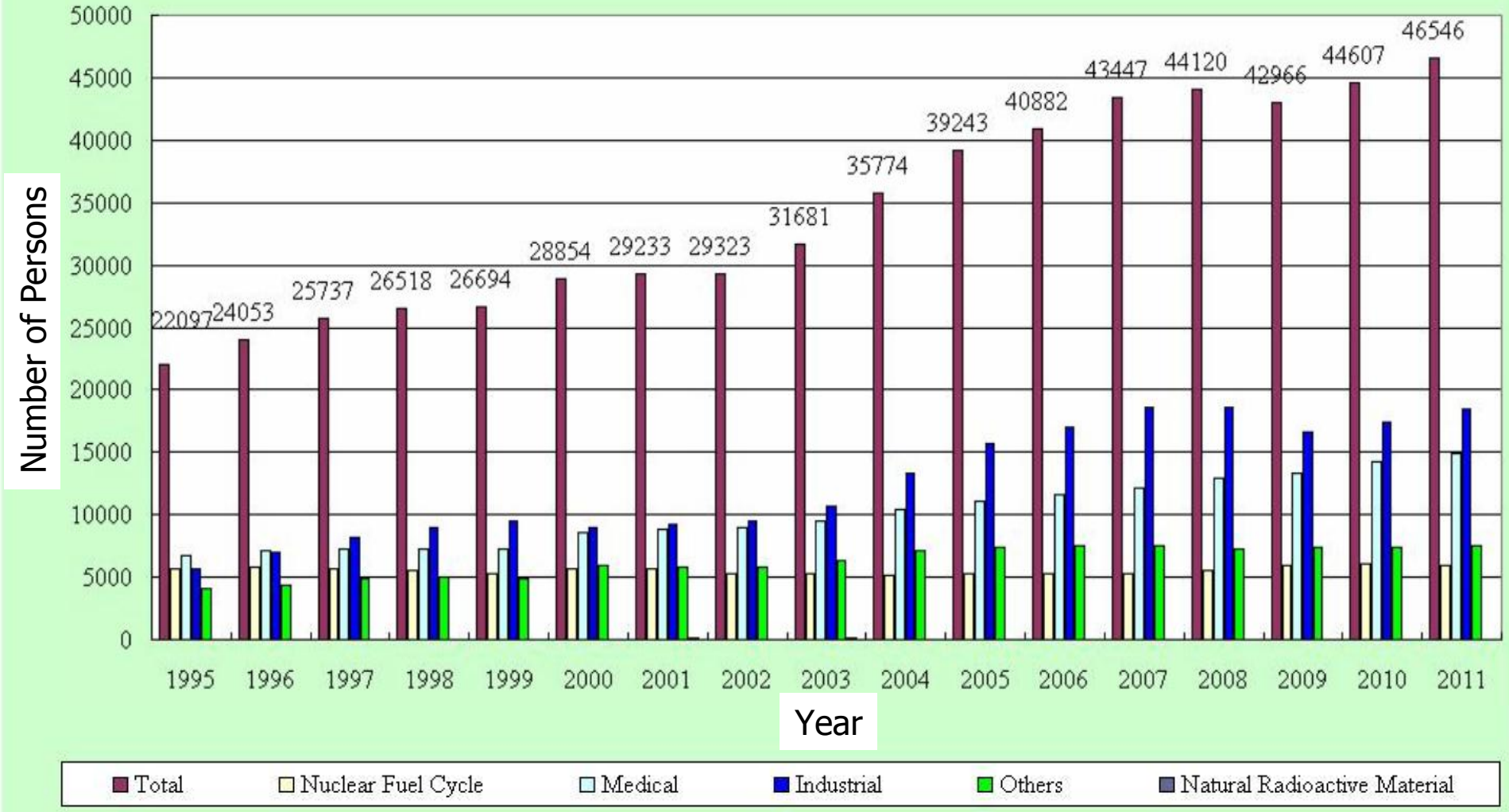




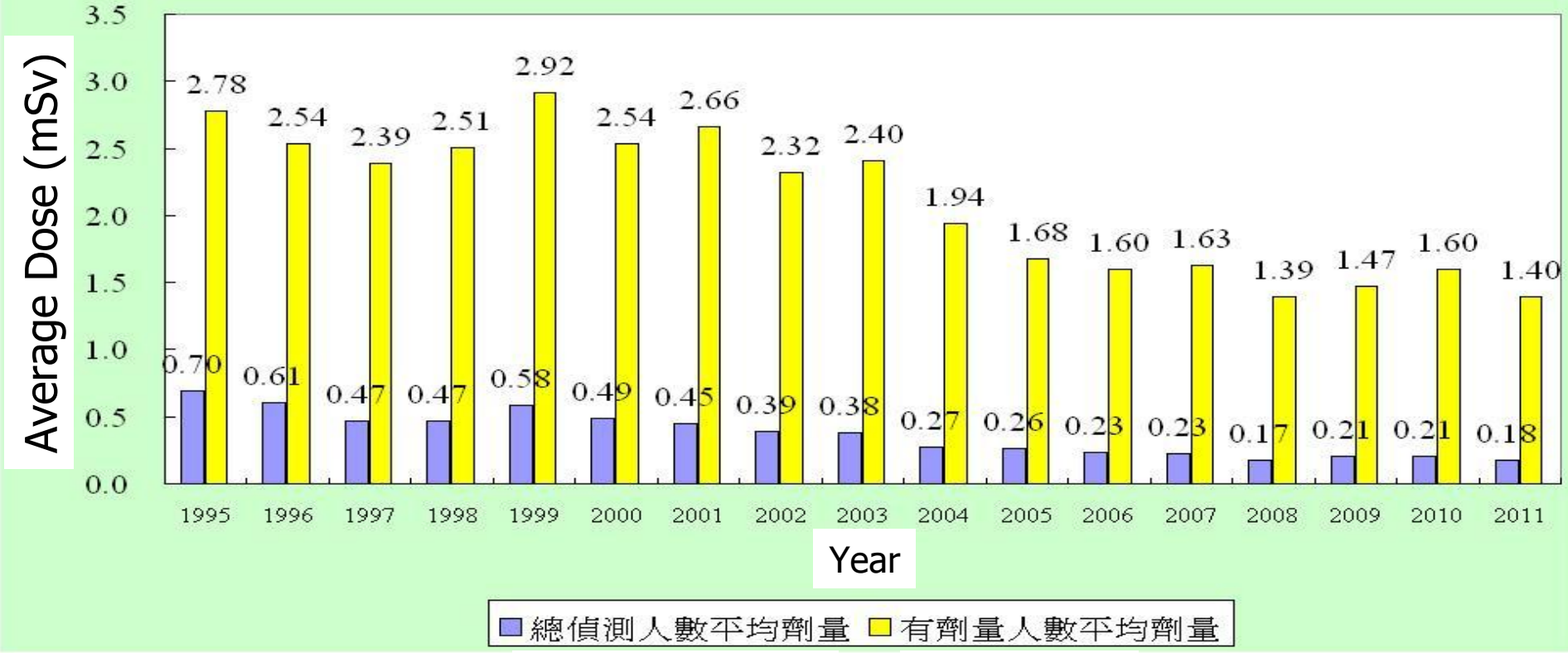
Radiation Protection Regulations

- Ionizing Radiation Protection Act
- Enforcement Rules for the Ionizing Radiation Protection Act
- Safety Standards for Protection against Ionizing Radiation
- Administrative Regulations for Radioactive Material and Equipment Capable of Producing Ionizing Radiation and Associated Practice
- Standards for Medical Exposure Quality Assurance
- Administrative Regulations on Establishment of Medical Exposure Quality Assurance Teams and Assignment of Specialists and Commissioning of Jobs to Relevant Organizations

Domestic Population of Radiation Workers (1995-2011)



Average Annual Dose Value of Radiation Workers (1995-2011)



(Average dose of total monitored persons)

(Average dose of persons with measurable dose)

Emergency response mechanism in case of overexposure

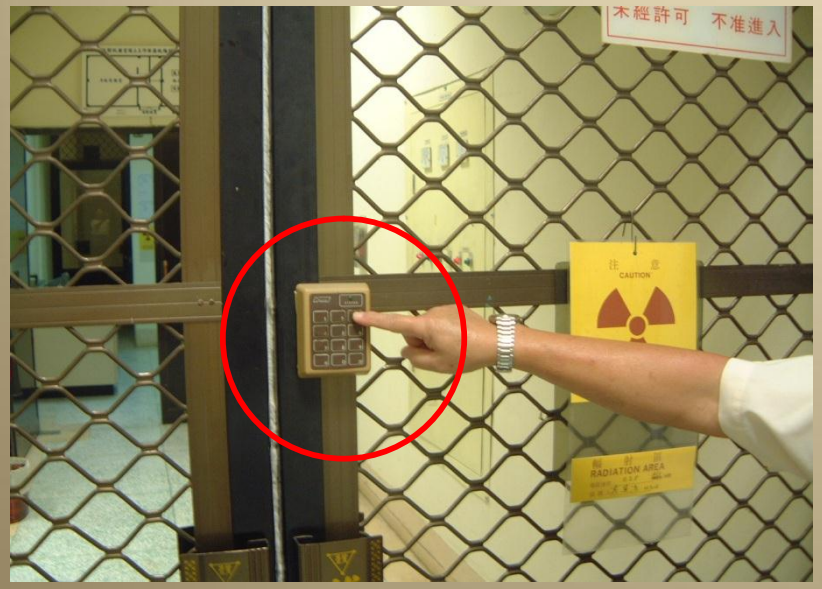
- Have developed dose assessment techniques such as dicentric biodosimetry and expertise, in response to radiological accidents
- There are 19 Radiation Accident Medical Centers in Taiwan.

Audit and Control of High Risk Radioactive Sources

- For IAEA Category 1 and Category 2 Higher Risk Source, implement annual inspection.
- The Security Plan for Regulating Category 1 and Category 2 Higher Risk Source was promulgated in 2011.

- **Conform with international standards**
  - **To Strengthen import/export control**
    - Basis: IAEA Radioactive Materials Safety and Security Action
    - Revised Radioactive Materials Import/Export Regulation

Strengthen radioactive sources control and security



Access control
(Entrance of the Storage room)

Locked cabinet holding
the source

Strengthen security management

- Basis: IAEA Radioactive Materials Security Technical Document TECDOC-1355 & IAEA Safety Guide RS-G-1.9 （2005）
- Install intrusion detection/monitoring alarms and CCTV

Area monitor

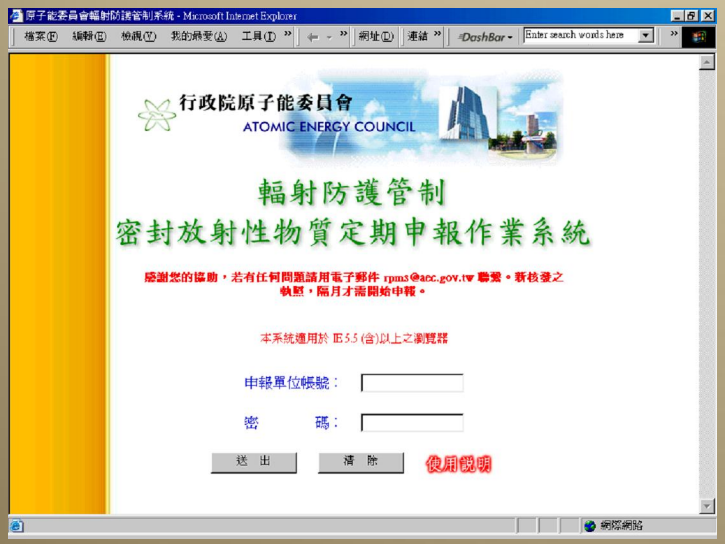
CCTV surveillance and intrusion alarm

Transparency of Radiation Safety Information

- Licenses of Radiation equipments and radioactive materials
- Certifications of RSOs and radiation workers
- Radiation Safety warning label and apparatus
- Procedures of handling of Emergency Accident
- Radiation safety and training information

Computerized Monitoring

- **E-Trade Facilitation and Control Project**
  - Deploy Customs Approval System and Radiation Protection Registration and Control System, to verify import, export, use, transfer, and disuse of sources.
  - Develop online source tracking system.



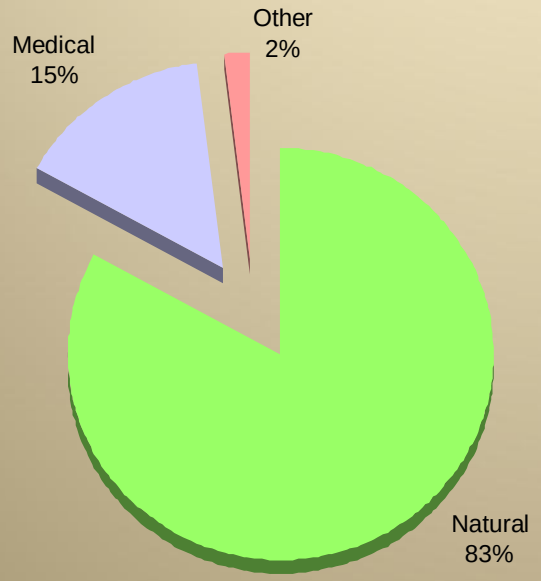
Establishment of radioactivity detection system

- In 1992, some apartments built between 1982-84 were first discovered containing ^{60}Co-contaminated steel rebar.
- Since 1995, iron and steel makers who own smelting furnance(s) are required to install portal type radiation detector(s) being able to effectively prevent from mis-smelting of radioactive sources.
- When imported metal scrap is detected containing radioactive materials, the materials is required to be sent back to the original export country.

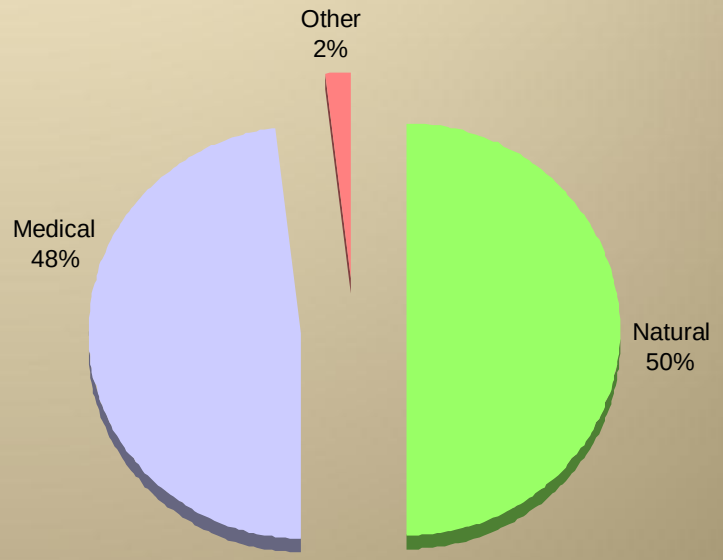
Medical Exposure Quality Assurance Program

- Optimize patient doses and image qualities
- Give QA label to each qualified machine

NCRP Report No. 93 (Early 1980s)



NCRP Report No. 160 (2006)



Radiation Exposure of the Population of the U.S.

Radiation Safety in Hospital

- Licensing radiation instruments, radio-materials and radiation workers.
- Initiate Medical Exposure Quality Assurance Program since 2005.
- Annual inspection of radiation safety and Medical Exposure QA program.

Numbers of Treatments and Scans in TAIWAN

Machine Type	Linear Accelerators, Gamma knife, Cyber knife, Tomotherapy machine	Teletherapy and Brachytherapy	Mammography	CT
Annual No.	1,148,461[a]	6,251[a]	627,000[b]	1,568,422[a]
Total	3,350,134			

a. Source from Department of Health, Taiwan, 2011

b. Source from Bureau of Health Promotion, Department of Health, Taiwan, 2012

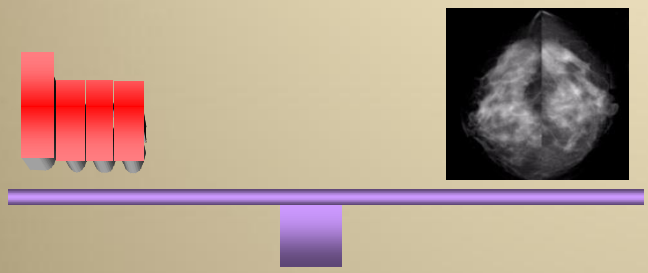
Medical Exposure Quality Assurance Plan

shall include:

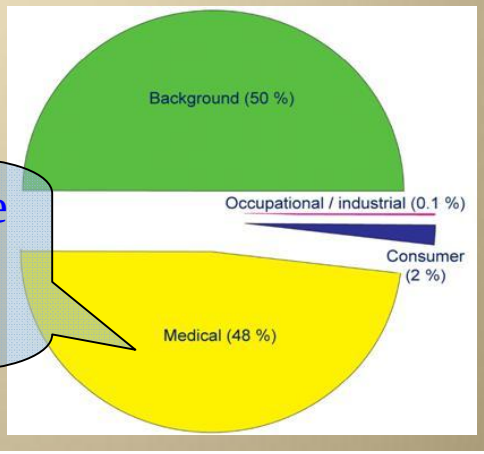
1. QA Organization
2. Procedures
3. QA Calibration items
4. Frequency, results and tolerance of Calibrations
5. Responding and resolving methods when tolerance is deviated

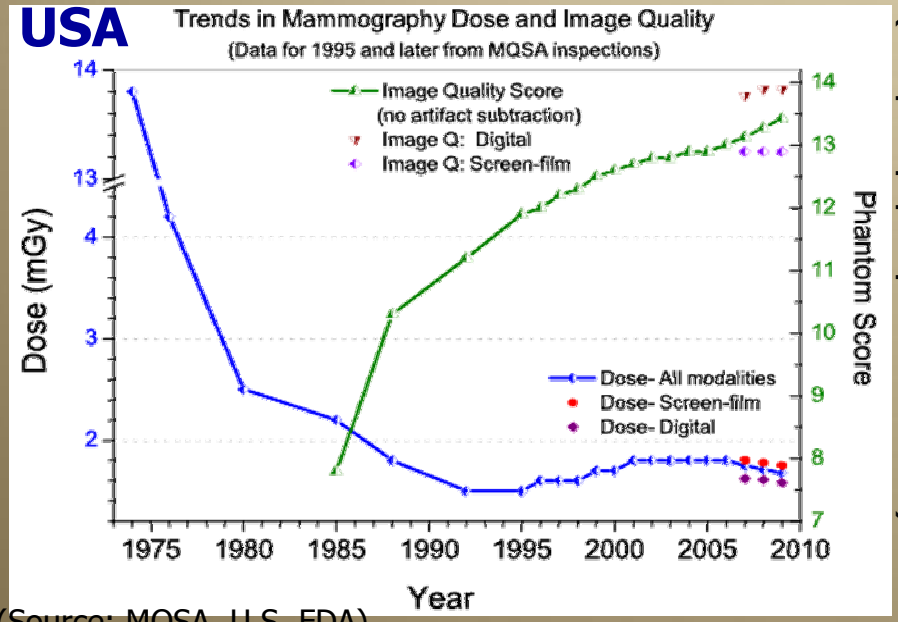
Mammography QA: Patient Dose Management

Source: NCRP-160, USA

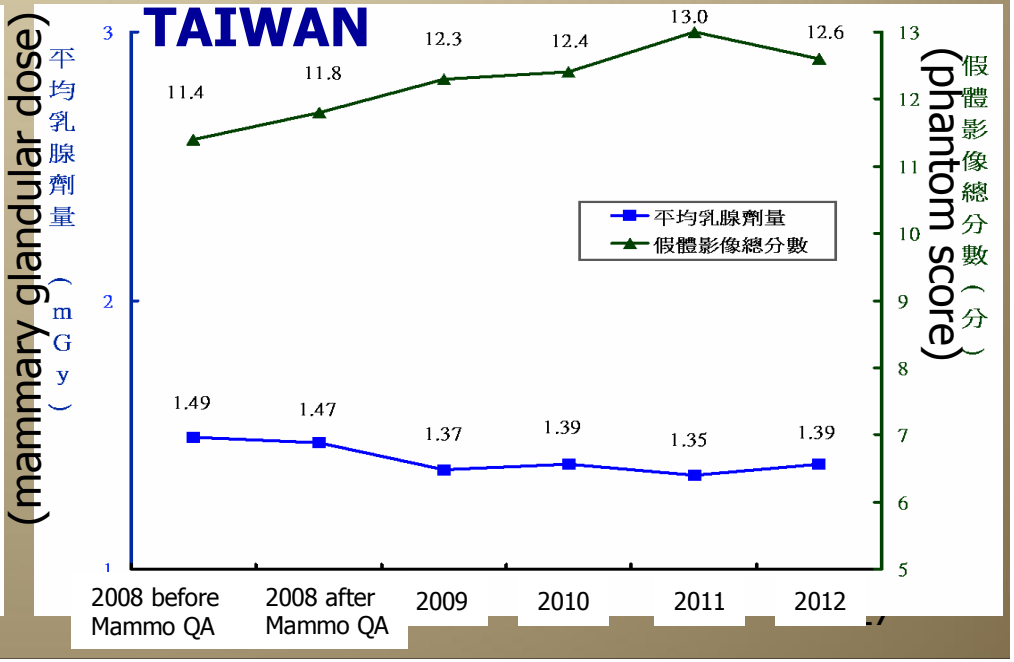


96 % of man-made dose is from radiological practice in medicine.





(Source: MQSA, U.S. FDA)



Test Items for CT

- **CT dose**
  - Adult Head
  - Adult Abdomen
  - Pediatric Abdomen (5 y/o)

- **Image quality**
  - CT number accuracy
  - Slice thickness
  - Low contrast
  - Uniformity
  - Artifacts
  - High contrast resolution

Re-evaluation of Nuclear Safety and Radiation Protection System

311 Fukushima Nuclear accident Created A Tremendous Shock to Taiwan

國內核電爭議 A6

福爾摩沙別成輻島

拒核災 環團逾千人大遊行

貢寮人：就業比生命重要？

嚇出恐懼

我愛台灣 不要核災

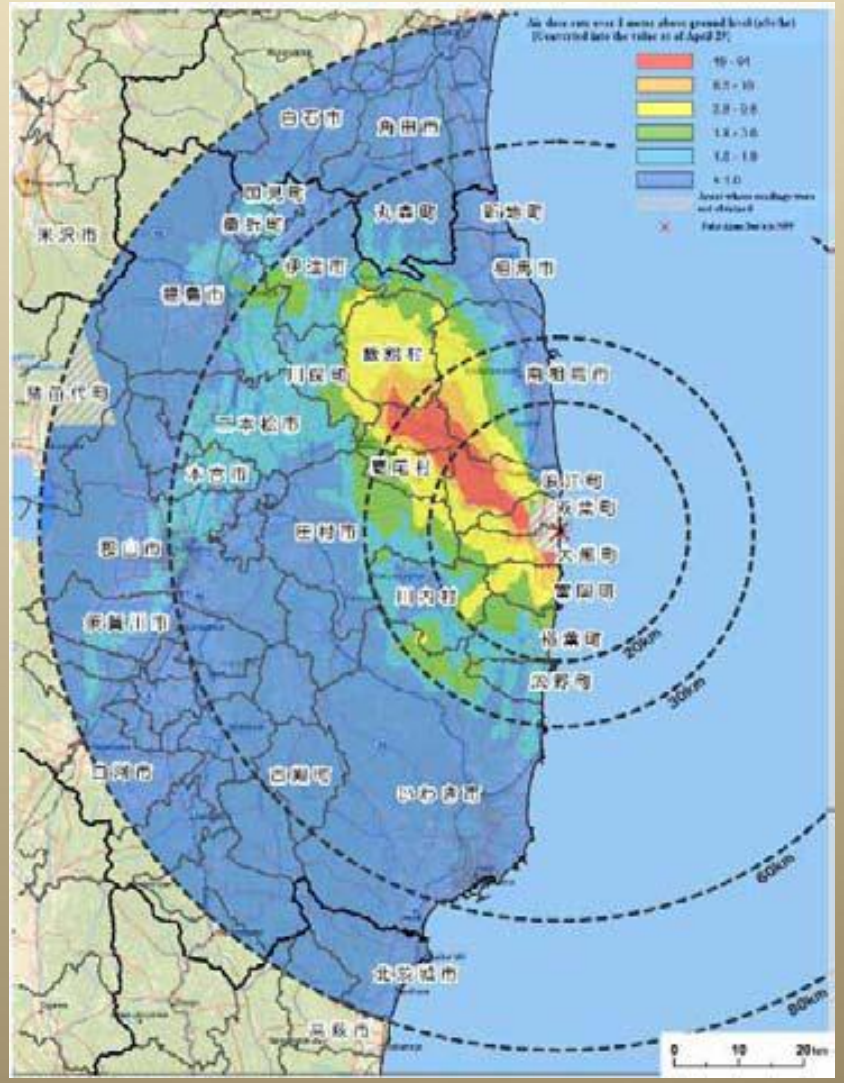
輻射後天若飄台 原能會：微量

顧民眾勿恐慌 大陸昨有31省市測到碘-131

日本輻射外釋未來5天分析圖

接受逾200萬微西弗 有致命危機

Results of airborne monitoring by MEXT and DOE



Source: MEXT

Lesson Learned from the Fukushima Accident

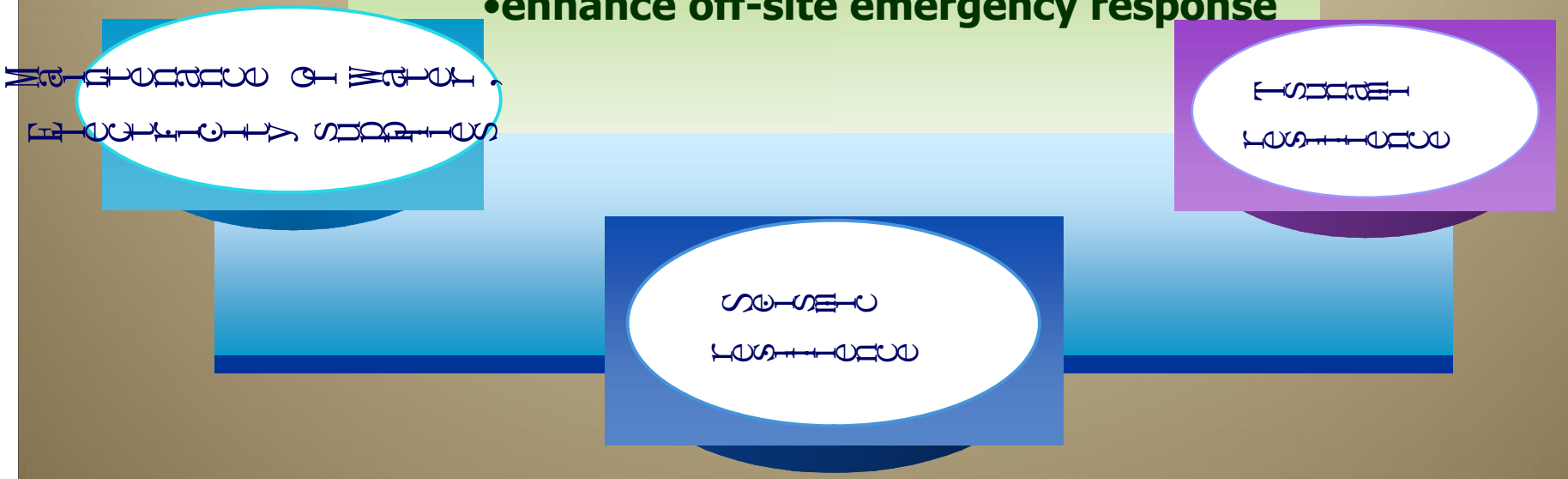
- Establish integrated emergency environmental radiation monitoring capabilities
  - ***prompt*** land and air monitoring
  - using ***computer forecasts*** to provide ***immediate*** alarms for evacuation and taking shelter at indoors
- Mobilize and coordinate man power and equipments of relevant organizations

Actions taken

Re-evaluation of Nuclear Safety

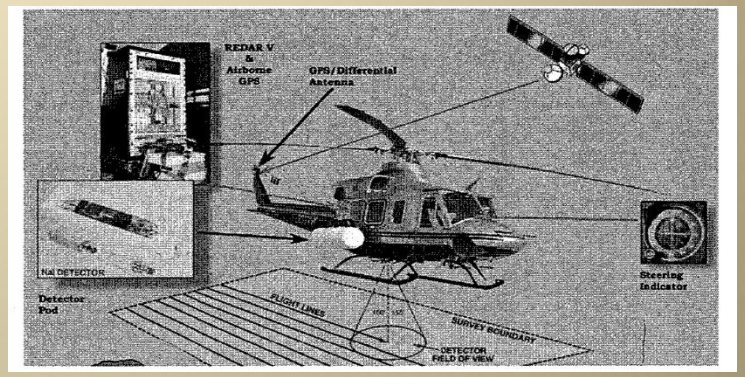
Radiation release control

- strengthen on-site safety system
- take measures as Ultimate Response
- enhance off-site emergency response



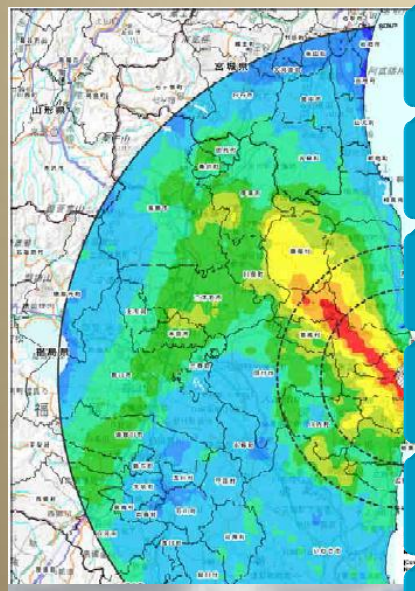
Re-evaluation of Radiation Protection System

- Enhancing capabilities to assess atmospheric dispersion and radiological impact
- Advancing Emergency Response Dose Assessment System in response to nuclear accidents
- Developing aerial monitoring techniques
- Enhancing capabilities of environmental monitoring

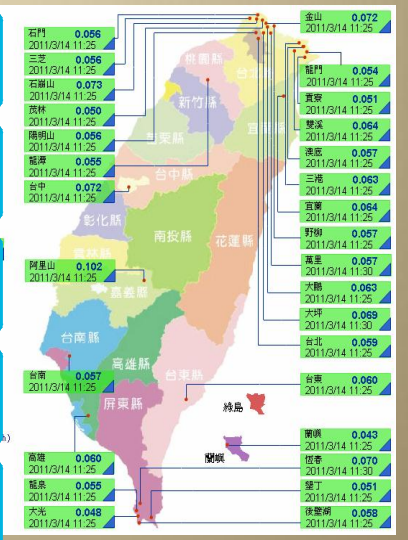


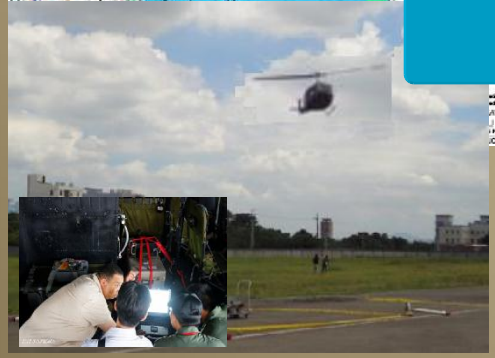
Actions taken

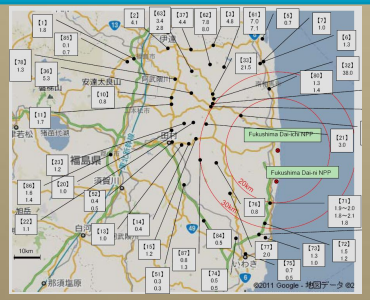
Establishment of Integrated Emergency Environmental Radiation Monitoring platform

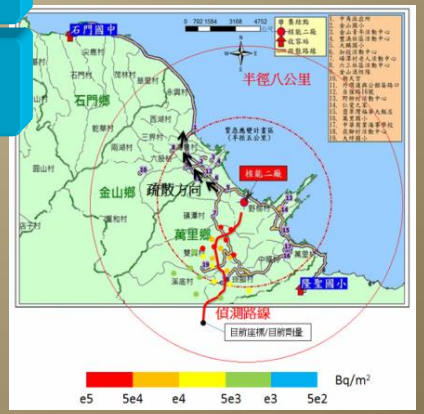


- Collect environ. radiation information
- Integrate capacities for environ. monitoring
- develop environ. monitoring plans
- Establish environ. radiation information system
- Promptly collect related information for decision making
- Basis for public emergency response



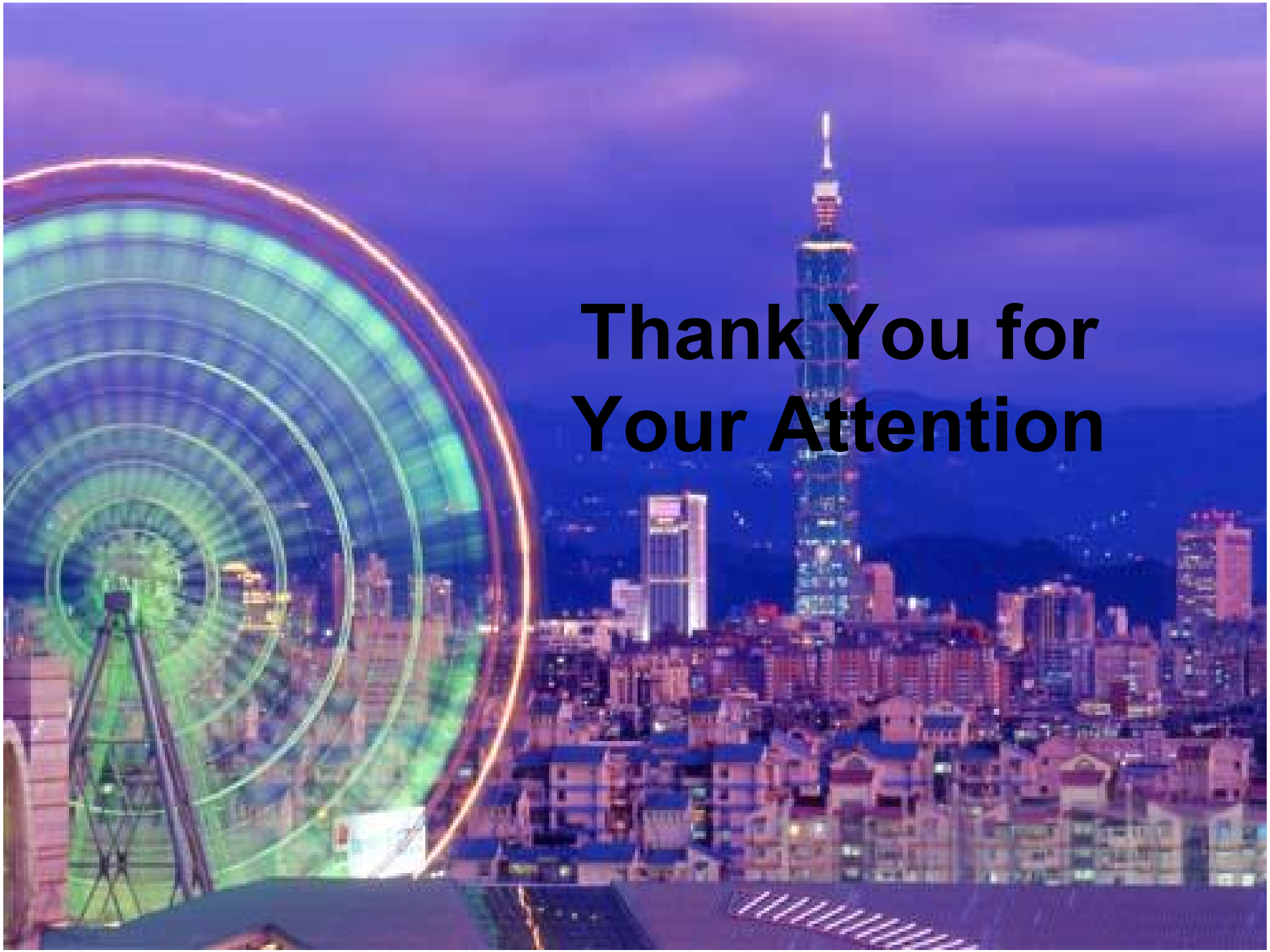






Conclusions

- Fukushima accident was made in Japan and preventable, due to multitude of errors and willful negligence-2012 Diet report
- The countermeasures taken in Japan after Fukushima nuclear accident provide extremely valuable lessons for us to learn , and help us strengthen our radiation protection capabilities.


Thank You for
Your Attention