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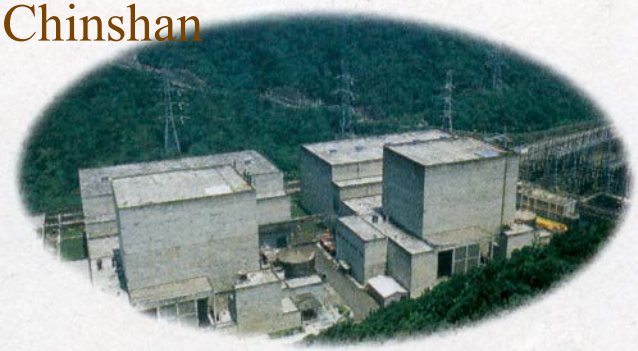
Recent Nuclear Activities and Applications in Taiwan

By
Dr. Min-Shen Ouyang
Minister of Atomic Energy Council
Honolulu, 24 March 2004

- Activities Regulating Nuclear Power Programs
  - operational statistics and performance records
  - emergency preparedness and annual exercises
  - transparency enhancement of safety information
- Nuclear Technology Applications in medicine and environmental protection

NPPs in Taiwan

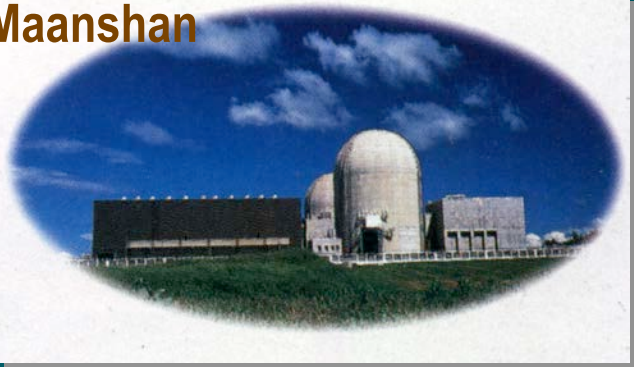
Chinshan

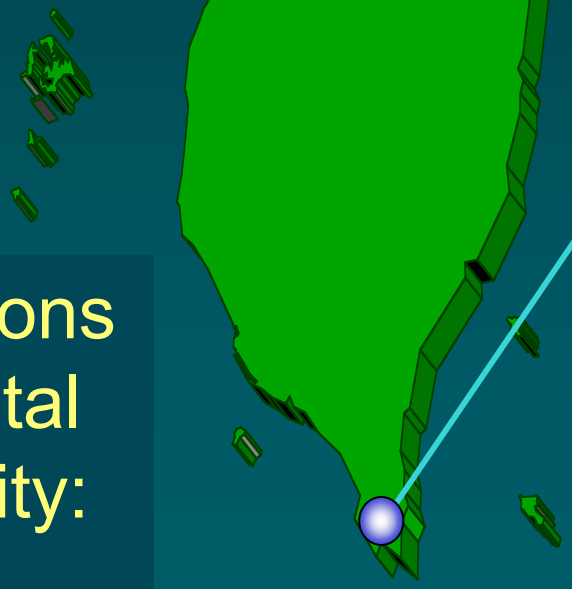


Kuosheng

Lungmen (under onstruction)

Maanshan





6 units at 3 stations in operation, total installed capacity: 5,144 MWe

2003 Performance of NPPs

- **Nuclear Share of Electricity**
  - nuclear power generated: 37.4 TWh
  - share of total supply: 21.5% (excl. IPPs)
- **Performance Statistics**
  - Capacity factor: 86.3% in 2003 (88% in 2002)
  - Auto scrams: 0.33/unit
  - Reportable events: 4/unit
  - Continuing operation: 476 days at Maanshan Unit 1

The Lungmen Project

- Two ABWR units (1350 MWe x 2)
- %Progress of Lungmen Project (as of Jan. 2004)

	Total Progress	Design	Procure-ment	Construc-tion	Pre-Op Testing
Wt %	100	19	15	58	8
Progress%	54	94	97	37	2

- Operations targeted for 2006 and 2007, but are facing possible delays.

Unloading Pier and Pump House

Reactor Bldg

Lungmen Unit 1

Turbine Bldg

Control Bldg

Radwaste Building

Submerged Discharge Tunnel

Preparedness for Nuclear Emergency

New "National Nuclear Emergency Response Center (NNERC)" put to service in Sept. 2002.

Nuclear Safety Duty Center

2003 Exercise - Nuclear Safety Week

Anti-Terrorism Action

Fire Fighting

2003 Exercise - Nuclear Safety Week

Transport and Treatment of Radiation Injured Patient

2003 Exercise - Nuclear Safety Week

Table-Top Exercise at NNERC

Transparency Enhancement of Nuclear Safety Information

Beginning in 2004, data available on web:

- selected parameters from SPDS
- ERM data at 21 sampling stations
- ERM data within each NPP will also be available soon.

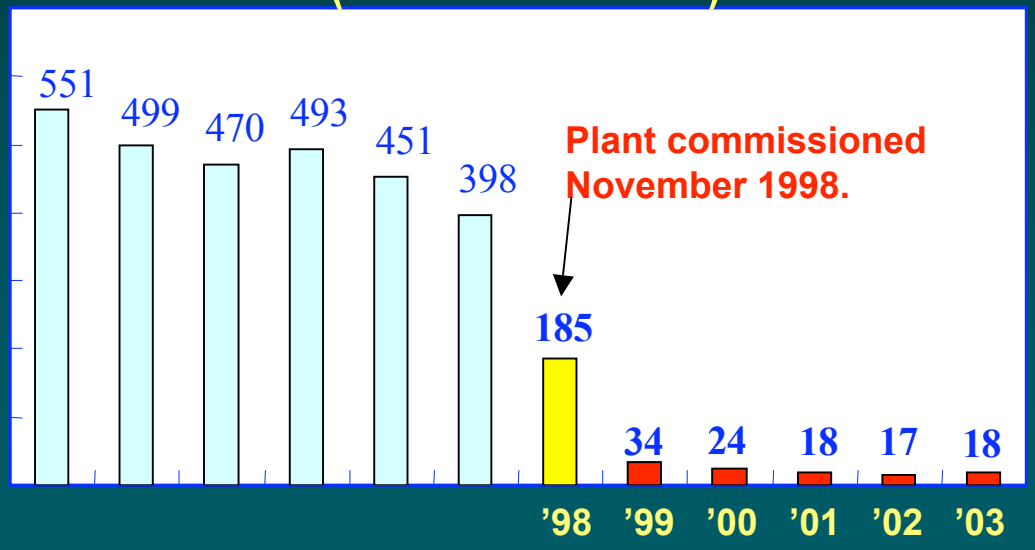
Nuclear Technology Applications

- high-efficiency solidification
- plasma incineration technology
- fuel cell systems
- plasma coating
- radiopharmaceuticals

High-Efficiency Solidification Technology (HEST)

PWRHEST

Annual Production
of Solidified waste at Maanshan NPS
(in 200-liter drums)



waste
solidified
by PWRHEST

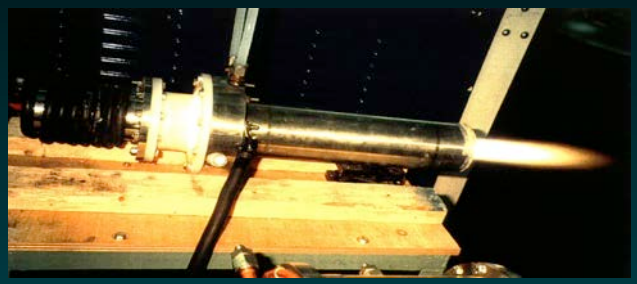
PWRHEST
System
at Maanshan

High-Efficiency Solidification Technology

- **PWRHEST**
- **BWRHEST**
  - Similar to PWRHEST, formulated in 1998
  - Successfully demonstrated by a demo plant at INER
  - Full-scale system at Kuosheng will be completed by end of 2004
  - Waste volume to reduce by 3 folds (345 → 115 drums/year/unit)
- **WOT → WOHEST**
  - **Wet Oxidation Technology** to treat both powdery and bead-type spent ion exchange resins generated from NPPs.
  - An in-house demo plant recently completed at INER
  - When connected to a PWRHEST or BWRHEST system, a **WOHEST** system will be formed to provide a total solution for volume reduction and stabilization of NPP wet waste.

Plasma Incineration & Melting Technology

INER's Plasma Incinerator for Treating Radioactive Waste



Plasma Torch INER-100NT

Capacity: 6 tons/day

Plasma Incineration & Melting Technology

Another plant with treatment capacity of 300 kg per hour for hazardous waste has also been constructed at INER.

One of its current R&D activities is to conduct verification testing for the Environmental Protection Administration.

Type of Waste	Volume Deduction
Combustible Waste	100 folds
Compressible Waste	2 ~ 10 folds
Contaminated Soil	2 ~5 folds
Insulator	5 ~ 10 folds
Cemented Waste	2 ~ 4 folds
Metal Waste	2 ~ 10 folds
Fly Ash	2 ~ 11 folds

Plasma Incineration & Melting Technology

Successful development of this technology is of great significance to Taiwan:

- Independency - entire system can be done domestically
- ready for commercialization; there is a large domestic market
- **environmental friendly**, and in line with the future trend.

Applications in domestic market:

- Treating low-level radioactive waste produced by NPPs
- Treating hazardous waste, fly ash, medical waste, toxic solvents, etc. and developing reuse of end product (vitreous slag) from furnace.

The process serves as an effective "terminator" of wastes; its intangible benefit should not be overlooked.

Fuel Cell Technology

- **Part of a 5-year clean energy program starting 2003.**
  - R&D activities include hydrogen production, hydrogen storage, and hydrogen energy applications.
  - Several types of plasma reformer for producing hydrogen were established with CH_4 transformation rate of 93%, and CO content lower than 100ppm.
  - Fabrication technology of carbon nanotubes (CNTs) was established with hydrogen storage capability greater than 2wt%.
- **Two types of fuel cell systems under exploration:**
  - Solid Oxide Fuel Cell (SOFC)
  - Direct Methanol Fuel Cell (DMFC).

Fuel Cell Technology

SOFC

So far established:

- fabrication technology of nano-scale powder and cell element
- design capacility of cell stack and system using INER's in-house computer software
- 1 kWe performance test station

Now being developed:

- SOFC modular system with a power range of 1~5 kWe
- used as power unit for auxiliary and distributed stationary application

DMFC

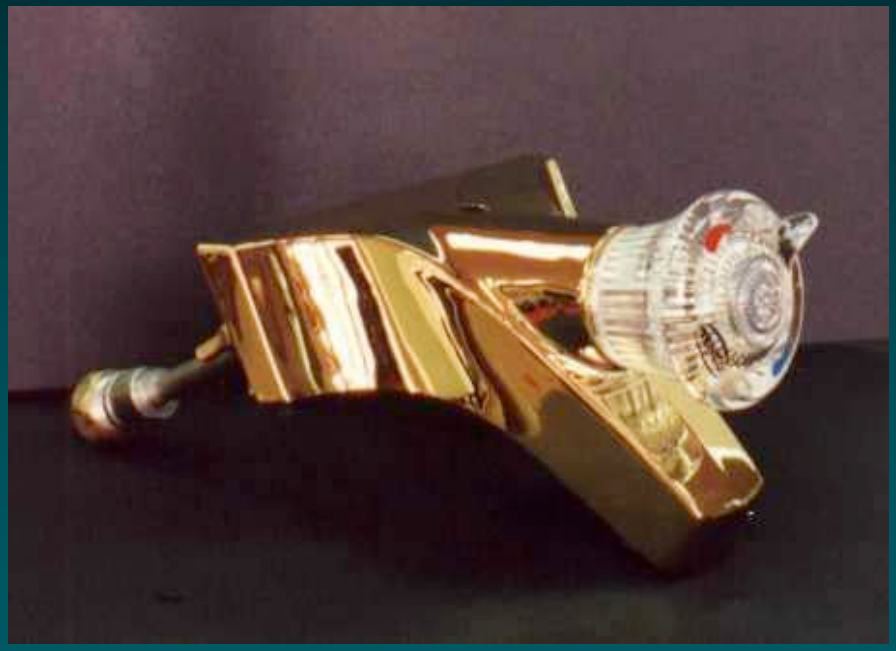
- small power density (30 mW/cm^2 at 50¢J).
- portable applications, e.g. cell phone .
- With 1.5 c.c. methanol, phone lasts for 75 mins.

Plasma Coating Process

- Clean process, compared to traditional electroplating
- Better quality product
- Entire system developed by INER, can be duplicated economically.
- Successfully transferred to local industry to replace electroplating.
- The process works in a closed system without pollution problems, and saved the traditional industry from being eliminated due to tougher environmental regulations.

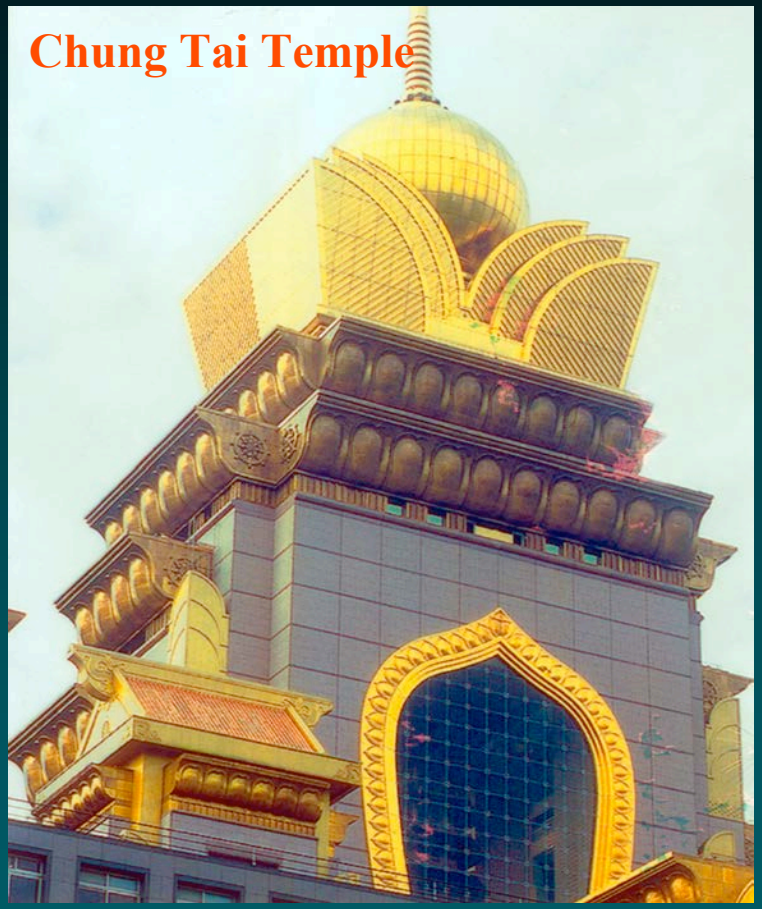
Plasma Coating Process

Decoration and Protective Coating



Works well on hardware surface for decoration and wear resistance; replacing electroplating bronze and gold

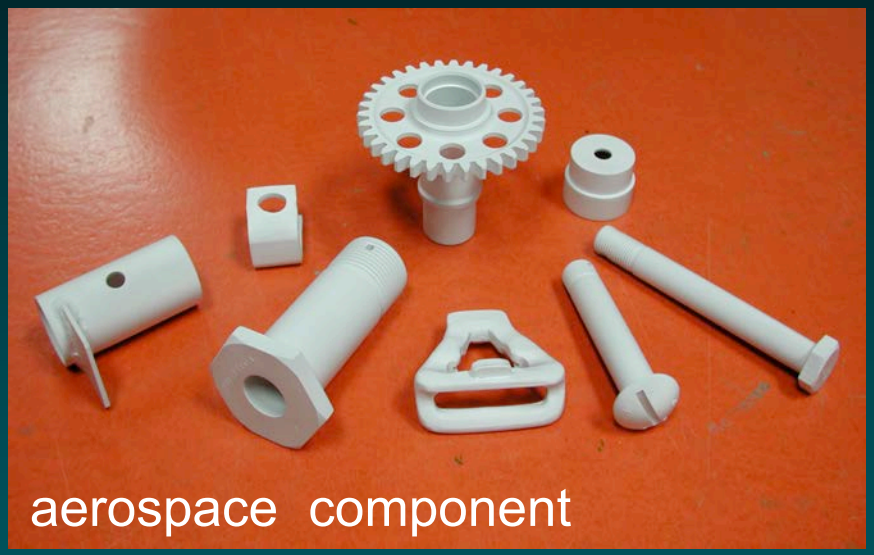
Titanium-Gold Plating



Works well for building material in replacing electrolysis chromogenic treatment

Plasma Coating Process

Corrosion-Resistant Coating



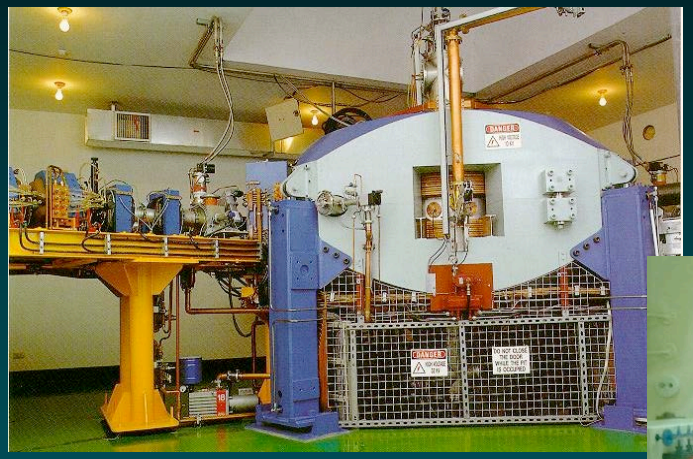
Plasma coating of dense aluminum film with thickness > 40£gm on aerospace component for corrosion resistance; replacing poisonous electroplating cadmium.

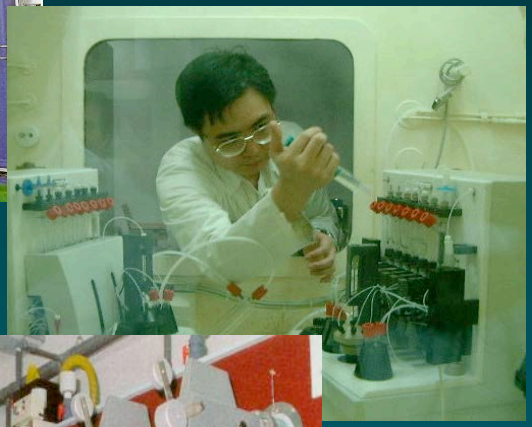
Plastic Metalization

Works well on plastic surface for decoration, anti-static and EMI shielding in 3C products; replacing electroplating and spray coating.

R&D of Radiopharmaceuticals

INER's Compact cyclotron and Radioisotope Production Facilities





Radiopharmaceuticals

I-123-NaI, Oral Solution

TlCl°Tl-201°, Injection Solution

Ga Citrate°Ga-67°, Injection Solution

Kr-81m Gas and Ventilation Apparatus

F-18-FDG, Injection Solution

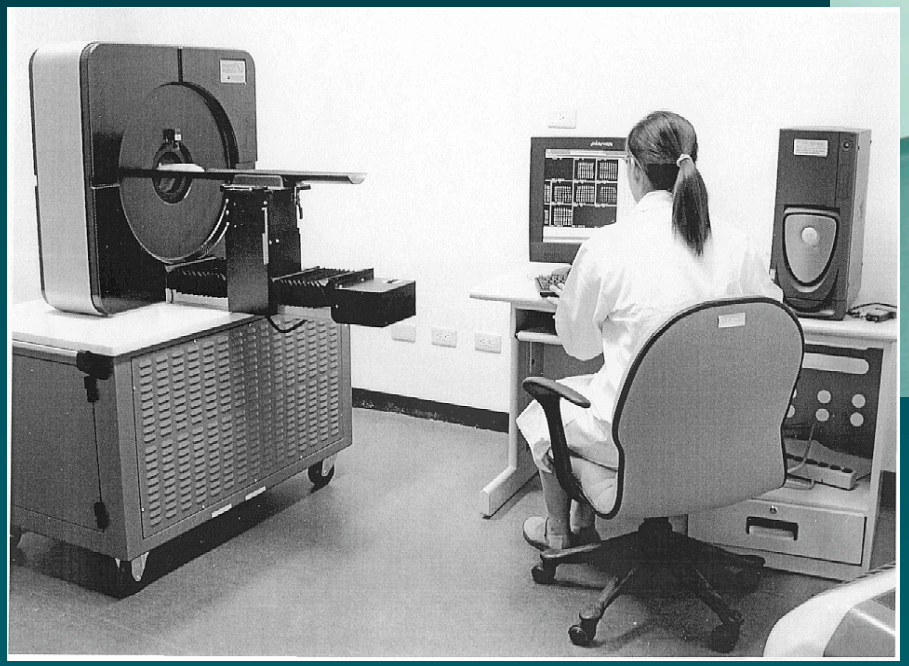
I-123-IBZM, Injection Solution

I-123-MIBG, Injection Solution

In-111-DTPA-Octreotide, Injection Solution

INER's Radiopharmacology Laboratory

(Established in 2003)



MicroPET

MicroSPECT/CT

Conclusions

- Nuclear is of international nature, and should only be used for peaceful applications.
- Taiwan does not develop nuclear weapons, nor does she support other countries to do so.

Conclusions

International Cooperation

- to enhance safety of nuclear activities
- to share advancement of nuclear technology
- to resolve nuclear issues of mutual concern

e.g. regional or international cooperation for final disposal of spent nuclear fuel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Thank You