

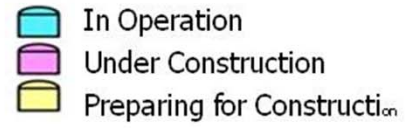
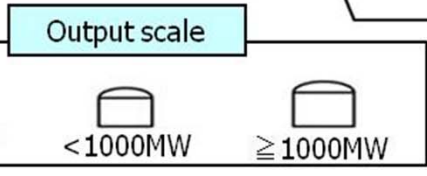
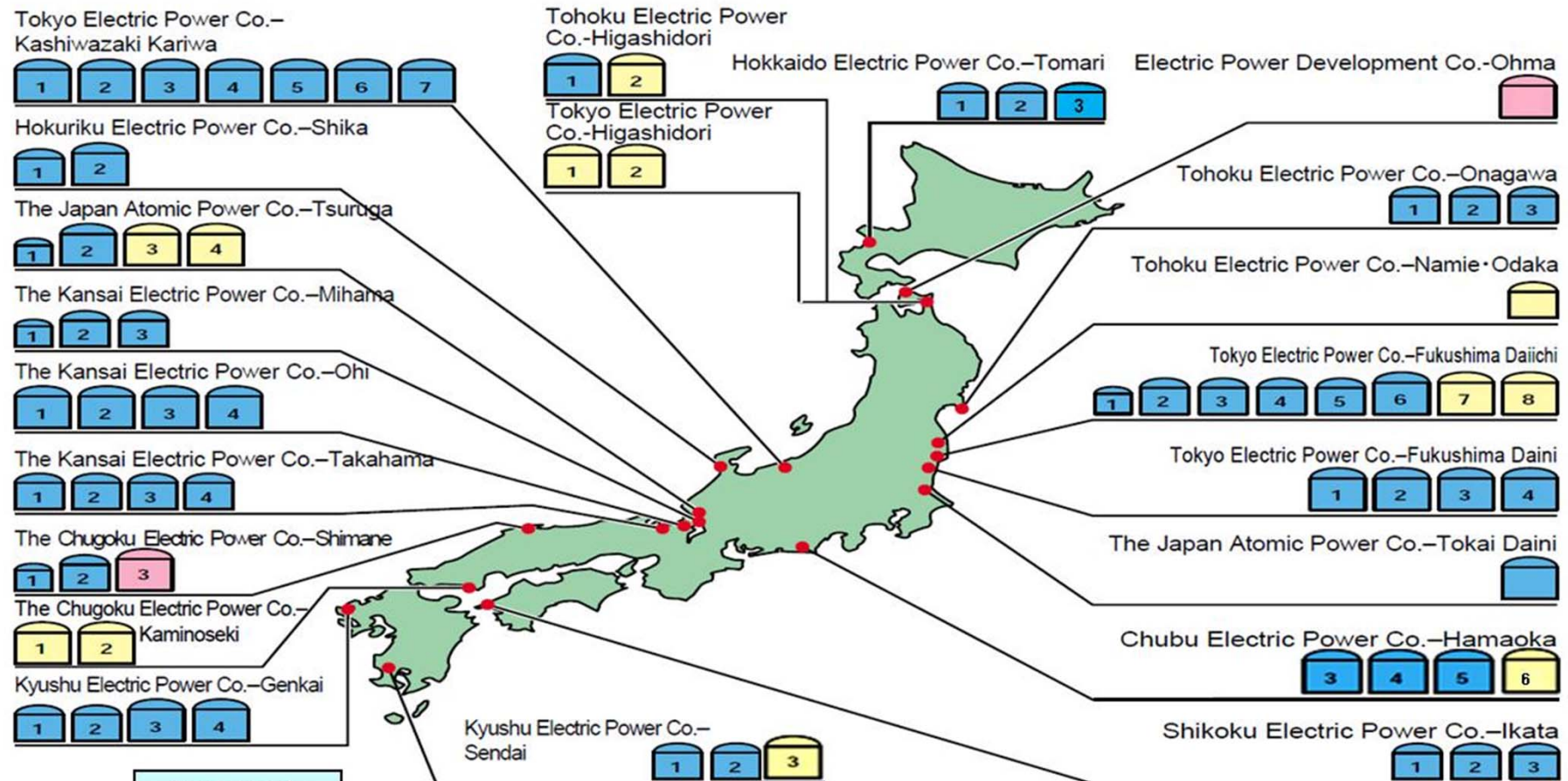
# Japan's Nuclear Energy Programs and Activities for International Cooperation

September 22, 2010

Professor Dr. Shunsuke Kondo  
Chairman  
Atomic Energy Commission of Japan

# Nuclear Power Generation in Japan: Current Status (1)

Starting the operation of the first nuclear power plant in 1966, 10 years after the establishment of the AEC, and adding the capacity continuously, 10 electric power companies are now operating 54 LWRs (30 BWRs and 24 PWRs) that supply about 30% of electricity. 2 units are under construction and 12 units are in preparation.



# Nuclear Power Generation in Japan: Current Status (2)

- Two units will start operation beyond 40 years by the end of this year.
- Three units are in the decommissioning stage.
- One large scale low-level waste disposal facility has been in operation for more than 10 years.
- Three nuclear power plant suppliers (Toshiba-WH, Hitachi-GE, and Mitsubishi Heavy Industries) have supplied these BWRs and PWRs on time and within budget, nurturing constructors and diverse small & medium enterprises that supply forged material, mechanical components and electrical components.

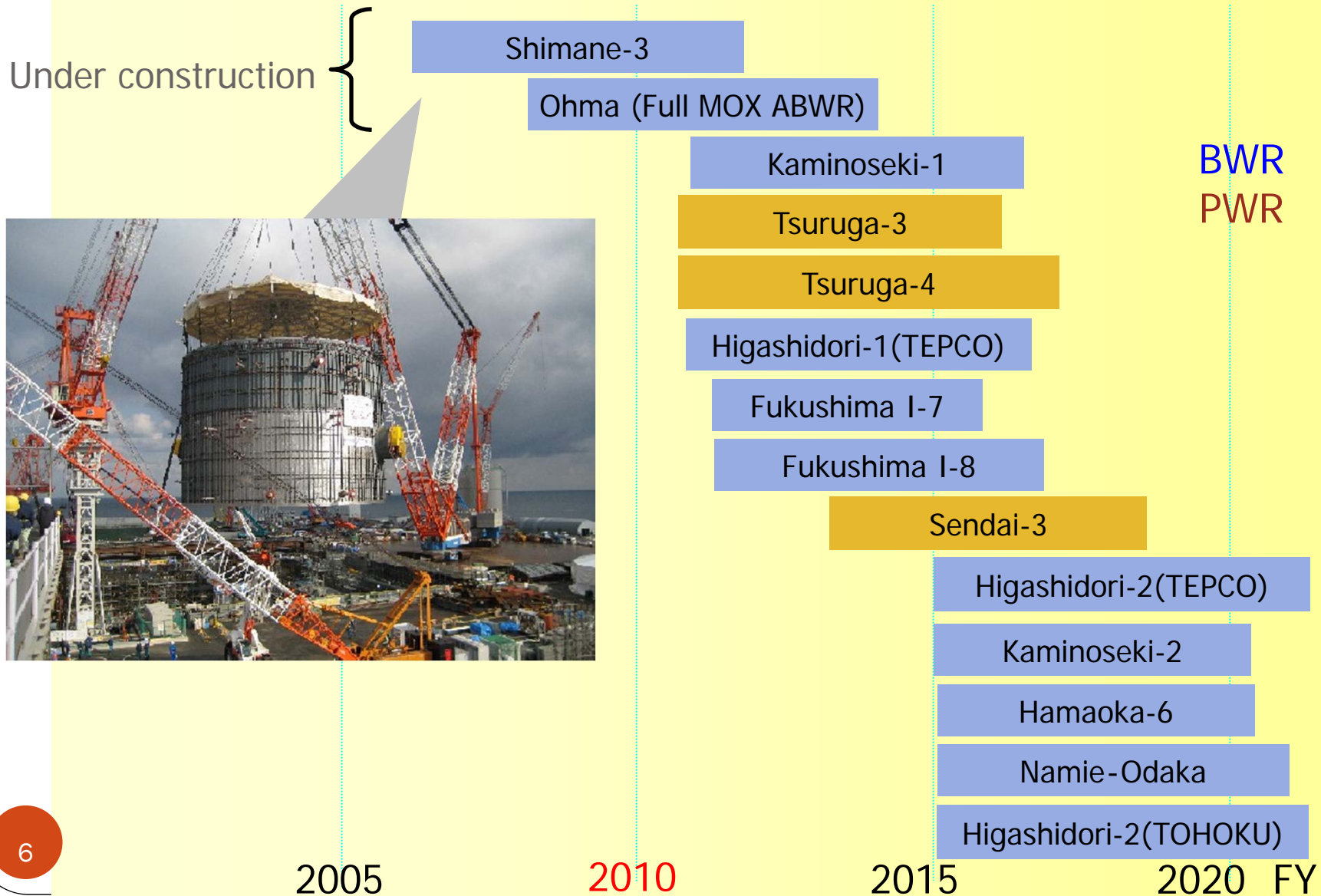
# Radiation Utilization in Japan: Current Status

- More than 5,000 firms (including industries , hospitals and research organizations) are registered as user of radiation and radioactive materials.
- Large scale radiation sources such as RIBF, SPring-8, J-PARC, HIMAC etc. are open to users in the field of science, industry, medicine etc.
- Government itself is promoting pest control projects based on radiation sterilized insect technology to protect fruit and vegetable from noxious insects in southern islands.

# Objectives of Nuclear Energy Policy

- I. Maintain proper infrastructure for the promotion of safe, secure, safeguarded and sustainable utilization of nuclear energy.
- II. Promote nuclear power with a view to making its share in electricity generation 50% or so in 2030.
- III. Promote radiation utilization and its innovation in science, medical activities, industry and agriculture.
- IV. Promote international cooperation for assuring safe, secure, safeguarded and sustainable utilization of nuclear energy in every part of the world, with a view to contributing to the improvement of the welfare of humankind.

# Electric power companies will add new plants continuously as in the past.



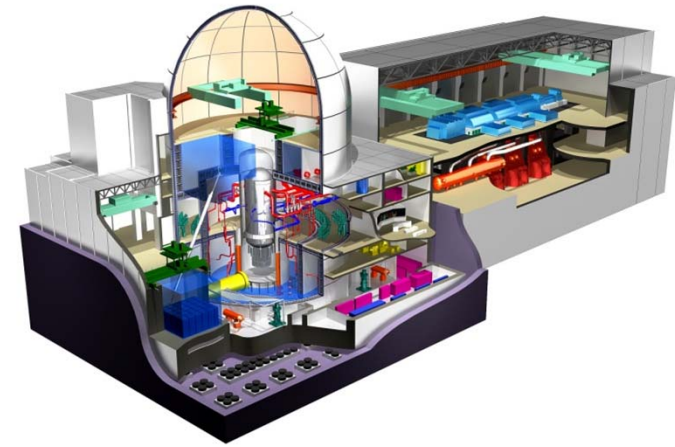
## Further on the Horizon

Government supports the R&D of next generation high-performance LWRs that meet;

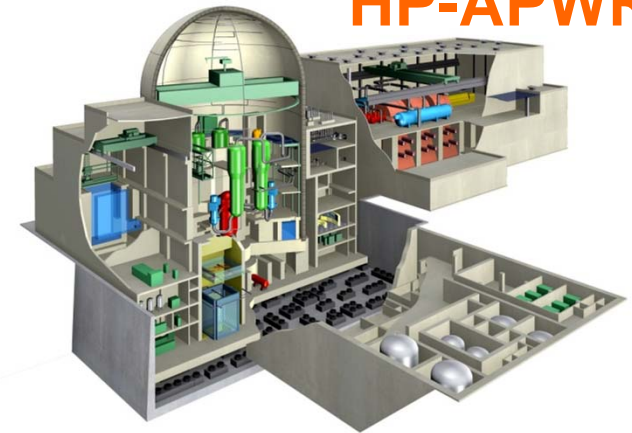
- ✓ Replacement demand in the 2030's, making attractive technologies deployable in preceding LWRs as well in the 2020's;
- ✓ Desired level of safety & security/economics/waste management/ etc: 1800 and 900MWe class plants with innovative materials and components and seismic isolation features.

Closing fuel cycle is pursued through using MOX fuel, establishing a high level waste repository, and promoting fast reactor fuel cycle technology R&D.

HP-ABWR



HP-APWR



# International Cooperation

What Japan can and should do for international community are;



## To share

- Knowledge, experience and lessons learned from continuous deployment of LWRs and their operation and from diffusion of radiation utilization in various fields;

## To support

- Human resource development and capacity building for safe, secure, safeguarded and sustainable utilization of nuclear energy
- Promotion of radiation utilization in science, agriculture, medicine and industry
- Deployment of nuclear power plants
  - Localization of technology and industrial activities

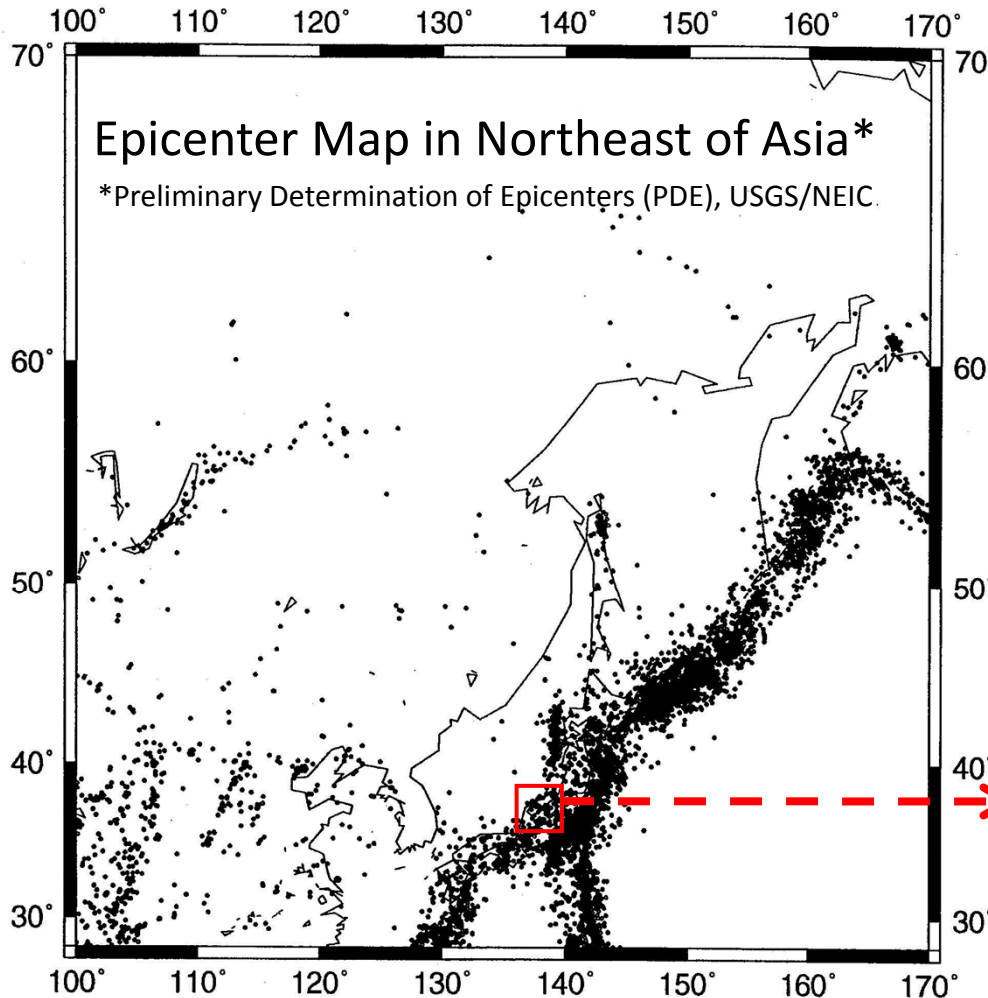


# International Cooperation



- To **share** knowledge, experience and lessons learned with international community;
  - Contribute to various activities of the IAEA
    - Participate in the development of code and standards
    - Participate in various review missions;
    - Host and/or participate in various international gathering for information exchange and mutual learning organized by the IAEA;
    - Cooperate with the IAEA organizations such as International Seismic Safety Center.
  - Encourage research organizations to promote exchange of experts and cooperative research projects

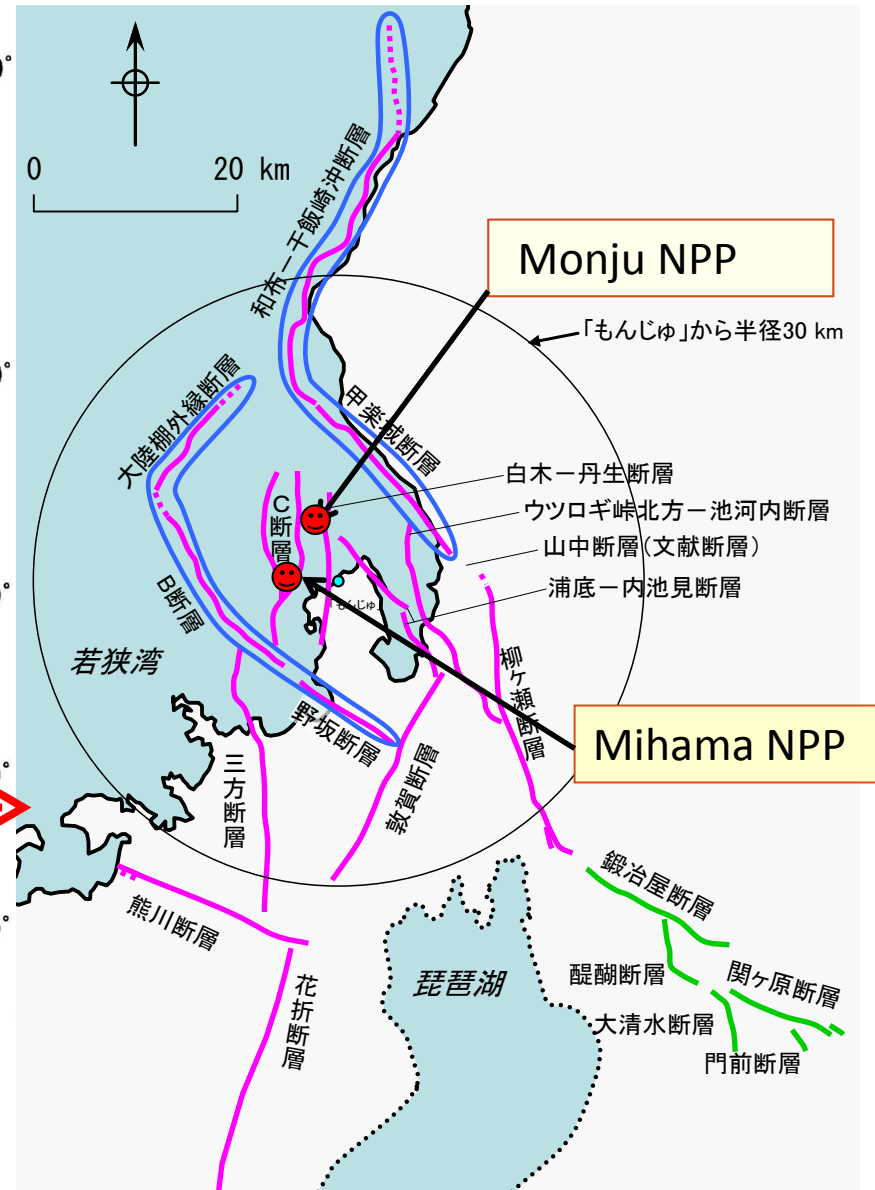
Japan is a country with frequent earthquake and not a few active faults can be found in the vicinity of NPPs.



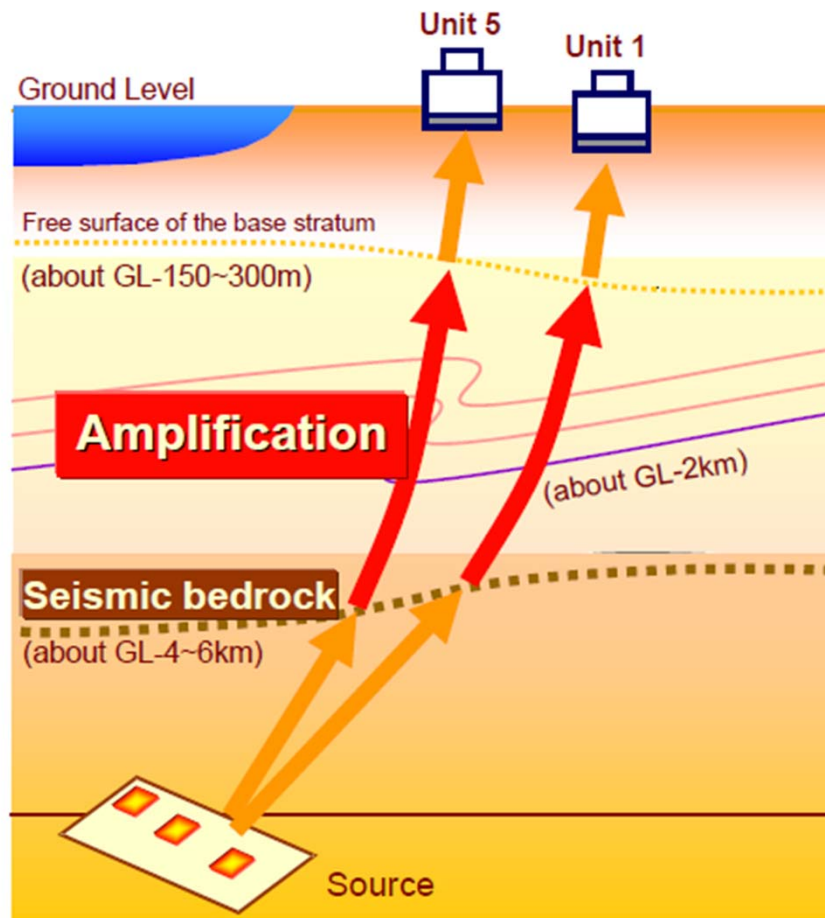
Period : 1979-1996

Depth < 50km

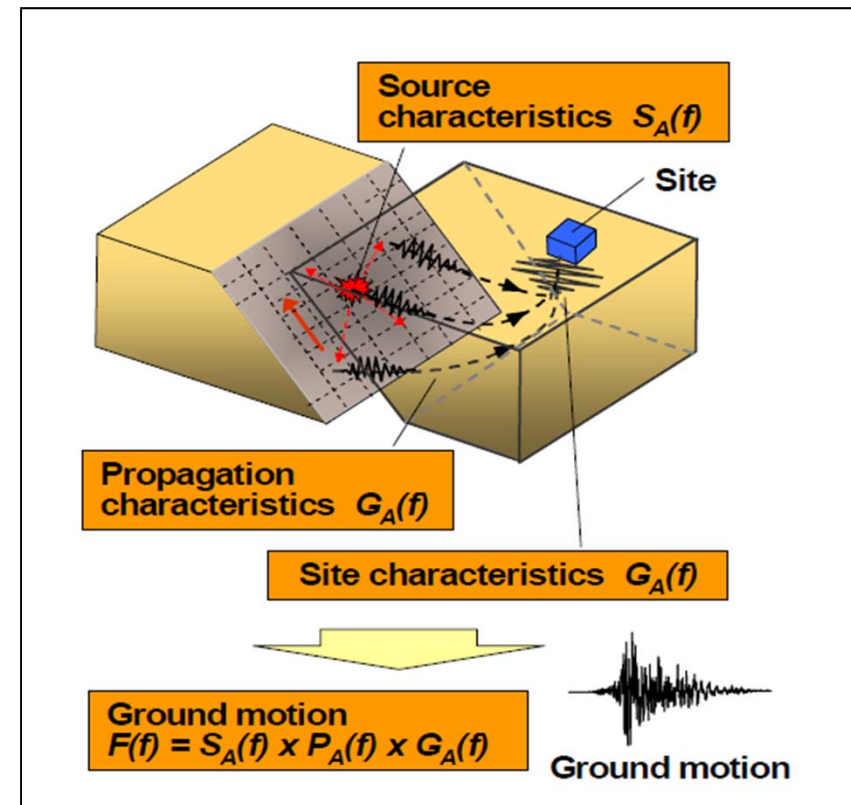
Cartalog : PDE(USGS/NEIC)



# Lessons learned from the 2007 earthquake at Kashiwazaki-Kariwa NPP



## The Concept of "Fault Model"



- ◆ To evaluate possible seismic motion at the site from nearby faults, it is necessary to use "fault model" in which not only the source characteristics (number of asperities, their sizes and locations on the fault) but also the propagation characteristics of crust geological structure (such as folding structure) and the site characteristics (such as low velocity sediment layers in the free base stratum under the plant) are considered.

## IAEA – INTERNATIONAL SEISMIC SAFETY CENTRE (ISSC)

Recognizing it important to internationally share diverse lessons learned from seismic events in Japan, Japanese government proposed the IAEA to establish the ISSC, contributing a significant part of its starting budget.

### PURPOSE:

- To promote the sharing of the experience and lessons with the international community to avoid /mitigate the consequences of extreme seismic events
- To improve the Safety Standards by reflecting the feedback from these experiences.
- To support MSs with no or limited seismic expertise through **advisory services** and **training courses**.
- To enhance the seismic safety worldwide by disseminating the best practice form MSs and and obtaining advice from top-level scientists and relevant experts of **Scientific Committee of the Center**.

### SCOPE:

- ISSC will **give scientific and expert support** to the works done by the IAEA on seismic matters:
- Support the development of the safety standards and the implementation of Safety Review and Advisory Services as a part of the statutory functions.
- Promote, collect and disseminate the knowledge related to the seismic safety.

# Radiation Utilization

- Three major R&D organizations make their large-scale radiation facilities open to international research communities
- RIKEN : RI-Beam Facility and SPRING-8 (X-ray)
- Japan Atomic Energy Agency (JAEA): JMTR, J-PARC (neutron source)
- National Institute for Radiological Sciences (NIRS) : HIMAC heavy ion accelerator for cancer therapy.
- Japan is participating in IAEA RCA projects in areas of health, agriculture, medicine, industry, environment and others:
  - JAEA Takasaki Advanced Radiation Research Institute acts as project country coordinator for radiation processing of polymer.
  - NIRS acts as project country coordinator for radiation therapy project and radiation protection project.
- These organizations are promoting exchange of experts and cooperative research projects with relevant institutions in the world.

# Use of Radiation for Better Living Standards

## Sterile insect technique (SIT)

Pest control based on radiation sterilization technology to protect fruit and vegetable

Melon fly

Potato weevil



## Agriculture

Radiation induced mutation



Post-harvest control utilizing radiation



Non-irradiated

Irradiated

## Medicine

Diagnosis; PET-CT



Therapy; Ion beam for cancer therapy



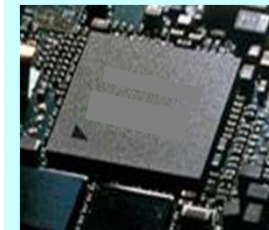
## Industry

Radiation process;

Radial tires



Semiconductors



Non-destructive inspection



# International Cooperation



## To Support HRD and Capacity Building;

- **HRD through education**
  - Government Scholarship for foreign student to study in Japanese universities
  - Provide funds to strengthen the nuclear engineering education in universities
  - University initiative such as an effective use of e-learning / networking with relevant organizations
- **Capacity building by training and education**
  - Contribute to the IAEA Asian Nuclear Safety Network (ANSN)
  - JAEA Nuclear HRD Center: accept trainees from all over the world and dispatch experts to relevant HRD programs in the world
  - JNES: sponsor training courses for experts in safety regulation
  - JAEA is to establish the Integrated Comprehensive Support Center for training experts in the field of nuclear safeguards and nuclear security
  - NIRS: organize RCA training courses on tumor imaging using radioisotopes, advanced clinical application of PET, radiation emergency preparedness etc.

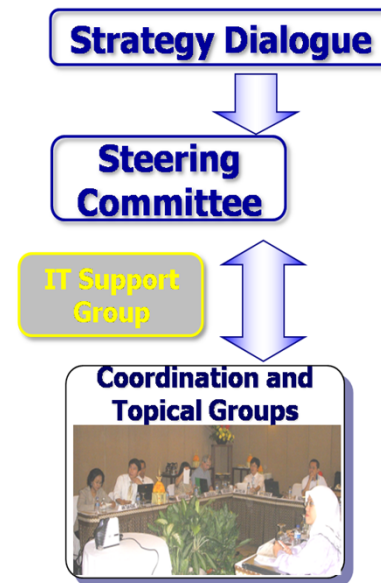
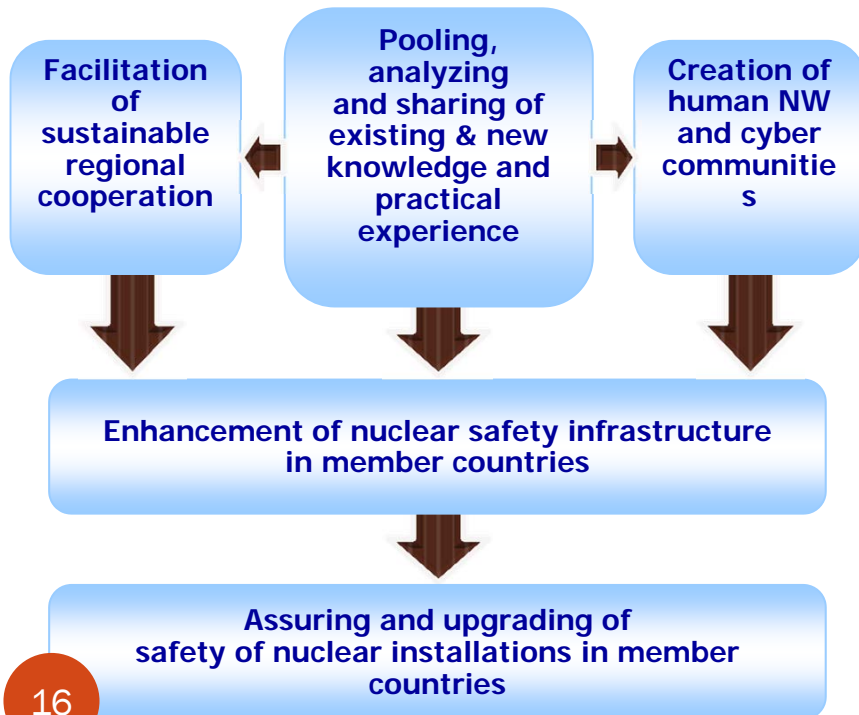
# IAEA – Asia Nuclear Safety Network (ANSN)

**PURPOSE: To support Integrated Capacity Building of NewComers**

■ In 2009, the 2<sup>nd</sup> Strategy Dialogue (SD) agreed on the **Vision 2020** to recognize the ANSN as a Capacity Building Platform

**“Realization of the first nuclear power plant in commercial operation in 2020 in the country embarking on Nuclear Power Programme”**

Japan’s Contribution  
 -\$130mil/y  
 -Role for CBCG and  
 3 TGs coordinator



Participating country:  
 Japan, China, Korea, Indonesia, the Philippines, Malaysia, Thailand, Vietnam, Australia, Singapore  
Observer country:  
 Bangladesh, Kazakhstan  
Supporting country:  
 USA, France, Germany  
Associated country:  
 Pakistan



## JNES – Japan Nuclear Energy Safety Organization

◆ JNES is an active player in the Cooperation for establishing nuclear safety infrastructures and human resources development in neighboring Asian countries (primarily **China, Vietnam**) by:

- holding training courses on nuclear safety regulation for the staff of the Chinese and Vietnamese nuclear safety regulatory related organizations
- dispatching experts to hold a nuclear safety seminars in China and Vietnam

◆ JNES has started Asian Seismic Safety Training Course

Abr: JNES HP

### Training course

<Vietnam<sub>(2009)</sub>>

#### Four Weeks Training in Japan

- Trainees from various nuclear regulatory organizations
- Number of Trainees : 30 people

<China<sub>(2009)</sub>>

#### Three Weeks Training in Japan

- theme: high level regulatory techniques
- Number of Trainees : 10 people

<Seismic Safety<sub>(2009)</sub>>

#### Ten more days Training in Japan

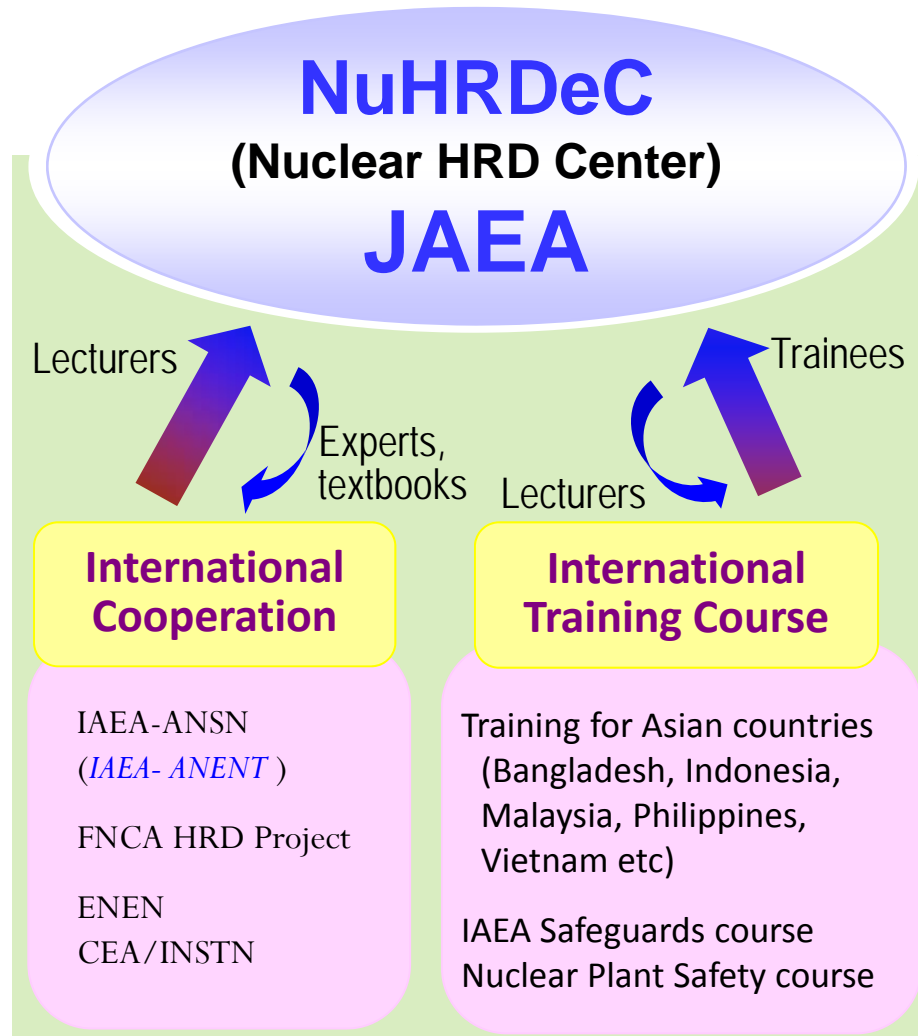
- Participants from 6 countries
- Number of Trainees : 25 people

**e-learning:** FREE information to learn the structure of regulation in Japan on this web site!

<http://www.ansn-jp.org/nsr/nsrdb/nsrwebmain/nsrmain/nsrmain.php>

\*search engine --> enter “JNES e-learning”

# Activities of JAEA-NuHRDeC



# Integrated/Comprehensive Support Center for Nuclear Non-proliferation and Nuclear Security

## PURPOSE:

To support emerging countries to building capacity in the areas of nuclear non-proliferation and security through human resource development, network development and technical assistance.

## Actions

- ✓ Hold Security, Safeguards and Non-proliferation training courses.
- ✓ Send experts to emerging countries for the strengthening of nuclear security.
- ✓ Start to develop nuclear measurement and detection technology in 2011, for a possible future support on nuclear security infrastructure. Emerging countries can use these services for free.

## International Cooperation



### Support deployment of nuclear power plants:

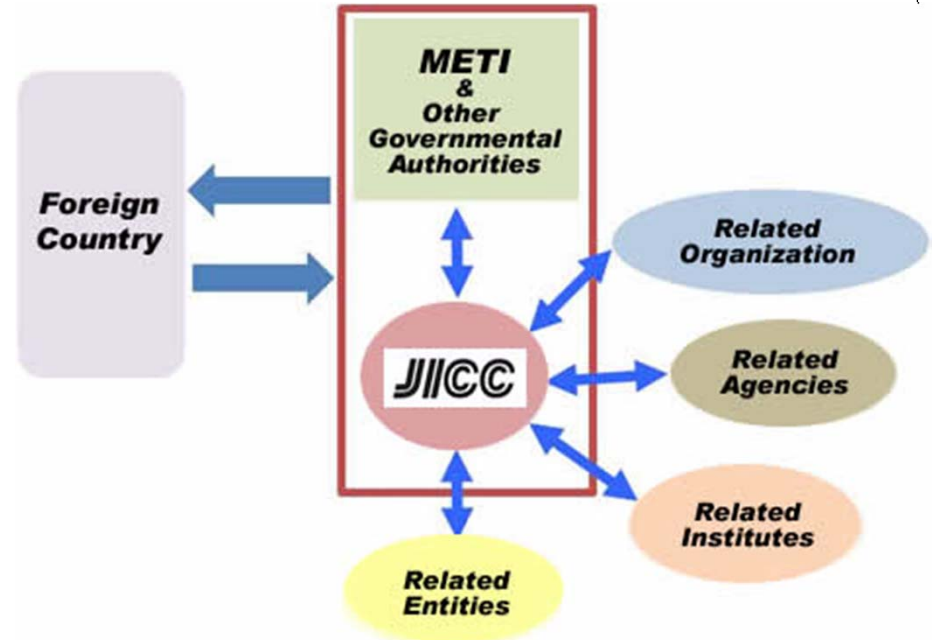
- **Why:**
  - Japanese manufacturers and electric utilities have nurtured capability to complete NPP construction on time and within budget, satisfying stringent requirements for safety and quality that reflects severe natural environment such as frequent visits of typhoon, tsunami and earthquake.
  - They have cultivated excellent organizational culture to value safety, quality, safety culture, cleanliness of workplaces and visualization.

# JAIF International Cooperation Center (JICC)

JICC will coordinate and implement a variety of cooperative activities in introducing nuclear energy development in foreign countries through exchanging information, dispatching experts, and hosting workshops, conferences and seminars, such as:

- (a) human resources development;
- (b) public information to enhance understanding of nuclear energy;
- (c) establishment of relevant laws and regulations;
- (d) preparation of necessary infrastructure.

JICC plays a key role as a contact window and facilitator of concrete cooperative activities by coordinating the wide variety of cooperation to be implemented by the related organizations in Japan so as to provide cooperation for nuclear energy development in an effective and efficient manner, under the strong commitment of the Government.



Contact: Mr. Toshiaki SAKAI, Director e-mail: [info@jaif-](mailto:info@jaif-icc.com)

[icc.com](http://icc.com)

Add: 2nd floor, Meiwa Building, 2-12-16, Shimbashi,  
Minato-ku, Tokyo 105-0004

TEL : +81-3-3591-2210 FAX : +81-3-3591-2215

## Recent Activities of JAIF International Cooperation Center (JICC)

### Vietnam:

- Seminar on Vietnam-Japan Cooperation on Nuclear Power at Hanoi, in September, 2009.
- Electricity of Vietnam mission to Japanese Nuclear Power in September, 2009
- Communist Party of Vietnam mission to Japanese Nuclear Power in December, 2009

### Indonesia:

- NPP Site Survey & Evaluation Workshop at Indonesia, in November, 2009
- Seminar on Prospects of Nuclear Electric Power at Indonesia, in March, 2010

### Jordan:

- Experts meeting at Jordan in March, 2010

### Kazakhstan:

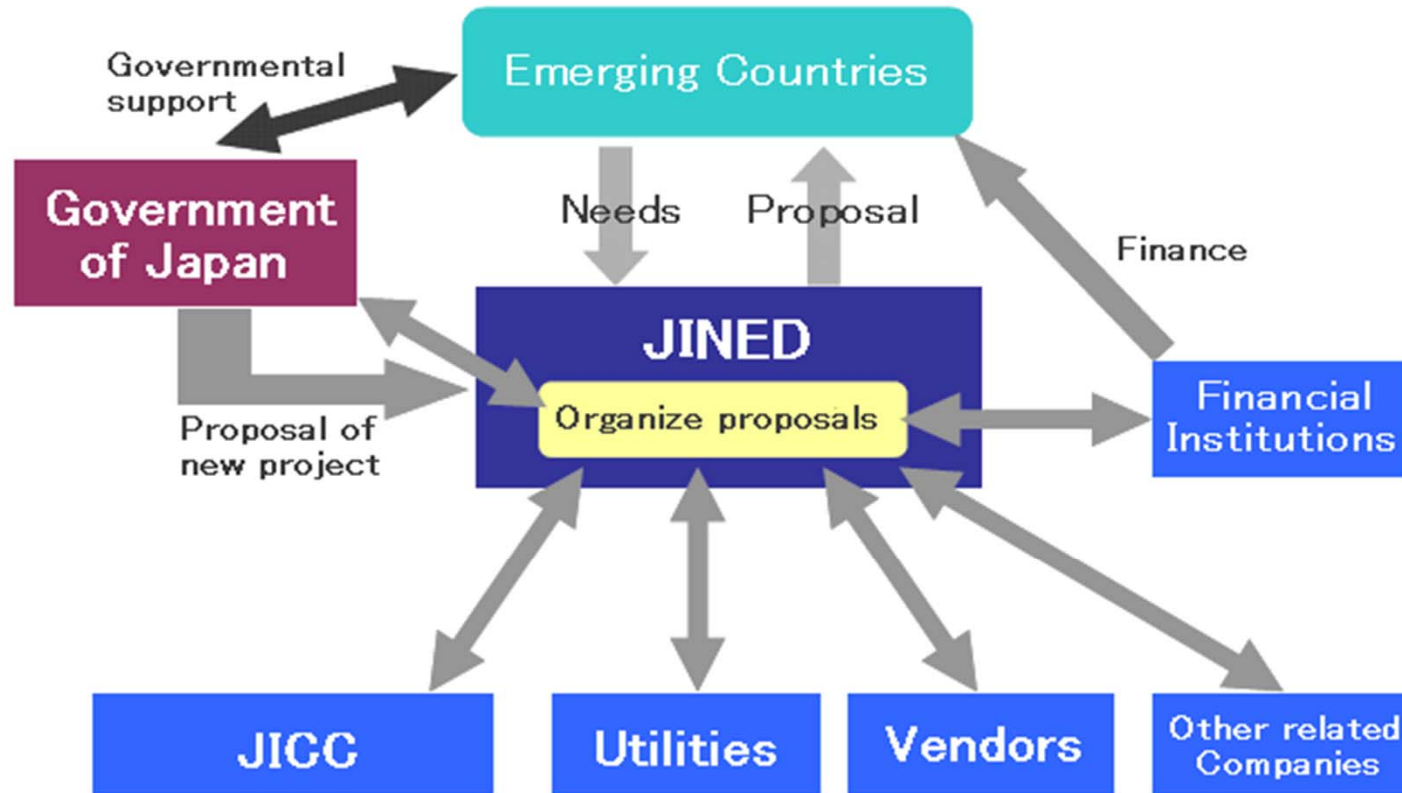
- Workshop on Nuclear Power Plant both in Japan and Kazakhstan in October, November and December, 2009 and 2010.

### Mongolia

- Workshop on Nuclear Power Generation in Japan in October, 2010

JICC expects to extend cooperation to Poland, Malaysia and Kuwait etc. in 2010-2011.

# International Nuclear Energy Development Corporation of Japan (JINED)



**ROLE:** to take care of emerging countries' needs regarding construction, operation and maintenance of nuclear power plants including human resources development and financing, in collaboration with government support programs before making proposals for getting orders.

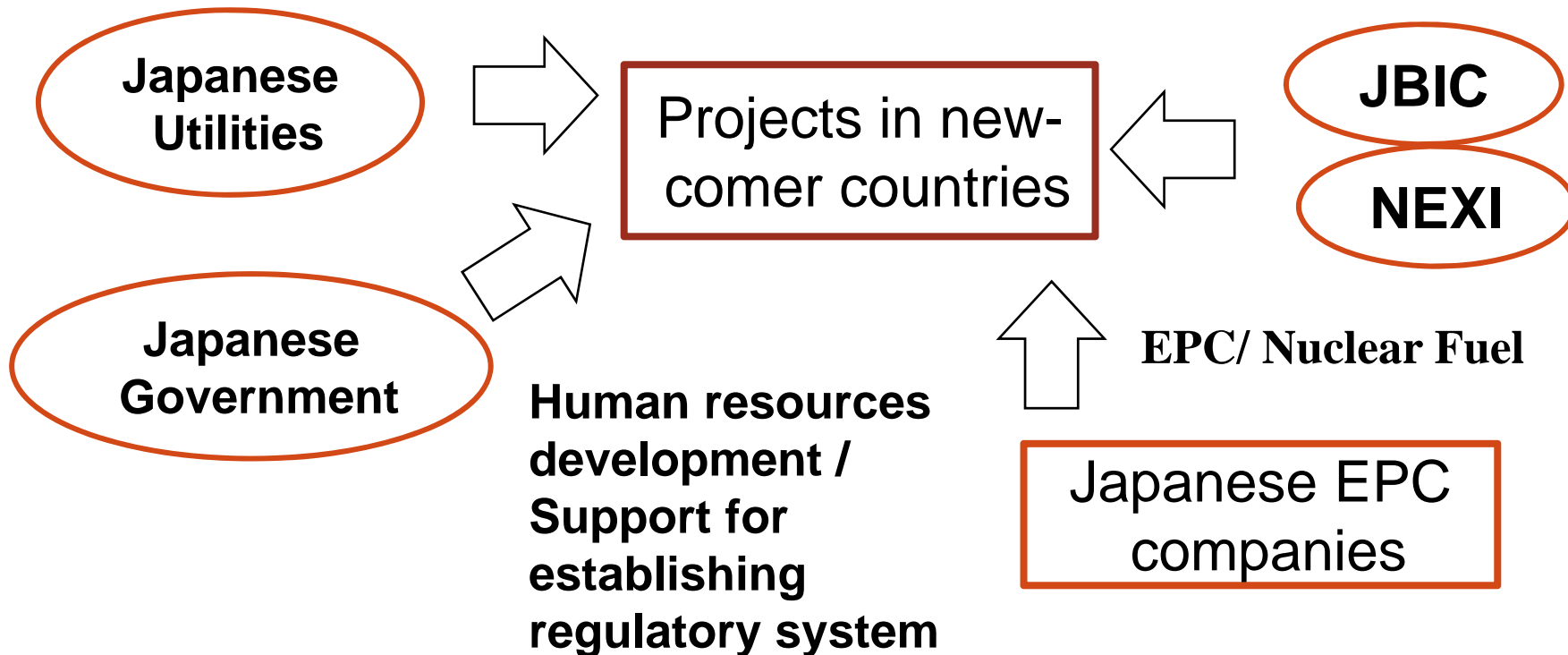
The company will officially be established in October 2010. The JINED preparatory office can be reached by calling TEL : +81-3-3504-0892 FAX : +81-3-3504-0896.

# Japan's Integrated Cooperation for New-comer Countries

☞ Japan provides services requested by emerging countries such as financing, human resources development, design, construction, operation, etc.

**Operation & Maintenance  
Support / Investment**

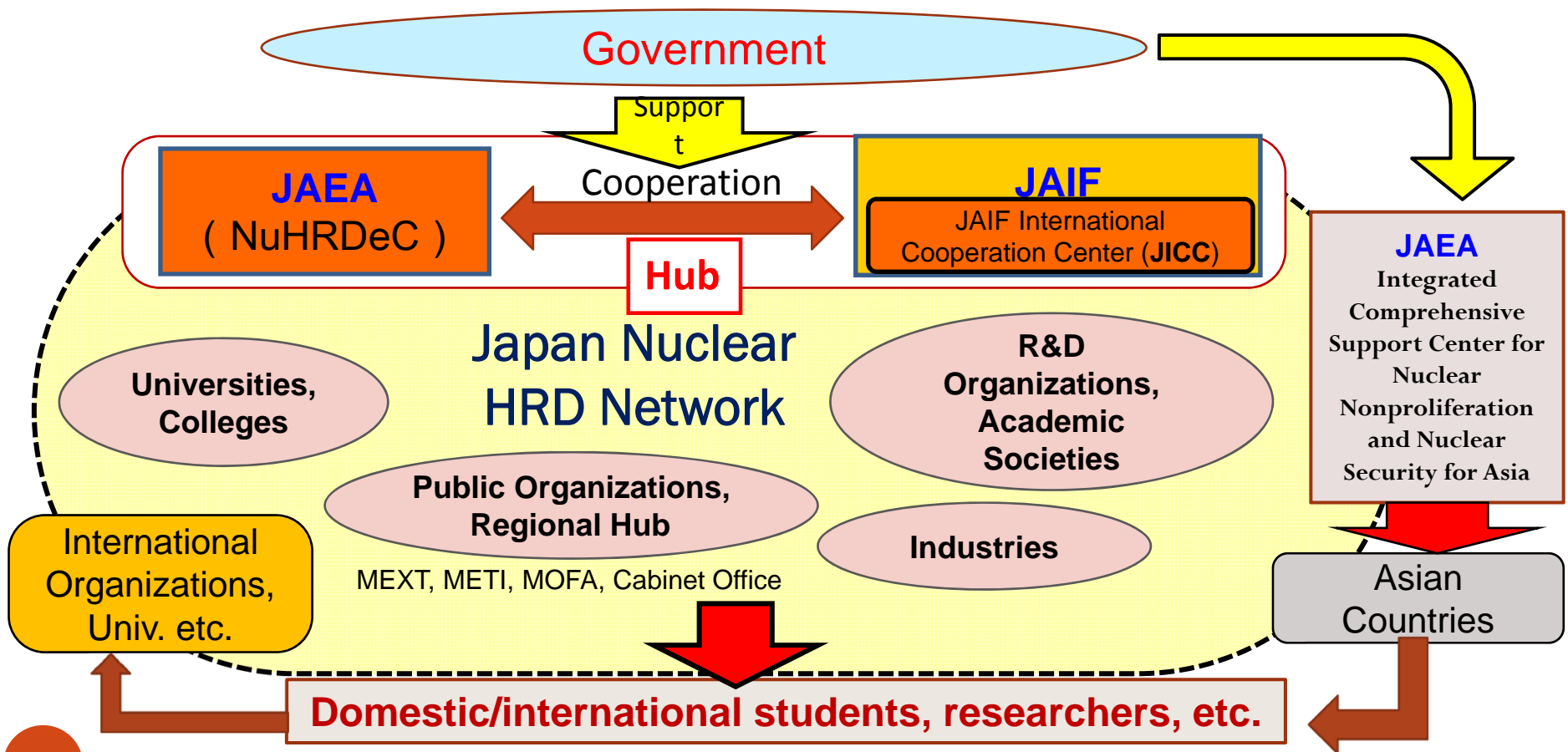
**Public Finance / Insurance**



Nuclear Energy Policy Planning Division, Ministry of Economy, Trade and Industry  
TEL: +81-3-3501-1991 FAX: +81-3-3580-8447



Japan Nuclear HRD Network will be set up to facilitate cooperation among the Government, universities, industries and others



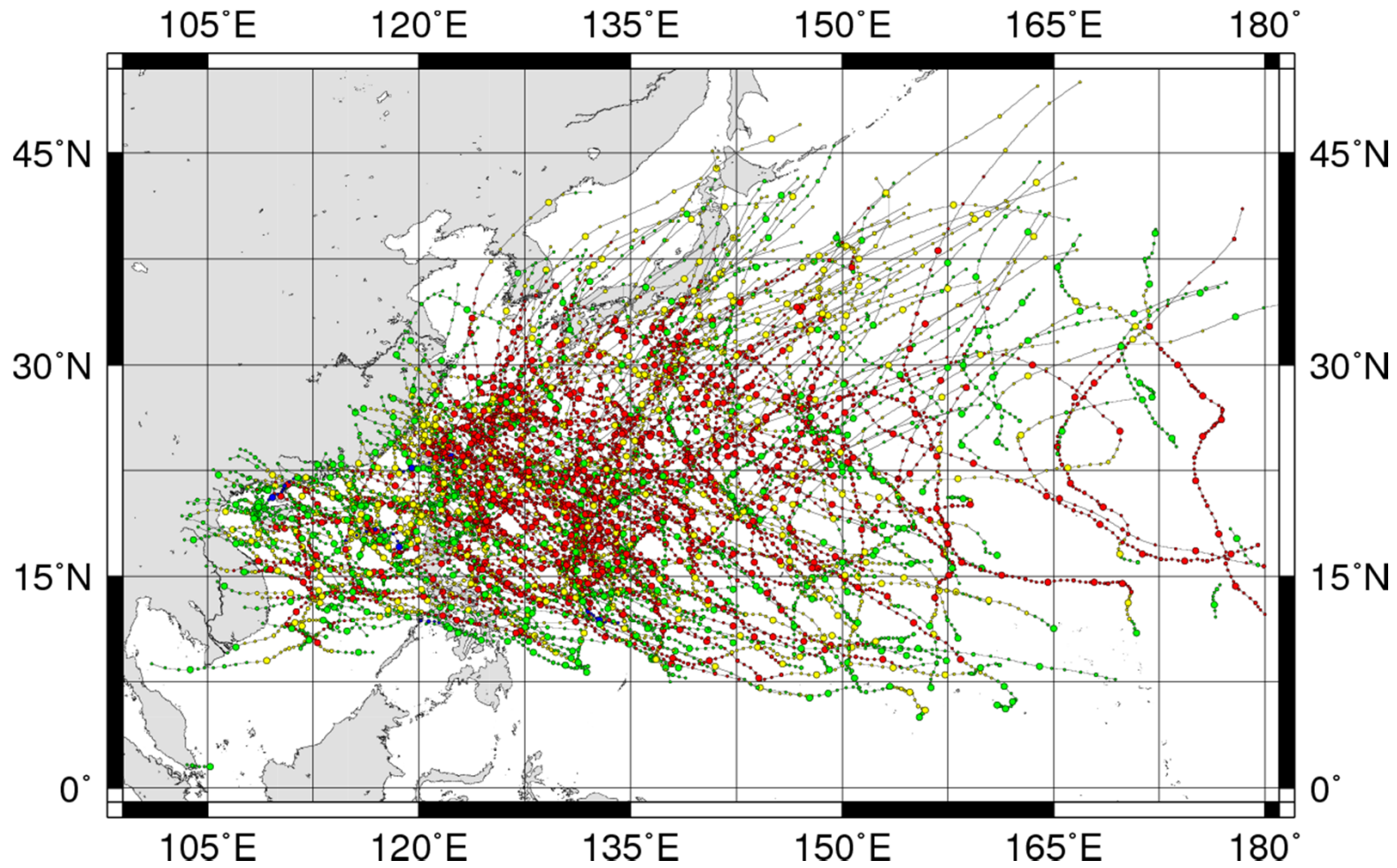
# CONCLUSIONS

- Accomplish successful fast track in going to nuclear in ten years and steady expansion of the capacity of the fleet in more than 40 years
- Diverse utilization of radiation is contributing to the improvement of living-standard and quality of life.
- Actively promoting international cooperation for sharing knowledge, experiences, and lessons learned in technical/institutional/infrastructure as well as supporting HRD and capacity building
- Decide to be active in supporting the deployment of NPPs also.

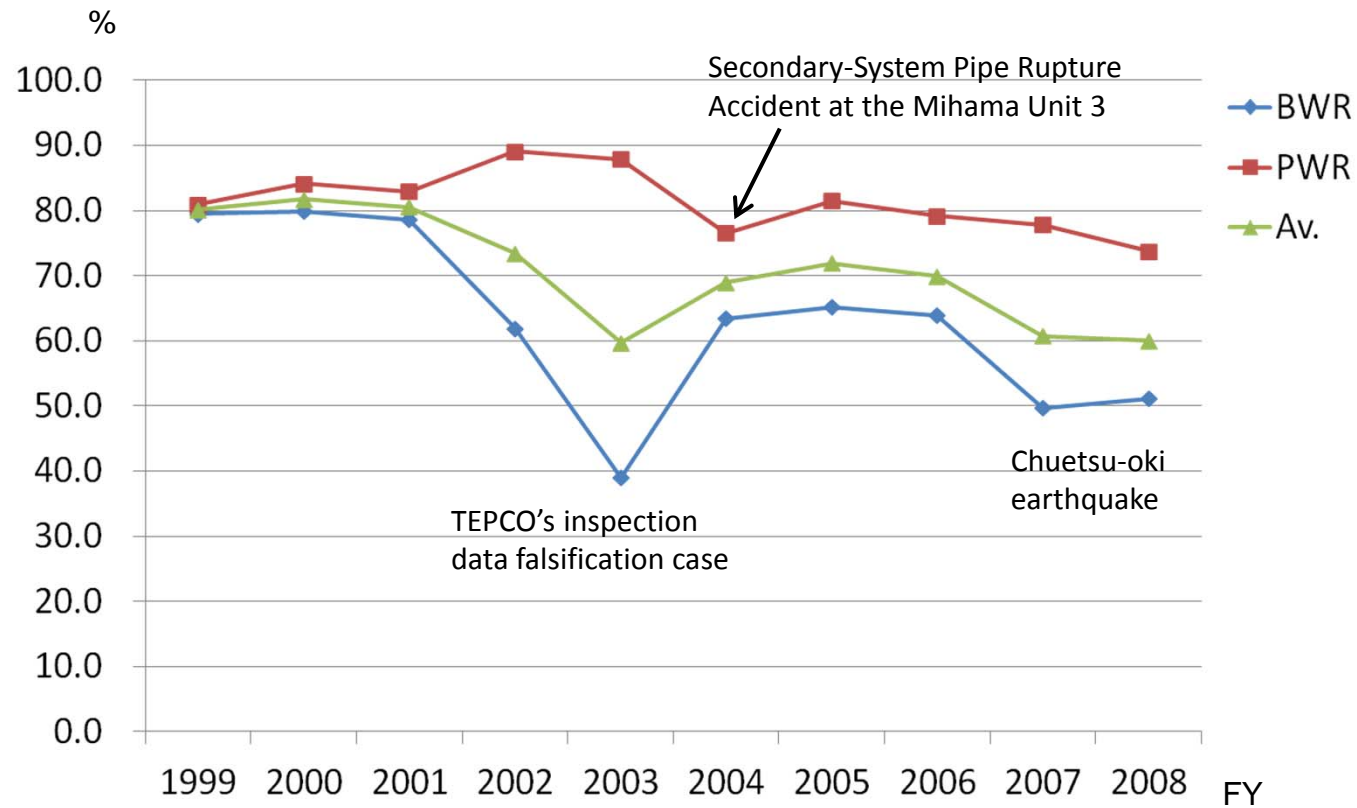
# Reference

## Routes of Typhoons in the East Asia(2000-2009)

### Routes of Typhoons in the East Asia (2000-2009)



## Capacity Factor



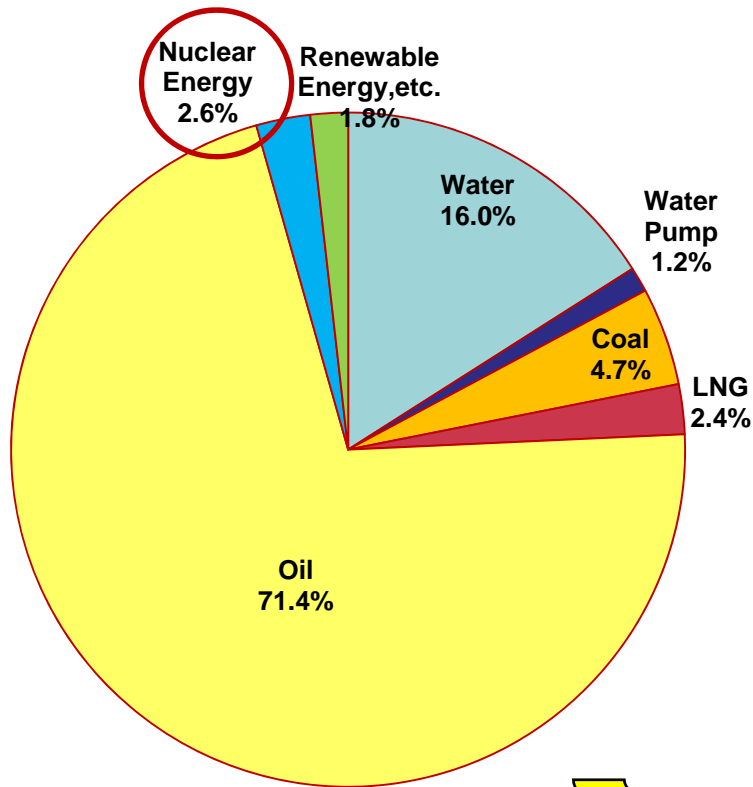
- Capacity Factor of Japanese plants had been maintained around 80%. (TEPCO's inspection data falsification case in 2002, an accident at Mihama unit 3 and Chuetsu-oki earthquake influenced capacity factor significantly. )

# Diversification of Energy Sources of Japan

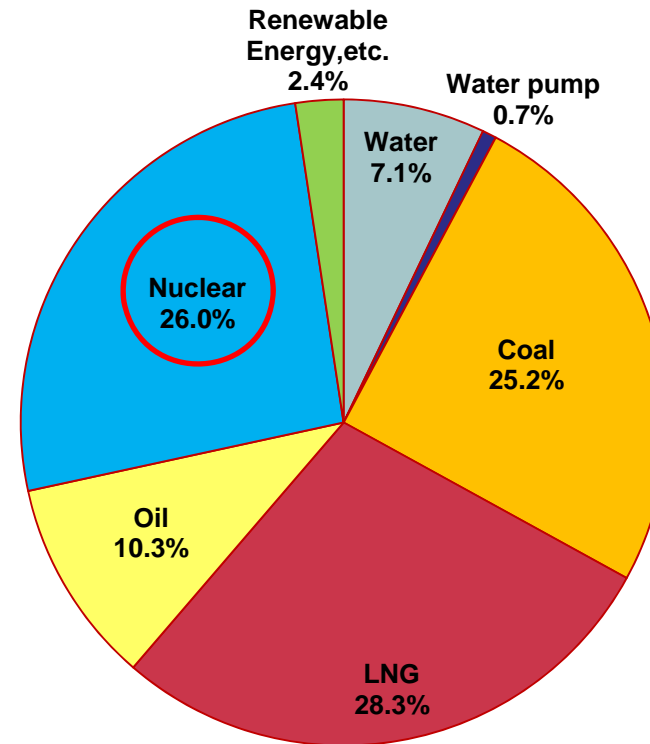
➡ After the Oil Crisis in the 1970s, Japan varied its power sources; from heavily relying on oil to shifting to other sources including nuclear energy.

## Change in Share of Power Sources

### Before the Oil Crisis (FY1973)



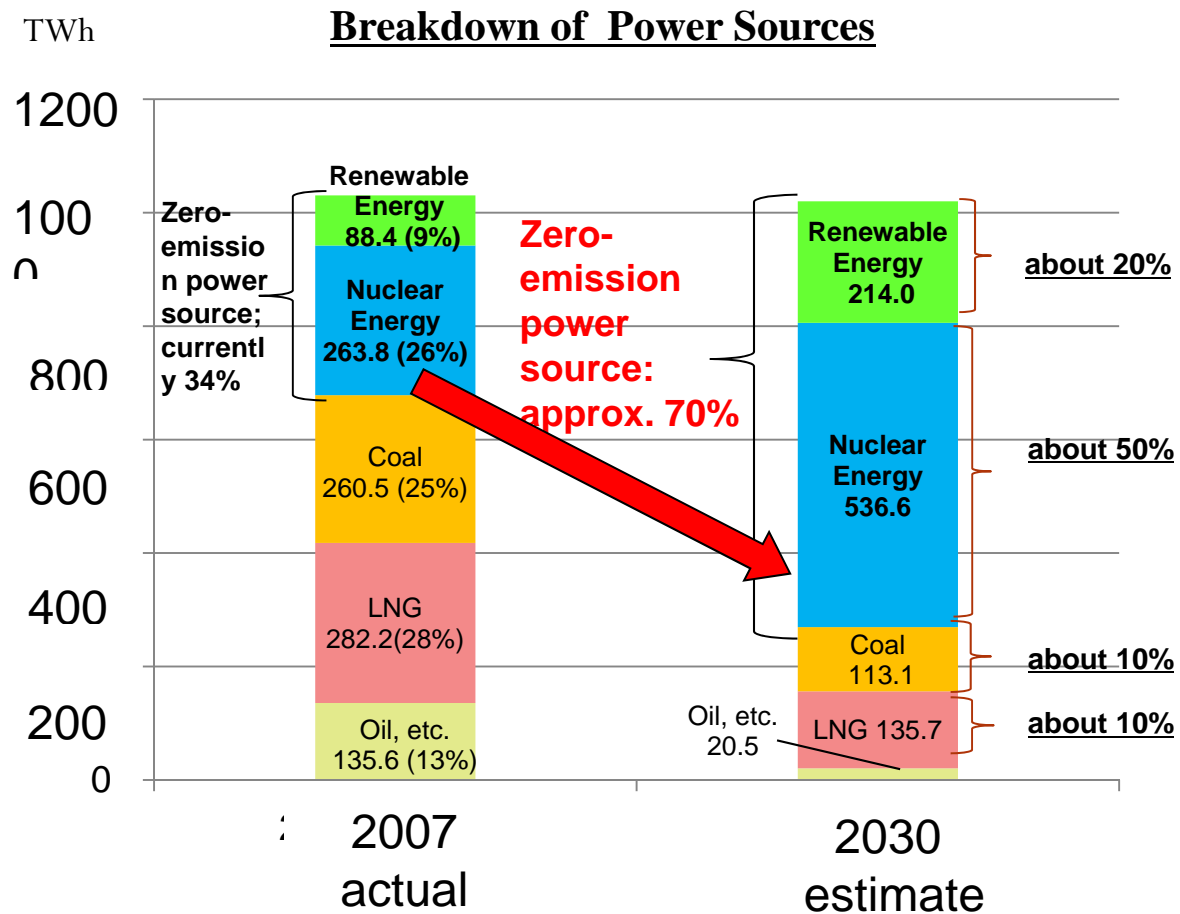
### Current (FY2008)



# Basic Energy Plan

## Targets toward 2030

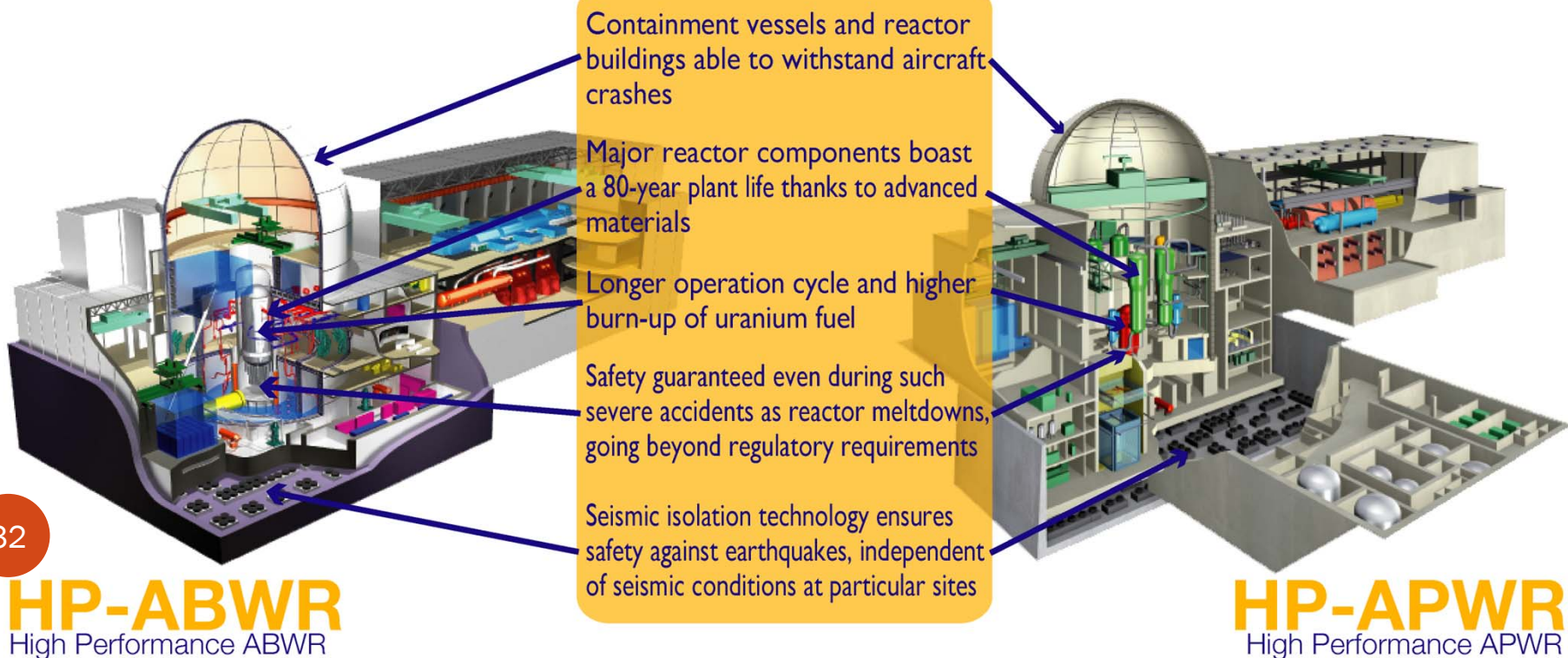
- ✓ Enhancing the **independent energy ratio to approx. 70%** by doubling energy self-sufficiency and the independent development ratio of fossil fuels (currently 38%),
- ✓ Increasing the **zero-emission power source ratio to approx. 70%** (currently 34%),
- ✓ Reducing **CO2 in the “living” (household sector) to half.**



# High-Performance (HP) Next Generation LWRs

*for expanding demand of global nuclear power in the 21th century*

- Top-level safety and most economical efficiency featured by:
  - Safety design with hybrid of passive and active
  - Shortened construction period and reduced power generation costs
- Electric output of 1,800MW<sub>e</sub>/ 800-1,000MW<sub>e</sub> depending on user needs
- Conceptual design through collaboration of Institute of Applied Energy and Japanese three plant vendors (Hitachi-GE, Mitsubishi Heavy Industry and Toshiba)
- Supported by Japanese government and electric power utilities.





## Outline of the IAE (The Institute of Applied Energy)

The IAE is an independent and non-profit research institute on energy technology issues, founded in 1978.

### ■ Mission and Goal

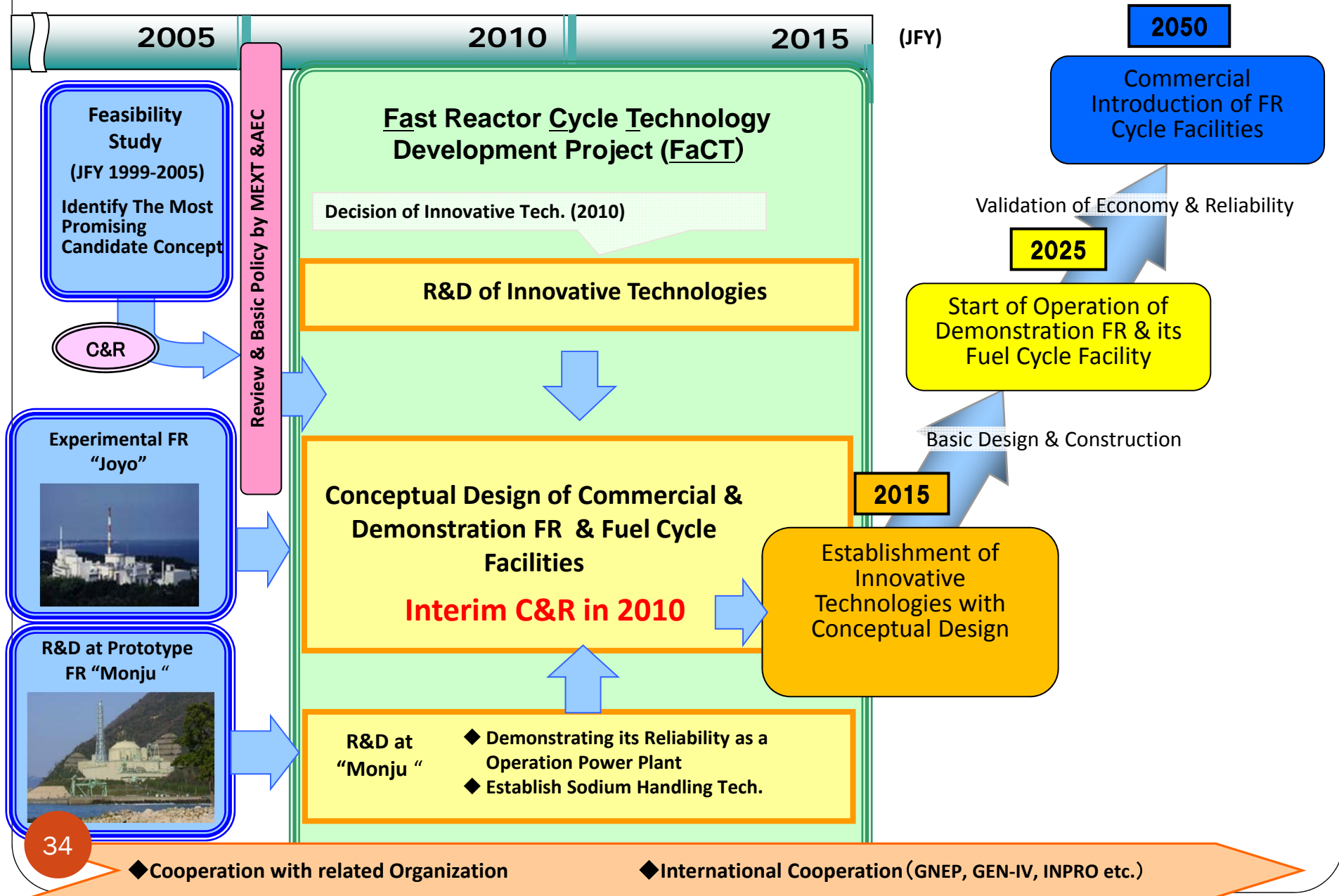
Its mission and goal are to study on energy from the technological viewpoints to ensure a reliable, affordable and environmentally sound source of energy.

### ■ Unique Aspect

The IAE has been conducting its study in collaboration with government, industry and academia. The IAE corporate members includes Japan's major power utilities, gas utilities, oil companies, vendors, constructors, automobile companies.

Web site at [URL:http://www.iae.or.jp/](http://www.iae.or.jp/)

# FR Cycle Development Program in JAPAN



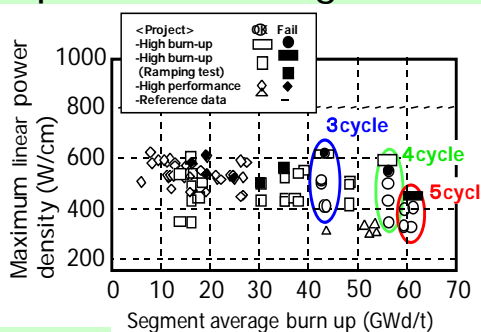
# Research and Development Using JMTR

- Japan Materials Testing Reactor (JMTR, 50MW) is one of the highest spec testing reactor with high neutron fluence, reliance, ...
- Currently under four-year refurbishment during FY2007-FY2010 (reoperation expected in FY2011)

## ➤ Lifetime extension of LWRs

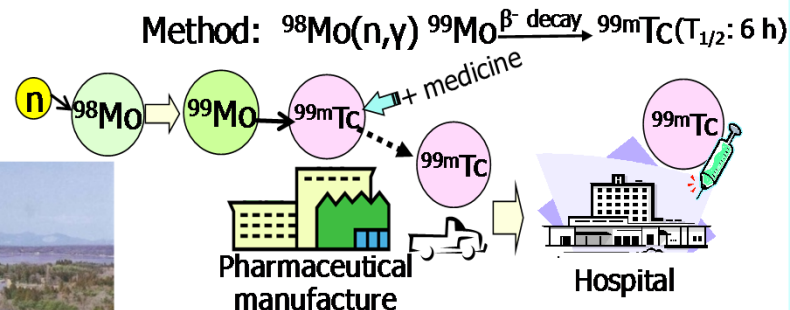
- Aging management of LWRs
- Development of next generation

Power ramping test of LWR fuels

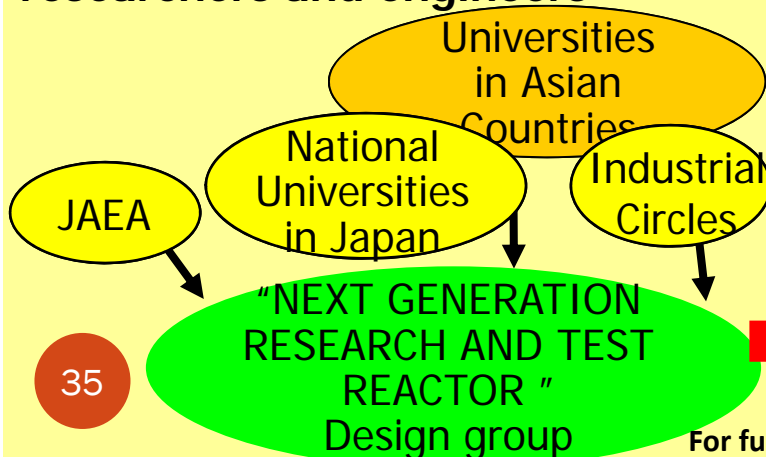


## ➤ Expansion of industry use

- Development of  $^{99m}\text{Tc}$  production technology



## ➤ Education and training for researchers and engineers



Contribution to the Introduction of Nuclear Power Plant into Foreign Countries

## ➤ Progress of science and technology

- Research on radiation damages
- Development of nuclear fusion reactors

