

Nuclear Sociology: A Unique Experience for Human Resource Development

Jor-Shan Choi

**Nuclear Non-Proliferation Research Laboratory
Department of Nuclear Engineering and Management**



**International Conference on Human Resource Development for
Introducing and Expanding Nuclear Power Programs**

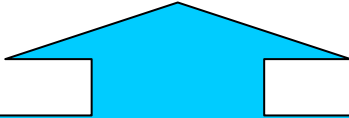
Abu Dhabi, United Arab Emirates

17 March 2010


Objective of Nuclear Sociology Study

Foster future nuclear professionals

Integration of Knowledge



**Policy and Regime
Nonproliferation
Peaceful Use of NE**



**Technology
Nuclear Engineering, &
Safeguards Technology**

Unique Feature of Nuclear Energy Program in Japan

**The Only Non-Nuclear Weapon State with Commercial
Nuclear Fuel Cycle Facilities under NPT**



**Rokkasho Enrichment
Plant (JNFL)**



**Rokkasho Reprocessing
Plant (JNFL)**



**Light-water reactor 55 Units
(49.58GWe)**

**Tokai Plutonium
Fuel Center (JAEA)**

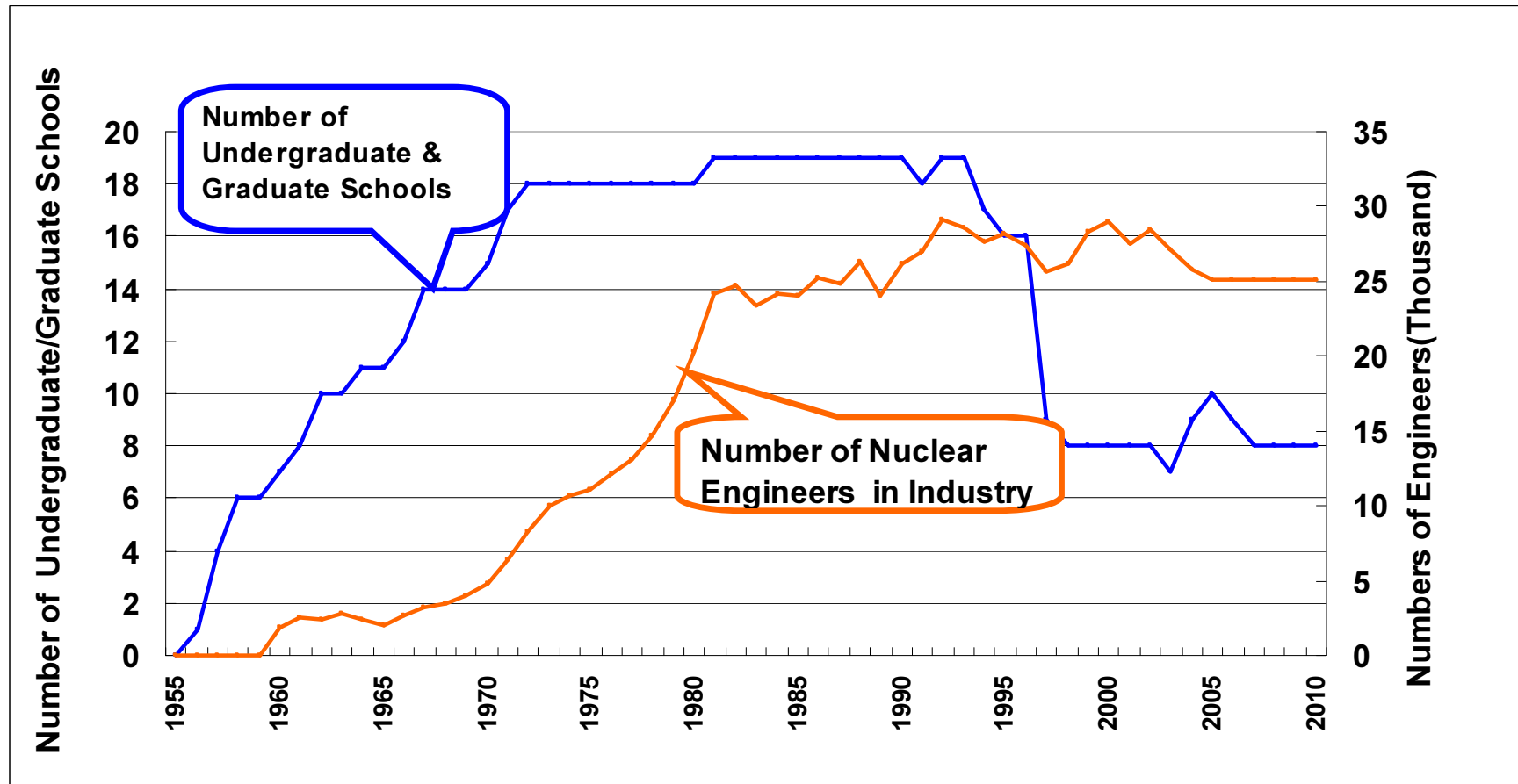


**Prototype FBR "MONJU"
(JAEA)**



**Tokai Reprocessing Plant
(JAEA)**

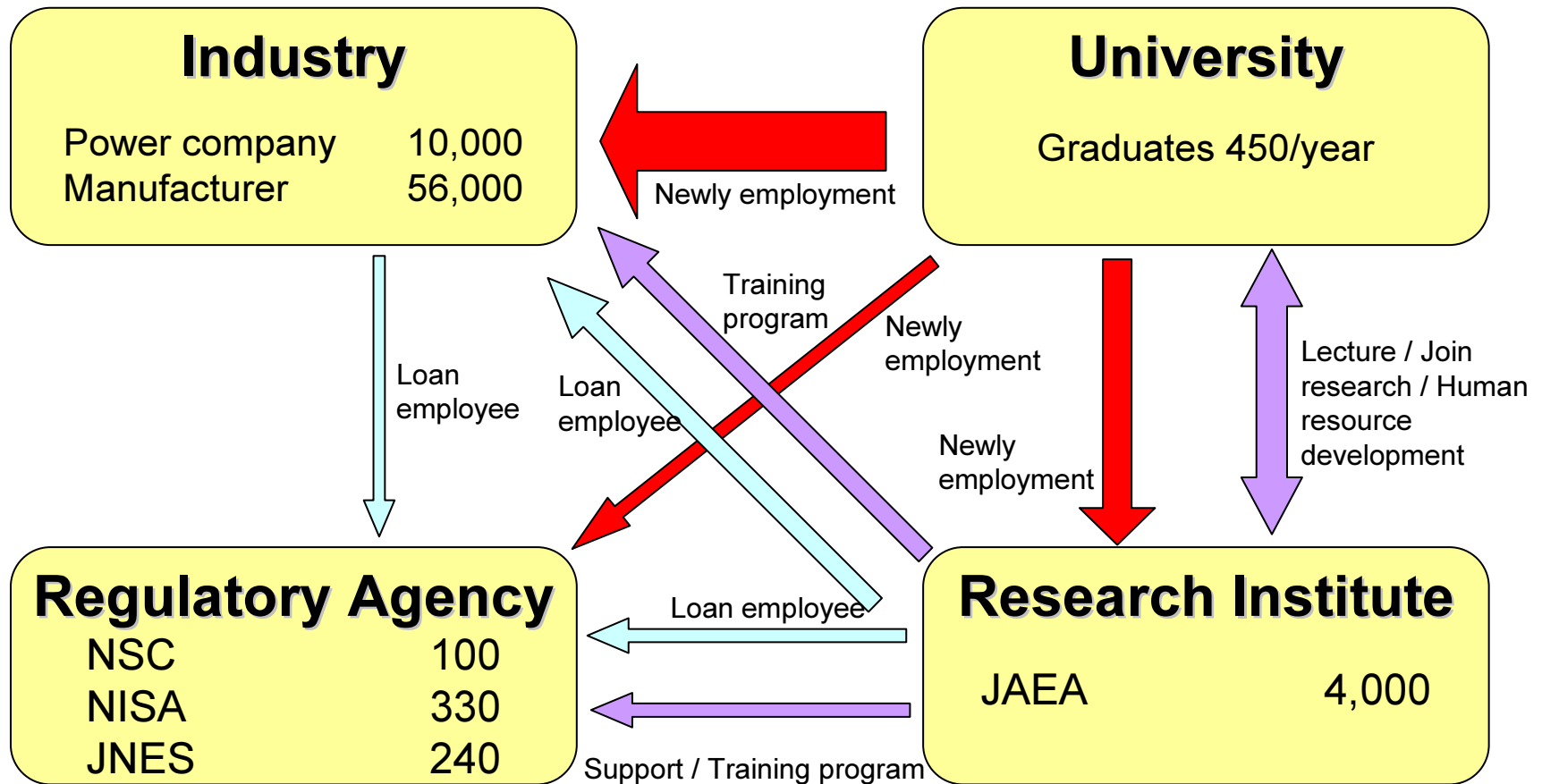
Nuclear Engineers graduated from Universities in Japan



Ministry of Education, Culture, Sports and Technology

Human Resource Development in Japan

(unit : person)



NSC : Nuclear Safety Commission in Japan
 NISA : Nuclear Industry and Safety Agency
 JNES : Japan Nuclear Energy Safety Organization

JAEA : Japan Atomic Energy Agency

Source: S. Tanaka, 1st FNCA Panel Mtg., 2007

Human Resource Development at the University of Tokyo

- Japan's "Nuclear Energy Policy" encourages the cooperation among the government, universities and related organizations.
- The University of Tokyo (Todai) re-established Department of Nuclear Engineering and Management in the graduate school of engineering on April 1, 2005.
- Education on Nuclear Nonproliferation started in the Department – "Nuclear Non-Proliferation Research Laboratory" : A cooperative program between Todai and JAEA.

Tokyo University: Global COE Program (2007 – 2012)

Nuclear Education and Research Initiative

Systematic Education and Research
including Nuclear Energy Sociology

First in the World

Nuclear Energy Sociology

What is Technology for Society ?
In collaboration with people outside Univ.

Nuclear Energy

Technology Innovation
Through comprehensive and
interdisciplinary approach

Radiation Application

Therapy, diagnosis, biology, etc.
Spread in interdisciplinary fields:
medicine, agriculture and so on

"We prepare next generation researchers to grasp the perspectives of complicated and divergent fields of nuclear energy." - Dr. Yoshiaki OKA, Prof. UT, Program Leader -



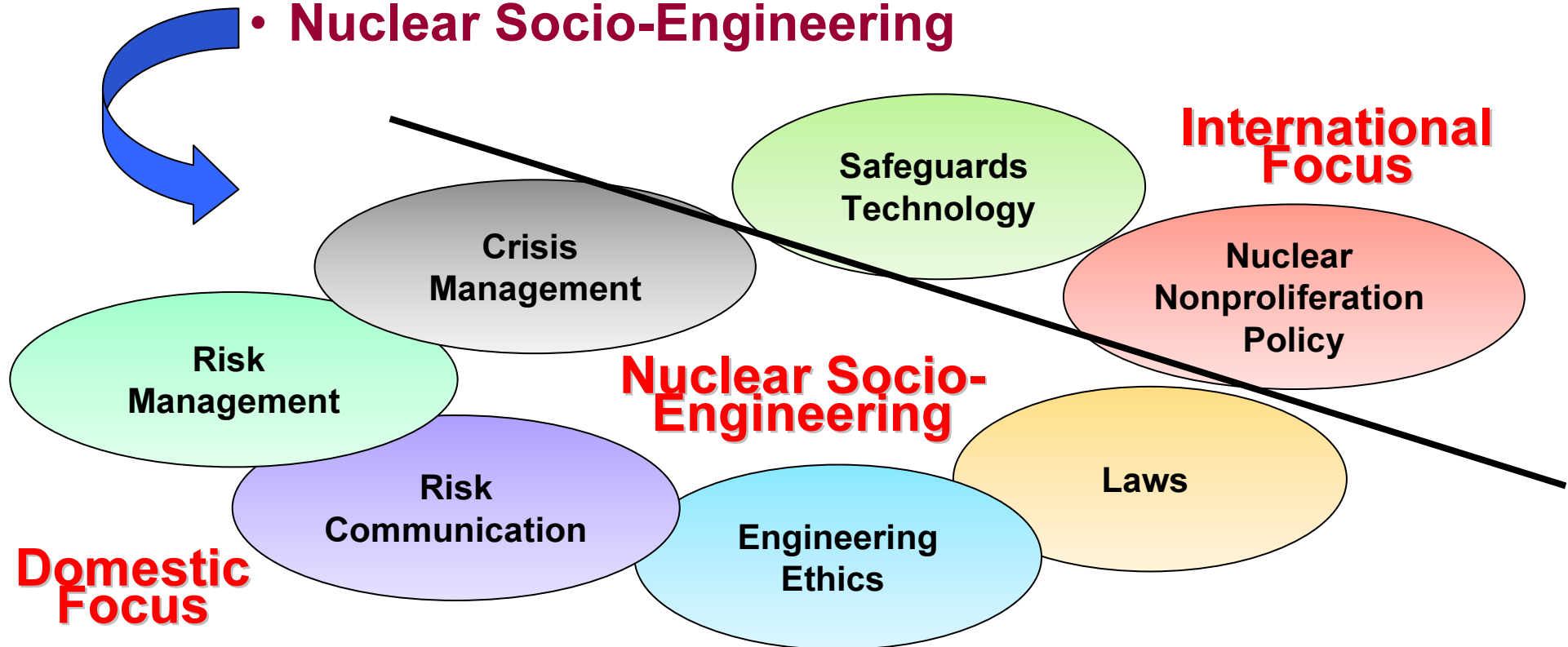
Nuclear Non-Proliferation

- To coexist with the peaceful use of nuclear energy
- To identify the technological and systematic problems

Department of *nuclear engineering and management*

■ Main courses of study in the Department

- Advanced Nuclear Energy
- Advanced Accelerators and Medical Physics
- **Nuclear Socio-Engineering**



Present Lectures in Nuclear Non-Proliferation Studies

- **International Projects and Cooperation**
 - Energy and Nuclear Program of individual countries (USA, Europe and Asian countries)
 - Projects of International Nuclear Cooperation , GEN-4, INPRO, etc.
 - Projects by Nuclear Energy Agency of OECD
 - CTBT
 - Cooperation on denuclearization, etc.
- **International Nuclear Nonproliferation Policy**
 - Chronology of international nuclear nonproliferation
 - International law and regimes related to nuclear nonproliferation
 - Regional issue on nuclear nonproliferation
 - Disarmament council
 - Various concepts of international security
 - Nuclear non-proliferation issues in Middle-east, North Korea, South Asia.
 - WMD and terrorism
- **International Safeguards**
 - Chronology of international Safeguards system
 - State system for accountancy and control
 - Safeguards Technologies, Inspection & complementary access, etc
 - Proliferation Resistance Technologies
 - Monitoring System of CTBT
 - Export control, Physical Protection, etc.

Students Benefited by Out Reach Programs

- **Internship to IAEA, JAEA, other organizations,**
- **Participations in forum, workshops, summer schools with other universities,**
- **Conducting research in the Non-Proliferation Research Laboratory**

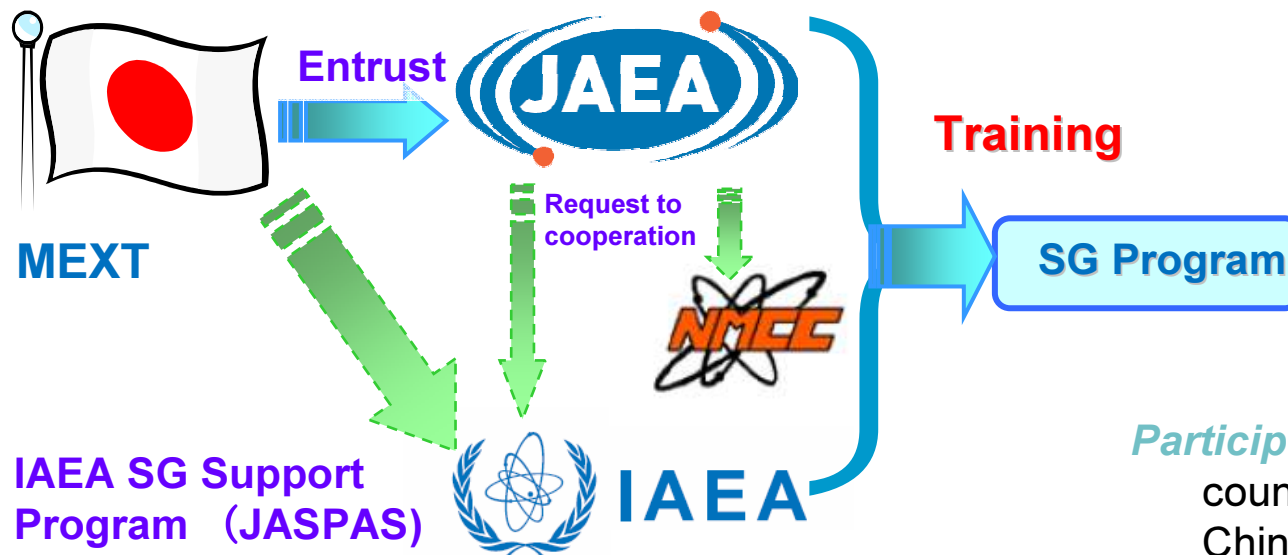
G-COE Students in International Transparency Workshop on Regional Nuclear Non-Proliferation in Asia Pacific (20-22 Feb. 2008)



Students Benefited by Out Reach Programs

Cooperation with IAEA - Safeguards Training Course

October 20-31, 2008



Participants : mainly from Asian countries (Kazakhstan, Uzbekistan, China, Bangladesh, Malaysia, Indonesia, Thailand, Myanmar, Vietnam, Singapore, Korea)

Safeguards Training Course are conducted by JAEA under entrustment by MEXT of Japan.

Students Benefited by Out Reach Programs

Student Participation in Todai Forum in Cambridge University (UK), Nuclear Nonproliferation Workshop (28 April 2009)



Students met Mr. Amano, DG of IAEA when he visited our Lab in Nov. 2009



Students Benefited by Out Reach Programs

A New Nuclear Non-Proliferation Study Committee

- A new study group on nuclear non-proliferation was formed in UT in October 2008.
- The group consists of **UT staff**, **UT PhD students** engineers/researchers from nuclear industries, utility companies, JAEA, and journalist.
- Many non-proliferation-related issues (technical and political) are discussed with wider views.
- The group discussed the **viability of nuclear fuel cycle concepts** including multilateral/multinational control and fuel supply in Asia



2008年(平成20年)9月20日(土曜日)

夕刊 読者 室 新 聞

核不拡散専門家を養成

来月 東大と産業界で機関設立

東大等は、電力会社など産業界と共同で、核拡散問題の専門家養成する教育研究機関を10月上旬に設立する。

唯一の被爆国で、原子力の平和利用を進める日本は、核拡散防止への貢献が期待されているが、専門家は少ない。国際原子力機関（IAEA）などの核拡散防止活動の即戦力となる人材を育て、実践的な政策提案を行うのがねらい。

久野祐輔・原子力国際専攻客員教授ら、原子力技術などを担当する東大教授9人が発起人となり、電力会社や燃料製造会社、原子炉メーカーなどを約20の企業や組織が参加する。「国際保障学研究会」などの名称が検討されている。

産業界が協力するのは、今後、アジアを中心に原子力のビジネス展開を図るうえで、核不拡散技術や政策に精通した人材が必要になるためだ。新しい機関は、原子力発電所の使用済み燃料から核兵器の材料となるプルトニウム、ウランを抽出しにくくする最新技術

や、核不拡散を巡る各国間の協力態勢、査察の在り方などを研究する。

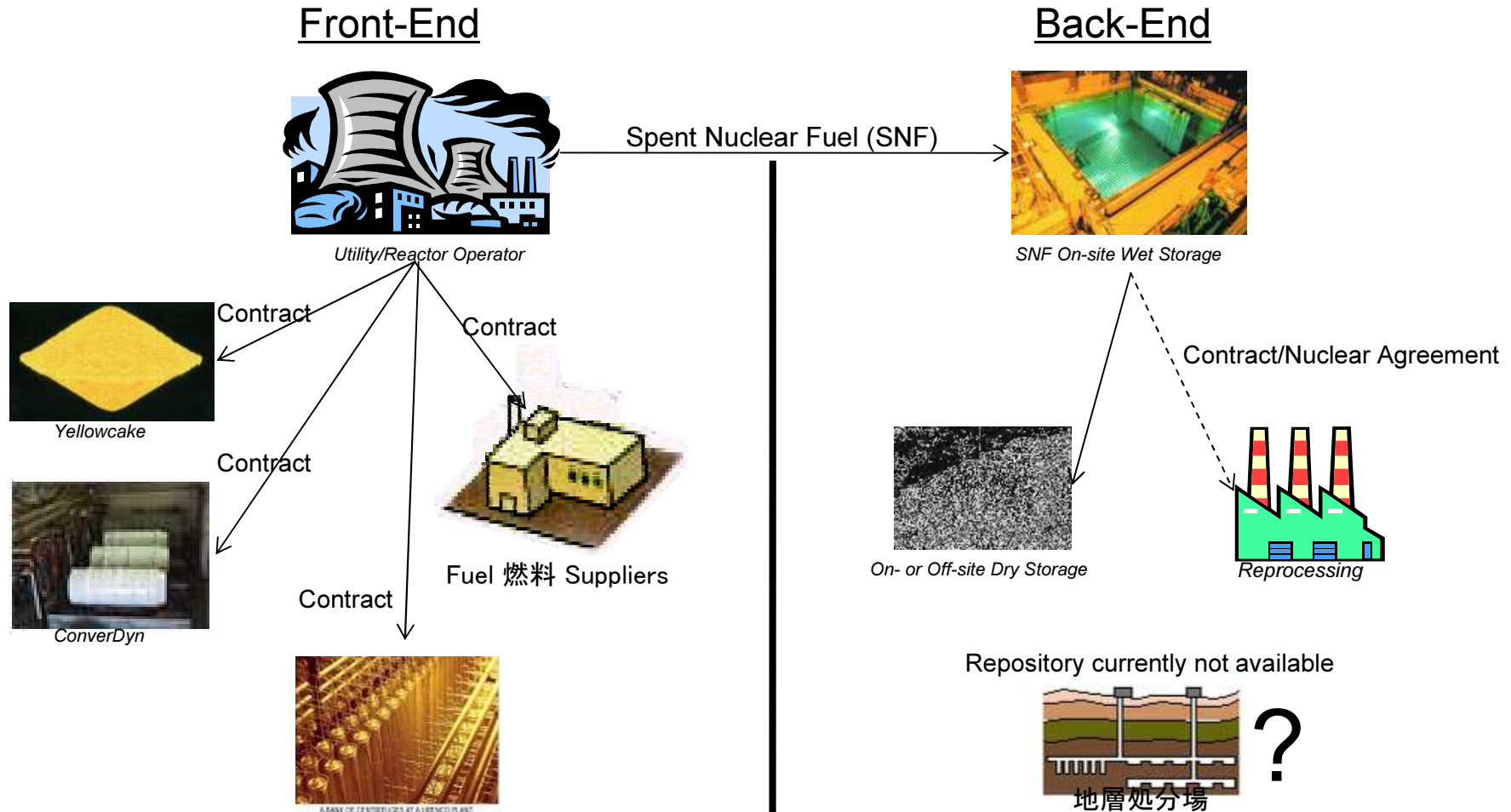
Yomiuri
Newspaper
2008.09.20

Current Research/Studies at Nuclear Non-proliferation Research Laboratory

- Nuclear Nonproliferation Policies
 - India-USA Civilian Nuclear Agreement
 - Assurance of nuclear supply/Multi-national Approach on Nuclear Fuel Cycles,
 - Building nuclear nonproliferation culture,
 - Study on International Laws,
 - Solution of CTBT
 - International and Regional Cooperation and Transparency study
- Nuclear Nonproliferation Technologies
 - Proliferation-Resistant Technologies
 - Advanced Technologies for International Safeguards
 - Verification of states' intention (Efficient Information System)
 - Others

Multinational Approach to Nuclear Fuel Cycle

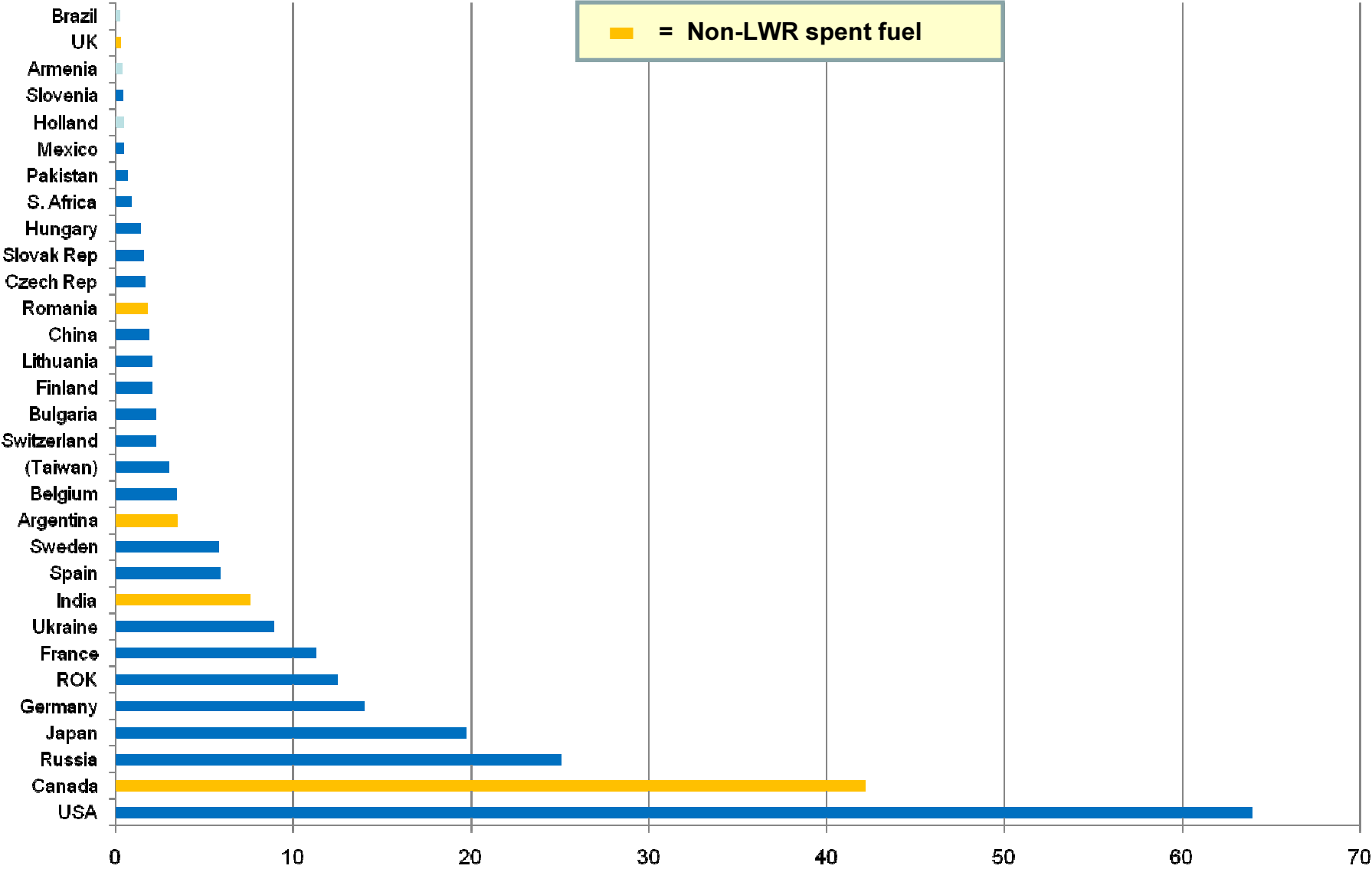
Current business practice for fuel-cycle services



Separate contracts for fuel services,
Enrichment service could be
political and restrictive

Reprocessing service restrictive,
No repository available,
Utilities constipated with spent fuel

Global Civilian Spent Fuel Inventories in 2010



Estimated Global Spent Fuel Inventory (1000 MgHM) in 2010

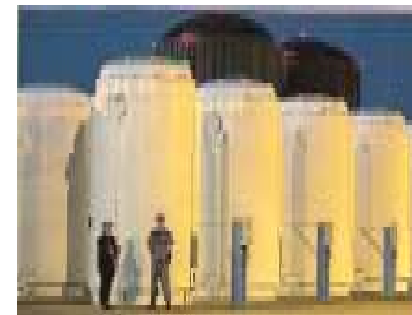
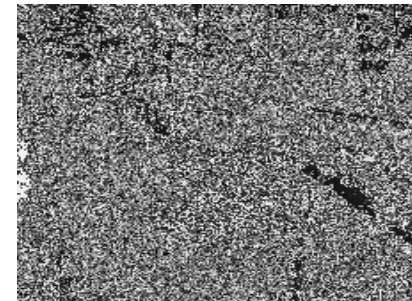
Indefinite Spent Fuel Storage

Key Decisions on Spent Fuel Management:

Before:	What can be done
Loss of full core reserve	Re-rack Transfer to pools of co-located reactor(s) On-site dry storage Transfer to away-from-reactor storage (AFR, wet or dry)
End of plant operation	On-site dry storage Transfer to AFR storage
Plant decommissioned & returned to green site	Transfer to AFR storage Transfer to disposal repository

The US experience on Spent Fuel Storage (years)

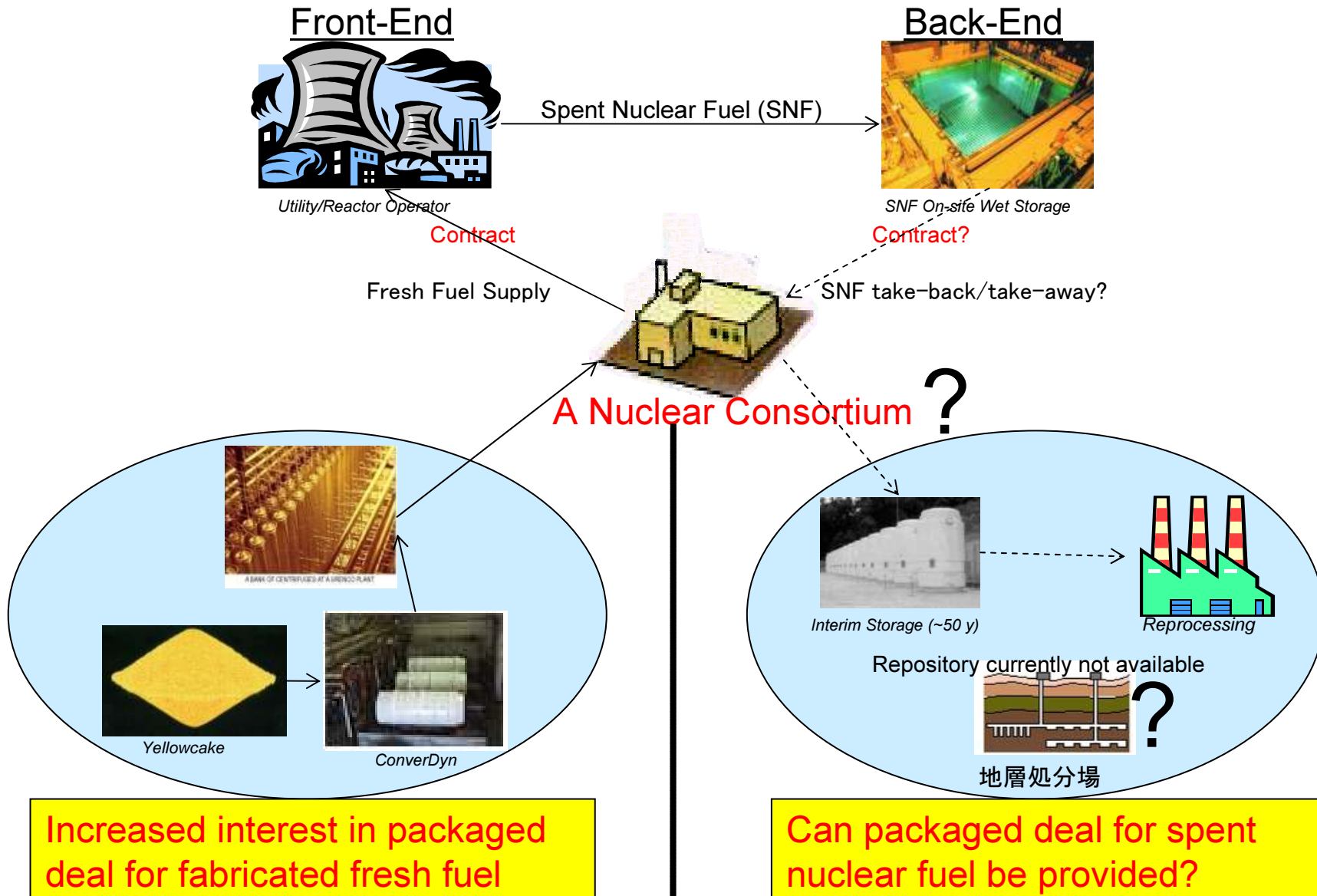
- Wet: Longest >40
Average: 16-25
- Dry: Longest >20
Average: 12-16
- The USDOE has opened and inspected dry storage casks at INL



Indefinite spent fuel storage will eventually lead to the need for centralized AFR storage. Could regional storage be possible? How to start?

Multinational Approach to Nuclear Fuel Cycle

A new model of fuel-cycle services for newcomer countries



Possible Outcome

- Newcomer countries have access to nuclear power at market prices.
- Fresh fuel supplies are assured at competitive prices.
- Spent fuel from less-stable region of the world could be taken-back/ taken-away on a contractual and time basis.
- Spent fuel in existing nuclear programs can be managed in a cooperative manner.
- Spread of sensitive fuel cycle technologies (enrichment/ reprocessing) reduced or eliminated.
- Allow the expanded use of nuclear energy with reduced proliferation risks and environmental/waste burden.

- This is not a restriction to a country's own fuel cycle development.
- It is an option aiming at improving nonproliferation and waste management.
- If a country decides to develop its own enrichment and reprocessing, it will have to deal with the nonproliferation and wastes issues and conform to international safeguards, safety, and security standards.

Future Challenges

- To produce graduates who can contribute to nuclear non-proliferation in international organizations like IAEA,
- To truly merge engineering education and sociology education,
- To maintain intern program; continuous dispatch UT students to IAEA, JAEA and other nuclear fields,
- To improve and maintain quality of lectures by invitation of world class experts and to motivate the student,
- To find more international exchange opportunities (longer term) to promote students in this course,
- To steadily develop meaningful research in the Non-proliferation study committee and to convey clear messages to global nuclear community on nuclear non-proliferation.

Thank you for your attention.