Workshop on
"Important Considerations for Introducing Nuclear Power in ASEAN: Can Regional Cooperation be Attractive for Nuclear Energy Development?"
jointly sponsored by the University of Tokyo (Todai) and
Universiti Kebangsaan Malaysia (UKM) and held in Hotel Equatorial Bangi in Putrajaya, Malaysia on 31 May to 1 June 2010

Summary

The Non-proliferation Study Laboratory of the Department of Nuclear Engineering and Management at the University of Tokyo (Todai) jointly organized a workshop with the Universiti Kebangsaan Malaysia (UKM) on "Important Considerations for Introducing Nuclear Power in ASEAN: Can Regional Cooperation be Attractive for Nuclear Energy Development?" at Hotel Equatorial Bangi in Putrajaya, Malaysia on 31 May to 1 June 2010. The focus of the workshop was two folds: (1) The technological and institutional aspects of introducing nuclear power, and (2) Regional cooperation in Asian Pacific nuclear energy program. Representatives from eleven countries (Australia, China and Taiwan, India, Japan, Kazakhstan, Malaysia, Mongolia, Republic of Korea, Singapore, the United States, and Vietnam) attended the workshop and participated in dialogue and discussion. The workshop was co-sponsored and supported by Global-COE/Go-NERI of Todai, the Faculty of Science and Technology of UKM, and the International Foundation for Safe and Secure Energy Technologies (IFSSET) of Switzerland.

The workshop started with an official opening ceremony which included the Recital of Doa and opening speeches by representatives of Todai and UKM. Professor Satoru Tanaka, the representative of Todai first described the G-COE/Go-NERI program at Todai, and then, he emphasized on the development and utilization of nuclear energy in parallel with nuclear safety, security and nonproliferation. In that context, the regional cooperation would play an important role within the Asia-Pacific Region. Prof. Emeritus Dato' Dr. Noramly Bin Muslim, who represented the UKM Vice Chancellor indicated that Malaysia would plan to operate its first nuclear power reactor in around 2021. He emphasized that regional cooperation in the areas of human resource

development and education & training are essential for emerging nuclear energy countries. He hoped that the workshop would serve as an important stepping stone to further the cooperation in Asia Pacific Region. After the speeches, an official group photo was taken, followed by interviews of representatives from Japan and UKM by public news media. The group picture taken at the workshop is included in Appendix I.

Session I: Important Considerations for Introducing Nuclear Power

The first workshop session was on the important considerations in the technological aspect for countries introducing nuclear power. These considerations include economics and financing, safety and reliability, public acceptance, infrastructural requirements, human resource development, security and non-proliferation, and spent fuel and radioactive waste management, etc. The session began with 3 presentations from 3 newcomer countries (Singapore, Vietnam, and Malaysia): (1) **Singapore**'s current energy situation depends on import of gas mainly from Malaysia and Indonesia. Singapore needs to integrate into the regional nuclear pursuit through the close cooperation with its neighboring states which are about to introduce nuclear power. The national nuclear energy policy should adopt a "System Dynamics Model", consisting of three factors of "strategic", "technology" and "economic", that caters for regional cooperation and influence. (2) **Vietnam**'s current status on nuclear energy is to introduce reactors from Russia, taking into account the take-back of spent fuel and radioactive waste, nuclear security and nuclear nonproliferation, public acceptance, human resource and infrastructure development, as important considerations for introducing nuclear energy in Vietnam. (3) **Malaysia**'s utility company (Tenaga Nasional Berhad, TNB) presented a detailed plan for selecting reactor technologies based on three aspects (national strategic or top tier decision aspect, intermediate or techno-economics aspect, and detail technical aspect). The preliminary evaluation provided encompassed all Gen III/III+ reactors (including AWBR, AP-600, EPR, APWR, ACR, CAND-6&9, VVER-1200, ESBWR, APR-1400, PBMR, GT-MHR and others). TNB would keep abreast with other new entrants as well as news in experienced nations embarking in nuclear new build.

Representatives from 3 existing nuclear power programs in Asia (China, Japan and ROK) presented their countries' programs respectively: (1) **China**'s current status and future nuclear energy program include the construction of additional 30 NPPs and operations of 70 NPPs by 2020, a transition from the current fleet of pressurized water reactors (PWRs) to fast reactors (FRs), and building an integrated fuel cycle industry. Possible regional cooperation for: (a) *nuclear developed nations in the region* could include regional technical cooperation for early commercialization of the back-end fuel cycle, and these national fuel cycle capabilities could become a fine base for establishing regional or international centers of the backend of fuel cycle; (b) *emerging nuclear energy states* in the region could include a packaged deal consisting of fresh fuel supply and spent fuel management at affordable costs, together with human resource development and training of personnel. The packaged deal for the nuclear fuel cycle (front-and-back-ends) would be most attractive for newcomer countries introducing nuclear power. As China is building its nuclear manufacturing and construction capabilities, China would export its nuclear power technology with fuel cycle services, including the spent fuel storage, and provide training courses for human resources development. (2) **Japan** indicated that the essential factors for countries introducing nuclear power include (a) strong government commitment and leadership, (b) stable political climate, (c) favorable investment climate for foreigners and (d) well-spread scientific knowledge. As a nuclear supplier, Japan can and is willing to assist a smooth introduction of NPPs in developing countries by first helping to formulate comprehensive nuclear power program or feasibility studies, and then in advance stage of planning, offering a comprehensive package that meets the country's nuclear program including human resources development, financing, and project management, actual construction, commissioning, operation, maintenance, and technology transfer to the country. However, from a supplier country's point of view, there is a concern that "fair trade" may not always prevail in the supply of nuclear power plants (NPPs) especially to developing countries. Japan being a member of OECD has to comply with its Guidelines excluding the provision of Official Development Assistance (ODA) to finance NPP projects. Japan is in the process of establishing a new company in late fall which is composed of a public-private partnership including the Ministry of Economy, Trade and Industry (METI), electric power companies, and nuclear vendors, and headed by Mr. Takeguro, currently the Vice President of Tokyo Electric Power Company (TEPCO). The

new company assists developing countries in offering a package proposal for their introduction of nuclear power plants. (3) **Republic of Korea (ROK)**'s experience in building up its nuclear power program indicated that the important considerations for introducing nuclear power include (a) Strong and persistent leadership, (b) Training and continuing re-training, (c) Avoiding corruption, (d) R&D activities including research institutes and nuclear think tanks, and (e) Standardization. Important experience in ROK's nuclear power development program and current status of the its nuclear industry include reactor technology development, technological self-reliance, operational performance of ROK's reactors, and economic efficiency in NPPs construction. This experience led to the successful award of an contract to the ROK–led consortium by UAE for building four NPPs (APR 1400). One of the company in the consortium, KEPCO plans to open the world's first graduate school focusing on nuclear power plant studies.

Session II: The Institutional Aspect: Non-Proliferation and Nuclear Security

The second workshop session focused on the institutional aspect of introducing nuclear power, covering both non-proliferation and nuclear security. The presentations in the session include:

(1) Asian Pacific Safeguards Network (APSN):
The speaker from Australia delineated the background and purposes of the establishment and the current and activities of Asian Pacific Safeguards Network (APSN). He mentioned that APSN is expected to be a useful vehicle for regional safeguards cooperation. The potentials for future APSN activities by 2030 include meetings, training, staff exchanges, cooperative research projects, safeguards regulatory infrastructure-building, etc. He hoped that such activities would contribute to improve the effectiveness and efficiency of safeguards in the Asian-Pacific (AP) Region.

(2) Security of Nuclear Power Plants (NPPs)
According to the speaker from India, the world now needs to confront a "new paradigm" on nuclear security, considering the possibilities of nuclear terrorism by non-state actors. He explained the vulnerabilities and threat perception,

Design Basis Threat (DBT), defense-in-depth approach for NNPs' security, various measures for security, safety, and emergency response. He emphasized that emerging nuclear countries need to first set-up a robust security infrastructure and legal framework through international cooperation and knowledge sharing, in order to develop a strong nuclear security culture.

(3) IAEA safeguards and state system of accounting for and control of nuclear materials (SSAC)

The speaker from Japan explained the roles and measures of the IAEA safeguards and state system of accounting for and control of nuclear materials (SSAC), providing examples of safeguards implementation in Japan's FBR "Monju" and Tokai / Rokkasho reprocessing plants. He presented Japan's "Three Nonnuclear Principles" as national credo and five key factors for international confidence as Japan's efforts for the peaceful use of nuclear energy. He also suggested that the measures for strengthening nuclear nonproliferation should include: (a) strengthening IAEA Safeguards, (b) implementation of the Guidelines for nuclear exports and nuclear related exports by Nuclear Suppliers Group (NSG Guidelines), (c) strengthening physical protection, (d) Proliferation Security Initiative (PSI), (e) efforts towards conclusion of CTBT and FMCT and (f) IAEA proposed Multilateral Nuclear Approaches to nuclear fuel cycle (MNA).

(4) Nuclear Security Summit

As a member of the Malaysian delegation to the Washington Nuclear Security Summit the speaker explained in detail of the Summit "Communiqué" and "Work Plan" urging concrete actions and measures for nuclear security. He pointed out that the following countries made specific national commitments at the Summit:

(a) Australia: Moving toward the ratification of the International Convention on Suppression of Acts of Nuclear Terrorism.

(b) China: Announce cooperation on Nuclear Security Centre of Excellence.

© India: Announcing the creation of Nuclear energy Centre with nuclear security component.

(d) Japan: Launching an integrated regional support centre; research and development on detection and forensics; Contributing new resources to IAEA 's nuclear security fund; Hosting and funding a world Institute of Nuclear Security best practices conference.

(e) Kazakhstan: Converting HEU reactor and eliminating remaining highly enriched uranium; cooperative work on BN-350 reactor shutdown and fuel security; hosting the Global Initiative in June; considering an international nuclear security training centre.
(f) Malaysia: Passed an export control law.
(g) ROK: Hosting the 2012 Nuclear Security Summit; hosting a Global Initiative activity.
(h) Vietnam: Converting HEU research reactor; joining the Global Initiative to combat nuclear terrorism.
(i) Philippines: Joining the Global Initiative to combat nuclear terrorism.
(j) Thailand: Joining the Global Initiative to combat nuclear terrorism.

(5) Physical Protection of Nuclear Facilities
The speaker from the US highlighted various important factors for physical protection of nuclear facilities including the determination of protection objectives, facility characterization and assets identification, threat definition and characterization and target identification for DBT. He also provided some examples of detection system and security equipments by showing a video on Honeywell's comprehensive security measures installed in a NPP in Spain. He, however cautioned that the over-reliance on technology could lead to poor security and stressed that the development of a nuclear security culture is crucial.

Session III: Regional Cooperation in Asian Pacific Nuclear Power Programs

The third workshop session consisted of a variety of presentations from participants in the AP region including:

(1) Spent Fuel Management
The speaker from Taiwan presented its energy policy, current status and future program of nuclear power utilization. He pointed out the most urgent and priority problem in Taiwan's nuclear program is its need for spent fuel management. He expressed his concern that the continued operation of existing NPPs in Taiwan would soon be jeopardized unless an executive, feasible and dependable spent fuel management plan is implemented *NOW*. In this context, he suggested that the establishment of regional spent fuel storages and regional high level radioactive waste repositories should be a priority cooperation item in R&D on

nuclear technologies in Asia Pacific Region. Other important considerations for regional cooperation are university education, training, regulations, regulatory practices and emergency-response plans.

(2) Multilateral Approaches to Nuclear Fuel Cycle (MNA)

Two speakers from Japan contributed to the concept of multilateral approaches to nuclear fuel cycle (MNA). The first speaker explained the past and current efforts for MNA, including the current efforts of IAEA nuclear fuel bank and LEU reserve at International Uranium Enrichment Center (IUEC), Russia. He presented a proposal entitled “Regional Network of Nuclear Fuel Cycle facilities in Asia Pacific” studied in the Nuclear Non-Proliferation Study Committee in G-COE at Todai to contribute to a stable LEU fuel supply, possible solutions on global spent fuel accumulation, cost savings for spent fuel treatment and an effective utilization of natural resources.

The second speaker presented his study analysis on four multilateral enrichment facilities (IUEC, MESP, URENCO, and Areva enrichment plant) by comparison of (a) principles such as universality, transparency, economic viability, incentives for participation and stability; and (b) structures such as ownership, host states, funding partners, technology holders and supervising authority. To provide the assurance of non-proliferation, he raised a question whether it is possible to establish a multinational nuclear enrichment plant without the participation of nuclear weapon States.

(3) Kazakhstan’s Nuclear Energy Program

The speaker from Kazakhstan delineated the current nuclear energy program in Kazakhstan and the future strategy in global nuclear industry. Including uranium production, Kazakhstan and other partners have a plan to provide nuclear energy services including uranium conversion, enrichment, fuel pellet and fuel assembly manufactures and nuclear power station construction. He also presented Kazakhstan’s current initiatives for establishing an International Centre of Nuclear and Technological Knowledge and Knowledge Base (KB).

(4) Mongolia’s Nuclear Initiative

The speaker from Mongolia explained the “Mongolian Nuclear Initiative” exploring ways to use Mongolia’s abundant natural resources as latitude for technological advancement. The Initiative, although its details have not yet worked out, includes spent-fuel take-back assurance and “cradle-to-grave” approach. Mongolia, however, may forgo development of nuclear fuel cycle

facilities other than in a multilateral context for Mongolia. Regarding bilateral cooperation, he informed that Mongolia concluded Memorandum of Understandings (MOUs) with Japan, Russia, India and France in 2009 and expects to conclude the MOUs with China and ROK in 2010.

(5) Regional Cooperation

The speaker from ROK overviewed the background, structure and activities of RCA[1], FNCA[2], ANSN[3], ANENT[4] and PNC[5], and the mutual relationships among them. There are several existing cooperative frameworks; however, he proposed that it would be worthwhile to seek a synergistic linkage between the current multilateral cooperation frameworks with some economic and/or political regimes in the Asian Pacific Region (such as ASEAN+3[6] and APEC[7]).

(6) Nuclear Cooperation Framework

The speaker from Japan explained several existing nuclear cooperation frameworks. For further nuclear cooperation, he pointed out that (a) sharing nuclear infrastructure, (b) small and medium reactor (SMR) without on-site refueling, and (c) regional fuel cycle approach including recycling and waste, coupled with assurance of supply of fuel and services, are important. Agreeing with the previous speaker, he also suggested that the cooperation frameworks should have synergy with different nuclear cooperative initiatives in the same region and also have a linkage with already existing or proposed regional economic cooperation such as AFTA[8], APEC, ASEAN+3, etc.

Session 4: Open Discussion

The co-chair of the fourth workshop session provided some background information before the open discussion. He overviewed the nuclear energy status in Asia Pacific Region, key issues for introducing nuclear power, current status of front-end fuel cycle services, stocks of separated Plutonium and HEU and the accumulation of global spent fuel inventories. As a possible solution for the urgent need for spent fuel management, he also proposed “A Nuclear

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[1] RCA: Regional Cooperative Agreement
[2] FNCA: Forum for Nuclear Cooperation
[3] ANSN: Asian Nuclear Safety Network
[4] ANENT: Asian Network for Education in Nuclear Technology
[5] PNC: Pacific Nuclear Council
[6] ASEAN+3: ASEAN+Japan, China and ROK
[7] APEC: Asia-Pacific Economic Cooperation
[8] AFTA: ASEAN Free Trade Area

Fuel-Cycle Network for Asia Pacific" including enrichment, reprocessing, spent fuel storage facilities and geologic repositories in the AP region.

The following is a list of opinions and comments presented by the workshop participants.

(1) **Important considerations for introducing NNPs** would include;

- Assured supply of fresh nuclear fuel
- Assured take-back of spent nuclear fuel (and high level radioactive waste (HLW))
- Some panelist argued that HLW producing states should be responsible for its management.
- "Cradle-to-grave" approach by vendors (and their states) ensuring both fresh fuel supply and spent fuel take-back
- "Comprehensive Packaged deal" approach by vendors (and their states) ensuring fresh fuel supply, spent fuel take-back, NPP construction, operation and maintenance, human resource development, coordination and management of services, legal and financing supports, etc
- Nuclear safety
- Nuclear security
- Nuclear non-proliferation (IAEA Safeguards, NSG Guidelines, etc)
- Human resource development, university education and training of personnel
- Infrastructure development, including legal infrastructure
- Emergency response
- Public acceptance
- Technical factors for plant selection would include plant economics, safety, licensability, proven technology, standardization, site selection, plant performance, constructability, technological monopoly

(2) Utilization of nuclear energy will continue to expand in Asia Pacific Region and ***regional cooperation*** would be a key to support such expansion.

- In the Region, however, there are existing nuclear power programs (ex. Japan, China/Taiwan, ROK) and emerging nuclear energy states. The social environmental and technological gaps between them are appreciable. Therefore, the needs for and the attractiveness to regional cooperation vary among countries. The challenges are "when, where, who, to whom, what and how" regional nuclear cooperation would be pursued.

- Despite the various gaps among countries in the Region, the following notions should be noted;
  - Every country has an inalienable right to use nuclear energy for

peaceful purposes
- The national sovereignty of each country should be fully respected

(3) ***Regional cooperation are urgently required*** in the following areas;
- For existing nuclear programs (ex. Taiwan, Korea, Japan):
  - ***Spent fuel management***
- For emerging nuclear countries:
  - ***human resource development, university education and training of personnel***
  - ***Infrastructure development***

(4) ***Possible solutions for spent fuel management*** would include;
- ***(Interim) spent fuel storage on a regional basis***
- ***regional nuclear fuel cycle network / center***

The emerging nuclear countries hope that the developed nations would provide necessary support appropriately reflecting their needs through regional cooperation. In this context, human resource and infrastructure developments (and reactor safety) are most attractive and most urgent priorities, while establishing a regional fuel cycle center is still a long way to go.

(5) ***Possible options for regional cooperation*** would include;
- Establish a new network / framework
- Utilization of existing initiatives such as APSN

In either case, synergy and link with other initiatives would be necessary
- Synergy with different nuclear cooperative initiative in the same region / in energy area
- Link with already existing or proposed regional economic cooperation (ex. AFTA, APEC, ASEAN+3, etc)

It is suggested that prior to establishing a “legal framework”, it may be better to establish a “network” with no legal obligation first, and such network may develop into a legal framework later in the future.

(6) The workshop participants reached a common understanding that ***human resource development, university education and training of personnel*** are attractive and eagerly anticipated through regional cooperation. Following views were expressed among participants.
- Reactor operation and nuclear R&D require highly qualified nuclear engineers with nuclear engineering knowledge.
- Not only nuclear engineering, but overall nuclear knowledge including electronic engineering, mechanical engineering and material engineering are required from reactor safety perspectives.
- The emerging nuclear energy states are recommended to establish

some nuclear institutes for education at the same time launching their nuclear energy programs.

- Several emerging nuclear energy states have a plan to establish new nuclear engineering department within their undergraduate and graduate schools.
- Due to the lack of qualified and skilled nuclear engineers, young students are sent abroad to study nuclear engineering while nuclear professionals abroad are called back to contribute nuclear education in home country.
- Various training courses for nuclear reactor operation should be provided under bilateral agreement with a nuclear developed state.
- Training courses provided by Japan, Korea and China would be highly welcomed by emerging nuclear energy states.
- Not only engineers, but also good lawyers are required for negotiations with foreign vendors. Nuclear law should be included in education programs in undergraduate and graduate schools.

The workshop aimed to promote and deepen mutual understanding on regional cooperation on nuclear energy development; therefore, there were no specific conclusions as a result of the open discussion.

Closing remarks were presented by representatives from Todai and UKM. Sincere appreciation for all the Todai/UKM staff and the workshop participants for the preparation as well as the active participation in wide-ranging discussion for two days was expressed. Both representatives hope to continue the discussion on regional nuclear cooperation in the future.

Appendix I: Snap shots taken at the workshop