Global Nuclear Human Resource Development in Tokyo Institute of Technology
-International HR Development Program for Nuclear Safety, Security and Non-Proliferation-

Masaki Saito
Tokyo Institute of Technology, Japan
Per Capita Electricity Consumption in Major Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Consumption (kWh/capital/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>16,766</td>
</tr>
<tr>
<td>U.S.A</td>
<td>13,515</td>
</tr>
<tr>
<td>Japan</td>
<td>8,220</td>
</tr>
<tr>
<td>South Korea</td>
<td>8,063</td>
</tr>
<tr>
<td>France</td>
<td>7,585</td>
</tr>
<tr>
<td>Germany</td>
<td>7,175</td>
</tr>
<tr>
<td>U.K.</td>
<td>6,192</td>
</tr>
<tr>
<td>Russia</td>
<td>6,122</td>
</tr>
<tr>
<td>Italy</td>
<td>5,762</td>
</tr>
<tr>
<td>Global Average</td>
<td>2,659</td>
</tr>
<tr>
<td>Brazil</td>
<td>2,060</td>
</tr>
<tr>
<td>China</td>
<td>2,060</td>
</tr>
<tr>
<td>Mexico</td>
<td>1,993</td>
</tr>
<tr>
<td>India</td>
<td>503</td>
</tr>
</tbody>
</table>

Distribution of Electricity Consumption by Countries

- U.S.A: 23.3%
- China: 15.6%
- Total: 17.4 trillion kWh
- Others: 30.8%

Generation Capacity of Nuclear Power Plants in Major Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Capacity (MW)</th>
<th>Number of Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.A</td>
<td>105,081</td>
<td>(104)</td>
</tr>
<tr>
<td>France</td>
<td>65,020</td>
<td>(55)</td>
</tr>
<tr>
<td>Japan</td>
<td>49,487</td>
<td>(35)</td>
</tr>
<tr>
<td>Russia</td>
<td>32,194</td>
<td>(27)</td>
</tr>
<tr>
<td>Germany</td>
<td>21,371</td>
<td>(17)</td>
</tr>
<tr>
<td>South Korea</td>
<td>17,716</td>
<td>(22)</td>
</tr>
<tr>
<td>Ukraine</td>
<td>13,268</td>
<td>(20)</td>
</tr>
<tr>
<td>Canada</td>
<td>11,654</td>
<td>(13)</td>
</tr>
<tr>
<td>U.K.</td>
<td>11,026</td>
<td>(16)</td>
</tr>
<tr>
<td>China</td>
<td>9,900</td>
<td>(14)</td>
</tr>
<tr>
<td>India</td>
<td>4,243</td>
<td>(17)</td>
</tr>
</tbody>
</table>

Nuclear Power Plants in Japan

(List of plants as of January 31, 2009)

- Tokai Electric Power Co., Ltd.
- Tōhoku Electric Power Co., Ltd.
- Hokkaido Electric Power Co., Ltd.
- Electric Power Development Co., Ltd.

(Source: Japan Atomic Industrial Forum, Inc. "World Nuclear Power Plants 2007/2008"
Historical Trend of Japan’s Primary Energy Supply

1953 Atoms for Peace

1957 Department of Nucl. Eng.

(Note) 1 PJ (= 10^{15} J) is equivalent to approximately 25,800,000 liters of crude oil in calorie.
(Source) Agency for Natural Resources and Energy
1953 Address of “Atoms for Peace” by Eisenhower
1955 Enactment of “Atomic Energy Fundamental Law” in Japan
1956 Establishment of Research Laboratory for Nuclear Reactors (RLNR) in Tokyo Tech.
1957 Opening of Graduate Courses of Nuclear Engineering in Three Universities:
Tokyo Tech., Kyoto Univ., Osaka Univ.,
2007 Fifty years anniversary of these graduate courses
Expansion of Education Programs for "Nuclear Energy" in Japan

- **Undergraduate Schools:**
  - 1958 Kyoto Univ.
  - 1960 Univ. of Tokyo,
  - 1962 Tohoku Univ., Osaka Univ.,
  - 1966 Nagoya Univ.
  - 1967 Hokkaido Univ., Kyushu Univ.

- **Graduate courses** were established 4 years after the opening of undergraduate courses in Univ. Tokyo, Nagoya Univ., Hokkaido Univ. and Kyushu Univ.
Nuclear Education in National Universities
Founded in 1881 and celebrating 130th anniversary in 2011, Tokyo Institute of Technology (Tokyo Tech.) has undertaken education and research of the highest quality in science and technology.

- 3 Undergraduate Schools (Science, Engineering, Bioscience and Biotechnology: 23 departments)
- 6 Graduate Schools (45 Departments)
- 5 Research Laboratories
- 10,000 Students (1,500 Doctor: 3,500 Master: 5,000 Undergraduate)
- 1,250 Students from abroad
- 1,100 Professors (Teaching Staff)
- About 500 M $/year (Budget in 2010)
Department of Nuclear Engineering, Tokyo Institute of Technology

- Establishment : 1957
- Educational staffs:
  Research Laboratory for Nuclear Reactors
  (22 Professors + Visiting Professors)
- Admission of students:
  ~ 30/year in Master
  ~ 10/year in Doctor
  5 ~ 10/year of Foreign Students
- The grand total of graduated Master students:
  More than 1,000 students
- The grand total of foreign students graduated:
  More than 130 students
Employment of students after graduation from the master program of nuclear engineering (1988-2008)
Global Nuclear Education Network (GNEN)
### International Program for Students from Abroad (1995 - 2010)

<table>
<thead>
<tr>
<th>Country</th>
<th>Master</th>
<th>Doctor</th>
<th>M+D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>17</td>
<td>22</td>
<td>39</td>
</tr>
<tr>
<td>China</td>
<td>10</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>Russia</td>
<td>4</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>Korea</td>
<td>5</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Vietnam</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Thailand</td>
<td>1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Ukraine</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Germany</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>M</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Egypt</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Hungary</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Turkey</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Malaysia</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Lithuania</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Sub. Total</th>
<th>53</th>
<th>77</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>~8/y</td>
<td></td>
</tr>
</tbody>
</table>

Mongolia(M2,D1), Costa Rica(D1), UAE(M1), USA(M1)
IAEA Internship

2003-2011
- 9 Students (Doctor)
- 12 Students (Master)
The Programmes

University

WNU Summer Institute

2005-2007
-2 Students (Doctor)
-1 Assistant Professor

University

ENEN

ANENT

UNENE
European Nuclear Education Network (ENEN)
(2009.3.6)
ICI Education Cooperation programme
-Joint Mobility project (2010-2012)-

Cooperation in higher education and training between the EU and Partner countries (PC) Australia, Japan, New Zealand and the Republic of Korea

(About 30 students will be exchanged from both sides)

Europe:
- European Nuclear Education Network Association
- Institut national des sciences et techniques nucléaires, France
- Ecole des Mines de Nantes, France;
- University Polotechnica Bucharest, Romania
- Technology, Slovak University of Technology in Bratislava, Slovakia

Japan:
- Tokyo Institute of Technology
- Research Reactor Institute, Kyoto University
- Japan Atomic Energy Agency
Tokyo Tech.-OINPE Workshop

(28 October, 2005)
Tokyo Tech.-MIT
INES 1
(2-4 November, 2005)
Japan University Network for Global Nuclear Human Resource Development

Tokyo Institute of Technology
In cooperation with
Ibaraki University, Osaka University, Okayama University, Kanazawa University, Kinki University, Kyushu University, Kyoto University, Tokai University, Nagoya University, Hachinohe Institute of Technology, University of Fukui, Hokkaido University, University of Yamanashi, Shonan Institute of Technology

Supported by
Ministry of Education, Culture, Sport, Science and Technology, Japan
Japanese University Network was established in 2010 supported by Japanese Government for Global Nuclear Human Resource Development in cooperation with 15 Universities by bringing together their limited Educational Resources, for efficient and effective higher educations, based on closer collaboration with Industry.

One of the main activities is the promotion of supports and cooperation in Nuclear Human Resource Development for Countries Introducing Nuclear Technologies for Peaceful Use.
Series of Strategic Global Nuclear Education
(Subcommittee (4) )

- Nuclear Educations in Countries Introducing Nuclear Technologies for Peaceful Use by Japanese Professors
  - Malaysia (Secretary: Tokyo Institute of Technology)
  - Vietnam (Secretary: Osaka University (Tokyo Tech))
  - Thailand (Secretary: Kyoto University)
  - Saudi Arabia (Secretary: Hokkaido University)
  - Mongolia (Secretary: Tokyo Institute of Technology)
  - Philippines (Secretary: University of Fukui)
  - Indonesia (Secretary: Tokyo Institute of Technology)
Special Educational Course on Nuclear Engineering for Installation, Operation and Regulation of Nuclear Power Plant
4 - 8 July 2011
Malaysian Nuclear Agency
VINATOM, Hanoi, Vietnam (December, 2011)
EGAT: Electricity Generating Authority of Thailand
TINT: Thailand Institute of Nuclear Technology
Global Human Resource Development Program for Nuclear Safety and Security
- DOJO for Global Nuclear Safety and Security -
Background of Program

1) Large-scale international terrorism occurred in U.S. on Sept. 11, 2001
   ➢ Nuclear power plants were also targets of the international terrorism.

2) G8 Hokkaido Touyako Summit held in July 2008
   Importance of 3S (Safety, Security(countermeasure against nuclear terrorism), and Safeguards (non-proliferation) was discussed.
   ⇒ Japan declared to take initiatives of the 3S.

3) Nuclear Security Summit held in Washington in April 2010
   ⇒ Japan expressed its intention to set up a support center for enhancing global nuclear security.
4) **Great East Japan Earthquake** occurred on March 11, 2011

Severe accident (large-scale atomic disaster) occurred in the **Fukushima Daiichi Nuclear Power Plant**.
Problems to be solved by the Program

Global nuclear crisis which endangers survival basis of humanity such as nuclear proliferation, nuclear terrorism, large-scale nuclear disaster and emergency radiation exposure:

3S (Safety, Security and Safeguard(Nonproliferation)) area

People to be developed by the Program

Person who works as an international leader in the nuclear-related field in terms of nuclear safety/security area, having extensive expertise and strong leadership:

Global Nuclear Safety and Security Agent
Problems to Be Solved

Nuclear Safety
- Raising personnel for protection from large-scale nuclear disaster
- Measures against large-scale nuclear accident
- Measures against emergency exposure
- Risk Communication
- Emergency response, etc.

Nuclear Security (Against Terrorism)
- Raising personnel for prevention of nuke terrorism,
- Protection of radioactive material and nuke-related facilities
- Protection of radioactive material at the time of transportation
- Practice at facilities for simulation

Nuclear Non-Proliferation/Safeguard
- Raising Japanese personnel for nuke non-proliferation
- Raising personnel from developing countries of Asia for nuke non-proliferation
- Raising and training inspectors of IAEA
Educational System for Nuclear Safety/Security Course

"Global Leaders (Tough Leaders)"

having extensive knowledge and strong leadership as well as expertise in nuclear power

High professionalism ➔ High sociality
Characteristics of the program

1) Entrance into residential “DOJO for Global nuclear safety/security Agent”
   Living together with other students and instructors, students learn from each other.

2) Selection is carried out in two stages to secure high-level education,
   30 students (freshman) → 15 students (GOJO) → 6 students (Ph. D. course)

3) On-site training in and out of Japan is required (Internship)
   6 months on-site training in Japan + 1 year overseas on-site training

4) High-level international Liberal Arts are required
   International politics, international laws, economy, philosophy, history, art, culture, foreign languages (two) etc.

5) Scholarship
   about 1,500 $/month for Master student
   about 2,500 $/month for PhD student
Summary

- Tokyo Tech Graduate School has continued a full scope education of nuclear engineering for past five decades since 1957.
- The number of students graduated from Master Program of Nuclear Engineering Department amounts to more than 1000.
- **International Course** was established in 1994 and totally more than 130 students have graduated from the master and doctor programs.
- **Global Nuclear Human Resource Development** has been initiated by Global Nuclear Education Network.
- **Global Human Resource Development Program for Nuclear Safety and Security** has been initiated for international leaders in the industrial, administrative, and academic fields. “Global DOJO for 3S Agents”
Einstein in Tokyo Institute of Technology in 1922

Thank you, Einstein.