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Introduction

- JAEA (founded in 1956) has been performing Human Resource Development (HRD) activity in the field of radiation utilization.

- The Nuclear Human Resource Development Center (NuHRDeC) of JAEA has a responsibility for carrying basic knowledge about nuclear and experiences to younger generation through comprehensive nuclear education and training program.

- In recent years, NuHRDeC actively promotes international training & cooperation specially in Asia, in cooperation with domestic and overseas university, as well as education and training for domestic nuclear engineers.

- Totally cumulative number of trainees at NuHRDeC since 1958 reaches about 55,000 for Japanese and 1,500 for foreigners.

- JAEA has other HRD centers such as Center for International Cooperation and Industry Academia Partnership (ICAP) in Tsuruga and Integrated Support Center for Nuclear Nonproliferation and Nuclear Security (ISCN) in Tokai.
Outlines of NuHRDeC Activities

Domestic Training Course
- Technical Training Courses
  - Nuclear engineers,
  - RI & radiation engineers,
  - National examinees
- Temporary On-demand Trainings

National Cooperation - Japan Nuclear HRD Net -
- An overall framework for Nuclear HRD, consisting of nuclear-related organizations from industries, academia and the Government

Cooperation with Universities etc.
- Nuclear Professional School, Graduate Schools of Univ. & Technical Colleges
- Japan Nuclear Education Network
- Nuclear HRD program by the Government
- Student Trainees, Summer School Programs, etc.

International Cooperation
- IAEA-ANENT (Asian Network for Education in Nuclear Technology), ANSN (Asian Nuclear Safety Network),
- FNCA (Forum for Nuclear Cooperation in Asia)
- ENEN (European Nuclear Education Network)
- CEA/INSTN

Instructor Training Program (ITP) for Asian countries
- Instructor Training Course (ITC)
- Follow-up Training Course (FTC)
- Nuclear Technology Seminar
  1) Reactor Plant Safety Course
  2) Nuclear Administration Course
  3) Site Preparation & Public Relations Course
  4) Basic Knowledge of Radiation for School Education Course
For HRD seeking peaceful use of nuclear energy in Asia, NuHRDeC has conducted Instructor Training Program (ITP) since 1996 under MEXT (Ministry of Education, Culture, Sports, Science and Technology) budgetary activities with the following purposes:

1. To develop a self-sustainable training system in Asian countries, using Japan’s knowledge, experiences and know-how.

2. To broadly disseminate the technology, lessons learned from Fukushima accident and safety culture of Japan to Asian countries.

3. To establish and keep the human network among participating countries.

ITP fairly provides a training opportunity for Asian countries regardless of whether the country plans to introduce Japanese NPP or not.

The training contents are weighted towards basic knowledge and/or theoretical concepts of nuclear energy.
## Instructor Training Program (2/2)

<table>
<thead>
<tr>
<th>Courses</th>
<th>Participation countries</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instructor Training Course (ITC) in Tokai</strong></td>
<td>8 countries (Indonesia, Thailand, Vietnam, Bangladesh, Kazakhstan, Malaysia, Philippines, Mongolia)</td>
</tr>
<tr>
<td>i. Reactor Engineering Course 1 (Reactor Physics) (8 weeks, 6 persons)</td>
<td></td>
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<tr>
<td>ii. Reactor Engineering Course 2 (Thermal Engineering) (8 weeks, 6 persons)</td>
<td></td>
</tr>
<tr>
<td>iii. Reactor Engineering Course 3 (Reactor Safety) (8 weeks, 6 persons)</td>
<td></td>
</tr>
<tr>
<td>iv. Environmental Radioactivity Monitoring Course (6 weeks, 8 persons)</td>
<td></td>
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<tr>
<td>v. Nuclear/Radiological Emergency Preparedness Course (6 weeks, 6 persons)</td>
<td></td>
</tr>
<tr>
<td><strong>Nuclear Technology Seminar</strong></td>
<td>11 countries (Indonesia, Thailand, Vietnam, Bangladesh, Kazakhstan, Malaysia, Philippines, Mongolia, China, Sri Lanka, Turkey)</td>
</tr>
<tr>
<td>i. Nuclear Plant Safety Course (4 weeks, 10 persons) in Tsuruga</td>
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</tr>
<tr>
<td>ii. Nuclear Administration Course (3 weeks, 10 persons) in Tsuruga</td>
<td></td>
</tr>
<tr>
<td>iii. Site Preparation &amp; Public Relations Course (1 week, 7 persons) in Tsuruga</td>
<td></td>
</tr>
<tr>
<td>iv. Basic Knowledge of Radiation for School Education Course (2 weeks, 14 persons) in Tokai</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 countries (Indonesia, Thailand, Vietnam, Bangladesh, Kazakhstan, Malaysia, Philippines, Mongolia, Sri Lanka, Turkey)</td>
</tr>
</tbody>
</table>
ITP Participating Countries as of 2014

- Kazakhstan
- Mongolia
- China
- Bangladesh
- Thailand
- Sri Lanka
- Vietnam
- Philippines
- Turkey
- Japan
- Indonesia

Legend:
- Pink: ITC/FTC + seminar
- Yellow: Only seminar
Instructor Training Program (ITP)

Tsuruga
(Nuclear Technology Seminar)
- Nuclear Plant Safety Course
- Nuclear Administration Course
- Site Preparation & Public Relations Course

Implemented by The Wakasa-wan Energy Research Center (WERC)

Tokai
(Instructor Training Course)
- Reactor Engineering Course (E-I, E-II, E-III)
- Environmental Radioactivity Monitoring Course
- Nuclear/Radiological Emergency Preparedness Course

(Nuclear Technology Seminar)
- Basic Knowledge on Radiation for School Education course
Image of ITC/FTC System

Asian countries
Vietnam
Bangladesh
Kazakhstan
Malaysia
Philippines
Indonesia
Thailand
Mongolia

Set-up FTC
(Main instructors)

① Go to Japan

(ITrainees)

③ Go home

(Instructors)

④ FTC training

⑤ Dispatch

(NuHRDeC, JAEA)
ITC

② Training for 6 - 8 weeks

- Reactor Engineering Ⅰ Ⅱ Ⅲ
- Environmental Monitoring
- Emergency Preparedness

Dispatch Japanese experts
(For 1 or 2 weeks)
## Instructor Training Course (ITC)

<table>
<thead>
<tr>
<th>Training Courses</th>
<th>Number of Trainees, Period of Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactor Engineering Ⅰ . Ⅱ . Ⅲ</td>
<td>18 trainees from 8 countries, 8 weeks</td>
</tr>
<tr>
<td>Nuclear and Radiological Emergency Preparedness</td>
<td>6 trainees from 6 countries, 6 weeks</td>
</tr>
<tr>
<td>Environmental and Radioactivity Monitoring</td>
<td>8 trainees from 8 countries, 6 weeks</td>
</tr>
</tbody>
</table>

- Curricula place emphasis on exercises with training facilities, experimental laboratories.
- Most of lecturers of ITC chosen from about 2000 JAEA’s staffs.
- Invitation of excellent trainees of past ITC as guest lecturers.

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**Reactor Engineering**

**Nuclear and Radiological Emergency Preparedness**

**Environmental and Radioactivity Monitoring**
## Number of Guest Lecturers

<table>
<thead>
<tr>
<th>Country</th>
<th>FY2010</th>
<th>FY2011</th>
<th>FY2012</th>
<th>FY2013</th>
<th>FY2014</th>
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<tr>
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<tr>
<td>Kazakhstan</td>
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<td>Malaysia</td>
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<td>3</td>
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<td>Philippines</td>
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<td>0</td>
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<td>1</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Mongolia</td>
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<tr>
<td><strong>Total</strong></td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>18</td>
</tr>
</tbody>
</table>
Follow-up Training Course (FTC)

After ITC, trainees are obliged to set up FTC.
- Preparation of curricula for 2 weeks FTC at their own country and allocation of lecturers including themselves.
- A few Japanese experts dispatched to each FTC to give technical advices and support to local lecturers. As of FY2014, cumulative number of experts dispatched to FTC: 446.

To make ITC/FTC further fruitful, Steering Committee Meeting together with each participating country every year.
- Based on opinion and/or needs from past trainees and/or their supervisors, improvement of future ITC/FTC.
- After Fukushima accident, needs of Asian countries were changed from knowledge on reactor physics or engineering to that of radiation or public acceptance.

2 years Joint Training Course (JTC) followed by FTC to support the countries that attended newly ITC. After 2009, JTC was abolished.
Purpose:

To teach basic and specialized knowledge related to reactor engineering.

Target:

Engineers/researchers regarding nuclear organizations, University teachers.

Lectures: 32 Lectures

(Reactor physics and kinetics, Reactor safety including assessment, Thermal-hydraulic, Fuel and material, Fukushima accident, etc.)

Exercises: 12 Exercises

(JRR-1 simulator, Neutron slowdown/diffusion, Boiling heat transfer, Computer code (Thermal-hydraulic and reactor safety), NDT, etc.)

Facility Visit: 21 Facilities

(Training Center of JAPC, Oarai R&D Center, Off-site Center, Mitsubishi Nuclear Fuel LTD, Naka Fusion Institute, National Institute of Radiological Sciences, J-PARC, Hitachi, Nuclear Safety Research Reactor, etc.)
ITC: Environmental Radioactivity Monitoring

- **Purposes:** To develop techniques and teaching ability on radiological monitoring
- **Target:** Engineers/researchers regarding nuclear organizations, University teachers
- **Lectures:** 21 Lectures (Environmental radiation and radioactivity monitoring, Gamma ray measured by Ge semiconductor, Alpha spectrum analysis of environmental samples, Liquid scintillation counter, etc.)
- **Exercises:** 10 Exercises (Sample preparation, Radioactivity measurement by Ge detector, Calibration of radiation survey meter, Radiation survey in Fukushima, etc.)
- **Facility Visit:** 14 Facility Visits (Radiation System Factory, Nuclear Safety Technology Center, National Institute of Radiological Sciences, Environmental Monitoring Center in JAEA, Nuclear Off-site Center, Emergency Support Center, Whole Body Counter of JAEA, etc.)
ITC: Nuclear & Radiological Emergency Preparedness

- **Purposes**: To teach “How to respond against the nuclear and radiological emergency case?”
- **Target**: Engineers/researchers regarding nuclear organizations, University teachers
- **Lectures**: 17 Lectures (Radiological protection, Radiation survey, Emergency case environmental monitoring, Internal exposure evaluation, etc.)
- **Exercises**: 13 Exercises (Fukushima area monitoring and Sample analyzing, Protective gear, Decontamination, Emergency response drill, etc.)
- **Facility Visit**: 8 Facility Visits (Fuji Radiation Survey Meter Factory, National Institute of Radiological Sciences, Nuclear Off-site Center, Emergency Support Center, etc.)

Field Monitoring in Fukushima

Radiation Survey for Emergency Situation
Before 2009, Joint Training Course (JTC) followed by FTC to support two or three Asian countries. As the number of ITP participating countries increases year after year, number of Japanese experts dispatched to one country has decreased and the contents of courses has been standardized.
Cumulative number of ITC & FTC participants has increased significantly year after year. Ratio of FTC to ITC shows multiplication factor of trainees in Asian countries in comparison with number of ITC trainees. This shows that ITC/FTP system is very effective for fostering local trainers in Asian countries.
Nuclear Technology Seminars

**Purposes**
To further cultivate experts experienced in the following area in Asian countries:
- Basic Radiation Knowledge
- Reactor Plant System and Safety Measures
- Nuclear Energy Policy, Reactor Regulation and Law
- Reactor Plant Site Location
- Public Acceptance and Public Administration, etc.

No obligation to set up FTC,
Desirable age: 30-45 years old

**Course Composition, Duration and Venue**
- **Seminar-1: Reactor Plant Safety Course** (4 weeks, 10 persons, at Tsuruga)
- **Seminar-2: Nuclear Administration Course** (3 weeks, 10 persons, at Tsuruga)
- **Seminar-3: Site Preparation and Public Relation Course** (1 week, 7 persons, at Tsuruga)
- **Seminar-4: Basic Knowledge of Radiation for School Education Course** (2 weeks, 14 persons, at Tokai)

As of FY2014, cumulative number of seminar participants: 436.
Seminar-1: Nuclear Plant Safety

- **Target:** Engineers/researchers regarding nuclear organization, University teachers

- **Lectures:** 21 Lectures (Outline of NPP and design features on safety, Fukushima accident and lessons learned from the accident, Operation control of NPP, International safety standard of IAEA, Safety culture, Fuel cycle, Probabilistic safety assessment, Safety evaluation of LWR, Radioactive waste management, Nuclear nonproliferation and nuclear security, Nuclear accident and safety, etc.)

- **Exercises:** 1 Exercise (PWR operation simulator training)

- **Facility Visit:** 12 Facility Tours (Monju NPP (FBR), PWR Operation Support Center(KEPCO), Mihama NPP of KEPCO, Mitsubishi Heavy Industry in Kobe, etc.)
Seminar-2: Nuclear Administration

- **Target**: Administrative officers from governments and nuclear organizations
- **Lectures**: 8 Lectures (Nuclear public administration and nuclear energy policy in Japan, Plant composition and features of NPP, Nuclear regulation in Japan, Human resource development on nuclear, Nuclear safety culture, Utilization of radiation, Risk communication, Nuclear nonproliferation and security, etc.)
- **Discussion**: Challenge on NPP introducing program in Asian countries
- **Facility Visits**: 10 Facilities (Mihama NPP(KEPCO), Nuclear Emergency Response Operation Facility(NISA), Mitsubishi Heavy Industry in Kobe, etc.)

Presentation from Trainee

Visit to Mihama Unit 3, 4
Seminar-3: Site Preparation and Public Relations

**Target:** Administrative officers from governments and nuclear organizations

**Lectures:** 8 Lectures (Coexistence of nuclear power generation and local government, Nuclear regulation in Japan, Outline of LWR (BWR and PWR), Nuclear public administration in Japan, Environmental impact assessment for NPP construction, Risk communication on public acceptance, etc.)

**Discussion:** Challenge on NPP introducing program in Asian countries

**Facility Visits:** 3 Facilities (Construction Site for APWR (Tsuruga Units 3 & 4) (JAPC), Nuclear Science Museum, Facility of WERC)

Discussion on Public Acceptance  Visit to Tsuruga Unit 3, 4 Construction Site
Seminar-4: Basic Radiation Knowledge for School Education

- **Target:** Officers in education, public relations and HRD from governments, nuclear related organizations, and School teachers (Nuclear Communicator)

- **Lectures:** 9 Lectures (Basic knowledge on radiation and protection, Basic nuclear theory and nuclear reactor, Situation of radiation exposure from Fukushima accident, etc.)

- **Experiments:** 3 Experiments (Cloud chamber, Radiation measurement using survey meter “Hakaru-kun”, Radioactivity measurement in the air dust.)

- **Discussion:** Radiation education to the public

- **Facility visit:** 6 Facility Tours (National Institute of Radiological Science, NPP(Tokai-II), Environmental monitoring center, etc.)
1. Cooperation with IAEA

- ANENT (Asian Network for Education in Nuclear Technology)
  NuHRDeC provides educational materials such as remote learning or laboratory exercises using JAEA’s facilities.

- ANSN (Asian Nuclear Safety Network)
  NuHRDeC provides related information including textbooks on nuclear safety.

2. FNCA (Forum for Nuclear Cooperation in Asia) related activities

- HRD project of FNCA focused on ANTEP (Asian Nuclear Training and Education Program)
  Contribution of NuHRDeC to the project by holding and participating in the workshop.

3. ENEN (European Nuclear Education Network), CEA/INSTN

- Exchange of information and educational materials
- Acceptance of EU researchers
Future Prospects & Summary

- ITP has contributed to establish a self-sustainable training system in Asian countries and a number of nuclear engineers have been trained by ITP participants who became mature instructors and fulfil its responsibility in their own countries.

- Importance of continuous improvement of ITP although meaningful evaluation has been obtained from trainees.

  - Balance between limited resources and further detailed support for ITC/FTC considering individual conditions of Asian countries
  
  - Increase in training courses in ITP for obtaining basic knowledge about nuclear or radiation based on enhanced needs after Fukushima accident
  
  - Enhancement of technical abilities for not only Asian countries but also JAEA’s staffs through JAEA’s support for, i.e. design or construction of research reactors in Asian countries

- Continuation of nuclear HRD activities at NuHRDeC in future as right missions of only one integrated nuclear research institute in Japan that has a responsibility for contributing to restoration from Fukushima accident and to dissemination of bitter lessons learned from the accident for further enhancement of both domestic and overseas nuclear safety.
We hope and try to further contribute to the safe and peaceful utilization of nuclear energy through effective and efficient Nuclear HRD activities.

Thank you for your kind attention!