Nuclear HRD in Japan

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Contents

1. National policy on nuclear HRD
2. Actions following the national policy
   1. Establishment of Nuclear HRD network
   2. Collaboration between university, nuclear research institute and utilities for better HRD
   3. Nuclear communication-related activity
      Sub-textbook
      Dissemination of simple radiation detectors (HAKARU-KUN project)
   4. International cooperation for HRD program
Maintaining and developing high-level nuclear technologies and human resources is imperative for smoothly decommissioning aged nuclear power plants, which are expected to increase in the future, as well as TEPCO’s Fukushima Daiichi Nuclear Power Plants.

Japan, with its experience of the accident, is expected to make contributions in the fields of safety, nuclear non-proliferation and nuclear security as an advanced nuclear nation. Because enhancing the nuclear safety in surrounding countries ensures the safety of Japan, maintaining and developing high-level nuclear technologies and human resources which enable Japan contribute to their safety enhancement is essential.

Regarding the disposal of radioactive waste from decommissioning of plants, it is basically utilities that proceed with measures toward the disposal, including the disposal of low-level radioactive waste, under the principle that the waste generators are responsible. Government of Japan (GOJ) will promote measures to ensure the safety, including promotion of necessary research and development activities, in order to facilitate the disposal. GOJ will also continue to promote development of technologies and securing of human resources necessary for the processes of smooth and safe decommissioning.
Japan Nuclear HRD Network (JN-HRD Net)

Government of Japan

Support

Cooperate

Hub/Secretariat

JAEA
Nuclear HRD Center

JAIF/
JAIF International Cooperation Center

Japan Nuclear HRD Network

Universities, Colleges

Public Organizations, Regional Hub

Industries

R&D Organizations, Academic Societies

International Organizations, ENEN, WNU, IAEA, etc.

Nuclear Power Introducing Countries

Students, Young researchers, Foreigners, etc.

E&T
Organization of JN-HRD Net

Obligation 1) Providing information regarding nuclear HRD to this network
Obligation 2) Appointing contact person

※70 member are registered under JN-HRD Net
Framework of JN-HRD Net

Steering Committee

Network Secretariat (JAEA and JAIF/JICC)

- **Chairman**
- **Secretariat**

- **Steering Committee**
  - Formulating basic policy and outline

- **Working Group**
  - Linking participating organizations
  - Conducting some HRD projects

- **Sub-Working Group (1)**: Discussion on elementary - high school education
- **Sub-Working Group (2)**: Discussion on basic nuclear education at universities and colleges
- **Sub-Working Group (3)**: Discussion on support of newly NPP introducing countries
- **Sub-Working Group (4)**: Discussion on HRD for internationally minded engineers
- **Sub-Working Group (5)**: Discussion on HRD of engineers in practical stage

(NW Steering Committee:
- Planning, discussing and reviewing overall network projects and activities)

NW planning WG:
- Planning, discussing and reviewing overall network projects and activities)

Secretariat has most important function for N-HRD Network as follows:
1. Holding steering committee meeting
2. Managing Working group and Sub-working groups
3. Linking participating organizations
4. Conducting some HRD projects

(Sub-Working Group: Discussing individual inter-organ projects and activities)
Roles of Sub-Working Groups

Sub-Working Group (1): Discussion on elementary - high school education

To reinforce action toward elementary, junior-high and high school educations to encourage students to proceed to a higher grade school to study science and engineering including nuclear field.

Sub-Working Group (2): Discussion on basic nuclear education at universities and colleges

To reinforce the basic education on nuclear technologies and related subjects at universities and colleges, and to rebuild the professional education system on nuclear energy.

Sub-Working Group (3): Discussion on support of newly NPP introducing countries

To support nuclear HRD in countries that plan to introduce nuclear energy (NPP) in the near future.

Sub-Working Group (4): Discussion on HRD for internationally minded engineers

To train young generations to be internationally minded talented persons.

Sub-Working Group (5): Discussion on HRD of engineers in practical stage

To support transfer of nuclear-related knowledge, skills and experience (know-how) to next generations.
Sub-Working Group (2): Discussion on basic nuclear education at universities and colleges

Industry
Power company
Manufacturer

University
Graduates
Most important Role for HRD

Regulatory Agency

National Research Institute
JAEA

JAEA : Japan Atomic Energy Agency

From Presentation of S. TANAKA at the 1st FNCA Panel Meeting of "Study Panel for Cooperation in the Field of Nuclear Energy in Asia", held at Tokyo, Japan, October 30-31, 2007.
JAEA’s Support for Nuclear HRD Program of Universities and Technical colleagues

Dispatching Researchers as professors

Japan Atomic Energy Agency

Research and practical training for Students

- Doctor
- Master
- Degree

Students as trainees

- Cooperation with Universities under agreements with JAEA (7 Universities: such as Univ. of Tokyo and Ibaraki Univ.)
- Cooperative Graduate School Program (20 Univ. and college)
- All Japanese universities can send students as trainees

Sub-Working Group (2) : Discussion on basic nuclear education at universities and colleges

Universities & Technical colleges

- Researcher & Engineer
- Fixed-Term Researcher
- Doctoral Research Fellow

R&D Division and Centre
The N-HRD network provides students with occasions for nuclear facility visits to broaden their horizon for nuclear engineering.

**Aim**

- Students will know that nuclear industries cover comprehensive work field to supply NPP.
- Students will see advanced nuclear facilities and technology. It promote students to have interest in nuclear engineering.

**Facilities**

1. Japan Atomic energy Agency HTTR
   - Develop HTGRs as heat source for the hydrogen production system

2. HITACHI GE-Nuclear Energy
   - Visit of Internal structures of ABWR
Activities based on the recommendations after Fukushima Accident

Various seminars on Nuclear safety, emergency preparedness, risk management and radiation are conducted at network participating organizations.

- **Nuclear safety seminar** - - - University of Fukui and Wakasa-wan Energy Research Center (WERC)
- **Comprehensive basic education on Nuclear safety and radiation biology/medicine** - - - Kyoto University Research Reactor Institute.
- **Exercises on Core Safety and Seismic tolerability of LW reactor** - - - Toshiba research facility, NCA
- **Practical education on disaster prevention and safety for future nuclear engineers** - - - Institute of National Colleges of Technology
Comprehensive HRD for radiation effect, protection and radiation medicine being conducted by National Institute of Radiological Sciences (NIRS)

Purpose: HRD for the nuclear disaster experts especially on radiation effects, protection and medicine

Target: University students, Engineers and Researchers on radiation, or Emergency Medical Staff etc.

Contents for HRD:

1) Basic Training Course on Radiation Effects and Radiation Protection

2) Advanced Training Course on Radiation Effects and Radiation Protection

3) Training for Medical Staff Experts for Emergency Exposures to Radiation

4) Basic Seminar for ordinary people or students on radiation protection

Practical Exercise at Training
- Trainings and education on nuclear emergency, risk management for engineers and technicians
  - Training on Radiation Control for emergency staff
  - Training to strengthening of capacity for severe accidents of NPP for emergency staff

- Study on transfer of core techniques between older and younger generations at NPP or plant manufacturer
  - Information Exchange or sharing on core techniques at NPP through OJT, etc.
  - Information Sharing through technological transfer and a data-base on technological know-how including trouble experiences

- Trainings on safety management learned from the accidents of Fukushima dai-ichi NPP
  - Simulation Training for all-electricity-loss disaster
  - Mid-night emergency training
  - Training of radiation protection managers and radiation control engineers
Examples of current activities of JN-HRD Net organizations after the Fukushima accident.

*Training for decontamination workers in Fukushima Prefecture.
*Training on radiation protection measures for workers at Fukushima dai-ichi NPP.

Decontamination activities in Fukushima Prefecture

Radiation Measurement Exercises

Exercise on access into high contaminated area
Activities of Japanese Government on Radiation Education to Young Generation

- Ministry of Education, Culture, Sports, Science and Technology (MEXT)
  - operating effective projects on radiation education for young generations
  - for elementary school, junior high school or high school students.

- Three representative examples;
  - [1] publishing sub-textbooks for school educations
  - [2] a project of “Hakaru-kun” using handy-type radiation survey-meters
  - [3] a project of “Technical and economic supports to activities by high school students to study radiation”.

Nuclear communication-related activity
Knowledge of radiation

* Asterisk mark indicates the advanced course.

After completing your major in a junior college or college of technology recognized by the National Institution for Academic Degrees and University Evaluation (NIAD-UE), you can obtain your “bachelor’s degree” if you pass the examination set by the NIAD-UE. Please check further details from the school you are applying in.
The TEPCO Fukushima Dai-ichi NPP accident elevated public concern on radiation and radioactive material.

Ministry of education, culture, sports, science and technology in Japan (MEXT) published sub-textbooks on radiation for students and teachers in elementary schools, junior high schools and high schools, immediately after the accident.
CONTENTS for Junior high school

- existing of radiation around us
- what is radiation
- basic knowledge (activity, Bq / Gy / Sv, half-life)
- survey meters and radiation detectors
- human effect by radiation exposure
- effective use of radiation
- radiation protection and management

Radiation from Plants

The more radiation the flower emits, the brighter the colour is shown on the plate.

Potassium K is contained in plants. K contains 0.012% of $^{40}\text{K}$ emitting radiation. Half-life is 1.3 million years.
Radiation in the Natural World since Ancient Times

**From Air**

A radioactive material called radon is contained in the air. Radon is noble gas, which is released from some rocks.

Radon is generated from the ground all over the world.

**From Foods**

A radioactive material called potassium K is contained in food. Potassium is one of three major nutrients for plants, so we take potassium into our body by eating such vegetables.

Potassium is a vital substance for the human body and takes up about 0.2% of our weight.
Relationship between Radiation Levels and Health

Non-Natural Radiation

Gray (Gy)

Amount of radiation energy absorbed by materials and human

100 Gy

10 Gy

1 Gy

0.1 Gy

0.01 mSv

Millisievert (mSv)

Cancer treatment (Affected parts)

Cardiac catheter (skin)

Annual limited dose (Radiation worker)

CT/once

Annual limited dose (General public)

X-ray photograph (Stomach)

X-ray photograph (chest)

Dental photograph

Natural Radiation

(mSv)

Outer space 0.4

Ground 0.5

Air (radon) 1.2

Food 0.3

World: Natural Radiation (2.4 mSv/person/year)

Japan: Natural Radiation (2.1 mSv/person/year)

Ramsar in Iran (natural radiation/year)

Kerala and Chennai in India

Pocos de Caldas in Brazil

No clear evidence for the increase of cancer risk

10 Gy

1 Gy

Cloudiness of eye lens

Sterility

Depression of blood forming

100 mSv

1 mSv

100 Gy

Cataract

Temporary hair loss

1000 mSv

0.1 mSv

0.01 mSv

Depression of blood

Cloudiness of eye lens

Sterility

Depression of blood forming

10 mSv

1 mSv

100 mSv

Depression of blood

Cloudiness of eye lens

Sterility

Depression of blood forming

1000 mSv

Depression of blood

Cloudiness of eye lens

Sterility

Depression of blood forming

100 Gy

Source: Documents from National Institute of Radiological Sciences and others


Effects of Radiation
Let’s Start Learning Radiation

Supplementary Material on Radiation for Secondary School Students

Through the experience of NPP accident Ministry of Education, Culture, Sports, Science and Technology (MEXT) published this supplemental learning material in Japanese.

It has been favourably evaluated by the International Atomic Energy Agency (IAEA). The IAEA expressed that this learning material could encourage young students to get interested in nuclear science.

This teaching scheme is highly valuable to the education sector as the learning material consists of reading source for students and instruction material for teachers.
Recently, new SUB-TEXTBOOKS was published in March in 2014 that containing not only radiation science, but also TEPCO NPP accident

Text for primary school students

Text for secondary school students

http://www.mext.go.jp/b_menu/shuppan/sonota/detail/1344732.htm
[2] HAKARU-KUN PROJECT

- Target and history -

• “The Hakaru-kun project”
  – long history, started in 1989.

• MEXT of Japan had developed several handy-type survey-meters
  - mainly focusing on estimating rough ambient dose equivalent.
  - had borrowed to students cost free
    (Prefectural governments will follow the activity in next year)

• Survey-meters are called as “Hakaru-kun”,
  – which is a nickname of the instruments, and
  – developed for the purpose of radiation education.
Training on radiation for teachers-in-future (students at education fac. of university)

Radiation experiments for children

- Field radiation measurements
- Experiment with cloud chamber (above)

Sub-Working Group (1) : Discussion on elementary - high school education
To cooperate with the countries that plan to introduce nuclear energy (NPP) in the near future


2. IAEA Regional Training Course on Providing Decision Support for Nuclear Power Planning and Development, June 2014

3. Instructor Training Program (ITP) of MEXT (JAEA)

4. Nuclear Researchers Exchange Program (NREP) of MEXT (NSRA) (not only NPP introducing countries)

5. IAEA/WERC/JICC Nuclear Policy School 2014 in Fukui, Japan

6. IAEA Asian Nuclear Safety Network (ANSN) Regional Workshop on Instructor Training Program (in 4th to 8th August, newly introducing)
Purpose: to provide a unique international educational experience to promising young professionals from newcomer countries seeking to develop nuclear power.

Sub-Working Group (3): Discussion on support of newly NPP introducing countries

Sub-Working Group (4): Discussion on HRD for internationally minded engineers

Japan-IAEA Nuclear Energy Management School in Tokyo and Tokai
June 2014

DG Mr. Y. Amano

IAEA Mr. de Grosbois

Lecture of DDG Bychkov

Discussion with specialist of IAEA and Japanese Venders

Tech. tour to Hamaoka nuclear power station

Tech. tour to Japanese vender

Awarding certification
IAEA Regional Training Course on Providing Decision Support for Nuclear Power Planning and Development,
on July 8 through July 19, 2013.

This course is a Nuclear Human Resource Development and Training Program eligible to future policy makers for nuclear power program in emerging countries.

Sub-Working Group (3) : Discussion on support of newly NPP introducing countries

Participants from 11 countries

Country report by each participants

Visit of nuclear industries

This course was supported by JAIF International Cooperation Center (JICC) and Wakasa Wan Energy Research Center (WERC)

NPP construction site

Presentation of final report
ITP is an Instructor’s training to level up teaching ability of instructors from Asian countries, who will be instructors of Follow-up Training Course (FTC) in their own country.

**Asian countries**
- Bangladesh
- Kazakhstan
- Indonesia
- Malaysia
- Mongolia
- Philippines
- Thailand
- Vietnam

**Instructor Training Program (ITP=ITC+FTC)**

1. Invited to Japan
2. Training in Japan for 6-8 weeks
   - Reactor Engineering I II III
   - Environmental monitoring
   - Emergency preparedness
3. Go home
4. FTC
5. Dispatch

**Set-up FTC** (Main instructors)

Dispatch Japanese experts
(For 1-2 weeks)
For Special lecture (on request from each country), Technical advise etc.

**ITP**

*Support of newly NPP introducing countries*
Achievement of Nuclear Researchers Exchange Program (NREP)

Accumulated number of participants (FY1985-FY2014)

<table>
<thead>
<tr>
<th>Country</th>
<th>Number</th>
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<tbody>
<tr>
<td>Bangladesh</td>
<td>106</td>
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<tr>
<td>China</td>
<td>560</td>
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<td>Indonesia</td>
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<td>Mongolia</td>
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<tr>
<td>The Philippines</td>
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<td>Sri Lanka</td>
<td>47</td>
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<tr>
<td>Thailand</td>
<td>194</td>
</tr>
<tr>
<td>Vietnam</td>
<td>157</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1633</strong></td>
</tr>
</tbody>
</table>

Percentage of participating countries

- **China**: 34.3%
- **Indonesia**: 16.2%
- **Vietnam**: 9.6%
- **Thailand**: 11.9%
- **Malaysia**: 6.4%
- **The Philippines**: 6.4%
- **Korea**: 8.2%
- **Bangladesh**: 6.5%
- **Sri Lanka**: 2.9%
- **Mongolia**: 0.4%
- **Kazakhstan**: 0.4%
- **Vietnam**: 9.6%

Young Researchers stay in Japan

Leading Persons After many years

After many years, Young Researchers stay in Japan
Participant : Government senior managements in charge of nuclear policy
Countries : 9 Asian countries [Bangladesh, Indonesia, Jordan, Malaysia, Mongolia, Philippines, Sri Lanka, Vietnam and Yemen]
Number of participants: 14
Duration : 1 week, February 24 - 28, 2014
Contents : Lectures on Japanese nuclear policy, Nuclear Safety Regulation, Nuclear Accident Management, Impact of Introducing NPP, etc., and Facility visits
IAEA Asian Nuclear Safety Network (ANSN)
Regional Workshop on Instructor Training Program

Host: Fukui Prefectural Government & Wakasa Wan Energy Research Center
Participant: Professional Staff of Regulatory Bodies, Technical Support Organization, Operators, Research Institutions, Hospitals or Schools
Countries: Member States of ANSN, IAEA  Number of participants: about 10
Duration: 1 week, August 4 - 8, 2014 (planned)
Contents: Provide occasion to have knowledge of instructors on the subject of “understanding nuclear safety” including lectures on:
- Training instructors for nuclear communicators,
- Training how to communicate about nuclear safety concepts to the public,
- Survived Onagawa NPP and lessons learned from the Fukushima Dai-ichi NPP accident, and
- radiation influence on human body, … etc.

In August

Lecture by IAEA Experts
How to manage PA center S for science Museum of Atomic Energy “AT HOME”
Discussion with local residents
Japan Nuclear HRD Network supports Asian countries

**Ministry of Education, Culture, Sports, Science and Technology (MEXT)**

**Japan Atomic Energy Agency (JAEA)**

**JN Nuclear HRD Net Secretariat**
- Nuclear HRD Center (Nordic)
  - Instruct Training Program (Eligible country: 8 countries)
  - Nuclear Safety Seminar (8-10 countries)
  - Site location of nuclear facilities course
  - Reactor Plant Safety course
  - Basic Radiation Education course
  - Dispatch of Experts (Follow-up training)

**Integrated Support Center for Nuclear Non-Proliferation and Nuclear Security (ISCN)**
- Training in Japan (Safeguards, Nuclear Proliferation, Security)
- Dispatch of Experts

**Nuclear Safety Research Association (NSRA)**
- MEXT Nuclear Researchers Exchange Program (Eligible country: FNCA)
- FNCA - ANTEP

**Fukui International Center of Nuclear HRD**
- The Wakes wan Energy Research Center (WERC)

**Ministry of Economy, Trade and Industry (METI)**
- Agency for Natural Resources and Energy (NPP-promoting body)

**Japan Atomic Industrial Forum (JAIF)**

**JAIF International Cooperation Center (JICC)**
- Acceptance of Trainee
- Dispatch of experts

**Cabinet Office (CAO)**
- Japan Atomic Energy Commission Forum for Nuclear Cooperation in Asia (FNCA) program

**University Network Lectures for NPP-introducing countries (Lecturer Dispatch)**
- Secretariat Tokyo Institute of Technology (Participating University)
  - The University of Tokyo Global Professional Course Nuclear Safety Security Exercise Network

**Japan Nuclear Energy Safety Organization (JINES)**
- Training for safety-related issues

**Ministry of Foreign Affairs (MOFA)**
- Acceptance of Trainee

**Industry**
- The Japan Atomic Power Company (JAPCO)
- FNCA - ANTEP

**International Nuclear Energy Development of Japan (JINED)**
- Electric Power Companies (Hokkaido, Tohoku, Tokyo, Chubu, Hokuriku, Kansai, Chugoku, Shikoku, Kyushu)
  - TOSHIBA, HITACHI-GE, Mitsubishi Heavy Industries
- Acceptance of Trainee

**Academia**
- University Network Lectures for NPP-introducing countries (Lecturer Dispatch) (Secretariat) Tokyo Institute of Technology (Participating University)
- The University of Tokyo Global Professional Course Nuclear Safety Security Exercise Network
- University Network Lectures for NPP-introducing countries (Lecturer Dispatch) (Secretariat) Tokyo Institute of Technology (Participating University)
  - The University of Tokyo Global Professional Course Nuclear Safety Security Exercise Network
1. Japan N-HRD Network plays important role for N-HRD for elementary school teachers, University students, Engineers and Foreign engineers etc

2. JAEA as Research institute support Universities and Technical colleagues for Nuclear HRD Program

3. Japanese Government is active with Radiation Education to Young Generation

4. Many institutions in Japan support foreign country for Nuclear HRD Program
Thank you for your kind attention!
We cooperate with you for enhancing Nuclear-HRD in Asia
- Trainings and education on nuclear emergency, risk management for engineers and technicians
  - Training on Radiation Control for emergency staff
  - Training to strengthening of capacity for severe accidents of NPP for emergency staff

- Study on transfer of core techniques between older and younger generations at NPP or plant manufacturer
  - Information Exchange or sharing on core techniques at NPP through OJT, etc.
  - Information Sharing through technological transfer and a data-base on technological know-how including trouble experiences

- Trainings on safety management learned from the accidents of Fukushima dai-ichi NPP
  - Simulation Training for all-electricity-loss disaster
  - Mid-night emergency training
  - Training of radiation protection managers and radiation control engineers

Sub-Working Group (5) : Discussion on HRD of engineers in practical stage
Training for decontamination workers in Fukushima Prefecture.
*Training on radiation protection measures for workers at Fukushima dai-ichi NPP.

Examples of current activities of JN-HRD Net organizations after the Fukushima accident.

Sub-Working Group (5) : Discussion on HRD of engineers in practical stage

Decontamination activities in Fukushima Prefecture

Radiation Measurement Exercises

Exercise on access into high contaminated area
[2] HAKARU-KUN PROJECT

- Sample Kits for Hakaru-kun Usage -

• A few kits supporting to the usage of Hakaru-kun, developed.
• First example; a radioactive sample kit
to be surveyed by Hakaru-kun to understand radiation emitting from some materials surrounding us and to recognize a range of dose level.
• The kit consists of
  – 1) paint for the bottom of a ship containing natural radioactive thorium,
  – 2) mineral encrustations left by hot springs containing natural radioactive radium and thorium,
  – 3) granite rock containing natural radioactive potassium,
  – 4) potassium-enriched salt, and
  – 5) lantern mantle containing radioactive thorium.
[2] HAKARU-KUN PROJECT
- Experiment Kits to test radiation -

• Second example; an experiment kit to test radiation features.
• The kit consists of
  – 1) the above radioactive sample kit,
  – 2) four Hakaru-kuns,
  – 3) three vacant bottles to test some additional materials such as soil or natural rock, etc.,
  – 4) several radiation shielding boards which are acrylic resin, aluminum, stainless steel and lead,
  – 5) setting boards for experimental items.
• Students can survey various samples
  – as well as environmental radiation
• and recognize
  – relationship between distance and radiation dose
  – shielding feature of various materials focusing on difference of material and its thickness