Human Resources Development in Nuclear Field in Japan

Yasushi Seki
Nuclear Technology and Education Center
Japan Atomic Energy Research Institute
http://nutec.tokai.jaeri.go.jp/panfu/english.htm

In this report, the recent topics in the nuclear field and related human resources development (HRD) in Japan and the comments on the items proposed for discussion in the 2003 FNCA HRD Workshop in Thailand are presented.

1. Recent topics in the nuclear field and related Human Resources Development (HRD)

The electricity blackout in Tokyo had been forecasted for the summer of 2003 because all seventeen Nuclear Power Plants (NPPs) of the Tokyo Electric Power Company were shutdown since August 2002 due to the disclosure of the falsified self-inspection data of BWR reactor components such as core shroud. An extensive campaign was carried out to conserve energy and to reduce the use of electricity by raising the room temperature of air conditioning and closing down factories and offices on hot summer days. Fortunately some of the NPPs without any actual problem could restart operation after the review by the regulatory office and consent by the local governments. With these measures and also the extraordinarily cool summer, the worried electricity blackout could be mitigated and also the importance of the nuclear power was recognized by much of the public.

On January 2003, Kanazawa branch of the Nagoya High Court issued the judicial ruling to nullify the construction license of prototype fast breeder reactor, Monju. The construction license of Monju was granted after the process of strict safety examination of the reactor. The Japan Nuclear Cycle Development Institute (JNC) hopes that the safety of the reactor will be fully confirmed in the Supreme Court to which the case was brought by the Japanese Government.

JAERI and JNC are scheduled to be unified in FY2005 to form an Independent Administrative Corporation. The final report on the unification has been published in September 2003 and the Law for the Unification will be passed during FY2004. The Human Resources Development (HRD) in the Nuclear Field is stated to be one of the important missions of the new unified Independent Administrative Corporation. The report urges the new Corporation to have closer cooperation with the universities and industries in strengthening the HRD mission and also to enhance the technology transfer and HRD

cooperation with the Asian countries.

2. Development of training material in radiation protection area to be used commonly in member countries

In the minutes of the 2002 FNCA Workshop on HRD, one of the action items for FY 2003 is to develop training material in radiation protection area to be used commonly in member countries. As the first step toward the development of the common training material, some lecture material used in the Joint Training Courses with BATAN, OAP, VAEC and NuTEC, JAERI have been uploaded in the internet home page of NuTEC, JAERI (http://nutec.tokai.jaeri.go.jp/english/e031.htm). Project Leaders (PLs) are requested to review the material and to give comments for improvement. Based on the result of the review by the PLs, further uploading of the training materials will be carried out in the future. It should be discussed whether or not to continue and enhance this activity to include similar contribution of such material from other member countries. The specification and the need of the material should be further discussed.

3. Introduction of e-learning system as the development subject of nuclear training technology

In this age of internet, the possibility of introducing an e-learning system to promote HRD in nuclear field was discussed in the 2002 HRD Workshop and it was agreed to start a survey of appropriate CD-ROMs which could be used for HRD.

The possibility of introducing an e-learning system should be further discussed in the context of the Asian Network on Nuclear Technology (ANENT) proposed by Korea in the IAEA framework, the Asian Nuclear Safety Network (ANSN) also proposed by the IAEA and World Nuclear University (WNU).

4. Investigation of basic data on HRD in nuclear field in member countries

It has been proposed at the Third FNCA Coordinators Meeting in 2002 that the HRD Project should investigate the basic data on HRD in nuclear field in member countries so that the data could be used to develop HRD strategy. The request for investigation has been sent to the FNCA Coordinators and the HRD Project Leaders of member countries and the results of the investigation were presented at FY2002 HRD workshop. However, the basic data presented by some countries were not sufficient to enable meaningful comparison and it was decided to continue the basic data investigation for another year in addition to the investigation of data on education systems such as nuclear related departments of universities. It was also planned in the last workshop to discuss in the 2003 HRD Workshop

how the collected basic data could be utilized for the formulation of HRD strategy.

In the Fourth FNCA Coordinators Meeting in 2003, the HRD in nuclear field has been discussed and found to be so important that it has been decided to hold a higher level meeting in the FNCA framework to discuss this topic in the near future. The HRD Project is asked to hold a preliminary discussion on the HRD strategy in the 2003 workshop so as to pave the way for the higher level meeting.

The basic data investigated for Japan have been improved in the following area.

(1) More precise numbers of graduate and undergraduate students and faculty members for each of the nuclear related departments in the universities have been investigated as shown in the Table 1.
(2) The information on the academic associations and societies related to nuclear field has been collected in the Table 2.
(3) In addition to the basic data directly related to human resources, the data related to the strategy for nuclear utilization such as the data on research reactors, the data on the level of the application of RI and radiation in medicine, agriculture, industry and environment and the future plan to construct NPPs, the number of NPPs being constructed and NPPs under operation have been collected and tabulated for each country. This comparison table has been sent to each FNCA Coordinators and HRD PLs for review prior to the 2003 Workshop.

5. HRD status and strategy

In Japan, many of the experienced nuclear engineers and scientists who have constructed nuclear power plants and developed the application methodology of RI and radiation, are aging and retiring. Also with the decrease in the construction of nuclear power plants and decrease in the nuclear energy research expenditures, it is becoming more difficult to maintain the present level of capability in designing and manufacturing of nuclear facilities.

On the other hand, the educational infrastructures in the universities such as nuclear research reactors and the facilities where handling of radioactive materials is permitted, are deteriorating due to the difficulties to meet the more strict regulatory requirements. With the decrease in the popularity of nuclear energy and maturing of nuclear technology it is becoming more difficult to attract sufficient number of promising young individuals to nuclear field. There is a strong concern in the future supply of capable human resources in the nuclear field. It is feared that the knowledge and expertise necessary for securing safety of nuclear power plants and radiation application could not be sufficiently preserved and transferred to the next generation.

In order to cope with the above situation, several proposals are being considered and some new systems are already being worked out.

The joint establishment of a graduate school to educate the core members of nuclear engineers and regulatory officers are being considered with close cooperation between some universities and the new unified corporation to be formed by JAERI and JNC in FY2005.

There are several similar plans to jointly establish graduate schools for the nuclear technology and sciences in the areas having various nuclear installations and universities. One of such plans is to establish a graduate school aiming to utilize strong neutron beam generated by the intense proton accelerator, J-PARC which is being constructed in Tokai-mura jointly with JAERI and KEK.

Furthermore, there is also a plan to establish a Nuclear Education System Network (NesNET) to serve as the focal organization to enhance better cooperation and coordination of maintenance teams for NPPs, nuclear education and training centers and infrastructures in the industries, universities and national research institutions.

In addition, a new qualification system for Professional Engineers in the Nuclear and Radiation Field has been established. This will become effective in 2004 as a national qualification to certify the professional level of nuclear and radiation engineers.

6. International Training Courses in Japan for FY2003

Review of the International HRD programs for Nuclear Science and Technology under the sponsorship of MEXT, i.e. MEXT Nuclear Researchers Exchange Program, Seminar for Nuclear Administrators, International Seminar on Nuclear Safety, International Training Program for Atomic Energy Safety Technology and Nuclear Safety Expert Dispatching Program are being carried out. The MEXT Nuclear Researchers Exchange Program has been conducted for 18 years since it was started in FY1985. The program is presently being reexamined to adjust to the changing needs. The Table 3 on the International Training Courses in Japan in FY2003 is attached.

Table 1 Survey of University Education Institutions

(1) Graduate School

As of April in FY2002

Graduate School	Graduate Department	Subject (indicates former name, established year)	Established Year	Number of Student						Number of Faculty					Notes
				Registered Student in FY2002*		Graduated Student	Graduated Foreign Student		Total	Professor	Assistant Professor	Lecturer	Assistant	Total	
				Master	Doctor		Master	Doctor							
Hokkaido University	Graduate School of Engineering	Quantum Energy Engineering (Nuclear Engineering, 1971)	1996	61 (21)	12 (10)	681	15	7	703	9	8	0	13	30	
Tohoku University	School of Engineering	Quantum Science and Energy Engineering (Nuclear Engineering, 1958)	1996	75 (35)	38 (17)	MC: 745 DC: 133	19	13	1,023	8	9	0	7	24	Number of Graduated Students include the number of students in the former dept.
	Graduate School of Science, Faculty of Science	Physics	1994	154 (91)	103 (46)				257	24	19	0	26	69	
The University of Tokyo	Graduate School of Engineering	Quantum Engineering and Systems Science (Nuclear Engineering, 1964)	1993	96 (31)	38 (15)	955	19	62	1,170	9	5	1	8	23	Same faculties as for under-graduate
Tokyo Institute of Technology	Graduate School of Science and Engineering	Nuclear Engineering	1957	60 (30)	36 (7+alpha)	Graduate in 2002: 52 MC: 60 DC: 35	15	26	284	Inter-locking Dean 1 14	11	0	15	40	
Nagoya University	Graduate School of Engineering	Nuclear Engineering	1970	41 (18)	12 (5)	721	11	8	793	5	2	0	5	12	Data as of May, 2002

*: ( ) in Registered Student in FY2002 indicate enrollment limit for a single year

Graduate School	Graduate Department	Subject (indicates former name, established year)	Established Year	Number of Student						Number of Faculty					Notes
				Registered Student in FY2002*		Graduated Student	Graduated Foreign Student		Total	Professor	Assistant Professor	Lecturer	Assistant	Total	
				Master	Doctor		Master	Doctor							
Kyoto University	Graduate School of Engineering	Nuclear Engineering	1957	42 (19)	14 (9)	310*1	10*2	8*3	3684	5	3	1	6	15	*1*2*3: since 1990
Osaka University	Graduate School of Engineering	Nuclear Engineering	1957	45 (20)	24 (10)	1,049	6	2	1,126	4	5	1	4	14	
Kobe University of Mercantile Marine	Graduate School of Maritime Science and Technology	Power Systems Engineering (first semester for doctor's degree) (Nuclear Engineering, 1977)	1990	29 (11)	(4)	168	9	0	206	4	5	0	2	11	
Kyushu University	Graduate School of Engineering	Dept. of Applied Quantum Physics and Nuclear Engineering (Nuclear Engineering, 1971)	1998	55 (25)	34 (12)	596	17	8	710	11	11	0	11	33	
	Inter-disciplinary Graduate School of Engineering Sciences	Advanced Energy Engineering Science (Energy and Environmental Engineering, 1979)	1998	70 (34)	26 (16)	96	1	2	195	5	5	0	7	17	Graduated student since 1998
Musashi Institute of Technology	Graduate School of Engineering	Energy Science and Nuclear Engineering (Atomic Energy Engineering, 1981)	2002	46 (20)	Applied to start in FY2003	135	5	0	186	13	2	2	0	17	
Tokai University	Graduate School of Engineering	Applied Science (Nuclear Engineering, established in 1963)	2001	33 (20)	6 (4)	323			362	10	3	0	0	13	
Total				807	343				7,399					318	

*: ( ) in Registered Student in FY2002 indicate enrollment limit for a single year

(2) University

As of April in FY2002

University	Department	Subject (indicated former name, established year)	Established Year	Number of Student			Number of Faculty					Notes
				Registered Student in FY2002*	Graduated Student	Graduated Foreign Student	Professor	Assistant Professor	Lecturer	Assistant	Total	
Hokkaido University	Faculty of Engineering	Dept. of Nuclear Engineering	1967	119 (40)	1,283	1	-	-	-	-	-	Faculties belong to Graduate School
Tohoku University	School of Engineering	Dept. of Quantum Science and Energy Engineering (Dept. of Nuclear Engineering, 1962)	1996	98 (35)	1,375 (1,192)	6 (3)	-	-	-	-	-	Number of Graduated Students include the number of students in the former dept.
The University of Tokyo	School of Engineering	Dept. of Systems Innovation (Dept. of Nuclear Engineering, 1960)	2000	80 (40)	1,272	1						Faculties belong to Graduate School
Nagoya University	School of Engineering	Physical Science and Engineering [Quantum Science and Energy Engineering Course] (Dept. of Nuclear Engineering, 1966)	1993	156 (about 45) Sophomore: 52 Junior: 41 Senior: 63	321	0	0	1	0	1	2	Number of Faculty is as of May, 2002

*: ( ) in Registered Student in FY2002 indicate enrollment limit for a single year

University	Department	Subject (indicated former name, established year)	Established Year	Number of Student			Number of Faculty					Notes
				Registered Student in FY2002*	Graduated Student	Graduated Foreign Student	Professor	Assistant Professor	Lecturer	Assistant	Total	
Kyoto University	Faculty of Engineering	Engineering Science [Energy Science/Nuclear Engineering Course] (Dept. of Nuclear Engineering, 1958)	1994	46 (20)	1,185	5*	-	-	-	-	-	*Registered Foreign Student is enrollment
Osaka University	School of Engineering	Dept. of Electronic, Information and Energy Engineering (Dept. of Nuclear Engineering, 1962) (Subdivided from Sophomore) [Energy and Quantum Engineering Div.]	2003	144 (40)	1,237	0	-	-	-	-	-	
Kobe University of Mercantile Marine	Faculty of Marine	Dept. of Power Systems Engineering (Nuclear Engineering, 1972)	1990	147 (30)	880	6	-	-	-	-	-	
Kyushu University	Faculty of Engineering	Dept. of Energy Science and Engineering (Nuclear Engineering, 1967)	1998	150 (100)	1,204	3	-	-	-	-	-	
Tokai University	School of Engineering	Dept. of Applied Science, Course of Energy Engineering (Dept. of Nuclear Engineering, 1971)	2001	231 (80)	3,407		5	4	1	0	10	
Kinki University	School of Science and Engineering	Dept. of Electrical & Electronic Engineering, Energy Engineering Course (Dept. of Nuclear Engineering, closed in 2003)	2002	276 (60)	2,690	0	5	3	3	0	11	
Total				1,447	14,854						23	

*: ( ) in Registered Student in FY2002 indicate enrollment limit for a single year

Table 2 Survey of Academic Associations and Societies in the Nuclear Field

As of March 31, 2003

Academic Associations and Societies and Association	Established Year	The Number of Regular Member (including Supporting Member Firm*)	The Number of Student Member	Total
Atomic Energy Society of Japan	1959	7,149	335	7,484
The Physical Society of Japan	1877	18,414	70	18,484
The Japan Society of Applied Physics	1946	23,217	384	23,601
The Japan Society of Plasma Science and Nuclear Fusion Research	1983	1,485	265	1,750
The Laser Society of Japan	1973	1,614	-	1,614
Japan Health Physics Society	1961	1,125	20	1,145
The Japan Radiation Research Society	1959	1,017	160	1,177
Japanese Society of Radiological Technology	1942	16,314	354	16,668
Japanese Society of Radiation Safety Management	2001	338	10	348
Japan Radiological Society	1950	7,446	-	7,446
Japan Society of Nuclear Medicine	1964	3,550	50	3,600
The Chemical Society of Japan	1878	30,494	5,568	36,062
The Japan Society for Analytical Chemistry	1952	7,547	1,004	8,551
The Japan Society of Mechanical Engineers	1897	34,779	4,379	39,158
The Japan Institute of Metals	1937	5,924	1,337	7,261
The Society of Materials Science, Japan	1952	3,221	152	3,373
Heat Transfer Society of Japan	1961	1,367	125	1,492
The Institute of Electrical Engineers of Japan	1888	23,697	2,667	26,364
Total		188,698	16,880	205,578

Notes: Supporting Member Firm is counted as one member per firm.

Table 3 International Training Courses in Japan for Asian Countries

Sponsor	Training Course	Host	Purpose	Duration & Participants	Total number of participants up to 2002
MEXT	A. Intl. Seminar of Nuclear Safety	RADA			554 (271 from Asian countries)
	(1) Course on Safety Analysis (1998~)		To provide technologies of safety design and analysis for various kinds of nuclear facilities.	2 weeks, 7	
	(2) Course on Facility Management (2002~)		To provide nuclear safety administration and regulation, operation and maintenance of nuclear facilities, emergency preparedness and safety training of employees.	2 weeks, 7	
	(3) Course on Radiation Application (2002~)		To provide wide knowledge for nuclear administration such as reactor R&D project, safety concepts in design, construction and operation, radioactive waste management, radiation application and public acceptance.	1weeks, 5	
	(4) Course on Nuclear Administration (2002~)		To provide administration and regulation in radiation applications as well as their application technologies	2 week, 8	
	(5) Course on Dissemination of Nuclear Knowledge (2002~)		To provide effective methods for dissemination of nuclear and radiation knowledge, concentrating in tools, practices and lectures for school education.	1 week, 5	

Sponsor	Training Course	Host	Purpose	Duration & Participants	Total number of participants up to 2002
MEXT	B. Intl. Atomic Energy Safety Technology Training Project	NuTEC, JAERI			
	(1) Bilateral Joint Training Course (JTC)		To enhance technical skills and safety culture by independence of nuclear training administration		
	1) JTC at BATAN			2 weeks, 20/course	
	• Radiation Protection Course (1997~)				113
	• Radiation Measurement and Nuclear Spectroscopy Course (1997~)				121
	• Maintenance of Research Reactor Course (2002~)			20~30	15
	• Application of Nuclear Technique in Industry and Environment Reliable for the Safety of Nuclear Facility (2003~)			20	0
	2) JTC at OAP			2 weeks, 20/course	
	• Radiation Protection Course (1998~)				98
	• Nuclear Technology and Application Course (1998~)				94
	• Nuclear and Radiological Emergency Preparedness course (2003~)				
	3) JTC at VAEC			2weeks, 20/course	
	• Radiation Protection Course (2001~)				40
	• Radiation Measurement and Nuclear Spectroscopy Course (2001~)				40
	(2) Instructor Training Program (ITP)		To enhance technical skills and safety culture by independence of nuclear training administration	2 months, 1~2/country	27
	(3) Safeguards Training Course (1996~)		To provide IAEA safeguards & particular techniques	3 weeks, 16/course	109
	(4) Workshop on Extended Shutdown and Decommissioning (2003)			1 week, 24/workshop	0

Sponsor	Training Course	Host	Purpose	Duration & Participants	Total number of participants up to 2002
MEXT	C. Seminar for Nuclear Administrators (1987~)[*1]	JAIF	To introduce Japanese experience and to exchange their experience and opinion among the participating countries in nuclear energy development and utilization for middle-level or high-level administrators	About 10 days, About 10 persons	136
	D. Nuclear Safety Experts Dispatching Program (in Asian region) (1995~)	NSRA			
	(1) Long-term program		To improve nuclear safety through exchange of technical knowledge	1.2~4 months/ 1~2	13
	(2) Short-term program		To discuss on the specified topics with experts from various organizations, during Long-term program ((1)and (2) are linked together to make this program effective).	1 week, 1~6	41
	E. The Nuclear Researchers Exchange Program Between Neighboring Countries (1985~)	JAERI JNC NIRS NIMS JCAC[*2] AIST	To invite foreign researchers at national nuclear institutes in Japan and to dispatch Japanese researchers to foreign countries for joint study on related subjects	Invitation: 2 months~ 1 year, Maximum dispatch: 2 months	Invitation: 1,269[*3] Dispatch: 602[*3] (The Number of Dispatch)

[*1] Concluded in FY2002

[*2] JCAC did not participate in this Program in FY2002

[*3] The number of visiting researchers and dispatch of Japanese researchers carried over to next FY is included

Sponsor	Training Course	Host	Purpose	Duration & Participants	Total number of participants up to 2002
METI	F. International Cooperation Program for Safety Management at NPPs (1) Nuclear Safety Management Course (3 courses) (2) Specific Subject Course (6 courses) (Countermeasures to Human Errors in NPP, Equipment Diagnosis Technology, Radiation Control and Radioactive Waste Disposal etc.) (3) Seminar in Participating Countries (4 times)	JEPIC	To enhance nuclear safety of NPPs	2~4 weeks/ course 1 week/time	45 About 250
	G. Long-term Training Course on Safety Regulation and Safety Analysis/Inspection (1996~) (1) Safety Regulation and Safety Analysis Course (2) Safety Regulation and Inspection Course	NUPEC	To learn various requirements for the establishment of safety regulations, standards, criteria, etc. from lectures about general safety regulations for nuclear power generation in Japan and OJT for safety analysis/inspection for the staffs of nuclear regulatory authority of Chinese government.	2~3 months, 4~5	47

Sponsor	Training Course	Host	Purpose	Duration & Participants	Total number of participants up to 2002
JICA	H. Training Courses in the Nuclear Field				
	(1) Nuclear Technology (1985~)[*4]	NuTEC Tokyo	To acquire Radioisotope and Radiation handling skill	1.5 months, 6~10	149
	1) A Group				
	2) B Group	NuTEC Tokai	To Acquirer Nuclear Reactor engineering skill		
	(2) Nuclear Power Generation Basic (1985~)	JEPIC JAPC	To improve planning, design, construction, operation and safety measures of NPP	2 months, 5~7	101
	(3) Seminar on Nuclear Safety and Regulation (1987~)[*5]	JAIF	To enhance nuclear safety and regulation in general for safety control of radiation	1 month, 5~10	109
	(4) Environmental Radioactivity analysis and Measurement (1990~)	JCAC	To acquire practical knowledge of environmental radioactivity analysis and measurement	1 month, 4~6	61
	(5) Human-Radiation Interface; Application and Safety of Radiation in Medical, Biological, and Environmental Sciences.[*6]	NIRS	To acquire knowledge on Human- Radiation relationship in view of medical, biological and environmental sciences	1 month, 8~9/2years	31

[*4] Concluded in FY2002
[*5] Concluded in FY2002
[*6] No plan in FY2003

Sponsor	Training Course	Host	Purpose	Duration & Participants	Total number of participants up to 2002
IAEA / RCA	Enhancement and Harmonization of Radiation Protection RAS/9/006, RAS/9/018, RAS/9/029	NIRS	To acquire knowledge and techniques required in the radiation protection	1 week, 10 (FY2003)	22
		JAERI Tokai JNC		5days 15(FY2003)	210
	Nuclear Medicine Application (RCA) (RAS/6/028) (1997~)*7	NIRS	To acquire knowledge and techniques in nuclear medicine		16
	LDR and HRDR Brachytherapy in Treating Cervical Cancer (RAS/6/035) (2001~)	Gunma Uni. and NIRS	To acquire knowledge and techniques in radiotherapy of uterine cervical cancer	1 week, 18 (FY2003) (RCA trainings in medicine J1 and J2 are not planned every year.)	44
	On the Job Training on Radiation Processing (1978~)	TRCRE	To acquire knowledge and techniques required in the radiation processing	MEXT: 6~12 months, 10~15 Bilateral:1~12 months, 3~5 RCA/IAEA: 1~2 weeks, 2~5	
MEXT	K. Graduate Course in Dept. of Nuclear Engineering (1) General Graduate Course (2) Intl. Graduate Course	Tokyo Institut eof Tech-nology	To acquire fundamental knowledge of Nuclear Engineering and to master professional ability		

*7 No plan in FY2003

Sponsor	Training Course	Host	Purpose	Duration	Total number of participants up to 2002
Japan Society for the Promotion of Science	L. Graduate School Educations (1) Invitation Fellowships for Research in Japan (Requirement: To hold a doctorate degree, which must have been received within six years) (2) Post Doctoral Fellowships for Foreign Researchers (Requirement: To hold a doctorate degree, which must have been received within six years) (3) Ronpaku (Dissertation Ph.D) Program (Requirement: To have excellent research activities)	Tokyo Institut eof Tech-nology	Short-term: To exchange scientific and technical information Long-term: To develop excellent professors and researchers through cooperative research To develop young excellent professors and researchers through cooperative research To get a doctoral degree through the dissertation research Period Up to five years	14~60 days 6~10 months 12~24 months Up to five years The Rnpaku fellow makes one visit of up to 90 days per year	

ETL: Electrochemical Laboratory
JAERI: Japan Atomic Energy Research Institute
JAIF: Japan Atomic Industrial Forum, Inc.
JAPC: The Japan Atomic Power Company
JCAC: Japan Chemical Analysis Center
JEPIC: Japan Electric Power Information Center, Inc.
JICA: The Japan International Cooperation Agency
JNC: Japan Nuclear Cycle Development Corporation
MEXT: Ministry of Education, Culture, Sports, Science and Technology
MITI: Ministry of International Trade and Industry
NIRS: National Institute of Radiological Sciences
NRIM: National Research Institute for Metals
NSRA: Nuclear Safety Research Association
NUPEC: Nuclear Power Engineering Corporation
NuTEC: Nuclear Technology and Education Center
RADA: Radiation Application Development Association
TRCRE: Takasaki Radiation Chemistry Research Establishment