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THE 2004 ACTIVITIES AND THE WORKSHOP OF THE HUMAN RESOURCES DEVELOPMENT PROJECT IN FNCA (CONTRACT RESEARCH)

August 2005

Nuclear Technology and Education Center

日本原子力研究所
Japan Atomic Energy Research Institute

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The 2004 Activities and the Workshop of the Human Resources Development Project in FNCA (Contract Research)

Nuclear Technology and Education Center

(Tokai Site)
Japan Atomic Energy Research Institute
Tokai-mura, Naka-gun, Ibaraki-ken

(Received June 6, 2005)

In 1999, the Project for Human Resources Development (HRD Project) was initiated as defined in the framework of the Forum for Nuclear Cooperation in Asia (FNCA), organized by the Atomic Energy Commission of Japan. The objective of the HRD Project is to solidify the foundation of technologies for nuclear development and utilization in Asia by promoting human resources development in Asian countries. In the Project there are two kinds of activity; In-workshop activity and Outside-of-workshop activity.

The FNCA 2004 Workshop on HRD Project was held on October 4-7, 2004, in Kuala Lumpur, Malaysia. The Workshop was sponsored by the Ministry of Science and Technology Innovation (MOSTI) of Malaysia and the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan. The Malaysian Institute for Nuclear Technology Research (MINT) and the Japan Atomic Energy Research Institute (JAERI) acted as the hosts. Participating countries were China, Indonesia, Republic of Korea, Japan, Malaysia, the Philippines, Thailand, and Vietnam. The activities of HRD Project was presented in the Sixth Coordinators Meeting of FNCA was held on March 30 – April 1, 2005, in Tokyo, Japan.

This report consists of presentation papers and materials at the FNCA 2004 Workshop, a review document of HRD Project for the Coordinators Meeting of FNCA, a letter of request from the Project Leader of Japan to the Project Leaders of the participating countries and theme of the country report as Outside-Workshop Activity.

Keywords : Human Resources Development, Nuclear Field, International Cooperation, Asian Countries, Workshop, Training, Education, FNCA

Present study is entrusted from Ministry of Education, Culture, Sports, Science and Technology

JAERI – Review 2005 - 025

FNCA人材養成プロジェクトにおける2004年度活動及び FNCA2004原子力人材養成ワークショップの開催 (受託研究)

日本原子力研究所
国際原子力総合技術センター

(2005年6月6日受理)

人材養成プロジェクトの活動は、1999年8月に原子力委員会によって組織された「アジア原子力協力フォーラム（FNCA）」の枠組みの中で実施している。本プロジェクトは、アジア諸国における人材養成を推進させることによって、アジア地域の原子力開発利用技術の基盤を整備することを目的とする。本プロジェクトは、ワークショップ内活動とワークショップ外活動の2つに分けられる。

ワークショップ内活動として、「FNCA2004原子力人材養成ワークショップ」が2004年10月4日から7日の4日間、マレーシアのクアラルンプールで開催された。本ワークショップの主催は、マレーシア科学技術革新省と日本の文部科学省で、参加国は、中国、インドネシア、韓国、日本、マレーシア、フィリピン、タイ及びベトナムである。また、ワークショップ外活動として、第6回FNCAコーディネーター会合（東京、2005年3月30日～4月1日）において人材養成に関する発表を行った。

本報告書は、ワークショップでの発表論文等の配布資料、コーディネーター会合における人材養成プロジェクト活動の概要、日本側プロジェクトリーダーから参加国プロジェクトリーダーへの提案レター等を収録したものである。

本報告書は、文部科学省からの受託研究「平成16年度近隣アジア諸国における原子力安全確保水準調査」の成果である。
日本原子力研究所（東海駐在）：〒319-1195　茨城県那珂郡東海村白方白根2-4

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1.2.1 Program of "FNCA 2004 Workshop on Human Resources Development"

October 4-7, 2004, Kuala Lumpur, Malaysia

Monday, October 4

8:30-9:10 Registration

MC: MINT Staff

[9:10-9:50 Opening Session - Joint opening ceremony of "FNCA 2004 Workshop on HRD" and "IAEA Training Course on Advanced Management Practices for Commercialization of Services and Technologies from Nuclear Research Institutions"]

9:10-9:20 **WELCOMING ADDRESS**

- Dr. Daud Mohamad, Director General of the Malaysian Institute for Nuclear Technology Research (MINT)

9:20-9:40 **OPENING REMARKS**

- Ms. Miwako Shimizu, Special Staff of Atomic Energy Division, Research and Development Bureau, Ministry of Education, Culture, Sports, Science and Technology (MEXT)
- Mr. Ibrahim Ali, Representative of the IAEA

9:40-9:50 **OPENING ADDRESS**

- Dato's Suriah Abd. Rahman, the Secretary General, Minister of Science, Technology and Innovation (MOSTI)

9:50-10:35 *<Coffee Break>*

[10:35-12:45 Open Lecture]

10:35-11:15 - Policies and Programs to Encourage Self-Sustainability in Research Institutions
Tan Sri Dr. Ahmad Zaharuddin Idrus
Science Adviser to the Prime Minister's Department

11:20-12:00 - Sustainability of Nuclear Research Institutions and HRD
Dr. Sueo Machi, Japanese FNCA Coordinator
Commissioner, Atomic Energy Commission of Japan

12:05-12:45 - Enablers for Commercialization
Mr. Norhalim Yunus
General Manager Technology Development
Malaysian Technology Development Corporation (MTDC)

12:45-14:00 *Lunch*

[14:00-14:55 Opening for FNCA 2004 Workshop on HRD] *MC: MINT Staff*

14:00-14:20 Introduction of Participants
(Include exchange information of the present status in each country)

14:20-14:55 "Review of Past Activities in HRD and the Scope of 2004 Workshop on HRD"
Hideo MATSUZURU, Japanese Project Leader (PL)
Japan Atomic Energy Research Institute (JAERI)

[14:55-17:10 Presentation Session 1– Review of history of nuclear human resources development and HRD Strategy Modeling]

(Presentations: 30 min. plus 10 min. Q&A for each country)

Presentation Session 1 Countries with Radiation Applications

CHEN Gang

14:55-15:45 Rapieh AMINUDDIN, Malaysia
15:45-16:00 *<Coffee Break>*
16:00-16:30 Warapon WANITSUKSOMBUT, Thailand
16:30-17:10 Estrella D. RELUNIA, The Philippines

17:10-17:40 "Highlights Progress of FNCA Activities and Draft and Proposal FNCA HRD Project Plan"
Dr. Sueo MACHI

17:40-17:50 Commemorative Photograph

Tuesday, October 5

[9:00-15:00 Presentation Session 2,3,4] (Presentations: 30 min. plus 10 min. Q&A for each country)

Presentation Session 2 Countries planning to construct Nuclear Power Plants

Warapon WANITSUKSOMBUT

9:00-9:30 VU Dang Ninh, Vietnam
9:30-9:50 KARSONO, Indonesia

9:50-10:20 *<Coffee Break>*

Presentation Session 3 Countries with operating Nuclear Power Plants

Estrella D. RELUNIA

10:20-11:00 CHEN Gang, China
11:00-12:00 Eui-Jin LEE, Korea

12:00-13:30 *Lunch*

Presentation Session 4 Japanese Experience in HRD

(Presentations: 20min. plus 10min. Q&A for each)

KARSONO

13:30-14:00 Fumitaka SUGIMOTO, JAERI

14:00-14:30 Masanori ARITOMI, Tokyo Institute of Technology

14:30-15:00 Yukoh NAKAYAMA, The Japan Atomic Power Company

15:00-15:30 *<Coffee Break>*

[15:30-17:30 Group Session – Examination of proposal for HRD strategy modeling]

15:30-17:30 Subgroup interaction (Formulate models in each group)

20:30-22:30 Joint Reception hosted by MEXT and MOSTI

Wednesday, October 6

[9:00-10:30 Presentation Session 5 – Formulating HRD strategy model]

(Presentations: 20 min. for each groups. plus 10min. Q&A for each)

Rapieh AMINUDDIN

9:00-9:45 Model for countries with operation nuclear power plants

9:45-10:00 Model for countries planning to construct Nuclear Power Plants

10:00-10:20 Model for countries with Radiation Applications

10:20-10:30 General Discussion

10:30-10:55 *<Coffee Break>*

[10:55-12:00 Presentation Session 6 – Nuclear Training Support]

VU Dang Ninh

10:55-11:00 "Training support in HRD"
Fumitaka SUGIMOTO

11:00-11:55 "Asian Network for Education in Nuclear Technology (ANENT)"
Fatimah Mohd Amin, ANENT Spokesperson

11:50-12:00 "HRD International Network"
Keiko HANAMITSU, Japan Atomic Industrial Forum, Inc. (JAIF)

12:00-13:30 *<Lunch>*

[13:30-17:15 Presentation Session 7 - Evaluation Method of FNCA Project Activities]

(Presentations: 10 min. for each country)

Hideo MATSUZURU

13:30-13:40	Rapieh AMINUDDIN
13:40-13:50	Warapon WANITSUKSOMBUT
13:50-14:00	Estrella D. RELUNIA
14:00-14:10	VU Dang Ninh
14:10-14:20	KARSONO
14:20-14:30	CHEN Gang
14:30-14:40	Eui-Jin LEE
14:40-15:15	Nobuo SASAMOTO

15:15-15:30 *<Coffee Break>*

15:30-17:15 General Discussion

[17:15-18:00 Discussion Session – Future plan]

Hideo MATSUZURU

17:15-17:45 Proposal on Annual Action Plans for 2004, and Future Action Plans of HRD Project
Keiko HANAMITSU

17:45-18:00 Discussion and Comments on Future Action Plan

Thursday, October 7

[9:20-11:15 Conclusion Session]

<Rapieh AMINUDDIN & Hideo MATSUZURU>

9:20-10:35 Recommendation and message

10:35-10:55 *<Coffee Break>*

10:55-11:15 Adoption of the Minutes

[11:15-11:35 Closing Session] *MINT*

11:15-11:25 Rapieh AMINUDDIN

11:25-11:35 Hideo MATUZURU

11:35-13:00 *<Lunch>*

[14:00-17:30 Technical Tour]

14:00-17:30 Visit MINT (MINT TECHPARK and Training Center)

1.2.2 List of Participants

for FNCA 2004 Workshop on Human Resources Development
October 4-7, 2004, Kuala Lumpur, Malaysia

≪CHINA≫	
Mr. CHEN Gang (Project Leader)	Deputy Manager, Management Training Center, Human Resources Department, China Guangdong Nuclear Power Holding Co., LTD (CGNPC)
≪INDONESIA≫	
Mr. KARSONO (Project Leader)	Director, Education and Training Center, Nuclear Energy Agency (BATAN)
≪KOREA≫	
Mr. Eui-Jin LEE (Project Leader)	Manager, Education Program Development, Nuclear Training Center, Korea Atomic Energy Research Institute (KAERI)
≪MALAYSIA≫	
Ms. Rapieh AMINUDDIN (Project Leader)	Director, Division of Human Resource Development, Malaysian Institute for Nuclear Technology Research (MINT)
≪THE PHILIPPINES≫	
Ms. (Dr.) Estrella Duran RELUNIA (Project Leader)	Officer-In-Charge, Nuclear Training Center, Nuclear Services & Training, Philippine Nuclear Research Institute (PNRI)
≪THAILAND≫	
Ms. Warapon WANITSUKSOMBUT (Project Leader)	Senior Radiation Physicist, Bureau of Radiation Safety Regulation, Office of Atoms for Peace (OAP)
≪VIETNAM≫	
Mr. VU Dang Ninh (Project Leader)	Director, Department of Administration and Personnel Development, Vietnam Atomic Energy Commission (VAEC)
≪JAPAN≫	
Mr. Hideo MATSUZURU (Project Leader)	Director, Nuclear Technology and Education Center (NuTEC), Japan Atomic Energy Research Institute (JAERI)

Mr. (Dr.) Sueo MACHI	The FNCA Coordinator of Japan, Commissioner, Atomic Energy Commission of Japan (AEC)
Ms. Miwako SHIMIZU	Special Staff, Atomic Energy Division, Research and Development Bureau, Ministry of Education, Culture, Sports, Science and Technology (MEXT)
Mr. (Prof.) Masanori ARITOMI	Professor, Research Laboratory for Nuclear Reactors, Tokyo Institute of Technology
Mr. Yukoh NAKAYAMA	Group Manager, Quality Promoting Group, Corporate Planning Department, The Japan Atomic Power Company

<Observer>

Mr. (Dr.) Takatoshi TAKEMOTO	Visiting Professor, Mechanical Engineering, Department of Engineering, Chulalongkorn University
Ms. Faridah bt Idris	Research Officer/Manager, MINT Scientific Calculation Centre, Division of Technical Services, Malaysian Institute for Nuclear Technology Research (MINT)

<Secretariat>

Ms. Zainida bt Zainal Abidin	Administrative Officer, Division of Human Resources Development and Training, Malaysian Institute for Nuclear Technology Research (MINT)
Mr. Zakaria bin Taib	Administrative Officer, Division of Human Resources Development and Training, Malaysian Institute for Nuclear Technology Research (MINT)
Ms. Zuraida bt Zainudin	Research Officer, Division of Human Resources Development and Training, Malaysian Institute for Nuclear Technology Research (MINT)

Ms. Fairuz Suzana bt Mohd. Chachuli	Research Officer, Division of Human Resources Development and Training, Malaysian Institute for Nuclear Technology Research (MINT)
Ms. Noor Azreen bt Maslan	Typist, Division of Human Resources Development and Training, Malaysian Institute for Nuclear Technology Research (MINT)
Ms. Hazalina bt Adu Yamin	Personal Assistant, Division of Human Resources Development and Training, Malaysian Institute for Nuclear Technology Research (MINT)
Ms. Keiko HANAMITSU	Deputy Manager, Asia Cooperation Center, Japan Atomic Industrial Forum, Inc.,
Dr. (Mr.) Nobuo SASAMOTO	Instructor, RI-Radiation training Division, Nuclear Technology and Education Center (NuTEC) Japan Atomic Energy Research Institute (JAERI)
Mr. Fumitaka SUGIMOTO	Chief, International Technology Transfer Division, Nuclear Technology and Education Center (NuTEC) Japan Atomic Energy Research Institute (JAERI)
Ms. Rei OUCHI	Secretariat, International Technology Transfer Division, Nuclear Technology and Education Center (NuTEC) Japan Atomic Energy Research Institute (JAERI)

1.2.3 Picture

From the left in the back row:

Faridah bt Idris, Zakaria bin Taib, Keiko HANAMITSU, Zainida bt Zainal Abidin, Nobuo SASAMOTO, Rei OUCHI, KARSONO, Tkatoshi TAKEMOTO, Eui-Jin LEE, CHEN Gang, Estrella Duran RELUNIA, Yukoh NAKAYAMA, Warapon WANITSUKSOMBUT, Fumitaka SUGIMOTO, VU Dang Ninh

From the left in the front row:

Masanori ARITOMI, Hideo MATSUZURU, Sueo MACHI, Adnan Haji Khalid, Miwako SHIMIZU, Rapieh AMINUDDIN

Meeting Hall

1.3 Opening Session

1.3.1 Welcoming Speech

WELCOMING SPEECH AT "FNCA "2004 WORKSHOP ON HUMAN RESOUCES DEVELOPMENT" AND "IAEA TRAINING COURSE ON ADVANCED MANAGEMENT PRACTICIES FOR COMMERCIALIZATION OF SERVICES AND TECHNOLOGIES FROM NUCLEAR RESEARCH INSTITUTIONS",

KUALA LUMPUR, 4 OCTOBER 2004

BY

Y.BHG.DR.DUAD MOHAMAD
DIRECTOR GENERAL,
MALAYSIAN INSTITUTE FOR NUCLEAR TECHNOLOGY RESEARCH (MINT)
MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION, MALAYISA

Yang Berbahagia Dato' Suriah Abdul Rahman
Secretary General
Ministry of Science, Technology and Innovation, Malaysia

Dr. Sueo Machi
FNCA Coordinator of Japan, and
Commissioner, Atomic Energy Commission of Japan

Ms. Miwako Shimizu
Representative from Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT)

Mr. Iberahim Ali
Manager, Customer Services Unit, MINT representing
International Atomic Energy Agency (IAEA)
Distinguish guests
Ladies and Gentlemen

Assalamualaikum and Good Morning

First and foremost, I would like to convey my gratitude and appreciation to Yang Berbahagia Dato' Suriah Abdul Rahman, Secretary General, Ministry or Science, Technology and Innovation, Malaysia who is able to be with us this morning representing the Honorable Minister of Science, Technology and Innovation for the joint Opening Ceremony of the "Forum for Nuclear Cooperation in Asia (FNCA) Workshop on Human Resources Development" and "International Atomic Energy Agency (IAEA) Training Course on Advance Management Practices for Commercialisation of Services and Technologies from Nuclear Research Institutions" organized by Malaysian Institute for Nuclear Technology Research (MINT) with the cooperation of MEXT and IAEA. I take this opportunity to thank MEXT and the IAEA for collaborating with MINT in organizing this event in Malaysia. On behalf of the organizing committee I wish all participants a warm welcome and "Selamat Datang" to this workshop and training course.

Ladies and Gentlemen,

Over the past year, nuclear technology has been used in Malaysia in the upward trend in various socio-economic sectors, including industrial, manufacturing, medical, agriculture and the environmental sectors. The Malaysian Institute for Nuclear Technology Research (MINT) has been entrusted to introduce and promote the utilization of nuclear technology in the country.

MINT has been conducting RandD activities and commercialisation of her products and services since many years ago.

MINT has employed several strategies in commercialisation of nuclear technology in Malaysia. Firstly, MINT adopts the concept of **MINT's Technology to Market Chain**. In this regard, whatever products and process developed in MINT's laboratories should eventually be taken up by the end-users viz-a-viz through direct marketing and providing technical services to customers, forming strategic partnership, provision of training and so on and so forth.

Secondly, MINT established a **Customer Service Unit** to coordinate sales and marketing of MINT's products and services. The customers of MINT include private and public sectors, government agency and customers from abroad such as Brunei, Singapore, Pakistan, Indonesia, Thailand and many others. In the year 1999, MINT has about 2,000 customers. While in 2003, the number has increased to 3,800 customers. This represent an increased of about 90% over the 5-year period. Currently, MINT has 25 strategic business units covering Industrial Testing and Evaluation, Industrial Safety and Quality Assurance, Agro-technology, Waste and Pollution Control, Medical Technology and a few others. Through the operation of these business units, MINT's revenue has increased over the last 5 years. For instance, in 2003 MINT has generated RM15.2 million. To date, MINT has generated an income of more than RM120 million.

Thirdly, MINT has been adopting **Quality Management System (QMS)** in many of her strategic business units. QMS provides confidence to customers on our products and services, meet customers' specifications and requirements, and at the same time ensures efficient and effective delivery system. This is in line with the overall government policy and aspiration towards providing quality services.

Ladies and Gentlemen,

With regard to human resource development, I am grateful to FNCA under the framework of MEXT, and the IAEA for giving the opportunity to Malaysian scientists to go for attachment and training at various established laboratories in Japan and other advanced countries. They involved formal and informal training, on-the-job training, fellowship and attachment at foreign institutions. Through these training and attachment programmes, Malaysian scientists were able to be exposed and acquire new knowledge and new technology so that we are competitive at the global level. The knowledge acquired could be utilized to develop our human resources capacity in Malaysia. We believe that training of human resource is a continuous process, and is a vital element for sustainability of an institution.

Ladies and Gentlemen,

MINT has taken various steps to enhance the capacity and capability of Malaysian scientists, engineers and technologists to acquire new knowledge in order to develop technologies. MINT conducts training courses for private and public sectors to enhance their capability in performing their duties. Various sectors have benefited from these training programmes, which include industrial and medical sectors. The various types of training modules provided by MINT are in the forms of Regular Training, Regional Training and In-house Training. MINT has been training more than 1,000 participants annually. The areas of special emphasis are Radiation Protection, Non-Destructive Training, medical x-rays and Technology Management. These training courses are recognized by respective authorities i.e. Atomic Energy Licensing Board (AELB), National Vocational and Technical Training Council (NVTTC) and Ministry of Health (MoH).

Ladies and Gentlemen,

In conclusion, I am of the opinion that a successful organization should take into consideration three main aspects for sustainability, i.e., 3M: Man, Machine and Money. Nonetheless, the primary factor that will determine sustainability of any institution is the human capital. It is therefore pertinent that combining of these two inter-related subject matters, i.e., "Workshop on human resource development, and Training on the advance management practices for commercialisation of services and technologies from nuclear institution" bode well towards achieving sustainability of nuclear institutions. There is a synergistic and strategic linkages between HRD and sustainability of an organization.

I am confident that all participants would have a fruitful discussion during the course of these the workshop and training course in the next 5 days or so. I wish to thank the plenary speakers Yang Berbahagia Tan Sri Ahmad Zaharuddin, Science Advisor; Mr. Sueo Machi, Commissioner, Atomic Energy Commission of Japan; Mr. Nurhalim, General Manager, Malaysian Technology Development Corporation (MTDC); and Dr. Hui of MOSTI for accepting our invitation and sharing your knowledge and experience with us. Thanks to all members of the secretariate for the effort in making this event a success. Lastly, once again I would like to thank Yang Berbahagia Dato Suriah Abdul Rahman, Secretary General, MOSTI for gracing the event on behalf of the Honorable Minister.

Thank you.

1.3.2 Opening Remarks

Remarks at
2004 FNCA Human Resources Development Workshop

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

October 4, 2004

Distinguished Guests,
Fellow Delegates,
Ladies and Gentlemen.

It is my great pleasure to have this opportunity of saying some words on behalf of Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan on the occasion of the FNCA 2004 Workshop on Human Resources Development.

First of all, I am delighted to hold jointly the opening session with IAEA Training course.

And I would like to extend my sincere gratitude to the government of Malaysia, especially to the Malaysian Institute for Nuclear Technology Research (MINT) for preparing this Workshop.

At the initiative of the Atomic Energy Commission of Japan, the FNCA was established as an effective mechanism to promote the regional nuclear cooperation and the first FNCA Meeting was held in Thailand in 2000.

Now, 9 member countries, Australia, China, Indonesia, Japan, Korea, Malaysia, the Philippines, Thailand and Viet Nam, carry on 11 projects in 8 fields including this project as the regional nuclear cooperation activities of FNCA.

The subject of this workshop, Human Resources Development (HRD), aims to enhance mutual cooperation with HRD activities for nuclear science and technology in FNCA countries and to support the construction of HRD strategy by clarifying issues and needs.

In this project, the survey of the basic data on HRD, such as the number of personnel, institutes and universities regarding the nuclear science and technology, has been conducted.

Some models of HRD strategy for use of nuclear energy will be discussed in this Workshop based on the survey.

Today, in this joint opening session, some presentations about HRD are scheduled. We hope the outcome of this workshop including today's lecture will make a contribution to the further progress of cooperation activities among FNCA countries.

Finally, the projects as the regional nuclear cooperation activities aim to gain better public understanding on the nuclear science and technology by information activities to the public.

We are sure that the cooperation activities in the Human Resources Development meet the objective of FNCA.

We sincerely wish for the further progress on this project through your cooperation.

Thank you for your attention.

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1.3.3 Opening Address

OPENING SPEECH FOR "FNCA "2004 WORKSHOP ON HUMAN RESOUCES DEVELOPMENT" AND "IAEA TRAINING COURSE ON ADVANCED MANAGEMENT PRACTICIES FOR COMMERCIALIZATION OF SERVICES AND TECHNOLOGIES FROM NUCLEAR RESEARCH INSTITUTIONS",

BY Y.B. DATO' DR. JAMALUDDIN MOHD. JARJIS
MINISTER OF SCIENCE, TECHNOLOGY AND INNOVATION, MALAYISA

KUALA LUMPUR, 4 OCTOBER 2004

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Yang Berbahagia Dr. Daud Mohamad
Director General
Malaysian Institute for Nuclear Technology Research (MINT)

Dr. Sueo Machi
FNCA Coordinator of Japan, and
Commissioner, Atomic Energy Commission of Japan

Ms. Miwako Shimizu
Representative from Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT)

Mr. Iberahim Ali
Manager, Customer Services Unit, MINT representing
International Atomic Energy Agency (IAEA)

Distinguished guests
Ladies and Gentlemen

Assalamualaikum and Good Morning

It is indeed a great pleasure for me to officiate the joint Opening Ceremony of this "Forum for Nuclear Cooperation in Asia (FNCA) Workshop on Human Resources Development" and the "International Atomic Energy Agency (IAEA) Training Course on Advance Management Practices for Commercialisation of Services and Technologies from Nuclear Research Institutions" organized by Malaysian Institute for Nuclear Technology Research (MINT) with the cooperation of MEXT and IAEA. I would also like to thank MEXT and the IAEA for giving us the trust and confident in organizing these events. I also with to take this opportunity to extend my warmest "Selamat Datang" or welcome to our friends from overseas to Malaysia and to our capital city, Kuala Lumpur. For those of you who are here for the first time, I hope you will take advantage of your stay to visit some interesting places around and outside Kuala Lumpur to make your stay more interesting and memorable.

It is indeed an honor for us to be given this opportunity to share with you our experience in the commercialisation of services and technologies from research institutions and also human resources development for the sustainability of our research institutions. Malaysia has always been supportive for these kinds of activities, as we believe they are very important for the sustainability of all research institutions including nuclear research institutions.

Ladies and Gentlemen,

The global economy to which we are greatly dependant and exposed becomes more volatile and unpredictable. Change is rapid, market shifts, uncertainty dominates, technologies proliferate, competitors multiply, products and services become obsolete rapidly. As the world becomes more competitive and more advanced, success and prosperity increasingly go to those who add value in the global value chain. Knowledge become the main driver for economic growth. The real asset of any organization and sustainable source of advantage is the knowledge and skill of its people and their ability to learn faster than the competitors. Hence, organizations need to consistently identify, develop and create new knowledge around key competencies, quickly disseminate it, and embody it in new products and services to deliver value to customers in ways that competitor cannot copy. It must also be able to integrate external knowledge with internal expertise to proactively anticipate changing markets and respond ahead of time, make decisions fast, accurately, and repeatedly.

If we are to survive and succeed we must reach beyond our borders and demonstrate that we are able to meet global standards. It is incumbent upon individuals to empower themselves with knowledge, skills and self belief. Without changing our mindset, attitude and mentality we will not usher in the future that we envision. We need to change the way we do things and the way we manage our country. We need world class management and working practices. Innovation, productivity, service and efficiency are potential benefits of doing business in any country.

Towards this end, Malaysia is seriously looking at formulating a comprehensive innovation agenda and instituting a national innovation system to enhance our competitiveness and resilience through science and technology. We need to develop our pool of intellectual capital to reach their full potential and capable of creating wealth and value, even under great constraints. More competent researchers and developers of knowledge and expert practitioners of more superior technologies are needed. We need to be more focused in our approach to innovation as our resources are quite limited. There needs to be stronger connectivity between researchers and research users to increase the commercialization rate.

Ladies and Gentlemen,

The government of Malaysia has undertaken a review of the S&T policy and launched the Second National Science and Technology Policy and Plan of Action in June 2003. The policy addresses seven key priority areas focused on strengthening research and technological capacity and capability in Malaysia, promoting commercialisation of research outputs, developing human resource capacity and capability, promoting a culture for science, innovation and techno-entrepreneurship, strengthening institutional framework and management for S&T and monitoring of S&T policy implementation, widespread diffusion and application of technology, leading to enhanced market-driven R&D to adapt and improve technologies and to build competence for specialisation in key emerging technologies. Various initiatives has been put in place to implement these strategic thrusts by the various ministries and agencies.

In supporting R&D and commercialisation of research outputs, the government will increase public and private sector investments in R&D including infrastructure development targeting for gross national R&D expenditure level of at least 1.5% of GDP by 2010 through the provision of the Intensification of Research in Priority Areas (IRPA) grants and other schemes. In addition the government will continue to encourage private sector R&D and to promote closer cooperation between the private sector and Public Research Institutions (PRIs) as well as public sector universities through collaborative linkages. This will be carried out through provision of various grant schemes such as Industry Research and Development Grant Scheme (IGS), Multimedia Grants Scheme (MGS), Demonstration and Application Grants (DAGS), Technology Acquisition Fund (TAF) and Commercialisation of R&D Fund (CRDF).

There is also other non-profit organization that provide commercialisation fund for the industries. It includes Malaysian Technology Development Corporation (MTDC) and Small and Medium Industry Development Corporation (SMIDEC) that provide funds or loans for the small and medium industry in research & development including commercialisation.

To further promote commercialisation of research output besides providing funds, the Malaysian government has also established Business Development Unit within Ministry of Science, Technology and Innovation to develop strategies and programmes aimed at enhancing the commercialisation and diffusion of research findings generated from organizations. All universities and research institutes have also established a similar unit or Research Management Centres (RMC) in commercialising their research output. The Business Development Unit aims to help spur the utilization of knowledge generated in Malaysia's R&D system and as a one-stop commercialisation center. Government has established as well incubation centres in Malaysia for the purpose of R&D plus comercialisation of the product/services. Examples of the incubation centres are Malaysian Technology Park, MTDC-UKM and SIRIM Technology Park.

Ladies and Gentlemen,

Malaysia however, faced some problems in commercialising its research output. According to the National Survey of Public Research Commercialisation done by the Business Development

Unit, Ministry of Science, Technology and Innovation (MOSTI), there are few challenges faced in commercialisation of research findings. The top four challenges faced by researchers are the ability to identify and attract suitable management team, access to funding, support for business plan and marketing plan and market penetration.

Malaysian Venture Capital (MAVCAP) has also identified key concerns with regards to commercialisation. First, the lack of business development competence that makes it difficult for start-ups, which often require the assembling of an experienced management team. Secondly, researchers are not keen to do commercialisation full time, as they are not willing to risk their academic career. Lastly, researchers are too absorbed with their research and that they lack of skills to engage in commercialisation activities.

Malaysian government will always strive for the improvement in commercialising our research and development products as we feel that it is important for the economic development of the country. This is especially important in time where we face stiff competitions from across the border.

Ladies and Gentlemen,

With regard to developing human resource capacity and capability, Malaysia will intensify development of critical mass for S&T through various initiatives such as higher ratio of students pursuing science, technical and engineering disciplines in upper secondary schools and universities, increasing number of post-graduates students in universities, increase number of post-doctoral fellowships, brain pool and brain gain programmes and others. In the long term, Malaysia requires a much more effective delivery systems for human resources to drive economic growth and progress and to overcome the shortage of S&T personnel to support its S&T agenda.

However, developing human resources is a complex, difficult and time-consuming task that demands strategic planning, meticulous execution and huge investment of money, time and efforts. It is very likely that the same challenges are faced by many countries. However, I believe through active collaboration between our countries through multi-lateral collaboration such as the IAEA and FNCA this monumental task can be made easier to some extent.

Malaysia will continue to work with other countries to promote a regional and international environment that is peaceful and stable. We will continue to build relationships with other countries and will cooperate to achieve common goals.

It is my hope that the presence of experts from FNCA counties and other countries in the region including Malaysia at this FNCA workshop and IAEA training course will provide a valuable opportunity for a beneficial exchange of ideas towards the common goal of advanced management practices for commercialisation of services and technologies of nuclear institutions and human resources development for sustainability of research institutions in the region.

If the activities were to contribute towards socio-economic development it must be demand driven and not simply informational. Project deliverables need to be clearly indicated in the project proposal stage. The technology outcomes must reach the end users and this requires effective communication and close collaboration or cooperation.

Participating countries have much to gain from these activities. The Malaysian government will continue to provide the necessary support such as funding and human resource for projects carried out by researchers and would like to give due recognition to FNCA and IAEA activities as an important part of our national S&T programme. This is so because nuclear technology transcends and cuts across many fields such as agriculture, medicine, manufacturing, environment, energy and many more. There is certainly synergy between activities of FNCA, IAEA and our strategic focus R&D areas such as biotechnology, advanced materials, advanced manufacturing, microelectronics, ICT, aerospace, energy, pharmaceuticals, nanotechnology and photonics.

Although nuclear power is not presently our energy option, we are taking cognizance of energy sources and demand on one hand and sustainable development on the other. Nuclear option is still alive and we have to continuously keep abreast with developments and progress in nuclear power technology, nuclear safety and human resource development planning for nuclear power program. We are certainly not going to deprive the future generations the choice to decide on the energy options they will take.

It is also my hope that this workshop and training course jointly organized by MINT with the cooperation of MEXT and IAEA be seen as one of the ways by which Malaysia repays the international community for the assistance and support received in the past.

With that note, I declare the "FNCA Workshop on Human Resources Development" and the "IAEA Training Course on Advanced Management Practices for Commercialisation of Services and Technologies from Nuclear Institutions" officially open.

Thank you.

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1.4 Open Lecture

1.4.1 Policies and Programs to Encourage Self-Sustainability in Research Institutions

1.4.2 Sustainability of Nuclear Research Institutions and HRD

1.4.3 Enablers for Commercialization

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IAEA TRAINING PROGRAMME:
ADVANCED MANAGEMENT PRACTICES FOR THE COMMERCIALISATION OF SERVICES AND TECHNOLOGIES OF NUCLEAR INSTITUTIONS

4 – 8 October 2004
Renaissance Hotel, Kuala Lumpur

Policies and Programs to Encourage Self-Sustainability in Research Institutes

Tan Sri Datuk Dr. Ahmad Zaharudin Idrus
Science Advisor
MOSTI

1

"... the most important resource of any nation must be the talents, skills, creativity and will of its people......*our people is our ultimate resource*. Without doubt, in the 1990s and beyond, Malaysia must give the fullest emphasis possible to the development of this ultimate resource"

Dato' Seri Dr. Mahathir Mohamed
(the Prime Minister of Malaysia's Vision 2020 statement 28 February 1991)

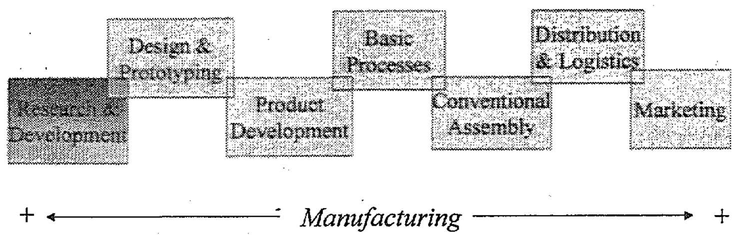
2

Strengthening S & T and R & D:
3rd. OPP (2001-2010)

"The Government will promote a culture of innovation as well as networking and clustering among stakeholders to enhance technology infusion. Efforts will be made to increase collaboration between public sector research institutions and the private sector for effective development, dissemination and commercialization of R & D"

3

VALUE CHAIN OF MANUFACTURING:
THE SECOND INDUSTRIAL MASTER PLAN IMP 2 (1996-2005)



1.4.1

4

Research & Development (R&D): Defined

Organization for Economic Cooperation & Development (OECD):

"Creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture, and society and the use of this stock to devise new applications"

R&D can be broken into four types:

1. Basic Research
2. Applied Research
3. Product Research, and
4. Process Research

5

Research & Development (R&D): Defined – *cont.*

1. Basic Research

"Experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena & observable facts without any particular application or use in view"

2. Applied Research

"Original investigation undertaken in order to acquire new knowledge directed primarily towards a specific practical area of objective."

6

Research & Development (R&D): Defined – *cont.*

3. Product Research

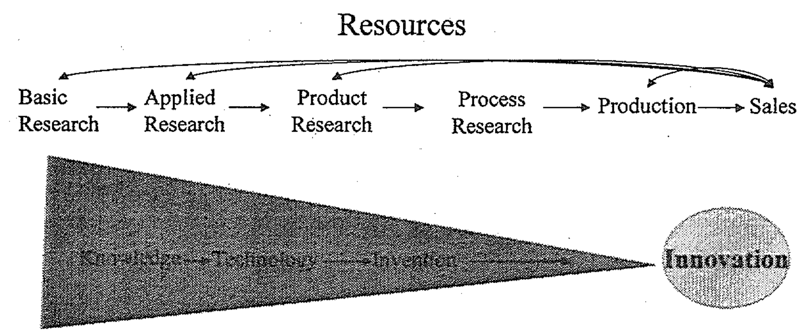
"Involves the improvement and extension of existing products and is more on the development side of R&D."

4. Process Research

"The development of new or improved processes, such as manufacturing processes, and again is more of a product of development than of research."

7

Simple Model of the Innovation Process



8

IRPA- Research Priority Areas

1. Experimental Applied Research
   - **Agriculture and Food Securities**
   - **Natural Resources & Environment**
   - **Manufacturing and Services**
   - **Social Transformation**
   - **Knowledge Advancement**
2. Prioritised Research
   - **Manufacturing**
   - **Plant Production and Primary Product**
   - **Information Communication Technology (ICT)**
   - **Health**
   - **Education & Training**
3. Strategic Research
   - **Design & Software Technology**
   - **Nanotechnology & Precision Engineering**
   - **Specialty Fine Chemical Technology**
   - **Optical Technology**

9

R & D Expenditure & Expertise **

	GERMANY	SWITZERLAND	JAPAN	TAIWAN	MALAYSIA
Characteristics of Companies	Big Very well organised factories Focussed	Big Very well organised Focussed	Big Very well organised Focussed	Small & medium Well organised Focussed	Small Not well organised Focussed
Market Sector	Local and international markets	Local and international markets	Local and international markets	Local and international markets	Local and regional
Investment in R&D	**10% of sales**	**10% of sales**	**10% of sales**	**10% of sales**	**0 – 0.5% of sales**
Level of Expertise (R&D)	·High – Ph.d, Masters, B.Sc ·High number (10% of total staff)	·High – Ph.d, Masters, B.Sc ·High number (10% of total staff)	·High – Ph.d, Masters, B.Sc ·High number (10% of total staff)	·B.Sc ·Low numbers	·B.Sc ·Very low numbers

**Note: Benchmarking under NTMP II Project (June 2002)

10

New Directions

- Increase the national capability and capacity for R&D, technology development and acquisition – R&D expenditure 1.5% of GDP and 60 researches per 10,000 labour force in 2020.
- Encourage partnerships between public funded organizations industry, local and foreign companies for the co-development of technologies to increase indigenous technology capability.
- Enhance the transformation of knowledge into products, processes, services or solutions that value add across every industry sector for maximum socio-economic benefit.

11

Policies and Programs

1. BRAIN GAIN PROGRAMME

- Appropriate talents/skills are the biggest magnet for R&D investment
- Attracting the best R&D talent is crucial to advancement
- Local expertise and local education standards is also very important
- Financial reward and an attractive environment to work and live are enticers

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Policies and Programs

2. MARKET SIZE & EMERGING MARKETS

- Size of the local market is an important factor for foreign R&D investment
- Need to increase local market size
- High correlation between foreign ownership of the manufacturing sector and follow on R&D investment
- Emerging markets also have more scope for investment

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Policies and Programs

3. FINANCIAL INCENTIVES

- Favourable tax regimes and government incentives tend to attract foreign investments
- Need to implement an attractive package to foreign investors
- Lower costs in terms of labour, cheaper land and office rental also influence investment companies

14

Policies and Programs

4. IP RIGHTS

- R&D requires strong IP laws to protect discoveries
- Most companies conduct their high end research in countries with the most robust IP protection laws
- Thus enforcing stronger IP policies is needed to attract R&D investment

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Policies and Programs

5. NEW ORGANISATIONAL STRATEGIES

- In order to achieve global innovation we need :
  - Effective collaboration between international R&D teams
  - Good management of people in diverse cultural environments
  - Aligning global research with business strategy

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Policies and Programs

6. LEGAL AND REGULATORY INFRASTRUCTURE

- Need to implement a legal and regulatory infrastructure that ensures the marketplace rewards innovation and investments
- Strict enforcement of this infrastructure must be guaranteed

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Summary

- Increase expertise and talent
- Increase local market size
- Encourage emerging markets
- Enforce strong IP rights regulations
- Provide attractive financial packages
- Develop new organisational strategies for R&D
- Establish legal and regulatory framework

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Thank you

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1.4.2

SUSTAINABLITY OF NUCLEAR RESEARCH INSTITUTUTIONS AND HUMAN RESOURCES DEVELOPMENT (HRD)

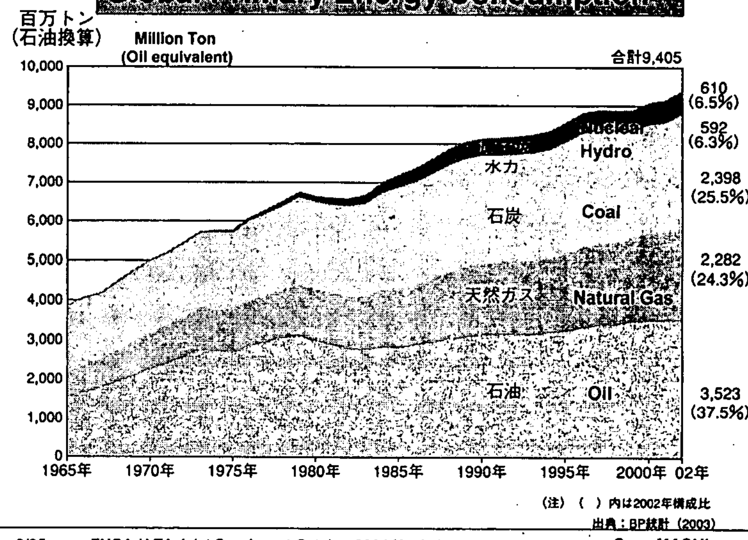
Sueo Machi, Commissioner,
Atomic Energy Commission of Japan
FNCA Coordinator of Japan

FNCA-IAEA Joint Session

"Advanced Management Practices and Human Resources Development for Sustainability of Research Institutes"
Kuala Lumpur, 4 October, 2004

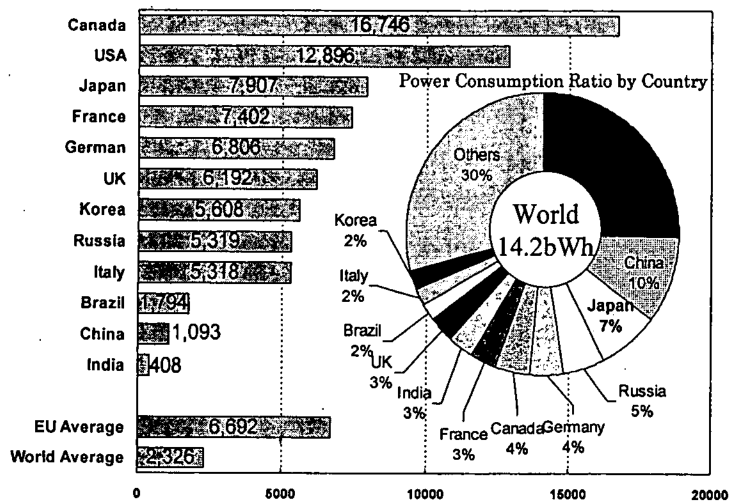
1/25 FNCA-IAEA Joint Session 4 October,2004 Kuala Lumpur *Sueo MACHI*

Global Primary Energy Consumption



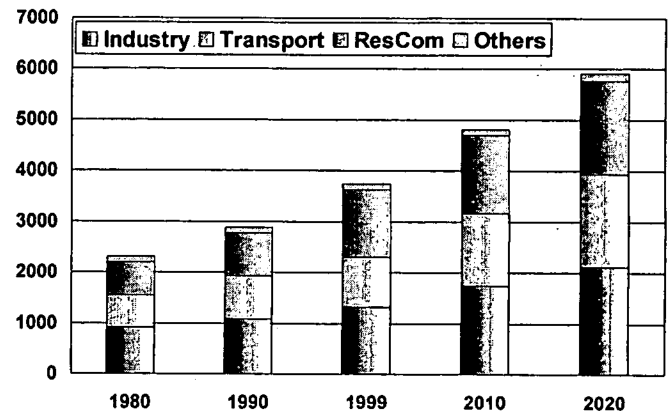
2/25 FNCA-IAEA Joint Session 4 October,2004 Kuala Lumpur *Sueo MACHI*

Power Consumption Per Capita



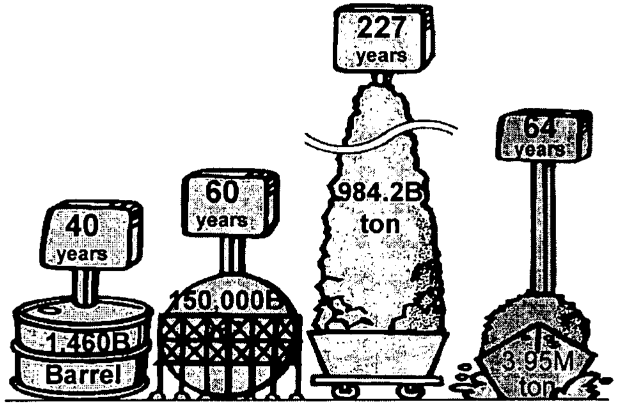
3/25 FNCA-IAEA Joint Session 4 October,2004 Kuala Lumpur *Sueo MACHI*

Energy Demand by Sector in APEC (Mtoc)



4/25 FNCA-IAEA Joint Session 4 October,2004 Kuala Lumpur *Sueo MACHI*

Reserves of Energy Resources



Oil	Natural Gas	Coal	Uranium
(End 2000)	(End 2000)	(End 2000)	(Jan. 1999)

5/25 FNCA-IAEA Joint Session 4 October,2004 Kuala Lumpur *Sueo MACHI*

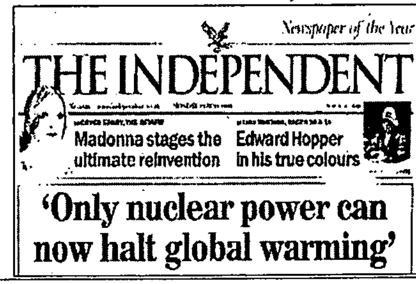
"Nuclear power is the only green solution"

J. Lovelock, 「Gia Theory」

The INDEPENDENT May 24, 04

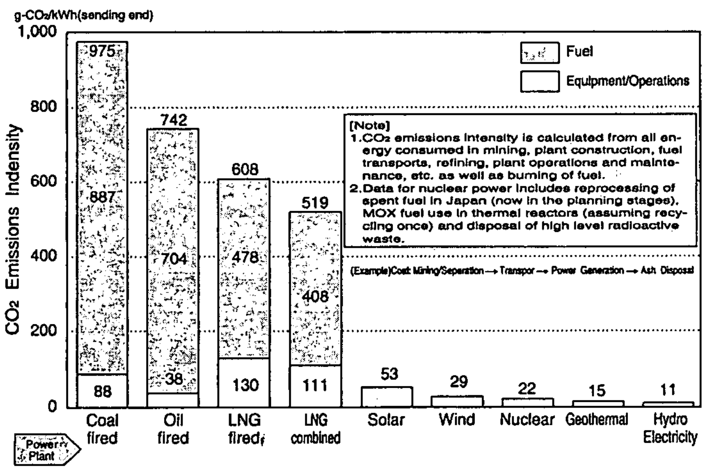
"The Earth's support system is in peril"

H.T. Jun 20, 04



6/25 FNCA-IAEA Joint Session 4 October,2004 Kuala Lumpur *Sueo MACHI*

Japan's Lifecycle Assessment CO_2 Emissions Intensity by Source



(Source) Central Research Institute of Electric Power Industry Report etc.

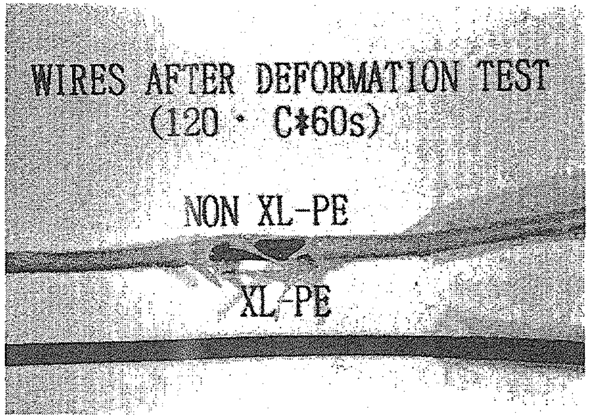
7/25 FNCA-IAEA Joint Session 4 October,2004 Kuala Lumpur *Sueo MACHI*

Nuclear Techniques for Sustainable Development and Welfare

- **Clean energy** --- Nuclear power and Kyoto Protocol
- **Cleaning environment** ---Removing pollutants
- **Food security** ---Environmentally friendly agriculture and food safety
- **Improved industry** ---Saving resources and high quality products
- **Better health care** ---Combating cancer

8/25 FNCA-IAEA Joint Session 4 October,2004 Kuala Lumpur *Sueo MACHI*

Heat Resistant Wire Insulation Cross-linked by Radiation

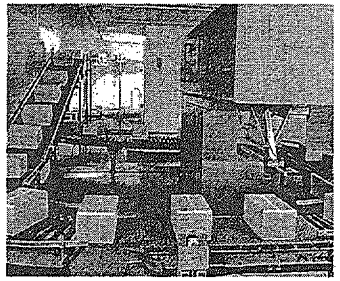


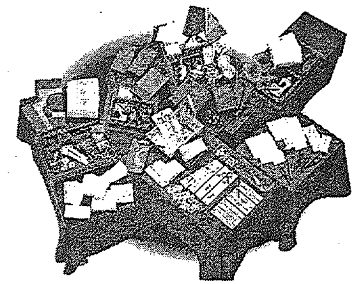
Efficient Processing by High Energy Accelerator

Energy: 5-10 MeV
Capacity: 10-100kW

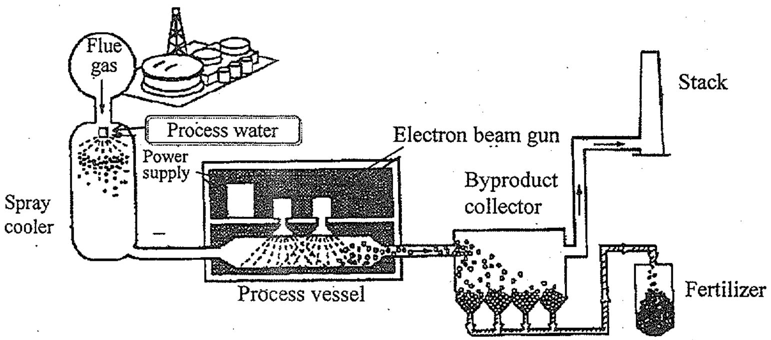
- High speed processing
- Larger capacity
- No replenishment of radiation source

- Sterilization of medical
- Food irradiation
- Processing of polymer products





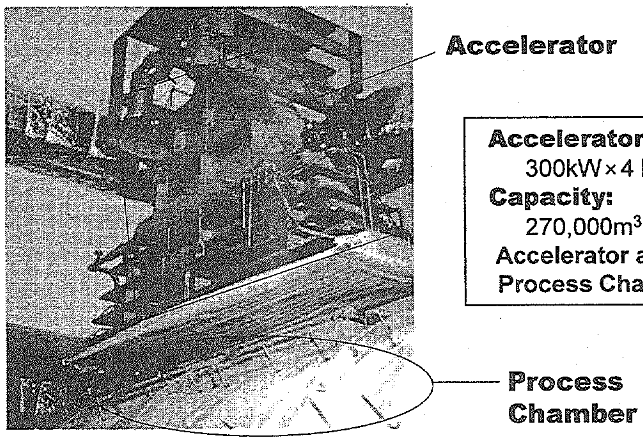
Innovative Technology for Cleaning Flue Gases by Electron Beams



Removal efficiency: SO_2 90% Absorbed dose: 10~15hGy
Temp: 65~70℃

Industrial and Pilot Plants of Cleaning Flue Gases from Power Stations by Electron Beam

	m^3/hour	Fuel	
China 1	300,000	coal	in operation
2	300,000	coal	in operation
3	630,000	coal	under construction
Poland	270,000	coal	in operation
Bulgaria	10,000	coal	in operation
China	300,000	coal	in operation (wet)



Accelerator:
300kW×4 heads
Capacity:
270,000m³ /hour
Accelerator and
Process Chamber

Cleaning Flue Gas from Coal Burning Power Station by Electron Beams. Industrial Scale Demonstration Plant in Poland (October, 2000)

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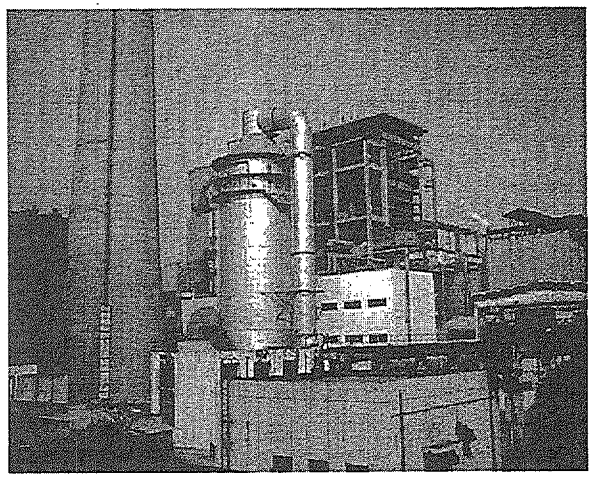
The Flue Gas Cleaning Plant in Changdu, China

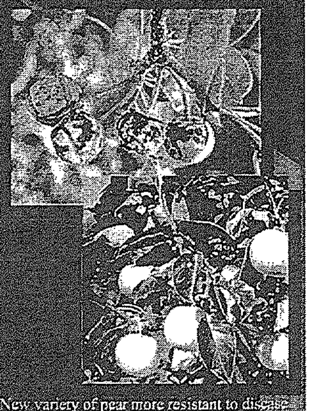


14/25 FNCA-IAEA Joint Session 4 October,2004 Kuala Lumpur *Sueo MACHI*

BREEDING MORE PRODUCTIVE PLANTS BY RADIATION

Recent Remarkable Achievements in Mutant Cultivars

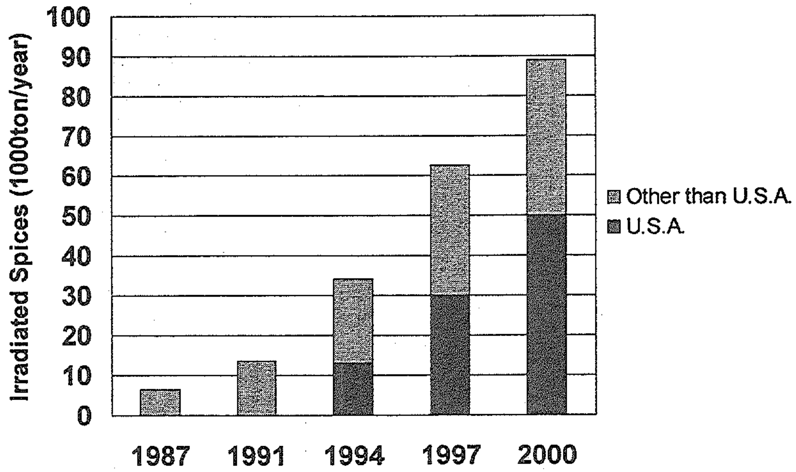
- **Cotton in Pakistan** - higher yield by factor of 2, grown on 70% of acreage
- **Rice in China** - higher yield, growing on 1.4 million ha.
- **Pears in Japan** - resistant to black spot disease; saving pesticide by factor of 4



New variety of pear more resistant to disease

INTERNATIONAL ATOMIC ENERGY AGENCY

Irradiation of Spices Worldwide



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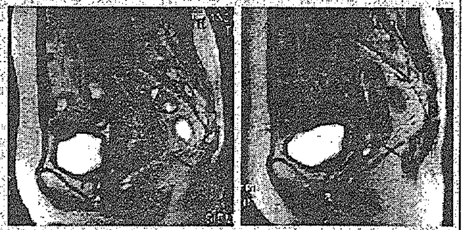
Therapy of Uterine Cancer
- FNCA Project -
Highest female mortality cancer in Asia

- Improvement of treatment protocol
- 210 clinical tests
- Survival rate after 4 years is: 59.2%
- Study on more advanced protocol is ongoing



MRI Image

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Sustainability of Nuclear Research Institutions

The roles of nuclear institutes are;

1) to develop new technologies to meet social and industrial needs;
2) to provide trained human resources to the industries and end-users of nuclear technology;
3) to disseminate informations to the publics for better understanding and recognition of nuclear applications;
4) to transfer technology for commercial production.

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The most important management practices are:

- the effective human resource development;
- close coordination and linkage with potential users of technology developed by institutes;
- focusing financial and human resources on selected specific subjects meeting national needs and interest/expertise of the institute,
- effective collaboration with relevant academic sector.

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Transfer of Technology from Research Institutions to Industry for Commercialization

- Demand Driven Research Is Better than Seed Oriented Research
- Joint Research with Industry
- Selection of Project Meeting National and Industrial Needs

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Sharing and Networking of Nuclear Institutions for HRD

University (Graduate School)	•Education and basic research training •Basic and applied research
Research Inst. (Gov. founded)	•OJT for research and development •Project type research (long and short term perspective)
Industrial Firms	•Training engineers, operators •Engineering and applied research (short term perspective)
Government	•Policy and funding

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Nuclear Related Technology Innovation in Horizon Attracting Young Scientists

- Fast breeder reactor system
- High temperature reactor – Hydrogen production
- High flux neutron source – Material science
  – Transmutation
- Ion beam application – Cancer therapy
  – Nano materials
  – Mutation breeding
- Nuclear fusion energy

22/25 FNCA-IAEA Joint Session 4 October,2004 Kuala Lumpur *Sueo MACHI*

Asian Network for Education in Nuclear Technology (ANENT)

Based on IAEA-GC 2002 Resolution on Knowledge Management
Consultancy Mtg. July 2003, ROK
Technical Mtg. Feb. 2004, Malaysia

The Main objective of ANENT is to facilitate co-operation in education, related research and training through:

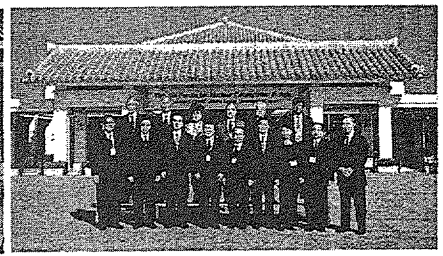
- exchange of students, teachers and researchers;
- establishment of reference curricula and facilitating mutual recognition of degrees; and
- serve as facilitator for communication between ANENT member organizations and other regional and global networks

23/25 FNCA-IAEA Joint Session 4 October,2004 Kuala Lumpur *Sueo MACHI*

Progress Report on FNCA Activities in 2003
S. Machi

Fourth FNCA Meeting, Dec. 2-3, 2003, Okinawa
Senior Official Meeting and Ministerial Level Meeting


SOM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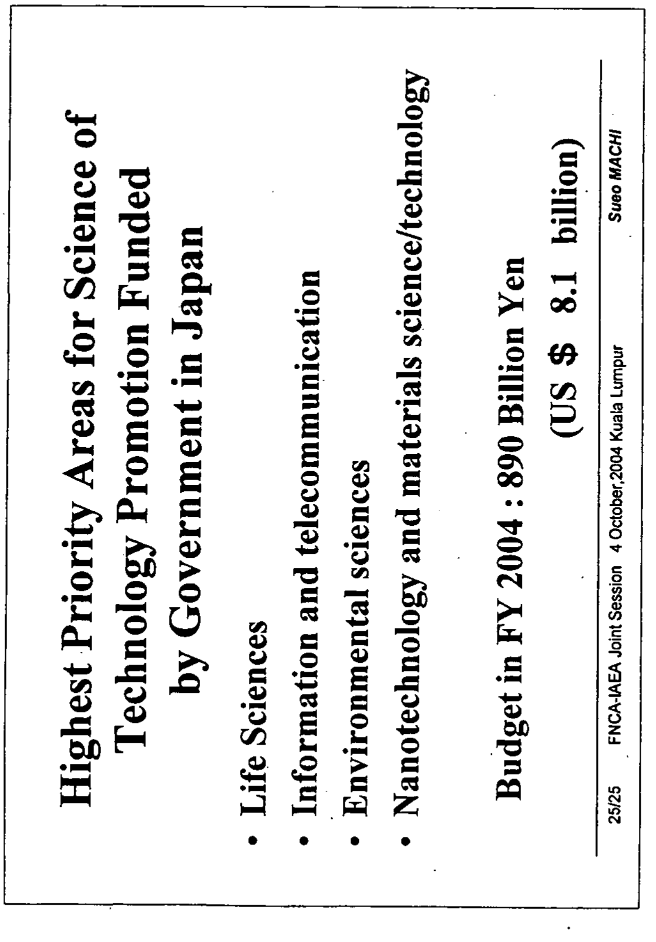
24/25 FNCA-IAEA Joint Session 4 October,2004 Kuala Lumpur *Sueo MACHI*


Highest Priority Areas for Science of Technology Promotion Funded by Government in Japan
• Life Sciences
• Information and telecommunication
• Environmental sciences
• Nanotechnology and materials science/technology
Budget in FY 2004 : 890 Billion Yen
(US $ 8.1 billion)
25/25 FNCA-IAEA Joint Session 4 October,2004 Kuala Lumpur
Sueo MACHI

1.4.3

Enablers for Commercialisation

Malaysian Technology Development Corporation

Ministry of Science, Technology and Innovation

1

Commercialisation in perspective

"Despite the potential offered by the resources of the federal laboratory system, the commercialization level of the results of federally funded research and development remained low. Studies indicated that only approximately 10% of federally owned patents were ever used."

US Congressional Paper 91132 : Industrial Competitiveness and Technological Advancement : Debate over Government Policy III. Yr2000

2

PENGKOMERSILAN R&D

COMMERCIALISATION COMPLEXITY

"The process involves a variety of players such as federal funding agencies, universities, research and transfer organizations, venture capitalists and private companies as well as individual scientists, entrepreneurs and angels....." (ITPS 2004)

3

Issues

- **Research results are not attractive to potential commercialising companies**
- **Commercialisation Units are not fully equipped to handle commercialisation e.g. personnel, expertise, funds, authority**
- **Research results from one organisation may not be attractive enough for commercialisation**
- **Difficulties in finding commercialisation partners**

4

Issues

- Delays in executing legal agreement
- Researcher's availability are limited to facilitate the commercialisation process
- Limited financing are available for commercialisation

5

Commercialisation Enablers

- Policies
- Supporting infrastructures
- Funding

6

Commercialisation Enablers

- Policies
  - DSTN2
  - IRPA
- Supporting infrastructures
  - University commercialisation offices
  - Incubators
  - Up-scaling services
- Funding
  - Grants, Venture Capital

7

Commercialisation Enablers

- **Policies**
- Clear policies governing technology transfer covering:
- Incentives and rewards system
- IPR management
- Human resource deployment
- Legal matters
- Commercial transactions

8

Commercialisation Enablers

- **Strengthening the commercialisation offices**
  - **Develop clear policy and procedures for Commercialisation Offices and allocate sufficient budget**
  - **Establish network of Commercialisation Offices**
  - **Appoint permanent officers or long term attachment and provide sufficient training**
  - **Decentralise authority to execute legal agreements to Commercialisation Office**

9

Commercialisation Enablers

- **Scaling-up/Pilot Plant Facilities**
- **Incubators**

10

Commercialisation Enablers

- **Funding**
  - **Commercialisation grants**
  - **Venture Capitals**

11

Long Term Factors Influencing Commercialisation

- **Culture of science, innovation and techno-entrepreneurship**
- **Working towards creating a critical mass of technology-based companies**
- **Market driven R&D**

12

Conclusion

- Commercialisation is a complex process that requires contribution from each member of the research organisation. For commercialisation initiatives to have a chance of success clear policies, infrastructures and funding should be in place.
- Ultimately commercialisation is a high risk venture and success is dependent upon various factors that are not necessarily controllable.
- Hence, from the government point of view, enhancement of the delivery system to assist those willing to take the risks of commercialisation is of paramount importance.

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THANK YOU

14

PENGKOMERSILAN R&D

SUCCESSFUL TECHNOLOGY TRANSFER :

LESSONS LEARNED

Profiting from Innovation - The Report of the Three-Year Study from the National Academy of Engineering / William G. Howard, Jr., Bruce R. Guile, editors 1992

LESSONS LEARNED BY THE GOVERNMENT

- ONE OF THE FIRST PRINCIPLES IS THE CLEAR NEED TO INSTITUTIONALISE TECHNOLOGY TRANSFER
- IMPORTANCE OF NETWORKS OF PERSONAL CONTACTS
- TECHNOLOGY IS MORE LIKELY TO BE TRANSFERRED WHERE EFFORTS ARE FOCUSED ON AREAS OF TECHNOLOGICAL STRENGTH WITHIN THE ORGANISATION
- FOCUS SHOULD BE ON INFORMATION EXCHANGE AT THE EARLIEST STAGES OF TECHNOLOGY DEVELOPMENT
- A PUBLIC AGENCY MUST HAVE BOTH POLITICAL AND SOCIAL SUPPORT TO SUSTAIN ANY SIGNIFICANT, ORGANISED TECHNOLOGY TRANSFER ACTIVITY

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1.5 Opening for FNCA 2004 Workshop on HRD

1.5.1 Review of Past Activities in HRD and the Scope of 2004 Workshop on HRD

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JAERI/NuTEC

Review of Past Activities in Human Resources Development (HRD) and the Scope of 2004 Workshop on HRD

Hideo MATSUZURU
Project Leader of Human Resources Development
Nuclear Technology and Education Centre
Japan Atomic Energy Research Institute
(NuTEC, JAERI)

1

JAERI/NuTEC

Contents

- Activities to Date
- Review of 2003 Workshop
- Results Achieved
- Scope of the Workshop
- Recent Topics in Japan

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JAERI/NuTEC

Activities to Date

- HRD project was approved in the FNCA framework and started in August 1999

➢ 1999 Workshop (November in Tokyo, Japan)
➢ 2000 Workshop (October in Tokai, Japan)
➢ 2001 Workshop (October in Daejon, Korea)
➢ 2002 Workshop (October in Batangas, the Philippines)
➢ 2003 Workshop (October in Bangkok, Thailand)

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2003 Workshop

➢ October 8-10, 2003 in Bangkok, Thailand
➢ Sponsored by MOST(Thailand) & MEXT(Japan),
➢ and hosted by OAP and JAERI
➢ 27 Participants from 7 member countries
➢ Discussions were made on;
- Development of training methodology
- Analysis of HRD Basic Data
- Strategy of HRD and so on.

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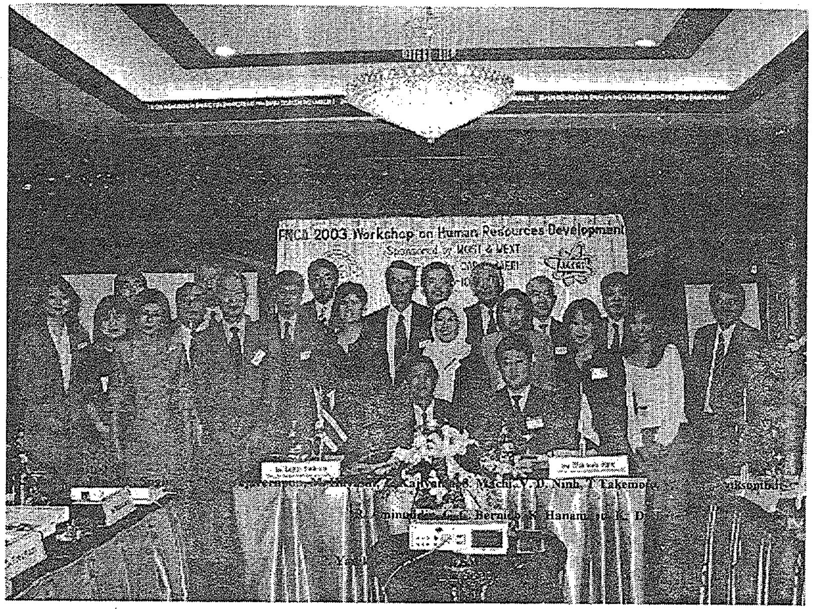

2003 Workshop Conclusions and recommendations

- HRD basic data:
  - will be completed in 2004, and
  - should be authorized and supported by a competent organization.
- HRD strategy
  - The strategy should be formulated by using HRD basic data.
  - Preparation of a model method was proposed for HRD strategy formulation.
- Hold close linkage with ANENT through participation and contribution to it.

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Development of Nuclear Training Tools

- Development of training materials on Radiation Protection to be commonly used in the member countries
- Survey of CD-ROM learning materials to correspond to future e-learning system

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Training material in radiation protection area

- ➢Text Book on Radiation Protection was jointly developed by BATAN, OAP, VAEC and JAERI, and posted in the HRD Project website.
- ➢HRD Project Leaders to give comments on the material
- ➢More discussion is needed to meet with specification and the need.

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e-learning materials

- We discussed on future co-operation in preparing e-learning materials for nuclear training, and decided to collect the information on the availability of multimedia CD-ROMs.
- The Philippines has provided an interactive, multimedia CD-ROM which intends to use in education of high school students in the area of nuclear science and technology.

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Information exchange

- Information of the nuclear training courses are exchanged by way of the project website.

Information on international and domestic nuclear training courses in each country will be updated periodically and the courses in FY2004 were provided in the website

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Survey of HRD basic data

HRD project should investigate the basic data on HRD in nuclear field in member countries in order that the data be used in the formulation of HRD strategy.

(Coordinators Meeting, March 2002)

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State-of-the-art of survey of HRD basic data in 2003

- ➢More precise data especially on university education
- ➢Data on academic associations and societies added
- ➢Data related to nuclear utilization hardware in member countries

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Results Achieved

- Text Book on Radiation Protection developed and posted
- Information exchanges on training curriculums and teaching materials continued
- HRD Basic Data collected were analysed and presented at the
- 2003 Workshop

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Action Items for 2004

- Publish 2003 workshop proceedings
- Enrich training materials in radiation protection area, and posts them in the HRD Project website for review and comments.
- Update the project homepage periodically.
- Distribute available training materials in English (text book, CD-ROM, etc.)
- Develop and discuss HRD strategy utilizing the Basic Data

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http://www3.tokai.jaeri.go.jp/nutec/fnca/fnca.htm 15

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Scope of this Workshop (1)

<u>Presentations of Session 1 – 4</u>

- Review the history of Nuclear Development and HRD in each country
- Construct a model HRD strategy for various cases
- Prepare your own HRD strategy

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(1) Nuclear Development Program

↓

(2) Identify the Human Resources Needs (type, number, when) based on Nuclear Development Program

↓

(3) Clarify the Needs of Hardware and Software for HRD

↓

(4) Formulate Human Resources Development (HRD) Strategy

↓

(5) Propose the items for the Regional Cooperation to enhance HRD

↓

(6) Prioritize the items for Regional Cooperation

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What is your definition of Nuclear Development Program?

Does your Nuclear Development Program aim at:

- only RI and radiation utilization?
  In which area (agriculture, medicine, industry)?
- also utilizing Research Reactor?
  If so, when and what type?
- and also constructing nuclear power plant?
  If so, when and how many NPPs?

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Identification of HRD needs for Nuclear Development?

- HRD Basic Data were surveyed and analysed in FNCA countries
- Comparison of your HRD Basic Data with those of other countries to re-evaluate and clarify your HRD needs

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Scope of this Workshop (2)

Session5: Group Discussion and Presentation

- Formulate the HRD Strategy model in each group
- Discuss how to use the model

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Scope of this Workshop (3)

Session 6: Presentation

- Information Exchange for Nuclear Training Support
- Discuss how to make use of the materials

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Scope of this Workshop (4)

Session 7: Presentation

- Evaluate FNCA - HRD Project activities by ourselves
- Submit our evaluation to the FNCA Coordinator Meeting

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Recent Topics in Japan (1)

- Report on the Unification of JAERI and JNC was submitted to the Government (September 19, 2003)
- The Japan Atomic Energy Research and Development Institute will be established in the middle of JPY2005.
- The Report emphasises the importance of HRD as one of major missions of the new institute.
- The Report requires the institute to contribute to Professional Graduate School (PGS) of Nuclear Engineering, which intends to educate core members of nuclear engineers and regulatory officials.
- The PGS of Tokyo University will be established in JPY2005 in Tokai area.

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Recent Topics in Japan (2)

- Joint Operative Graduate Schools not only for Nuclear Engineering, but for advanced scientific fields, is being realised in various sites of the JAERI and the JNC, by using nuclear research facilities, e.g., JRR-3,4, and also advanced research facilities (accelerators) such as,
- TIARA、ion beam (Takasaki Radiation Chemistry Research Establishment)
- Spring 8, synchrotron radiation (Kansai R.E.)
- J-PARC, neutron, neutrino (Tokai R.E)
- A new national qualification system of Professional Engineers in Nuclear and Radiation Field was established in 2004

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1.6 Presentation Session 1 (Country Report)

1.6.1 Malaysia
1.6.2 Thailand
1.6.3 The Philippines

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1.6.1 Malaysia

COUNTRY REPORT FROM MALAYSIA- MODEL FOR HRD STRATEGY

Rapieh AMIN NUDDIN, MINT

1. INTRODUCTION

In this paper more information is provided in addition to what has been collected in the past years. Models for HRD strategies are also proposed. Consolidation and deliberation of similar inputs from the other workshop participants should enable this workshop to come up with a very useful model of HRD strategy that will be adopted and used in participating countries for formulating HRD strategy.

2. BACKGROUND

2.1. The subject of a model for HRD strategy was raised during my second presentation at the 5th HRD Workshop in which I suggested that the FNCA HRD Project may come up with a model for HRD Strategy. This received overwhelming and unanimous support from every member of the project.

2.2. In my country report at the first FNCA HRD workshop, I stated that we need to have good and adequate information to formulate HRD strategy. The HRD project have collected a large amount of information and we spent sometime in the last 2 workshops to discuss how these information can be used to formulate HRD strategy.

2.3. For this 2004 workshop the sponsor has stated the following:-

2.2.1. The main objective of the FNCA 2004 Workshop on HRD is to provide a model to formulate HRD strategy in each country by sharing experiences and precedents.

2.2.2. Although the purpose of 'Survey of the basic data' carried out in 2002 was to formulate HRD strategy in each country, the sponsor felt that there were some difficulties in policy discussion. Therefore, it could be meaningful to provide the model as an essential feature of HRD strategy. The model would be flexibly utilized depending on the national policy of each country in the future.

2.2.3. The steps to follow in the strategy modeling are as follows:-

2.2.3.1.Review the history of nuclear human resources development in the country, establish a framework for discussion, and propose factors needed for strategy.

2.2.3.2.Recognize the current situation of needs on human resources based on nuclear development policy in the country.

2.2.3.3.Compare the actual state, which was clarified by the needs recognition, with the result of 'Survey of the basic data', and identify the shortfall of human resources in your country.

2.2.4. Historical review could be useful for making discussion frameworks, and also could be a new source of perspective on the Model.

2.2.5. The 'Survey of the basic data on HRD' consists of data from 2002 to 2004, and those data were 'static' data for a certain year. It was difficult to analyze the trend by the survey data. In fact, it should be 'dynamic' analysis, such that how many and what kinds of human resources are needed with what purposes and by when.

3. RECENT TOPICS IN THE NUCLEAR FIELD AND RELATED HRD IN YOUR COUNTRY.

3.1. Before proceeding to the model a report needs to be made on recent topics in the nuclear field and related HRD in Malaysia 4 items deserves mention in this report:-

3.1.1. The Department of Museum and Antiquity has sought MINT's services in conservation work. NAA, XRD, XRF, radioisotope dating, NDT are some of the nuclear techniques that have been provided in the conservation work. MINT is also providing training on nuclear techniques to their personnel.

3.1.2. MINT has submitted an application for a special program to allow MINT researchers to use their research projects for Masters or PhD thesis and register for post-graduate studies at local universities under the government funding. It is like an on-the-job post graduate studies This application has received favourable support from several parties and we hope the program can start by the end of this year. We intend to link this programme with MEXT researcher exchange programme where research done under this programme can also be used as thesis for the post graduate or even post doctoral studies if this is agreeable by the Japanese side.

3.1.3. MINT has upgraded its training rooms to enable proper recording of training sessions to produce CDs for e-learning.

3.1.4. Malaysia has set up a national on-line facility or web-site http://www.mygfl.net.my to facilitate and encourage life long learning in the society. One of the functions of this facility is metadata management system which provides for a structured cataloging method to help users discover relevant information. Implementation of metadata for web resources and learning objects would result in the availability of consistent, accurate, and well-structured descriptions of resources such as packaged content, publication, web pages, or an image. MINT could become a content provider and in doing so would increase accessibility of the general public to nuclear knowledge.

4. HISTORICAL REVIEW OF EXPERIENCES OF HRD IN THE NUCLEAR FIELD

4.1. Table 1 illustrates the development of nuclear technology in Malaysia. It is by no means complete but gives some idea when nuclear technology was first introduced in Malaysia and how the various applications of peaceful uses of nuclear energy has evolved and the direction in which it will further develop.

Table 1- Historical review of the development of nuclear technology in Malaysia.

	1970	1975	1980	1985	1990	1995	2000	2005
PUBLIC INSTITUTION	CRANE (1972) PUSPATI (1973)	PUSPATI became research center in (1975)		UTN (19 83)		MINT (1994)		Probably change name again
	Human resource development (post-graduate studies and –on-the-job training) Basic physical infrastructure (Assistance from IAEA, Japan , Australia)		-establish research areas and programmes -Mission oriented R&D activities -Consolodation of research -IRPA -Research collaboration		-Rationalisation of R&D activities - Commercialisation of R&D output and services -Industry and end-user linkages		-Focus on niche areas -Alignment with national agenda	
MAJOR FACILITIES			I Megawatt Triga Reactor (1982), waste treatment plant (1985), RI production (1984) SSDL, SINAGAMA (Gamma irradiation facility) (1989),		ALURTRON- EBM (1992), RAYMINTEX (1996), MINT TECH PARK (1999)			Gamma greenhouse and Gamma field
ACTS AND REGULATION	Radioactive substances Act (1968)		AELA ACT 304) (1984), EST. AELB (1985)	Radiation Protection (LICENCING) Regulations (1986), RP (BSS) Regulations (1988), RP (Transport) Regulations (1990)	APPEAL (1990)			Radiation Protection (RWM) Regulation (2005 onwards)
HRD- IAEA	◄──────────────────►							
Japan		JAIF, Bilateral, INCA, FNCA ◄──────────────►						
Australia		Colombo Plan, ADAB ◄──────►						
University			BSc. Nuclear Science (UKM)				BSc Health Physics.(UTM), Bachelor Diagnostic Imaging and Radiotherapy (UKM), Masters medical Physics (UM), Masters in	Masters in radiation Processing (UPM)

MINT			Seminars to promote application of nuclear technology in various fields	Public courses in radiation protection	Public courses in NDT	Public courses in radiation safety in medical applications	
PRIVATE			ANSELL gama irradiation facility (1983)		STERIL GAMA (1992)		
NUCLEAR MEDICINE	IST X-ray machine in Taiping Hospital (1897), RI used in medicine in HKL(1962), 1st nuclear medicine center in HKL (1964), UM (1967)		NMC Kucing (1980),	Production of RI for medicine (1984)	8 more NMC		3 more NMC-Kuantan, Kota Kinabalu, UPM Hospital, Cyclotron for NM in Putra Jaya Hospital

4.2. Lessons learnt from history

- HRD often started late so project slow to take of
- Difficult to get training
- Not enough manpower to send for training
- Not enough funding for training
- Difficulty to attract personnel or people to specialize in nuclear due to lack of recognition and incentive
- Demand driven eg increase in cancer cases lead to rapid growth in nuclear medicine and radiotherapy, AIDS and other diseases and contamination lead to increase in demand for rubber gloves and condoms
- Wastage in training- leave the job after training for promotion

5. MODEL AS A WAY OF FORMULATING HRD STRATEGY.

5.1 Policy targets of nuclear development 2000-2010

5.1.1 Malaysia does not have as yet a national nuclear technology developmet policy. What we have is a Science and Technology Policy which is stated in the Second National Science and Technology Policy

5.1.2 Without a national nuclear technology development policy the long term planning and middle term planning of the various applications of nuclear technology are found in the Third Outline Perspective Plan

(OPP3) and 5 year development plan (it is now the 8th Malaysia Plan) respectively as well as the national policy for the various sectors. For example, development planning of nuclear medicine is the responsibility of the Ministry of Health and is guided by the National Health Policy, Outline Perspecive Plan 3 and the 8th Malaysia Development Plan for the health sector. Same for energy, education, agriculture and the other sectors.

5.1.3 When MINT formulated its 8th Malaysia Development Plan it has to refer to the OPP3 and the national policy of the various sectors. The following are some of the projects under the 8th Malaysia Plan for MINT:-

- HRD project
- EBM
- Reactor utilization
- Gamma green house and gamma field
- Public acceptance

5.1.4 Manpower planning is a different exercise and we have to submit our application through the Public Service Department.

5.1.5 So, not having a nuclear development policy does make HRD planning quite complicated.

5.2 Need for a national database and information system for HRD in nuclear technology.

5.2.1 Being in the K-economy, things are moving fast and change is really rapid. In the nuclear area even in the IAEA there are so many programmes and activities and some of these overlapping with each other. When different people participate in different programmes, it is difficult to keep track of things. Something needs to be done to make sure that things do not contradict and duplicate each other.

5.2.2 At MINT we are trying to address this issue in our ICT Strategic Plan. This is something very difficult to do and we are trying to engage a consultant to do this. But MINT have to come up with processes and workflow so that the consultant can develop the system for data capturing, data mining, reporting etc. We have to change the way we do things as it cannot handle the speed at which things are moving. The use of ICT will make things more efficient and effective.

5.2.3 At MINT we are developing a Human Resource Development Information System (HRDIS) for MINT. We are also developing a database for HRD in Nuclear Science and Technology and for Nuclear

Education at national level. In fact this develops from the FNCA effort of data collection. We plan that this would lead to a Model for HRD Strategy for MINT and for the nation. I have not given much thought for a strategy at FNCA level.

5.2.4 A good Model of HRD Strategy will assist the system developer to develop an information and knowledge management system that will support planning, policy formulation, decision making and day to day operations.

5.3 HRD strategies

5.3.1 Before we go any further, we need to define what is HRD strategy model and specify the level of strategy we want whether at FNCA, national or organizational level.

- Human resource development (HRD) can be defined as educating and training of people to make them competent to perform future tasks.
- Strategy is a means of achieving objectives.
- Model means something to be copied: something worthy to be imitated, representative of others in the same style, etc.

5.3.2 The following models are proposed

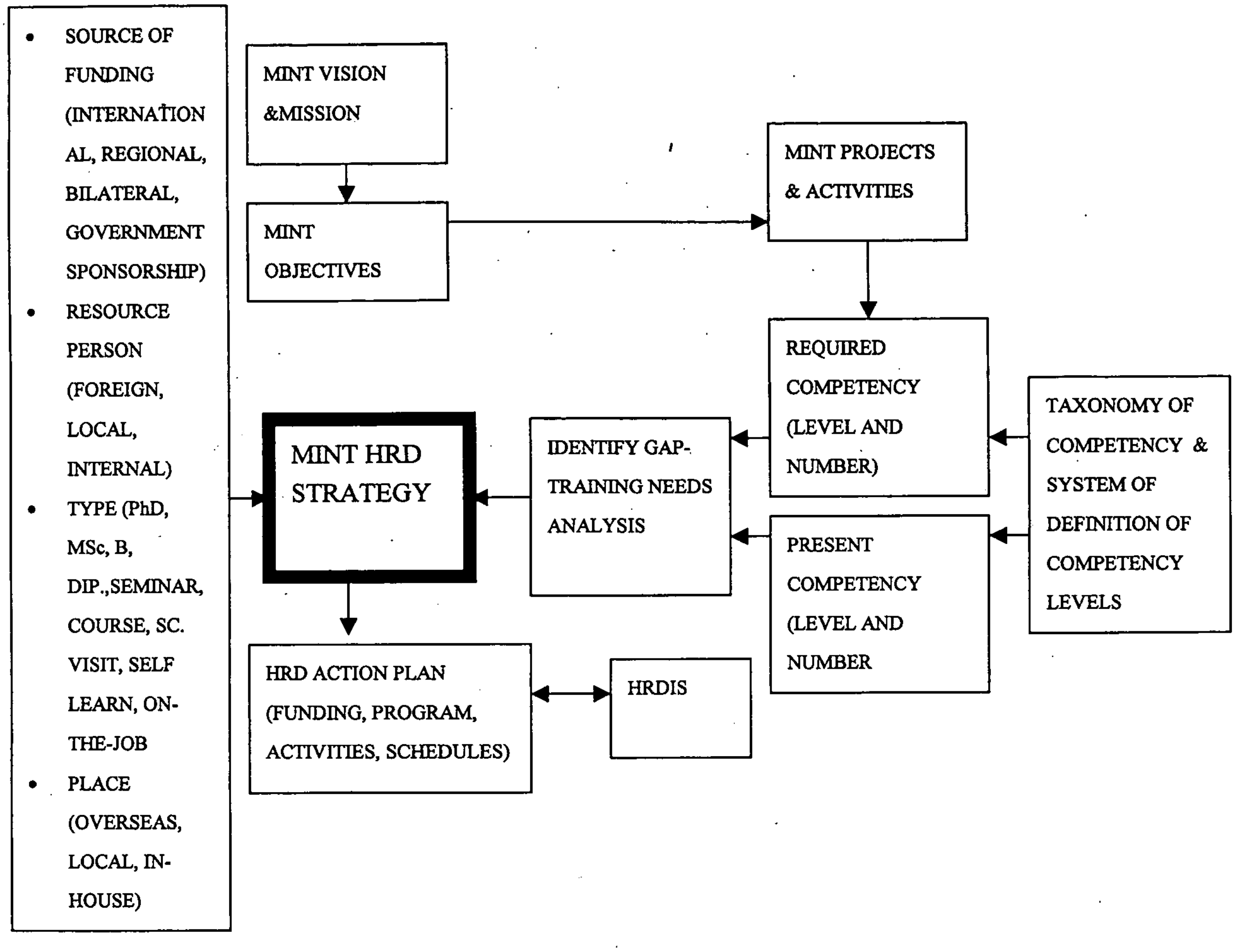

Figure 1 - MODEL 1: HRD STRATEGY- MINT LEVEL

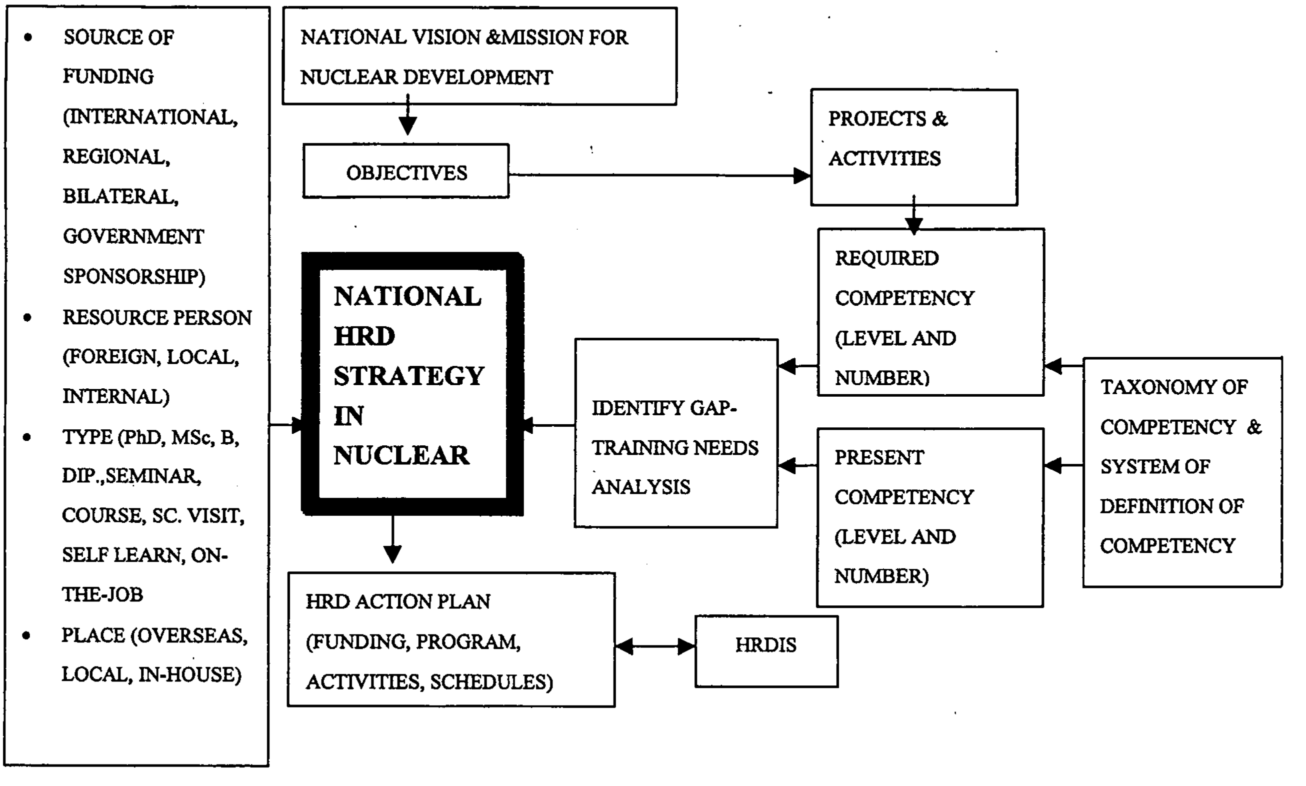

Figure 2 - MODEL 2: HRD STRATEGY NATIONAL LEVEL

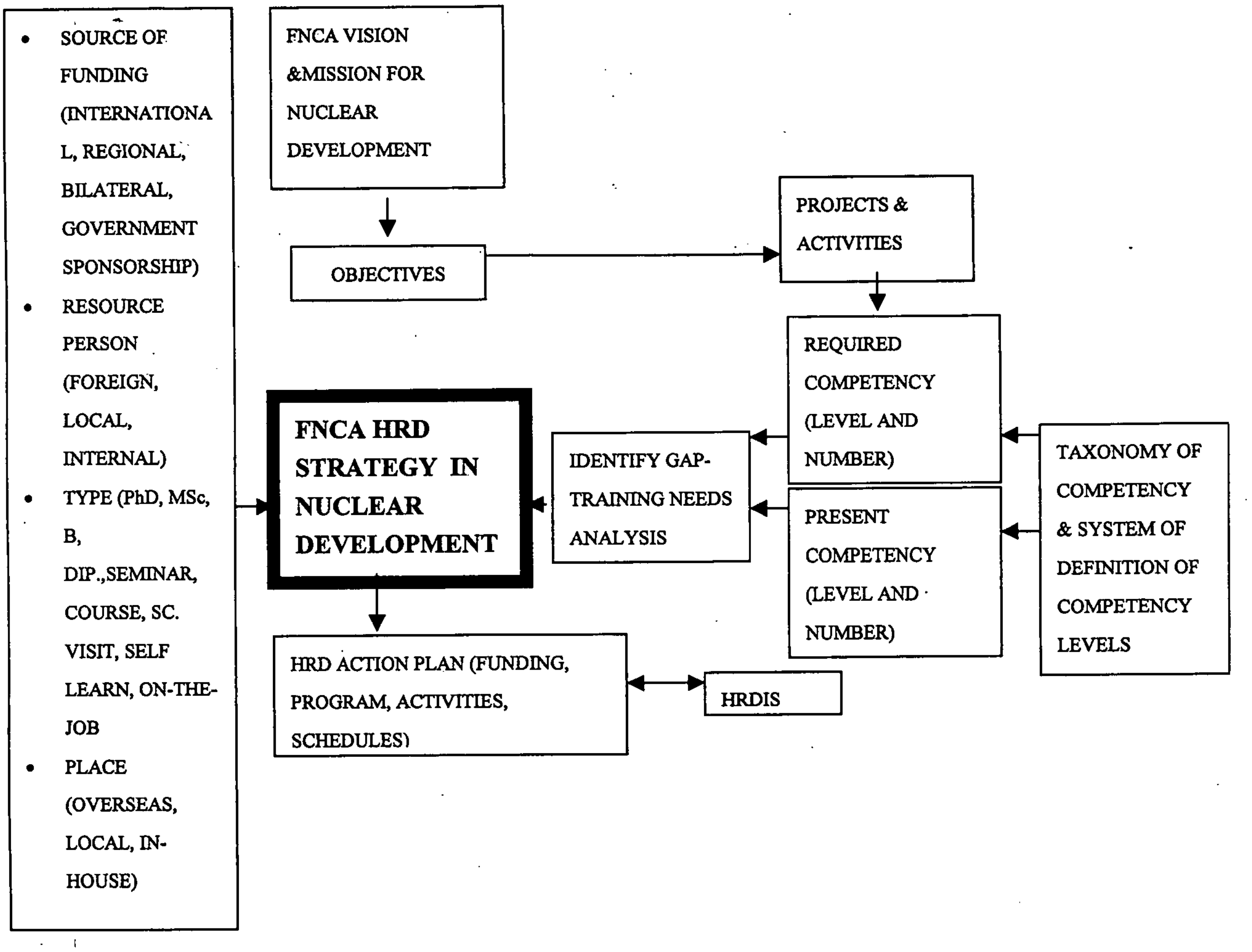

Figure 3 - MODEL 3: HRD STRATEGY FNCA LEVEL

6. CONCLUSION

In conclusion I would like to make the following recommendations:-

- A recommendation be made at the FNCA Ministerial level meeting for each member country to formulate a national nuclear development policy.
- The Model of HRD Strategy that will be developed in this workshop should be robust and able to guide the development of national information system for HRD.
- National HRD committee for nuclear technology be formed to consolidate HRD initiatives in various ministries, organizations, programmes and projects. This committee should include expert in HRD strategy and information management.
- The adequacy of the HRD strategy should be tested. Instead of every country doing the same thing, case study or lead country approach should be adopted so that we can get results faster.

COUNTRY REPORT FROM MALAYSIA- MODEL FOR HRD STRATEGY

Rapieh AMIN NUDDIN

Malaysian Institute for Nuclear Technology Research (MINT)

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PRESENTATION OUTLINE

- INTRODUCTION
- BACKGROUND
- RECENT TOPICS
- HISTORICAL REVIEW
- HRD STRATEGY MODEL
- CONCLUSION

2

INTRODUCTION

- The objective of this paper is to provide more information on HRD and propose model for HRD strategies.
- Consolidation and deliberation of similar inputs from the other workshop participants should enable this workshop to come up with a very useful model of HRD strategy that will be adopted and used in participating countries for formulating HRD strategy.

3

BACKGROUND

- A model for HRD strategy was raised at the 5th HRD Workshop.
- Need to have the right and adequate information to formulate HRD strategy.

4

WORDS FROM SPONSOR:-

1. The main objective of the FNCA 2004 Workshop on HRD is to provide a model to formulate HRD strategy in each country by sharing experiences and precedents.
2. There were some difficulties in policy discussion.

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Continue…

3. The steps to follow in the strategy modeling are as follows:-
   - Review the history of nuclear human resources development .
   - Recognize the current situation of needs on human resources based on nuclear development policy in the country.
   - Identify the shortfall of human resources in your country.

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4. Historical review could be useful for making discussion frameworks
5. Data from 2002 to 2004 are 'static' – should be dynamic.

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RECENT TOPICS IN THE NUCLEAR FIELD AND RELATED HRD IN YOUR COUNTRY.

- The Department of Museum and Antiquity has sought MINT's services.
- MINT has submitted an application for a special program – on-the-job post graduate studies.
- MINT has upgraded its training rooms for recording of training sessions to produce CDs for e-learning.
- Malaysia has set up a national on-line facility or web-site http://www.mygfl.net.my to facilitate and encourage life long learning in the society.

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HRD- IAEA	←→							
Japan		JAIF, Bilateral, INCA, FNCA ←→						
Australia		←→ Colombo Plan, ADAB						

9

	1970	1975	1980	1985	1990	1995	2000	2005
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LESSONS LEARNT FROM HISTORY

- HRD often started late so project slow to take off.
- Difficult to get training places.
- Not enough manpower to send for training.
- Not enough funding.
- Difficulty to attract personnel or people to specialize in nuclear due to lack of recognition and incentive.
- Demand driven.
- Wastage in training- leave the job after training for promotion, etc.

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MODEL AS A WAY OF FORMULATING HRD STRATEGY.

1. Policy targets of nuclear development 2000-2010
   - Malaysia does not have as yet a national nuclear technology development policy, but Second National Science and Technology Policy.
   - Planning based on Third Outline Perspective Plan (OPP3) and 5 year development plan (it is now the 8th Malaysia Plan) national policy for the various sectors.

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continued...

- Planning in MINT for 8th Malaysia Development Plan refers to OPP3 and the national policy of the various sectors.
- The following are some of the projects under the plan :-
  - HRD project
  - EBM
  - Reactor utilization
  - Gamma green house and gamma field
  - Public acceptance
- Manpower planning submit application to the Public Service Department
- So, it is a complicated business

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2. Need for a national database and information system for HRD in nuclear technology
   - K-economy : too many programmes and activities overlapping - difficult to keep track.
   - Under MINT's ICT Strategic Plan - develop a system for data capturing, data mining, reporting etc.
   - Human Resource Development Information Database at MINT – HRDMS, Training Record, HRD Nuclear Science & Technology, Nuclear Education etc.
   - A good Model of HRD Strategy will assist the system developer to develop an information and knowledge management system that will support planning, policy formulation, decision making and day to day operations.

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DEFINITION OF HRD STRATEGY MODEL

- Human resource development (HRD) can be defined as educating and training of people to make them competent to perform future tasks.
- Strategy is a means of achieving objectives.
- Model means something to be copied: something worthy to be imitated, representative of others in the same style, etc.

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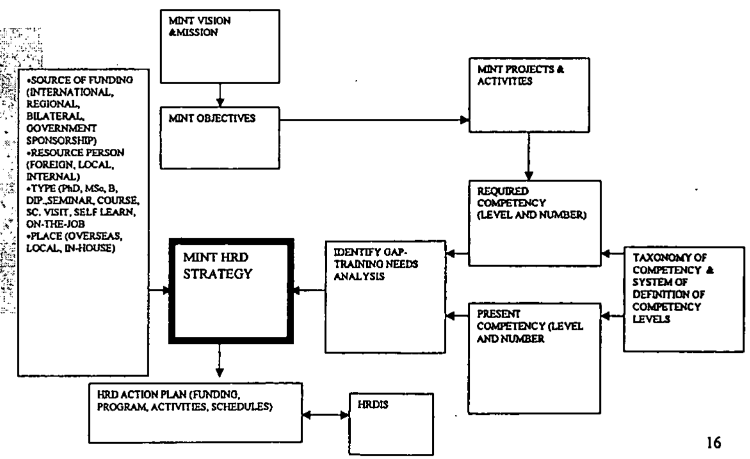
MODEL 1: HRD STRATEGY-MINT LEVEL



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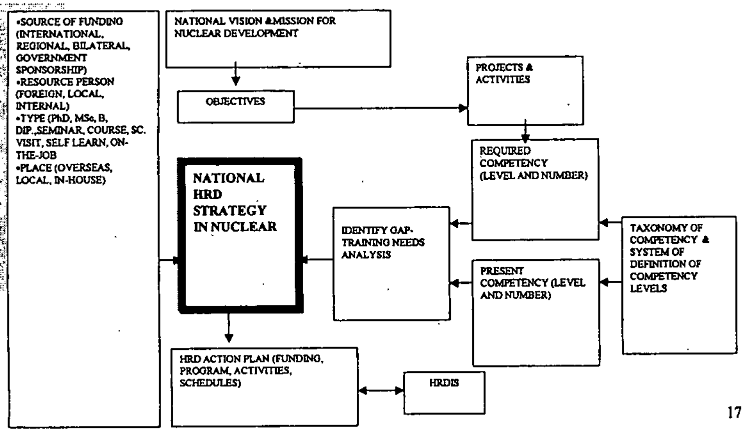
MODEL 2: HRD STRATEGY NATIONAL LEVEL



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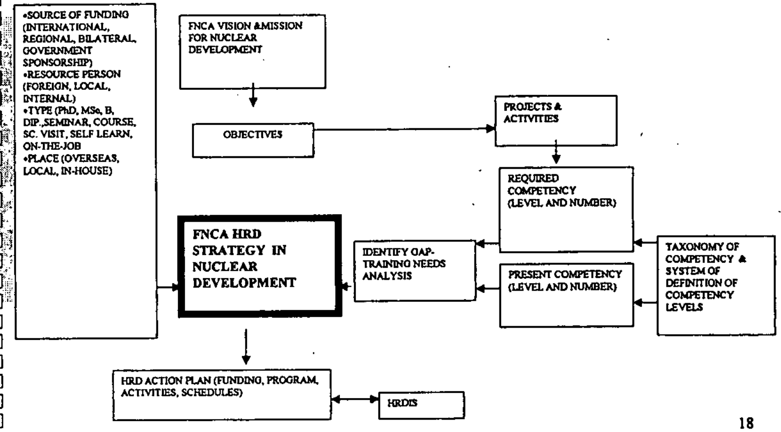
MODEL 3: HRD STRATEGY FNCA LEVEL



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CONCLUSION

- Each member country should formulate a national nuclear development policy – FNCA Ministerial Level Meeting
- The Model of HRD Strategy should be robust and able to guide the development of national information system for HRD.
- National HRD committee for nuclear technology be formed to consolidate HRD initiatives in various ministries, organizations, programmes and projects - to include expert in HRD strategy and information management.
- The adequacy of the HRD strategy should be tested - case study or lead country approach should be adopted so that we can get results,faster.

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THANK YOU…

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1.6.2 Thailand
HUMAN RESOURCE DEVELOPMENT STRATEGY OF THAILAND

Warapon Wanitsuksombut
Office of Atoms for Peace, Thailand

Introduction

Human resource development in nuclear field is depending on the demand on the usage of nuclear applications. Among all nuclear applications, medical and industrial utilizations of nuclear energy is the most successful and well known applications in the country. Since nuclear power is not planned in near future, human resource in nuclear power development is limited. Human resource of medical profession in nuclear field is recognized to be necessary for the safety in medical exposure control. While human resources in radiation safety are the key for occupation control in industry and research. Human resources in research and development in nuclear applications and reactor utilizations are also important for the country development.

Status of Academic Courses and Training Courses in Nuclear

Nuclear Science has been included in curriculum of science study in every universities and colleges. In some universities the special subjects in nuclear are included and graduate courses are offered for example Physics, Chemistry, Medical Physics, Nuclear Technology, Environmental Science, Radiation Technology, etc. Furthermore short training courses in special topics are offered in many institutes and societies. Summary of graduate courses and special training courses are shown in Table 1.

Table 1 Summary of graduate courses and special training courses in Nuclear

Field	Graduate Courses	No. of graduated students		Training Courses	No. of cumulative participants
		Master	Doctor		
Medicine	5	37	18	NI	-
Technology	6*	64	20	8	1171
Agriculture	-	-	-	13	998
Radiation Safety and Radiological Protection	-**	-	-	4	3874
Reactor Operator (license)	-	-	-	1	52
Irradiator Operator(license)	-	-	-	1	40
Industrial Radiography	-	-	-	2	223

* includes all subject; physics, nuclear technology, applied radiation and isotopes
** Usually cooperated in other fields
NI – No Information

Qualification Training Courses

There are several training courses recognized as qualification courses; reactor operator, irradiator operator, industrial radiography and radiation protection. In order to meet international standards, these training courses should be certified. The HRD project has stimulated the exchange of information among member countries which helping in the improvement of those training courses to be complied to the standards.

Radiation Safety Officer Qualification

Radiation safety officer qualification has recently announced in the radiation safety regulation. Thailand has conducted radiation protection courses for tens years. But the qualification theme has not been established yet. Models of other countries are studied in order to choose suitable model for Thailand. The qualification will be launch as soon as possible and projected to be fulfilling in 5 years.

Professional Society could have important role in human resource development. An example is the proposal from Society of Medical Physics to conduct Radiation Protection Courses for three fields of Medicine; diagnostic radiology, radiotherapy, and nuclear medicine.

Qualified Personnel for Medical Exposure Control

In the medical service practice, quality control of machine, drugs and personnel in medical professional must be certified. The medical doctor applying radiation and radioisotopes to patient must have special qualification, as well as other related professional such as medical physicist, radiologist and radiation technologist.

Thailand has required authorized medical doctor in the licensing process to use radiation and radioisotopes in medical diagnostic and treatment. It is also required to have a radiation safety officer and qualified experts either medical physicist or radiologist. Medical societies in nuclear field and academic institute play a strong role in building and supporting human resources in this field.

The highest public medical exposure comes from diagnostic radiology. Quality control of diagnostic radiology equipment is the key function to reduce radiation doses to person passing examination. Qualified expert for conducting quality control of the equipment is also required.

Summary of Needs

Qualified personnel needed could be categorized as radiation safety officer, qualified expert for quality control of diagnostic radiology and qualified expert for nondestructive testing radiography in industry. Table 2 shows the figures of demand in each field.

Table 2 Categories and quantities of qualified personnel needed

Categories of qualified personnel	Number of facilities or equipment	Number of persons needed
Radiation Safety Officer	7000	thousands
Qualified Expert for quality control of diagnostic radiology equipment	5000	hundreds
Qualified Expert for nondestructive testing radiography(NDT Level 3)	20	hundreds

HRD Strategy

Professional society as well as academic institute have the role of training to develop manpower in nuclear. Concerning authority should provide information on quality and quantity of personnel needs. To obtain such information, effective working group should be appointed and intensive survey should be conducted. The strategy should include prediction of future nuclear application which is expanding quickly.

HUMAN RESOURCE DEVELOPMENT STRATEGY OF THAILAND

Warapon Wanitsuksombut

Office of Atoms for Peace, Thailand

1

Introduction

- Human resource development in nuclear field is depending on the demand on the usage of nuclear applications. Among all nuclear applications, medical and industrial utilizations of nuclear energy is the most successful and well known applications in the country. Since nuclear power is not planned in near future, human resource in nuclear power development is limited. Human resource of medical profession in nuclear field is recognized to be necessary for the safety in medical exposure control. While human resources in radiation safety are the key for occupation control in industry and research. Human resources in research and development in nuclear applications and reactor utilizations are also important for the country development.

2

Status of Academic Courses and Training Courses in Nuclear

- Nuclear Science has been included in curriculum of science study in every universities and colleges. In some universities the special subjects in nuclear are included and graduate courses are offered for example Physics, Chemistry, Medical Physics, Nuclear Technology, Environmental Science, Radiation Technology, etc. Furthermore short training courses in special topics are offered in many institutes and societies. Summary of graduate courses and special training courses are shown in Table 1.

3

Table 1 Summary of graduate courses and special training courses in Nuclear

Field	Graduate Courses	No. of graduated students		Training Courses	No. of cumulative participants
		Master	Doctor		
Medicine	5	37	18	NI	-
Technology	6*	64	20	8	1171
Agriculture	-	-	-	13	998
Radiation Safety and Radiological Protection	-**	-	-	4	3874
Reactor Operator (license)	-	-	-	1	52
Irradiator Operator (license)	-	-	-	1	40
Industrial Radiography	-	-	-	2	223

* includes all subject; physics, nuclear technology, applied radiation and isotopes
** Usually cooperated in other fields
NI – No Information

4

Qualification Training Courses

- There are several training courses recognized as qualification courses; reactor operator, irradiator operator, industrial radiography and radiation protection. In order to meet international standards, these training courses should be certified. The HRD project has stimulated the exchange of information among member countries which helping in the improvement of those training courses to be complied to the standards.

5

Radiation Safety Officer Qualification

- Radiation safety officer qualification has recently announced in the radiation safety regulation. Thailand has conducted radiation protection courses for tens years. But the qualification theme has not been established yet. Models of other countries are studied in order to choose suitable model for Thailand. The qualification will be launch as soon as possible and projected to be fulfilling in 5 years.

6

Qualified Personnel for Medical Exposure Control

- In the medical service practice, quality control of machine, drugs and personnel in medical professional must be certified. The medical doctor applying radiation and radioisotopes to patient must have special qualification, as well as other related professional such as medical physicist, radiologist and radiation technologist.
- The highest public medical exposure comes from diagnostic radiology. Quality control of diagnostic radiology equipment is the key function to reduce radiation doses to person passing examination. Qualified expert for conducting quality control of the equipment is also required.

7

Summary of Needs

Table 2 Categories and quantities of qualified personnel needed

Categories of qualified personnel	Number of facilities or equipment	Number of persons needed
Radiation Safety Officer	7000	thousands
Qualified Expert for quality control of diagnostic radiology equipment	5000	hundreds
Qualified Expert for nondestructive testing radiography(NDT Level 3)	20	hundreds

8

HRD Strategy

- Professional society as well as academic institute have the role of training to develop manpower in nuclear. Concerning authority should provide information on quality and quantity of personnel needs. To obtain such information, effective working group should be appointed and intensive survey should be conducted. The strategy should include prediction of future nuclear application which is expanding quickly.

9

1.6.3 The Philippines

HUMAN RESOURCE DEVELOPMENT IN THE NUCLEAR FIELD: STRATEGY FOR THE PHILIPPINES

by
CORAZON C. BERNIDO, ESTRELLA D. RELUNIA
& JOCELYN L. DAVID

1. INTRODUCTION

The Philippine Nuclear Research Institute (PNRI) formerly the Philippine Atomic Energy Commission (PAEC) is the sole agency mandated by the Philippine Government to develop and regulate the safe and peaceful uses of nuclear science and technology. PNRI's vision is to be an institution of excellence in nuclear science and technology propelled by a dynamic and committed workforce in the mainstream of national development. It's mission is to contribute to the improvement of the quality of Filipino life through the highest standards of nuclear research and development, specialized nuclear services, nuclear technology transfer and effective and efficient implementation of nuclear safety practices and regulations.

Human resources development in the country is presently geared towards radiation safety, radioisotope applications and research utilizing radioisotopes, nuclear safety and security, safety culture, ISO standardization and accreditation, harmonization of radiation protection practices, training for nuclear regulatory staff, emergency preparedness, training in nuclear science for teachers, and Nondestructive Testing (NDT).

2. HISTORICAL BACKGROUND

Nuclear technology was formally introduced in the Philippines with the signing of the Agreement for Cooperation on the Peaceful uses of Atomic Energy between the Philippines and the United States in 1955. In 1958, the Philippine Atomic Energy Commission (PAEC) was created by the Science Act of 1958 otherwise known as R.A. 2067, and was given the dual responsibility of promoting and regulating the utilization of peaceful applications of atomic energy. Its initial efforts were manpower training and development program and the acquisition and installation of a 1-megawatt nuclear research reactor (PRR-1) and its associated laboratories. In 1958, the Philippines became a member of the International Atomic Energy Agency. By 1960, some 58 Filipinos had been trained in various fields of atomic energy such as physics, engineering, radioisotope applications, reactor technology, nuclear and radiochemistry and health physics. In 1959, the PAEC Nuclear Training Institute conducted the first Radioisotope Techniques Training Course (April 3 – May 5, 1959) with 18 participants. As the PAEC R & D Program was firmed up, the PAEC Nuclear Training Institute correspondingly programmed and conducted, in addition to the basic RTTC, other courses on Industrial Uses of Radioisotopes (IURC), Radiological Health and Safety (RHSC), Medical Uses of Radioisotopes, Agricultural uses of Radioisotopes, Neutron Activation Analysis and Radiochemistry. These courses were offered to researchers of science-oriented agencies and educational institutions.

In 1963, PAEC's main facility, the first Philippine Research Reactor (PRR-1) rated at 1 megawatt, became critical or was able to sustain a chain reaction on August 26. Human resource development then was focused on the operation, maintenance and utilization of research reactors.

In 1968, R.A. 5207 was passed. This Act provides for the licensing of atomic energy facilities and nuclear materials and became the basis for licensing the first Philippine Nuclear Power Plant. Human Resource Development at this time was geared towards licensing regulations, safeguards and nuclear safety. PAEC was again reorganized in 1974 under P.D. 606, and transferred from NSDB to the Office of the President to better respond to the nuclear power development program of the country.

The introduction of nuclear power program in the country in 1975 necessitated a more aggressive approach in human resource development. The PAEC in support of the Nuclear Power program conducted training courses in Introduction to Nuclear Power and the Nuclear Operator's Course for the personnel of the utility company. Nuclear Science and Engineering Courses for colleges and universities were also pursued. Nuclear Engineering (3-unit), Nuclear Physics(3-unit) and Nuclear Chemistry (3-unit) subjects were also included in all Engineering courses. The University of the Philippines started offering the MS Nuclear Engineering Program. Fellowship training through the International Atomic Energy Agency were on nuclear power operation, nuclear instrumentation, nuclear licensing and regulation, safety, radiological emergencies. Environmental impacts of nuclear power, radioactive waste management. (Attached is the Nuclear Manpower Development Program both for the Regulatory and Utility).

In 1977, PAEC and other energy governing bodies were absorbed and placed under the administrative jurisdiction of the Ministry of Energy.

In 1980, by virtue of Executive Order 613, PAEC was again placed under the direct supervision and control of the Office of the President to ensure objectivity and effectiveness in the exercise of its regulatory and licensing functions.

PAEC was again attached to the Office of the President under E.O. 708, in 1981,and again in 1982, under E.O. 784, PAEC was placed under the administrative supervision of NSTA.

Under E.O. 980, in 1984, a board of commissioners was formed composed of a chairman and four associate commissioners in preparation for the licensing of the BNPP-1, the first nuclear power plant.

In 1986, the Bataan Nuclear Power Plant was nearing completion when President Corazon Aquino, came into power. One of her very first Executive Orders was to mothball the nuclear power plant. With the Philippine Government decision not to go nuclear, the activities in development of human resource related to nuclear power plant was frozen. The University of the Philippines stopped offering courses in MS Nuclear Engineering and schools and universities offering engineering courses revised their curriculum removing nuclear engineering as a required subject. A revamp of the science curriculum in colleges and universities took place with nuclear power given the least emphasis.

With the decision to mothball the BNPP-1, the PAEC revised its Nuclear Manpower Development Program. Personnel training on Applications of radioisotopes in different fields were now the priority areas of human resource development. It was also at this time that PAEC decided to convert the PRR-1 research reactor to TRIGA. Personnel were then sent abroad to train on the conversion, maintenance and operation of the TRIGA reactor.

In 1981, MS Medical Physics Course was established at the UST Graduate School as an initiative of the PAEC, IAEA and the Department of Health. The program is still on-going up to the present.

In 1985, Medical Physics and Radiation Dosimetry Division was created in the Radiation Health Service., DOH.

In 1987, the PAEC then composed of a Chairman and four (4) associate commissioners was reorganized to PNRI, headed by a Director and a Deputy Director. Its main functions are to conduct research and development on the application of radiation and nuclear materials, processes and techniques in agriculture, food, health, nutrition and medicine and in industrial or commercial enterprises; license and regulate all activities relative to nuclear applications. At this time, the Co-60 Irradiation Facility was nearing completion. Human resource development at this time were then on installation, operation and maintenance of the Co-60 Irradiation Facility.

There was a complete turnabout of the areas of human resource development in the 90's. Major emphasis were on applications of radioisotopes in industry and hydrology, medicine, biology, and agriculture, safety in nuclear energy, nuclear regulations and safeguards, waste management radiation protection and research. All these fellowships and training abroad were sponsored by the International Atomic Energy Agency Program.

With the equipment granted by IAEA in support of the BNPP-1, PNRI started developing its human resource on Nondestructive Testing. Under the IAEA technical assistance program, fellows were sent abroad to train on radiography, ultrasonics, liquid penetrant, magnetic particle and eddy current testing. Soon, PNRI was training the industry in nondestructive testing. In cooperation with the Philippine Society for Nondestructive Testing (PSNT), the PNRI has trained a total of 2,208 NDT technicians and engineers.

3. THE NEED FOR A STRATEGY

The strategy for human resource development in the nuclear field addresses the needs of the following:

1) users of nuclear technology in industry, medicine, agriculture, research, and other areas;
2) radiation safety officers in organizations or institutions licensed to use radioactive materials
3) manpower in support of a future nuclear power program, the research reactor, as well as public information and nuclear awareness specialists;
4) the education sector especially professors and teachers in tertiary and secondary education;
5) PNRI for its research, promotion, training and regulatory functions.

4. STATUS OF HUMAN RESOURCES DEVELOPMENT ACTIVITIES

PNRI ACTIVITIES

The Philippine Nuclear Research Institute regularly conducts national training courses in nuclear science and technology, and radiation protection to users of radioisotopes in academic and research institutions, hospitals and medical institutions, and industrial companies. The PNRI also conducts training courses and seminars in nuclear science for high science teachers and university/college faculty. These courses range from three days to five weeks. The following courses are of five week duration: Nuclear Technology for University/College Faculty, Seminar in Nuclear Science for High
School Science Teachers, and Radiation Cytogenetics Course. Our four-week courses are: Radioisotope Techniques Training Course (RTTC) either for medical personnel for academe (research), Industrial Uses of Radioisotopes Course and Radiological Health and Safety Course. Two week courses include the nondestructive testing courses (RT, UT, SM, ET). One week courses include the Radioimmunoassay Course, Introduction to Nuclear Science for High School Science Teachers, Introduction to Nuclear Science for Elementary Science Teachers and Radiation Safety Courses.

In spite of all these efforts, the negative attitudes of the population towards anything "nuclear" is still high. The reason may be the misconceptions and inadequate information regarding the beneficial uses of nuclear science and technology. One effective way to counteract this negative perception is to coordinate with the Department of Education (DepEd) and the Commission on Higher Education (CHED) for the inclusion of nuclear science in all levels of the science curriculum. There are around 6,673 schools offering secondary education and 100,000 science teachers. One-week Introduction to Nuclear Science Course is offered by PNRI to high school science teachers, or university upon request by a particular school or university.

Up to the present time, around 7,000 have participated in national training courses conducted by PNRI. The trainees are users of radioisotopes in the Philippines, researchers, practitioners in the medical field and industry as well as high school teachers and university faculty. There are around 400 trainees per year. Minimum entrance requirement is a Bachelor's degree in science and engineering except for level 1 radiographic testing course.

In addition to training courses, PNRI accepts undergraduate and graduate students for On-the-job training, as well as thesis and research advisorships, in different areas of nuclear science. From 1995 up to the present time, around 500 students have availed of this type of training from PNRI.(Appendix 1 shows the summary of number of trainees trained by PNRI)

Nuclear Science and Technology Education in Schools and Universities

In secondary or high school education, radiation and nuclear science/technology including nuclear power are taught mainly in the fourth year science and technology curriculum, under Physics. In the college or university level in the Philippines, not all curricula for a Bachelor of Science college or university degree incorporate nuclear science/technology as a one semester 3-unit course. Although recommended by the Technical Panel of the Commission on Higher Education (CHED), it is not a requirement but the option of a particular school to include nuclear science and technology topics in their Bachelor of Science curricula. The MS in Medical Physics established in 1981 at the UST Graduate School. So far, 14 graduated with MS degrees and 37 students are still completing the degree. In 1997, another private university, De La Salle University started offering BS Medical Physics in June 1997.

Training Abroad Through Linkages With Other Countries

Foreign training availed of by PNRI personnel as well as by those from other agencies, shows that 68% came from IAEA, 27% from Japan and 5% through bilateral arrangements with other countries.

The fora/activities participated in by Philippine researchers and scientists in Japan include the STA Scientist Exchange Program, the Group Training Courses sponsored by the Japan International Cooperation Agency (JICA), the activities under the Forum for Nuclear Cooperation in Asia (FNCA), and the seminars managed by the INTC/RADA (International Nuclear Technology Cooperation Center/Radiation Application Development Association).

5. DEVELOPMENT OF AN HRD STRATEGY

5.1 Objectives of the HRD Strategy

The HRD strategy has the objective of ensuring sufficient human resources and manpower for the activities outlined below, and ensuring radiation protection and the safe utilization of nuclear techniques, as well as the implementation of nuclear regulations.
Activity Areas

The needs for human resources in the nuclear field arise from the following activity areas:

a) Nuclear applications in industry, medicine, agriculture, research, and other areas;
b) Manpower in support of a future nuclear power program and in support of the Philippines' research reactor;
c) Science and technology education, specifically in the nuclear field.

In (a) there is a need for training users of radioisotopes, and for training radiation safety officers and medical physicists, as required by regulations. There is a need for M.S. and Ph.D. holders in Medical Physics. In (b) the need is more long range in nature, but the more immediate need is in the area of public acceptance and public awareness of nuclear science and technology, as well as graduate degrees, MS or Ph.D. holders in Nuclear Engineering. Also in support of the research reactor there is a need for personnel trained in the repair of research reactors, as well as in their utilization. In (c) there is a need to enhance and upgrade nuclear science and technology education
in schools and universities in the secondary level and in the tertiary level. This means training the teachers, and revising high school and college curricula to include nuclear science education. Addressing the need in the activity area (c) will greatly contribute to the social and political climate necessary for a successful nuclear power program.

5.2 Framework for HRD Strategy

The national human development strategy in the nuclear field includes: 1) conduct of local training by PNRI; 2) nuclear science and technology education in schools and universities; 3) role of international cooperation, i.e. training abroad through linkages with relevant institutions and organizations in foreign countries; 4) new techniques for education and training; and 5) preservation of expertise – how to address brain drain and retirement of personnel with expertise in nuclear S & T. An interagency committee chaired by the DOST, with representatives from PNRI, DECS and CHED will supervise the implementation of this HRD strategy.

5.2.1 Role of the Philippine Nuclear Research Institute

The training made available and conducted by PNRI locally, as well those made available through PNRI's linkages with the International Atomic Energy Agency (IAEA) and other foreign institutions, are able to meet some of the HRD requirements. However, the PNRI is acutely facing a shortage of technical personnel to replace those due for retirement and those lost through brain drain, because of the government's policy of no hiring which has been in effect for a number of years. The situation will become critical in a few more years. The DOST shall support the PNRI in its request to the Department of Budget and Management (DBM) for more funds to be able to recruit young and talented graduates.

5.2.2 Nuclear Science and Technology Education

There is a pressing problem of nuclear science education in the secondary level as well as in the tertiary level. Revision of the school curricula in science and technology to include nuclear S & T should be initiated by PNRI in cooperation with DECS, CHED and DOST. At the same time, science teachers and supervisors should be trained in the basics of radiation and nuclear technology. The infrastructure for the offering of graduate academic programs in nuclear science and technology in the country needs to be developed or enhanced. The possibility of forming a consortium among three or four universities in the offering of M.S. Medical Physics is being explored.

5.2.3 The Role of International Cooperation

In addition to the training programs presently available through PNRI's linkages with foreign institutions, the following needs can be met through international cooperation, especially in the areas of academic training and exchange programs.

5.2.3.1 Academic Training

In support of the research reactor which is undergoing repair and the future of the country's nuclear power program, young engineers should be encourage to take up M.S./Ph.D in Nuclear Engineering with full support of the Philippine Government.

There is also a growing need for M.S. Medical Physics graduates who will be employed in hospitals with radiotherapy facilities, linear accelerators, and baby cyclotrons for Positron Emission Tomography (PET) scanning. The M.S. Medical Physics Program at UST should be supported by training faculty abroad for the Ph.D. degrees.

5.2.3.2 Exchange Programs

An exchange program scheme should be devise for teachers. A Filipino teacher may go to another country for training while a teacher from another country may come to the

Philippines to demonstrate the teaching of nuclear science and technology. The training for high school teachers now being implemented by MEXT/RADA is a welcome development.

Faculty development in the field of Medical Physics may be enhance by some arrangement such as visiting professors in Medical Physics from other countries.

There is a need to develop certain types of training courses such as a training course on the applications of radioisotopes in agriculture, biotechnology and research. Training of trainors could be undertaken in other countries.

5.2.4 New Techniques for Education and Training

Efforts should be directed to develop training materials, visual aids, computer-aided instruction and simple equipment for detecting radioactivity.

The infrastructure for internet-based learning in the Philippines is growing rapidly. In addition, the interconnectivity of countries in the region is enhanced by an IAEA/RCA project on Electronic Networking and Outreach. Therefore, development of internet-based teaching and learning modules on nuclear science and technology will be important in the near future.

5.2.5 Preservation of Expertise

The government through the DOST has revived the Balik Scientist Program, to counteract brain drain.Ways and means to strengthen this program have to be implemented. Due to the shortage of experts in the area of nuclear S & T, the DOST could provide a mechanism for the hiring of retired experts as consultants.

5.2.6 Role of Nuclear Science Societies

There are at present six (6) active nuclear societies in the country. They are: 1) The Radioisotope Society of the Philippines (RSP); 2) Philippine Society for Nondestructive Testing (PSNT); 3) Philippine Association for Radiation Protection (PARP); 4) Philippine Society of Nuclear Medicine (PSNM); 5) Philippine Organization of Medical Physicists, and 6) Nuclear Research Foundation (NRF).

These societies assist PNRI in the dissemination of nuclear knowledge to the public through the conduct of seminars, conferences, meetings and nuclear training courses.

5.2.7 Advocacy Agenda

Increased efforts shall be directed at changing knowledge-base, attitudes, beliefs, values, behavior and norms of the individual and institutional stakeholders in nuclear science and development of nuclear science culture.

Figure 1 shows the factors of HRD in Atomic Energy Development in the country.

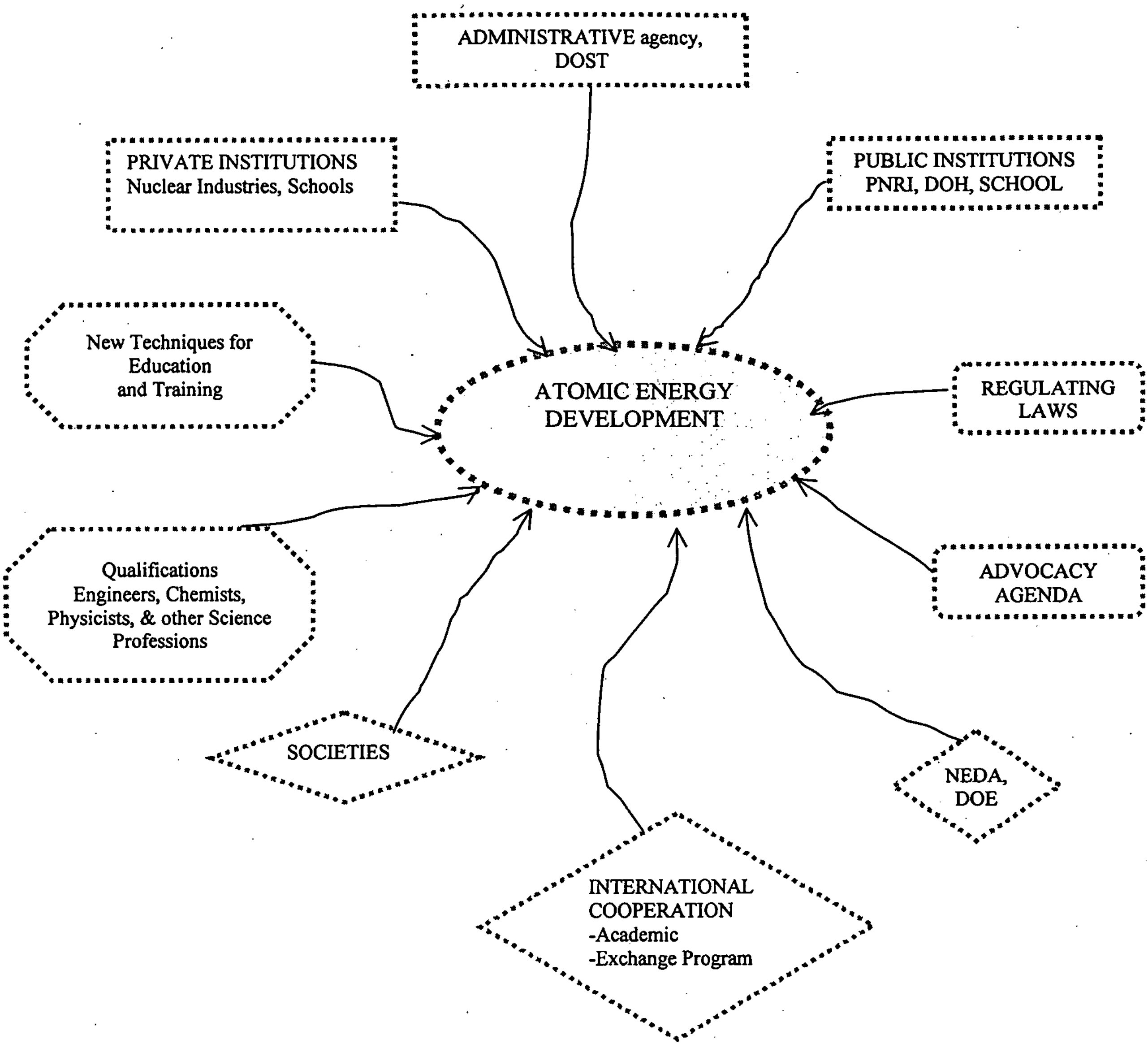

Figure 1. FACTORS OF HUMAN RESOURCE DEVELOPMENT IN ATOMIC ENERGY DEVELOPMENT IN THE PHILIPPINES

6. POLICY TARGETS OF NUCLEAR DEVELOPMENT (2005 – 2014)

A projection of the country's energy needs shows a window for nuclear power in the year 2020. The Policy Targets of nuclear development assumes that the Government is not embarking on a Nuclear Power Program in the near future.

Please refer to attached sheet for the projection.

POLICY TARGETS OF NUCLEAR DEVELOPMENT (2004-2014): PHILIPPINES

AREAS/NEEDS FOR DEVELOPMENT	2004	2005	2006	2007	2008	2009
1.Users of nuclear technology						
1.1 Industry						
-Irradiation	1	1	1	1	2	2
-NDT	1	2	2	3	3	4
--others	1	1	1	1	1	1
1.2 Medicine	2	2	2	2	3	3
1.3 Agriculture	2	3	3	4	4	5
1.4 Research	2	3	4	4	4	4
1.5 Environment	2	3	3	4	4	5
1.6 Others						
-ICT	1	2	2	3	3	3
-Data Base System	1	1	1	2	2	2
-Q.C.	1	2	2	3	3	4
2. Radiation Safety Officers	2	5	8	10	10	12

POLICY TARGETS OF NUCLEAR DEVELOPMENT (2004-2014): PHILIPPINES

AREAS/NEEDS FOR DEVELOPMENT	2010	2011	2012	2013	2014	TOTAL
1.Users of nuclear technology						
1.1 Industry						
-Irradiation	2	3	3	3	3	22
-NDT	4	4	4	4	4	35
--others	1	1	1	1	1	11
1.2 Medicine	4	4	4	4	4	34
1.3 Agriculture	5	5	4	4	4	43
1.4 Research	4	4	4	5	5	43
1.5 Environment	5	6	6	6	6	50
1.6 Others						
-ICT	3	3	4	4	4	32
-Data Base System	3	3	3	3	3	24
-Q.C.	4	4	5	5	5	38
2. Radiation Safety Officers	12	15	15	20	25	134

POLICY TARGETS OF NUCLEAR DEVELOPMENT (2004-2014): PHILIPPINES

AREAS/NEEDS FOR DEVELOPMENT	2004	2005	2006	2007	2008	2009
3. Support Manpower						
3.1 Research Reactor	1	2	2	2	3	3
3.2 Disposal facility of RAM	1	1	1	1	2	2
3.3 Nuclear Power	-	-	-	-	-	1
4. Education						
4.1 Tertiary	1	2	2	3	3	4
4.2 Secondary	2	4	6	8	10	12
5. Advocacy Agenda						
5.1 Promotion	2	4	4	4	6	6
5.2 Training						
-e-learning module	2	2	2	3	3	3
5.3 Science culture	2	2	2	3	3	3
6. Nuclear Regulations/Licensing	2	2	2	2	2	2
TOTAL	29	44	46	63	71	81

POLICY TARGETS OF NUCLEAR DEVELOPMENT (2004-2014): PHILIPPINES

AREAS/NEEDS FOR DEVELOPMENT	2010	2011	2012	2013	2014	TOTAL
3. Support Manpower						
3.1 Research Reactor	3	4	4	4	4	32
3.2 Disposal facility of RAM	2	2	2	2	2	18
3.3 Nuclear Power	1	1	1	1	1	6
4. Education						
4.1 Tertiary	4	4	5	5	5	38
4.2 Secondary	12	14	14	16	16	114
5. Advocacy Agenda						
5.1 Promotion	6	8	8	8	10	66
5.2 Training						
-e-learning module	4	4	4	5	5	37
5.3 Science culture	4	4	4	5	5	37
6. Nuclear Regulations/Licensing	3	3	3	3	3	27
TOTAL	86	96	98	108	115	841

7. RECOMMENDED ACTION PLAN AND TIMETABLE

Year 2005	Request for increase number of PNRI technical personnel complement
Year 2005 – 2014	Implementation of the Strategy

Appendix 1.

SUMMARY OF PERSONNEL TRAINED IN NUCLEAR SCIENCE AND TECHNOLOGY (LOCAL)

COURSE	NUMBER OF TRAINEES
1. Radiological Health and Safety Course	511
2. Radioisotope Techniques Training Course	1858
3. Industrial Uses of Radioisotope Course	714
4. Introductory Course for Science Teachers	324
5. Nuclear Technology for University/College Faculty	331
6. Seminar in Nuclear Science for High School Science Teachers	476
7. Others	360
8. Nondestructive Testing Courses	2,208
9. OJT, Thesis Advisorship	500
TOTAL	6,958

Appendix 2.

FOREIGN TRAINING OF PNRI PERSONNEL FROM 1964 TO PRESENT

FIELDS	YEARS									
	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Nuclear Power, Fuel Cycle, and Waste Technology										1
Nuclear Installation, Radiation and Waste Safety										1
Nuclear Science Applications (Human Health)		1					1	2	1	
Nuclear Science Applications (Environment)										
Nuclear Science Applications (Food and Agriculture)								1		
Physical and Chemical Sciences	1		2	1	1	1	1	2		
Safeguards, Licensing, Regulations										
Information Technology										
Public Information, Technology Transfer, Education and Training										
Project Planning, Design, Management, Evaluation										
Meetings and Conferences										
General Atomic Energy Development										
Total Number of Trained Personnel	1	1	2	1	1	1	2	5	1	2

FOREIGN TRAINING OF PNRI PERSONNEL FROM 1964 TO PRESENT

FIELDS	YEARS									
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Nuclear Power, Fuel Cycle, and Waste Technology		1	1	1	1	3		3	2	1
Nuclear Installation, Radiation and Waste Safety						2	2			1
Nuclear Science Applications (Human Health)			2	1		1				3
Nuclear Science Applications (Environment)							1	1		1
Nuclear Science Applications (Food and Agriculture)					4	3			1	
Physical and Chemical Sciences	3	1	2	1	2		2	4	3	4
Safeguards, Licensing, Regulations						1	2	1	4	2
Information Technology										
Public Information, Technology Transfer, Education and Training					1					
Project Planning, Design, Management, Evaluation										
Meetings and Conferences										
General Atomic Energy Development										
Total Number of Trained Personnel	3	2	5	3	8	10	7	9	10	12

FOREIGN TRAINING OF PNRI PERSONNEL FROM 1964 TO PRESENT

FIELDS	YEARS									
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Nuclear Power, Fuel Cycle, and Waste Technology	2	3				1		2		1
Nuclear Installation, Radiation and Waste Safety	9	5	5	6	3	8	8	8	7	6
Nuclear Science Applications (Human Health)	1	4	2	3	3	1	3	1	2	5
Nuclear Science Applications (Environment)	2	2			2	3	3	1	0	4
Nuclear Science Applications (Food and Agriculture)	1	1	3	2	3	4	1	8	5	2
Physical and Chemical Sciences	11	10	6	6	8	12	6	8	11	11
Safeguards, Licensing and Regulations	5	2	1		3			1		1
Information Technology			1			1	2	1	2	
Public Information, Technology Transfer, Education and Training		1				1		2		3
Project Planning, Design, Management, Evaluation				1	1		2			
Meetings and Conferences						7	1	21	8	23
General Atomic Energy Development					1	2	2	2	2	2
Total Number of Trained Personnel	31	28	18	18	24	40	28	55	37	58

FOREIGN TRAINING OF PNRI PERSONNEL FROM 1964 TO PRESENT

FIELDS	YEARS										
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total No. of Trained Personnel
Nuclear Power, Fuel Cycle, and Waste Technology	2	3	1	1	2	2	4		1	2		41
Nuclear Installation, Radiation and Waste Safety	12	16	14	12	18	20	13	21	23	27	20	267
Nuclear Science Applications (Human Health)	6	2	1	4	3	7	3	5	3	5		71
Nuclear Science Applications (Environment)	3	3	4	5	5	7	5	6	4	4	9	76
Nuclear Science Applications (Food and Agriculture)	5	7	3	4	5	7	7	8	6	9	3	111
Physical and Chemical Sciences	13	9	7	12	8	16	16	13	16	18	11	260
Safeguards, Licensing and Regulations	2	1	6	1	3	4	4	4	6	2	2	58
Information Technology		1	1			2	5	1	2	4	4	27
Public Information, Technology Transfer, Education and Training	1	7	1	2	4	4	2	1		6	3	39
Project Planning, Design, Management, Evaluation	3			2		4	1	7	2	2	1	27
Meetings and Conferences	16	23	24	22	25	30	26	29	33	31	9	328
General Atomic Energy Development	2	1	3	2	3	2	2	2	4	5	3	40
ISO and Certification			1				1					2
Total Number of Trained Personnel	65	73	66	67	76	105	89	97	100	119	65	1345

Appendix 3. Nuclear Manpower Development Program

NUCLEAR POWER MANPOWER DEVELOPMENT PROGRAM

In support of the Philippine Nuclear Power Program, the specialized training of personnel from the Regulatory Body and the personnel from the Utility in certain specific areas is necessary. Some types of training have to be done abroad (on-the-job or formal courses) while some may be done locally. These categories are presented separately.

In the case of the Regulatory Body, all of the training abroad may be requested from the International Atomic Energy Agency (IAEA), and the United Nations Development Program (UNDP) as part of a Technical Assistance Project. In the case of the Utility, while some of the training abroad may be requested under the same IAEA/UNDP project, it has to shoulder most of the budgetary requirements for training.

Part A. Training Needed by the Regulatory Body

The Regulatory Body will carry out the functions of: a)Assessment and licensing; b) Regulatory inspection and enforcement; c) Development of regulation and guides; and d) Administrative and legal support.

At the initial stage of a nuclear power program when the first nuclear plant is planned, around 30 regulatory personnel have to possess adequate training in different areas, as shown in Table 1. As more power plants are in different stages of planning, implementation and operation, the number of regulatory personnel to be trained will increase to around fifty. These additional personnel will be trained in the same areas as in Table 1.

Local training offered by the Philippine Nuclear Research Institute that may be availed of by the Regulatory Body and the Utility are shown in Table 2. In addition, the offering of a graduate degree program in Nuclear Engineering (M.S. Nuclear Engineering) may be revived (Table 3). In the past, this type of program had been offered at the University of the Philippines, as a result of a Memorandum of Agreement entered into by the National Power Corporation, Philippine Atomic Energy Commission (now PNRI), and the University of the Philippines in 1976.

Part B. Training Needed by the Utility

It is estimated that the manpower needed to operate a nuclear power plant is around one thousand (1,000), and around 350 staff of the Utility need appropriate training. Initially, the different fields of training needed to be obtained abroad are shown in Table 4, while the training that can be undertaken locally are shown in Table 5.

Part C. Budgetary Requirements

I. Training Program for the Regulatory Body

As mentioned previously, the training abroad of personnel from the Regulatory Body may be facilitated and funded by a Technical Assistance Project that may be proposed to the IAEA and UNDP. For a total of 519 man-months of training slots as outlined in Table 1 for the first nuclear power plant, this would involve a Technical Assistance funding of US$1,634,850. This amount is arrived at using the 1994 IAEA estimate of $3150 per man-month of training. For subsequent plants, additional personnel have to be trained and thus this amount has to be doubled.

For 30 personnel from the Regulatory Body that have to be trained abroad, the amount to be budgeted for clothing and pre-travel expenses based on present rates will total approximately P730,800. (Note: 1 US$ = P30.00).

II. Training Program for the Utility

The estimated cost for training initially around 180 personnel is US$12,000,000 as indicated in Table 6. This will involve an outlay of about US$2,400,000 (unescalated) every year for a five-year training period.

Part D. Training Schedule

The training or retraining for both the Regulatory and Utility staff will start as soon as the Comprehensive Nuclear Power Program is approved, and will follow the sequence of expertise needed as the program progresses. The training can start as early as six years to seven years before the first nuclear power plant operates.

These schedules are given in Tables 7 and 8 for the Regulatory Body and the Utility, respectively and are factored in the overall program time schedule (Part II).

RECOMMENDATIONS:

Training of both utility and regulatory personnel should start as soon as the decision to go ahead with the Comprehensive Nuclear Power Program is made.

TABLE 1. Fellowships Abroad Needed by the Regulatory Body

Field of Training	No. to be Trained/ Months of Training
Pre-Project Activities (Year 1)	
1. M.S. or Ph.D. in Nuclear Engineering	5 / 24-60 mos.
2. Siting of nuclear power plants	2 / 3 mos.
3. Safety Analysis Review	1 / 3 mos.
4. Public Information Regarding Nuclear Power Plants	1 / 3 mos.
5. Environmental Impact of Nuclear Power Plants	2 / 3 mos.
6. Legal Aspects of Nuclear Power Regulation	1 / 6 mos.
Project Implementation (Year 2)	
7. Conduct of Regulatory Licensing & Inspection Programs	1 / 2 mos.
8. Operators Licensing	1 / 6 mos.
9. Nuclear Power Plant Simulator Training	1 / 6 mos.
10. Codes & Standards Development	1 / 12 mos.
11. Nuclear Safeguards	1 / 6 mos.
12. Regulatory Records Management	1 / 6 mos.
13. Conduct of Training Programs for Regulatory Personnel	1 / 3 mos.
14. Management of Nuclear Manpower Development Program	1 / 2 mos.
Plant Construction (Year 3)	
15. Structural Analysis	1 / 6 mos.
16. Civil Works Construction Inspection	3 / 6 mos.
17. Materials Engineering	1 / 6 mos.
18. Non-destructive Examination (Welding & Piping)	2 / 6 mos.
19. Containment System	1 / 6 mos.
20. Quality Assurance Review & Inspection	4 / 6 mos.

Table 1. (Cont'd.)

Field of Training	No. to be Trained / Months of Training
Commissioning (Year 4)	
21. Electrical Systems Installation and Testing	2 / 12 mos.
22. Instrumentation & Control Systems & Testing	2 / 12 mos.
23. Mechanical Systems Installation and Testing	2 / 12 mos.
24. Accident & Transient Analysis	1 / 6 mos.
25. Management Oversight & Risk Tree Analysis (MORT)	1 / 3 mos.
26. Emergency Planning	1 / 6 mos.
27. Pre-operation & Start-up Testing (Control Engineering)	1 / 6 mos.
28. Pre-operation & Start-up Testing (Nuclear Engineering)	1 / 6 mos.
29. Pre-Service Inspection	1 / 6 mos.
Operation and Maintenance (Year 5)	
30. Reactor Core Physics Evaluation	1 / 12 mos.
31. Reactor Systems Safety	1 / 12 mos.
32. Physical Security Evaluation	1 / 6 mos.
33. Fueling/Refueling Operating Procedures	1 / 9 mos.
34. Plant Operations & Maintenance Procedures Review & Evaluation	1 / 6 mos.
35. Scientific Visits (Inspection of Plant Activities)	3 / 2 mos.
Operation and Maintenance (Year 6)	
36. In-plant Waste Management	1 / 6 mos.
37. Radwaste Disposal	1 / 6 mos.
38. Radioactive Waste Transportation	1 / 2 mos.
39. Radiation Protection	1 / 9 mos.
40. PWR Plant Chemistry	1 / 3 mos.
41. In-Service Inspection	1 / 6 mos.

Table 2. Local Training Available at PNRI

Title of Training Course	Duration
1. Introduction to Nuclear Power Course	6 weeks
2. Nuclear Power Plant Operators Course (Introductory Level)	12 weeks
3. Radioisotope Techniques Training Course	4 weeks
4. Safe Transport of Radioactive Materials Seminar	3 days
5. Radiological Health and Safety Course	4 weeks
6. Nondestructive Testing Training Courses, Levels 1-3 (Radiographic Testing, Ultrasonic Testing, Eddy Current Testing, Surface Methods)	1-2 weeks, depending on the Level
7. Seminars/Courses to be conducted locally by foreign IAEA experts	Upon request

Table 3. Academic Programs That May Be Offered In Support of the Nuclear Power Program

Type of Program	Possible Venue
1. M.S. Nuclear Engineering	University of the Philippines
2. Technician Courses (for skills needed in support of nuclear power)	Manila Technician Institute (TUP)

Table 4. Training Abroad Needed by the Utility

Field of Training	No. to be Trained / Months of Training
I. Design and Construction	
1. Executive Familiarization Course (for Top Management)	8 / 0.5 mo.
2. Project/Construction Management Program	6 / 3 mos.
3. Civil Works Installation and Testing	3 / 6 mos.
4. Mechanical Systems Installation and Testing	3 / 6 mos.
5. Electrical Systems Installation and Testing	3 / 6 mos.
6. I and C Systems Installation and Testing	3 / 6 mos.
7. Reactor Systems Installation	2 / 3 mos.
8. Construction Quality Assurance	4 / 6 mos.
9. Non-Destructive Examination	4 / 3 mos.
10. Special Processes	3 / 3 mos.
11. QA Records Management	2 / 2 mos.
12. Contracts Administration	3 / 4 mos.
13. Project Cost Control Engineering	3 / 4 mos.
14. Project Scheduling and Monitoring	3 / 4 mos.
15. Project Engineer Course	6 / 2 mos.
16. Design Review and Engineering	6 / 6 mos.
17. Site Investigation and Selection	2 / 2 mos.
TOTAL	239 MM
II. Commissioning and Operation	
A. Operations	
1. Plant Start-up/Commissioning	9 / 6 mos.
2. Fueling Operation	3 / 2 mos.
3. Reactor Operator Training	48 / 10 mos.
4. Plant Operation (OJT)	9 / 6 mos.
5. STA Training	8 / 4 mos.

Table 4. (Cont'd.)

Field of Training			No. to be Trained / Months of Training
B.	Maintenance		
	1.	Plant Start-up/Commissioning	5 / 6 mos.
	2.	Maintenance Engineer Training	7 / 3 mos.
	3.	I and C Engineer Training	2 / 3 mos.
	4.	Plant Maintenance (OJT)	5 / 6 mos.
	5.	Managed Maintenance Program	5 / 3 mos.
C.	Technical Services		
	1.	M.S. in Nuclear Engineering	6 / 24 mos.
	2.	Plant Start-up/Commissioning	4 / 6 mos.
	3.	Fuel Management	4 / 6 mos.
	4.	Reactor Engineering	6 / 6 mos.
	5.	SNM Accounting	2 / 2 mos.
	6.	Operational Core Analysis Program	6 / 1 mo.
	7.	PWR Chemistry	3 / 3 mos.
	8.	On-the-Job Training at Operating Nuclear Plant	4 / 6 mos.
	9.	Nuclear Safety Analysis	4 / 6 mos.
D.	Radiation Protection		
	1.	Plant/Start-up/Commissioning	4 / 6 mos.
	2.	Health Physics Training Course	9 / 9 mos.
	3.	On-the-Job Training at Operating Nuclear Plant	4 / 6 mos.
	4.	Emergency Planning and Preparedness	4 / 2 mos.
E.	Radwaste Management		
	1.	Nuclear Fuel Management	3 / 3 mos.
	2.	OJT at Operating Nuclear Plant	3 / 6 mos.
	3.	Interregional Training Course on Radioactive Waste Management	3 / 1 mo.
	4.	Spent Fuel Disposal and Repository	2 / 1 mo.
	5.	Radwaste Packaging, Transportation and Disposal	2 / 1 mo.

Table 4. (Cont'd.)

Field of Training			No. to be Trained/ Months of Training
F.	Quality Assurance		
	1.	QA Training in Start-up/ Commissioning	4 / 6 mos.
	2.	Pre-Service Inspection Training	4 / 6 mos.
	3.	In-Service Inspection Training	4 / 6 mos.
	4.	Reactor and Steam Generator Pre/ In-Service Inspection	2 / 1 mo.
	5.	OJT at Operating Nuclear Plant	4 / 6 mos.
G.	Safety and Security		
	1.	Fire Protection Engineering	2 / 4 mos.
	2.	Industrial Safety in Nuclear Plants	2 / 2 mos.
	3.	Protection of Nuclear Facilities	3 / 2 mos.
H.	Engineering		
	1.	Systems Engineering	4 / 2 mos.
	2.	Design Basis Reconstruction	3 / 2 mos.
	3.	Configuration Management	2 / 2 mos.
	4.	Computer Aided Engineering	2 / 6 mos.
	5.	Transient Real-Time Engineering Analysis Tool System	2 / 6 mos.
	6.	Probabilistic Risk Assessment	2 / 1 mo.
	7.	Design Review (OJT)	4 / 6 mos.
		TOTAL	1,364 MM

Table 5. Local Training Needed by the Utility (NPC)

Field/Title of Training	Duration
1. PWR Information Course	12 weeks
2. Introduction to Nuclear Power Course	6 weeks
3. Nuclear Power Plant Operators Course	6 weeks
4. Licensed Candidates On-Site Training	52 weeks
5. OJT at Conventional Power Plant	26 weeks
6. Equipment Operator Training	40 weeks
7. Plant Mechanic Training	12 weeks
8. Plant Electrician Training	12 weeks
9. I and C Technician Training	12 weeks
10. HP Technician Training	12 weeks
11. Radiation Protection Training	1 week
12. Organic Security Training	6 weeks
13. General Employee Training	1 week
14. Chemical Technician Training	12 weeks

Table 6. Estimated Cost of Utility (NPC)
Training Abroad

A.	Program Cost	
1.	Reactor Operator Training, Courses @ $ 1,000,000	$ 4,000,000
2.	STA Training	200,000
3.	Maintenance Engineer Training	200,000
4.	I and C Engineer Training	200,000
5.	Managed Maintenance Program	100,000
6.	M.S. in Nuclear Engineering	100,000
7.	Fuel Management	50,000
8.	Reactor Engineering	200,000
9.	Operational Core Analysis	50,000
10.	PWR Chemistry	200,000
11.	Health Physics Program	500,000
12.	PSI/ISI Program	100,000
13.	Project Control and Monitoring	50,000
14.	Project Engineer Course	100,000
15.	Various Programs	200,000
	SUB-TOTAL	$ 6,300,000
B.	Travel, Living and Accommodation	
1.	Plane Fare, 282 RT @ 2,000	$ 564,000
2.	Miscellaneous Expenses, 282 RT @ 500	141,000
3.	Per Diem, $3,000/mo. x 1603 mos.	4,809,000
	SUB-TOTAL	$ 5,514,000
	TOTAL	$11,814,000
	SAY	$12,000,000

Table 7. Training Schedule for the Regulatory Body and Budgetary Requirements

Year / Training Areas	Cost of Foreign Training (US $)	Clothing Allowance/ Pre-departure Expenses
Year 1 Pre-Project Activities (Nos. 1-6, Table 1) Total Man-Months = 216	$680,400	P151,200
Year 2 Project Implementation (Nos. 7-14, Table 1) Total Man-Months = 43	$135,450	P100,800
Year 3 Plant Construction (Nos. 15-20, Table 1) Total Man-Months = 72	$226,800	P151,200
Year 4 Commissioning (Nos. 21-29, Table 1) Total Man-Months = 105	$330,750	P151,200
Year 5 Operation & Maintenance (Nos. 30-35, Table 1) Total Man-Months = 51	$160,650	P100,800
Year 6 Operation & Maintenance (Nos. 36-41, Table 1) Total Man-Months = 32	$100,800	P 75,600
TOTALS:	$ 1,634,850	P730,800

NUCLEAR MANPOWER DEVELOPMENT PROGRAM
TRAINING SCHEDULE (UTILITY)

Field of Training	YEAR 1				2				3				4				5			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
I. Design and Construction																				
1. Executive Familiarization Course		(4)	(4)																	
2. Proj./Construction Management			(3)		(3)															
3. Civil Works Installation					(3)															
4. Mechanical Systems Installation					(3)															
5. Electrical Systems Installation					(3)															
6. I & C Systems Installation					(3)															
7. Reactor Systems Installation						(2)														
8. Construction Quality Assurance		(2)			(2)															
9. Non-Destructive Examination		(2)		(2)																

( ) Number of personnel to be trained

NUCLEAR MANPOWER DEVELOPMENT PROGRAM
TRAINING SCHEDULE (UTILITY)

Field of Training	YEAR 1				2				3				4				5			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
10. Special Processes				(3)																
11. QA Records Management				(2)																
12. Contracts Administration			(3)																	
13. Project Cost Control Engineering					(3)															
14. Proj. Scheduling and Monitoring					(3)															
15. Project Engineer Course					(6)															
16. Design Review and Engineering						(3)			(3)											
17. Site Investigation and Selection		(2)																		
II. Commissioning and Operation																				
A. Operations																				
1. Plant/Startup/ Commissioning		(4)			(5)															
2. Fueling Operation									(3)											

( ) Number of personnel to be trained

TRAINING SCHEDULE (UTILITY)

15

Field of Training	YEAR 1				2				3				4				5			
	1	2	3	4	1	2	3	4	1	2	3	1	1	2	3	4	1	2	3	4
3. Reactor Operator Training						(2)				12				12				12		
4. Plant Operation (OJT)					(4)				(5)											
5. STA Training									(8)											
B. Maintenance																				
1. Plant Startup/ Commissioning		(2)			(3)															
2. Maintenance Engineer Training					(7)															
3. I & C Engineer Training					(2)															
4. Plant Maintenance (OJT)					(3)				(2)											
5. Managed Maintenance Program												(6)								
C. Technical Services																				
1. M.S. in Nuclear Engineering						(3)											(3)			

( ) Number of personnel to be trained

NUCLEAR MANPOWER DEVELOPMENT PROGRAM
TRAINING SCHEDULE

Field of Training	YEAR 1				2				3				4				5			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
4. Emergency Planning and Preparedness								(4)												
E. Radwaste Management																				
1. Nuclear Fuel Management				(3)																
2. OJT at Operating Nuclear Plant					(3)															
3. IAEC Course on Waste Management								(3)												
4. Spent Fuel Disposal									(2)											
5. Radwaste Packaging. Disposal											(2)									
F. Quality Assurance																				
1. Plant Startup/ Commissioning			(2)				(2)													
2. Pre-Service Inspection					(4)															
3. In-Service Insp							(4)													

( ) Number of personnel to be trained

NUCLEAR MANPOWER DEVELOPMENT PROGRAM
TRAINING SCHEDULE

Field of Training	YEAR 1				2				3				4				5			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
4. Reactor and Steam Genrator PSI/ISI										(2)										
5. OJT at Operating Nuclear Plant											(4)									
G. Safety & Security																				
1. Fire Protection Engineering			(2)																	
2. Industrial Safety in Nuclear Plants			(2)																	
3. Protection of Nuclear Facilities					(1)				(1)				(1)							
H. Engineering																				
1. Systems Engr'g.			(4)																	
2. Design Basis Reconstruction					(3)															
3. Configuration Management						(2)														
4. Computer Aided Engineering							(2)													

( ) Number of personnel to be trained

NUCLEAR MANPOWER DEVELOPMENT PRORGAM
TRAINING SCHEDULE

YEAR

Field of Training	1				2				3				4				5			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
5. Transient Real Time Engineering Analysis									(2)											
6. Probabilistic Risk Assesment				(2)																
7. Design Review (OJT)					(2)						(2)									

( ) Number of personnel to be trained

Appendix 4.

SUMMARY OF PERSONNEL TRAINED IN NUCLEAR SCIENCE AND TECHNOLOGY (LOCAL)

Radioisotopes Techniques Training Course

Session	Date	Number of Participants
1st	April 3- May 15, 1959	18
2nd	May 11 – June 6, 1959	20
3rd	July 27 – September 4, 1959	20
4th	October 5 – November 13, 1959	20
5th	April 3 – May 12, 1961	20
6th	April 18 – May 27, 1960	20
7th	November 3 – December 16, 1960	19
8th	April 3 – May 12, 1961	29
9th	April 17 – May 12, 1961	12
10th	May 15 – June 9, 1961	19
11th	July 24 – September 1, 1961	22
12th	October 30 – December 8, 1961	22
13th	April 30 – June 8, 1962	20
14th	July 30 – September 7, 1962	18
15th	January 14 – February 22, 1963	19
16th	April 22 – May 31, 1963	19
17th	August 12 – September 22, 1963	24
18th	November 4 – December 13, 1963	18
19th	April 27 – June 5, 1964	22
20th	January 11 – February 19, 1965	18
21st	October 18 – November 26, 1965	21
22nd	June 6 – July 15, 1966	24
23rd	July 18 – August 26, 1966	24
24th	April 24 – June 2, 1967	24
25th	October 16 – November 24, 1967	23
26th	January 15 – February 23, 1968	25
27th	May 20 – June 28, 1968	19
28th	July 22 – August 30, 1968	23
29th	January 6 – February 14, 1969	24
30th	April 28 – June 6, 1969	26
31st	January 5 – February 13, 1970	24
32nd	May 4 – June 11, 1970	20
33rd	October 19 – November 26, 1970	26
34th	May 3 – June 11, 1971	20
35th	September 6 – October 15, 1971	31
36th	May 2 – June 9, 1972	20
37th	August 15 – October 6, 1972	33
38th	April 23 – May 26, 1973	23
39th	February 11 – March 22, 1974	28
40th	April 15 – May 24, 1974	17

Radioisotopes Techniques Training Course

Session	Date	Number of Participants
41st	August 5 – September 13, 1974	35
42nd	January 27 – March 7, 1975	28
43rd	April 7 – May 16, 1975	16
44th	August 4 – September 18, 1975	43
45th	April 5 – May 15, 1976	13
46th	July 26 – September 10, 1976	36
47th	April 18 – May 27, 1977	24
48th	April 18 – May 27, 1977	19
49th	August 22 – September 30, 1977	27
50th	April 17- May 26, 1978	3
51st	October 17 – November 17, 1978	19
52nd	April 16 – May 25, 1979	14
53rd	February 4 – March 14, 1980	25
54th	April 14 – May 23, 1980	4
55th	February 2 – March 20, 1981	24
56th	October 5 – November 13, 1981	18
57th	February 8 – March 19, 1982	18
58th	January 31 – March 11, 1983	23
59th	April 16 – May 26, 1984	26
60th	March 4 – April 12, 1985	18
61st	June 16 – July 25, 1986	22
62nd	June 22 – July 31, 1987	29
63rd	October 13 – November 20, 1987	15
64th	February 16 – March 25, 1988	22
65th	January 23 – February 24, 1989	22
66th	May 2 – June 2, 1989	21
67th	October 23 – November 17, 1989	19
68th	February 19 – March 16, 1990	16
69th	February 4 – March 1, 1991	13
70th	May 6 – June 7, 1991	10
71st	October 14 – November 8, 1991	11
72nd	March 30 – April 29, 1992	10
73rd	March 8 – April 2, 1993	18
74th	February 11 – March 11, 1994	15
75th	July 25 – August 18, 1994	29
76th	July 24 – August 18, 1995	26
77th	April 22 – May 24, 1996	10
78th	July 22 – August 16, 1996	24
79th	July 21 – August 15, 1997	20
80th	July 20 – August 14, 1998	25

SUMMARY OF PERSONNEL TRAINED IN NUCLEAR SCIENCE AND TECHNOLOGY (LOCAL)

Radioisotopes Techniques Training Course

Session	Date	Number of Participants
81st	July 19 – August 13, 1999	23
82nd	July 17 – August 11, 2000	26
83rd	July 16 – August 10, 2001	27
84th	July 22 – August 16, 2002	35
85th	October 28 – November 22 , 2002	11
86th	July 14 – August 8, 2003	34
87th	July 19 – August 13, 2004	18
	Total Number of Participants	1858

SUMMARY OF PERSONNEL TRAINED IN NUCLEAR SCIENCE AND TECHNOLOGY (LOCAL)

Industrial Uses of Radioisotope Course

Session	Date	Number of Participants
1st	January 3 – 31, 1962	14
2nd	October 29 – December 7, 1962	12
3rd	April 19 – May 28, 1965	14
4th	February 6 – March 17, 1967	16
5th	February 26 – April 5, 1968	11
6th	July 7 – August 15, 1969	13
7th	August 10 – September 18, 1970	16
8th	May 3 – June 11, 1971	12
9th	January 24 – March 3, 1972	14
10th	January 27 – March 7, 1975	13
11th	September 13 – October 22, 1976	12
12th	August 22 – September 30, 1977	25
13th	April 17 – May 26, 1978	3
14th	October 10 – November 17, 1978	27
15th	October 15 – November 23, 1979	23
16th	October 13 – November 21, 1980	34
17th	June 29 – August 7, 1981	22
18th	October 6 – November 13, 1981	24
19th	April 12 – May 21, 1982	23
20th	August 16 – September 24, 1982	18
21st	March 7 – April 15, 1983	27
22nd	September 12 – October 21, 1983	18
23rd	June 18 – July 21, 1984	22
24th	January 21 – March 1, 1985	24
25th	August 12 – September 20, 1985	22
26th	March 10 – April 18, 1986	11
27th	January 26 – March 6, 1987	9
28th	October 13 – November 20, 1987	13
29th	April 4 – May 5, 1989	24
30th	October 23 – November 17, 1989	15
31st	September 10 – October 5, 1990	18
32nd	September 9 – October 4, 1991	16
33rd	February 3 – 28, 1992	11
34th	February 8 – March 5, 1993	21
35th	March 21 – April 15, 1994	19
36th	February 13 – March 10, 1995	13
37th	February 12 – March 8, 1996	13
38th	February 10 – March 7, 1997	16
39th	October 5 – 30, 1998	13
40th	October 4 – 29, 1999	10
41st	September 18 – October 13, 2000	14
42nd	October 15 – November 9, 2001	10
43rd	April 19 – May 14, 2004	9
	Total Number of Participants	714

SUMMARY OF PERSONNEL TRAINED IN NUCLEAR SCIENCE AND TECHNOLOGY (LOCAL)

Radiological Health and Safety Course

Session	Date	Number of Participants
1st	February 5 – March 2, 1962	19
2nd	October 29 – December 7, 1962	12
3rd	August 02 – September 10, 1965	17
4th	February 6 – March 17, 1967	9
5th	February 23 – April 5, 1968	7
6th	July 7 – August 15, 1969	6
7th	August 10 – September 18, 1970	10
8th	July 30 – September 14, 1973	14
9th	June 23 – July 31, 1980	24
10th	October 8 – November 16, 1984	15
11th	October 21 – November 29, 1985	16
12th	September 26 – October 21, 1988	28
13th	August 7-September 1, 1989	19
14th	August 6 – 31, 1990	21
15th	June 10 – July 5, 1991	22
16th	November 25 – December 18, 1991	10
17th	June 15 – July 10, 1992	26
18th	June 14 – July 9, 1994	18
19th	June 13 – July 9, 1994	19
20th	June 5 – 30, 1995	18
21st	June 10 – July 5, 1996	22
22nd	June 9 – July 4, 1997	19
23rd	June 3 – July 8, 1998	23
24th	June 7 – July 2, 1999	11
25th	June 5 – 30, 2000	28
26th	June 4 – 29, 2001	23
27th	May 27 – June 21, 2002	24
28th	June 2 – 27, 2003	15
29th	June 7 – July 2, 2004	16
	Total Number of Participants	511

SUMMARY OF PERSONNEL TRAINED IN NUCLEAR SCIENCE AND TECHNOLOGY (LOCAL)

Nuclear Technology for University/College Faculty

Session	Date	Number of Participants
1st		
2nd		
3rd		
4th	June 30, 1967	22
5th		
6th	May 4 - June 11, 1970	6
7th	May 3 - June 11, 1971	11
8th	May 2 - June 9, 1972	1
9th	May 26, 1973	4
10th		
11th	April 7 - May 16, 1975	4
12th	April 5 - May 15, 1976	8
13th	April 18 - May 27, 1977	6
14th	April 18 - May 27, 1977	11
15th	April 11 – May 20, 1977	21
16th	April 17 - May 26, 1978	4
17th	April 17 - May 26, 1978	12
18th	April 16 - May 25, 1979	12
19th	April 14 - May 23, 1980	12
20th	April 14 - May 23, 1980	13
21st	April 20 - May 29, 1981	16
22nd	April 12 - May 21, 1982	14
23rd	April 16 – May 26, 1984	13
24th	April 28 - June 6, 1986	15
25th		
26th		
27th		
28th	April 23 – May 25, 1990	18
29th	April 27 –May 29, 1992	18
30th	May 3 – June 4, 1993	9
31st	April 18- May 20, 1994	7
32nd	April 17 – May 19, 1995	4
33rd	April 21 – May 23, 1997	19
34th	April 20 – May 22, 1998	6
35th	April 26 – May 28, 1999	8
36th	April 24 – May 26, 2000	4
37th	April 16 – May 18, 2001	11
38th	April 22- May 24, 2002	6
39th	April 21 – May 23, 2003	6
40th	April 12 – May 14, 2004	10

SUMMARY OF PERSONNEL TRAINED IN NUCLEAR SCIENCE AND TECHNOLOGY (LOCAL)

Seminar on Nuclear Science for High School Science Teachers

Session	Date	Number of Participants
1st	January 27 - May 17, 1969	25
2nd	May 11 - June 5, 1970	21
3rd	May 10 - June 4, 1971	34
4th	May 8 - June 9, 1972	9
5th	April 23 - May 26, 1973	31
6th	April 15 - May 24, 1974	21
7th	April 7 - May 16, 1975	19
8th	April 5 - May 15, 1976	8
9th	April 18 - May 27, 1977	14
10th	April 18 - May 27, 1977	20
11th	April 20 - May 29, 1981	11
12th	April 18 - May 27, 1983	20
13th	April 18 - May 27, 1983	20
14th	April 27 -June 5, 1987	25
15th	May 6 – June 7, 1991	7
16th	April 27 – May 29, 1992	11
17th	May 3 – June 4, 1993	14
18th	April 18 – May 20, 1994	12
19th	April 17 – May 19, 1995	14
20th	April 21 – May 24, 1996	16
21st	April 21 - May 23, 1997	19
22nd	April 21 – May 22, 1998	16
23rd	April 26 – May 28, 1999	6
24th	April 24 – May 26, 2000	16
25th	April 16 – May 18, 2001	15
26th	April 22 – May 24, 2002	11
27th	April 21 – May 23, 2003	26
28th	April 12 – May 14, 2004	15

SUMMARY OF PERSONNEL TRAINED IN NUCLEAR SCIENCE AND TECHNOLOGY (LOCAL)

Radiation Cytogenetics in Biomedical, Occupational Health and safety, and Environmental Monitoring Problems

Session	Date	Number of Participants
1st	November 6- 21, 1975	14
2nd	August 22 – September 23, 1988	12
3rd	April 2 – May 4, 1990	8
4th	May 2 – 25, 1995	14
	Total Number of Participants	48

Training Course on Radioimmunoassay

Session	Date	Number of Participants
1st		
2nd	July 5 – 15, 1988	24
3rd	August 21 – 31, 1990	18
4th	August 26 – September 6, 1991	18
5th	August 3 – 14, 1992	15
6th	November 20 – 24, 1995	12
7th	October 7 – 11, 1996	16
8th	September 1 – 5, 1997	10
9th	September 21 – 25, 1998	11
10th	November 15 – 19, 1999	17
11th	October 23 – 27, 2000	11
12th	November 5 – 9, 2001	13
13th	October 14 – 18, 2002	18
14th	November 24 – December 1, 2003	16
	Total Number of Participants	199

Basic Nuclear Electronics Course (Instrumentation)

Session	Date	Number of Participants
1st	September 28 – October 30, 1964	11
2nd	March 12 – April 6, 1984	18
3rd	July 25 – August 19, 1988	14
4th	July 3 – August 4, 1989	11
	Total Number of Participants	54

Seminar on Safe Transport of Radioactive Materials

Session	Date	Number of Participants
1st	July 29 – 31, 1991	17
2nd	August 24 – 26, 1993	17
	Total Number of Participants	34

Seminar on ISO 11137: Requirements for Radiation Sterilization

Session	Date	Number of Participants
1st	August 1 – 3, 2001	2

Seminar –Workshop on Improvement of Safety Practices in Industrial Radiography

Session	Date	Number of Participants
1st	September 6 – 7, 2001	23

Introductory Course in Nuclear Science for University/High School Faculty

Session	Date	Number of Participants
1st	April 3 – 7, 1995	17
2nd	September 25 – 29, 1995	11
3rd	January 15 – 19, 1996	31
4th	April 19 – 23, 1999	30
5th	April 24 – 28, 2000	21
	Total Number of Participants	110

Introductory Course in Nuclear Science for Elementary School Science Teachers

Session	Date	Number of Participants
1st	January 17 – 19, 2001	30
2nd	May 21 – 23, 2001	22
	Total Number of Participants	52

High School Nuclear Science Education Training

Session	Date	Number of Participants
1st (Chemistry)	May 7 – 10, 1996	35
2nd (Physics)	May 13 – 17, 1996	42
2nd (Chemistry)	May 13 – 17, 1996	33
	Total Number of Participants	110

Seminar-Workshop on Application of Radioisotopes in Teaching

Session	Date	Number of Participants
1st (Chemistry)	April 16 – 20, 2001	22
1nd (Biology)	April 16 – 20, 2001	11
2nd (Chemistry)	May 8 – 12, 2001	10
2nd (Biology)	May 8 – 12, 2001	9
	Total Number of Participants	52

HUMAN RESOURCE DEVELOPMENT IN THE NUCLEAR FIELD: STRATEGY FOR THE PHILIPPINES

CORAZON C. BERNIDO, ESTRELLA D. RELUNIA and JOCELYN L. DAVID

1

HUMAN RESOURCE DEVELOPMENT IN THE NUCLEAR FIELD: STRATEGY FOR THE PHILIPPINES

PNRI is mandated to develop and regulate the safe and peaceful uses of nuclear science and technology.

2

HUMAN RESOURCE DEVELOPMENT IN THE NUCLEAR FIELD: STRATEGY FOR THE PHILIPPINES

MISSION: To contribute to the improvement of the quality of Filipino life through the highest standards of nuclear research and development, specialized nuclear services, nuclear technology transfer and effective and efficient implementation of nuclear safety practices and regulations.

3

HUMAN RESOURCE DEVELOPMENT IN THE NUCLEAR FIELD: STRATEGY FOR THE PHILIPPINES

Vision: To be an institution of excellence in nuclear science and technology propelled by a dynamic and committed workforce in the mainstream of national development.

4

HUMAN RESOURCE DEVELOPMENT IN THE NUCLEAR FIELD: STRATEGY FOR THE PHILIPPINES

The Human Resources Development in the country is presently geared towards radiation safety,radioisotope applications and research utilizing radioisotopes, nuclear safety and security, safety culture, ISO standardization and accreditation, harmonization of radiation protection practices, training for nuclear regulatory staff, emergency preparedness, training in nuclear science for teachers, and Nondestructive Testing.

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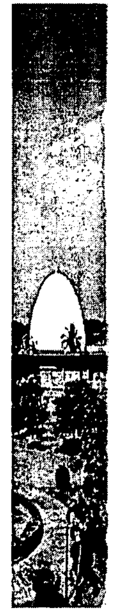

HISTORICAL BACKGROUND

An Agreement for Cooperation on the Peaceful Uses of Atomic Energy was signed between Philippines and United States of America in 1955.

Science Act of 1958 (R.A. 2067) led to the creation of Philippine Atomic Energy Commission (now Philippine Nuclear Research Institute).

HISTORICAL BACKGROUND

PAEC was given the dual responsibility of promoting and regulating the utilization of peaceful applications of atomic energy.

Its initial efforts: manpower training and development program, and acquisition and installation of a 1-Megawatt nuclear research reactor (PRR-1) and its associated laboratories.

HISTORICAL BACKGROUND

In 1958, the Philippines became a member of the International Atomic Energy Agency.

By 1960, some 58 Filipinos had been trained in various fields of atomic energy such as physics, engineering, radioisotope applications, reactor technology, nuclear and radiochemistry and health physics.

8

HISTORICAL BACKGROUND

In 1959, the PAEC Nuclear Training Institute conducted the first Radioisotope Techniques Training Course (April 3 – May 5, 1959) with 18 participants.

9

HISTORICAL BACKGROUND

The Philippine Research Reactor (PRR-1) rated at 1 Megawatt became critical on August 26, 1963.

The Human Resource Development then was focused on the operation, maintenance and utilization of research reactors.

HISTORICAL BACKGROUND

RA 5207 was passed in 1968 to provide for the licensing of atomic energy facilities and nuclear materials and to become the basis for licensing the first Philippine Nuclear Power Plant.

The Human Resource Development was geared towards licensing regulations, safeguards and nuclear safety.

11

HISTORICAL BACKGROUND

The introduction of nuclear power program in 1975 necessitated the PAEC to conduct "Introduction to Nuclear Power Course" and "Nuclear Operator's Course" for the personnel of the utility company. Nuclear Science and Engineering Courses for colleges and universities were also pursued.

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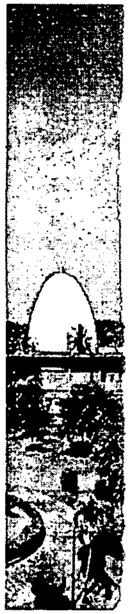

HISTORICAL BACKGROUND

Nuclear Engineering, nuclear physics and nuclear chemistry subjects were included in all engineering courses. The University of the Philippines offered MS Nuclear Engineering program. Fellowships and training through the IAEA were availed.

13

HISTORICAL BACKGROUND

PAEC and other energy governing bodies were absorbed and placed under the Ministry of Energy in 1977.

Executive Order 613 directed PAEC to be placed under the Office of the President in 1980, to ensure objectivity and effectiveness in executing regulatory and licensing functions.

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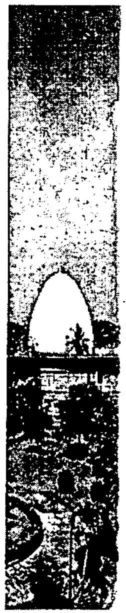


HISTORICAL BACKGROUND

PAEC was attached to the Office of the Prime Minister in 1981 by virtue of Executive Order 708.

Executive Order 784 empowered PAEC to be placed under the administrative supervision of the National Science and Technology Authority in 1982.

15

HISTORICAL BACKGROUND

By virtue of Executive Order 980 issued in 1984, the Board of Commissioners was formed consisting of a Chairman and four Associate Commissioners. Their task included overseeing the licensing of the BNPP-1.

16

HISTORICAL BACKGROUND

When the Bataan Nuclear Power Plant was near to its completion in 1986, President Corazon C. Aquino mothballed it through an Executive Order.

Human resource development on nuclear power was frozen.

17

HISTORICAL BACKGROUND

The University of the Philippines stopped offering the MS in Nuclear Engineering course. Colleges and universities removed the nuclear science and engineering subjects in their engineering course curriculum

18

HISTORICAL BACKGROUND

In 1981, the MS in Applied Physics major in Medical Physics was established at the University of Santo Tomas Graduate School, as a collaborative project among PAEC, IAEA and the Department of Health. The program is still on-going.

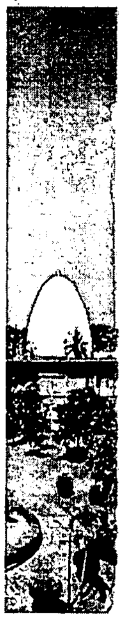
19

HISTORICAL BACKGROUND

In 1985, the Medical Physics and Radiation Dosimetry Division was created under the Radiation Health Services of the Department of Health.

In 1987, the PAEC was reorganized into Philippine Nuclear Research Institute, and a Director and a Deputy Director replaced the Chairman and four Associate Commissioners .

20



HISTORICAL BACKGROUND

In the 1990's, the Human Resource Development emphasized on applications of radioisotopes in industry, hydrology, medicine, biology,environment and agriculture, nuclear safety and regulations, safeguards, radiation protection and waste management. The foreign fellowships and training were sponsored by the IAEA.

21

HISTORICAL BACKGROUND

Using the equipment acquired through the IAEA grants-in-aid, PNRI started developing its human resource on Nondestructive testing. Under the IAEA technical assistance program, fellows underwent foreign training on radiography, ultrasonics, liquid penetrant,magnetic particle and eddy current testing.

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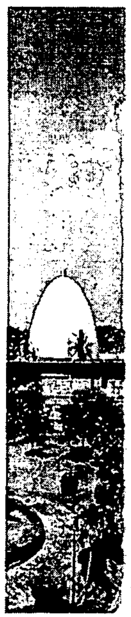

HISTORICAL BACKGROUND

Through the collaborative efforts between the Philippine Society for Nondestructive Testing (PSNT) and the PNRI, a total of 2,208 NDT technicians and engineers have been trained.

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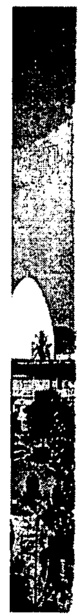

CHRONOLOGY OF HUMAN RESOURCES DEVELOPMENT

	1955	1956	1957	1958	1959
Private sector					
Public Institution					
Regulation and Qualification					
Policy Organization	Signing of Bilateral Agreement with USA on peaceful uses of atomic energy			IAEA Membership RA 2067 ◆——→ (Science Act of 1958) Creation of PAEC Development of	Nuclear Energy
Human Resource Development		Nuclear Training Institute, PAEC Local Training ◆······→			

24

CHRONOLOGY OF HUMAN RESOURCES DEVELOPMENT

	1960	1961	1962	1963	1964
Private sector					
Public Institution				PRR-1	
Regulation and Qualification					
Policy Organization	IAEA Membership RA 2067 (Science Act of 1958) Creation of PAEC (Since 1958)			PRR-1	
Human Resource Development	Nuclear Training Institute, PAEC Local Training (Since 1959)				Overseas Training and Study

25

CHRONOLOGY OF HUMAN RESOURCES DEVELOPMENT

	1965	1966	1967	1968	1969
Private sector					
Public Institution					
Regulation and Qualification				RA 5207 Licensing Atomic Energy Facilities	
Policy Organization	IAEA Membership (since 1958)				
Human Resource Development	Nuclear Training Institute, PAEC Local Training (since 1959) Overseas Training and Study (Since 1958)				

26

CHRONOLOGY OF HUMAN RESOURCES DEVELOPMENT

	1970	1971	1972	1973	1974
Private sector					
Public Institution					
Regulation and Qualification					
Policy Organization	IAEA Membership (Since 1958)				P.D. 606 Reorganization of PAEC re: Nuclear Power Plant
Human Resource Development	Nuclear Training Institute, PAEC Local Training (Since 1959) Overseas Training and Study (Since 1958				

27

CHRONOLOGY OF HUMAN RESOURCES DEVELOPMENT

	1975	1976	1977	1978	1979
Private sector					
Public Institution					
Regulation and Qualification					
Policy Organization	IAEA Membership (Since 1958)				
Human Resource Development	Local Training (since 1956) Overseas Training and Study (since 1964)	Nuclear Engineering subject included in Engineering curriculum Nuclear Manpower Development Program (prepared by Regulatory and Utility) MS Nuclear Engineering, UP Graduate School, Institute of Engineering			

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CHRONOLOGY OF HUMAN RESOURCES DEVELOPMENT

	1980	1981	1982	1983	1984
Private sector					
Public Institution					
Regulation and Qualification					
Policy Organization	EO 613 PAEC, OP	EO 708 PAEC, PM	EO 780 PAEC, NSTA		EO 980 PAEC Creation of Board of Commissioners
Human Resource Development	Nuclear Engineering Subjects included in Engineering Curriculum (Since 1976) Nuclear Manpower Development Program (Since 1976) MS Nuclear Engineering (Since 1976) Local Training (Since 1959) Overseas Training and Study (Since 1958)	MS Applied Physics major in Medical Physics			

29

CHRONOLOGY OF HUMAN RESOURCES DEVELOPMENT

	1985	1986	1987	1988	1989
Private sector					
Public Institution					
Regulation and Qualification					
Policy Organization	IAEA Membership	BNPP-1 Mothballed by Pres. Corazon C. Aquino			
Human Resource Development	Nuclear Training Institute, PAEC Local training (since 1956) Nuclear engineering subject in engineering curriculum (since 1976) Overseas training and study (since 1964) Nuclear Manpower Development Program (since 1976) MS Nuclear Engineering (since 1976) MS in Applied Physics (Medical Physics)			EO 128 PNRI, DOST Nuclear Training Unit	

30

CHRONOLOGY OF HUMAN RESOURCES DEVELOPMENT

	1990	1991	1992	1993	1994
Private sector					
Public Institution					
Regulation and Qualification					
Policy Organization	IAEA Membership				
Human Resource Development	Nuclear Training Institute, PAEC Local training (since 1956) Overseas training and study (since 1964) MS in Applied Physics (Medical Physics)				

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CHRONOLOGY OF HUMAN RESOURCES DEVELOPMENT

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Private sector										
Public Institution										
Regulation and Qualification										
Policy Organization	IAEA Membership									
Human Resource Development	Nuclear Training Unit, PNRI Local training (since 1988) Overseas training and study (since 1964) MS in Applied Physics (Medical Physics)									

32

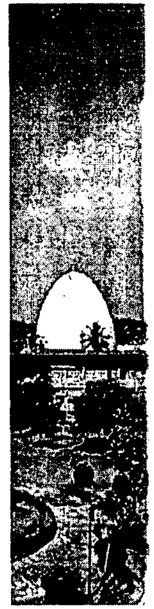
THE NEED FOR A STRATEGY

The strategy for human resource development in the nuclear field addresses the needs of the following:

users of nuclear technology in industry, medicine, agriculture, research and other areas;

radiation safety officers in organizations or institutions licensed to use radioactive materials;

33



THE NEED FOR A STRATEGY

The strategy for human resource development in the nuclear field addresses the needs of the following:

3. manpower in support of a future nuclear power program, the research reactor, as well as public information and nuclear awareness specialists;

34

THE NEED FOR A STRATEGY

The strategy for human resource development in the nuclear field addresses the needs of the following:

4. The education sector especially professors and teachers in tertiary and secondary education;
5. PNRI for its research, promotion, training and regulatory functions.

35

STATUS OF HUMAN RESOURCES DEVELOPMENT ACTIVITIES

The PNRI regularly conducts national training courses in nuclear science and technology, and radiation protection for the users of radioisotopes in academic and research institutions, medical institutions and industries. The nuclear training courses and seminars cater to the educators as well.

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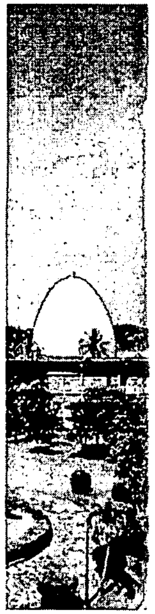

STATUS OF HUMAN RESOURCES DEVELOPMENT ACTIVITIES

Courses and Seminars:

Five-week duration

1. Nuclear Technology for University/College Faculty
2. Seminar in Nuclear Science for high School Science Teachers
3. Radiation Cytogenetics Course

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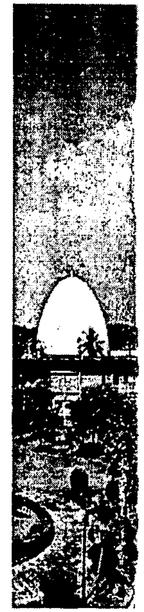


STATUS OF HUMAN RESOURCES DEVELOPMENT ACTIVITIES

Courses and Seminars:

Four-week duration

1. Radioisotope Techniques Training Course (medical or research)
2. Industrial Uses of Radioisotope Course
3. Radiological Health and Safety Course

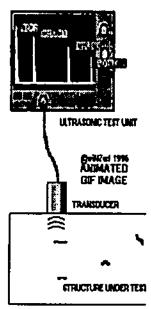
38

STATUS OF HUMAN RESOURCES DEVELOPMENT ACTIVITIES

Courses and Seminars:

Two-week Duration

1. Radiographic Testing
2. Ultrasonic Testing
3. Magnetic Particle Testing
4. Liquid Penetrant Testing
5. Eddy Current Testing



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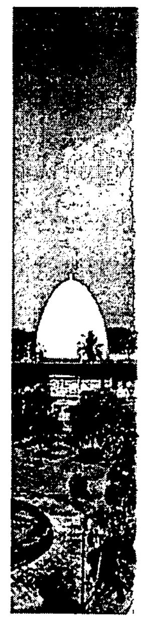

STATUS OF HUMAN RESOURCES DEVELOPMENT ACTIVITIES

Courses and Seminars:

One-week duration

1. Radioimmunoassay Training Course
2. Introduction to Nuclear Science for High School Science Teachers
3. Introduction to Nuclear Science for Elementary Teachers
4. Radiation Safety Course

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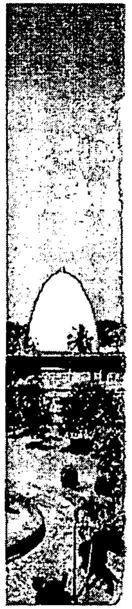


STATUS OF HUMAN RESOURCES DEVELOPMENT ACTIVITIES

The Negative attitude of the population towards anything "nuclear" is high because of misconception and inadequate information about the beneficial uses of radiation.

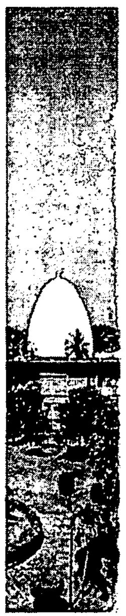
To counteract this, nuclear science should be included in all levels of science curriculum.

41

STATUS OF HUMAN RESOURCES DEVELOPMENT ACTIVITIES

There are about 6,673 schools offering secondary education with 100,000 science teachers.

42



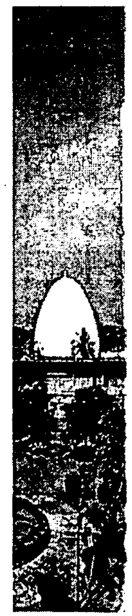
STATUS OF HUMAN RESOURCES DEVELOPMENT ACTIVITIES

To date, around 7,000 individuals have participated in the national training courses conducted by PNRI.

There are around 400 trainees every year.

The minimum entrance requirement to the courses (except for level 1 NDT courses) is a Bachelor's degree in engineering or science.

43



STATUS OF HUMAN RESOURCES DEVELOPMENT ACTIVITIES

PNRI offers On-the-Job Training, Thesis Advisorship and Research Advisorship to undergraduate and graduate students.

Since 1995, about 500 students have availed of this services from the PNRI

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NUCLEAR SCIENCE AND TECHNOLOGY EDUCATION IN SCHOOLS AND UNIVERSITIES

Nuclear science and technology is taught mainly in fourth year high school, as part of physics subject.

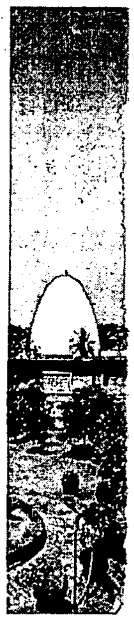
Not all colleges or universities in the Philippines opt to incorporate in their curricula for Bachelor of Science degrees a 3-unit course on nuclear science.

45

NUCLEAR SCIENCE AND TECHNOLOGY EDUCATION IN SCHOOLS AND UNIVERSITIES

A Technical Panel of the Commission on Higher Education recommends the inclusion of nuclear science and technology topics in Bachelor of Science curricula.

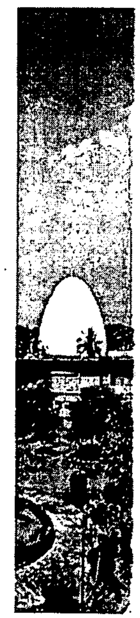
46



NUCLEAR SCIENCE AND TECHNOLOGY EDUCATION IN SCHOOLS AND UNIVERSITIES

The University of Santo Tomas Graduate School established the Master of Science in Applied Physics major in Medical Physics in 1981, in collaboration with the IAEA, the PNRI, the National Cancer Control Center and the Department of Health.

47



NUCLEAR SCIENCE AND TECHNOLOGY EDUCATION IN SCHOOLS AND UNIVERSITIES

To date, 14 graduated with MS in Applied Physics major in Medical Physics degrees and 37 are still working on the completion of the course.

In 1997, the De La Salle University started offering BS in Medical Physics

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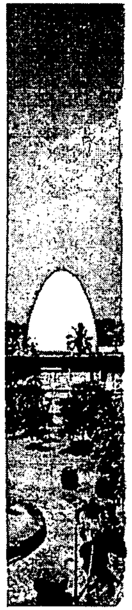

TRAINING ABROAD THROUGH LINKAGES WITH OTHER COUNTRIES

Foreign trainings of personnel from PNRI and other agencies were sponsored by IAEA (68%), Japan (27%) and other countries through bilateral agreements (5%).

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TRAINING ABROAD THROUGH LINKAGES WITH OTHER COUNTRIES

Filipino researchers and scientists undertook trainings in Japan through the STA Scientists Exchange Program, the Japan International Cooperation Agency, the FNCA, the MEXT and the INTC/RADA.

50

DEVELOPMENT OF AN HRD STRATEGY

Objectives of the HRD Strategy:

To ensure the development of sufficient human manpower and resources, the promotion of radiation protection, and the safe utilization of nuclear techniques.

51

DEVELOPMENT OF AN HRD STRATEGY

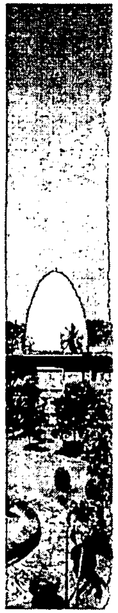
Activity Areas

The needs for human resources in the nuclear field arise from the following activity areas:

a) Nuclear applications in industry, medicine, agriculture, research, and other areas.

b) Manpower in support of the future nuclear power program and the operation of a research reactor.

52



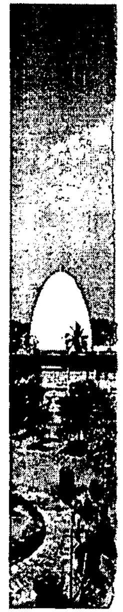
DEVELOPMENT OF AN HRD STRATEGY

Activity Areas

The needs for human resources in the nuclear field arise from the following activity areas:

c) Science and technology education, especially in the nuclear field.

53



FRAMEWORK FOR HRD STRATEGY

The national human development strategy in the nuclear fields includes:

1) conduct of local training by PNRI;
2) Nuclear science and technology education in schools and universities;
3) role of international cooperation, training abroad through linkages with relevant institutions and organizations in foreign countries.

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FRAMEWORK FOR HRD STRATEGY

The national human development strategy in the nuclear fields includes:

4) new techniques for education and training; and
5) preservation of expertise – how to address brain drain and retirement of personnel with expertise in nuclear science and technology.

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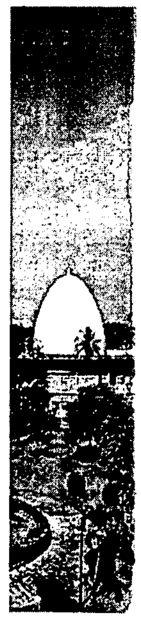

FRAMEWORK FOR HRD STRATEGY

An inter-agency committee chaired by the DOST representative, and consisting of other representatives from PNRI, the Department of Education and the Commission on Higher Education will supervise the implementation of this HRD strategy.

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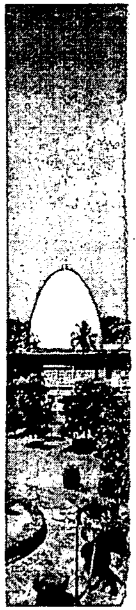

FRAMEWORK FOR HRD STRATEGY:
ROLE OF THE PHILIPPINE NUCLEAR RESEARCH INSTITUTE

The trainings conducted by PNRI and those made available through PNRI's linkages with the IAEA and other foreign institutions, are able to meet some of the HRD requirements.

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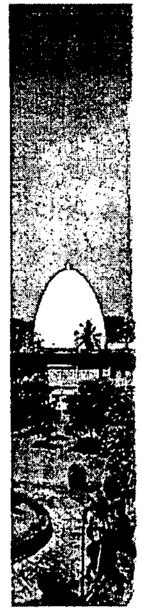

FRAMEWORK FOR HRD STRATEGY:
ROLE OF THE PHILIPPINE NUCLEAR RESEARCH INSTITUTE

However, PNRI is acutely facing a shortage of technical personnel who will be replacing the retired employees and those lost through brain drain, because of the government's policy of "No Hiring" for a number of years. The situation will become critical in a few more years.

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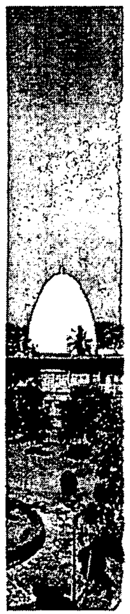

FRAMEWORK FOR HRD STRATEGY:
ROLE OF THE PHILIPPINE NUCLEAR RESEARCH INSTITUTE

The DOST shall support the PNRI in its request to the Department of Budget and Management for more funds to allow recruitment of young and talented graduates.

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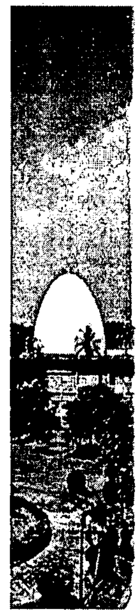
FRAMEWORK FOR HRD STRATEGY:
NUCLEAR SCIENCE AND TECHNOLOGY EDUCATION

There is a pressing problem of nuclear science education in the secondary level as well as in the tertiary level. The revision of curricula to include nuclear science and technology should be initiated by PNRI in cooperation with DECS, CHED and DOST.

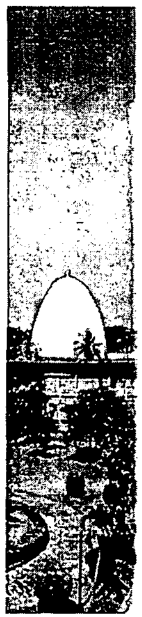
FRAMEWORK FOR HRD STRATEGY:
NUCLEAR SCIENCE AND TECHNOLOGY EDUCATION

Science teachers and supervisors should be trained on the basics of nuclear science and technology. The infrastructure for the offering of graduate academic programs in nuclear science and technology needs to be developed and enhanced.



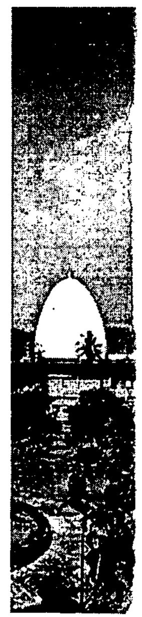
FRAMEWORK FOR HRD STRATEGY:
NUCLEAR SCIENCE AND TECHNOLOGY EDUCATION

The possibility of forming a consortium among three or four universities for the offering of MS Applied Physics major in Medical Physics is being explored.



FRAMEWORK FOR HRD STRATEGY:
The Role of International Cooperation

In addition to the training programs presently available through PNRI's linkages with foreign institutions, the following needs can be met through international cooperation, especially in the areas of academic training and exchange programs.



FRAMEWORK FOR HRD STRATEGY:
Academic Training

To prepare for the operation of the research reactor and the country's nuclear power program, the young engineers should be encouraged to pursue M.S. and Ph.D. in Nuclear Engineering with full support of the Philippine government.

FRAMEWORK FOR HRD STRATEGY:
Academic Training

There is a growing need for M.S. Medical Physics graduates who will be employed in hospitals with radiotherapy facilities, linear accelerators, and baby cyclotrons for Positron Emission Tomography (PET) scanning. Faculty members of the M.S. Medical Physics program should pursue Ph.D. in Medical Physics abroad.

FRAMEWORK FOR HRD STRATEGY:
Academic Training

A teacher exchange program scheme should be worked out to provide exposure in teaching and learning nuclear science and technology. The training for high school teachers now being implemented by MEXT/RADA is a welcome development.

FRAMEWORK FOR HRD STRATEGY:
Exchange Programs

Faculty development in the field of Medical Physics may be enhanced by some arrangement such as inviting visiting professors from other countries.

Certain types of training courses on the applications of radioisotopes in agriculture, biotechnology and research should be developed. The training of trainors could be undertaken in other countries.

FRAMEWORK FOR HRD STRATEGY:
New Techniques for Education and Traini

Efforts should be directed towards the development of training materials, visual aids, computer-aided instruction and simple equipment for detecting radioactivity.

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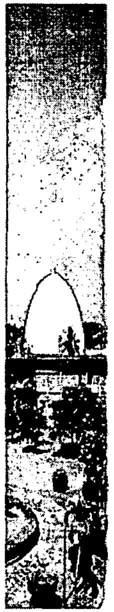

FRAMEWORK FOR HRD STRATEGY:
New Techniques for Education and Traini

The infrastructure for internet-based learning in the Philippines is growing rapidly. The interconnectivity of countries in the region is enhanced by an IAEA/RCA project on Electronic Networking and Outreach. The internet-based teaching and learning modules on nuclear science and technology will be important in the near future.

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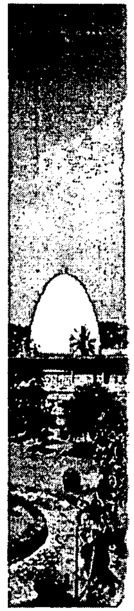

FRAMEWORK FOR HRD STRATEGY:
Preservation of Expertise

The DOST has revived the "Balik Scientist" program, to counteract brain drain. Ways and means to strengthen this program have to be enforced. To address the shortage of experts in nuclear science and technology, the DOST could provide mechanisms for the hiring of retired experts as consultants.

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FRAMEWORK FOR HRD STRATEGY:
Role of Nuclear Science Societies

There are at present six active nuclear societies in the country:

1) Radioisotope Society of the Philippines
2) Philippine Society for Nondestructive Testing
3) Philippine Association for Radiation Protection

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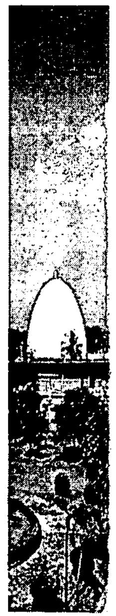

FRAMEWORK FOR HRD STRATEGY:
Role of Nuclear Science Societies

There are at present six active nuclear societies in the country:

4) Philippine Society of Nuclear Medicine
5) Philippine Organization of Medical Physicists
6) Nuclear Research Foundation

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FRAMEWORK FOR HRD STRATEGY:
Role of Nuclear Science Societies

These societies assist PNRI in disseminating nuclear knowledge to the public through the conduct of seminars, conferences, meetings and nuclear training courses.

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FRAMEWORK FOR HRD STRATEGY:
Advocacy Agenda

Increased efforts shall be directed at changing knowledge-based attitudes, beliefs, values, behavior and norms of the individual and institutional stakeholders in nuclear science and development of nuclear science culture.

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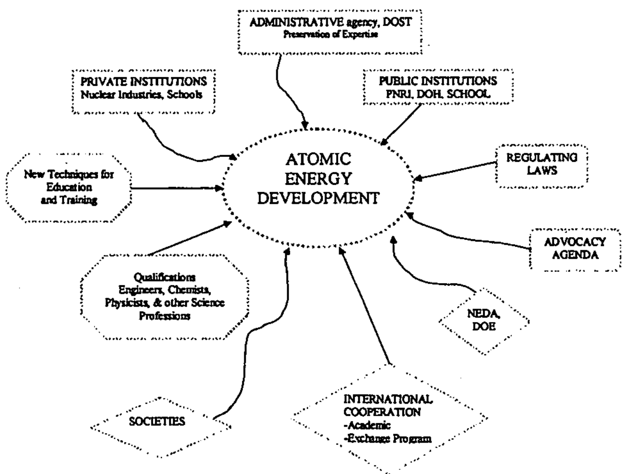
FACTORS OF HRD IN ATOMIC ENERGY DEVELOPMENT: PHILIPPINES



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POLICY TARGETS OF NUCLEAR DEVELOPMENT (2005-2014

A projection of the country's energy needs shows an open window for nuclear power in the year 2020. The policy targets of nuclear development assumes that the Government is not embarking on a Nuclear Power Program in the near future.

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POLICY TARGETS OF NUCLEAR DEVELOPMENT (2005-2014)

AREAS/NEEDS FOR DEVELOPMENT	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	TOTAL
1.Users of nuclear technology												
1.1 Industry												
-Irradiation	1	1	1	1	2	2	2	3	3	3	3	22
-NDT	1	2	2	3	3	4	4	4	4	4	4	35
--others	1	1	1	1	1	1	1	1	1	1	1	11
1.2 Medicine	2	2	2	2	3	3	4	4	4	4	4	34
1.3 Agriculture	2	3	3	4	4	5	5	5	4	4	4	43
1.4 Research	2	3	4	4	4	4	4	4	4	5	5	43
1.5 Environment	2	3	3	4	4	5	5	6	6	6	6	50
1.6 Others												
-ICT	1	2	2	3	3	3	3	3	4	4	4	32
-Data Base System	1	1	1	2	2	2	3	3	3	3	3	24
-Q.C.	1	2	2	3	3	4	4	4	5	5	5	38
2. Radiation Safety Officers	2	5	8	10	10	12	12	15	15	20	25	134

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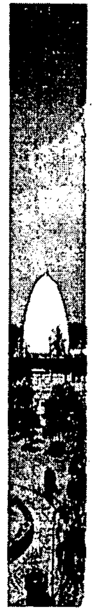

POLICY TARGETS OF NUCLEAR DEVELOPMENT (2005-2014)

AREAS/NEEDS FOR DEVELOPMENT	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	TOTAL
3. Support Manpower												
3.1 Research Reactor	1	2	2	2	3	3	3	4	4	4	4	32
3.2 Disposal facility of RAM	1	1	1	1	2	2	2	2	2	2	2	18
3.3 Nuclear Power	-	-	-	-	-	1	1	1	1	1	1	6
4. Education												
4.1 Tertiary	1	2	2	3	3	4	4	4	5	5	5	38
4.2 Secondary	2	4	6	8	10	12	12	14	14	16	16	114
5. Advocacy agenda												
5.1 Promotion	2	4	4	4	6	6	6	8	8	8	10	66
5.2 Training												
-e-learning module	2	2	2	3	3	3	4	4	4	5	5	37
5.3 Science culture	2	2	2	3	3	3	4	4	4	5	5	37
6. Nuclear Regulations/Licensing	2	2	2	2	2	2	3	3	3	3	3	27
TOTAL	29	44	46	63	71	81	86	96	98	108	115	841

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1.7 Special Presentation

1.7.1 Highlights Progress of FNCA Activties and Draft and Proposal FNCA HRD Project Plan

FNCA 2004 Workshop on Application of Accelerator September 7, 2004, Beijing, China

Highlights
Progress of FNCA Activities

Sueo MACHI

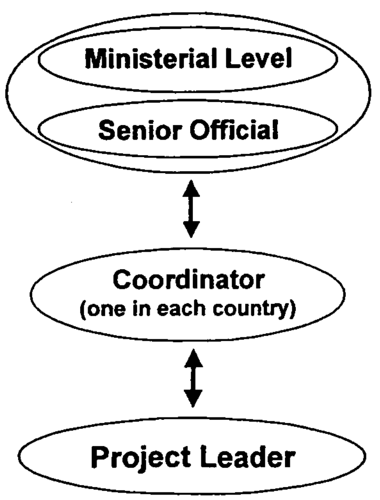
FNCA Coordinator of Japan

Commissioner

Atomic Energy Commission of Japan

FNCA (Forum for Nuclear Cooperation in Asia)

Participating Countries: Australia, China, Indonesia, Japan, Korea, Malaysia, the Philippines, Thailand, Vietnam



FNCA Vision Statement

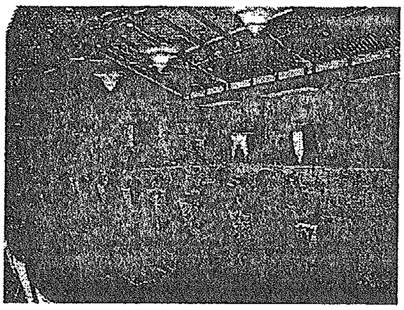
The FNCA is to be recognized as an effective mechanism for enhancing socioeconomic development through **active regional partnership** in the peaceful and safe utilization of nuclear technology.

Goals of FNCA

- **To achieve socio-economic development** by safe utilization of nuclear technology
- To utilize **nuclear technology** in those fields where it has a **distinct advantage**
- To **respond to the needs** of the FNCA

Progress Report on FNCA Activities in 2003
S. Machi

Fourth FNCA Meeting, Dec. 2-3, 2003, Okinawa
Senior Official Meeting and Ministerial Level Meeting



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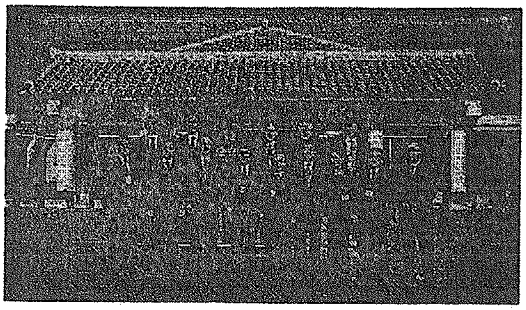
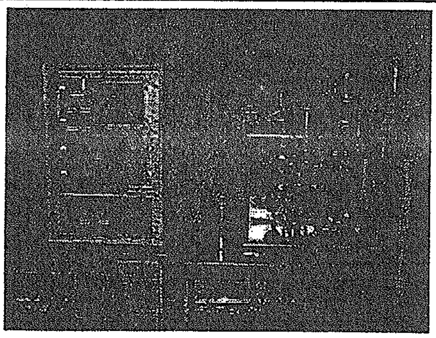


MM

Highlights of FNCA Projects

Tc-99m Generator Production

- Installation and operation of proto-type loading machine in BATAN in Dec., 2003 and Jan, 2004
- QA test of the products in 2004
- Strategic planning for installation of machine in FNCA countries



Loading machine of Mo-99 adsorbed PZC

Highlights of FNCA Projects

Mutation Breeding 1

- **Drought resistant**

  Soybean – the Philippines, Viet Nam, Malaysia, Indonesia

  Sorghum– China, Indonesia

  ⇨ Yield increase

Mutant sorghum (Indonesia)

Highlights of FNCA Projects

Mutation Breeding 2

- Insect resistant orchid

  Malaysia, Thailand

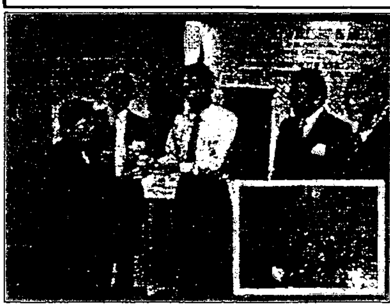
  ⇨ Export increase

- Disease resistant banana

  Indonesia, Malaysia, the Philippines, Viet Nam

  ⇨ Environmental protection

  ⇨ Reducing pesticide, germicide



Offer of orchid mutant from Thailand to Malaysia

Highlights of FNCA Projects

Biofertilizer 1

- Field demonstration in Viet Nam , for peanuts, 2003 (Rhizobia)
- Extension of biofertilizer to farmers
- Strategic field demonstration for less fertile soil

Peanuts with biofertilizer (Viet Nam 2003)

Peanuts without biofertilizer (Viet Nam 2003)

Highlights of FNCA Projects

Biofertilizer 2

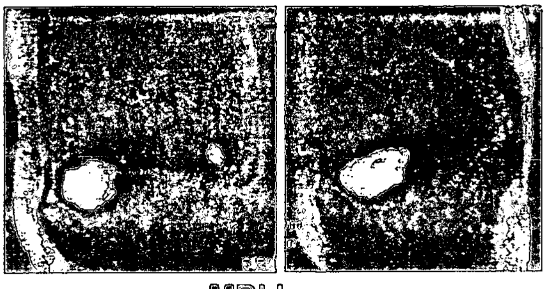
- Radiation sterilization of carriers such as peat and soil for production of inoculant

Peanuts with biofertilizer, Viet Nam, 2003

Highlights of FNCA Projects

Radiotherapy of Uterine Cancer

- For IIIB patient, after 5 years
  Survival rate 52.5%
  Local tumor control 81.5%
- Standard protocol was published for radiation oncologist
- Chemo-radio therapy for advanced uterine cancer, clinical study started in 2003



MRI Image

Radiotherapy of uterine cervix cancer by FNCA protocol

Highlights of FNCA Projects

Public Information of Nuclear Energy

- Survey on "Radiation" in 7 countries in 2002 for high school students
  ⇨strategy for effective PI
- Project leaders meeting, Viet Nam, 2003
- Enhancing communication with media, 2004
- Training nuclear communicators, 2005
- FNCA web-site upgrade by contribution of FNCA countries, 2004

Students answering questionnaires in Viet Nam

Highlights of FNCA Projects

Nuclear Safety Culture

- The 1st peer review in Dalat NRI, Viet Nam, 2003
  ⇨ useful recommendations
- The 2nd peer review
  HANARO, Korea 2004
- Self-assessment of the safety culture (IAEA Code of Conduct)

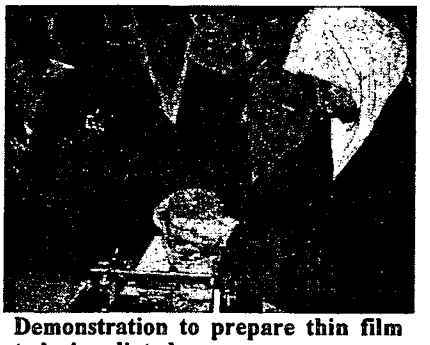
Peer review team in Da Lat, Viet Nam

Highlights of FNCA Projects

Application of Electron Accelerators

- Demonstration experiment for thin film irradiation at MINT, Malaysia, 2003
- Demonstration in China for flue gas, 2004
- Economical and technical evaluation of low energy EB applications, 2004

Electron accelerator in MINT, Malaysia



Demonstration to prepare thin film to be irradiated

New Activities 1

1.Title

Panel on "Roles of Nuclear Energy for Sustainable Development in Asia" – approved by the 4th FNCA Meeting

2. Background

- **Sharp increase of energy demand in Asia due to population growth and socio-economic development**
- **Global warming due to GHG should be avoided**
- **Energy security is priority issues in Asia**

3. Outline of the Panel

Activities:

- **Long term energy planning in each country and the region**
- **Assessment of the cost competitive production of electricity and reduction of GHG emission in different energy mixes including nuclear if appropriate in each country**

New Activities 2

Projects on "Positron Emission Tomography, Cyclotron and Isotopes for Nuclear Medicine" proposed by the Government of Malaysia has been strongly supported by all FNCA countries at the last SOM, the PET is the most advanced and efficient nuclear medicine technology for early diagnosis for cancer. Australia, China, Japan, Korea, the Philippine have PET. Malaysia and Vietnam will install PET in 2004. Project will start in 2005.

(3) Evaluation of Projects (Draft)

1) Indicators for evaluation

As agreed at the 3rd Coordinators Meeting, FNCA Projects should be completed in 3 to 5 years in accordance with the evaluation.

The evaluation should be made based on following indicators:

a.Socio-economic impact (potential and tangible)

b.Scientific impact (new finding)

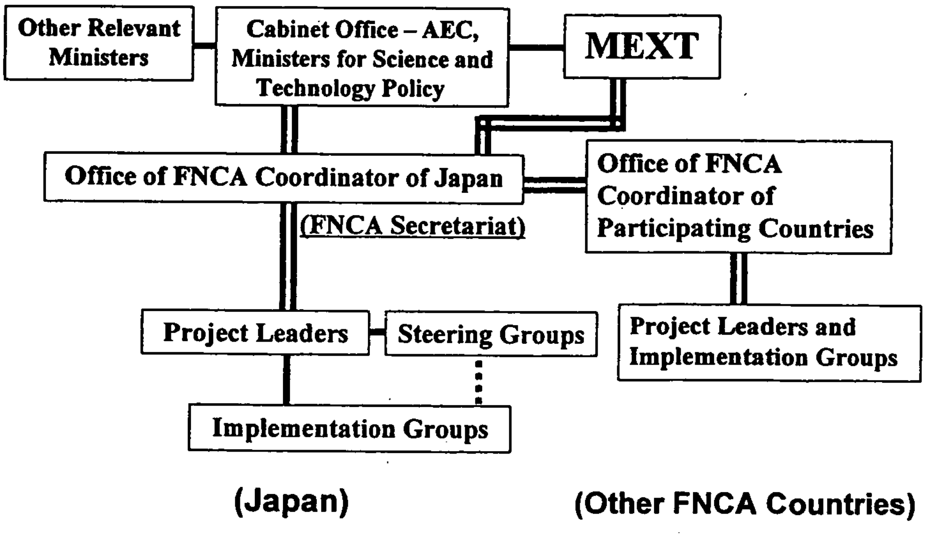
c.Technology development and its potential economic impact

d.Social impact (for HRD and PI projects)

e.Others

Figure 1

(1)FNCA Management Scheme in Japan



1.8 Presentation Session 2,3,4 (Country Report)

1.8.1 Vietnam
1.8.2 Indonesia
1.8.3 China
1.8.4 Korea

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1.8.1 Vietnam

Recent HRD Topics in the Nuclear Field and HRD Strategy Country Report of Vietnam

at

The 6th Workshop on HRD in Nuclear Field of FNCA

04-07 October 2004, Malaysia

by

Mr. Vu Dang Ninh

Director, Department of Administration and Personnel

Vietnam Atomic Energy Commission

I. Programme of atomic energy development in vietnam

Under the guideline of the National Steering Team on nuclear power research and development in Vietnam, a long-term programme for research, development and use of atomic energy in Vietnam has been formulated.

The overall objective of the programme is to build the atomic energy branch in Vietnam to become an economic and technical branch with a high scientific and technological content in actual service of the cause of industrialization and modernization of the country.

The main contents referred to in the programme include research, development and use of atomic energy, establishment of necessary infrastructure in service of the development of atomic energy branch, implementation of nuclear power plant construction projects in Vietnam. The programme presents 10 principal viewpoints in research, development and use of atomic energy in Vietnam, namely:

1. *Vietnam's consistent policy and viewpoint is to use atomic energy for peaceful purposes only;*
2. *Vietnam atomic energy branch is built and developed in nuclear power and non-power fields;*
3. *Safety is the top priority in research, development and use of atomic energy;*
4. *Continuous and prior attention should be paid to human resource development;*
5. *Modern establishments for nuclear science and technology research should be built;*
6. *The state management for atomic energy, radiation protection and nuclear safety should be enhanced and strengthened;*
7. *Stepwise self-reliance on nuclear fuel should be gained;*
8. *National infrastructure for radwaste treatment and management should be built soon;*

9. Special attention should be paid to fundamental research on atomic energy;

10. International nuclear cooperation should be promoted;

In the period from now up to 2020, the following 5 specific objectives should be reached:

1. To make nuclear power become one of the main energy sources of the country. The first nuclear power plant shall have been put into operation by 2017-2020. After that, other nuclear power plants shall continue to be constructed so that nuclear power shall account for a significant percentage in national power supply after 2030.

2. To create nuclear industry in Vietnam, step by step to master nuclear power technology, nuclear fuel, and nuclear techniques. Up to 2030, nuclear power plant localization percentage should reach about 30%, nuclear fuel will be able to commence to be fabricated from domestic or imported uranium, most nuclear equipment will be able to be manufactured in service of the requirements for the application of nuclear techniques for social and economic development.

3. Nuclear techniques and radiation technology should be widely applied in national economic sectors (industry, agriculture, health care, oil and gas, communication and transportation, construction, geology, hydrology, mining, etc.).

4. Technical and legal infrastructure for radiation protection and nuclear safety should be built in accordance with international standards. The state management body for radiation protection and nuclear safety should be consolidated and strengthened from central to local level.

5. National nuclear science and technology capacity should be built and developed on a level to advanced countries in the region about both material bases and professional staff, in which some fields reach the international levels.

In order to achieve the afore-mentioned objectives, some orientations in activities of Vietnam atomic energy branch for the period of from now up to 2020 are:

1. Development of nuclear power plant and nuclear technology

The period of from now to 2020 is the stage that Vietnam has to base on foreign technologies, first nuclear power units shall be built in turn-key mode. Survey and study should be invested, and other necessary conditions should be prepared to be able to construct the first nuclear power plant in Vietnam with a capacity of 2000 MW, which is expected to put into operation during 2015-2020. At the same time, study to assimilate and master imported technologies should be conducted to operate it in a safe and economic manner, creating a good premise for stepwise localization of the next projects. To obtain the objective, preparation works for the first nuclear power plant need to be completed before 2010.

Research and development in relation to design and manufacturing of some equipment and fuel for nuclear power plant should be carried out. Issues related to reactor technology, safety, nuclear fuel and material should be conducted on a multipurpose research reactor with a high power. Further study and site selection for the next nuclear power plants will continue to be carried out.

2. Use of nuclear techniques, radiation and radioisotopes

Nuclear techniques, radiation and radioisotope should be widely applied in national economic branches, approaching advanced levels in the region before 2010, and international standards before 2020. Priorities should be given to fields that have actual needs and large scale.

3. Radiation protection and nuclear safety

The state management body for radiation protection and nuclear safety should be consolidated and strengthened from central to local level.

Technical and material bases should be upgraded and strengthened to ensure radiation protection and nuclear safety in research, development and application of atomic energy, quality control for radiation equipment and dosimeters, respond to radiation and nuclear accidents. A national environmental radioactive monitoring network should be established.

Adequate staff will be provided for the state management body for radiation protection and nuclear safety, as well as technical services in service of the state management for radiation protection and nuclear safety. Especially, there should be a expert team of nuclear safety analysis and assessment who will be able to analyze, assess and appraise safety in design, construction and operation of nuclear power plant.

4. Nuclear law and regulations

Legal framework system on atomic energy needs to be completed. It is imperative to formulate and promulgate Vietnam atomic energy law, regulations, codes of standards in relation to construction of nuclear power plant and management of radiation protection and nuclear safety to ensure necessary international legal basis for atomic energy development in Vietnam.

5. Nuclear fuel cycle

Investigation, exploration and assessment of uranium reserves at a level of C1 (it is equivalent to the lowest level of RAR defined by IAEA) at some potential areas to be industrial uranium mines should be conducted.

Technological flow-chart for the production of technically commercial uranium products, technological flow-chart for the production of nuclear uranium products, and technological flow-chart for the fabrication of UO_2 fuel ceramics at the laboratory scale should be investigated and established.

A pilot plant for the fabrication of fuel rods should be set up, and a feasibility report on the construction of nuclear fuel fabrication plant for the next nuclear power projects should be formulated.

6. Radioactive waste management

National infrastructure to ensure radioactive waste management should be upgraded and completed.

Decommissioning plan for Dalat reactor after its retirement should be made.

Regulations, management organization, radioactive waste management technologies should be completed.

Feasibility study on national radioactive waste disposal site construction project should be conducted.

7. Nuclear science and technology capacity building

Vietnam Atomic Energy Commission should be built to be a modern research, development and training center, being a contact point for technology transfer in the field of atomic energy.

System of research and training institutions of related branches and ministries should be set up at advanced level in the region to serve atomic energy program.

Nuclear science subjects and nuclear engineering departments/faculty at some universities should be upgraded or new ones established and provided with modern equipment.

A multipurpose research reactor with a large power should be built.

8. Development of domestic industry and stepwise localization of nuclear power equipment

A network of industrial bases should be established (companies, plants) geared for nuclear power project to ensure their participation in the implementation of common works such as the provision of materials, civil works, equipment installation, etc. right at the first nuclear power project. Participation percentage of domestic companies should be reached 20-30% right at the first nuclear power project.

Development investment priority should be defined and geared for some mechanical and electrical engineering companies to provide high quality products for the second nuclear power project onwards, and ensure an annual increase in localization portion of about 5-10% for each next project.

9. Public information

Public information system should be established and completed in service of nuclear power development. Mass media and public support for nuclear power development should be gained. Social and non-profit-making organizations work for sustainable and safe development of nuclear power in Vietnam should be formed. Specialized information units should be established. Nuclear documentation system and stores should be developed. Adequate and science-based information in relation to peaceful uses of atomic energy should be publicized and disseminated regularly to the public. It is needed to co-ordinate with mass media to disseminate and propagate atomic energy knowledge and applications at schools and social organization, to organize exhibitions, publish publications on atomic energy.

10. International co-operation

International co-operation plays an important role for Vietnam in the research, development and peaceful uses of atomic energy. It is both resources and legal basis for sustainable and steady development of atomic energy branch of Vietnam.

Vietnam's international cooperation in atomic energy field is oriented as follows: ***special importance will be attached to comprehensive co-operation with IAEA, cooperating with nuclear powers, consolidating traditional cooperative relationships, promoting and strengthening collaborative relationships with neighboring countries***. Effectiveness and efficiency of international cooperation should be enhanced, taking every opportunity to approach advanced nuclear science and technology achievements throughout the world to make contribution to successful implementation of the programme of nuclear power development.

11. Staff training and human resource development (presented in detail below)

II. STAFF TRAINING AND HUMAN RESOURCE DEVELOPMENT

In recent years, human resource development activities in nuclear field in Vietnam can be summarized as follows:

Setting-up of an integrated manpower education and training programme for nuclear energy field;

Formulation of a national programme to educate and train high-qualified experts for research, development and application of atomic energy actually geared towards first nuclear power units in Vietnam;

Upgrading of VAEC's education and training system namely the systematization and standardization of teaching curriculum and textbooks, teaching facilities, laboratories and qualified lecturers for different training levels (Certificate, Diploma, and Degree);

Close collaboration with domestic universities and colleges to train nuclear and nuclear-related students;

The opening of refresher training courses;

Rejuvenation of staff in nuclear field;

The opening of training courses for concerned officials and managers about peaceful use of atomic energy, radiation protection and nuclear safety;

Good collaboration with IAEA, RCA and FNCA in the organization and participation in training courses;

Effective bilateral cooperation in the education and training of nuclear and related fields, ***especially with Japan through the MEXT programme and VAEC-JAERI training programme*** about radiation protection.

III. Conclusion

Atomic energy has widely applied in many fields of social and economic life and become a technical and economic branch over the world. After a sluggish period of time, nuclear power is having restorative signal, promising to well develop in the next decades.

In Vietnam, nuclear power is currently under consideration in social and economic development strategy of the country. A long-term programme for research, development and use of atomic energy in Vietnam in which nuclear power is central has been formulated with the aim of building the atomic energy branch of Vietnam to become an economic and technical branch with a high scientific and technological content in service of the development of the country. Human resource development is confirmed to be a deciding factor to successfully realize this programme, thus international cooperation for nuclear human resource development is very important and should be further strengthened.

The 6th Workshop on HRD in Nuclear Field of FNCA

Recent HRD Topics in the Nuclear Field and HRD Strategy

Country Report of Vietnam

by
Mr. Vu Dang Ninh
Director, Department of Administration and Personnel
Vietnam Atomic Energy Commission

1

I. Programme of atomic energy development in vietnam

- The programme presents 10 principal viewpoints in research, development and use of atomic energy in Vietnam, namely:

1. Vietnam's consistent policy and viewpoint is to use atomic energy for peaceful purposes only;

2

I. Programme of atomic energy development in vietnam

2. Vietnam atomic energy branch is built and developed in nuclear power and non-power fields;

3. Safety is the top priority in research, development and use of atomic energy;

4. Continuous and prior attention should be paid to human resource development;

3

I. Programme of atomic energy development in vietnam

5. Modern establishments for nuclear science and technology research should be built;

6. The state management for atomic energy, radiation protection and nuclear safety should be enhanced and strengthened;

7. Stepwise self-reliance on nuclear fuel should be gained;

4

I. Programme of atomic energy development in vietnam

8.National infrastructure for radwaste treatment and management should be built soon;

9.Special attention should be paid to fundamental research on atomic energy;

10.International nuclear cooperation should be promoted;

5

In the period from now up to 2020, the following 5 specific objectives should be reached

- 1. To make nuclear power become one of the main energy sources of the country. The first nuclear power plant shall have been put into operation by 2017-2020. After that, other nuclear power plants shall continue to be constructed so that nuclear power shall account for a significant percentage in national power supply after 2030.

6

In the period from now up to 2020, the following 5 specific objectives should be reached

- 2. To create nuclear industry in Vietnam, step by step to master nuclear power technology, nuclear fuel, and nuclear techniques. Up to 2030, nuclear power plant localization percentage should reach about 30%, nuclear fuel will be able to commence to be fabricated from domestic or imported uranium, most nuclear equipment will be able to be manufactured in service of the requirements for the application of nuclear techniques for social and economic development.

7

In the period from now up to 2020, the following 5 specific objectives should be reached

- 3. Nuclear techniques and radiation technology should be widely applied in national economic sectors (industry, agriculture, health care, oil and gas, communication and transportation, construction, geology, hydrology, mining, etc.).

8

In the period from now up to 2020, the following 5 specific objectives should be reached

- 4. Technical and legal infrastructure for radiation protection and nuclear safety should be built in accordance with international standards. The state management body for radiation protection and nuclear safety should be consolidated and strengthened from central to local level.

9

In the period from now up to 2020, the following 5 specific objectives should be reached

- 5. National nuclear science and technology capacity should be built and developed on a level to advanced countries in the region about both material bases and professional staff, in which some fields reach the international levels.

10

some orientations in activities of Vietnam atomic energy branch for the period of from now up to 2020 are

- *1.Development of nuclear power plant and nuclear technology*
- *2.Use of nuclear techniques, radiation and radioisotopes*
- *3.Radiation protection and nuclear safety*
- *4.Nuclear law and regulations*

11

some orientations in activities of Vietnam atomic energy branch for the period of from now up to 2020 are

- *5.Nuclear fuel cycle*
- *6.Radioactive waste management*
- *7.Nuclear science and technology capacity building*
- *8.Development of domestic industry and stepwise localization of nuclear power equipment*

12

some orientations in activities of Vietnam atomic energy branch for the period of from now up to 2020 are

- *9.Public information*
- *10.International co-operation*
- *11.Staff training and human resource development*

13

II. Staff training and human resource development

- 1.Setting-up of an integrated manpower education and training programme for nuclear energy field;
- 2.Formulation of a national programme to educate and train high-qualified experts for research, development and application of atomic energy actually geared towards first nuclear power units in Vietnam;

14

II. Staff training and human resource development

- 3.Upgrading of VAEC's education and training system namely the systematization and standardization of teaching curriculum and textbooks, teaching facilities, laboratories and qualified lecturers for different training levels (Certificate, Diploma, and Degree);

15

II. Staff training and human resource development

- 4.Close collaboration with domestic universities and colleges to train nuclear and nuclear-related students;
- 5.The opening of refresher training courses;
- 6.Rejuvenation of staff in nuclear field;

16

II. Staff training and human resource development

- 7.The opening of training courses for concerned officials and managers about peaceful use of atomic energy, radiation protection and nuclear safety;
- 8.Good collaboration with IAEA, RCA and FNCA in the organization and participation in training courses;

17

II. Staff training and human resource development

- 9.Effective bilateral cooperation in the education and training of nuclear and related fields, especially with Japan through the MEXT programme and VAEC-JAERI training programme about radiation protection.

18

III.Conclusion

- Atomic energy has widely applied in many fields of social and economic life and become a technical and economic branch over the world. After a sluggish period of time, nuclear power is having restorative signal, promising to well develop in the next decades.
- In Vietnam, nuclear power is currently under consideration in social and economic development strategy of the country.

19

III.Conclusion

- A long-term programme for research, development and use of atomic energy in Vietnam in which nuclear power is central has been formulated with the aim of building the atomic energy branch of Vietnam to become an economic and technical branch with a high scientific and technological content in service of the development of the country.

20

III.Conclusion

- Human resource development is confirmed to be a deciding factor to successfully realize this programme, thus international cooperation for nuclear human resource development is very important and should be further strengthened.

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Thank you for your attention!

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1.8.2 Indonesia

Review of the Human Resources Development in the Nuclear Field

Karsono, Hendriyanto
Education and Training Center
National Nuclear Energy Agency - INDONESIA

History of Nuclear Organization Development in Indonesia

The nuclear activity in Indonesia was initiated with the forming of a State Committee for the investigation of radioactivity in the year 1954. In consideration of the development and beneficial use of the atomic energy for the welfare of people, through Government Regulation No. 65 year 1958 The Council for Atomic Energy and The Atomic Energy Institution was formed. The National Atomic Energy Agency (BATAN) itself was established in 1964 through Act No. 31 year 1964. Through Act No. 10 year 1997 the regulatory function was separated from BATAN and become an independent body so called BAPETEN.

The first nuclear facility in Indonesia is Bandung Center for Atomic Reactor with the operation of Triga Mark II with 250 kW thermal power was formed in 1965. This research reactor was upgraded to 2 MW thermal power which achieve its first criticality in year 2000. The Pasar Jumat Atomic Energy Research Center was formed in 1968 with the operation of Gamma Cell Co-60 Irradiator. The second reactor, i.e. Kartini Research Reactor with 100 kW thermal power, located at Yogyakarta Atomic Energy Research Center began to operate in 1979. The Serpong Nuclear Research Center was formed in 1987 with operation of GA Siwabessy Research Reactor with 30 MW thermal power.

The Education and Training Center of BATAN was established in 1981, first is located in the head quarter and in 1992 was moved to Pasar Jumat Atomic Energy Research Center. In 1985 Education and Training Center created the School for Nuclear Technicians in Yogyakarta, which have three years program with two majors i.e. techno-physics and techno-chemistry. In 2001 this school was developed independently from Education and Training Center and became The Polytechnic Institute of Nuclear Technology (POINT) with 4 years program.

Education and Training Program

The education program in the nuclear field is done domestically as well as abroad. Four major universities which provide some courses on nuclear related are Gajah Mada University (UGM) in Yogyakarta, Indonesia University (UI) in Jakarta, Bandung Institute of Technology (ITB) and Padjadjaran University (Unpad) in Bandung.

In the year 1980 to 1995 UGM and UI graduated many students with specialization on nuclear engineering and reactor technology (UGM), radiation protection and nuclear instrumentation (UI). Figure 1 depicts the number of BATAN's personnels graduated from various national universities for the duration of 1982 – 2003.

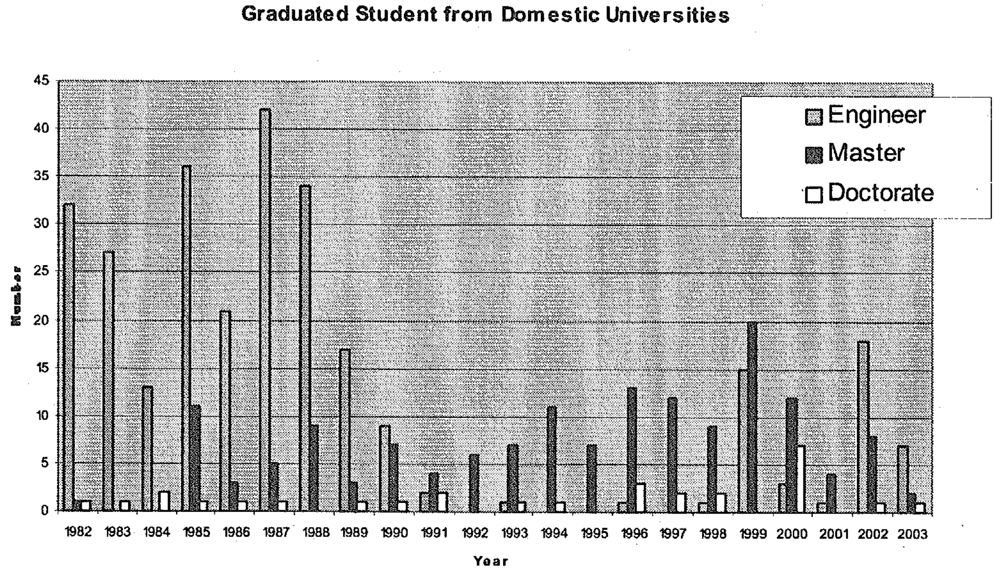


Figure 1: Number of personnels graduated from various national universities

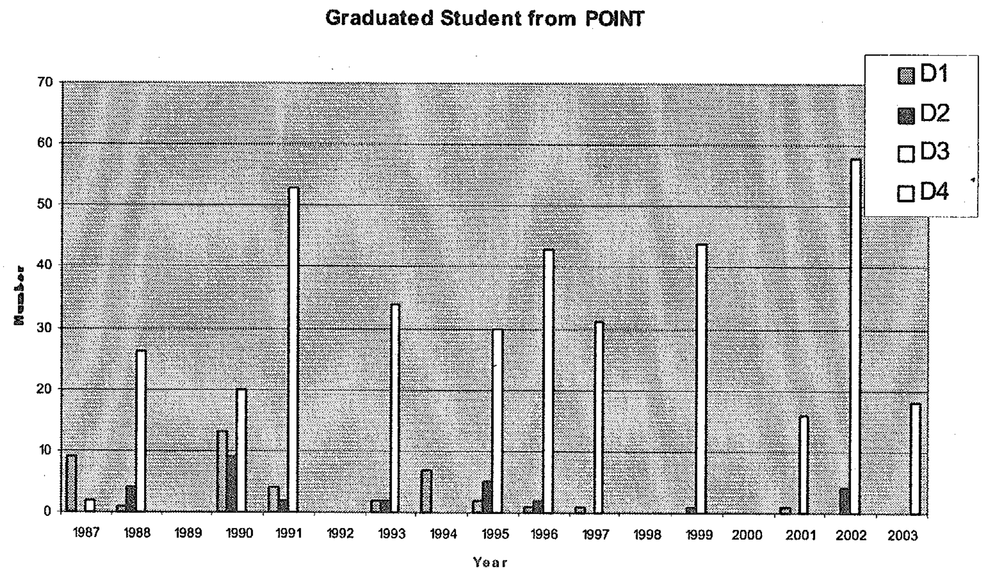


Figure 2: Number of students graduated from POINT

Figure 2 above depicts the number of students graduated from The Polytechnic Institute of

Nuclear Technology during the period of 1987-2003.

Human resources development through government-financed was started in 1986 with the Overseas Fellowship Program (OFP) to the developed country such as Germany, Japan, France, and United States. The OFP program is then replaced by Science and Technology Manpower Development Programs (STMDP) and Science and Technology for Industrial Development Programs (STAID). The above program together with the scholarships from bilateral, regional, international coopeations, successfully produces many undergraduates, master and doctorate degree (Figure 3).

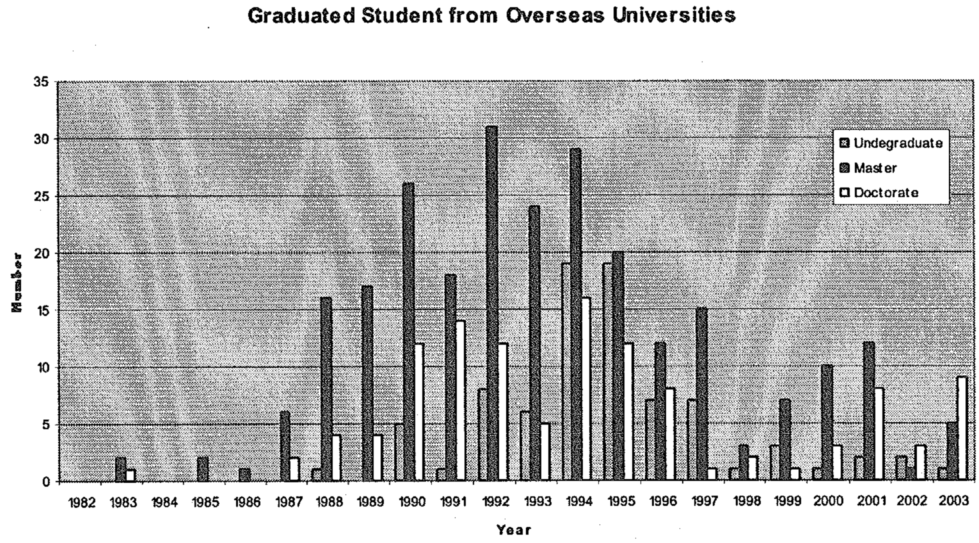


Figure 3: Number of personnels graduated from overseas various overseas universities

The training program is also done in Indonesia and abroad. The overseas training is under the above program (OFP, STMDP, and STAID) and sponsored by international institution such as IAEA, JAERI (Japan), DAAD/CDG (Germany), AUSAID (Australia) and other countries.

The national training programs in the nuclear field are mainly organized by the Education and Training Center of BATAN and funded by government annual budget. In average, 20 to 30 participants attend each training course. The ETC offers also training courses in support of the licensing requirements of the regulatory authority and those related to the application of nuclear technology. Total number of trainings implemented in the year 1982 – 2004 are represented in Figure 4 and Figure 5.

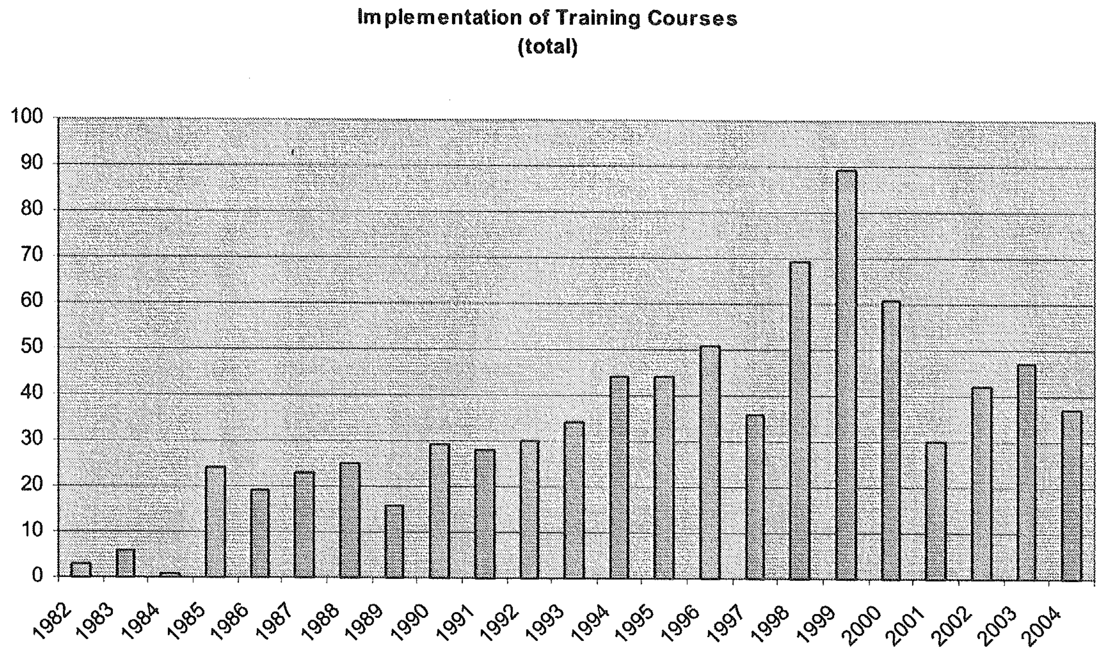


Figure 4: Number of trainings organized by the BATAN ETC

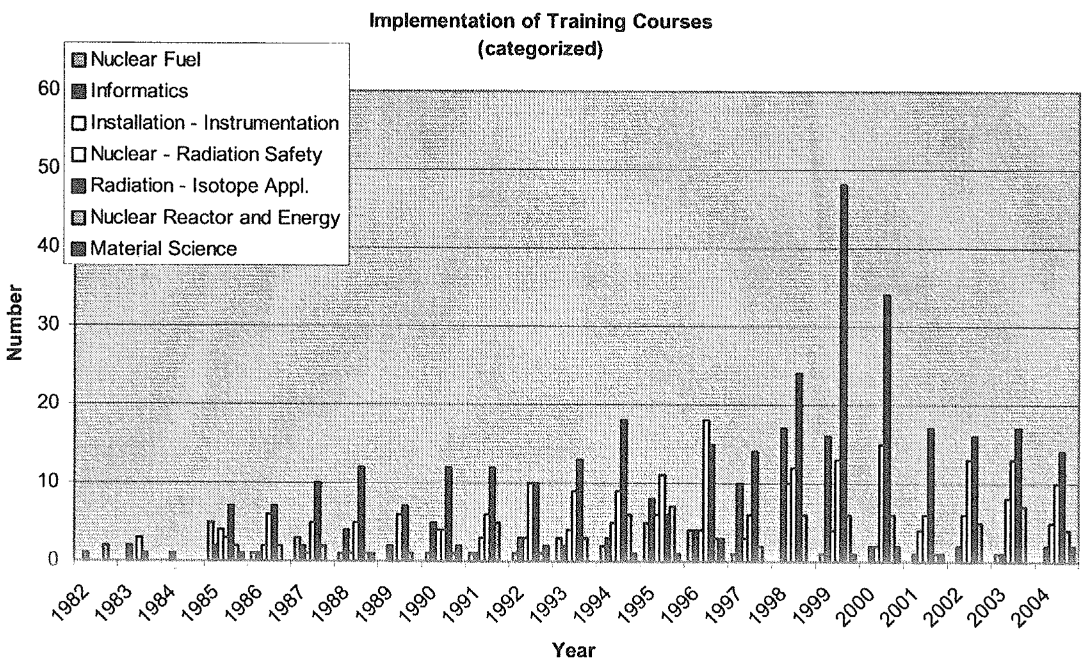


Figure 5: Number of trainings organized by the BATAN ETC (by category)

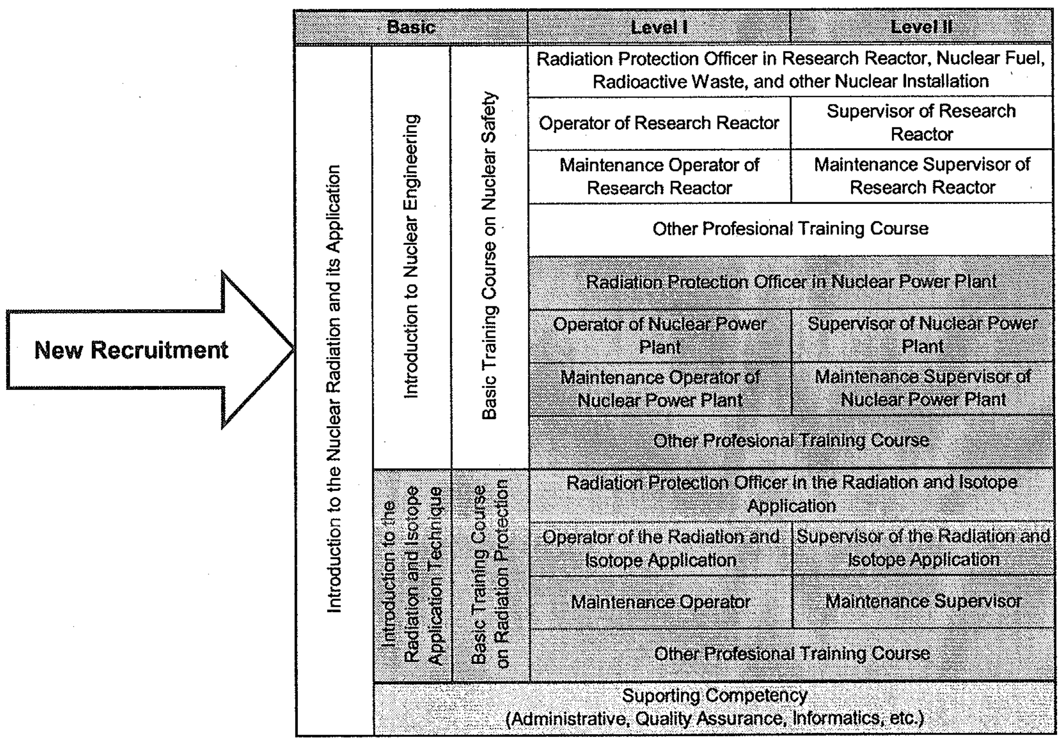
Education and Training Strategy

Since five years ago the nuclear engineering is not favorable to the young generation (partly due to the limited career prospects in the nuclear field), the number of students in nuclear disciplines is decreased. To date, there is no university that offers a full course in nuclear engineering at the undergraduate level. One university offers nuclear engineering as major at the undergraduate level. Therefore the human resource for NPP program will be recruited from general engineering education.

During the last five years the total number of BATAN employee is decreasing from year to year, due to the zero growth policy of the government and retirement. The highest population now is about 40 to 50 years old. It means that in ten to fifteen years they will be retired. By that time the first nuclear power plant is expected to be operated.

This challenge for Indonesia in the development of human resource in nuclear science and technology would have to be addressed through an expanded effort to create awareness among the young, creating job opportunities and intensifying efforts to introduce more courses in nuclear science and technology in institutions of higher education.

BATAN as the nuclear promoting body is responsible to provide the adequate human resources for nuclear power plant as well as the other application. The following figure represents training scheme for the new employees who will work in nuclear power plant or other nuclear installations.



Most of the training courses have been conducted by the Education and Training Center of BATAN, and attended by participants from BATAN staff or professionals from outside of BATAN. In addition, some staffs participated in international or regional trainings and on the job training in special topic (other professional training courses).Some training courses related to the nuclear power plant, the middle parts of Level I and Level II, are still under preparation.

On the education side, BATAN will extend the curriculum and syllabi of Polytechnic Institute of Nuclear Technology (POINT) to fulfill the recent requirements of human resources in the field of nuclear power plant. BATAN also strengthened the cooperation with national universities as well as bilateral, regional, and international cooperations.

Evaluation on FNCA-HRD Project of Indonesia

FNCA-HRD Project has contributed to the promotion of a regional cooperation in the nuclear human resources development, especially in encouraging the exchange of information and materials on HRD planning and implementation among the Member Countries. Major results of the project for the 2002-2004 periods are as follows:

- Collect and analyze basic data about research institutions, university/education institutions, radiation and radioisotope apllications, training courses (including list of implemented nuclear training courses and its cumulative number of trainees), etc.
- Information exchanged on national strategies on human resources development through annual workshops.
- Discussion to deal with strategic issues on how to attract the young generation.

The benefit of the project to end-users (Member Countries) is emphasizing the importance of regional cooperation in HRD, especially in planning and implementation of education and training.

Mutual Support and Others

- Request and Proposal on education and training of young generation with linkage between FNCA and ANENT.

  Qualified manpower is an essential for the successful implementation of a national long-term nuclear development program as well as the associated R & D programs. Therefore, it is necessary for young generation and newly-recruited personnels to have nuclear knowledge. It is expected that FNCA and ANENT can provide curriculum and syllabi of some courses related to the construction and operation of NPP.

2004 FNCA Workshop on Human Resources Development

October 4 – 7, 2004, Kuala Lumpur, Malaysia

Review of the Human Resources Development in the Nuclear Field

Karsono, Hendriyanto
Education and Training Center
National Nuclear Energy Agency

1

History of Nuclear Organization Development

- **Organization Development**
  - State Committee for the Investigation of Radioactivity (1954)
  - Council for Atomic Energy, Atomic Energy Institution (1958)
  - National Atomic Energy Agency (1964)
  - Two separate bodies (1997):
    - National Nuclear Energy Agency (promoting body)
    - Nuclear Energy Control Agency (regulatory body)
- **Nuclear Facilities**
  - Triga Mark II Reactor at Bandung (1965, upgraded in 2000)
  - Gamma Cell Co-60 Irradiator at Pasar Jumat (1968)
  - Kartini Research Reactor, 100 kW (1978)
  - G.A. Siwabessy Research Reactor, 30 MW (1987)

2

History of Nuclear Organization Development

- **Education and Training Facilities**
  - The Education and Training Center (1981)
  - PolNT (Polytechnic Institute of Nuclear Technology, 2001), formerly known as School for Nuclear Technician
  - To provide well-educated and well-trained personnels, and to support promotion of nuclear technology to the public through E & T

3

Education and Training Program

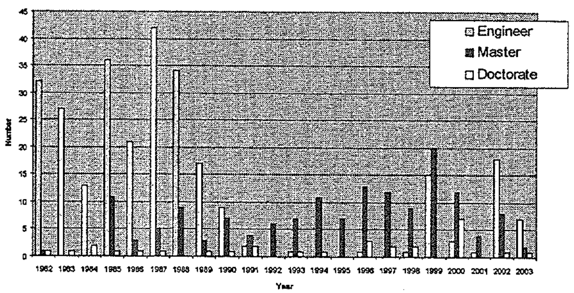
- **Education Program**
  - Carried-out in Indonesia, as well as overseas
  - Government-financed scholarships, bilateral/regional/international scholarships
- **Domestic Education Program**
  - National network of universities/education institutions
    - University of Indonesia (UI): radiation protection, and nuclear instrumentation (1980-1995), medical physics (currently)
    - University of Gadjah Mada (UGM): nuclear engineering (closed in 1995, currently offered as major for industrial engineering students)
    - University of Padjadjaran (UNPAD): nuclear medicine
    - Other universities (ITB, IPB), and PolNT

4

Education and Training Program

- **Domestic Education Program**
  - No. of personnels graduated from universities in 1982-2003

Graduated Student from Domestic Universities



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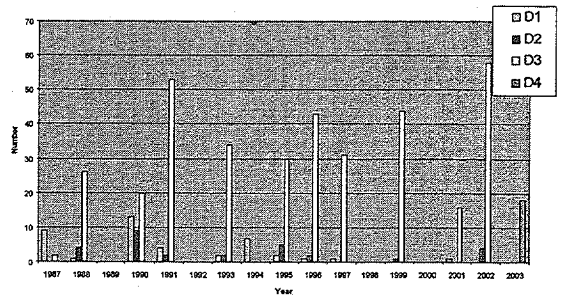
Education and Training Program

- **Domestic Education Program**
  - No. of personnels graduated from PoINT in 1987-2003

Graduated Student from POINT



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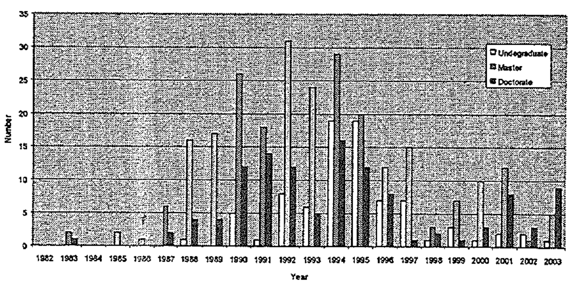
Education and Training Program

- **Overseas Education Program**
  - Government's financed program (OFP, STMDP, STAID)
  - Scholarships from bilateral/regional/international cooperations

Graduated Student from Overseas Universities



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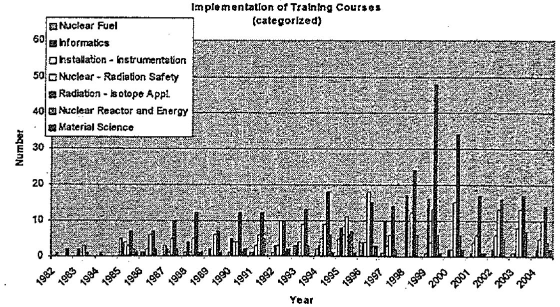
Education and Training Program

- **Training Program**
  - Carried-out in Indonesia, as well as overseas
  - Government-financed, bilateral/regional/internat'l cooperations
  - Provide also trainings to support public education program, and licensing requirement (industry, hospitals, etc.)

Implementation of Training Courses (categorized)



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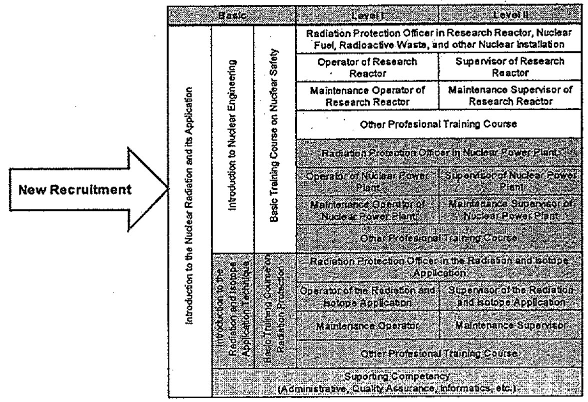
Education and Training Srategy

- **Current situation / challenge in HRD in nuclear**
  - Since 1998 nuclear engineering is not favorable to the young
  - No university offers a full course in nuclear engineering at undergraduate level, UGM offers it as major for industrial engineering students
  - Since 1998 no. of BATAN's employee is decreasing, highest population now is about 40 – 50 years
- **Some efforts to overcome the challenge ?**
  - Expanded effort to create awareness among the young
  - Creating job opportunities
  - Intensifying efforts to introduce more courses in nuclear S & T in institutions of higher education

9

Education and Training Srategy

- **Training scheme for new employees**



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FNCA – HRD Project of Indonesia

- **Major results for 2002 - 2004**
  - Collect, update, and analyze basic data (research institutes, universities, radiation & radioisotope applications, trainings,etc.)
  - Information exchanged on national strategics on HRD through annual workshops
  - Discussion to deal with strategic issues on how to attract the young generation
- **Benefit, mutual support and others**
  - Emphasizing the importance of regional cooperation in HRD
  - Expect FNCA and ANENT to provide curricula and syllabi of some courses related to the construction and operation of NPP

11

1.8.3 China

Recent HRD Topics in the Nuclear Field and HRD Strategy Country Report of China

CHEN Gang

CHINA Guangdong Nuclear Power Holding Co., Ltd

The 6th Workshop on Human Resources Development in Nuclear Field of FNCA

October 4 – 7, 2004, Malaysia

1. Recent topics in the nuclear field and related HRD in China.

China started the nuclear power analyze since 1955. Focused on nuclear power plant construction from 1980s, the application of nuclear power in the civil field is boosted. Up to July 2004, there are nine nuclear power plant units putting into use in the mainland of China. The total nuclear power capacity is amounted to 7,010 MW. It is predicted that the Tian Wan nuclear power plant will be put into commercial operation in 2005. At that time, the total unit capacity will amounted to 9,130 MW. In 2003, the accumulated electricity off-take of nuclear power has reached 43.8 billion Kwh, and the net electricity supply has reached 41.5 billion Kwh, which accounting for 2.29% of the total national generation amount. There are 2/3 of the NPPs were introduced by foreign techniques.

After 20 years rapid progress, we have a good base at the relative aspects, for instance, the nuclear power technology R&D, nuclear engineering, equipment manufacture, plant construction, operation management etc.. China has possessed the ability to construct 300MW and 600MW PWR independently, and also the ability to construct 1000MW PWR with the proper cooperation of foreign companies. So far, there are four main actions for Chinese nuclear technology progress:

1) Increase the nuclear power proportion in the gross energy supply.

Nuclear energy is becoming an important part of national energy strategy in China and it will be a pillar in power industry, combine with coal fuel power plants and hydraulic power plants. Especially in the southeast part of China whose economy is prosperity and power burden is heavy. Recently, nuclear power construction has come into a new stage, the government have approved San Men project in Zejiang province and Lian Ao project II in Guangdong province. Each of them has two 1,000 MW nuclear power units. At the same time, the Yangjiang project in Guangdong province and QinShan project II in Zejiang province are in the process of approval. These projects will relieve the stress of environment protection and transportation greatly in the future.

2) Realize localization and independence in the nuclear power unit construction.

With the guidance of "Independence, Sino cooperate, Technology import", integrating technical route and apply advanced technology is our rhythm. Increasing the economy and safety of our nuclear power units is our targets. Localization large nuclear power units construction and elevating the ability of our nuclear power industry is our purpose.

3) Develop other application form for nuclear power actively.

The research of other application form for nuclear power has been developed actively. Research of low temperature heat supply from nuclear power has been accomplished. Supported by national project, the High Temperature Gas-Cooled Reactor (HTGCR) has reached 100% power. Experimental fast breeder reactor is under construction.

4) Apply new technology in wide range.

Isotope and radiation technology has got widely application in many aspects, such as, medical treatment, agriculture, industry, environment protection and public safety etc. At the end of 2003, there are more than 300 companies in the nuclear technology application field in China, and the gross production has reached 4.9 billions USD. It is predicted that the isotope and radiation technology industry dimensions will exceed 1.2 billions USD.

With the rapid progress of nuclear power technology application, the human resource team in nuclear industry field is increasing. We have formed a talent base for constant development. After experiencing 20 years' construction, we have formed a set of suitable management mode and owned a professional team. We pay attention on the following team's construction: The engineering technology professional team meeting nuclear power designing, construction and localization; Management expert team in construction and operation of nuclear power plant; Artificer team in the operation and maintenance of nuclear power plants.

So far, the three talent teams can't meet the demand of the rapid development of nuclear power. The nuclear power careers should get more understand and support from our society; should make the young generation well known of the nuclear knowledge. Our senior academy should get ready for human resource demand in the relative professional field. Our corporation, design academy, production factory, construction company should enhance training level, solve the professional cultivation problem on the way of nuclear power progress.

2. HRD strategy or the Model as the way of formulating HRD strategy.

Before 2020, the gross capacity of nuclear power will reach 4% or more in the China electric power supply market. The total industry dimension of nuclear power will reach 36,000 MW. Two or three nuclear power units will under construction each year in the later 15 years. We need to construct 27 nuclear power units amount 1,000MW altogether.

To meet the demand of senior talent, it is necessary to found a set of senior talent developing strategy that is integral and manipulate. In other words, we should cultivate a senior talent teams that complies with the Chinese economic demand, nuclear power industry structure demand, the trade level of domestic or foreign talent, and the mid-term and long-term targets. These teams must have the following characters: sufficient quantities, logical structure, excellent stuffs, entirely kinds. Through inner selecting and cultivation, external import, we are aiming to found a "three senior talents" talent teams with an average age of 40 years old. They are senior management team, senior professional team, and senior artificer team. The guidelines of "three seniors" team building are: Integral planning, Grade management, Choosing excellence.

The human resource development policy should be planed integrally by the nation, the implementing ways should be developed by the enterprises. The backup team should be tested periodically, the excellence be selected out and be dynamic updated. It is required to broad the channels to find talent, to inspire behaviors of the employees to study new knowledge and increase skills, to create high performance. And also we should appraise excellent managing talent, professionals and artificers and provide encouragement to them.

The targets of building “three senior talents”:(1) Developing senior management talent, its main task is to elevate the core ability of supervisor, including the leadership, predictability, innovation, reinforce, organizing ability, harmony ability. (2) Developing senior professional, its main task is to elevate the technical analysis ability, the plan design ability, implementing ability, technical innovation ability and so on. (3) Developing senior artificer, its main task is to elevate the skill level, operational level, the ability to solve the question and other core abilities.

The means of develop “three senior talents”: Combining the enterprise integral plan and personal study is the first step. Here, the integral plan includes peer review, continuous study and skill training, and the individual study focuses on knowledge updating, broadening. If it is relative with the job position, the on-job-training is encouraged. Secondly, developing the senior management talents is through the two ways, accumulating the experience through position cumulating and broadening the eyesight to elevate talent. Thirdly, senior professional should be engaged in the activities of engineer construction, operation, maintenance, modification and so on. The foreign project management training and technical study are necessary, too. Lastly, the development of artificers is mainly by these two means. One is basic skill training and to found apprentice system, reinforce the skill appraisal system. The other is starting the skill competition to select best ones.

Develop human resource should pay attention to the general stuff of the employees. the following four aspects are the embodiment of the stuff.

1) Individual moral character: mentality character, moral character, personality, responsibility, and so on.

2) Knowledge stuff: general knowledge, profession knowledge, and technique level, studying ability.

3) Psychological stuff: intelligence; emotion, purpose, and so on.

4) Physical stuff: constitution, physical strength, physique, and so on.

The policy of the human resource management should be focused on developing the general stuff of the employees, elevating the ability and performance of the staffs.

3. The personnel will be needed to achieve the policy targets

In the field of nuclear power construction & production energy development, it is necessary to make a relevant limit to the majors for the new employees, who are imported according to the project. Here are the example of Guangdong nuclear power plants new personnel requirement:

1) The majors to be kept fixedness or increased: electric(15%-20%);nuclear physics and nuclear power engineering(15~20%); thermal energy & pyrology (15%); mechanism (10%); finance and economics (5~7%), architecture (3~6%) ;instrument automation (3~5%); total amount: 71~88%.

2) The majors to be kept fixedness or decreased: electronics (5%); law (0.5%); nuclear medicine (0.3%); water treatment and chemistry (1%); material & mechanics (2%); total amount: 9% or so.

3) The majors to be restrained: literature & art and such majors irrelevant to the engineering, production and management. The plant public communication service and technique support outside should be consigned to the special social service organization.

4) IT personnel is to employ a small quantity of professional.

5) As to the background of new operational personnel, our suggestion is that proportion: Master 5% (3.2%); Bachelor 30% (46.8%); Junior college 0% (24.0%) ;Technical school 65% (26.0%).

6) To the majors relying on the nuclear theory, employing one to three doctors is necessary. And the masters proportion should be 10% to 15%, the rest is basically bachelors.

7) To the artificer: we should pay less attention to their degree and concentrate on employing experienced person.

To cover the shortfall of human resources, self-training by each company training center is the priority measure. Some high-tech related overseas trainings are needed and mainly choice the country which introduce the technology to China. It will less than 100 students per year.

4. Proposal for securing interested excellent students to contribute to the nuclear field

In order to secure interest excellent students to contribute to the nuclear field, Chinese government has increased the propaganda of nuclear development policy and schedule. Transmit the advantage of nuclear industry and the contribution for the economic to the public. The high level universities increase the new students enrollment on nuclear specialty. The nuclear industry companies are attractive to excellent students since they will have relative high salary and bright future due to the high development rate of this field.

5. Mutual support and others

1) Request and Proposal on education and training of young generation with linkage between FNCA and Asian Network for Higher Education in Nuclear Technology (ANENT).

Due to the high development of Chinese nuclear industry, the nuclear knowledge education for young generation and proper on the job training for new comers are highly necessary. We hope very much FNCA and ANENT can provide some courses such like: Nuclear power plants management; the trend of nuclear industry development; QA and QC for the plants operation and so on. We hope to share Japanese nuclear experience on nuclear power plants management and organization. We also want to learn Japanese nuclear power plants human resources management.

2) Investigation of training materials in CD ROM for the purpose of introduction and utilization of e-learning system

It's good for information sharing among China and other countries. Since the contents of training materials are use for basic knowledge training, They are not so efficiency for the trainees understand the materials. So far did not introduce in e-learning system.

6. Request and Proposal on HRD Project and its development

Way of using the Model, Development of HRD Project, Expectation of FNCA support: FNCA can provide a platform for membership countries to communicate their ways of national situation of nuclear development, the government policy of nuclear industry, HRD strategy issued for young generation and nuclear industry staffs. We can use such important information to analyze the international development trend of nuclear area. Expecting FNCA can accumulate these information integrate and provide the analyzing result to all of the membership.

Recent HRD Topics in the Nuclear Field & HRD Strategy
Country Report of China

CHEN Gang
CHINA Guangdong Nuclear Power Holding Co., Ltd

The 6th Workshop on Human Resources Development in Nuclear Field of FNCA
October 4 – 7, 2004, Malaysia

1

Recent topics in the nuclear field and related HRD in China

- Up to July 2004, there are 9 nuclear power plant units putting into use in the mainland of China.
- The total nuclear power capacity is amounted to 7,010 MW. It is predicted that the Tian Wan nuclear power plant will be put into commercial operation in 2005. At that time, the total unit capacity will amounted to 9,130 MW.
- In 2003, the accumulated electricity off-take of nuclear power has reached 43.8 billion Kwh, and the net electricity supply has reached 41.5 billion Kwh, which accounting for 2.29% of the total national generation amount.

2

Four main actions for Chinese nuclear technology progress

1) Increase the nuclear power proportion in the gross energy supply.

- Nuclear energy is becoming an important part of national energy strategy in China and it will be a pillar in power industry, combine with coal fuel power plants and hydraulic power plants.
- Recently, nuclear power construction has come into a new stage, the government have approved San Men project in Zejiang province and Lian Ao project II in Guangdong province. Each of them has two 1,000 MW nuclear power units.
- The Yangjiang project in Guangdong province and QinShan project II in Zejiang province are in the process of approval.

3

- **2) Realize localization and independence in the nuclear power unit construction.**
  Independence, Sino cooperate, Technology import
- **3) Develop other application form for nuclear power actively.**
  Research of low temperature heat supply from nuclear power has been accomplished. The High Temperature Gas-Cooled Reactor (HTGCR) has reached 100% power. Experimental fast breeder reactor is under construction.
- **4) Apply new technology in wide range.**
  Isotope and radiation technology has got widely application. At the end of 2003, there are more than 300 companies in the nuclear technology application field in China, and the gross production has reached 4.9 billions USD. It is predicted that the isotope and radiation technology industry dimensions will exceed 1.2 billions USD.

4

HRD strategy: Pay attention on the following team's building

- The engineering technology professional team meeting nuclear power designing, construction and localization;
- Management expert team in construction and operation of nuclear power plant;
- Artificer team in the operation and maintenance of nuclear power plants.

5

HRD strategy or the Model as the way of formulating HRD strategy

- Before 2020, the gross capacity of nuclear power will reach 4% or more in the China electric power supply market.
- The total industry dimension of nuclear power will reach 36,000 MW. Two or three nuclear power units will under construction each year in the later 15 years.
- We need to construct 27 nuclear power units amount 1,000MW altogether.

6

Senior talents developing strategy.

- Senior talent teams must have the following characters:
  - sufficient quantities
  - logical structure
  - excellent stuffs
  - entirely kinds.
- To found a "three senior talents" talent teams with an average age of 40 years old: Senior management team, Senior professional team, and Senior artificer team.
- The guidelines of "three seniors" team building are: Integral planning, Grade management, Choosing excellence.

7

The targets of building "three senior talents"

(1) Developing senior management talent, its main task is to elevate the core ability of supervisor, including the leadership, predictability, innovation, reinforce, organizing ability, harmony ability.

(2) Developing senior professional, its main task is to elevate the technical analysis ability, the plan design ability, implementing ability, technical innovation ability and so on.

(3) Developing senior artificer, its main task is to elevate the skill level, operational level, the ability to solve the question and other core abilities.

8

3. The personnel achieve the policy targets

Here are the example of Guangdong nuclear power plants new personnel requirement:

- 1) The majors to be kept fixedness or increased: electric(15%-20%);nuclear physics and nuclear power engineering(15~20%); thermal energy & pyrology (15%) ; mechanism (10%) ; finance and economics (5~7%) , architecture (3~6%) ;instrument automation (3~5%) ; total amount: 71~88%.
- 2) The majors to be kept fixedness or decreased: electronics (5%) ; law (0.5%) ; nuclear medicine (0.3%) ; water treatment and chemistry (1%) ; material & mechanics (2%) ; total amount: 9% or so.
- 3) The majors to be restrained: literature & art and such majors irrelevant to the engineering, production and management. The plant public communication service and technique support outside should be consigned to the special social service organization.
- 4) IT personnel is to employ a small quantity of professional.
- 5) For new operational personnel, proportion: Master 5% (3.2%) ; Bachelor 30% (46.8%) ; Junior college 0% (24.0%) ;Technical school 65% (26.0%) .
- 6) To the majors relying on the nuclear theory, employing one to three doctors is necessary. And the masters proportion should be 10% to 15%, the rest is basically bachelors.
- 7) To the artificer: we should pay less attention to their degree and concentrate on employing experienced person.
  To cover the shortfall of human resources, self-training by each company training center is the priority measure.

9

4. Proposal for securing interested excellent students to contribute to the nuclear field

In order to secure interest excellent students to contribute to the nuclear field, Chinese government has increased the propaganda of nuclear development policy and schedule. Transmit the advantage of nuclear industry and the contribution for the economic to the public. The high level universities increase the new students enrollment on nuclear specialty. The nuclear industry companies are attractive to excellent students since they will have relative high salary and bright future due to the high development rate of this field.

10

5. Mutual support and others

- Due to the high development of Chinese nuclear industry, the nuclear knowledge education for young generation and proper on the job training for new comers are highly necessary.
- FNCA and ANENT provide some courses such like: Nuclear power plants management; the trend of nuclear industry development; QA and QC for the plants operation and so on.
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Expecting FNCA can accumulate these information integrate and provide the analyzing result to all of the membership.

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1.8.4 Korea

Model for the Human Resources Development Strategy in the Nuclear Field

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The 6th FNCA Workshop on Human Resources Development in the Nuclear Field
4-7 October 2004, Kuala Lumpur, Malaysia

1. Review of the Nuclear Human Resources Development in Korea

Since the commercial operation of the first nuclear power plant in April 1978, Korea has achieved a rapid growth in nuclear power. In 2004, 19 nuclear power plants are currently in operation and 8 nuclear power plants are under construction. The installed nuclear capacity is 16,716MW. Also nuclear power generation reached 129,672GWh which are about 40% of the total electricity generation.

As shown in Figure 1, the Korean nuclear energy development program, which was started in the 1960s, can be categorized into 5 steps from view of human resources development, e.g., (1) preparation for nuclear energy from the 1950s - 1960s, (2) introduction of nuclear power in the 1970s, (3) promoting localization in the 1980s, (4) technology self-reliance in the 1990s, and (5) nuclear energy policy towards the 21st century.

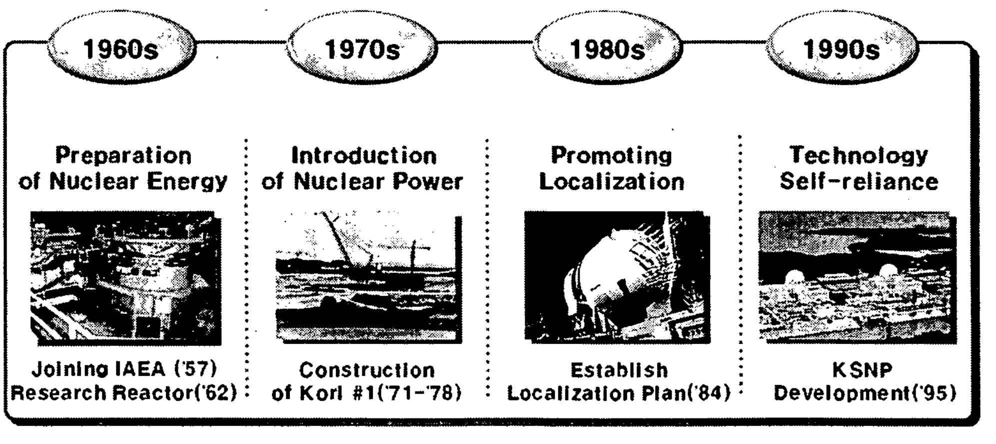

Figure 1. Brief History of Nuclear Energy

- Preparation for nuclear energy from the 1950s-1960s

A nuclear related government organization was established in 1956 under the

Ministry of Education in Korea. The government joined the IAEA in 1957. From that time the government started to send dozens of scientists and engineers abroad with scholarships in order to prepare for the peaceful uses of nuclear energy in Korea. The Office of Atomic Energy, which was established in 1958, promulgated the Atomic Energy Law. A nuclear engineering education program was also started at Universities from 1958. The Korea Atomic Energy Research Institute (KAERI) was established in 1959 under the umbrella of the Office of Atomic Energy. The Institute started construction of the TRIGA Mark-II research reactor for the purpose of education and basic research. For the introduction of the first nuclear power plant, a steering committee was established in 1962 and final plan was set up in 1969. In order to provide training courses for nuclear personnel, the Nuclear Training Center was established at KAERI in 1967.

- Introduction of Nuclear Power in the 1970s

The first nuclear power plant, which was started its construction in 1971, and it was synchronized in April 1978, and the first three units were constructed in the form of a turnkey contract. During the construction of the first nuclear power plant, basic training courses were conducted at NTC/KAERI. And specific training courses were conducted by the reactor suppliers in Korea and the supplier's countries. During this period, reactor operation license laws and the national technical qualification system (engineer, technician, craftsman) with a linkage to the national education system were established in 1970, 1975, respectively. When the Utility (now the Korea Hydro and Nuclear Company) started operation of the first nuclear power plant in 1978, the Utility Training Center (now Nuclear Power Education Institute) was established as an in-house training center for the training of operators and maintenance crews. From the middle of the 1970s, a number of qualified scientists and engineers who had moved to advanced countries due to the brain drain began to return home. They played an essential role in participating in the self-reliance of nuclear energy related technology.

- Promotion of Technology Localization in the 1980s

From Korean nuclear unit 4, the contractual form was changed from a turnkey to a non-turnkey. The domestic participation had rapidly increased calling for taking the initial role in many areas of the practical works. So, localization plan was established at the beginning of 1980s and was started in 1984 from the construction of the Yonggwang Unit 3 and 4. From the middle of 1980, the total responsibility for the project management and practical design works such as architect engineering, design and manufacturing of equipment and components, nuclear fuel design, nuclear steam supply system (NSSS) design as well as project management itself was formally imposed upon the Korean vendors. For the effective management of human resources during this period, a Manpower Development Committee was established for the coordination and cooperation among members with respect to manpower training. In addition, 3 universities opened a nuclear engineering department to cope with the manpower demand on nuclear engineers. KAERI moved to the Deaduk Science Park in 1985. KAERI was responsible for the works on the development of the NSSS and nuclear fuel design. Accumulation of technical capabilities made it possible for KAERI to start construction of a 30MW HANARO research reactor in 1989.

- Technology Self-reliance in the 1990s

The Korea Institute of Nuclear Safety (KINS) was established in 1990 to support the Regulatory Authority (Ministry of Science and Technology, MOST) for the licensing, inspection, evaluation and analysis of nuclear safety. From the operation of the Yonggwang Unit 3 and 4 in 1995 and 1996, the Korean nuclear society declared a successful implementation of the self-reliance of nuclear power technology as of the operation of the Korean Standard Nuclear Power Plant (KSNP, 1,000MW). Along this line, KAERI started operation of a 30MW HANARO research reactor in 1995. According to the long-tern nuclear energy development program, 6 more KSNP were constructed during this period. Development of the Advanced Power Reactor 1,400 (APR 1,400) was launched from the middle of 1990s. Also, the development of advanced reactors such as the fast breed reactor, and the small and medium size reactor was included in the long-term nuclear energy development program. From the middle of the 1990s, a number of IAEA Member States expressed their interests in the Korean technology of self-reliance. The IAEA requested Korea to host the IAEA's fellowship programs and regional training courses. Upon those requests, there was a MOU between Korea and IAEA for the strengthening of cooperation on nuclear education and training. The IAEA provided the NTC of KAERI with the recognition of an International Center for Excellence in 1997.

- Nuclear Energy Policy towards 21st Century

Korea is operating its own designed nuclear power plants such as the KSNP, and APR 1400. APR 1400 had its inauguration in 2003 aiming of its operation by 2011. Korea makes strong efforts to develop future nuclear technologies. They are the System-Integrated Modular Advanced reactor (SMART), Korea Advanced Liquid Metal Reactor (KALIMER) and the Hydrogen Production Reactor. In parallel, KAERI is establishing an Advanced Radiation Technology R&D Center and a High Power Proton Accelerator

Center. The Advanced Radiation Technology R&D Center is schedule to open in 2005. In order to strengthen international cooperation for nuclear education and training, the International Nuclear Training and Education Center (INTEC) was established in 2002 under the KNTC of KAERI. The RCA Regional office in Korea, which was established in cooperation with the RAC Member Countries in 2002, is providing post-doctorial programs, nuclear engineering master courses, and nuclear medical internships for Member Countries. Korea expects that radiation technology combined with bio, nano, information, and space technology will be the emerging technology for the future. From this point of view, the University of Science and Technology (UST) has been established with an equal partnership of 22 national R&D institutes. The KAERI opened the UST-KAERI Campus to provide Master Degree, and Ph. D. Degree Courses for younger generation in 2004. The KINS also established the Nuclear Safety School in 2004.

2. Model for Human Resources Development Strategy in Korea

Qualified manpower is an essential for the successful implementation of a national long-term nuclear development program as well as the associated R&D programs. Such manpower could only be developed systematically under a well established national model and strategy, which addresses the demand for human resources, number of personnel and timing, and the education and training. To discuss a model for human resources development, it is suggested to consider the following: (1) approach to the HRD Model, (2) HRD policy targets, (3) estimation of the manpower requirement, (4) organizational coordination frameworks for the HRD, (5) promotion of HRD in the action plan.

- Approach to the HRD Planning Model (See Figure 2)

Approach to the HRD planning model could consist of the formulation of strategic objectives and targets, review of the current manpower and an estimation of future manpower, long-term organizational structure development, and the implementation of action plans for HRD.

- The Government Policy targets for HRD

The first step of HRD is to identify the strategic objectives and targets. The following are the Korean Government policy targets for HRD:

- Support for nuclear education programs at universities
- Maintaining qualified nuclear personnel at nuclear industries
- Encouraging a global competitiveness of the nuclear manpower

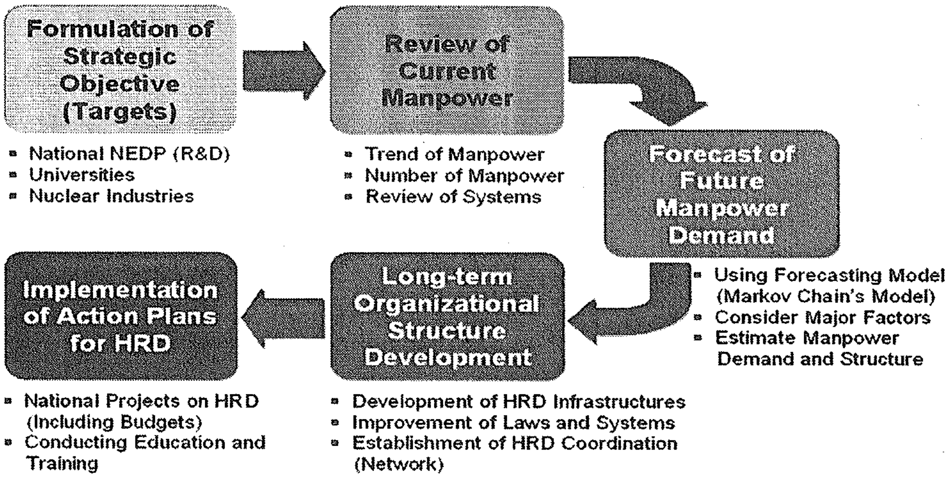

Figure 2. Model for HRD Planning

● Review of Current Manpower

As shown in Figure 3, there were about 38,000 nuclear personnel engaged in nuclear industries, R&D institutes and radioisotope related organizations in 2002. However, it is recognized that the first generation of the nuclear workforce is getting older and being retired and less of youth are studying nuclear science and engineering. Therefore, the Korean Government has established a promotion program on nuclear human resources development which targets university education, nuclear industries' manpower, etc,, as mentioned the above.

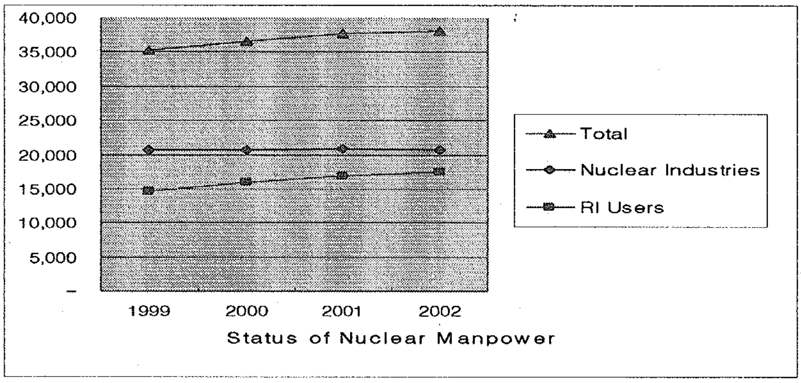

Figure 3. Status of the Nuclear Manpower

● Estimation of the Future Manpower

Estimation of the future manpower means to forecast the future manpower demand which is required for the long-term nuclear development program. In order to have a view of the future manpower demand and structure, it is sometime introduced as a stochastic model for the manpower estimation. For example, the Markov chains model for manpower planning, which is shown below, could be one of the useful tools for the estimation of the future manpower demand and structure.

$$\boldsymbol{n(T) = n(T\text{-}1)\ \{P + W'\ r'\} + M(T)\ r}$$

n(T), n(T-1): expected stock at time T, T-1
P: transition matrix,
W': wastage vector,
r': recruitment vector
M((T) : manpower gap between time T and T-1 (created seats)
r: recruitment vector for M(T)

$$n(T) = n(p1 + p2 + p3 + p4)\begin{matrix} p11 & p12 & p13 & p14 \\ p21 & p22 & p23 & p24 \\ p31 & p32 & p33 & p34 \\ p41 & p42 & p43 & p44 \end{matrix} + \begin{matrix} w'1 \\ w'2 \\ w'3 \\ w'4 \end{matrix}\ (r'1\ r'2\ r'3\ r'4) + M\,(r1\ r2\ r3\ r4)$$

- Organizational Coordination Framework for HRD

There are many nuclear related organizations which coordinate with each other continuously for the sustainable development of nuclear energy. The Government, utility, nuclear industries, regulatory authority, and R&D institutes are manpower demand organizations. Universities and training organizations as well as societies and associations are providing education and training programs upon a request from the above organizations. Therefore, it is quite valuable to build a national network for human resources development among related organizations. In the case of Korea, the Korean Network of Nuclear Education and Training has been established for this cooperation purpose.

- Promotion of HRD and the implementation of action plans for HRD

Promotion of human resources development conducting action plans for HRD under the support of the national projects which also means financial support for the manpower development. Figure 4 shows the Korean projects for nuclear manpower development which are currently being implemented for university students, young researchers as an example.

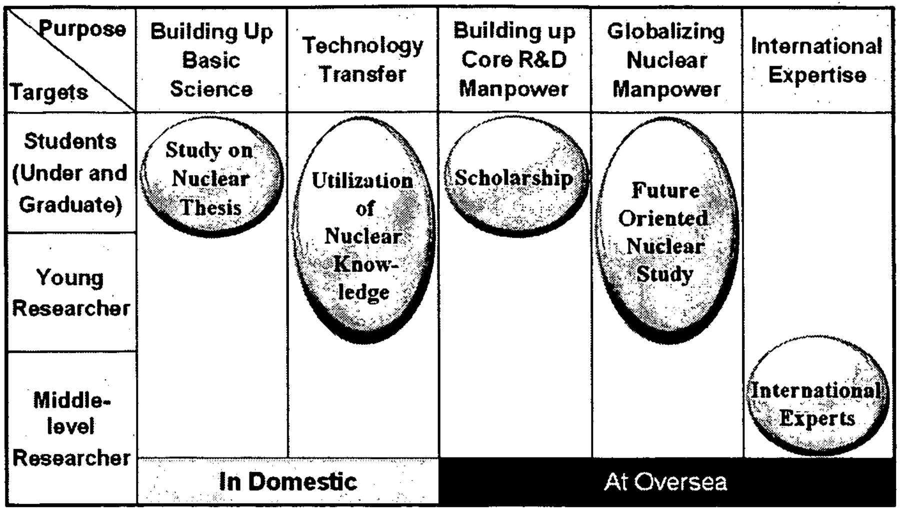

Figure 4. Korean Projects for Nuclear Manpower Development

3. Mutual Cooperation for Human Resources Development

The importance of human resources development in the nuclear field is recognized worldwide. Even though the Asian region has a technology difference among the members, it is still obvious that each country can make a strong effort on nuclear manpower development for one's long-term nuclear development program. FNCA has made a great contribution to the mutual cooperation for the human resources development among the member countries. In this context, it is proposed to have mutual cooperation items for human resources development as follows:

Planning of HRD
- Policy and its strategies
- Model and its process
- Related laws and qualifications

Infrastructure of HRD
- Organizations, and its facilities and equipment
- Instructors
- Education and training programs

Implementation of HRD
- Conducting education and training.

- Asian Network for Education in Nuclear Technology (ANENT)

The IAEA sponsored Asian Network for Education in Nuclear technology (ANENT) is established to promote the preservation and succession of nuclear knowledge and to ensure the continued availability of qualified human resources in the nuclear field in the Asian region. The First Coordination Committee meeting was held in February 2004 in Kuala Lumpur, Malaysia. The objective of ANENT is to facilitate cooperation in education, and related research and training in nuclear technology through:

- sharing of information and materials of nuclear education and training
- exchange of students, teachers and researchers
- establishment of reference curricula and facilitating mutual recognition of degree
- facilitating communication ANENT member institutes and other regional and global networks.

Membership of ANENT is open to universities, research centers, government agencies and education and training institutes. 11 countries attended the first ANENT Coordination Committee.

The first ANENT Coordination Committee meeting identified five group activities and their respective coordinators as shown in Table 1. KAERI became the coordinator for Group Activity (GA) 1 on the "Web-based Exchange of Information and Material for Nuclear Education and Training". The specific tasks assigned under Group Activity 1 are (1) the identification of existing information and material, and (2) the establishment of a web-based network including its database system.

Table 1. Group activities of the ANENT and the responsible coordinators

Activity	Scope	Coordinator
GA 1	Exchange of information and materials for nuclear education and training	KAERI/Korea
GA 2	Exchange of student, teachers and researchers	MINT/Malaysia
GA 3	Distance learning	PNRI/The Philippines
GA 4	Establishment of reference curricula and facilitating credit transfer and mutual recognition of degrees	HUT/Vietnam
GA 5	Liaison with other networks and organizations	UC/Sri-Lanka

The web-based networking is intended to establish an effective and sustainable focal point, which fulfills effectively the following roles of:

- communication among the ANENT members
- connection to sources (websites) of information/materials and courses for the nuclear education and training which are available worldwide
- sharing of collected information/materials through a database
- support for the ANENT activities.

KAERI has established a website (www.anent-iaea.org) as shown in Figure 5. As shown in Figure 6, the DB on nuclear education and training was inter-connected with group activities on the Web-site. The required information and material for nuclear education and training is being collected and loaded onto the database. The website is to be improved step-by-step, while its effective and sustainable operational system will be secured so that the intended web-based networking within the ANENT framework can be accomplished.

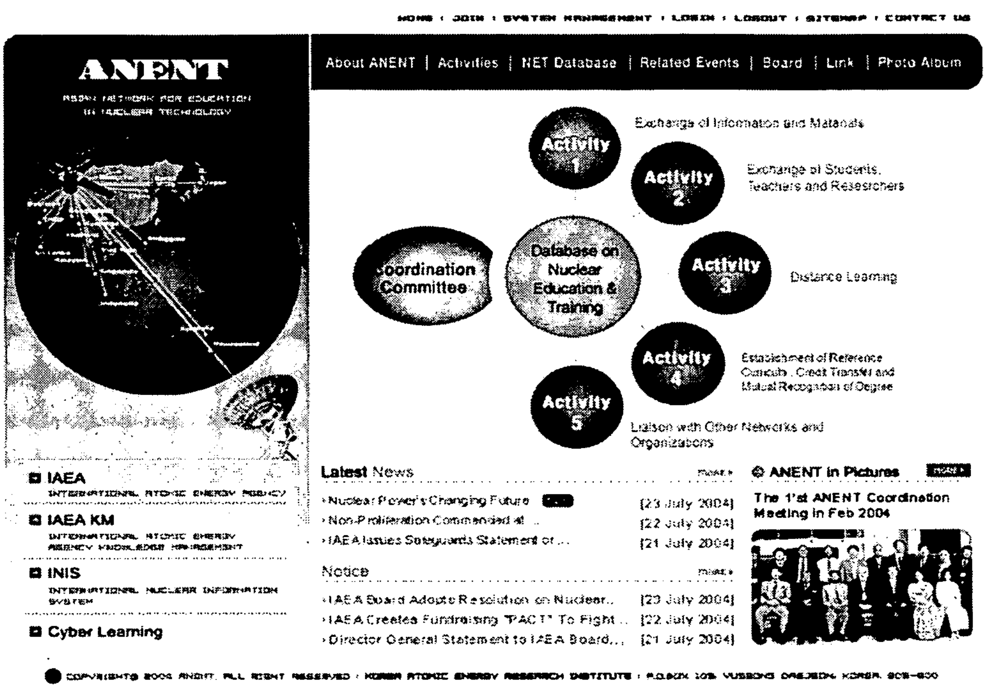

Figure 5. Web-site of ANENT

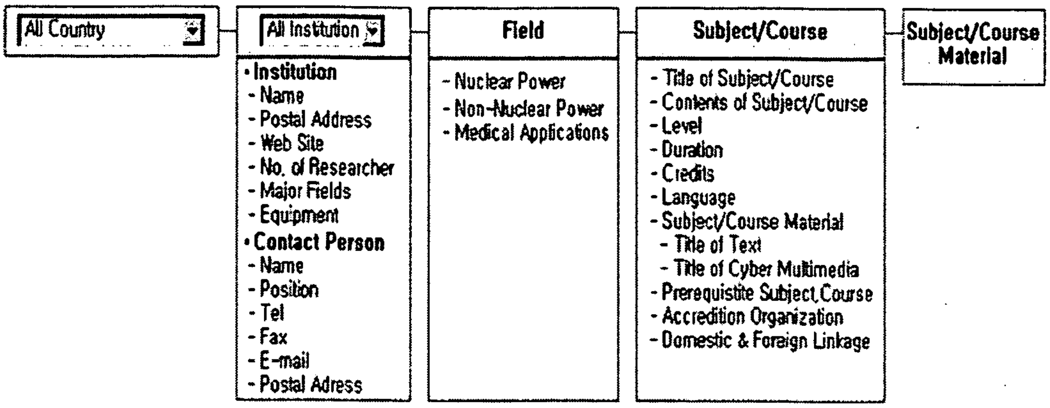

Figure 6. Structure of Database on Nuclear Education and Training

4. Project Evaluation on Human Resources Development for 2002-2004

FNCA has made a great contribution in promoting regional cooperation to meet the need of human resources for the sustainable development of nuclear technology in Asia. In general, all of the FNCA projects being carried out have contributed to the human resources development in the Asia region. Particularly, the HRD project has been a useful mechanism to encourage the exchange of information and materials on HRD planning and implementation among the Member Countries.

The objective of the HRD project is to solidify the foundation of technologies for nuclear development and utilization in Asia by promoting human resources development in Asian countries. The following are the major results of the HRD project for the duration of 2002-2004:

- Information and materials of national strategies on human resources development have been exchanged through annual workshops
- Investigation has been conducted to collect and analyze basic data about research institutions, universities, radiation and radioisotope applications, training courses and its materials, etc. Particularly, those basic data was very useful to bench mark the formulation of the national human resource development strategies.
- Discussions have been initiated to deal with strategy issues on how to attract the younger generation, and how to prepare and improve the HRD action plans for younger generation.
- Exchange of teaching materials which were written in English among member countries has been a desirable reference for the mutual cooperation for HRD.
- JAERI/NuTEC homepage which has interlinked with member countries and,

annual publications (JAERI-Review) have not only been to recognize the importance of HRD but also a valuable mechanism for strengthening the mutual interests on HRD.

The following are the socio-economic and scientific impacts in Korea from the HRD project:

(Socio-economic impacts)

- Korea Nuclear Young Network was established under the Korea Nuclear Society in 2002
- Korea WIN-expert Foundation was established in 2003
- UST-KAERI Campus was opened to provide Master Degree and Ph. D. Degree courses for young students in 2004
- National projects on nuclear manpower development have improved since 2002.

(Scientific impacts)

- Projects on education program developments such as the development of a specific curricular and its teaching materials as well as nuclear policy courses, radiation protection and the development of a cyber education system and its multi-media materials was launched in 2002
- Technical road-map on HRD was included in the formulation of the national road-map on nuclear development in 2003
- The HRD project provided an opportunity to promote in published English teaching materials.

The following are possible applications to other fields or benefit to end-users from the implementation of the HRD project:

- HRD project has emphasized the importance of regional cooperation of HRD. Regional cooperation has impacted to activate bilateral cooperation among member countries.
- From the utilization of HRD basic data, mobility of HRD personnel has been increased.

Finally, it is our understanding that the FNCA HRD project should be continued for the mutual cooperation on HRD planning and implementation for the Asian region. Cooperation among member counties is felt beneficial in terms of technology transfer which can solve the common problems of HRD, which is needed for the sustainable development of nuclear technology.

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Model for the Human Resources Development Strategy in the Nuclear Field

4 October 2004

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Korea Atomic Energy Research Institute

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- Introduction of Nuclear Power (1970s)
- Promotion of Technology Localization (1980s)
- Technology Self-reliance (1990s)
- Nuclear Energy Policy toward the 21st Century

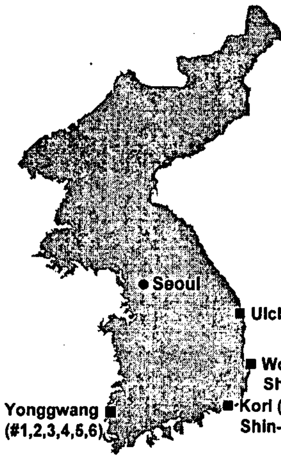
Review of Nuclear Human Resources Development

■ Brief History of Nuclear Energy

1960s	1970s	1930s	1990s
Preparation for Nuclear Energy	Introduction of Nuclear Power	Promoting Localization	Technology Self-reliance
			
Joining IAEA ('57) Research Reactor('62)	Construction of Kori #1('71-'78)	Establish Localization Plan('84)	KSNP Development('95)

http://www.kntc.re.kr 5 Nuclear Training Center / Korea Atomic Energy Research Institute

Status of Nuclear Power Plants



Units (MW)

Site	In Operation	Under Const	Total
Kori	4 (3,137)	4 (4,800)	8 (7,937)
Wolsong	4 (2,779)	2 (2,000)	6 (4,779)
Yonggwang	6 (5,900)	-	6 (5,900)
Ulchin	5 (4,900)	1 (1,000)	6 (5,900)
Total	19 (16,716)	7 (7,800)	26 (24,516)

http://www.kntc.re.kr 6 Nuclear Training Center / Korea Atomic Energy Research Institute

Nuclear Power Plants in Operation

■ 19 units 16,716 MW

Plant		Reactor Type	Capacity (MW)	NSSS Supplier	Plant A/E	Commercial Operation
Kori (KRN)	#1	PWR	650	W/H	Gilbert	'78.04
	#2	PWR	587	W/H	Gilbert	'83.07
	#3	PWR	950	W/H	Bechtel/KOPEC	'85.09
	#4	PWR	950	W/H	Bechtel/KOPEC	'86.04
Wolsong (WSN)	#1	PHWR	679	AECL	AECL	'83.04
	#2	PHWR	700	AECL/DOOSAN	AECL/KOPEC	'97.06
	#3	PHWR	700	AECL/DOOSAN	AECL/KOPEC	'98.06
	#4	PHWR	700	AECL/DOOSAN	AECL/KOPEC	'99.09
Yonggwang (YGN)	#1	PWR	950	W/H	Bechtel/KOPEC	'86.08
	#2	PWR	950	W/H	Bechtel/KOPEC	'87.06
	#3	PWR	1,000	DOOSAN	KOPEC	'95.03
	#4	PWR	1,000	DOOSAN	KOPEC	'96.01
	#5	PWR	1,000	DOOSAN	KOPEC	'02.05
	#6	PWR	1,000	DOOSAN	KOPEC	'02.12
Ulchin (UCN)	#1	PWR	950	Framatome	Framatome	'88.09
	#2	PWR	950	Framatome	Framatome	'89.09
	#3	PWR	1,000	DOOSAN	KOPEC	'98.08
	#4	PWR	1,000	DOOSAN	KOPEC	'99.12
	#5	PWR	1,000	DOOSAN	KOPEC	'04.07

NSSS : Nuclear Steam Supply System, A/E : Architect Engineering

http://www.kntc.re.kr 7 Nuclear Training Center / Korea Atomic Energy Research Institute

Nuclear Power Plants Under Construction

■ 7 units (7,800 MW)

Plant		Reactor Type	Capacity (MW)	NSSS Supplier	Plant A/E	Commercial Operation
Ulchin (UCN)	#6	PWR	1,000	DOOSAN	KOPEC	2005. 06
Shin-Kori (Shin-KRN)	#1	PWR	1,000	DOOSAN	KOPEC	2009. 12
	#2	PWR	1,000	DOOSAN	KOPEC	2010. 10
Shin-Wolsong (Shin-WSN)	#1	PWR	1,000	DOOSAN	KOPEC	2010. 09
	#2	PWR	1,000	DOOSAN	KOPEC	2011. 09
Shin-Kori	#3	PWR	1,400	DOOSAN	KOPEC	2011. 06
	#4	PWR	1,400	DOOSAN	KOPEC	2012. 06

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Review of Nuclear Human Resources Development

■ Preparation for Nuclear Energy (1950s-1960s)

Government Organization –	1956	- Scholarship for NE at Oversea
Joining IAEA –	1957	
Atomic Energy Laws –	1958	- Nuclear Eng. Education at HY Univ.
Construction of TRIGA Mark-II –	1959	- Establish KAERI - Nuclear Eng. Education at Seoul Uni.
	1960	
	1961	- Training by IAEA RI Mobile Lab.
	1962	- Laws for RI Treatment License
Organizing NPP Steering Com. –		- Training for Radiation Workers
	1967	- Establish NTC/KAERI
	1968	- Basic Training for NPP at NTC
Final plan for the 1st NPP –	1969	- Establish Korea Nuclear Society

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Review of Nuclear Human Resources Development

■ Introduction of Nuclear Power (1970s)

Signing of NPP Contract –	1970	- Establish RO License Laws
Land Breaking of 1st NPP –	1971	- Basic Training at NTC/KAERI - Training at Supplier's Countries
	1973	- Civilize KAERI
	1976	- Establish National Technical Qualification System
Start of the 2nd, 3rd NPP Const. –	1977	- Open NDT Training at NTC
Operation of the 1st NPP –	1978	- Open Utility Training Center at NPP Site
	1979	- Nuclear Eng. Education at KH Uni.

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Review of Nuclear Human Resources Development

■ Promotion of Technology Localization (1980s)

Establish Localization Plan – (YW Unit 1, 2)	1980	
	1981	
Establish KOPEC (A/E) –	1982	- Establish Nuclear Engineering Dep't at KAIST
Start Localization Plan – (NSSS and Nuclear Fuel Design, From YW Unit 3, 4)	1984	- Establish Energy Eng. Dep't at Jeju Uni.
	1985	- KAERI Move to Daeduk Science Park - Establish Nuclear Eng. Dep't at Chosun Uni.
	1986	
	1988	- Start IAEA/KOICA Regional Training
	1989	- HANARO Research Reactor Construction (30 MW)

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Review of Nuclear Human Resources Development

■ Technology Self-reliance (1990s)

Establish Korea Institute of Nuclear Safety (KINS) –	1990	
	1991	
	1992	
	1993	
Complete NSSS and Fuel Design and Manufacturing – Construction of KSNP –	1995	- Operate HANARO Research Reactor
Development of APR 1400 –	1996	- MOU with IAEA for Fellowship Training at KAERI
	1997	- IAEA's Recognition of NTC as 'International Center for Excellence'
Development of Advanced Reactor –	1998	- MOU with IAEA for Regional TC
	1999	

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Review of Nuclear Human Resources Development

- Nuclear Energy Policy towards the 21st Century

	Year	
Operation of KSNP –	2000	- Suggestion of INU Network Concept to IAEA
Establish 2nd Nuclear Promotion Plan –	2001	
	2002	- Open INTEC at NTC/KAERI - Open RCA Regional Office at KAERI
	2003	- Open RCA-KAIST Master Course
Construction of APR 1400 –	2004	
	2005	- Open UST-KAERI Campus - Establish Nuclear Safety School at KINS - Open Advanced Radiation Technology R&D Center
Operation of APR 1400 –	2011	

Model for Human Resources Development Strategy in Korea

Model for Nuclear Human Resources Strategy

- Comprehensive Nuclear Energy Promotion Plan
- Approach to HRD Planning Model
- Policy Targets of HRD
- Review and Estimation of Manpower Requirement
- Organizational Coordination Framework for HRD
- Action Plan for Promotion of HRD
- Implementation of Nuclear Education and Training

Model for Nuclear Human Resources Strategy

- 10 Promotion Areas of the Comprehensive Nuclear Energy Promotion Plan

① Electricity Generation and Reactor Development
② Nuclear Fuel Cycle
③ Utilization of Radiation and Radioisotopes
④ Fostering and Promotion of Nuclear Industry
⑤ Enhancement of Public Und'ing and Site Acquisition
⑥ Nuclear Safety and Radiation Protection
⑦ Radioactive Waste Management
⑧ Basic and Fundamental Nuclear R&D
⑨ Training of Nuclear Manpower
⑩ Nuclear Diplomacy and International Cooperation

Model for Nuclear Human Resources Strategy

- **Approach to HRD Planning Model**
  - Formulation of Strategic Objective (Targets)
  - Review of Current Manpower and Estimation of Manpower Demand
  - Long-term Organizational Structure Development
  - Implementation of Action Plans for HRD

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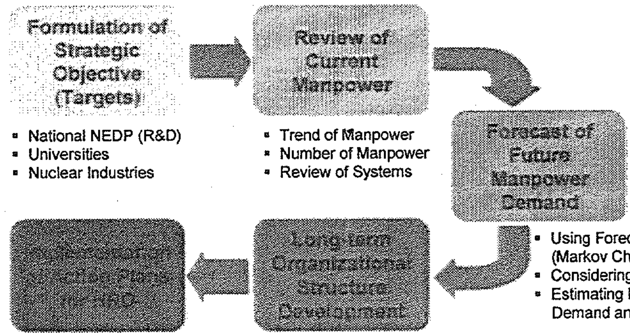
Model for Nuclear Human Resources Strategy



- National NEDP (R&D)
- Universities
- Nuclear Industries

- Trend of Manpower
- Number of Manpower
- Review of Systems

- Using Forecasting Model (Markov Chain's Model)
- Considering Major Factors
- Estimating Manpower Demand and Structure

- National Projects on HRD (Including Budgets)
- Conducting Education and Training

- Development of HRD Infrastructures
- Improvement of Laws and Systems
- Establishment of HRD Coordination (Committee or Network)

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Model for Nuclear Human Resources Strategy

- **Government Policy Targets for HRD**

Support for nuclear education program at universities
- Enlargement of fellowship program for students
- Providing intern job opportunities at research institutes and industries
- Support for updating curricula, linkage with the advanced technology

Maintaining qualified nuclear personnel at industries
- Providing fringe benefits for radiation workers
- Enhancement of training organizations and its training programs
- Activation of exchange programs among industries, research institutes and universities

Encouraging global competitiveness of nuclear manpower
- Providing international career for young researchers and students
- Fostering joint research projects with international organizations & advanced countries
- Utilization of outstanding experts from overseas

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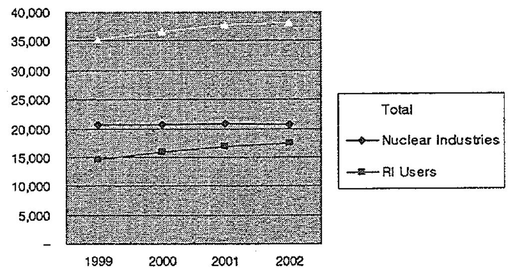
Model for Nuclear Human Resources Strategy

- **Review of Current Manpower**



Status of Nuclear Manpower

Classification \ Year	1999	2000	2001	2002
Nuclear Industries	20,698	20,646	20,798	20,736
RI Users	14,629	15,925	16,857	17,348
Total	35,327	36,571	37,655	38,084

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Model for Nuclear Human Resources Strategy

■ **Stochastic Model for Manpower Estimation (Example)**

Forecast of future manpower demand and structure

$$n(T) = n(T\text{-}1)\,\{P + W'\,r'\} + M(T)\,r$$

n(T), n(T-1): expected stock at time T, T-1
P: transition matrix, W': wastage vector, r': recruitment vector
M((T) : manpower gap between time T and T-1 (created seats)
r: recruitment vector for M(T)

$$n(T) = n(p_1 + p_2 + p_3 + p_4)\left[\begin{bmatrix} p_{11} & p_{12} & p_{13} & p_{14} \\ p_{21} & p_{22} & p_{23} & p_{24} \\ p_{31} & p_{32} & p_{33} & p_{34} \\ p_{41} & p_{42} & p_{43} & p_{44} \end{bmatrix} + \begin{bmatrix} w'_1 \\ w'_2 \\ w'_3 \\ w'_4 \end{bmatrix} (r'_1\ r'_2\ r'_3\ r'_4)\right] + M(r_1\ r_2\ r_3\ r_4)$$

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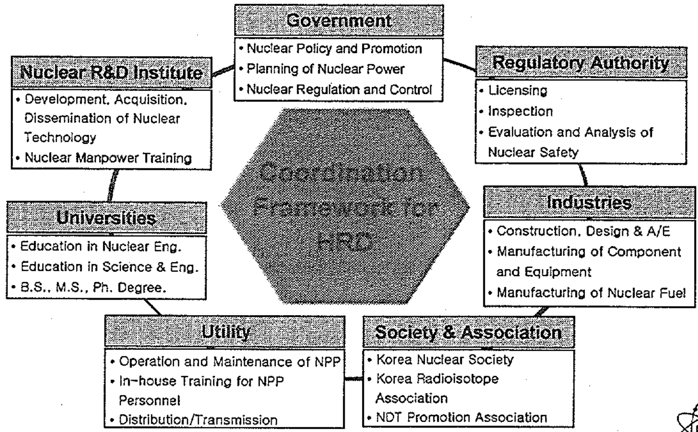
Model for Nuclear Human Resources Strategy

■ **Organizational Coordination framework for HRD**



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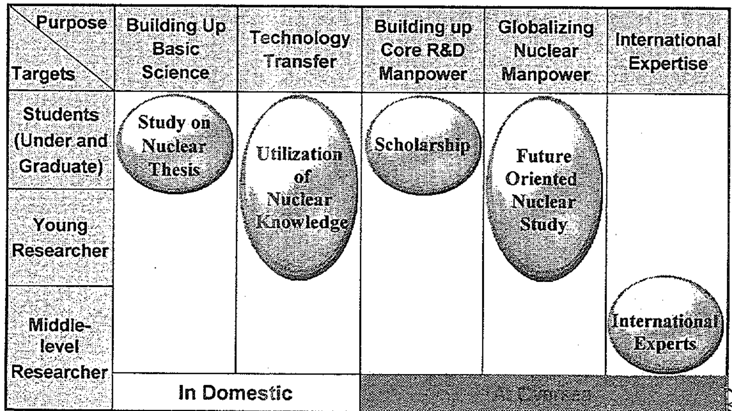
Model for Nuclear Human Resources Strategy

■ **Promotion of HRD :**
National Project for Nuclear Manpower Development



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Model for Nuclear Human Resources Strategy

■ **Implementation of Nuclear Education and Training**

● : Pre-requisite ⊙ : Option ○ : Recommendation

Field	Title of Training Courses	Nuclear Power Related Organizations						Duration (weeks)
		Gov.	R&D	Utility	A/E	Manu.	Fuel	
Nuclear Theory & Fundamentals	Nuclear Physics	●	●	●	●	●	●	2-4
	Reactor Theory and Kinetics	●	●	●	●	●	●	2-4
	Reactor Control and Instrumentation	●	●	●	●	●	●	2-4
	Thermo-Hydraulics and Heat Transfer	●	●	●	●	●	●	2-4
	Radiation Protection & Measurement	●	●	●	●	●	●	2-4
	Nuclear Fuel Cycle & Waste Management	●	●	●	●	●	●	2-4
	Nuclear Materials	●	●	●	●	●	●	2-4
	Research Reactor Experiment	○	○	○	○	○	○	2
Nuclear Policy, Planning, Project Management	Energy Planning	●	●	●	○	○	○	4
	Nuclear High-Level Decision Makers	●	●	●				1-2
	Nuclear Power Plant Planning and Implementation	●	⊙	●	●	●	●	6
	Nuclear Power Project Management	⊙	⊙	●	●	●	⊙	6-10

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Model for Nuclear Human Resources Strategy

Safeguards, Nuclear Fuel Cycle	Safeguards Courses	●	●	●	◎	◎	●	4
	Basic Course for Nuclear Fuel Materials Treatment	◎	●	●			●	4
	Supervisory Course for Nuclear Fuel Materials Treatment	◎	●	●			●	6
	Radioactive Waste Management	●	●	●			●	4
	Decontamination and Decommissioning of Nuclear Facilities	●	●	●			◎	4
Operation & Maintenance Or Nuclear Power Plant	Operator Training Course(MCR & Local)			●				24-50
	Maintenance Training Course (Mech., Elec., T&C, Computer)			●				38-60
	Technical Staff Training Course (Chemistry, Rx, Radiation, Procurement, QA, etc)			●				11-52
	Trainers for Simulator (Instructor & Maintenance)	○	○	●				44-58
Nuclear Power Technology	Nuclear Power Plant System Technology	●	●	●	●	◎	●	4
	Quality Assurance of Nuclear Power	●	●	●	●	●	●	4
	ASME Codes	◎	◎	●	●	◎	●	4
	Electric Technology and Codes	◎	◎	●	●	◎		2-4
	Instrument & Control Technology and Codes	◎	◎	●	●	◎		2-4
	Concrete Technology and Codes	○	○	●	●			2-4
	Preparedness to Radiological Emergency	●	●	●	○		○	2-4

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Model for Nuclear Human Resources Strategy

Nuclear Power Safety	Safety Management of NPP	●	●	●	●	◎	●	4-6
	Safety Analysis Review of NPP	●	●	●	◎	◎	◎	4-6
	Radiological Dose Assessment	●	●	●	◎	◎	◎	4
	Nuclear Inspection Technology	●	○	●	○	◎	○	4
	NSSS Design and Reactor Safety	◎	●	●	●	◎		4
	Probabilistic Safety Assessment	◎	●	●	◎	◎	◎	4
	Accident Management of NPP	●	●	●	○	◎	○	4
	Fire Safety of NPP	●	◎	●	○	○	○	2-4
	Risk-Based Optimization of NPP Operation	●	●	●	○	○	○	4
Radiation Protection	Basic Application of Radioisotopes	◎	●					4
	Radiation Protection	◎	●					6
	Medical Application of Radioisotopes	◎	●					4
Welding, NDT, and Industry Application	Nuclear Welding Technology	○	○	◎	●	●	◎	4
	Non-Destructive Testing Technology	○	○	◎	●	●	◎	4
	Radiographic Testing Technology	○	○	◎	●	●	◎	2-4
	Ultrasonic Testing Technology	○	○	◎	●	●	◎	2-4
	PSI/ISI Technology	○	◎	●	●	●	◎	4
	KEPEC Codes	○	◎	●	●	●	◎	3

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Mutual Cooperation for Human Resources Development

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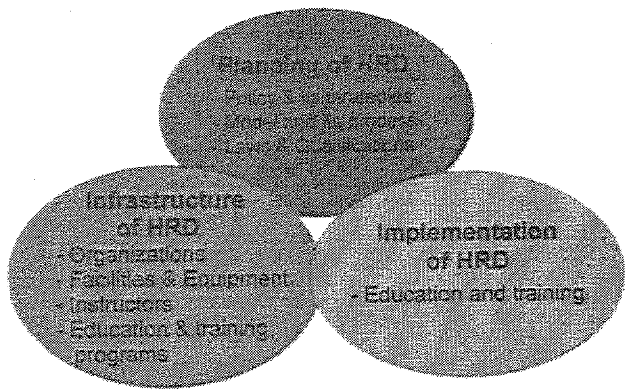
Mutual Cooperation for HRD

- Proposed Cooperation Items for HRD



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Mutual Cooperation for HRD

- Asian Network for Education in Nuclear Technology
  - Work Packages
  - Development of ANENT Web-site
  - Database of Education and Training on Web-site
  - Future Plan of ANENT

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Mutual Cooperation for HRD

- Work Packages (Group Activities)

GA	Scope	Coordinator
GA 1	Share of information and materials (Development of ANENT Web-site)	KAERI/Korea
GA 2	Exchange of students, teachers, and researchers	MINT/Malaysia
GA 3	Distance learning (compile existing course and material)	PNRI/Philippines
GA 4	Establishment of reference curricula, facilitating credit transfer and mutual recognition of degree	HUT/Vietnam
GA 5	Liaise with other networks and organizations	UC/Sri-Lanka

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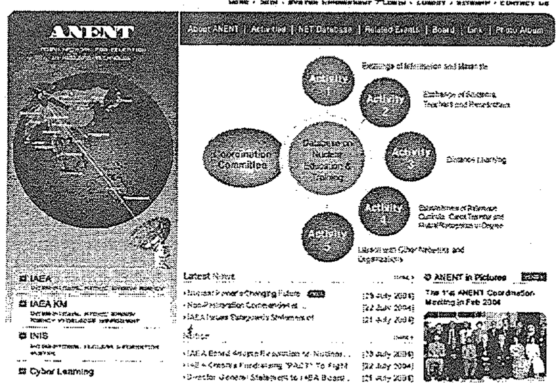
Mutual Cooperation for HRD

- Design and Construction of ANENT Web-site : www.anent-iaea.org



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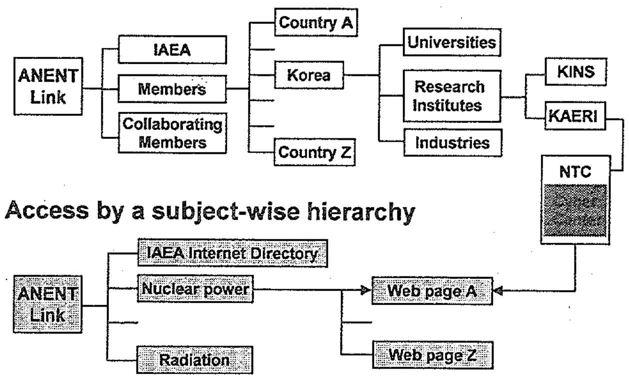
Mutual Cooperation for HRD

- ANENT Web-site Link System
  - Access by an institutional hierarchy
  - Access by a subject-wise hierarchy



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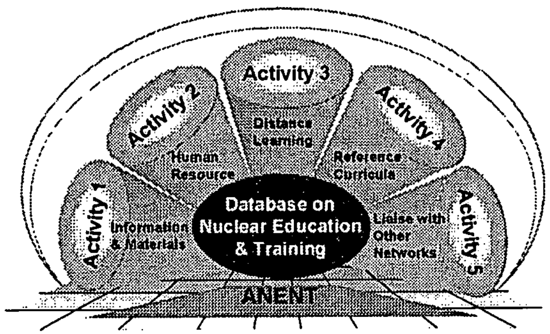
Mutual Cooperation for HRD

■ Database of Education and Training on Web-site

Integrated DB System



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Mutual Cooperation for HRD

■ Database of Education and Training on Web-site

- DB Hierarchy

Country	Institutions	Field	Subject/Course	Material
	• Institution - Name - Postal Address - Web Site - No. of Researcher - Major Fields - Equipment • Contact Person - Name - Position - Tel - Fax - E-mail - Postal Adress	- Nuclear Power - Non-Nuclear Power - Medical Applications	- Title of Subject/Course - Contents of Subject/Course - Level - Duration - Credits - Language - Subject/Course Material - Title of Text - Title of Cyber Multimedia - Prerequisite Subject Course - Accreditation Organization - Domestic & Foreign Linkage	

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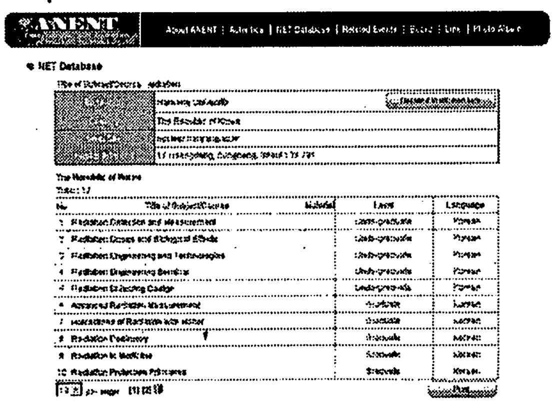
Mutual Cooperation for HRD

■ Database of Education and Training on Web-site

- Sample of DB



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Mutual Cooperation for HRD

■ Future Plan of ANENT

- Improvement of the ANENT web
  - addition of data to NET DB
  - testing of the web functions
  - reflection of comments from ANENT members
- Report to the 2nd ANENT Coordination Committee Meeting
- Long term improvement addressing the issues of:
  - upgrading of the web functions
  - maintaining the required quality of the contents
  - assurance of a sustainable operation

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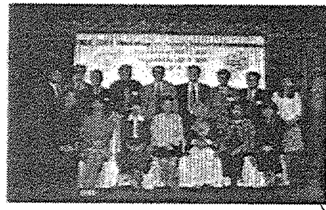
Project Evaluation on FNCA HRD 2002 ~ 2004

Project Evaluation of FNCA HRD 2002-2004

- Major Results
- Overall Outcomes on Socio-economic, Scientific Impact
- Possible Application, Benefits to End-users
- Proposals



Project Evaluation of FNCA HRD 2002-2004

- Major Results
  - Activating Information Exchange on HRD Planning and Implementation among MCs
  - Survey of Basic Data on HRD Strategy
  - Enhancing HRD Action Plans
  - HRD Publications: JAERI-Review
  - Producing English Textbooks: JAERI (2), Korea (1), Malaysia (1)

Project Evaluation of FNCA HRD 2002-2004

- Socio-economic Impacts
  - Establish Korea Nuclear Young Network under KNS (2002)
  - Establish Korea WIN-Expert Foundation (2003)
  - Open UST-KAERI Campus (2004)
  - Improved National Projects on Nuclear Manpower Development (2004)
- Scientific Impacts
  - Implementing Projects on Education Program Development (3 Projects) : Development of Cyber or Multi-media Training Materials, etc.
  - Technical Road-map on HRD (2003)
  - Emphasizing Nuclear Knowledge Mgt. System (2004)
  - Encouraging Production of English Training Materials

Project Evaluation of FNCA HRD 2002-2004

- **Possible Application, Benefits to End- users**
  - Activation of Bilateral Cooperation among MCs
  - Mutual Studies (Projects) on Specific Topics on Education and Training Matters
  - Improvement of Mobility on Instructors and Trainees

- **Proposals**
  - Mutual Studies (Projects) on Specific Topics on Education and Training Matters
  - Enhancing Exchange of Multi-Media Education Materials on Web-site

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1.9 Japanese Experience in HRD

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1.9.1 Review of Human Resources Development in Nuclear Field in Japan

Review of Human Resources Development in Nuclear Field in Japan

Fumitaka SUGIMOTO, Nobuo SASAMOTO, and Hideo MATSUZURU
Nuclear Technology and Education Center
Japan Atomic Energy Research Institute
http://www3.tokai.jaeri.go.jp/nutec/fnca/fnca.htm

Reviewing the experiences of the countries proceeding in nuclear development and the introduction of foreign technologies could be a useful reference for the countries that enhance the similar technologies in near future. There are, however, some differences in scale and condition of the development between countries, and it could be difficult to assimilate to precedents. The report summarizes reviews of the history of Human Resources Development (HRD) focused on the phases of nuclear development in Japan, in order to contribute to the formulation of effective strategies for HRD in each country.

The history of HRD to support a nuclear development programme in Japan could be divided into three phases as follows.

I. HRD in the start-up stage of nuclear development
- Study abroad
- Establishment of a nuclear engineering course in universities
- Establishment of an official training and education system, such as the RI school and the Nuclear Engineering School (NE school) of the Japan Atomic Energy Research Institute (JAERI)

II. HRD in the stage of introduction of a nuclear power plant (NPP)
- Training by foreign manufacturers and by the NE School of JAERI

III. HRD in the stage of a large-scale construction of NPP
- Establishment of an education and training center in each company

We propose the grouping of the member countries into three classes, i.e., 1) countries with radiation applications, 2) countries with a future plan to construct NPPs, and 3) countries with NPPs in operation, depending on the three phases mentioned above. It should be pointed out that the phase I might be common for all countries during the history of development of nuclear and radiation application. This paper gives a detailed description of the phase I, together with brief definitions of the phases II and III in the whole HRD history.

The details of phase II and III will be reported elsewhere by Mr. Y. NAKAYAMA, and Prof. M. ARITOMI will give the achievement of university for HRD in a nuclear field. Figure 1 shows a scale of nuclear development in each phase.

1. Status in the phase of start-up of nuclear development

Nuclear development in Japan was substantially started in 1956. Figure 2 shows the chronology in the first decade of nuclear development. In 1954, the first budget for nuclear energy was approved, and bills relating to nuclear energy were established in 1955. In 1956, Atomic Energy Commission (AEC) and Atomic Energy Bureau of Science and Technology Agency were established as headquarters of nuclear development in Japan. AEC established the first 5yr. plan for utilization of nuclear energy as a constructive road map for the development and introduction of nuclear technology. The Government set up JAERI and the Atomic Fuel Corporation in 1956, and the National Institute of Radiological Science (NIRS) in 1957. Around the same time, the Japan Atomic Industrial Forum (JAIF), five nuclear consortiums (Toshiba, Hitachi, Mitsubishi, Fuji, and Sumitomo), and Japan Atomic Power Company (JAPC) were set up. National frameworks of legislation and qualification were also developed. In 1957, the Nuclear Reactor and Fuel Regulation Law and qualification system of the chief engineer of reactor operation were established, and in the following year, the Law Concerning Prevention of Radiation Hazard and qualification system of the radiation protection supervisor were established. Figure 3 shows these elements. By combining Figures 2 and 3, it might be said that the framework of nuclear development was intensively achieved in a relatively short period of time in Japan.

Through the upward phases, Japan imported the first nuclear research reactor JRR-1 from U.S., and it went critical in 1957. Successively the second reactor, JRR-2, also went critical in 1960. In 1962, the third reactor, JRR-3, built by domestic technologies for the first time was started its operation. The demonstration power reactor JPDR designed by GE was started its operation in 1963. The first commercial reactor was operated in 1966.

2. Goal of nuclear development in Japan

In this section, we'll briefly review the goal of nuclear development in Japan formulated in 1956.

Goal:

Development of domestic production of NPPs which is most suitable to conditions in Japan. To achieve the goal, an establishment of nuclear technology foundation by focusing on basic researches and development of the related technologies is needed.

Policy:

① To proceed developments of NPPs and radiation application, simultaneously.
② To proceed maximum utilization of domestic resources for nuclear fuel, and also domestic technologies for reprocessing.
③ To proceed research and development of own breeder reactor.
④ To establish the framework for development production of own RI.
⑤ To seek close cooperation between some universities and national institutes.

In case of Japan, the most important thing was to define the explicit goal to undertake development of own nuclear reactors. Based upon the goal, it was succeeded indeed to build JRR-3 of JAERI by domestic technologies within the decade learning by process of construction, operation and improvement of the imported nuclear reactors. To formulate the HRD strategy modeling of each country by taking some sort of reference to experiences of Japan, it may need to be careful. That is, it might be the key of HRD whether the national strategy intends to introduce NPP with a final goal of its home manufacturing or not.

3. Foreseeable number of personnel required

To achieve the goal stated above, the number of personnel was estimated under the assumption that there could be 20 NPPs, 15 NPPs under construction after 15 years, in 1970. In fact, however, there were 3 NPPs in operation, and there were 2000 facilities for use of RI in 1970.

Expected maximum personnel (as of 1956):

Nuclear science and technology specialists: 1,300
Science and technology specialists on related nuclear field: 5,300
Science and technology specialists on radiation application: 5,500
Radiation safety supervisors: 350

These numbers of personnel were somehow revised by the result of questionnaire asking personnel to be required to 1000 companies implemented from 1958 to 1959.

Nuclear science and technology specialists are engineers who possess high knowledge and skills in either nuclear physics, nuclear engineering, or the related specialized nuclear field. They should be educated and trained in the nuclear engineering faculty of universities that were just started to establish around in 1960. There were consequently few personnel categorized in this specialty at the time of formulating the goal in 1956.

Science and technology specialists related to nuclear field are engineers who possess knowledge and skills in either mechanical engineering, electrical engineering, physics, chemistry or metallurgy with knowledge and skills related to nuclear field. Although it could conjecture that there would be about 4,000 specialists judging from the result of questionnaire, it did not always mean that they possessed knowledge and skills of nuclear engineering which is a comprehensive field throughout the wide area of technology. Thus they needed a follow-up education in this comprehensive category in some way.

With regard to science and technology specialists on radiation application and radiation safety supervisors, there was not detailed description in the reference materials, but it was only specified that the estimate was based on the number of facilities for use of RI.

4. HRD in start-up stage of nuclear development

Let us review the way of training and education in Japan. First of all, it was started by study abroad. Figure 4 shows the cumulative number of students studied abroad in nuclear field except for Japanese universities. The majority of the countries visited were developed countries in the nuclear field, such as U.S., England, Canada, and North Europe. It was the most general and effective way of HRD for students to go to developed countries for study abroad especially in the era without enough amount of national or private training institutes for nuclear engineers and solid education system for nuclear field in universities in Japan. Many students did their jobs actively as leaders in early nuclear fields after they came back to Japan. About 700 students went to study abroad for the first 15 years.

Secondly, the establishment of an advanced education system, in particular, nuclear engineering major in the university is important. The meeting among the university, AEC, and the Science Council of Japan was held in 1956, and systematical development of department of nuclear engineering in the university was proposed to the government. The following year, in 1957, the four national universities established graduate schools for nuclear engineering, respectively, and continuously the education system was improved. Furthermore, some private universities initiatively established the nuclear engineering department.

Thirdly, it was required to establish professional training sections of nuclear research and development institute. In the case of Japan, JAERI set up the RI school in Tokyo in 1958, and also set up the NE school in Tokai in 1959. At the same time, NIRS set up training department in 1960 for radiological scientists and engineers. It was defined that the NE school of JAERI should provide follow-up training or advanced research training for personnel, who graduated universities, engaged in nuclear field. The RI school and the training school of NIRS were also considered to take the complementary role as HRD institutes in nuclear field, even after the completion of systemization of nuclear education in universities.

In Fig. 5 is given a comparison between the cumulative number of trainees at the NE school of JAERI and the number of NPPs in operation. The implemented course was mainly for advanced reactor engineers, and the cumulative number of trainees has been monotonically increasing according to the increase of the number of NPPs in Japan. The tendency for reactor engineering makes an apparent contrast with that for the RI application to be given in the following figure. Figure 6 shows a comparison of the cumulative number of trainees at the RI school of JAERI and the number of facilities for use of RI. Besides the RI school, other private training sectors were set up later, and the number of trainees at the RI school is not the total trainee in Japan. Facilities for use of RI reached its peak of about 5000 in 1990's with few fluctuations in the number since then. On the other hand, the cumulative number of trainees was increased about double of facilities for use of RI, and still it keeps on increasing. It could be considered to bring in new personnel to fill up retired employees.

In summary, the primary HRD in Japan was promoted with study abroad, university, and national training institute as the important pillars, and HRD process based on the framework for Japanese nuclear development was successfully achieved.

5. HRD in introduction and the beginning of a large-scale construction of NPP

It was indispensable to secure excellent engineers and well-trained experts in nuclear manufacturers and promising operators of NPPs in the era of introduction of NPP and the beginning of a large-scale construction of NPP in Japan. Therefore, in the present report, only the necessary and important roles of training center in electric power companies including JAPC are presented.

JAPC was set up under the cooperation between the government and the nine electric power companies. The Tokai nuclear power station 1 (gas cool reactor) of JAPC was started its operation in 1966. In 1970, the Tsuruga nuclear power station 1 (BWR) of JAPC also and the Mihama nuclear power station 1 (PWR) of Kansai Electric Power Company were started operations in succession.

Before starting these power reactors' operation, training for operators for NPP came up to urgent task. The training was implemented by training institutes of foreign manufacturers that supplied NPP, and the NE school and JPDR of JAERI.

Considering the large-scale introduction and construction of NPPs in future, the time was ripe for establishment of original NPP training centers in Japan. Responded to the opinion, JAPC set up an original training center in 1968, and with that as a start, BWR set up a BWR operation training center (BTC), PWR set up a Nuclear Power Plant training center (NTC) in 1971. Training equipments was developed with full size simulators in these training centers, and it was utilized for training from 1974. Operators of Japanese NPPs, afterwards, have been on a level with one of the best in the world by the training at the training centers together with on-the-job trainings.

6. Conclusion

- The paper gives the HRD experiences in Japan aiming at development of own commercial NPPs in Japan, corresponding to the three phases of the Japanese nuclear development history, that is, the start-up phase, the phase of introduction of NPP, and that of a large-scale construction of NPP.
- The above phases could be corresponding to the participating FNCA member countries, such as countries with radiation application, countries planning to construct NPPs, and countries with NPPs in operation. Experiences in Japan, therefore, could be one of the useful information for formulating the strategy modeling.
- Particularly, the first phase of start-up of nuclear development is the essential basis for achieving other two phases. It should be made special mentions for the first phase are as follows:
  - Framework of nuclear development was intensively constructed in a short period of time in Japan
  - Early set up us the training centers in JAERI and NIRS
  - Simultaneous systematical establishment of nuclear development in private companies, as well as in national institutes.
- HRD in Japan corresponding to nuclear development consisted mainly of study abroad, development of department of nuclear engineering in universities, and set up the training centers in JAERI and NIRS in the first phase, and self-training of operators in electric power companies and training of technical engineers of private sectors including electric power companies in the second and third phases.

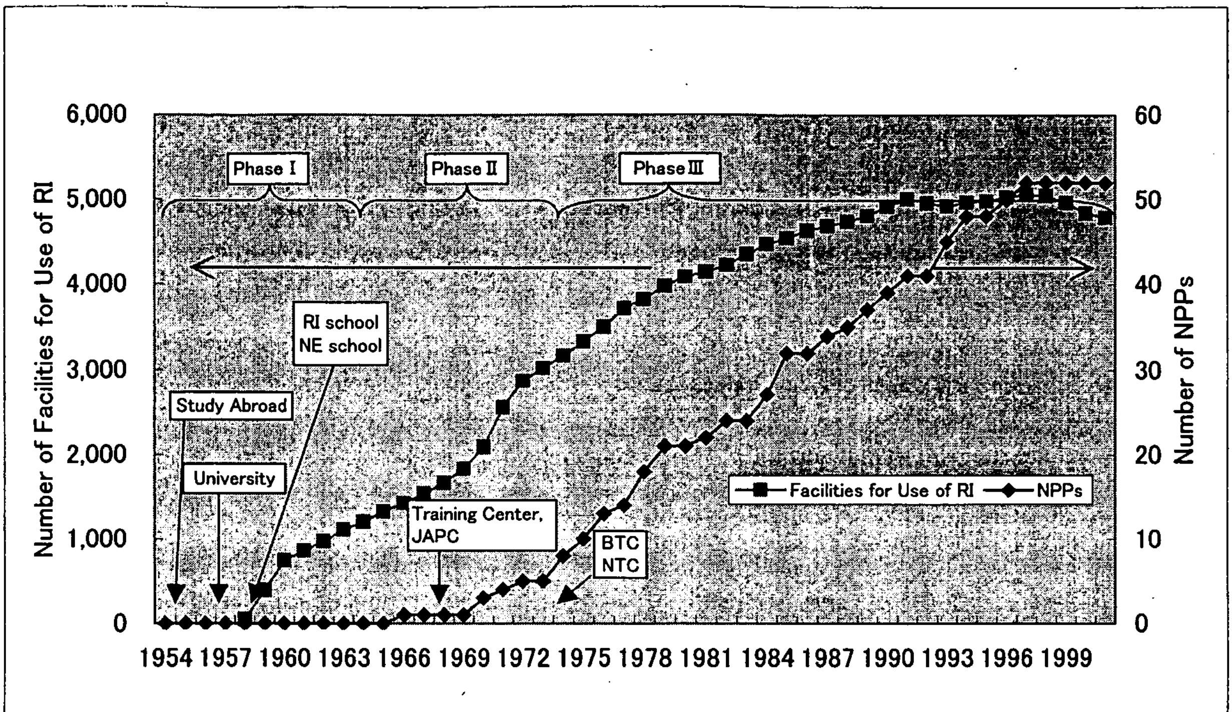

Fig. 1 Scale of Nuclear Develpment in Three Phases

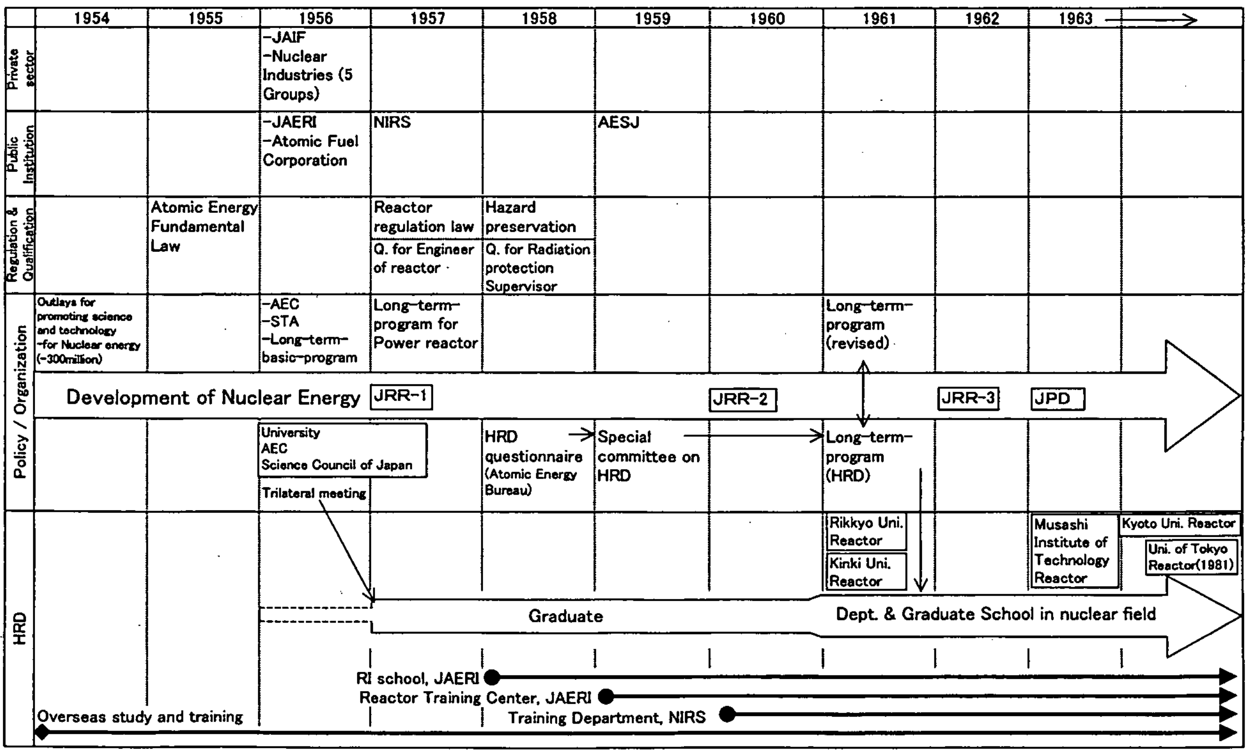

Fig. 2 Chronology in the first decade of nuclear development

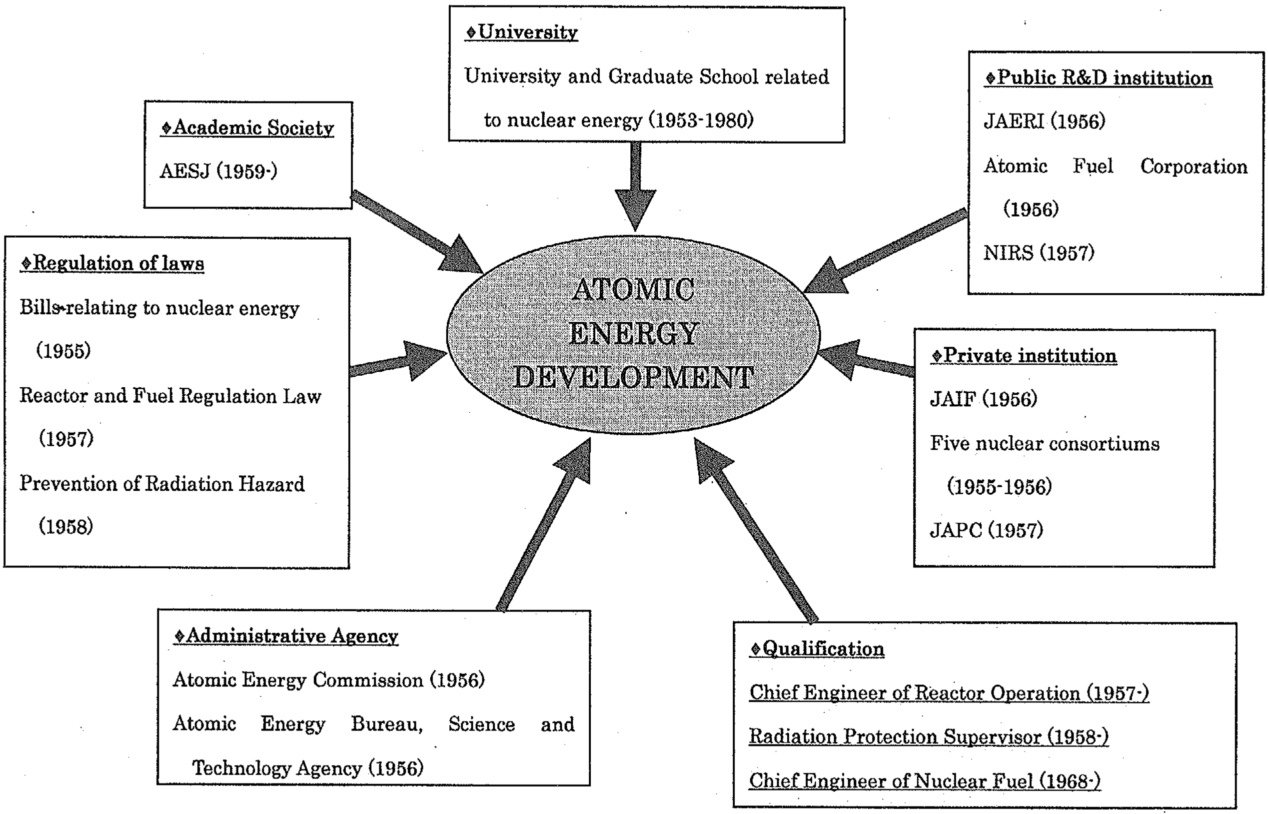

Fig. 3 Factors of HRD in Atomic Energy Development in Japan

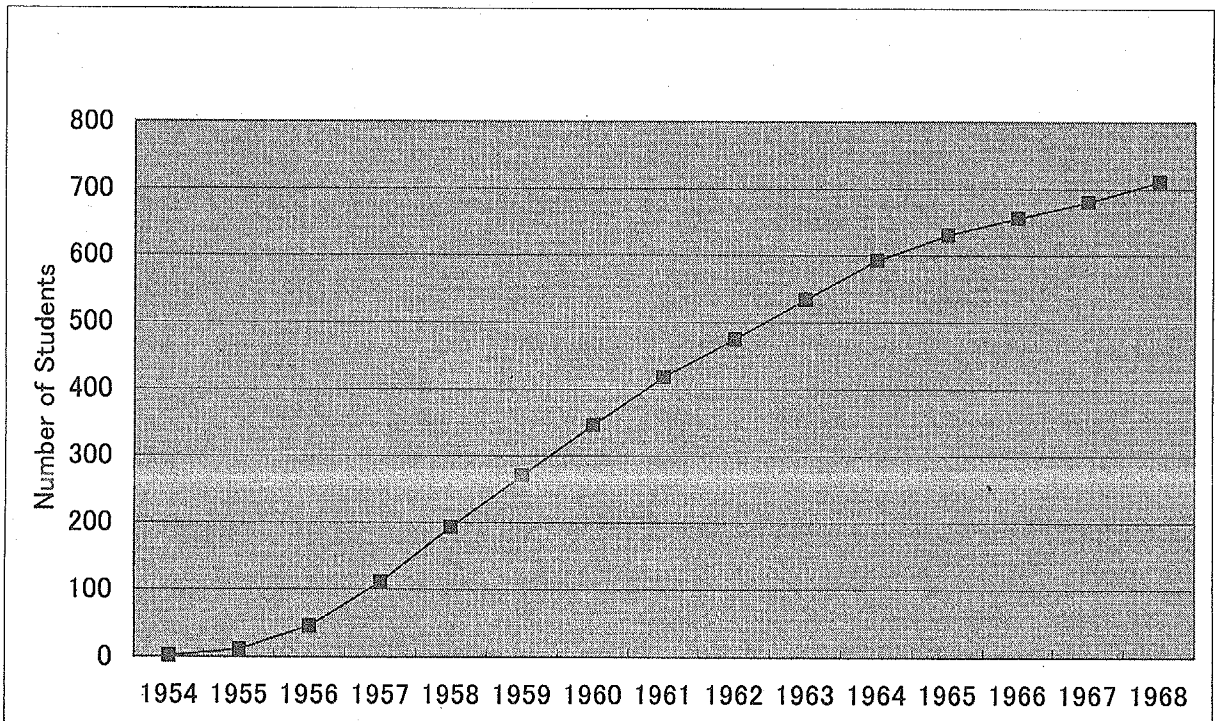

Fig. 4 Cumulative Number of Students Studied Abroad (Except University)

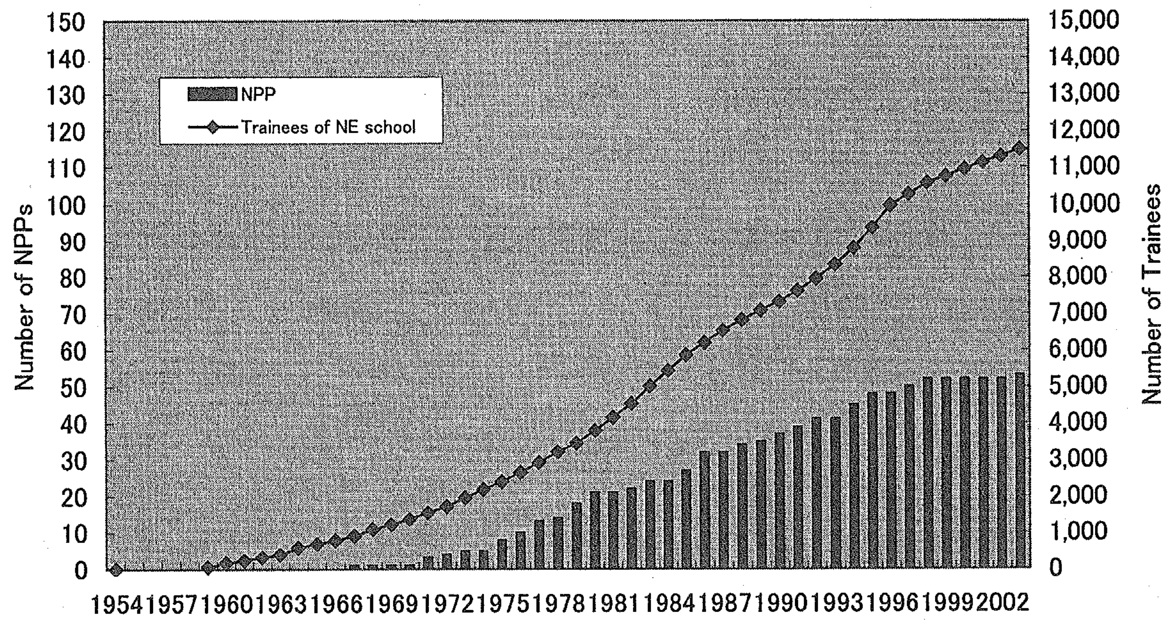

Fig. 5 Cumulative Number of Trainees of NE school and NPPs

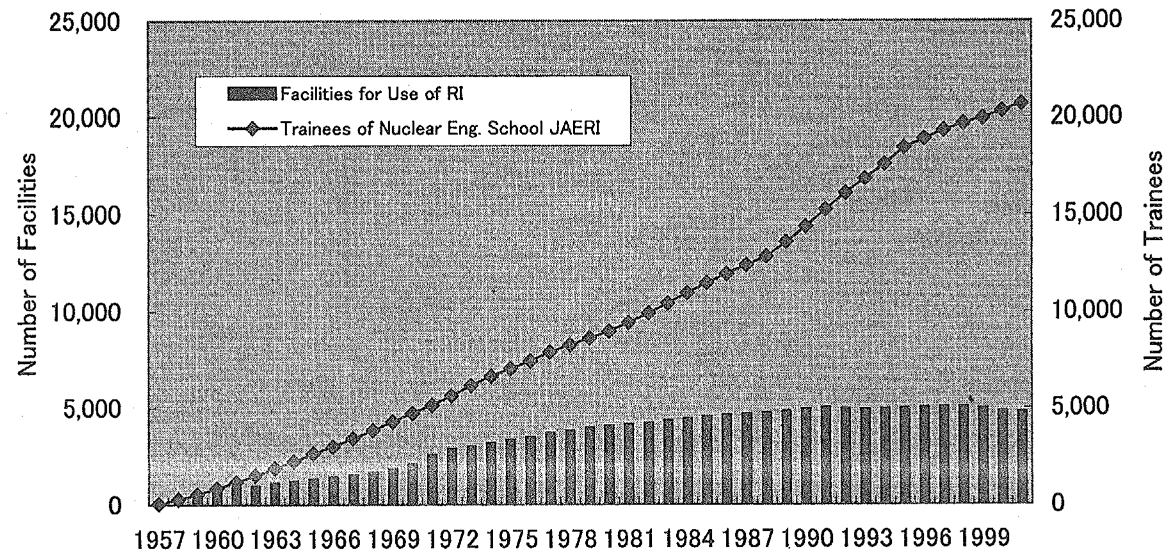

Fig. 6 Cumulative Number of Facilities for Use of RI and Trainees of NE school and NPPs

Review of Human Resources Development in Nuclear Field in Japan

Fumitaka SUGIMOTO, Nobuo SASAMOTO, Hideo MATSUZURU

Nuclear Technology and Education Center
Japan Atomic Energy Research Institute
(NuTEC JAERI)

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1. Status in the phase of start-up of nuclear development
2. Goal of nuclear development in Japan
3. Foreseeable number of personnel required
4. HRD in start-up stage of nuclear development
5. HRD in introduction and the beginning of a large-scale of construction of NPP
6. Conclusion

2

Introduction

- Three phases of HRD history in supporting nuclear development programme
- Three phases of development
  - Phase I: Start-up stage of nuclear development
  - Phase II: Introduction of NPP
  - Phase III: Large-scale construction of NPP (home manufacturing)

3

Introduction (Cont'd)

- Outline of HRD history in each phase

Phase I
- Study abroad
- Establishment of nuclear engineering course in Univ.
- Establishment of official training and education system (RI school and nuclear engineering (NE) school of JAERI)

Phase II
- Operator training by foreign manufacturers and NE school by JAERI

Phase III
- Establishment of own education and training center in each electric power company

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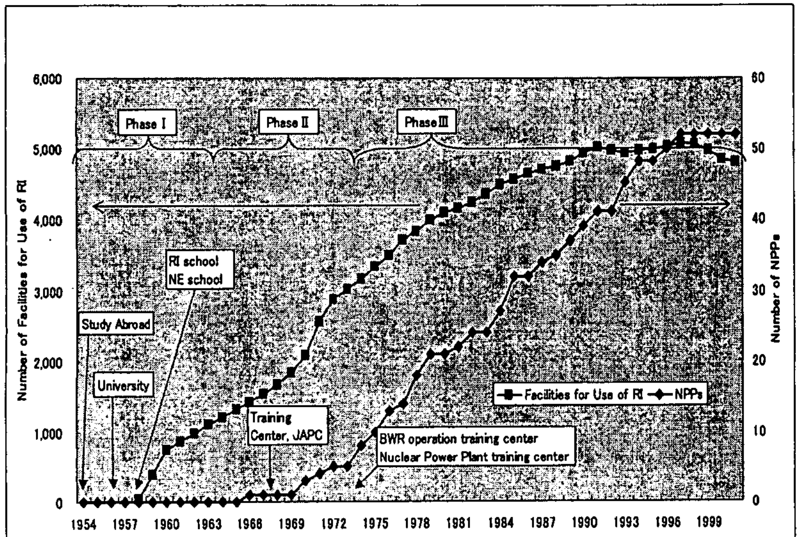

Fig. 1 Scale of Nuclear Develpment in Three Phases

5

Set up of nuclear development

- Establishment of
  - Administrative agencies (AEC, STA)
  - Public institutes (JAERI, Atomic Fuel Corporation, NIRS)
- Set up of
  - Program for nuclear development
  - Law, regulation and qualification
- Framework of nuclear development was intensively constructed in a short period of time
- Simultaneous systematical establishment
  - in official sector
  - in private sector

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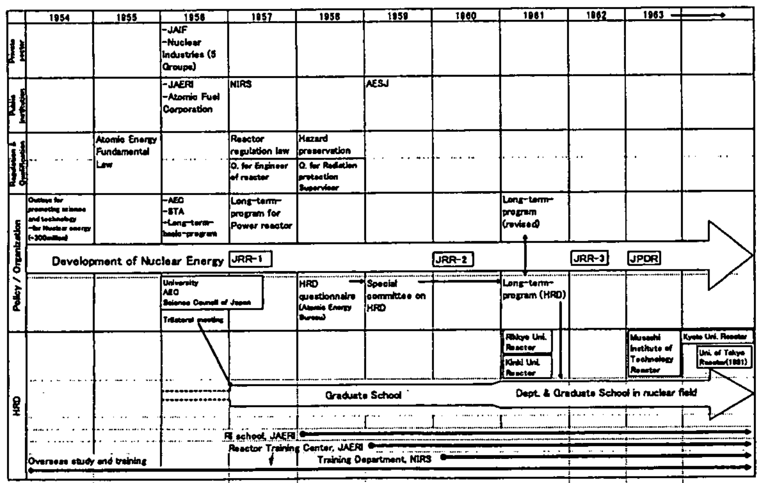

Fig. 2 Chronology in the first decade of nuclear development

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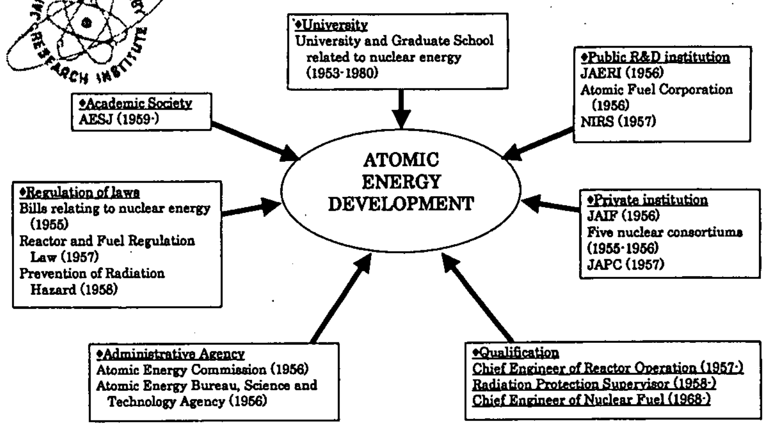

Fig. 3 Factors of HRD in Atomic Energy Development in Japan

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Goal of nuclear development in Japan (Approved in 1956)

- Goal: To develop NPPs by domestic technologies
- Policy:
  - Simultaneous development of NPPs and radiation application
  - Domestic development of nuclear fuel and reprocessing process
  - Research & Development of own breeder reactor
  - Domestic production of RI

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Goal of nuclear development in Japan (Cont'd)

- Success to build JRR-3 by domestic technology through construction, operation and improvement of imported reactors
- Technical cooperation with U.S. manufacturer for commercial nuclear reactor
  - ➢ Advanced research reactor by home manufacturing
- HRD strategy differs depending on final goal (Introduce NPP? or Its home manufacturing?)

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Foreseeable Number of Personnel Required

- Personnel required under assumption of;
  - 20 NPPs in operations & 15 NPPs under construction (after 15yr)

Actual Status in 1970

3 NPPs in operation

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Foreseeable Number of Personnel Required (Cont'd)

- Foreseen number of personnel
  - Nuclear S&T Specialists: 1,300
    (Nuclear engineering, nuclear physics, and others)
  - S&T Specialist related nuclear field: 5,300
    (Physics, mechanical engineering, and others)
  - S&T Specialist on radiation application: 5,500
  - Radiation safety supervisor: 350

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HRD in start-up of Nuclear Development

- Study Abroad
  - Countries accepted are;
    U.S., England, Canada, North Europe
  - Around 700 students went to study abroad for the first 15yr
  - Trainees or students did active jobs as leaders in nuclear field

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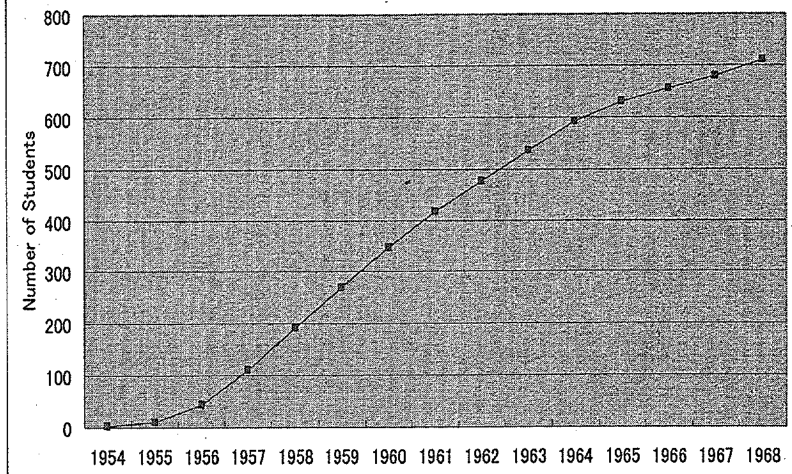

Fig. 4 Cumulative Number of Students Studied Abroad (Except University)

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Study Abroad to;

- U.S.
  - Argonne National Laboratory, Reactor School
  - Oak Ridge National Laboratory, RI School
  - Brookhaven National Laboratory
  - M.I.T
  - Michigan Univ.
- U.K.
  - Harwell Laboratory, Reactor School, RI School
  - Oxford Univ.
  - Birmingham Univ.
  - London Univ.
- Norway
- Sweden
- Canada

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HRD in start-up of Nuclear Development (Cont'd)

- Trilateral meeting among University, AEC, and Science Council of Japan in 1956
  - Systematical development of Dept. of nuclear engineering in univ. was proposed to government

Graduate school and Univ. for nuclear engineering were established one after another

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HRD in start-up of Nuclear Development (Cont'd)

- Importance of HRD institute for national research development
  - RI school (JAERI,1958)
    Complementary role to university education
  - NE school (JAERI,1959)
    For follow-up or advanced training of those engaged in nuclear field
  - Training school for radiology engineers (NIRS,1960)
    Complementary role to university education

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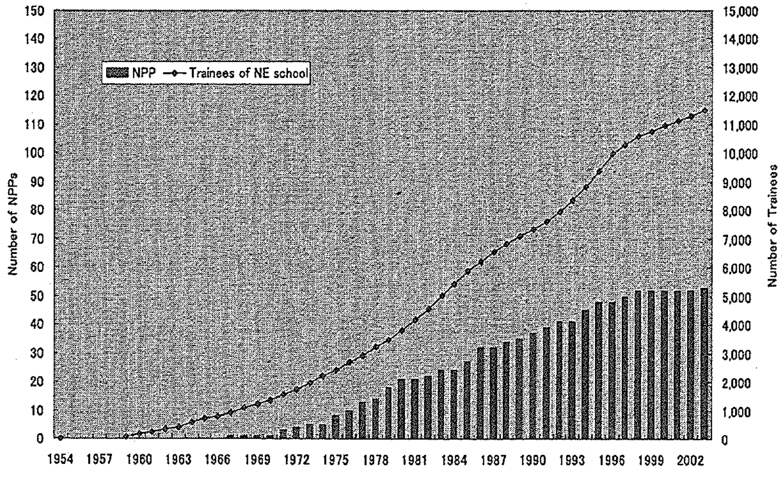

Fig. 5 Cumulative Number of Trainees of NE school and NPPs

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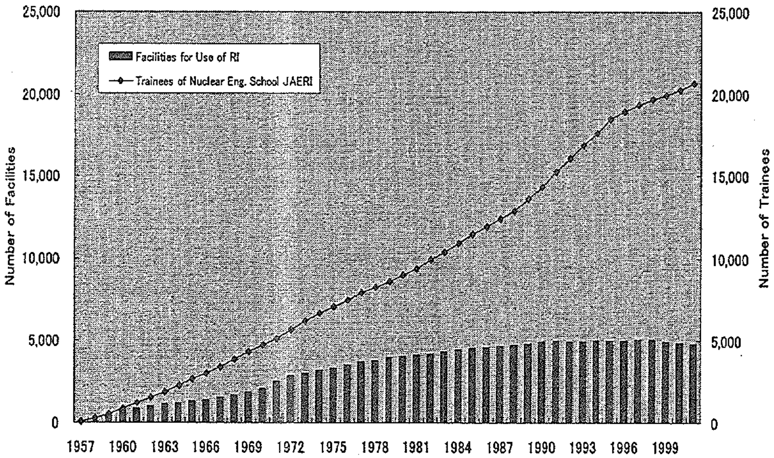

Fig. 6 Cumulative Number of Trainees of NE school and NPP

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HRD in introduction and the beginning of a large-scale construction of NPP

- Establishment of JAPC by government and nine electric power companies
  - To introduce NPPs
  - To have experiences on NPP operation
- Operator trainings for the first 3 NPPs operation in Japan by
  - Program implemented in foreign manufacturers
  - NE school and JPDR of JAERI

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HRD in introduction and the beginning of a large-scale construction of NPP

- Training for NPP operators came up to urgent task for large-scale construction of NPPs in future
  - Own training center of JAPC
  - BWR operation training center (BTC) for BWR
  - Nuclear Power Plant training center (NTC) for PWR

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Conclusion

- Reviewing HRD experiences in Japan aiming at development of own commercial NPPs, corresponding to
  - Start-up stage of nuclear development
  - Introduction of NPP
  - Large-scale construction of NPP
- Three phases could be corresponding to FNCA member countries grouping into three classes
- Experiences in Japan could be useful for formulating HRD strategy modeling

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Conclusion (Cont'd)

- Particularly, phase I is essential basis for achieving other two phases.
  - Framework of nuclear development was intensively constructed in a short period of time
  - Early set up of national institutes (JAERI and NIRS) and each training center
  - Simultaneous systematical establishment in private companies, as well as in national institutes

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Conclusion (Cont'd)

- HRD corresponding to each phase

Phase I;

Study abroad

Establishment & improvement of Uni. & Graduate school

Training centers of JAERI and NIRS

Phase II & III;

Original training course for nuclear reactor operations in electric power companies

Progress of internal engineers

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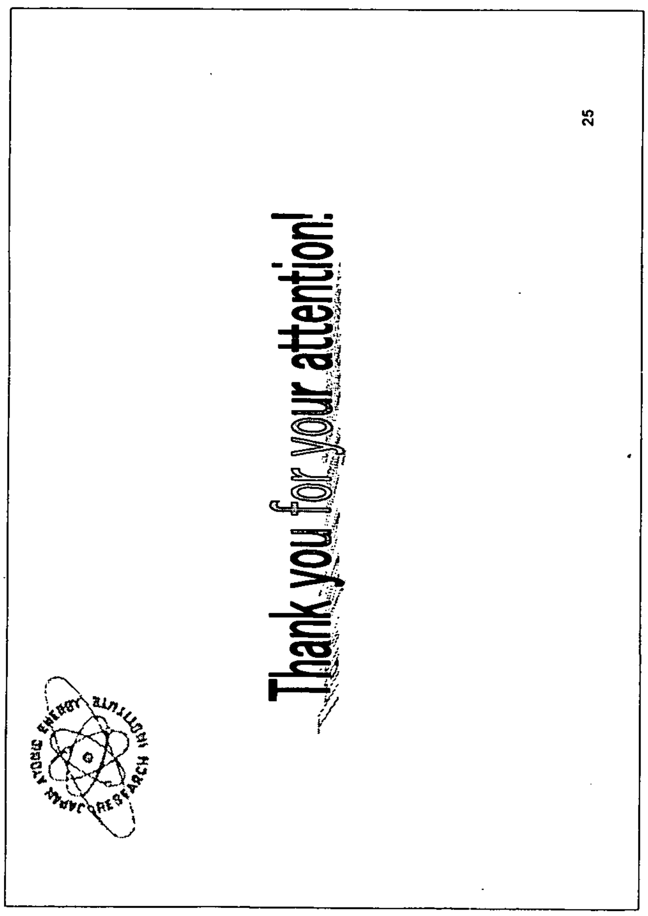
Thank you for your attention!
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1.9.2 University Education on Nuclear Engineering for Foreign Scientists, Engineers and Students

UNIVERSITY EDUCATION ON NUCLEAR ENGINEERING FOR FOREIGN SCIENTISTS, ENGINEERS AND STUDENTS

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ABSTRACT

The purpose of this paper is to offer information necessary for FNCA membership countries to formulate the strategy of human resource development for introduction of light water reactors as commercial reactors and for development of radiation utilization. It is discussed first how the academic field of nuclear engineering was established and how the related human resource was developed at the beginning of atomic energy development in Japan. Next, the programs applicable to develop excellent professor, scientists and engineers engaged in nuclear engineering from these countries are addressed on the basis of the author's experience, which are performed through collaborative researches, information exchanges and so on in Japanese universities. Finally, graduate education of nuclear engineering in Japanese universities is introduced, which is provided for foreign students to learn the fundamental knowledge through the lectures and to master his/her professional ability through the related researches such as on-the-job-training.

1. INTRODUCTION

Vietnam and Indonesia have plans to introduce light water reactors (LWRs) as commercial reactors in the future. In addition, Thailand is researching whether nuclear energy is a subject to investigate its introduction as one of electricity sources or not. All FNCA membership countries have plans to develop radiation utilization for material science, medical science, agriculture and so on.

It had been prohibited in Japan to develop nuclear energy after World War II. Since uses of nuclear energy were promoted worldwide, the development of nuclear energy was permitted in 1955. After that, Japan Atomic Energy Research Institute (JAERI) was founded and Department of Nuclear Engineering was born in some universities. In Japan, a gas cooled reactor had first been imported from Great Britain and the pressurized water reactor (PWR) and boiling water reactor (BWR) had first been introduced from the United States of America as commercial reactors. After that, PWRs and BWRs were improved upon independently in Japan. In 1975, the *'Improvement and Standardization Program for Light Water Reactors (LWRs)'* was instituted under the organization of the Ministry of International Trade and Industry (MITI), and then the operating performance of LWRs has been improved in the first and the second phases of this program. In the third phase of this program, an advanced pressurized water reactor (APWR) and an advanced boiling water reactor (ABWR) were developed as standard designs for large-sized LWRs and were completed in 1986. Although these programs were organized by the government, the research and development were performed mainly by utilities and reactor venders. In Japan, fifty-two nuclear power plants are in operation at the end of August, 2004; twenty-seven BWRs, two ABWRs and twenty-three PWRs. Their total installed capacity is about 45.742GW. The nuclear power contributes about 30% in total generated electric power in Japan.

It is discussed first in this paper how the academic field of nuclear engineering was established and how the related human resource was developed at the beginning of atomic energy development in Japan in order that FNCA membership countries formulate the strategy of human resource development. There are some programs in Japanese universities to support human resource development in nuclear engineering such as the JSPS programs. Next, the Japanese program applicable to develop foreign excellent professor, scientists and engineers engaged in nuclear engineering are addressed on the basis of my experience. Graduate education of nuclear engineering in Japanese universities is provided for foreign students to learn the fundamental knowledge through the lectures and to master their professional ability through the related researches such as on-the-job-training; doctor course and master course. Finally, the graduate education systems are introduced from my experience.

2. HUMAN RESOURCE DEVELOPMENT AT THE BEGINNING OF NUCLEAR ENERGY DEVELOPMENT IN JAPANESE UNIVERSITIES

The academic field of nuclear engineering had never been established in Japanese universities, when introduction of nuclear power plants was planned. Then, referring the curriculum of nuclear engineering in European and American universities, professors eager for nuclear energy development were gathered from the related departments in Faculty of Engineering and Faculty of Science in order to set up Department of Nuclear Engineering in these universities. The academic field of nuclear engineering is the synergy of inter-disciplines covering physics, chemistry, mechanical engineering, electrical engineering, control engineering, material science, chemical engineering and other science and engineering fields, though it is characterized by neutron physics and radiation engineering. There were, however, few professors versed well in nuclear engineering, that is, they had never learned it. Then, they were learning nuclear engineering using the related textbooks published in Europe and America and by going abroad for study. Most of the professors, who went abroad for study, were supported financially by Japanese government, though Japanese economic situation was not good at that time. The base of nuclear engineering had been soon established from their great efforts and educated successors such as professors of the second generation, scientists and engineers necessary for government, nuclear industry, research institutes and so on.

In 1960's in Japan, heavy industries such as shipbuilding, automobile and iron manufacture existed, and thermal power plants using fossil fuel and hydroelectric power plants could be constructed by Japanese own technologies, and operated and maintained by Japanese workers. In other words, the basis of human resource, who could design, construct, operate, inspect and maintain nuclear power plants and evaluate its safety, existed. In Korea, China and Taiwan which succeeded in introducing nuclear power plants, the same infrastructure had been in existence.

Safety of nuclear power plants is not achieved only in their design stage but also in every stage such as their construction, quality assurance / quality control (QA/QC), maintenance and inspection. This fact indicates that not only highly level specialists graduated from universities but also skilled workers engaged in construction, operation, inspection and maintenance of nuclear power plants are necessary to introduce nuclear power plants. Since their skilled workers learned the basis of engineering but were not familiar with nuclear engineering, they learned the knowledge of nuclear power plants through education program in the utilities and reactor venders. Such a situation is not changed up to now. Although about 50 operators are necessary for 1,000MWe-class large-sized LWRs, more than 1,500 workers are necessary for the peak of manpower during their periodical maintenance and inspection. It is one of important problems with regard to introduction of nuclear power plants to establish human resource development program for skilled workers engaged in the maintenance and inspection. If skilled workers necessary for maintenance and inspection of nuclear power plants cannot be developed in your own country and the maintenance and inspection are depended on oversea reactor venders, the electric charge becomes as expensive as that in Europe, America and Japan.

On the basis of experience in Japan, It is addressed how human resource development for nuclear engineering is instituted here. The purpose of FNCA human resource development is to support to develop the human resources in the membership own countries. It is important to bring up the persons of ability required to achieve this purpose.

At first, future plans of nuclear development should be categorized as follows:
(1) The projects to be achieved within five years,
(2) The projects to be achieved from ten to twenty years,
(3) The far future projects
The field of nuclear development can be classified into:
(1) Nuclear power plants and related nuclear fuel cycle facilities
(2) Research reactors
(3) Utilization of radioactive rays
(4) Accelerators
(5) Others

The fields of persons of ability required to achieve the future plans, which are brought up by FNCA human resource development, can be classified into the followings:
(1) Governmental sector
  (1.1) Decision makers of energy and nuclear development policy,
  (1.2) Decision makers of radioactive ray utilization policy including development and utilization of accelerators,
  (1.3) Administrators under the policy; to make the related laws and safety regulations,
  (1.4) Practical workers such as inspectors
(2) Educational sector
  (2.1) Excellent researchers in universities and research laboratories to raise research activities and bring up the successors; to cooperate joint researches and to get Doctor Degrees,
  (2.2) Professors in universities to bring up skilled engineers, designers, scientists and so on; to get Doctor Degree,
  (2.3) Professors and teachers in universities and professional schools to bring up professional workers

On the basis of experience in Japan, it is addressed how human resource development for nuclear engineering is instituted here. If there is a plan that light water reactors will be introduced as commercial reactors in the future, professors, who can teach the following subjects, are necessary:
(1) Nuclear Reactor Theory,
(2) Reactor Thermal Hydrodynamics,
(3) Nuclear Reactor Safety,
(4) Reactor Control and Instrumentation,
(5) Nuclear Fuel and Materials Science and Engineering,
(6) Radiation Protection and Engineering,
(7) Reactor Structure Mechanics,
(8) Reactor Chemical Engineering, and
(9) Reactor Water Chemistry.
If there are several universities having Department of Nuclear Engineering in your country, it is not required in every university for professors to cover the whole field mentioned above but is in your country.

It should be considered in which fields professors exist:
(1) There are professors familiar to the subjects of nuclear engineering,
(2) There are professors in the related fields, for instance thermal engineering in Department of Mechanical Engineering, and
(3) There are no professors in the subjected field.

In the case of nuclear power plants, it generally takes long period from the planning to the starts of the construction and operation. In addition, human resource development cannot be achieved for a short time. It is the most difficult problem how developed excellent engineers and skilled workers can be bound to the nuclear industry until they are required for construction, operation, maintenance and inspection of nuclear power plants. For this purpose, the scheme for binding them to nuclear industries should be made carefully. Since the excellent engineers and skilled workers are sought in various fields, if the scheme cannot be established, developed human resources may be dispersed.

The subjects of radiation biology and radiation utilization had already existed in medical science such as medical care for atomic bomb victim and X-ray to eradicate tuberculosis. After Department of Nuclear Engineering was set up, professors, scientists and engineers engaged in radiation utilization could be developed in the department. At the beginning of nuclear energy development, accelerators such as synchrotron had been used only for nuclear physics. Recently, accelerators are used in the wide fields of material science, medical science, agriculture and so on. In nuclear engineering, particle beam engineering related to development and application of accelerators is newly born.

As for radiation utilization, many countries make a plan to introduce accelerators. From Japanese experience, about ten percentages of the purchase price is needed every year for the running cost. If this running cost is not budgeted, it is difficult to use them for a long time. For the plan to use accelerators, it is necessary to develop the engineers who can design, manufacture and repair them. In other words, the running cost should be reduced by developing the human resource required for maintenance of accelerators in your own country.

3. ACCEPTANCE STATE OF FOREGN RESEARCHERS FOR NUCLEAR ENGINEERING IN JAPANESE UNIVERSITIES

As reference when FNCS participating countries formulate the strategy of human resource development in nuclear engineering field, acceptance states of foreign professors, scientists and engineers for nuclear engineering into Japanese universities are mentioned here on the basis of my experience. Research Laboratory for Nuclear Reactors, Tokyo Institute of Technology actively accepts young and excellent scientists and students from Asia to develop them to be excellent professors and researchers and to promote cooperative works in the future. Since the system of Japanese universities is different from that of American ones, the professor is not in position to give the scholarship to doctor students and cannot employ postdoctoral researchers directly from his research fund. The researchers, who wish to attend the Japanese universities, should obtain travel and living allowance from their own government, or pass fellowships. Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan Science Promotion Society (JSPS) and other Japanese organizations have set up the programs to support excellent foreign scientists and engineers to work in Japanese universities and research institutes.

The JSPS programs are addressed below:

(1) JSPS Invitation Fellowship Program for Research in Japan – Short-Term Program

Scientists with distinguished research achievement are invited to Japan to hold discussion with Japanese researchers, participate in seminars, give lecture, or perform similar functions that will contribute to advancement of research in the subjected field. Prospective Japanese host researchers apply to JSPS. Candidates are senior scientists, university professors and other persons with substantial professional experience. Successful candidates can work in Japan from 14 to 60 days.

(2) JSPS Invitation Fellowship Program for Research in Japan – Long-Term Program

This program is designed to allow Japanese researchers to invite their overseas colleagues to participate in cooperative research at Japanese universities and research institutes. Prospective Japanese host researchers apply to JSPS. Candidates should hold a doctorate degree for a period of more than 6 years prior to April 1 of the subject fiscal year, or be university professor including associate and assistant professors, research associate, or other persons who do not hold doctoral degree but have substantial professional experience. Successful candidates can work in Japan from 2 to 10 months.

(3) JSPS Postdoctoral Fellowship for Foreign Researchers

This program was established in 1988 to allow researchers employed at Japanese universities and research institutes to promising young researchers from overseas to Japan to participate in collaborative research activities under their guidance. Prospective Japanese host researchers apply to JSPS in the case of Vietnam, Indonesia and Thailand. Candidates should hold a doctorate degree when the Fellowship goes to effect, which must have been received within 6 years prior to April 1 of that fiscal year. Successful candidates can work in Japan from 12 to 24 months.

(4) Scientist Exchange Program

Japanese scientists who visit the counterpart countries under this program are selected through a competitive process. The scientists, who visit to Japanese universities and research institutes, are nominated by the counterpart institutions. If it is desired to apply this program, please ask the counterpart institution in each country the detail information of this program.

(5) RONPAKU (Dissertation Ph.D.) Program

JSPS supports and promotes the Asian researchers, who have achieved excellent research activities, to pursue a doctorate degree from Japanese universities. This program is called JSPS Ronpaku (Dissertation Ph.D.) program. In this program, the successful candidates should complete their doctor thesis within five years. A Ronpaku researcher should visit his supervisor's laboratory up to 90 days every year. Likewise, his supervisor shall visit his research institute to supervise and guide the student in conducting his doctorate works. Four papers published in academic journals are required to get Doctor Degree by dissertation (Ronpaku) in the Department of Nuclear Engineering, Tokyo Institute of Technology.

The requirements for the candidates are as follows:

(1) Two papers related to his/her Doctor Thesis were published in academic journal or are submitted thereto.
(2) Candidates have such their research activity and ability that they can make their Doctor Thesis within four years because they will present their Doctor Thesis in the fourth year and take its final examination in the fifth year in the case of Tokyo Institute of Technology.
(3) Their organization supports their Ronpaku program.

In addition, the candidates should prepare the following materials;

(1) list and copies of papers published in academic journal,
(2) previous research activities; field of research, major new findings and originality and related papers published in academic journal and presented in international conferences,
(3) future research plan in his/her organization,
(4) desired research plan in Research Laboratory for Nuclear Reactors, Tokyo Institute of Technology, and
(5) research plan in JSPS Ronpaku Program including item (3) and (4).

4. GRADUATE COURSE IN DEPARTMENT OF NUCLEAR ENGINEERING OF TOKYO INSTITUTE OF TECHNOLOGY

Undergraduate course of Nuclear Engineering is not provided at Tokyo Institute of Technology. However, the Department of Nuclear Engineering provides two kinds of graduate courses: (1) General Graduate Course in which the lectures are given in Japanese as its academic language, (2) International Graduate Course where lectures are given in English, so that it is not required for foreign students to have mastered Japanese. As a general rule, master course program is for two years, to learn the fundamental knowledge by attending lectures, seminars, conducting researches and finally writing a Master thesis. Doctor course program is for three years to conduct both analytical and experimental works, and finally to compose a doctor dissertation under the supervision and guidance from his/her professor.

As for foreign students in General Graduate Course, there are scholarship students awarded by Japanese government or by their own governments, and non-scholarship students. In general, scholarship students come to Japan in April, attend Japanese intensive course for six months, conduct the research for six months in their supervisor's laboratory as a researcher, and enter the graduate course in the following April. The application system of scholarship is different from each country, and the acceptance procedure will differ for applicants nominated by a Japanese embassy and applicants nominated directly by Japanese university. Therefore, the candidates can either apply their scholarship directly to their own governments, or, Japanese supervisors can apply it to the Japan Society of Promotion Science (JSPS). I would like to recommend that the candidates should ask their own governments or Japanese Embassy on the application method and deadline. Non-scholarship students can enter Department of Nuclear Engineering in Graduate Course of Tokyo Institute of Technology in April or October.

There are two kinds of foreign students studying in our International Graduate Course: One is a scholarship student awarded by Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the other is a non-scholarship student. For the candidates who live in foreign countries, the application deadline is at the beginning of December and the result of their entrance examination is decided based only on the review of the application form. Therefore, the candidates for Doctor course should contact frequently with their intended advising professor in Department of Nuclear Engineering before six months to the application deadline, appeal their scholar and research ability to the professor and write their three-year research plan for doctor course based on his/her supervisor's suggestion. Two or three scholarship students can be admitted to Department of Nuclear Engineering each year. It is required for the scholarship student to have got high score of TOEFL. The deadline for applications is the beginning of December.

The candidates who live in Japan can apply for this course in June. The entrance examinations, paper and oral tests, are carried out on August. In this case, scholarship will not be awarded to the successful candidates.

5. CONCLUSIONS

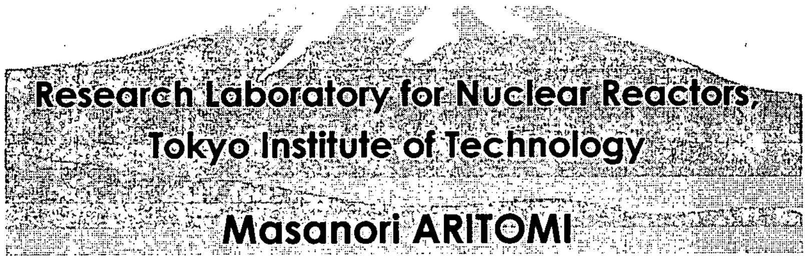
In the country where nuclear power plant will be introduced, professors eager for nuclear energy development should be joined from the related departments in Faculty of Engineering and Faculty of Science, establish the academic field of Nuclear Engineering and educate the successors, excellent researchers and engineers necessary for nuclear power plant development. Professors engaged in the subjects wanting its establishment will be developed. The above-mentioned program is to assist such a human resource development.

Safety of nuclear power plants is not achieved only in their design stage but also in every stage such as their construction, quality assurance / quality control (QA/QC), maintenance and inspection. Not only highly level specialists graduated from universities but also skilled workers engaged in construction, operation, inspection and maintenance of nuclear power plants are necessary to introduce nuclear power plants. It is especially one of important problems with regard to introduction of nuclear power plants to establish human resource development program for skilled workers engaged in the inspection and maintenance. On the other hand, it is important to develop human resource of the engineers who can design, manufacture and repair accelerators, in order to use efficiently them for radiation utilization such as material science, medical science, agriculture,

In Japanese universities, an expensive research fund cannot be obtained, and the number of research staffs is limited. Therefore, it is not viable to conduct the research using large-scaled test facilities connected directly with real plants, which are normally carried out in JAERI and/or reactor venders. The research objectives in Japanese universities are to create new concepts of systems and components of nuclear power plants based on revolutionary ideas, to study their scientific feasibility, and to investigate physical phenomena which have never been well-presented by analytical codes applied to design and safety assessment of nuclear power plants.

Since there are many kinds of scholarships and fellowships systems awarded to the foreign students, researchers and engineers, and these systems are frequently changed, the detailed description cannot be introduced in this paper. If exchange of research personnel including students to Japanese university is desired, please contact with the intended supervisor or myself in the planning stage.

UNIVERSITY EDUCATION ON NUCLEAR ENGINEERING FOR FOREIGN SCIENTISTS, ENGINEERS AND STUDENTS IN JAPAN



Research Laboratory for Nuclear Reactors,
Tokyo Institute of Technology
Masanori ARITOMI

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CONTENTS

1. Human Resource Development at the Beginning of Nuclear Energy Development in Japanese University
2. Acceptance State of Asian professors, scientists and engineers for Nuclear Engineering in Japanese University
3. Graduate Course in Department of Nuclear Engineering, Tokyo Institute of Technology
4. Conclusions

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1. HUMAN RESOURCE DEVELOPMENT AT THE BEGINNING OF NUCLEAR ENERGY DEVELOPMENT IN JAPANESE UNIVERSITY

◆ At the end of World War II, nuclear energy development was prohibited in Japan.
  x Uses of nuclear energy were promoted worldwide
    → It was permitted in 1955 in Japan.

◆ Department of Nuclear Engineering was born in some universities.

◆ The academic field of nuclear engineering had never been established.

3

◆ The curriculum of nuclear engineering referred those in the European and American universities,

◆ Professors motivated in nuclear energy development were gathered from various related departments in the Faculty of Engineering and Faculty of Science in order to set up Department of Nuclear Engineering in the universities.

◆ The academic field of nuclear engineering is characterized by neutronic physics and radiation engineering.

4

◆ It is the synergy of inter-disciplines covering physics, chemistry, mechanical engineering, electrical engineering, control engineering, material science, chemical engineering and other science and engineering fields.
  x There were only few professors well prepared in nuclear engineering.
    → They studied nuclear engineering using the related textbooks published in Europe and America and by studying abroad.

◆ Most of the professors, who went abroad, were supported financially by Japanese government.

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◆ The base of nuclear engineering was soon established due to their great efforts
  + The educated successors such as professors in the second generation, scientists and engineers necessary employed in the government, nuclear industry, research institutes and others could be developed.

◆ The purpose of FNCA human resource development in nuclear engineering is to support to develop the human resource in the membership own countries.

6

◆ PWR and BWR were initially introduced from the USA.
  → The PWRs and BWRs were improved independently in Japan.

◆ In the 1960's in Japan, heavy industries such as shipbuilding, automobile and iron manufacture existed.
  → Thermal power plants and hydroelectric power plants could be constructed, operated and maintained by Japanese own technologies.

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◆ The safety of nuclear power plants shall not be achieved only during the design stage, but also at every stage such as their construction, QA/QC, operation, maintenance and inspection.

◆ Not only highly level specialists graduated from universities but also skilled workers engaged in construction, operation, inspection and maintenance of nuclear power plants.

◆ If skilled workers necessary for the maintenance and inspection cannot be developed in your own country and they are depended on oversea reactor venders, the electric charge becomes as expensive as in Japan.

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◆ Their skilled workers learned the basis of engineering but were not familiar with nuclear engineering.
  → They learned the knowledge of nuclear power plants through education program in the utilities and reactor venders.

◆ More than 1,500 workers are necessary at the peak of manpower during periodical maintenance and inspection for a 1,000MWe-class large-sized LWRs.

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◆ In the case where LWRs will be introduced as commercial reactors,
- Nuclear Reactor Theory,
- Reactor Thermal Hydrodynamics,
- Nuclear Reactor Safety,
- Reactor Control and Instrumentation,
- Nuclear Fuel and Materials Science and Engineering,
- Radiation Protection and Engineering,
- Reactor Structure Mechanics,
- Reactor Chemical Engineering,
- Reactor Water Chemistry.

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◆ It should be considered which fields' professors exist:
- There are professors familiar to the subjects of nuclear engineering,
- There are professors in the related fields, for instance thermal engineering in Department of Mechanical Engineering,
- There is no professor in the related field.

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◆ In the case of nuclear power plants, it generally takes long period from the planning to the starts of the construction and operation.

◆ Human resource development cannot be achieved for a short time.

◆ It is the most difficult problem how developed excellent engineers and skilled workers can be bound to the nuclear industry until they are required for construction, operation, maintenance and inspection of nuclear power plants.

◆ For this purpose, the scheme for binding them to nuclear industries should be made carefully.

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◆ The subjects of radiation biology and utilization
- had already existed in medical science.
  - medical care for atomic bomb victims,
  - X-ray to eradicate tuberculosis.
- After Department of Nuclear Engineering was set up, the professors, researchers and engineers engaged in radiation utilization could be developed.

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◆ Particle beam engineering
- At the beginning of nuclear energy development, accelerators such as synchrotron had been used only for nuclear physics.
- The accelerators are used in the wide fields of material science, medical science, agriculture and so on.
  → Particle beam engineering related to development and application of accelerators is newly established.

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◆ About ten percentages of the purchase price is needed every year for the running cost to use them efficiently for long term.

◆ For the plan to use accelerators, it is necessary to develop the engineers who can design, manufacture and repair them.
  → The running cost should be reduced by developing the human resource required for maintenance of accelerators in your own country.

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2. Acceptance State of Foreign Scientists and Engineers for Nuclear Engineering in Japanese Universities

◆ Foreign young and excellent scientists and students are accepted to develop them to be excellent professors, scientists and engineers and to promote cooperative works.

◆ The system of Japanese universities is different from that of American ones.
  = The university professor is not in position to give the scholarship to doctor students and cannot employ postdoctoral researchers directly.

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- The candidates should get fellowship for their travel fees and daily allowances.
- There are many fellowships to support the foreign scientists and engineers.
  - MEXT, JSPS, FNCA HRD and so on.

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Japan Science Promotion Society's Programs

- JSPS Invitation Fellowship Program for Research in Japan
  - Scientists with distinguished research achievement

  < Short-Term Program>
  - From 14 to 60 days

  < Long-Term Program>
  - Candidates should hold a doctorate degree for a period of more than 6 years prior to April 1 of subject year.
  - From 2 to 10 months

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- JSPS Postdoctoral Fellowship for Foreign Researchers
  - Young scientists
  - Candidates should hold a doctorate degree within 6 years prior to April 1 of subject year
  - From 12 to 24 months
- Scientist Exchange Program
  - Under Memoranda of Understanding concluded with counterpart institutions

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- JSPS Ronpaku (Dissertation Ph.D.) program
  - To support and promote the Asian excellent scientists to get doctor degree from Japanese universities.
  - The successful candidates should complete their doctor thesis within five years.
  - A Ronpaku researchers should visit their supervisor's laboratory for shorter than 90 days every year.
  - Their supervisor shall visit their research institute for at least seven days every year to supervise and guide the student in conducting their doctorate work.

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- Four papers published in academic journals are required to get doctor degree by dissertation in the Department of Nuclear Engineering, Tokyo Institute of Technology.
  - x Two papers are required for doctor students.
- The application deadline is the beginning of August.
- The requirements for the candidates
  - (1) Two papers were published or are submitted thereto.
  - (2) Having excellent research ability
  - (3) Their organization supporting the Ronpaku program

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- The candidates should prepare;
  - (1) list and copies of papers published in academic journal and presented in international conferences,
  - (2) previous research activities, field of research, major new findings and originality,
  - (3) future research plan in their organization,
  - (4) desired research plan in Research Laboratory for Nuclear Reactors, Tokyo Institute of Technology, and
  - (5) research plan in JSPS Ronpaku Program including item (3) and (4).

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3. Graduate Course in Department of Nuclear Engineering of Tokyo Institute of Technology

◆ The Department of Nuclear Engineering provides two kinds of graduate courses

- General Graduate Course in which the lectures are given in Japanese as its academic language.
- International Graduate Course where lectures are given in English.

◆ Master course program is for two years, to learn the fundamental knowledge by attending lectures, seminars, conducting researches and finally writing a Master thesis.

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◆ Doctor course program is for three years to research for their doctor thesis and finally to compose a doctor dissertation under the supervision and guidance from their professor.

◆ Foreign students in General Graduate Course

- There are scholarship students awarded by Japanese government or by their own governments, and non-scholarship students.
- Scholarship students come to Japan in April, attend Japanese intensive course for six months, conduct the research for six months in their supervisor's laboratory as a researcher, and enter the graduate course in the following April.

24

- ◆ The application system of scholarship is different from each country, and the acceptance procedure will differ for applicants nominated by a Japanese embassy and applicants nominated directly by Japanese university.
  - → The candidates should ask their own governments or Japanese Embassy on the application method and deadline.
- ◆ Non-scholarship students can enter our Department in April or October.
- ◆ Two kinds of foreign students studying in our International Graduate Course
  - – A scholarship student awarded by MEXT
  - – A non-scholarship student

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- ◆ For the candidates who live in foreign countries, the application deadline is at the beginning of December.
  - – The result of their entrance examination is judged only by reviewing the Application Form.
    - → The candidates for Doctor course should contact frequently with their intended advising professor in our Department before six months to the application deadline, appeal their scholar and research ability to the professor and write their three-year research plan for doctor course based on their supervisor's suggestion.

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- – It is required for the scholarship student to submit a high score of TOEFL together with the Application Form.
- – Two or three scholarship students can be admitted to our Department each year.
- – The candidates who live in Japan can apply for this course in June.
- – The entrance examinations, paper and oral tests, are given in August.
  - · Scholarship will not be awarded to the successful candidates.

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4. Conclusions

(1) In the country where nuclear power plant will be introduced, professors eager for nuclear energy development should be joined from the related departments, establish the academic field of Nuclear Engineering and prepare the successors, educate excellent scientists and engineers necessary for nuclear power plant development.
- – Professors engaged in the subjects wanting its establishment will be developed.

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(2) Safety of nuclear power plants is not achieved only in their design stage but also in every stage such as their construction, QA/QC, maintenance and inspection.
→ Not only highly level specialists graduated from universities but also skilled workers engaged in construction, operation, inspection and maintenance of nuclear power plants are necessary to introduce nuclear power plants.

(3) It is important to develop human resource of the engineers who can design, manufacture and repair accelerators, in order to use efficiently them for radiation utilization.

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(4) There are many kinds of scholarships and fellowships systems awarded to the foreign students, researchers and engineers.
- These systems are frequently changed.
- If exchange of research personnel including students to Japanese university is desired, please contact with the intended supervisor or myself in the planning stage.

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1.9.3 History of Human Resources Development in Japanese Commercial Nuclear Power Plants

History of Human Resource Development in Japanese commercial nuclear power plants

5th.Oct.2004

Yukoh Nakayama
Japan Atomic Power Company

Contents

1. Introduction

We are strongly dependent on foreign energy resources in Japan. To develop industries and to improve people's living, We have to have diversify energy and to achieve the best energy mix. As nuclear power provides a large amount of energy with a small amount of resource, We started operation of commercial nuclear power plants during the 1960s.

Today, nuclear generated electric power accounts for more than 30% of the total power generated in Japan.

We hope that all people in the world will more understand the necessity of nuclear power as an alternate energy resource for fossil energy resource from the standpoint of preventing warming of earth environment due to carbon dioxide.

Although how to educate the engineers in the nuclear power plants depends on the national energy strategy, at least we believe that it is better to manage the reactor operation by themselves to get the national consensus in their country.

I would like to explain the history of human resource development in Japanese commercial nuclear power plant, especially that of JAPC. Because JAPC history stand for that of Japanese nuclear development.

(1)The atomic Energy Basic Act

①The atomic Energy Basic Act was enforced on 1st Jan.1956. Nuclear power development in Japan has been promoted on the basis of three principles in the law, to be democratic, independent and publicly open limited in peaceful purpose.

②Electric power companies have been building and operating nuclear power stations, while trying to achieve coordination with various technological standards, and while being monitored by the Atomic Energy Commission, the Nuclear Safety Commission, the national and local government under the Atomic Energy Act.

In the process of getting license for construction and operation, it is confirmed that the reliability and safety of nuclear power stations is maintained above the certain level.

(2)Establishment of New Company for Introduction

① The Atomic Energy Commission decided in September, 1957 to introduce nuclear power generation, and decided that "it will be appropriate to establish a new company for the plan consisting of nine electric power companies, Electric Power Development Co. , Ltd., and related industries, and to be led by the private sector".

Following this decision, The Japan Atomic Power Company was established with electric power companies, atomic energy related companies, and related construction companies providing capital.

In establishing the company, the government provided 20% of the capital through Electric Power Development Co., Ltd., which is a public corporation.

② Since the Calder Hall type gas cooled reactor had been already operating in U. K. , and as it was thought easy to acquire and domestically produce natural uranium fuel, the Atomic Energy Commission and the Japan Atomic Power Company decided to import it from the U. K.

It was decided to construct the first nuclear power station, Tokai Power Station (166MWe) , with the Japan Atomic Power Company as the main project promoting body.

Then the Japan Atomic Power Company decided to introduce a reactor having reached a stage of practical use from an industrialized country promptly and as fast as possible, to improve power generating technologies, to promote domestic production, and to develop engineers.

③ As it was the first experience to introduce atomic power generation, there was a strong concern about investment risk, and commercialize development of atomic energy started with its risk spread nationally.

There are ten electric power companies in Japan, one in each supply region. There are a number of wholesale electric companies, but major wholesale electric companies are the Japan Atomic Power Company which is specialized in nuclear power generation, and only one additional company.

Power Stations of JAPC
Nov.1957; JAPC is established
Jan.1960; Construction of Tokai 1 (GCR) begins
Apr.1966; Construction of Tsuruga 1(BWR) begins
Jul.1966; Tokai 1 starts commercial operation
Mar.1970; Tsuruga 1 starts commercial operation
Jun.1973; Construction of Tokai 2 (BWR) begins
Nov.1978; Tokai 2 starts commercial operation
Apr.1982; Construction of Tsuruga 2 (PWR) begins
Feb.1987; Tsuruga 2 starts commercial operation
Mar.1998; Tokai1 PS ceased commercial operation
Jun.2004; Tsuruga 3 & 4 (APWR) start the preparation of construction

2. Nuclear Power Development in Early Stage

(1) Human Development in Early Stage

①The Japan Atomic Energy Research Institute were established in 1956 and full-scale basic research activity started. Then the talented people gathered to get involved in this field.
- JAERI (Japan Atomic Energy Research Institute) was established in 1956
- Power Reactor and Nuclear Fuel Development Corporation, in 1957
- National Institute of Radiological Science, in 1957

② Nuclear Education at University started.
③ Construction of Commercial Reactor started

(2) Construction of Commercial Reactor started

①Tokai 1 is the first commercial NPP, introduced proven Calder Hall type reactor from the U.K. The construction of Tokai 1 started in Jan.1960.
Many engineers were dispatched from electricity utilities to JAPC
In Dec.1965, there were 82 engineers in head office, 215 engineers in site, totally 297 engineers.

② Training of Tokai Power Station Staff

a. As preparation for operating the first nuclear power station in Japan, Tokai Power Station, young and capable people were sent to GE, WH, and Calder Hall Operator School in U. K. to learn operation, core design, fuel and radiation management, construction and maintenance technologies, etc.

b. Today, it is possible to secure qualified and capable project leaders, electric and machinery engineers for the construction of nuclear power stations, and operators, maintenance engineers, radiation control engineers who are totally qualified with many years of experience with actual reactors. But, on the early stage the experienced engineers in thermal power plant were gathered from the electric power companies, and new comers were trained at thermal power stations and after then train them in the area of nuclear power plant.

c. The thermal power stations and nuclear power stations are very similar in that the water-steam system is the main part in both. Therefore, experiences in thermal power plant are essential for nuclear power plant. It is important, however, to let them understand differences in the philosophy of design and safety and to let them recognize the importance of nuclear safety as the mechanism to generate energy is different between them.

Training of Tokai Power Station Staff
Overseas (total: 56 engineers)
USA
Oak Ridge National Laboratory School
Argonne National Laboratory School
GE , WH
UK
Harwell Reactor School
Calder Hall Operator School
Calder Hall NPP, Chapelcross NPP
Domestic (for new employees)
JAERI Reactor School
Thermal Power Station
Factories of Suppliers

d. The branch office was opened in London for the smooth introduction of technologies.

e. Some of main equipment imported from the U. K. But they were below the Japanese standard. For example, the pressure vessels, in-core temperature measuring devices, etc. were poor quality. They were all replaced with those domestically made.

As for those which required special consideration of earthquake, and as for those, which were thought to require some improvement for safety, some improved features were added.

In the process of solving those problems and also in the process of discussion to solve those problems, human resource was developed.

3. Light Water Reactor Age

(1) Development of Light Water Reactor

Development of commercial light water reactor in Japan goes back as far as to the 1970s during which the Tsuruga Power Station (Boiling Water Type, 357MWe) started operation. The Tsuruga power station was constructed and operated by engineers sent from all electric power companies, those who had experience of operating and constructing Tokai Power Station and those who were employed while it was being built.

Of those engineers, those who were going to lead the project were trained at U. S. GE and also at the JPDR which was already being operated as a power demonstration reactor.

During the early stage of the commencement of operation, various troubles occurred, including leaking of fission products from nuclear fuel, troubles in waste treatment facilities, stress corrosion cracking on piping, etc. It took about 10 years from the commencement of operation to fully overcome such problems, and it was around the beginning of the 1980s.

Engineers who were educated and trained through such experiences went back to their respective electric power companies to support the age of light water reactor.

<u>Tsuruga 1</u>
Output: 357 MWe (gross)
Type of reactor: BWR
Const. Start: Apr.1966
Init.Criticality: Oct.1969
Commercial OP.: Mar.1970
Main Contractor:GE
Architect engineer:EBASCO
Suppliers: GE, B/W, Hitachi, Toshiba, Nuclear Fuel Industries Ltd. etc.

Tsuruga 1 Construction

The construction staff experienced and got the knowledge through Tokai 1 & JPDR construction, actually 54 engineers transferred from Tokai 1 and 42 engineers experienced at JPDR construction by dispatch training.

GE, EBASCO, Toshiba and Hitachi also joined JPDR construction.

Many engineers from the utilities to Tsuruga 1/Tokai 1 established the LWR age in their respective utilities.

Number of Tsuruga Engineers

In the peek period of the construction , There were 60 senior engineers who graduate university and expected to get the leader in future, 80 normal engineers who graduated industrial high school, totally 140 engineers, those include in site 30 senior engineer, 63 normal engineer, totally 1 93 engineers. They were charged in operator(47), nuclear, health physics, chemical, instrument engineer(22), mechanical and electrical maintenance engineer (22).

Training for Tsuruga 1 Staff

The engineers with experience of Tokai 1 or JPDR construction dispatched to GE.

Domestically Tokai 1 operators and engineers from utilities dispatched to JPDR (JAERI) Construction, JAERI Reactor School, and thermal Power Plant of utilities.

Tokai 2

Output: 1100 MWe (gross)

Type of reactor: BWR

Const. Start: Jun.1973

Init.Criticality: Jan.1978

Commercial OP.: Nov.1978

Main Contractor: GE/Hitachi/Shimizu

Architect engineer:EBASCO

Suppliers: GE, Nuclear Fuel Industries Ltd. Shimizu/Kajima

Training for Tokai 2 Staff

The engineers of core management, chemical controls, computer dispatched to GE BWR training center. The operators gathered from Tsuruga 1 and trained at BTC.

Tsuruga 2

Output: 1160 MWe (gross)
Type of reactor: PWR
Const. Start: Apr.1982
Init.Criticality: May 1986
Commercial OP.: Feb.1987
Main Contractor:MHI
Suppliers: MHI, Mitsubishi Nuclear Fuel Co.

Training for Tsuruga 2 Staff

As Tsuruga 2 was a first PWR for JAPC, The operators dispatched WH training course (Lecture, Simulator), NTC, PWR including start-up tests plants of other utilities.

Maintenance person dispatched PWR under construction, Seminars in Manufacture Company, PWR start-up test plants of other utilities.

(2) Establishment of Light Water Reactor

Taking advantage of various experiences gained in the operation of early phase light water reactors, light water reactors (BWR, PWR) were constructed. Toward the end of the 1970s, a nuclear power station of 1,000MWe level started operation, and the age of LWR arrived.

Today, Japan has a total of 52 nuclear power units, which as a whole account for more than 30% of the annual electric power supply of 914 billion kWh in Japan (as of Fiscal Year 2003).

Today, the economic efficiency and the lower cost are considered such as longer operation cycles and shorter maintenance outage.

4. Characteristics of Training & Education

(1) Characteristics of Training Facilities, Organizations and Contents

① In the 1950s when the development of atomic energy started, a nuclear training course was provided at the Japan Atomic Energy Research Institute. Young and capable persons came to the course from the Ministry of International Trade and Industry (MITI), the Science and Technology Agency (STA); electric power companies and manufacturers which intended to enter the field.

② To learn effects of radiation on people and measures to deal with persons who are exposed to radiation, those who were intended to be engaged in the control of radiation were dispatched to the National Institute of Radiological Science.

③ After commissioning of a plant, the plant is operated by operators with abundant experiences, which were gained through the start-up test of the plant, but it will be gradually taken over by operators in the next generation year by year, and those operators result in decreasing gradually.

As Japan moved to the stage of safety management of nuclear power stations from the age of developing engineers to introduce nuclear power generation, it became important to educate and train staff to reliably operate and maintain nuclear power.

As part of such efforts, a nuclear basic course with an emphasis on practical education was established within the Japan Atomic Power Company to educate and train high school graduates from 1968. But, each electric power companies have started the operation of NPP and the trainees from the electric power companies have decreased. So the education of the trainees from the electric power companies has finished in 1980 and totally 581 person have finished the course during this period include the trainees from other electric power companies.

④ In addition, for educating and training operators with full-scope simulator, training facilities for BWR and PWR were established at two sites, allowing sufficient training in practical technique in addition to knowledge and basic education.

(Training facilities for BWR were established in 1971, and those for PWR in 1972.)

⑤ It was recognized through the operation of light water reactors over a long period that it would be essential to improve the level of people engaged in maintenance in order to further improve the reliability of nuclear power stations.

To cope with such situations, JAPC started to establish the maintenance training facilities in 1988, where training for inspection, dismantling and assembling of reactors similar to real ones, training for inspection and assembly of standard equipment, and basic training on automatic control, etc. could be done.

These maintenance training facilities are being extensively used not only by employees of electric power companies but also by employees of subsidiary companies, and engineering companies.

Today, other electric power companies have their own training facilities and are using this not only for training their employees but also certifying the qualification of their employees.

5.Conclusions

Finally, let me briefly state our current conclusions.

In the long run, the further development of nuclear power in Japan depends upon the mutual cooperation of the industrial world, the government and the academic world to secure and foster engineers who possess the following qualities.

"The Ideal Nuclear Engineer" has the following characteristics.

- He possesses advanced knowledge of nuclear engineering.
- He possesses knowledge of hardware matters such as systems and equipment, and also has a good background as field engineer.
- He is social and ethically sensitive based on the wide and long point of view.
- He exercises leadership and has potential and will to reform the current situation.

This is the kind of engineer needed at the present time.

Japanese educators and nuclear industry professionals face many and great challenges in the future, but we are planning now to meet these difficulties. We are confident that cooperation between government, industry, and academic institutions will secure for Japan the education of bright young nuclear engineers who continue to contribute not only to the progress of nuclear energy in Japan, but in all the world. The human development in nuclear field is very important for all mankind to progress the prosperity and supply the energy stable and safely.

History of Human Resource Development in Japanese Commercial Nuclear Power Plants

5th.Oct.2004

Yukoh Nakayama
Japan Atomic Power Company

Contents

1.Introduction

- Japan is strongly dependent on foreign energy resources
- Nuclear power plants are started operation during 1960s
- Nuclear power accounts for more than 30% of the total electricity

JAPC 3

Peaceful Utilization of Nuclear Power

- The Atomic Energy Basic Act enforced on 1st Jan. 1956
  - Three principles in R&D
    - Democracy, Independent, Publicly Open
  - The Atomic Energy Commission, The Nuclear Safety Commission

JAPC 4

Introduction of Nuclear Power Generation

- Establishment of a new private company
  - 9 Electric Power Companies
  - Electric Power Development Co. (Government)
  - Related Industries (Manufacturer, Bank, Trading Co....)
  - ⇨ JAPC was established in Nov.1957.
- The government provided 20% of the capital through the EPDC
- Investment risk spread nationally
- Introduce proven "Calder Hall type Reactor" from U.K.

JAPC 5

Power Stations of JAPC

Nov.1957 ; JAPC is established
Jan.1960 ; Construction of Tokai 1 begins ⇐ GCR
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Jun.2004; Tsuruga 3 & 4 (APWR) starts the preparation of construction

2. Nuclear Power Development in Early Stage

(1)Human Resources Development in Early Stage

1) Basic Research Activity started
   - JAERI(Japan Atomic Energy Research Institute) was established in 1956
   - Power Reactor and Nuclear Fuel Development Corporation, in 1957
   - National Institute of Radiological Science, in 1957

2) Nuclear Education at Universities started

3) Construction of Commercial Reactor started

JAPC 8

Construction of Commercial Reactor started

- Tokai 1 was the first commercial NPP introduced proven Calder Hall type reactor from the UK
- Construction of Tokai 1 started in Jan.1960.
- Many engineers were dispatched from electricity utilities to JAPC
- 82 engineers in head office, 215 in site, total 297(Dec.1965)

JAPC 9

Training for Tokai 1 Staff(1/3)

- Dispatched to Reactor School, Manufactures in USA and U.K.
- Engineers with experience in Thermal power generation were gathered from utilities
- Education and Training at Thermal power station in utility company

JAPC 10

Training for Tokai 1 Staff (2/3)

- Overseas (total: 56 engineers)
  - USA
    - Oak Ridge National Laboratory School
    - Argonne National Laboratory School
    - GE, WH
  - UK
    - Harwell Reactor School
    - Calder Hall Operator School
    - Calder Hall NPP, Chapelcross NPP
- Domestic (*for new employees*)
    - JAERI Reactor School
    - Thermal Power Station
    - Factories of Suppliers

JAPC 11

Training of Tokai 1 Staff (3/3)

- Branch office was opened in London(1959)
- In the process of solving some problems, human resource was developed

  - Modification and improvement of imported equipment according to Japanese standard
  - Special consideration of seismic design

JAPC 12

3. Light Water Reactor Age

The Light Water Reactor Age

(1) Development of First LWR

- BWR: Tsuruga -1 JAPC (Mar.1970, 357MWe)
- PWR: Mihama-1 Kepco (Nov.1970, 340MWe)

(2) Establishment of Light Water Reactor Age

- Improve and standardized to establish larger and Japanese-type LWRs

JAPC 14

(1) Development of First LWR

Tsuruga 1

- Output: 357 MWe (gross)
- Type of reactor: BWR
- Const. Start:Apr.1966
- Init.Criticality:Oct.1969
- Commercial OP.:Mar.1970
- Main Contractor:GE
- Architect engineer:EBASCO
- Suppliers:GE, B/W, Hitachi, Toshiba, Nuclear Fuel Industries Ltd. etc.

JAPC 15

Tsuruga 1 Construction

- Experience and knowledge through Tokai 1 & JPDR construction
  - 54 Engineers transferred from Tokai 1
  - 42 Engineers have experience of JAERI construction by dispatch training
- GE, EBASCO, Toshiba and Hitachi also joined JPDR construction.
- Engineers from Utilities to Tsuruga 1/Tokai 1 make the LWR age in their respective utilities.

Engineers

- In the peek period of the construction(total)
  - Senior engineer (graduate university and leader in future) 60, engineer 80, total 140
- In site
  - Senior engineer 30, engineer 63, total 93
    - operator 47
    - engineer(nuclear, health physics, chemical, instrument) 22
    - maintenance(mechanical, electrical) 22

JAPC 17

Training for Tsuruga 1 Staff

– Overseas

Engineers with experience of Tokai 1 or JPDR construction

⇨ GE

– Domestic

Tokai 1 operators and Seconded engineers from utilities

⇨ JPDR (JAERI) Construction,
JAERI Reactor School,
Thermal Power Plant of utility

JAPC 18

Tokai 2

- Output: 1100 MWe (gross)
- Type of reactor: BWR
- Const. Start:Jun.1973
- Init.Criticality:Jan.1978
- Commercial OP.:Nov.1978
- Main Contractor:GE/Hitachi/Shimizu
- Architect engineer:EBASCO
- Suppliers:GE, Nuclear Fuel Industries Ltd. Shimizu/Kajima

JAPC 19

Training for Tokai 2 Staff

<Overseas>

- Engineers of Core Management
  Chemical Control
  Computer
  dispatched to GE BWR training center

<Domestic>

- Operators :Tsuruga 1, BTC

Tsuruga 2

- Output: 1160 MWe (gross)
- Type of reactor: PWR
- Const. Start: Apr.1982
- Init.Criticality: May 1986
- Commercial OP.: Feb.1987
- Main Contractor:MHI
- Suppliers:MHI, Mitsubishi Nuclear Fuel Co.

JAPC 21

Training for Tsuruga 2 Staff

First PWR for JAPC

⇩

- Operator
  - WH training course (Lecture, Simulator)
  - NTC
  - PWR plants
- Maintenance personnel
  - PWR under construction
  - Seminars in manufacture company
  - Start-up tests in NPs of Kansai, Shikoku, Kyushu

4. Characteristics of Training & Education

- 1950's
  - Overseas
  - Domestic
    - Japan Atomic Energy Research Institute(JAERI)
    - National Institute of Radiological Science(NIRS)
- 1970's
  - Education and training in utilities
  - Practical education in "Nuclear Basic Course" in JAPC
  - Full-scope simulator training for operators
  - Maintenance training facilities in each utilities

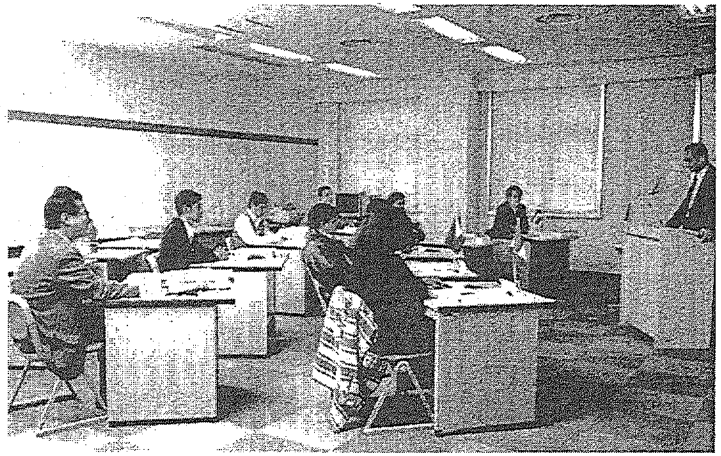
JAPC 23

Overview of JAPC Training Center

JAPC 24

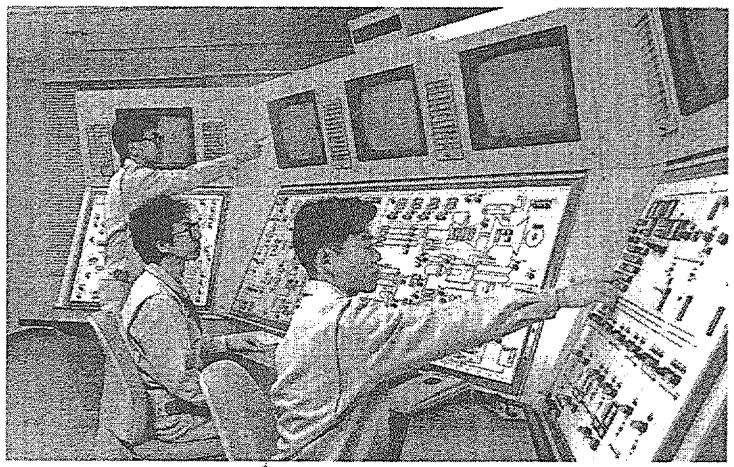
Disassembling Actual Electric Driven Mortor

JAPC 25



JICA Nuclear Power Course

JAPC 26



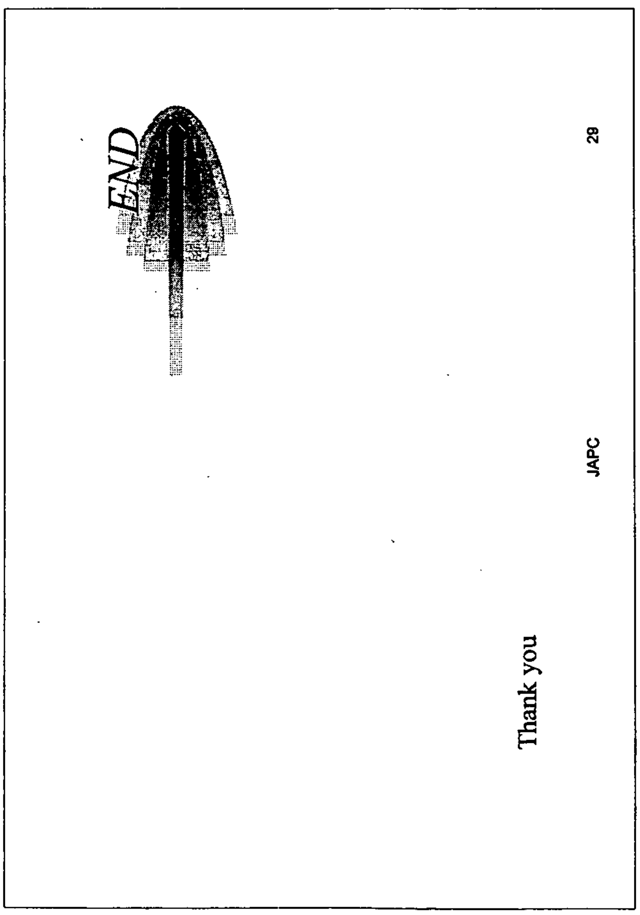
Compact Simurator

JAPC 27

5.Conclusions

- Advanced knowledge of nuclear engineering
- Knowledge of field engineer
- Social and ethically sensitive
- Leadership and will to reform the current situation.

JAPC 28


END
Thank you
JAPC
29

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1.10 Presentation Session 5 (Formulating HRD Strategy Model)

1.10.1 Model for Countries with Operation Nuclear Power Plants
1.10.2 Model for Countries Planning to Construct Nuclear Power Plants
1.10.3 Model for Countries with Radiation Applications

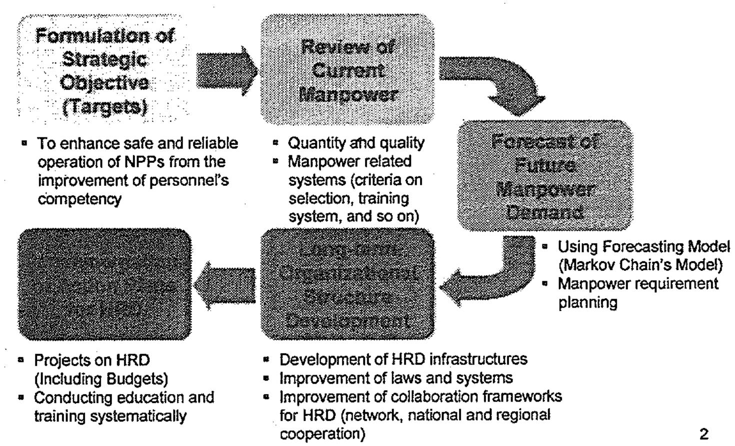
1.10.1

HRD Strategy Model for NPP Operational Countries

China, Korea, Japan

1

HRD Strategy Model



2

Targets : Key Personnel

- Regulatory personnel (Assessment, license, and inspection personnel)
- NPP operational personnel (operators, engineering, mechanical, electrical, I & C, chemistry, fuel handling, QA & QC, safety, and health physics staffs)
- R&D personnel
- Design and manufacturing personnel
- Instructors

3

Implementation Strategy

- Review of strengths, weakness and concerns
- Review of personnel qualification and training requirements (selection, training, etc.)
- Forecasting future manpower requirements
- Set up of systematic approach to training (organizations, facilities and equipment, instructors, training programs)
- Enhancing collaboration framework with related organizations (national and regional cooperation)
- Implementing HRD projects on action plans
- Improving human resources management and support system

4

1.10.2

HRD Strategy Model for introducing nuclear power

Vu Dang Ninh, VAEC
Karsono, BATAN

1

The first stage

1. Set the goal for nuclear power program
2. Preview the assessment of manpower (number, specialty, qualify of personnel)
3. Manpower **demand** for nuclear power program
4. Comparison the gap between the demand and actual manpower

2

Demanded manpower

1. Regulation (technical criteria, standard, etc.)
2. Assessment (safety analysis, environment, etc.)
3. Construction (civil, architect, electrical, mechanical, instrument, etc.)
4. Operation
5. Maintenance

3

The second stage

1. Set up education and training schedule
2. Total planning for each demand and schedule
3. Preparation of training infrastructure (recruiting, training of trainers, facilities)

4

The third stage

Implementation of training

- Training materials, curriculum
- Equipments
- Qualification system
- Accommodation for trainees

5

The fourth stage

1. Adjustment of the HRD schedule and actual condition
2. Re-train operator, maintenance, etc.
3. Re-assessment of training program

6

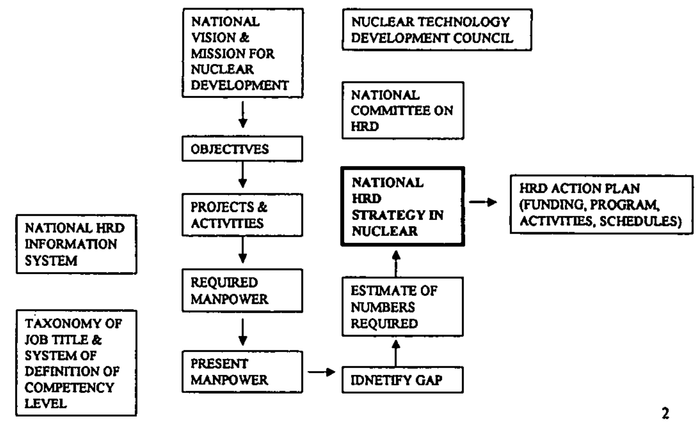
1.10.3

HRD STRATEGY FOR COUNTRIES WITH RI APPLICATIONS

Malaysia, Thailand, The Philippines

1

HRD STRATEGY NATIONAL LEVEL



2

POLICY TARGETS OF NUCLEAR DEVELOPMENT

AREAS/NEEDS FOR DEVELOPMENT
1. Users of nuclear technology
1.1 Industry
·Irradiation
·NDT
·others
1.2 Medicine
1.3 Agriculture
1.4 Research
1.5 Environment
1.6 Others
·ICT
·Data Base System
·Q.C.
2. Radiation Safety Officers

3

POLICY TARGETS OF NUCLEAR DEVELOPMENT (Cont'd)

AREAS/NEEDS FOR DEVELOPMENT
3. Support Manpower
3.1 Research Reactor
3.2 Disposal facility of RAM
3.3 Nuclear Power
4. Education
4.1 Tertiary
4.2 Secondary
5. Advocacy agenda
5.1 Promotion
5.2 Training
·e-learning module
5.3 Science culture
6. Nuclear Regulations/Licensing

4

Corporation with FNCA member countries for TC

- ➢ Train the trainers in the region
- ➢ Collaborative education system
- ➢ Harmonization of Radiation Protection practices
- ➢ OJT/practical and theses advisers program
- ➢ Each training center offers one course for all the member countries
- ➢ Each country will submit to FNCA a list of national expert
- ➢ Continuous learning for FNCA countries through cooperative program with develop NPPs

5

1.11 Presentation Session 6 (Nuclear Training Support)

1.11.1 Training Support in HRD
1.11.2 Asian Network for Education in Nuclear Technology (ANENT)
1.11.3 HRD International Network

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Presentation Session 6 - Nuclear Training Support

Training Support in HRD

Fumitaka SUGIMOTO
Nuclear Technology and Education Center
Japan Atomic Energy Research Institute
(NuTEC JAERI)

1

Training materials

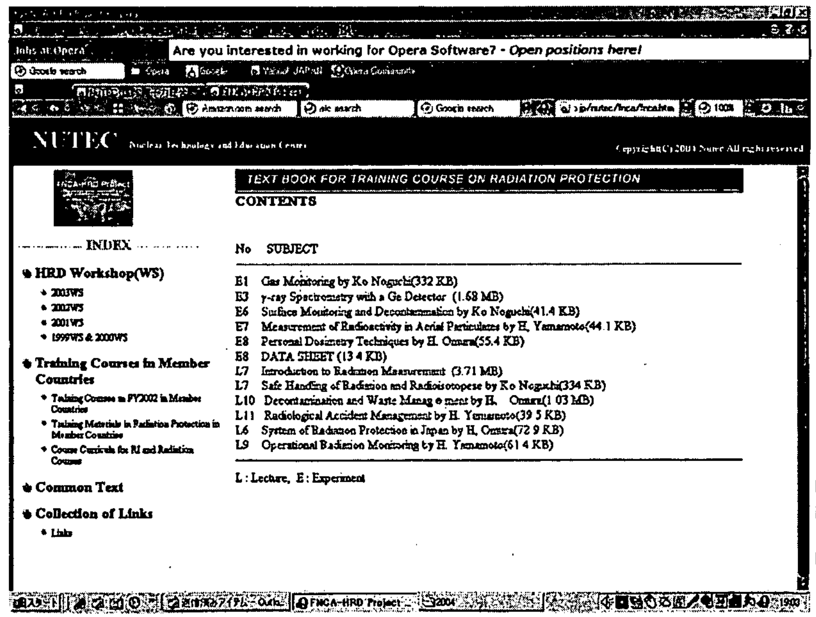
- The training materials on radiation protection from the joint training programs with Indonesia, Thailand and Vietnam, have been posted in the FNCA-HRD Project website in 2002.
  - L7 Introduction to Radiation Measurement
  - E3 Gamma-ray Spectrometry with a Ge Detector

2

New materials posted in 2004

- E1 Gas Monitoring
- E6 Surface Monitoring and Decontamination
- E7 Measurement of Radioactivity in Aerial particulates
- E8 Personal Dosimetry Techniques
- E8 DATA SHEET
- L7 Safe Handling of Radiation and Radioisotopes
- L10 Decontamination and Waste Management
- L11 Radiological Accident Management
- L6 System of Radiation Protection in Japan
- L9 Operational Radiation Monitoring

3



1.11.1

Exchanged materials

- 'Thermal-Hydraulics of Nuclear Reactors' by Japan in 2002
- 'Exercises in reactor physics' focused on Q&A by Japan in 2002
- 'Radiation SAFETY second edition' by Malaysia in 2003
- CD-ROMs of training materials for high school students by the Philippines in 2003

5

1.11.2

Asian Network for Education in Nuclear Technology (ANENT)

Fatimah Mohd Amin
ANENT Spokesperson

1

Outline of Presentation

- Events to date
- Terms of Reference (TOR)
- Action Plan
- Membership
- Prospects

2

Events to Date

- IAEA resolutions at 46th & 47th General Conferences – emphasized importance of preserving & Managing nuclear knowledge
- Consultancy meeting to prepare groundwork for the establishment of ANENT – July/Aug 2004, ROK, TOR prepared
- 1st Coordination Committee Meeting, Feb 2004, Malaysia, agreement on Action Plan
- Lead institutions implement work packages

3

Terms of Reference (TOR)

Objective is to facilitate cooperation in education, training & research in nuclear technology through:

✓Sharing of materials for education & training
✓Exchange of students, teachers & researchers
✓Establishment of reference curricula, mutual recognition of degrees & credit transfer
✓Communication with other networks & organizations

4

Terms of Reference (cont'd)

Strategies adopted:

- Integrate available resources for education & training; develop new materials only where none exist
- Work in synergy with IAEA & other existing mechanisms
- Utilise information technology as much as possible
- Bilateral cooperation as starting point for multilateral networking
- Learn form other networks through collaboration

5

Activity	Lead Institution
Exchange of information and materials for education & training	Korean Atomic Energy Research Institute **(KAERI)**
Exchange of students, teachers and researchers	Malaysian Institute for Nuclear Technology Research **(MINT)**
Distance learning	Philippine Nuclear Research Institute **(PNRI)**
Establishment of reference curricula and facilitating credit transfer and mutual recognition of degrees	Hanoi University of Technology **(HUT)**
Liaise with other networks and organization	Atomic Energy Authority, Sri Lanka

6

Action Plan

Milestone	Timeframe	Remarks
Establishment of based network web	Started in 2003 and continuing	
1st Coordination Committee Meeting	Feb 2004	
Implementation of ANENT activities	2004-2005	IAEA Support
2nd Coordination Committee Meeting	2005	To review progress
Full operation of ANENT	Beginning 2006	IAEA support, but not in central role

7

Country	Participating Institution
Australia	Australian Nuclear Science & Technology Organization (ANSTO)
China	Beijing Institute of Nuclear Engineering
India	Bhabha Atomic Research Centre (BARC)
Indonesia	National Nuclear Energy Agency (BATAN)
Malaysia	Malaysian Institute for Nuclear Technology Research (MINT)
Malaysia	Universiti Kebangsaan Malaysia (UKM)
Malaysia	Universiti Putra Malaysia (UPM)
Mongolia	National University of Mongolia
Pakistan	Pakistan Institute of Engineering & Applied Sciences (PIEAS)
Pakistan	KANUPP Institute of Nuclear Power Engineering (KINPOE)
Republic of Korea	Korean Atomic Energy Research Institute (KAERI)
Republic of Korea	Department of Nuclear Medicine
	Seoul National University
Sri Lanka	Atomic Energy Authority
Sri Lanka	University of Colombo
Thailand	Office of Atoms for Peace (OAP)

8

Collaborating Institutions

European Nuclear Education Network (ENEN)

Asian School of Nuclear Medicine (ASNM)

World Nuclear University (WNU)

9

Progress to Date

- Web site established
- Various information collated
- Information on ANENT disseminated through:
- - IAEA Bulletin (June 2004)
- - Int. Conf. On Nuclear Knowledge Management, Saclay, Sept. 2004
- Nuclear Plant Journal (Sept/Oct 2004)

10

Prospects

- Differences in level of knowledge & resources among countries in Asia – diversity provides opportunity for sharing of know-how & experience
- Opportunity for sharing and optimum utilization of facilities in the region
- Mutual recognition of degrees – facilitate exchange of students, teachers & researchers; accelerate capacity building
- Establishment of reference curricula – maintain professional stds; enhance mobility & job opportunities of nuclear workforce

11

1.11.3

HRD International Network

Keiko Hanamitsu
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Asia Cooperation Center (ACC)
Japan Atomic Industrial Forum, Inc. (JAIF)
Tel +81 3 5777 0753 Fax +81 3 5777 0757
http://www.jaif.or.jp
E-mail:hanamitu@jaif.or.jp
1-2-13 Shiba-Daimon, Minato-ku,
Tokyo 105-8605, Japan

HRD Int'l Network

Japan

FNCA 9 countries
8 fields 11 project + 2
HRD
- Exchange materials
- Basic data survey
- HRD strategy

Integration
(JAERI+JNC)
Professional Graduate School (PGS)
New local Univs
NES-Net concept

ROK

KN-Net
STU concept
RCA Regional Office
ANENT website

IAEA

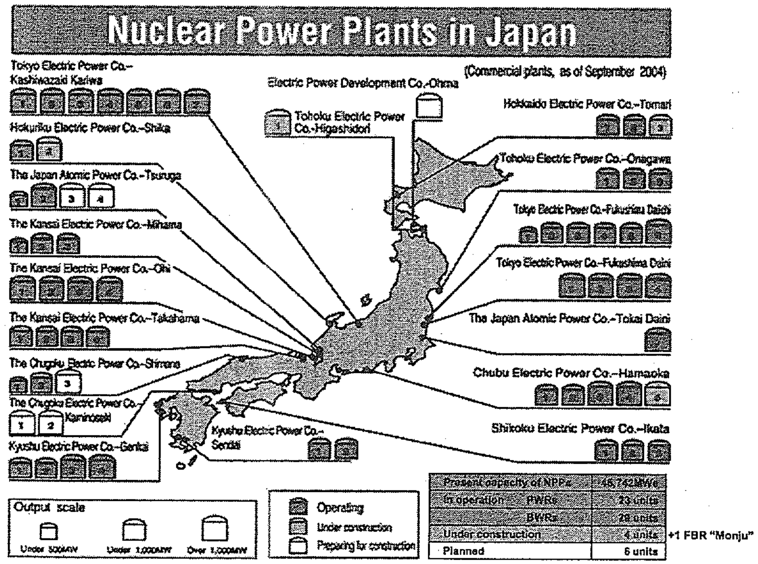
Nuclear Knowledge
ANENT

RCA
Asia 17 countries
7 fields 26 projects including nuclear education

Europe etc.

WNU
25 countries, 36 orgs
10 WGs
Summer Institute

ENEN
17 countries, 21 Orgs
Master course (EMSNE)



NES-Net concept

Nuclear Education System Network

<u>Background</u>

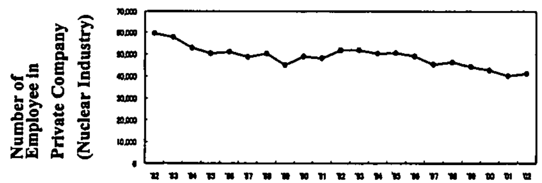
Increasing retired nuclear experts
Decreasing students in nuclear engineering
Reduced budget for nuclear education and training

<u>Problems to be solved at NPP</u>

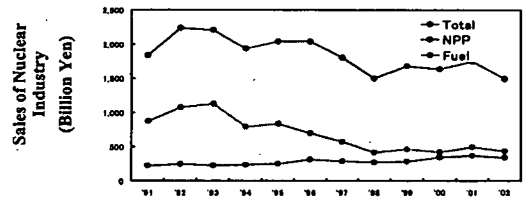
Complicated contracts systems
Manpower required for maintenance
Various admin.& work process and management rules (obstacles of linkage and future alliance)

Business Trend of Japanese Nuclear Industries

Decrease of Engineers



Reduced Sales of Nuclear Vendors



NES-Net concept

First Task

NES-Net Nuclear Education Information Center on Web-site

to standardize various existing nuclear education programs for NPP management (especially maintenance) owned by related companies to

- Transfer of nuclear technology and skill effectively
- Upgrade worker's skill and ensure safety
- Save resources and manpower

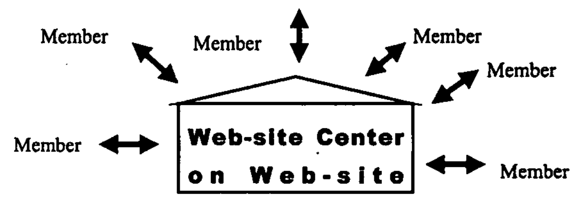
Aiming for close linkage and future alliance

NES-Net Nuclear Education Information Center: Plan

- Survey on existing similar network systems of domestic and international in nuclear or non-nuclear
- Survey on existing web-site network systems for sharing manpower and facilities
- Questionnaires survey to members on potential needs, expected information and services for NES-Net Web-site

→ Building Web-site!

NES-Net Nuclear Education Information Center: Image



Membership: Industries, research and development organizations, and Universities

NES-Net Nuclear Education Information Center :Future Prospect

On Web-site:

Information supply ⇨ education materials, E-learning, certification, archives, two-way education and research, experiments, exams

Resources:

Web-site ⇨ facilities, training courses, lectures

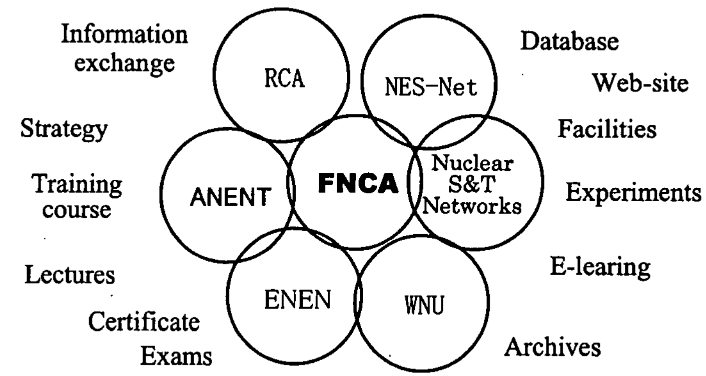
Members:

Domestic use for nuclear related members

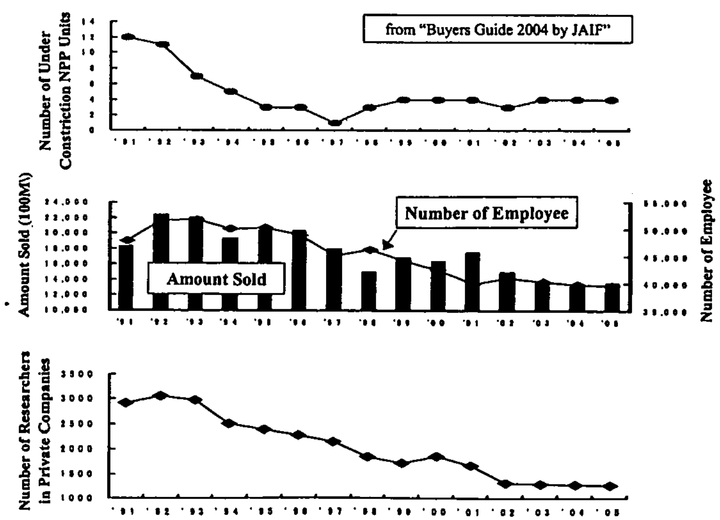
⇨ Non-nuclear industries and Overseas

Conclusion

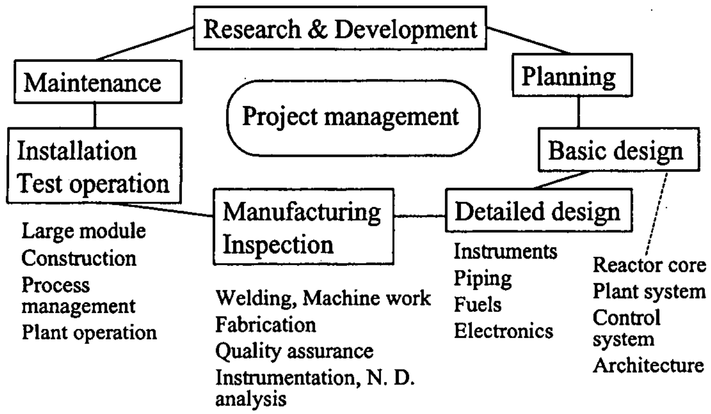
Competition & Cooperation



Business Trend of Japanese Nuclear Industries



Technological Expertise for Nuclear Power Plant Construction



Nuclear Education at Risk

The decreasing number of

- **nuclear education programs,**
- **students applying for the nuclear engineering,**
- **young professionals in nuclear engineering,**
- **recruitment by nuclear industries.**

Imbalance between graduating students and recruitment

- **Students graduating from master course - 300 person / year**
- **Recruitment by nuclear industries and organizations - 70 person / year**

Unfavorable wind in social environment

Nuclear Education in Universities - Graduate School Programs -

Universities	Present name of department	Established
Tokyo Insti. Tech.	Nuclear Eng.	1957
Osaka Univ.	Nuclear Power Eng.	1957
Kyoto Univ.	Nuclear Eng.	1957
Tohoku Univ.	Quantum Energy Eng.	1958
Univ. Tokyo 1964	System-Quantum Eng.	
Nagoya Univ.	Material Sci.& Eng.	1970
Hokkaido Univ.	Quantum Energy Eng.	1971
Kyushu Univ.	Energy Quantum Eng.	1971
Kobe Univ.	Marine Eng.	1977

Reviving Nuclear Education in Japan

1. New Programs of graduate schools

Fukui Univ.: "Nuclear and Energy Safety Engineering" started in 2004

Ibaraki Univ.: "Applied Beam Science" (incl. Nucl. Energy) started in 2004.

Univ. of Tokyo: A new type graduate course "Nuclear Department" is scheduled to open in 2005.

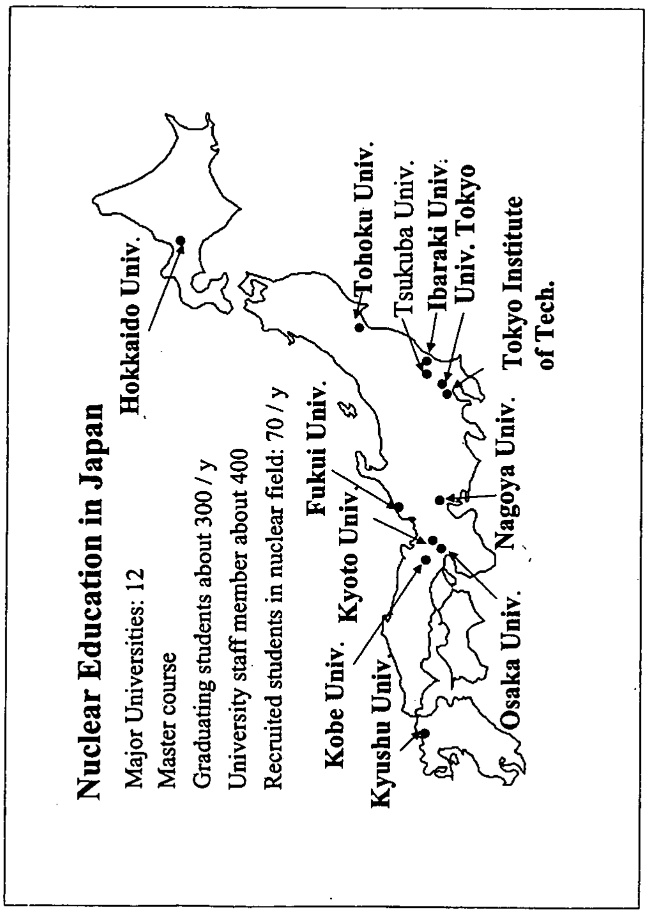
2. Cooperative nuclear education by universities and research institutes

JNC (Japan Nuclear Cycle Development Institute) --- **Fukui Univ., Kanazawa Univ., Tokyo Insti. Tech.**

JAERI (Japan Atomic Energy Research Institute) --- **Ibaraki Univ., Tokyo Insti. Tech., Univ. Tokyo**

3. Creation of nuclear education network in industries

A concept of NES-net


Nuclear Education in Japan
Major Universities: 12
Master course
Graduating students about 300 / y
University staff member about 400
Recruited students in nuclear field: 70 / y
Hokkaido Univ.
Tohoku Univ.
Tsukuba Univ.
Ibaraki Univ.
Univ. Tokyo
Tokyo Institute of Tech.
Fukui Univ.
Nagoya Univ.
Kyoto Univ.
Kobe Univ.
Osaka Univ.
Kyushu Univ.

1.12 Presentation Session 7

1.12.1 Evaluation of FNCA HRD Project

1.12.2 Summary of Member Country's Evaluation Reports

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1.12.1 Evaluation of FNCA HRD Project

Evaluation Report of Malaysia

Project name: Human Resources Development
Project leader (country): Ms. Rapieh Aminuddin
Date:2002-2004 (the project started end of 1999)

(1) OBJECT OF PROJECT: Planning and implementation –

The objective is to solidify the foundation of technologies for nuclear development and utilization in Asia by promoting HRD in Asian countries.

Main activity is to hold a workshop once a year with the objective to clarify issues and needs in HRD of each country and to mutually support HRD activities of each country mainly through information exchange upon training materials and training techniques

The tasks of the HRD project :- To identify the needs of HRD for each Asian country for consideration in planning of the international HRD programs and to mutually support activities for HRD in each country by exchanging resources on HRD (information on experiences, technologies and materials for training etc). (Refer annex 1)

(2) MAJOR OUTCOME OF PROJECT

(a)Basic data on HRD

Basic data on HRD is important for strategic planning. Before the project data is scattered. Now we have a **national and FNCA HRD in nuclear technology database** which should be update continuously. Some analysis have been done which show among other things strength and stage of development of member countries in nuclear power and various applications and utilization of radiation and radioisotope which can guide HRD strategy formulation.

(b)HRD Strategy Model

This is the latest initiative. At the moment there is no standard approach or system agreed upon to be used in HRD strategy formulation and we are relatively unsure if the basic data that has been collected are adequate and whether the analysis provide the kind of information required for strategy formulation. Exchange of ideas and experience in strategy formulation could result in the best practice of HRD strategy formulation

(c) Development of nuclear training materials and technology

Common training material for Radiation Protection is now in the FNCA HRD Project Website and more courses are expected as initiative from Japan. A list of training materials of member countries have also been compiled by Korea. Malaysia contributed a textbook on Radiation Protection and the Philippines came up with a CD to teach nuclear technology to high school which can be purchased. The usefulness of E-learning is well accepted but its implementation is premature as it requires infrastructure and competent manpower.

(d) Information exchange and FNCA HRD Project Home Page

A lot of information have been exchanged and shared. Among them the idea of forming AINST, ANENT, Nuclear Young Generation Network, associations and societies in nuclear, international training offered by Japan and other member countries.

(e)HRD needs and mutual support

HRD needs of member countries have been identified, refined and reviewed. This could provide useful inputs for mutual support.

(3) EVALUATION INDICATORS FOR ABOVE OUTCOME

		Achievement of project objective	Indicators for project activity
1	**Basic data on HRD**	More than 90%	5 excellent
2	**HRD Strategy and Model**	More than 70% (on-going)	5 excellent
3	**Development of nuclear training materials and technology**	More than 90%	5 excellent
4	**Information exchange and FNCA HRD Project Home Page**	More than 70%	5 excellent
5	**HRD needs and mutual support**	More than 90%	5 excellent

(4) PROJECT OUTLOOK

/ Continuation ☐ Change/Revision ☐ Termination

The reason if any: Most of the activities are on-going and need longer time to be complete an see results

(5) RIPPLE EFFECT TO OTHER FIELDS OR BENEFITS TO END-USERS

HRD is often treated as one aspect of project and is an action reactive to the project. So it is a sub- activity of projects sometimes happening on ad hoc basis managed by project leaders with little knowledge of HRD. Hence, it is not planned ahead and has no proper system and resources to support its activities. The FNCA project made us realize that HRD needs to have proper strategy backed by database and information system. This notion is new to nuclear institute. FNCA HRD Project gives opportunity for HRD managers in member countries to exchange information and come up with best practice in HRD strategic planning and management. With well managed human resources nuclear technology in member countries and in the region can advance and flourish at a faster rate.

(6) OPINION ABOUT THE PROJECT (PROBLEMS, IDEAS, REMARKS, PROPOSAL)

The project at present cover quite a diversed area- HRD strategy, training materials , training, e-learning, HRD information system, training needs analysis. Each of these is a very specialized area that requires specific competencies and experience. For eachof the activities to run efficiently and effectively, I would like to make 2 suggestions- i. National FNCA HRD working group to be set up led by project leader, ii. FNCA HRD project to form sub-projects, e.g HRD strategy (covering information system and training needs analysis), Training (covering training materials as well) and e-learning.

Evaluation Report of Thailand

Project name: Human Resource Development
Project leader (Thailand): Ms. Warapon Wanitsuksombut
Date: Sept 24, 2004
Object of project: Planning and implementation

1. Major outcome of project:
   (1) Collection and analysis of data on Human Resource Development of the country. The activity helps determining status on human resources and the development. The project offers us the chance to make comparison of data to other countries. Also the data collection let us know status of the country, the analysis of data will help the country to determine its strategy. As for Thailand, there is adequate development of personnel in various application of nuclear technology. The data also identify the needs for qualified personnel in radiation safety and radiological protection especially qualified expert to do quality control in medical field.
   (2) Preparation of teaching materials. It is important to prepare teaching material in local language because Thailand utilizes Thai language as its national language. We found that textbook in local language is more useful.
   (3) Qualification scheme for radiation safety officer is the most important task. Model of qualified training courses are adopted from information exchange in HRD Project. The information exchange has initiated further development in regulations for controlling of radioactive materials. The project also helps in developing competent professional in nuclear field.

2. Evaluation indications for above outcome
   Socio-economic impact
   (Application of Achievement of project object): 4 points
   Scientific impact (Basic technology or Activity): 4 points

3. Project outlook
   ☒ Continuation ☐ Change/Revision ☐ Termination

4. Ripple effect to other fields or Benefits to end-users
   Human resource development contributes to basic education in schools and college which is the fundamental of nuclear science. It helps in giving information to public to create public acceptance on nuclear. The project also draws attention of high position management to the need of human resource development.

5. Opinion about the project:
   The project should be continued to support formulating of country Human Resource Development Strategy.

Evaluation Report of the Philippines

Project name: Human Resources Development in the Nuclear Field
Project leader (country): Dr. Corazon C. Bernido, Dr. Estrella D. Relunia / Philippines
Date: 2002-2004

1. Major outcome of project :

(1) Exchange of information and HRD needs, exchange of training materials (2 textbooks from Japan, 1 textbook from Malaysia, Nuclear Science for High School CD-ROM from the Philippines)

(2) Survey of Basic Data on HRD which gave baseline data of available human resources which is a necessary step for the formulation of a national HRD strategy

(3) Training of High School Science Teachers, sponsored by MEXT/RADA in response to the need of the Philippines, as presented during FNCA HRD workshops

(4) Formulation of a national HRD strategy which is important in order to address the HRD needs in the nuclear field

(5) Inputs to the FNCA HRD homepage which posts relevant information, such as the schedule of training courses, list of training materials in the different participating countries. The FNCA HRD homepage also posts the training materials in joint training courses conducted by Japan and Indonesia, etc.

Publications:

(1) Country Report-Philippines, The 2002 Activities and the 4th Workshop of the HRD Project in FNCA, by C.C. Bernido, JAERI-Review 2003-018, July 2003

(2) Country Report-Philippines, 2003 FNCA HRD Workshop in the Nuclear Field, by C.C. Bernido, JAERI-Review 2004-014, July 2004.

(3) Education for the Young Generation in the Philippines, by C.C. Bernido, JAERI-Review 2004-014, July 2004.

2. Evaluation indicators
   Socio-economic impact
   (Application or Achievement of project objection) : 4 point
   Scientific impact (Basic technology or Activity): 4 point

3. Project outlook
   ☐√√ Continuation ☐ Change/Revision ☐ Termination
   The reason if any:

4. Ripple effect to other fields
   Human resources development is a basic need which will have an impact in all the different applications of nuclear science and technology.

5. Opinion about the project (problems, ideas, remarks, proposal)

   Continue the development of common training materials, finalize the national HRD strategy, and extend the MEXT Scientist Exchange Program to include M.S. and Ph.D. degrees in the nuclear field. Form linkages with ANENT, and IAEA/RCA.

(extend to separate paper if necessary)

Evaluation Report of Vietnam

Project name: Human Resource Development
Project leader (country): Vu Dang Ninh
Date: 20 September 2004
Object of project: survey, analysis, and assessment of current status on nuclear manpower. Planning and implementation of HDR programme.
1. Major outcome of project (each item should be written within 5 lines) (1) Complete survey of current status on nuclear manpower (2] Contribution to the formulation of HRD plan in the Strategy on Atomic Energy being submitted to the Government of Viet Nam (3) Conduct study and elucidation on HRD programme for nuclear power development. (4) Formulate a Draft HRD planning in the nuclear field to 2020 (5] Implement International cooperation on the HRD, including information and materials exchange, training, scientific visits,... Publications: (1) Prepare teaching materials in radiation protection, application of nuclear techniques,.... These materials are used for young staff training
2. Evaluation indicators for above outcome Socio-economic impact (Application or Achievement of project object) : 4 point Scientific impact (Basic technology or Activity): 4 point
3. Project outlook X Continuation ☐ Change/Revision ☐ Termination The reason if any: - HRD is one of the most important issues in the long-term programme on nuclear energy development - Current nuclear manpower shortage is a serious problem in Viet Nam - Viet Nam has been beneficial from the FNCA's HRD project
4. Ripple effect to other fields - Created close cooperative relationships between the VAEC and some universities in Viet Nam in the nuclear manpower training.
5. Opinion about the project (problems, ideas, remarks, proposal) - Viet Nam wishes to continue to receive the assistance and supports from the advantaged countries in the field of nuclear manpower training and development through the FNCA's HRD project. - Further exchange information and experiences with FNCA's member countries in the issues related to HRD.

Evaluation Report of Indonesia

Project Name	:	Human Resource Development – FNCA
Project Leader	:	Drs. Karsono, MSc. (Indonesia)
Date	:	September 30, 2004
Object of Project	:	Planning and Implementation ■ Collection and Analysis of Data ■ Preparation of Teaching Material

---

1. Major Outcome of Project
   - ■ Collection and Analysis of Data
     - o List of nuclear training courses have been implemented, and its cumulative number of trainees. The TC are categorized as Basic/General Nuclear Energy/Nuclear Fuel, Nuclear Power Generation Technique/Reactor Engineering, Radiation/ Radioisotope Application Technique, and Safety.
     - o Survey of University / Education Institutions (in the field of nuclear technology)
   - ■ Preparation of Teaching Material
     - o Development of Training Materials (in Indonesian)
2. Evaluation Indicators for Above Outcome
   - ■ Achievement of project object 4
   - ■ Project activity 4
3. Project Outlook

   √☐ **Continuation** ☐ Change/revision ☐ Termination
4. Ripple Effect to Other Fields or Benefit to End Users
   - o Getting benefit of nuclear techniques
   - o Enhancement of radiation safety
   - o Increase of knowledge of nuclear technology
   - o Strengthening competencies of BATAN's personnels
5. Opinion about the Project

6. Schedule for Projects Evaluation

Evaluation Report of China

Project name: FNCA-HRD Project
Project leader (country): CHEN Gang (China)
Date: 2004.09.20
1. Major outcome of project (1) The project has improved the information sharing among the Asia countries in the human resources area. Even different countries have different focus region of nuclear technical development. We can share each of the country's policy of HRD and how can they face and solve the problems. During the workshop, we can have open talking on each topic of HRD that can give each of us has overviews of the realistic of Asia countries human resources development on nuclear field. (2) The project provide the staffs training experience feedback. We can receive the mutual support training courses information in the workshop. They are contribute to help other countries get the services and support of knowledge learning. We believe many countries need these support. The project provides a bridge to link these activities. (3) The project gives us a transparent platform to communicate each Asian country human resources situation related nuclear area. Publications: The publication was clear and fruitful.
2. Evaluation indicators Socio-economic impact (Application or Achievement of project objection): 80 point Scientific impact (Basic technology or Activity) : 50 point
3. Project outlook ■ Continuation □ Change/Revision □ Termination The reason if any: To keep communication and contact. Improve understand of each country. Provide information to support and learn each other.
4. Ripple effect to other fields HRD area are widely effect every field of FNCA since the human recourse is the key factor for all analyze regions. Almost all regions face the problems such as lack of human resources, training staffs. HRD analyze can not be put in a isolated field.
5. Opinion about the project (problems, ideas, remarks, proposal) Here are some proposal to improve our project: 1) Increase more HRD management topics in the workshop and not only focus on technical points. Be course technical questions can be discuss in other FNCA field deeply. Now we begin talk about HRD strategy is a good progress. 2) The statistic requirement and details need to be modified. Since each countries has different development level of nuclear technique. The same statistic form and data collection will create some confuse and difficulty.

3) Increase one more representative of each country. Only one project leader maybe has some limit of information sharing.

6. Indicator of Project Evaluation

Group (B)

Human Resources Development

Object: Planning and implementation

Activity items: Collection and analysis of data, preparation of teaching materials

Indicators for achievement of project objection: **More than 50%**

Indicators for project activity: **Good**

Evaluation Report of Korea

Project name: Human Resources Development in the Nuclear Field
Project leader (country): Eui-Jin Lee (Korea)
Date: 21 September 2004
1. Major outcome of project (each item should be written within 5 lines) The following are the main results of project: (1) Information and materials of national strategies on human resources development have been exchanged through annual workshops (2) Investigation has been conducted to collect and analyze basic data about research institutions, universities, radiation and radioisotope applications, training courses and its materials, etc. Particularly, this basic data was very useful to bench mark the formulation of the national human resource development strategies. (3) Discussions have been initiated to deal with strategy issues on how to attract the younger generation, and how to prepare and improve HRD action plans for the younger generation. (4) Exchange of teaching materials which were written in English among member countries have been a desirable reference for the mutual cooperation for HRD. (5) JAERI/NuTEC homepage which has interlinked with member countries and, annual publications (JAERI-Review) have not only been to recognize the importance of HRD but also a valuable mechanism in strengthening the mutual interests on HRD. The following are major outcome of project to be supposed tentatively; - Korea Nuclear Young Network was established under the Korea Nuclear Society in 2002. - Korea WIN-expert Foundation was established in 2003. - UST-KAERI Campus was opened to provide Master Degree and Ph. D. Degree courses for young students in 2004. - National projects on nuclear manpower development have improved since 2002. - Projects on education program developments such as the development of a specific curricular and its teaching materials as well as nuclear policy courses, radiation protection and the development of a cyber education system and its multi-media materials was launched in 2002. - Technical road-map on HRD was included in the formulation of the national road-map on nuclear development in 2003. - The HRD project provided an opportunity to promote in published English teaching materials. Publications: (1) Annual publication : JAERI-Review from 1999 to 1003 (2) English textbooks : 2 from Japan, 1 from Korea, 1 from Malaysia

2. Evaluation indicators
Socio-economic impact
(Application or Achievement of project objection) : 5 point
Scientific impact (Basic technology or Activity): 5 point

3. Project outlook
■ Continuation ☐ Change/Revision ☐ Termination
The reason if any:

4. Ripple effect to other fields
(1) HRD project has emphasized the importance of regional cooperation of HRD. Regional cooperation has impacted to activate bilateral cooperation among member countries.
(2) From the utilization of HRD basic data, mobility of HRD personnel has been increased.

5. Opinion about the project (problems, ideas, remarks, proposal)

The FNCA HRD project should be continued for the mutual cooperation on HRD planning and implementation for the Asian region. Cooperation among member counties is felt beneficial in terms of technology transfer which can solve the common problems of HRD needed for the sustainable development of nuclear technology.

(extend to separate paper if necessary)

1.12.2 Summary of Member Country's Evaluation Reports

EVALUATION OF FNCA HRD PROJECT
Summary of member country's Evaluation Reports

Nobuo SASAMOTO
Japan Atomic Energy Research Institute

1. Major Outcome of Project

The objective of the HRD Project is to solidify the foundation of technologies for nuclear development and utilization in Asia by promoting Human Resources Development (HRD) in Asian countries. Major cooperative activity of the objective is to hold a Workshop once a year. The objective of workshops is to clarify the issues and needs in HRD of each country and to mutually support HRD activities of each country mainly through information exchange upon training materials and training techniques.

a) Utility of Workshop

Information of national strategies on HRD, materials, and experiences have been exchanged and each country's own activity of HRD was triggered by annual Workshops; such as education of nuclear science for younger generation, enhancing country's own HRD program, and regulations for controlling of radioactive materials and radiation safety, etc.

b) Survey of needs and basic data on HRD

Needs and basic data on HRD (Universities, Research institutes, Facilities for use of Radio-Isotopes (RI), Training institutes, etc.), that are essential for strategic planning, have been surveyed and analyzed. The result of survey gave baseline data of available human resources, and is useful for formulation of a national HRD strategy.

c) HRD strategy model

Three types of common model of HRD strategy corresponding to the phase of nuclear development have been proposed. The models together with basic data on HRD will be utilized for formulation of a national HRD strategy.

d) Publications

- 5 reports on activities of FNCA and HRD workshop – JAERI-Review 2000-014 (2000), JAERI-Review 2001-020 (2001), JAERI-Review 2002-015 (2002), JAERI-Review 2003-018 (2003), JAERI-Review 2004-014 (2004)
- 12 training materials were updated to the FNCA-HRD Project website.

- 3 textbooks were distributed to member countries (2 from Japan, 1 from Malaysia)
- 1 CD-ROM for high school students from the Philippines
- Training materials written in English have been posted in the FNCA-HRD Project website toward common use among FNCA member countries.

2. Evaluation Indicator

Socio-economic impact

(Achievement of project objection): 4 point

Scientific impact

(Activity): 5 point

3. Project Outlook

■ Continuation □ Change/Revision □ Termination

The reason if any:

All member countries checked "Continuation".

3 types of models of HRD strategy for each group divided into three classes depending on the nuclear development were proposed based on the result of the survey of needs and basic data on HRD carried out from 2002 to 2004. The achievement in the present phase of this project is to formulate models of HRD strategy. During the next phase, country's own HRD strategy will be formulated based on the obtained models and experiences in member countries. Besides mutual support for HRD activities pursuing further nuclear development and utilization is still beneficial in the next phase.

4. Ripple Effects to Other Fields

・HRD project has emphasized the importance of regional cooperation of HRD. Cooperation among member countries and mobility of HRD personnel were strengthened by the HRD project.

・HRD widely provides the bases of the development for every field of FNCA. To have proper strategy backed by substantial database is a prerequisite for success in the nuclear field.

・HRD improves basic nuclear science education for younger generation and public acceptance on nuclear fields.

5. Opinion about the project (problems, ideas, remarks, proposal)

- Opinion and proposal on HRD project and its management

  —To implement HRD project more efficiently and effectively, national HRD working group or committee might be set up and sub project (HRD strategy, Training, e-learning) might be formed.

  —Strengthening of linkages with ANENT, IAEA/RCA, IAEA/EBP, ENEN, WNU and so on

  —Strong requirements from all countries to continue the project to assure proper planning and implementation of the country HRD strategy.

—HRD of core personnel should be given more emphasis.

—Increase one more representative of each country to enhance HRD activities.

- Opinion and proposal on needs, survey data, and materials

  —Basic data collected need to be updated. However some items in the survey need to be modified to include key information relevant to HRD strategy.

Evaluation of FNCA HRD Project

Summary of Evaluation Reports Submitted by Member Countries

Nobuo SASAMOTO
and Rei OUCHI
Nuclear Technology and Education Center
Japan Atomic Energy Research Institute

1

Objective of the HRD Project

- To solidify the foundation of technologies for nuclear development and utilization in Asia by promoting human resources development in Asian countries

2

Main Activity to the Objective

- To hold a workshop annually to clarify issues and needs on HRD in each country for formulating national HRD strategy
- To promote mutual support for HRD in each country mainly through exchange of HRD methods
  - information of experiences, training materials, training techniques

3

Major Outcome of the Project (1)

- Utility of Workshop
  - Exchange of related HRD information has been successfully carried out through WS
  - Each country's own activity of HRD was triggered by annual WSs
    - Education of nuclear science for younger generations, enhancing country own HRD program, and regulations for controlling of radioactive materials and radiation safety, etc.

4

Major Outcome of the Project (2)

- Survey of Needs and Basic Data on HRD
  - Needs, issues and basic data on HRD have been surveyed and analyzed
  - The result of survey gives fundamental data to be utilized for formulation of a national HRD strategy
- HRD Strategy Model
  - Three types of common model of HRD strategy were proposed
  - The models together with basic data on HRD will be utilized for formulation of a national HRD strategy

5

Major Outcome of the Project (3)

- Publications
  - 5 reports on activities of the HRD workshops (JAERI-Review; 2000~2004)
  - 12 training materials were uploaded to FNCA-HRD Project website
  - 3 textbooks were distributed to member countries (2 from Japan, 1 from Malaysia)
  - 1 CD-ROM for high school students from the Philippines

6

Evaluation Indicator

- Simple averaging procedure of each country score gives the followings;

Socio-economic impact 4 point

Scientific impact 5 point

7

Project Outlook

- All countries checked "Continuation"
- The reasons for the above decision
  - 3 types of model of HRD strategy were proposed
  - During the next phase, country's own HRD strategy will be formulated based on the models
  - Mutual support for HRD activities is still beneficial

8

Ripple Effect to Other Fields

- Cooperation among member countries and mobility of HRD personnel were strengthened by HRD project.
- HRD widely provides the base for the development for nuclear field of FNCA.
- HRD improves basic nuclear science education for younger generation and public acceptance on nuclear fields.

9

Opinion and proposal on HRD Project and its management (1)

- To implement HRD project more efficiently and effectively, national HRD working group or committee might be set up and sub project (HRD strategy, Training, e-learning) might be formed
- Strengthening linkages with ANENT, IAEA/RCA, IAEA/EBP, ENEN, WNU and so on

10

Opinion and proposal on HRD Project and its management (2)

- Strong requirements from all countries to continue the project to assure proper implementation of the country HRD strategy.
- HRD of core personnel should be given more emphasis.
- Increase one more representative of each country to enhance HRD activities.

11

Opinion and Proposal on Needs, Survey Data and Materials

- Basic data collected need to be updated. However some items in the survey need to be modified to include key information relevant to HRD strategy.

12

1.13 Discussion Session (Future Plan)

1.13.1 Draft Proposal FNCA HRD Project Plan

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Draft Proposal FNCA HRD Project Plan

Background

Effective knowledge management needed

Decreasing well qualified students

Increasing retiring experts

FNCA HRD project

Needs Action Plan leading the tangible results

Action Proposal 1

Study on HRD Strategy for Specific Cases related to Nuclear Technology

Study theme examples:

1. Develop the first NPP in the near future
2. Develop the large and/or advanced NPP
3. Apply nuclear tech., for non-generation: industrial, medical, agricultural use

Action Proposal 1

Study on specific case

By the next Workshop

Select the study theme, which should meet national and industrial program.

Communicate with the program planner.

At the WS

Presentation and discussion

After the WS

Compile and publish the result

Action Proposal 2

Cooperation with ANENT/IAEA

Analyze and discuss possible cooperation

1. Strategy and planning
2. Training materials
3. Enhance active participation to ANENT

Action Proposal 3

Supporting Tool Development
for HRD Strategy
(selected and revised basic data)

- Training courses on nuclear S&T
- Nuclear related qualifications/ licenses
- Nuclear related educational organizations:
  (Univs, graduate schools, academic associations, and societies)

Action Proposal 3

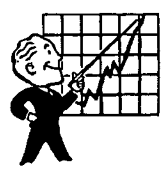
Strategy supporting tool

1. Admin Agencies and National R&D Institutes
2. Educational organizations
   (universities, graduate schools, and training schools)
3. Radiation and radioisotopes use for agriculture and medical care
4. Training courses
   Number of courses, organizers, quota and cumulative trainees categorized by purpose
5. Qualifications (licenses) of national exam
   Number of qualifications, annual licensees, and cumulative licensees
6. Academic associations and societies
   Number of organizations, regular/ supporting members, and student members
7. Background data for analysis
8. Present status of nuclear application in FNCA countries

Action Proposal 3

Strategy supporting tool

- Update with clear definition and analysis
- Use as supporting data for HRD case study
- Compile and publish the report



Additional Suggestion

"HRD for Nuclear Science &Technology"

One of the round table discussion topics
For the FNCA Meeting
On December 1st, 2004
In Hanoi, Viet Nam

We need the message and recommendation.

1.14 Conclusion Session
1.14.1 Minutes

MINUTES
FNCA 2004 Workshop on Human Resources Development

October 4-7, 2004
Kuala Lumpur, Malaysia

FNCA 2004 Workshop on Human Resources Development (HRD) took place on October 4-7, 2004 in Kuala Lumpur, Malaysia. This Workshop was sponsored by the Ministry of Science and Technology Innovation (MOSTI) of Malaysia and the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan. The Malaysian Institute for Nuclear Technology Research (MINT) and the Japan Atomic Energy Research Institute (JAERI) acted as the hosts.

The number of participants in the Workshop totaled 14 people including 2 observers. On the first day of the workshop, the opening session was jointly conducted together with IAEA Training Course on Advanced Management Practices for Commercialization of Services and Technologies from Nuclear Research Institutions. 4 speeches were delivered- first was opening remark by Dr. Daud Mohamad, the Director General of MINT, then by Ms. Miwako Shimizu, Special Staff of Atomic Energy Division of MEXT and followed by Mr. Ibrahim Ail, representative of the IAEA. Finally the official opening speech of the Minister of MOSTI was delivered by Dato' Suriah Abd. Rahman, the Secretary General of MOSTI.

Plenary Session was held after the Opening Ceremony during which lectures were presented by Tan Sri Dr. Ahmad Zaharuddin Idrus, Science Adviser to the Prime Minister's Department, Dr. Sueo Machi, Japanese FNCA Coordinator, Commissioner, Atomic Energy Commission of Japan and Mr. Norhalim Yunus, General Manager Technology Development, Malaysian Technology Development Corporation (MTDC).

The participants of the Workshop were the Project Leaders, who are the persons responsible for human resources development – one from each of the eight member countries, i.e. China, Indonesia, Korea, Malaysia, Thailand, the Philippines, Vietnam and Japan. Besides the Project Leaders, four additional participants from Japan attended the Workshop. The observers were one from Malaysia and one from Japan.

Themes and contents of the country reports for the Workshop were as follows, as agreed upon in the last Workshop and as proposed in the 5th Coordinators Meeting held in March 2004:

1. Recent topics in the nuclear field and related HRD in each country.
2. Historical review of experiences of HRD in the nuclear field corresponding to the stages of nuclear development in each country.
3. HRD strategy or the Model as the way of formulating HRD strategy taking into account policy targets of nuclear development in the coming 10 or 20 years in each country, the kinds and numbers needed to achieve the policy targets, the number of personnel needed, the measure needed to cover shortfall of human resources, proposal for securing interested excellent students to contribute to the nuclear field and issue and solution.
4. Mutual support and others.
   ① Request and proposal on education and training of young generation with linkage between FNCA and Asian Network for Education in Nuclear Technology (ANENT).
   ② Investigation of training materials in CD ROM for the purpose of introduction and utilization of e-learning system.
   ③ Review and comment on the training materials newly posted in the website of FNCA-HRD Project http://www3.tokai.jaeri.go.jp/nutec/fnca/fnca.htm
   ④ List of International and Domestic training courses to be held in 2004
5. Proposed future plan of FNCA HRD Project form Japan
6. Request and Proposal on HRD Project and its development
   ① Way of using the Model
   ② Development of HRD Project
   ③ Expectation of FNCA support

Country reports were presented on the first and second day of the FNCA HRD Workshop according to the following themes; countries with radiation applications, countries planning to construct nuclear power plants and countries with operating nuclear power plants. On the second day, besides the presentation session, participants were divided into three groups based on the same themes. The aim of the discussion was to develop an HRD Strategy Model for each of the three themes. On the third day, HRD strategy models formulated by subgroup interaction were presented and a very lively discussion of the proposed models followed. On the same day, three special topics – Training Support in HRD, Present Status of ANENT and HRD International Network were presented. In the afternoon of the third day, each participant presented their evaluation of HRD Projects. These evaluations were consolidated into one evaluation coming from the workshop. Presentation and discussion of future action ended the third day of the workshop. Adoption of minutes, formulation of recommendations or message for the ministerial meeting and closing session were held on the fourth day.

During discussions in the Workshop, the following points, proposals, opinions, and comments were agreed upon:

1. Recent topics in the nuclear field and related HRD in each country.
2. Development of Nuclear Training Technology

   NuTEC/JAERI has newly provided some of the training materials from the joint training programs with Indonesia, Thailand and Vietnam in the website (FNCA-HRD Project http://www3.tokai.jaeri.go.jp/nutec/fnca/fnca.htm), as the training materials on radiation protection to be used commonly. Project leaders are requested to review and give comments on these training materials.

3. HRD strategy or the Model as the way of formulating HRD strategy.

   Groups working for formulation of the models of the HRD strategy produced the following models:-

   - Models for countries with Radioisotopes and Radiation Applications
   - Models for countries planning to construct NPPs
   - Models for countries with operation NPPs

   These models are attached as appendix 1. These models will be refined and the final version will be submitted by 31 October 2004.

4. Evaluation of the HRD project

   Evaluations of each of the project leaders were consolidated into evaluation of the FNCA HRD Workshop and is attached as appendix 2.

5. Future plan for FY 2005 to 2007

   The workshop agreed that the mid-term plan of the HRD Project will be as appendix 3.

6. Linkages with other networks related to HRD

   FNCA HRD Project should maintain linkages with other networks related to HRD such as ANENT, ENEN, WNU, etc.

The Workshop agreed on the Conclusions and Recommendations for the FNCA 2004 Workshop on Human Resources Development as shown in appendix 4. The conclusions and recommendations will be submitted to the Ministerial Meeting to be held in December 2004 where HRD strategy will be discussed.

Remarks

Vietnam tentatively offered to host the 2005 FNCA HRD Workshop. All participants appreciated the offer and agreed on Vietnam as the venue for the Workshop in 2005.

The Workshop included a technical tour to the Malaysian Institute for Nuclear Technology Research (MINT). The participants expressed their sincere gratitude to the organizers and host institutions.

The Minutes were discussed and agreed upon by all participants in the Workshop. This will be reported at the 6th FNCA Coordinators Meeting to be held in March 2005 in Tokyo, Japan.

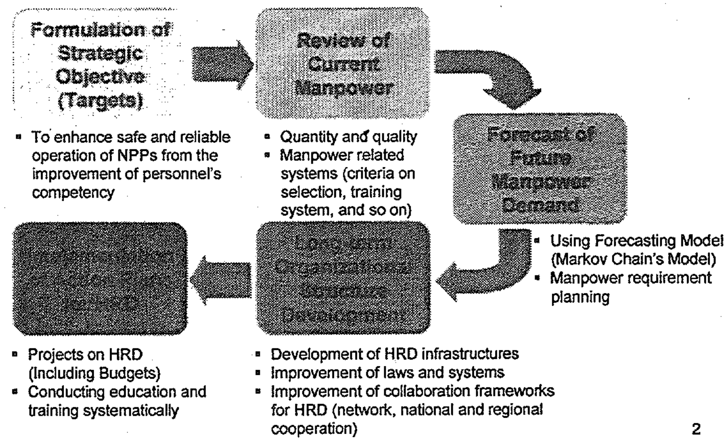
Appendix 1

HRD Strategy Model for NPP Operational Countries

China, Korea, Japan

1

HRD Strategy Model



2

Targets : Key Personnel

- Regulatory personnel (Assessment, license, and inspection personnel)
- NPP operational personnel (operators, engineering, mechanical, electrical, I & C, chemistry, fuel handling, QA & QC, safety, and health physics staffs)
- R&D personnel
- Design and manufacturing personnel
- Instructors

3

Implementation Strategy

- Review of strengths, weakness and concerns
- Review of personnel qualification and training requirements (selection, training, etc.)
- Forecasting future manpower requirements
- Set up of systematic approach to training (organizations, facilities and equipment, instructors, training programs)
- Enhancing collaboration framework with related organizations (national and regional cooperation)
- Implementing HRD projects on action plans
- Improving human resources management and support system

4

HRD Strategy Model for introducing nuclear power

Vu Dang Ninh, VAEC
Karsono, BATAN

1

The first stage

1. Set the goal for nuclear power program
2. Preview the assessment of manpower (number, specialty, qualify of personnel)
3. Manpower **<u>demand</u>** for nuclear power program
4. Comparison the gap between the demand and actual manpower

2

Demanded manpower

1. Regulation (technical criteria, standard, etc.)
2. Assessment (safety analysis, environment, etc.)
3. Construction (civil, architect, electrical, mechanical, instrument, etc.)
4. Operation
5. Maintenance

3

The second stage

1. Set up education and training schedule
2. Total planning for each demand and schedule
3. Preparation of training infrastructure (recruiting, training of trainers, facilities)

4

The third stage

Implementation of training
- Training materials, curriculum
- Equipments
- Qualification system
- Accommodation for trainees

5

The fourth stage

1. Adjustment of the HRD schedule and actual condition
2. Re-train operator, maintenance, etc.
3. Re-assessment of training program

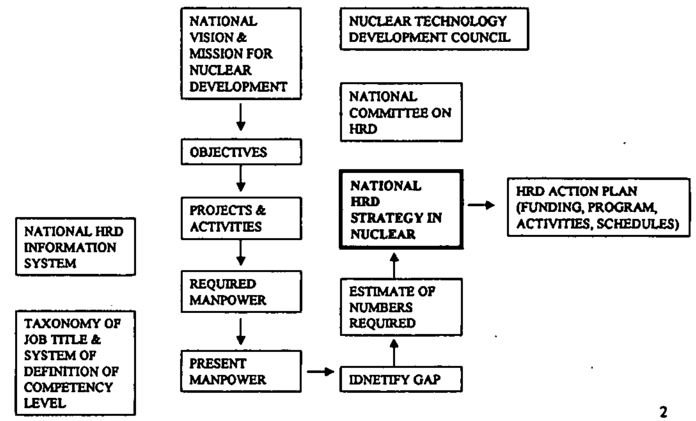
6

HRD STRATEGY FOR COUNTRIES WITH RI APPLICATIONS

Malaysia, Thailand, The Philippines

1

HRD STRATEGY NATIONAL LEVEL



2

POLICY TARGETS OF NUCLEAR DEVELOPMENT

AREAS/NEEDS FOR DEVELOPMENT
1. Users of nuclear technology
1.1 Industry
·Irradiation
·NDT
·others
1.2 Medicine
1.3 Agriculture
1.4 Research
1.5 Environment
1.6 Others
·ICT
·Data Base System
·Q.C.
2. Radiation Safety Officers

3

POLICY TARGETS OF NUCLEAR DEVELOPMENT (Cont'd)

AREAS/NEEDS FOR DEVELOPMENT
3. Support Manpower
3.1 Research Reactor
3.2 Disposal facility of RAM
3.3 Nuclear Power
4. Education
4.1 Tertiary
4.2 Secondary
5. Advocacy agenda
5.1 Promotion
5.2 Training
·e-learning module
5.3 Science culture
6. Nuclear Regulations/Licensing

4

Corporation with FNCA member countries for TC

- Train the trainers in the region
- Collaborative education system
- Harmonization of Radiation Protection practices
- OJT/practical and theses advisers program
- Each training center offers one course for all the member countries
- Each country will submit to FNCA a list of national expert
- Continuous learning for FNCA countries through cooperative program with develop NPPs

5

Appendix 2

Project name: Human Resources Development (HRD)
Project leader (country): Hideo Matsuzuru (JAPAN)
Date: October 7, 2004
Object of project: To solidify the foundation of technologies for nuclear development and utilization in Asia by promoting human resources development in Asian countries
1. Major outcome of project (1)Utility of Workshop ·Exchange of related HRD information has been successfully carried out through Workshop. ·Each country's own activity of HRD was triggered by annual Workshops. Education of nuclear science for younger generations, enhancing country own HRD program, and regulations for controlling of radioactive materials and radiation safety, etc. (2) Survey of Needs and Basic Data on HRD ·Needs, issues and basic data on HRD have been surveyed and analyzed. ·The result of survey gives fundamental data to be utilized for formulation of a national HRD strategy. (3) HRD Strategy Model ·Three types of common model of HRD strategy were proposed. The models together with basic data on HRD will be utilized for formulation of a national HRD strategy. (4) Publications ·5 reports on activities of the HRD workshops (JAERI-Review; 2000~2004) ·12 training materials were uploaded to FNCA-HRD Project website. ·3 textbooks were distributed to member countries (2 from Japan, 1 from Malaysia). ·1 CD-ROM for high school students from the Philippines
2. Evaluation indicators for above outcome Socio-economic impact (Achievement of project object) : <u>4point</u> Scientific impact (Activity): <u>5point</u>
3. Project outlook ☒ Continuation ☐ Change/Revision ☐ Termination The reasons for the above decision: ·3 types of model of HRD strategy were proposed. ·During the next phase, country's own HRD strategy will be formulated based on the models. ·Mutual support for HRD activities is still beneficial.
4. Ripple effect to other fields or Benefits to end-users ·Cooperation among member countries and mobility of HRD personnel were strengthened by HRD project. ·HRD widely provides the base for the development for nuclear field of FNCA. ·HRD improves basic nuclear science education for younger generation and public acceptance on nuclear fields.
5. Opinion about the project (problems, ideas, remarks, proposal)

(1)To implement HRD project more efficiently and effectively, national HRD working group or committee might be set up and sub project (HRD strategy, Training, e-learning) might be formed.
(2)Strengthening linkages with Asian Network for Education in Nuclear Technology(ANENT), International Atomic Energy Agency(IAEA)/Regional Cooperation Agreement(RCA), IAEA/Extra Budgetary Program(EBP), European Nuclear Engineering Education Network(ENEN), World Nuclear University(WNU) and so on are desirable.
(3)Strong requirements from all countries raised to continue the project to assure proper implementation of the country HRD strategy.
-HRD of core personnel should be given more emphasis.
-Increase one more representative of each country to enhance HRD activities.
(4)Basic data collected need to be updated. However some items in the survey need to be modified to include key information relevant to HRD strategy.

Appendix 3

The Mid-term plans for Human Resources Development (HRD) Project

Item	FY2005	FY2006	FY2007	Notes
1. General Schedule	• 6th FNCA Meeting • 7th FNCA Coordinator Meeting (CRD in Japan)	• 7th FNCA Meeting • 8th FNCA Coordinator Meeting (CRD in Japan)	• 8th FNCA Meeting • 9th FNCA Coordinator Meeting (CRD in Japan)	
2. HRD Workshop	2005 Workshop	2006 Workshop	2007 Workshop	(Vietnam, China, Indonesia)
1) HRD Strategy Study	HRD Strategy of the WS host country	HRD Strategy of the WS host country	HRD Strategy of the WS host country	Discussion about the WS host country With the participants from policy-maker level and educational orgs
	Study on	HRD Strategy for Specific case		Each member country
2) Cooperation with ANENT and other Networks	Study on HRD strategy	& planning, training materials,	active participation	Analysis and discussion
3) Supporting tool Development for HRD Strategy				Revised survey of basic data
• Training Course	Re-survey, update and analysis			Feedback to HRD strategy
• Qualification		Re-survey, update and analysis		
• Educational orgs. (University, Academy)			Re-survey, update an d analysis	
3. HRD Activity plans Outside FNCA activities	• Execute of activity plan • JAERI activity on FY2005 Publication of Reports • Update of HRD Web-site	• Execute of activity plan • JAERI activity on FY2006 Publication of Reports • Update of HRD Web-site	• Execute of activity plan • JAERI activity on FY2007 Publication of Reports • Update of HRD Web-site	

Appendix 4

CONCLUSIONS AND RECOMMENDATIONS OF 2004 FNCA HRD WORKSHOP

1. During the 2004 FNCA HRD workshop, project leaders reviewed historical and current development of nuclear technology in their country. Based on these reviews and future nuclear technology development plants, three drafts of HRD strategy models were proposed:
   - Model 1 – HRD Strategy Model for Countries with Radioisotope and Radiation Applications.
   - Model 2 – HRD Strategy Model for Countries planning to construct Nuclear Power Plants.
   - Model 3 – HRD Strategy Model for Countries operating Nuclear Power Plants.

2. Project leaders shall do a pilot study using the model and present the result at the next workshop. Based on the findings of the pilot study, the models shall be revised and proposed.

3. To implement HRD project more efficiently and effectively, national HRD working group or committee may be set up and sub project (HRD strategy, Training, e-learning) may be formed.

4. HRD basic data collected need to be updated continuously to support HRD strategy development and implementation.

5. Status of ANENT was presented and discussed with the project leaders. The necessity of linkage with ANENT and other networks was suggested for the sustainable development of nuclear science and technology in the region.

6. During the workshop, Project Leaders evaluated the achievement of the FNCA HRD projects. The workshop agreed that the project have been very beneficial to member countries and recommended that it should be continued.

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2. Outside-Workshop Activity

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2.1 Document on Human Resources Development for the Sixth Coordinators Meeting of FNCA

2.1.1 Project Review on Human Resources Development in the Nuclear Field

Review of Present Status of the Activities in Human Resources Development (HRD)

—The Forum for Nuclear Cooperation in Asia (FNCA) —

Mr. Hideo MATSUZURU
Project Leader of Japan

Director
Nuclear Technology and Education Center (NuTEC)
Japan Atomic Energy Research Institute (JAERI)

I. Name of the Project: Human Resources Development (HRD)

II. Objective of the Project

In 1999, the Project for HRD was added to the existing fields of cooperation as defined in the framework of the Forum for Nuclear Cooperation in Asia, FNCA. The objective of the HRD Project is to solidify the foundation of technologies for nuclear development and utilization in Asia by promoting human resources development in Asian countries. Major cooperative activity of the Project is to hold a Workshop once a year.

The objective of workshops was to clarify the issues and needs in HRD of each country and to mutually support HRD activities of each country mainly through information exchange upon training materials and training techniques.

III. Achievement from FY2002 through FY 2004

a) Specific Results and Outcomes

a-1) Utility of Workshop

- Exchange of related HRD information has been successfully carried out through Workshop.
- Each country's own activity of HRD was triggered by annual Workshops. Education of nuclear science for younger generations, enhancing country own HRD program, and regulations for controlling of radioactive materials and radiation safety, etc.

a-2) Survey of Needs and Basic Data on HRD

- Needs, issues and basic data on HRD have been surveyed and analyzed.
- The result of survey gives fundamental data to be utilized for formulation of a national HRD strategy.

a-3) HRD Strategy Model

- Three types of common model of HRD strategy were proposed. The models together with basic data on HRD will be utilized for formulation of a national HRD strategy.

a-4) Publications

- 5 reports on activities of the HRD workshops (JAERI-Review; 2000~2004) 12 training materials were uploaded to FNCA-HRD Project website.
- 3 textbooks were distributed to member countries (2 from Japan, 1 from Malaysia)
- 1 CD-ROM for high school students from the Philippines

b) Specific Social and Economic Impact

HRD is one of the most important factors for national development, and is essential for the implementations of other FNCA projects. The actual socioeconomic impact of HRD project is to be achieved through other technical projects.

In Japan, 53 NPPs and more than 5000 facilities for use of RI have been safely operated over the 50 years. This might be ascribed to that the nuclear HRD system has been established extensively in academic and nuclear industry sectors, in line with national nuclear development program.

Information exchanges have been done among the member countries, on training materials & education systems, and survey & analysis of the basic data. Also discussion has been made on HRD Strategy Model to be an indicator of formulating HRD Strategy in each member country.

These activities have not led enough socioeconomic impact yet. However they could have an effect if the achievements could be utilized for developing the guidelines for HRD system in each member country. We just found a clue for bringing socioeconomic impact, and we should look closely to see the development of the impact for long term such as 10 to 20 years.

Evaluation by Project Group

Adopted at the FNCA 2004 Workshop on HRD
Oct. 4 – Oct. 7, 2004 at Kuala Lumpur, Malaysia

Project name: Human Resources Development (HRD)
Project leader (country): Hideo Matsuzuru (JAPAN)
Date: October 7, 2004
Object of project: To solidify the foundation of technologies for nuclear development and utilization in Asia by promoting human resources development in Asian countries
1. Major outcome of project (1)Utility of Workshop -Exchange of related HRD information has been successfully carried out through Workshop. -Each country's own activity of HRD was triggered by annual Workshops. Education of nuclear science for younger generations, enhancing country own HRD program, and regulations for controlling of radioactive materials and radiation safety, etc. (2) Survey of Needs and Basic Data on HRD -Needs, issues and basic data on HRD have been surveyed and analyzed. -The result of survey gives fundamental data to be utilized for formulation of a national HRD strategy. (3) HRD Strategy Model -Three types of common model of HRD strategy were proposed. The models together with basic data on HRD will be utilized for formulation of a national HRD strategy. (4) Publications -5 reports on activities of the HRD workshops (JAERI-Review; 2000~2004) -12 training materials were uploaded to FNCA-HRD Project website. -3 textbooks were distributed to member countries (2 from Japan, 1 from Malaysia). -1 CD-ROM for high school students from the Philippines
2. Evaluation indicators for above outcome Socio-economic impact (Achievement of project object): <u>4point</u> Scientific impact (Activity): <u>5point</u>

3. Project outlook

☒ Continuation ☐ Change/Revision ☐ Termination

The reasons for the above decision:

-3 types of model of HRD strategy were proposed.

-During the next phase, country's own HRD strategy will be formulated based on the models.

-Mutual support for HRD activities is still beneficial.

4. Ripple effect to other fields or Benefits to end-users

-Cooperation among member countries and mobility of HRD personnel were strengthened by HRD project.

-HRD widely provides the base for the development for nuclear field of FNCA.

-HRD improves basic nuclear science education for younger generation and public acceptance on nuclear fields.

5. Opinion about the project (problems, ideas, remarks, proposal)

(1)To implement HRD project more efficiently and effectively, national HRD working group or committee might be set up and sub project (HRD strategy, Training, e-learning) might be formed.

(2)Strengthening linkages with Asian Network for Education in Nuclear Technology(ANENT), International Atomic Energy Agency(IAEA)/Regional Cooperation Agreement(RCA), IAEA/Extra Budgetary Program(EBP), European Nuclear Engineering Education Network(ENEN), World Nuclear University(WNU) and so on are desirable.

(3)Strong requirements form all countries raised to continue the project to assure proper implementation of the country HRD strategy.

-HRD of core personnel should be given more emphasis.

-Increase one more representative of each country to enhance HRD activities.

(4)Basic data collected need to be updated. However some items in the survey need to be modified to include key information relevant to HRD strategy.

Attachment-1

Minutes of the FNCA 2004 Workshop on Human Resources Development (HRD)

October 4- 7, 2004, Kuala Lumpur, Malaysia

FNCA 2004 Workshop on Human Resources Development (HRD) took place on October 4-7, 2004 in Kuala Lumpur, Malaysia. This Workshop was sponsored by the Ministry of Science and Technology Innovation (MOSTI) of Malaysia and the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan. The Malaysian Institute for Nuclear Technology Research (MINT) and the Japan Atomic Energy Research Institute (JAERI) acted as the hosts.

The number of participants in the Workshop totaled 14 people including 2 observers. On the first day of the workshop, the opening session was jointly conducted together with IAEA Training Course on Advanced Management Practices for Commercialization of Services and Technologies from Nuclear Research Institutions. 4 speeches were delivered- first was opening remark by Dr. Daud Mohamad, the Director General of MINT, then by Ms. Miwako Shimizu, Special Staff of Atomic Energy Division of MEXT and followed by Mr. Ibrahim Ail, representative of the IAEA. Finally the official opening speech of the Minister of MOSTI was delivered by Dato' Suriah Abd. Rahman, the Secretary General of MOSTI.

Plenary Session was held after the Opening Ceremony during which lectures were presented by Tan Sri Dr. Ahmad Zaharuddin Idrus, Science Adviser to the Prime Minister's Department, Dr. Sueo Machi, Japanese FNCA Coordinator, Commissioner, Atomic Energy Commission of Japan and Mr. Norhalim Yunus, General Manager Technology Development, Malaysian Technology Development Corporation (MTDC).

The participants of the Workshop were the Project Leaders, who are the persons responsible for human resources development – one from each of the eight member countries, i.e. China, Indonesia, Korea, Malaysia, Thailand, the Philippines, Vietnam and Japan. Besides the Project Leaders, four additional participants from Japan attended the Workshop. The observers were one from Malaysia and one from Japan.

Themes and contents of the country reports for the Workshop were as follows, as agreed upon in the last Workshop and as proposed in the 5th Coordinators Meeting held in March 2004:

1. Recent topics in the nuclear field and related HRD in each country.
2. Historical review of experiences of HRD in the nuclear field corresponding to the stages of nuclear development in each country.

3. HRD strategy or the Model as the way of formulating HRD strategy taking into account policy targets of nuclear development in the coming 10 or 20 years in each country, the kinds and numbers needed to achieve the policy targets, the number of personnel needed, the measure needed to cover shortfall of human resources, proposal for securing interested excellent students to contribute to the nuclear field and issue and solution.
4. Mutual support and others.
   ① Request and proposal on education and training of young generation with linkage between FNCA and Asian Network for Education in Nuclear Technology (ANENT).
   ② Investigation of training materials in CD ROM for the purpose of introduction and utilization of e-learning system.
   ③ Review and comment on the training materials newly posted in the website of FNCA-HRD Project http://www3.tokai.jaeri.go.jp/nutec/fnca/fnca.htm
   ④ List of International and Domestic training courses to be held in 2004
5. Proposed future plan of FNCA HRD Project form Japan
6. Request and Proposal on HRD Project and its development
   ① Way of using the Model
   ② Development of HRD Project
   ③ Expectation of FNCA support

Country reports were presented on the first and second day of the FNCA HRD Workshop according to the following themes; countries with radiation applications, countries planning to construct nuclear power plants and countries with operating nuclear power plants. On the second day, besides the presentation session, participants were divided into three groups based on the same themes. The aim of the discussion was to develop an HRD Strategy Model for each of the three themes. On the third day, HRD strategy models formulated by subgroup interaction were presented and a very lively discussion of the proposed models followed. On the same day, three special topics – Training Support in HRD, Present Status of ANENT and HRD International Network were presented. In the afternoon of the third day, participant presented their evaluation of HRD Projects. These evaluations were consolidated into one evaluation coming from the workshop. Presentation and discussion of future action ended the third day of the workshop. Adoption of minutes, formulation of recommendations or message for the ministerial meeting and closing session were held on the fourth day.

During discussions in the Workshop, the following points, proposals, opinions, and comments were agreed upon:

1. Recent topics in the nuclear field and related HRD in each country.

2. Development of Nuclear Training Technology

   NuTEC/JAERI has newly provided some of the training materials from the joint training programs with Indonesia, Thailand and Vietnam in the website

(FNCA-HRD Project http://www3.tokai.jaeri.go.jp/nutec/fnca/fnca.htm), as the training materials on radiation protection to be used commonly. Project leaders are requested to review and give comments on these training materials.

3. HRD strategy or the Model as the way of formulating HRD strategy.
   Groups working for formulation of the models of the HRD strategy produced the following models:-
   - Models for countries with Radioisotopes and Radiation Applications
   - Models for countries planning to construct NPPs
   - Models for countries with operation NPPs

   These models are attached as Annex-1.

4. Evaluation of the HRD project
   Evaluations of each of the project leaders were consolidated into evaluation of the FNCA HRD Workshop.

5. Three Year Work Plan for 2005-2007
   The workshop agreed that the Three Year Work Plan of the HRD Project will be as Annex-2.

6. Linkages with other networks related to HRD
   FNCA HRD Project should maintain linkages with other networks related to HRD such as ANENT, ENEN, WNU, etc.

The Workshop agreed on the Conclusions and Recommendations for the FNCA 2004 Workshop on Human Resources Development as shown in Annex-3.

Remarks

Vietnam tentatively offered to host the 2005 FNCA HRD Workshop. All participants appreciated the offer and agreed on Vietnam as the venue for the Workshop in 2005.

The Workshop included a technical tour to the Malaysian Institute for Nuclear Technology Research (MINT). The participants expressed their sincere gratitude to the organizers and host institutions.

The Minutes were discussed and agreed upon by all participants in the Workshop.

Annex-1: Strategy Models
Annex-2: The Three Year Work Plan on the FNCA Human Resources Development
Annex-3: Conclusions and Recommendations
Annex-4: Program of the FNCA 2004 Workshop on Human Resources Development
Annex-5: List of Participants

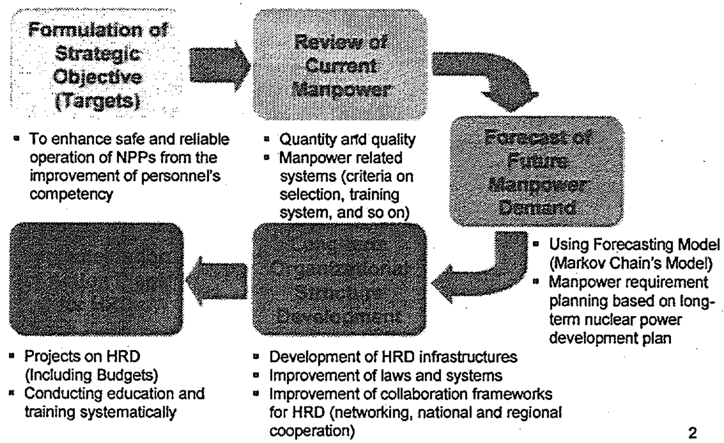
Revision by Korea

HRD Strategy Model for NPP Operational Countries (Draft)

China, Korea, Japan

1

HRD Strategy Model



2

Formulation of Targets : Key Personnel

- NPP operational personnel (operators, engineering, mechanical, electrical, I & C, chemistry, fuel handling, QA & QC, safety, and health physics staffs)
- Regulatory personnel (assessment, license, and inspection personnel)
- R&D personnel
- Design and manufacturing personnel
- Instructors, and others

3

Review of Current Manpower

- Review of current manpower in terms of quantity and quality
  - Strengths
  - Weakness and concern
- Review of manpower related system
  - Selection criteria
  - Education and training system

Annex-1

4

Forecast of Future Manpower Demand

Stochastic Model for Manpower Estimation (Example) based on long-term nuclear power development plan

$n(T) = n(T\text{-}1)\,\{P + W'r'\} + M(T)\,r$

n(T), n(T-1): expected stock at time T, T-1
P: transition matrix, W': wastage vector, r': recruitment vector
M((T) : manpower gap between time T and T-1 (created seats)
r: recruitment vector for M(T)

$$n(T) = n(p_1 + p_2 + p_3 + p_4)\left[\begin{vmatrix} p_{11} & p_{12} & p_{13} & p_{14} \\ p_{21} & p_{22} & p_{23} & p_{24} \\ p_{31} & p_{32} & p_{33} & p_{34} \\ p_{41} & p_{42} & p_{43} & p_{44} \end{vmatrix} + \begin{vmatrix} w'_1 \\ w'_2 \\ w'_3 \\ w'_4 \end{vmatrix} (r'_1\, r'_2\, r'_3\, r'_4)\right] + M(r_1\, r_2\, r_3\, r_4)$$

5

Organizational Structure Development

- Development of HRD infrastructures
  - Organizations, facilities and equipment
  - Education and training programs
  - Instructors and teaching materials
- Improvement of laws and systems
  - Procedures and criterion on education and training matters
- Improvement of collaboration frameworks for HRD (networking, national and regional cooperation)

6

Implementation for Action Plans

- Enhancement of systematic approach to training (organizations, facilities and equipment, instructors, training programs & materials)
- Development of training programs necessary for specific needs
- Enhancing collaboration for the implementation of education and training among stakeholders
- Improving human resources management and support system

7

HRD Strategy Model for introducing nuclear power

Vu Dang Ninh, VAEC
Karsono, BATAN

1

The first stage

1. Set the goal for nuclear power program
2. Preview the assessment of manpower (number, specialty, qualify of personnel)
3. Manpower **demand** for nuclear power program
4. Comparison the gap between the demand and actual manpower

2

Demanded manpower

1. Regulation (technical criteria, standard, etc.)
2. Assessment (safety analysis, environment, etc.)
3. Construction (civil, architect, electrical, mechanical, instrument, etc.)
4. Operation
5. Maintenance

3

The second stage

1. Set up education and training schedule
2. Total planning for each demand and schedule
3. Preparation of training infrastructure (recruiting, training of trainers, facilities)

4

The third stage

Implementation of training
- Training materials, curriculum
- Equipments
- Qualification system
- Accommodation for trainees

5

The fourth stage

1. Adjustment of the HRD schedule and actual condition
2. Re-train operator, maintenance, etc.
3. Re-assessment of training program

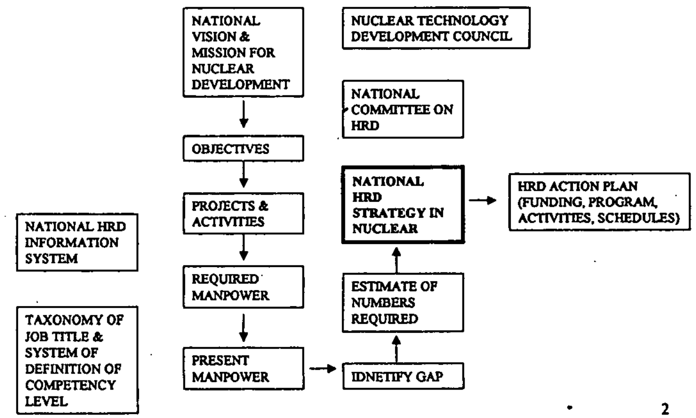
6

HRD STRATEGY FOR COUNTRIES WITH RI APPLICATIONS

Malaysia, Thailand, The Philippines

1

HRD STRATEGY NATIONAL LEVEL



2

POLICY TARGETS OF NUCLEAR DEVELOPMENT

AREAS/NEEDS FOR DEVELOPMENT
1. Users of nuclear technology
1.1 Industry
·Irradiation
·NDT
·others
1.2 Medicine
1.3 Agriculture
1.4 Research
1.5 Environment
1.6 Others
·ICT
·Data Base System
·Q.C.
2. Radiation Safety Officers

3

POLICY TARGETS OF NUCLEAR DEVELOPMENT (Cont'd)

AREAS/NEEDS FOR DEVELOPMENT
3. Support Manpower
3.1 Research Reactor
3.2 Disposal facility of RAM
3.3 Nuclear Power
4. Education
4.1 Tertiary
4.2 Secondary
5. Advocacy agenda
5.1 Promotion
5.2 Training
·e-learning module
5.3 Science culture
6. Nuclear Regulations/Licensing

4

Corporation with FNCA member countries for TC

- Train the trainers in the region
- Collaborative education system
- Harmonization of Radiation Protection practices
- OJT/practical and theses advisers program
- Each training center offers one course for all the member countries
- Each country will submit to FNCA a list of national expert
- Continuous learning for FNCA countries through cooperative program with develop NPPs

5

Annex-2

The Three Year Work Plan on the FNCA Human Resources Development (HRD)

	FY2005	FY2006	FY2007	Notes
1. General Schedule	• 6^{th} FNCA Meeting • 7^{th} FNCA Coordinator Meeting (CRD in Japan)	• 7^{th} FNCA Meeting • 8^{th} FNCA Coordinator Meeting (CRD in Japan)	• 8^{th} FNCA Meeting • 9^{th} FNCA Coordinator Meeting (CRD in Japan)	
2. HRD Workshop	2005 Workshop (Vietnam)	2006 Workshop (China, *To be determine*)	2007 Workshop (Indonesia, *To be determine*)	
1) HRD Strategy Study	HRD Strategy of the WS host country	HRD Strategy of the WS host country	HRD Strategy of the WS host country	Discussion about the WS host country With the participants from policy-maker level and educational orgs
	Study on	**HRD Strategy for Specific case**		Each member country
2) Cooperation with ANENT and other Networks	Study on HRD strategy	& planning, training materials,	active participation	Analysis and discussion
3) Supporting tool Development for HRD Strategy				Revised survey of basic data
• Training Course	Re-survey, update and analysis			Feedback to HRD strategy
• Qualification		Re-survey, update and analysis		
• Educational orgs. (University, Academy)			Re-survey, update and analysis	
3. HRD Activity plans Outside FNCA activities	• Execute of activity plan • JAERI activity on FY2005 Publication of Reports • Update of HRD Web-site	• Execute of activity plan • JAERI activity on FY2006 Publication of Reports • Update of HRD Web-site	• Execute of activity plan • JAERI activity on FY2007 Publication of Reports • Update of HRD Web-site	

Annex-3

Conclusions and Recommendations

1. During the 2004 FNCA HRD workshop, project leaders reviewed historical and current development of nuclear technology in their country. Based on these reviews and future nuclear technology development plants, three drafts of HRD strategy models were proposed:
   - Model 1 – HRD Strategy Model for Countries with Radioisotope and Radiation Applications.
   - Model 2 – HRD Strategy Model for Countries planning to construct Nuclear Power Plants.
   - Model 3 – HRD Strategy Model for Countries operating Nuclear Power Plants.

2. Project leaders shall do a pilot study using the model and present the result at the next workshop. Based on the findings of the pilot study, the models shall be revised and proposed.

3. To implement HRD project more efficiently and effectively, national HRD working group or committee may be set up and sub project (HRD strategy, Training, e-learning) may be formed.

4. HRD basic data collected need to be updated continuously to support HRD strategy development and implementation.

5. Status of ANENT was presented and discussed with the project leaders. The necessity of linkage with ANENT and other networks was suggested for the sustainable development of nuclear science and technology in the region.

6. During the workshop, Project Leaders evaluated the achievement of the FNCA HRD projects. The workshop agreed that the project have been very beneficial to member countries and recommended that it should be continued.

Annex-4

Program of the FNCA 2004 Workshop on Human Resources Development

Renaissance Hotel, Kuala Lumpur, Malaysia
October 4 – 7, 2004

Monday, October 4, 2004

Opening Session

08:30	**Registration** **Opening Ceremony – Joint open ceremony of "FNCA 2004 Workshop on HRD" and "IAEA Training Course on Advanced Management Practices for Commercialization of Services and Technologies from Nuclear Research Institutions"**
09:10	Welcoming Remarks by Dr. Daud Mohamad Director General of the Malaysian Institute for Nuclear Technology Research (MINT)
09:20	Opening Remarks by Ms. Miwako Shimizu Special Staff of MEXT
09:40	Opening Address by Dato's Suriah Abd. Rahman The Secretary General Minister of Science, Technology and Innovation (MOSTI)
09:50	Coffee Break

Open Lecture

10:25 – 11:15	Tan Sri Dr. Ahmad Zaharuddin Idrus Science Adviser to the Prime Minister's Department *"Policies and Programs to Encourage Self-Sustainability in Research Institutions"*
11:20 – 12:00	Dr. Sueo Machi Japanese FNCA Coordinator, Commissioner, Atomic Energy Commission of Japan *"Sustainability of Nuclear Research Institutions and HRD"*
12:05 – 12:45	Mr. Norhalim Yunus General Manager Technology Development Malaysian Technology Development Corporation (MTDC) *"Enablers for Commercialization"*
12:45 – 14:00	Lunch Break

Opening for FNCA 2004 Workshop on HRD

14:00 – 14:20	Introduction of Participants (Include exchange information of the present status in each country)
14:20 – 14:55	Mr. Hideo Matsuzuru (NuTEC, JAERI) *"Review of Past Activities in HRD and the Scope of 2004 WS on HRD"*

Session 1: **Country Report "Review of history of nuclear human resources development and HRD Strategy Modeling"**
- Countries with Radiation Applications -

Chair Person:
China - Mr. Chen Gang (CGNPC)

14:55 – 15:45 (1) Malaysia Ms. Rapieh Aminuddin (MINT)
"Model for HRD Strategy"

15:45 – 16:00 Coffee Break

16:00 – 16:30 (2) Thailand Ms. Warapon Wanitsuksombut (OAP)
"HRD Strategy of Thailand"

16:30 – 17:10 (3) The Philippines Dr. Estrella D. Relunia (PNRI)
"Strategy for the Philippines"

17:10 – 17:40 Dr. Sueo Machi
"Highlights Progress of FNCA Activities and Draft and Proposal FNCA HRD Project Plan"

17:40 – 17:50 **Taking Group Photo**

Tuesday, October 5, 2004

Session 2 : **Country Report (continued)**
- Countries planning to construct Nuclear Power Plants -

Chair Person:
Thailand - Ms. Warapon Wanitsuksombut (OAP)

09:00 – 09:30 (4) Vietnam Mr. Vu Dang Ninh (VAEC)
"Recent HRD Topics in the Nuclear Field and HRD Strategy"

09:30 – 09:50 (5) Indonesia Mr. Karsono (BATAN)
"Review of the Human Resources Development in the Nuclear Field"

09:50 – 10:20 Coffee Break

Session 3 : **Country Report (continued)**
- Countries with operating Nuclear Power Plants -

Chair Person:
The Philippines - Dr. Estrella D. Relunia (PNRI)

10:20 – 11:00 (6) China Mr. Chen Gang (CGNPC)
"Recent HRD Topics in the Nuclear Field and HRD Strategy"

11:00 – 12:00 (7) Korea Mr. Eui-Jin Lee (KAERI)
"Model for the HRD Strategy in the Nuclear Field"

12:15 – 13:15 Lunch Break

Session 4 : **Country Report (continued)**
- Japanese Experience in HRD -
Chair Person:
Indonesia - Mr. Karsono (BATAN)

13:30 – 14:00 (8) Japan Mr. Fumitaka Sugimoto (JAERI)
"Review of HRD in Nuclear Field in Japan"

14:00 – 14:30 (9) Japan Prof. Masanori Aritomi (Tokyo Tech)
"University Education on Nuclear Engineering for Foreign Scientists, Engineers and Students"

14:30 – 15:00 (10) Japan Mr. Yukoh Nakayama (JAPCO)
"History of HRD in Japanese commercial nuclear power plants"

15:00 – 15:30 Coffee Break

Group Session: **Examination of proposal for HRD strategy modeling**

15:30 – 17:30 Subgroup interaction (Formulate models in each group)

20:30 – 22:30 "Welcome Party Jointly Hosted by Malaysia and Japan"

Wednesday, October 6, 2004

Session 5: **Formulating HRD strategy model**
Chair Person:
Malaysia - Ms. Rapieh Aminuddin (MINT)

09:00 – 09:45 Model for countries with operation nuclear power plants

09:45 – 10:00 Model for countries planning to construct Nuclear Power Plants

10:00 – 10:20 Model for countries with Radiation Applications

10:20 – 10:30 General Discussion

10:30 – 10:55 Coffee Break

Session 6: **Nuclear Training Support**
Chair Person:
Vietnam - Mr. Vu Dang Ninh (VAEC)

10:55 – 11:00 Mr. Fumitaka Sugimoto (JAERI)
"Training Support in HRD"

10:40 – 11:05 Ms. Fatimah Mohd Amin (ANENT Spokespoerson)
"Asian Network for Education in Nuclear Technology (ANENT)"

11:00 – 12:00 Ms. Keiko Hanamitsu (JAIF)
"HRD International Network"

12:00 – 13:30 Lunch Break

Session 7: Evaluation Method of FNCA Project Activities

Chair Person:
Japan - Mr. Hideo Matsuzuru (JAERI)

13:30 – 13:40 Rapieh Aminuddin (MINT)
13:40 – 13:50 Warapon Wanitsuksombut (OAP)
13:50 – 14:00 Estrella D. Relunia (PNRI)
14:00 – 14:10 Vu Dang Ninh (VAEC)
14:10 – 14:20 Karsono (BATAN)
14:20 – 14:30 Chen Gang (CGNPC)
14:30 – 14:40 Eui-Jin Lee (KAERI)
14:40 – 15:15 Nobuo Sasamoto (JAERI)
15:15 – 15:30 Coffee Break
15:30 – 17:15 General Discussion

Discussion Session: Future Plan

Chair Person:
Japan - Mr. Hideo Matsuzuru (JAERI)

17:15 – 17:45 Ms. Keiko Hanamitsu (JAIF)
"Proposal on Annual Action Plans for 2004, and Future Action Plans of HRD Project"

17:45 – 18:00 Discussion and Comments on Future Action Plan

<u>Thursday, October 7, 2004</u>

Conclusion Session:

Co-Chair Persons:
Malaysia - Ms. Rapieh Aminuddin (MINT)
Japan - Mr. Hideo Matsuzuru (JAERI)

09:20 – 10:35 Recommendation and Message
10:35 – 10:55 Coffee Break
10:55 – 11:15 Adoption of the Minutes

Closing Session:

Chair Person: MINT

11:15 – 11:25 Rapieh Aminuddin (MINT)
11:25 – 11:35 Hideo Matsuzuru (JAERI)
11:35 – 13:00 Lunch Break

Technical Visit to MINT

14:00 – 17:30 Visit MINT TECHPARK and Training Center

Annex-5

List of Participants

China
Mr. Chen Gang: Deputy Manager
Management Training Center, Human Resources Development
China Guangdong Nuclear Power Holding Co., LTD (CGNPC)

Indonesia
Mr. Karsono: Director
Education and Training Center
National Nuclear Energy Agency (BATAN)

Japan
Dr. Sueo Machi: The FNCA Coordinator of Japan
Commissioner
Atomic Energy Commission of Japan (AEC)

Ms. Miwako Shimizu: Special Staff, Atomic Energy Division
Research and Development Bureau
Ministry of Education, Culture, Science and Technology (MEXT)

Mr. Hideo Matzsuzuru:
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Japan Atomic Energy Research Institute (JAERI)

Prof. Masanori Aritomi:
Professor
Research Laboratory for Nuclear Reactors
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Mr. Yukoh Nakayama: Group Manager
Quality Promoting Group, Corporate Planning Department
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Korea
Mr. Eui-Jin Lee: Manager
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Malaysia
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The Philippines
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Officer-In-Charge
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Philippine Nuclear Research Institute (PNRI)

Thailand
Mr. Warapon Wanitsuksombut:

Senior Radiation Physicist
Bureau of Radiation Safety Regulation
Office of Atoms for Peace (OAP)

Viet Nam

Mr. Vu Dang Ninh: Director
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Vietnam Atomic Energy Commission (VAEC)

Observers (Local Participants)

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Ms. Faridah bt Idris: Research Officer / Manager
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Division of Technical Services, MINT

Secretariat

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Ms. Hazalina bt Abu Yamin:
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Ms. Keiko Hanamitsu: Deputy Manager
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Dr. Nobuo Sasamoto: Instructor
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Nuclear Technology and Education Center, JAERI

Mr. Fumitaka Sugimoto:
Chief
International Technology Transfer Division, NuTEC, JAERI

Ms. Rei Ouchi: Secretariat
International Technology Transfer Division, NuTEC, JAERI

Attachment-2

List of Project Leaders of the FNCA Human Resources Development (HRD)

(as of February, 2005)

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JAERI/NuTEC

Review of Present Status of the Activities in HRD

Hideo Matsuzuru

Nuclear Technology and Education Center
Japan Atomic Energy Research Institute

FNCA Coordinators Meeing 2005 1

JAERI/NuTEC

Human Resources Development

I. Name of the Project:
   Human Resources Development

II. Objective of the Project:
   - Solidify the foundation of technologies for nuclear development and utilize the technologies in Asia by promoting HRD
   - Clarify the issues and needs in HRD to mutually support HRD activities of each country

FNCA Coordinators Meeing 2005 2

JAERI/NuTEC

Specific Results and Outcomes (1)

- **Workshop**
  - Exchange of HRD information
  - Topics
    - Education of nuclear science for younger generations
    - Enhancement of national HRD program
    - Regulations for controlling of radioactive materials and radiation safety, etc.

FNCA Coordinators Meeing 2005 3

JAERI/NuTEC

Specific Results and Outcomes (2)

- **Survey of Needs and Basic Data on HRD**
  - Needs, issues and basic data on HRD have been surveyed and analyzed
  - The result of survey gives fundamental data to be utilized for formulation of a national HRD strategy
- **HRD Strategy Model**
  - Three types of common model of HRD strategy were proposed
  - The models together with basic data on HRD will be utilized for formulation of a national HRD strategy

FNCA Coordinators Meeing 2005 4

JAERI/NuTEC

Achievement from FN2002-2004

- **Specific Social and Economic Impact**
  - Socioeconomic impact is to be achieved through other technical projects.
  - Activities have not led enough impact yet.
  - However they could have an effect if HRD widely provides the base for the development for nuclear field of FNCA.

FNCA Coordinators Meeing 2005 5

JAERI/NuTEC

Specific Results and Outcomes (3)

- **Publications**
  - 5 reports on activities of the HRD workshops (JAERI-Review; 2000~2004)
  - 12 training materials were uploaded to FNCA-HRD Project website
  - 3 textbooks were distributed to member countries (2 from Japan, 1 from Malaysia)
  - 1 CD-ROM for high school students from the Philippines

FNCA Coordinators Meeing 2005 6

JAERI/NuTEC

Evaluation

- **Evaluation Indicator**

  Simple averaging procedure of each country score gives the followings;

  Socio-economic impact _4_ point

  Scientific impact _5_ point

FNCA Coordinators Meeing 2005 7

JAERI/NuTEC

Evaluation (Cont') Project Outlook

- **All countries checked "Continuation"**
- **The reasons for the above decision**
  - 3 types of model of HRD strategy were proposed
  - During the next phase, country's own HRD strategy will be formulated based on the models
  - Mutual support for HRD activities is still beneficial

FNCA Coordinators Meeing 2005 8

Evaluation (Cont')
Ripple Effect to Other Fields

- Cooperation among member countries and mobility of HRD personnel were strengthened by HRD project.
- HRD widely provides the base for the development for nuclear field of FNCA.
- HRD improves basic nuclear science education for younger generation and public acceptance on nuclear fields.

FNCA Coordinators Meeing 2005 9

Evaluation (Cont')
Opinion and proposal

- Continuation of the project to assure proper implementation of the national HRD strategy
- High priority for HRD of core personnel
- Set-up of national HRD working groups for specific items
- Two-representative of each country to enhance HRD activities
- Strengthen of linkages with ANENT, IAEA/RCA, IAEA/EBP, ENEN, WNU and so on

FNCA Coordinators Meeing 2005 10

Closing Session
Doc-CS-1

2.1.2 Record of the Sixth FNCA Coordinators Meeting

March 30- April 1, 2005, Tokyo, Japan

April 1, 2005

1. Session 1

The Sixth Coordinators Meeting (CM) was held from March 30 through April 1, 2005 in Tokyo, Japan, hosted by the Atomic Energy Commission (AEC) of Japan and Cabinet Office (CAO) of Japan.

Dr. Sueo Machi, the Commissioner of Atomic Energy Commission of Japan (and FNCA Coordinator of Japan) gave the welcome remarks at the Opening Session.

The Meeting was participated in by delegates from FNCA countries, i.e., Australia, the People's Republic of China, Indonesia, Japan, the Republic of Korea, Malaysia, the Philippines, Thailand and Viet Nam. ***(Attachment 1)***

The program of the Meeting is given to ***Attachment 2***.

2. Session 2

In Session 2, Professor Vuong Huu Tan, Chairman of Vietnam Atomic Energy Commission and the FNCA Coordinator of Vietnam gave a summary report of the Fifth FNCA Meeting in Hanoi, Viet Nam (Ministerial Level Meeting and Senior Officials Meeting) ***(Attachment 3)***. The Sixth Coordinators Meeting took note of the report.

3. Session 3: Progress of New Activities

In Session 3, progress of two new activities was reported namely: the Panel on "Role of Nuclear Energy for Sustainable Development in Asia" and the project on "Cyclotron and PET (Positron emission tomography) in Medicine".

Dr. Machi reported the results of the 1st Meeting held on October 20- 21, 2004 in Tokyo. The Panel was composed by the nuclear experts and energy experts. He emphasized that the Panel clearly noted that the demand will rapidly increase in the future while the per capita reserve of fossil fuel is at the lowest level in the region of FNCA countries.

The 6th Meeting agreed that the formulation of strategy for energy supply in long term is of importance.

China stated that nuclear power capacity will be predictably expanded to 36-40GW with power capacity doubled to 900GW by 2020.

Korea stated that 19 nuclear power units are in operation and 8 units will be added before 2015 to meet increasing demand.

Malaysia, the Philippines and Thailand stated that there is no definite plan to use nuclear power in the near future and nuclear power is the last option. These countries have other energy resources such as fossil fuel, hydro power, and geothermal energy.

Indonesia stated that the recent price increase of oil might trigger the recognition of benefit of nuclear power, and that his government has a plan to construct the 1st NPP in the second decade of this century among other to save oil reserve.

Viet Nam stated that his government has completed pre-FS on the 1st NPP hoping to start operation before 2018 in order to meet the rapidly increasing power demand.

Australia stated that media in his country are recently discussing the benefits of nuclear power in terms of CO_2 after the Kyoto Protocol entered into force in Feb., 2005 and after the potential sale of the Olympic Dam mine, which has the world's largest known reserve of uranium.

China and Indonesia stressed that the CDM of Kyoto Protocol should include nuclear power because it can provide energy without emission of GHG. They also pointed out that the FNCA can be a forum to appeal COP to include nuclear power in CDM. Viet Nam, Korea and Japan supported the suggestion.

FNCA Coordinator of Japan stated that 4 years ago the same issue was discussed at the FNCA Ministerial Level Meeting without reaching consensus. However, circumstance has changed in terms of rapid increase of energy demand and the Kyoto Protocol entered into the force. Therefore the time is matured to discuss this question again to reach consensus. The Panel on "Role of Nuclear Energy for Sustainable Development in Asia" provides excellent forum to exchange views on this point and to report the Panel's conclusion to the Ministerial Level Meeting for its appropriate action to appeal for the inclusion of nuclear power in CDM.

Mr. Adnan Haji. Khalid of Malaysia made presentation on the new "cyclotron and PET in medicine" project. He reported on the revised title of the project, the objectives, component of the project and new plan as modified with the cooperation of the Japanese expert mission to Malaysia. The project will start in FY2005 with national workshop. Dr. Endo, project leader of Japan explained the project from the technological viewpoint.

CT, using X-ray, show the anatomy image. While PET show the physiology and metabolism image. PET using of 18F-FDG is useful for several cases of cancer diagnosis such as the detection of early cancer, the staging of the disease, the evaluation the response to therapy and the knowing the recurrence and prognosis.

Current status on the application of cyclotron and PET in medicine in Viet Nam,

Thailand, the Philippines and Malaysia was presented. Viet Nam has already installed PET camera and cyclotron in private hospital, and has another plan to install in Hanoi and Ho-Chi Minh city respectively next year.
Thailand has an on-going national project of PET in cooperation with the IAEA. Government has a plan of PET and Cyclotron center in Bangkok.
The Philippines has been operating a medical cyclotron and PET for the past three years, and would be willing to share her experiences in licensing and regulation of the cyclotron, and in the diagnosis and treatment of cancer and other pertinent diseases.
Malaysia has installed the first PET-CT in Penang recently and will have the first cyclotron facilities by the end of 2005. In addition a National Cancer Institute will be established very soon in Putrajaya.
(Attachment 4).

4. Session 4: Human Resources Development

In Session 4, Human Resources Development was dealt with to follow up the discussion on HRD at the Fifth FNCA Ministerial Level Meeting in Hanoi, Viet Nam on 1 December 2004. During the Ministerial Level Meeting it was agreed that the proposal of Viet Nam on the Asian Nuclear University (ANU) should be carefully studied at the Senior Level Meeting.

In answer of this Ministerial action, Prof. Tan presented possible scheme and an action plan for the establishment of the ANU. He cited the difficulties for assuring the quality of nuclear HRD in FNCA countries due to inadequate teaching materials, obsolete curricula, qualified teachers and lack of laboratory infrastructures. The following scheme was to build a network of nuclear universities in Asia within the FNCA framework. Prof. Tan proposed the following action plan: organization of the first meeting for the FNCA nuclear university, set up a peer review mission, exchange curricula and teaching materials, mobilize all possible financial supports for nuclear HRD activities. ***(Attachment 5)***

The Meeting agreed that a) nuclear HRD is essential for sustainable development, b) each country should come up with its own nuclear HRD plan according to its own national agenda, c) to organize an expert mission to examine the needs and to propose the possible mechanism of implementation, d) to submit the expert mission report to the HRD project workshop, e) the HRD project workshop should prepare the specific action plan to be presented to the Senior Officials Meeting (SOM) ,f) SOM to make recommendation after careful review to the Ministerial Level Meeting for decision.

Dr. Soedyartomo Soentono of Indonesia suggested that the project should start as small in specific area such as standardization of curricula particularly on nuclear safety and radiation, in accordance with international standards.

5. Session 5: Future Cooperation under the FNCA

Dr. Machi as the lead-off speaker made presentation on policy and program of FNCA in the future. Among other things, he stressed on the following points:

1) Future activities of FNCA should be designed to meet the needs and interest of the member countries and the need to have close linkage with; the end-users

2) Selected policy issues of common areas of interest should be taken up for discussion at the Ministerial Level Meeting;

3) Member countries should contribute more to the FNCA project such as to host the project activities and to share facilities;

4) Better synergy between FNCA activities and other regional activities such as RCA and IAEA;

5) The important role of coordinators to have closer communication with project leaders and linkages with the end-users.

The Meeting agreed with the above points and stressed that the selection of the project should be in accordance with the priority area of the country and in implementing the national agenda so that the project will benefit end-users and the public at large. All the participating countries have offered to share their facilities for the FNCA projects.

Session 6: Progress, Evaluation and Planning of FNCA Projects

8 out of 11 on-going FNCA projects which have been implemented for the past 5 years were reviewed and evaluated.

1. Utilization of Research Reactors
<Tc-99m Production>
Dr. Tsuguo Genka, project leader of Japan gave overview on the progress and achievements of the project. He reported that:

1) the technology of PZC-based Tc-99m generator has been successfully established,
2) the clinical trial of radiopharmaceutical kits labeled with Tc-99m from PZC-based Tc-99m generator are comparable with fission type generator, and
3) cost estimation for PZC type Tc-99m generator is much lower than fission type generator.

The Meeting was briefed on the situation with regards to Japanese and Indonesian patents related to the PZC based Tc-99m generator and associated systems. The Meeting agreed that the project has achieved its objectives to demonstrate usefulness of new technology to produce Tc-99m generator by (n, gamma) reaction. Therefore the current project should be terminated in the current year.

For future plan, the Meeting agreed to embark on new phase to commercialize the application of the technology. However, as not all FNCA countries has the capacity to produce Mo-99 on their own, it is essential for FNCA to establish a reliable network of supplier countries to ensure continuous supply of Mo-99. The Meeting agreed to start the new phase in FY2005 and to be completed within two years.

<Neutron Activation Analysis (NAA)>

Dr. Mitsuru Ebihara, Project Leader of Japan made a presentation of the progress and achievements of the project. He reported that the NAA Ko-method technique has been successfully applied for the analysis of suspended particulate matter (SPM) for monitoring the environmental pollution level in the FNCA countries.

The Meeting however took note that the objective of the project has not been fully achieved due to insufficient linkage with the environmental agencies to use the NAA data. For the future plan, the Meeting agreed that the current project is to be terminated in FY2004 and a new project on "Monitoring Environmental Pollution by NAA for Environmental Protection Strategy" will be initiated. In this regard, all countries are requested to establish strong linkages with their environmental agencies to ensure that the project will be carried out based on the actual need of the authority.

< Neutron Scattering (NS)>
Dr. Yukio Morii, Project Leader of Japan made presentation on the progress and achievements of the project. He reported that SANS technique has been successfully carried out for structural analysis of natural polymer such as k-carrageenan and NR-TPE for medical, biological and industrial applications.

The Meeting took note that advanced SANS facilities are currently available only in certain member countries such as Australia, China, Indonesia, Japan, and Korea. For future plan, the Meeting agreed to suspend the project until some of the new high flux research reactors such as in Australia, China and Thailand become available. In the meantime, existing mechanism such as MEXT scientist exchange program could be used to support SANS activity. In addition, communication and contact should continue among the relevant scientist involved in SANS project. The Meeting also agreed that efforts should be made to know the actual needs of industry that might be addressed by SANS technology and also to explain to them what SANS could offer to help and solve their problems.

Proposal on "Enhancement of Research Reactor Technology for Effective Utilization" was accepted.

2. Agricultural Application
<Mutation Breeding (MB)>
Dr. Hitoshi Nakagawa, Acting Project Leader made a presentation on the progress and

achievements of the project.

The drought tolerant sorghum mutant lines have been successfully developed, one of which has been registered in China. The sorghum project will be extended for another two years to achieve the registration of additional new mutant varieties and to formulate extension strategies.
Malaysia and Thailand accepted the roles of leading countries for the Banana Sub-project and the Orchid Sub-project, respectively. These two sub-projects need 2-4 more years to achieve their objectives.
Since mutation breeding takes several years before mutant varieties are developed, Dr. Machi suggested that milestones be set up at important steps in phase of the project.
Korea announced its intention to join the project again and to share the related facilities. The Meeting welcomed the offer of Korea. The mutation breeding manual, edited by the Philippines and Japan was completed and published in FNCA website (http://www.fnca.jp/mb/mbm/mbm.html).

<Biofertilizer (BF)>
Dr. Tadashi Yokoyama, Project Leader of Japan presented the progress and achievements of the project which commissioned in 2002 as follow.
a) selection of effective microorganisms, b) improvement of inoculant, c) improvement of soil microbial activities. Most countries have conducted field trails/ demonstrations which confirmed the effectiveness of BF for many types of plants. The effectiveness of 15-55 kGy irradiation for carrier sterilization was demonstrated by China, Indonesia, Malaysia, Thailand and Viet Nam. A fertilizer cost benefit analysis conducted by the Philippines, Thailand and Viet Nam indicated increased economic returns to the farmer with the application of BF.

Dr. Omsub Nopamornbodi, BF expert from Thailand presented a paper on the status and future of BF application in Thailand.

3. Application of Radioisotopes and Radiation for Medical Care
< Radiation Oncology (RO)>
Dr. Tsujii, Project Leader of Japan made a presentation on the progress and achievements of the project. He reported that standardized protocol of radiation therapy in uterine cervical cancer (CERVIX-I) was established and published in 2003 for dissemination and training. The protocol for accelerated hyper-fractionated radiotherapy (CERVIX-II) has been clinically tested and has an overall survival rate of 77% which is higher than that of CERVIX-I. QA/QC dosimetry audits of brachytherapy have been undertaken in the Philippines, Thailand, Viet Nam, Korea and Japan by a group of experts from FNCA countries in 2003 and 2004. The audit results indicated that QA/QC of these countries are within the acceptable range.

The project should be continued until 2006 for testing a new clinical protocol using chemo-radiotherapy (CERVIX-III). A new activity will be the design and clinical testing of protocol in head and neck cancer which is also common in FNCA countries. The QA/QC audit brachytherapy will be conducted in Malaysia, China and Indonesia.

4. Nuclear Safety Culture (NSC)
Dr. John Easey of Australia made a presentation on the progress and achievements of the project. He reported on the peer review of research reactors safety culture carried out in Viet Nam, and Korea and on the improvements to be made to enhance safety culture.

He also reported on the bilateral meeting between Australia and Japan in March 2005 to enhance Safety Culture. The Meeting took note of the need for the establishment of a strong independent regulatory body is a necessary first step towards a strong safety culture.

For future activities, the Meeting took note that Indonesia has agreed to host the Nuclear Safety Culture workshop in 2005 in Yogyakarta.

The Meeting also agreed that the project on Safety Culture should be continued as there should be no compromise on safety issue. The Meeting took note of the recent initiative by Australia on safety and security of nuclear and radiation facilities. It agreed that the aspect of security should be dealt separately from the nuclear safety project.

5. Public Information of Nuclear Energy (PI)
Dr. Y. Tanaka, Project Leader of Japan presented the progress and achievements of the project. The Meeting agreed 1) the enhancement of communication with media, and training nuclear communicators are important activities of the PI project, 2) RSB should be continued to be better utilized by FNCA countries for their PI activities.

Japan suggested that achievement of FNCA activities and its social impacts should be informed to public and media in each country.

Dr. Machi stressed that media, public, and opinion leaders should be invited to nuclear research institutes and nuclear power plants for them to better understand safety assurance and benefits of nuclear applications.

A proposed joint survey on "the role of nuclear energy in terms of environmental impact and energy security" will be examined at the forthcoming PI Project Leaders Meeting to be held in Japan in the Fall of 2005. With these comments, the Meeting agreed that the project will be continued following the proposed future plan.

6. Human Resources Development (HRD)
Mr. Matsuzuru, Project Leader of Japan reported the progress and achievements of the project. The Meeting noted that the HRD strategy should be formulated in accordance with nuclear program of each country, and FNCA would support appropriately.

It was agreed that the national nuclear HRD plan should be demand-driven and possible contribution of each country to the project should be defined to be integrated in overall FNCA HRD plan.

Dr. Machi reiterated that the next HRD workshop should be devoted to preparation of specific mechanism and action plan for the proposed Asian Nuclear University (ANU) to be reviewed by the next SOM in Nov. or Dec. 2005. With these comments, the Meeting agreed to continue the project in view of the importance of HRD.

7. Industrial Application, Electron Accelerator (EB)
Dr. Kume, Project Leader of Japan made a presentation on the progress and achievements of the project and proposed the plan in 2005. He reported on the application of low energy EB accelerator for liquids solids, and gases and potential application of this technology.

Dr. Mao of ENTECH, China presented a paper on "Industrial Application of EB for Flue Gas Cleaning in China". He shared the information on the construction cost of the flue gas cleaning facility for 300MW coal burning power plant is about USD 200million in China.

The Meeting agreed that this project should make technical and economic assessment of EB application for the specific processing such as natural polymers, waste water treatment and flue gas in the workshop in 2005.

8. Radioactive Waste Management (RWM)
Dr. Kosako, Project Leader of Japan made a presentation on the progress and achievements of the project. The Meeting noted good achievements of TENORM Task Group in 2003 and 2004 and spent radiation sources.

The Philippines expressed a wish to host a meeting to discuss waste management safety and security as proposed at the Ministerial Level Meeting in Viet Nam in 2004.

The Meeting agreed to organize the Project Workshop in the Philippines including a major agenda item of safety and security of the waste management. With these comments, the Meeting agreed the project will be continued following the proposed future plan.

The Philippines voted the importance of this workshop and requested countries to provide where possible additional resources and enhance the value of the outcomes.

Attachment 6.

7. Wrap-up Session

In the Wrap-up Session, the drafted minutes of the 6th CM was discussed by the delegates.

8. Closing Session

In the Closing Session, the Minutes of the 6th CM was adopted by the delegates. Dr. Machi gave the closing remarks, and officially closed the Sixfth FNCA Coordinators Meeting.

END

2.2 Document from Project Leader of Japan to Project Leaders of Participating Countries

2.2.1 Request for Country Report for FNCA 2004 HRD WS

The presentations of HRD strategy based on 'Survey of the basic data' were made in the last WS in 2003, however, discussion could not be focused due to the lack of definition and common recognition of 'HRD strategy'.

'Model Method' for formulation of HRD strategy was proposed in the last WS, and was stated in the attachment of Minutes on FNCA 2003 HRD WS, Conclusions and Recommendations. To seek the Model according to the proposal, we made a diagram on historical development in early stages of nuclear development in Japan ('50s ~ '60s), and further review into details will be done for diverse analysis. This historical review could be useful for making discussion frameworks, and also could be a new source of perspective on the Model. 'Survey of the basic data on HRD' consists of data from 2002 to 2004, and those data were 'static' data for a certain year. It was difficult to analyze the trend by the survey data. In fact, it should be 'dynamic' analysis, such that how many and what kinds of human resources are needed with what purposes and by when.

Followings are steps to formulate of the strategy modeling that we would like to propose. (1) Review the history of nuclear human resources development in your country, establish a framework for discussion, and propose factors needed for strategy. (2) Recognize the current situation of needs on human resources based on nuclear development policy in your country. (3) Compare the actual state, which was clarified by the needs recognition, with the result of 'Survey of the basic data', and identify the shortfall of human resources in your country.

Although the purpose of 'Survey of the basic data' was to formulate HRD strategy in each country, there were some difficulties in policy discussion. Therefore, it could be meaningful to provide the Model as an essential feature of HRD strategy for now. The Model will be flexibly utilized depending on the national policy of each country in the future.

The purpose of the FNCA 2004 Workshop on HRD is to provide the Model to formulate of the HRD strategy in each country by sharing experiences and precedents.

To promote our discussion in the WS as stated above, we would like to request you to submit your country report on the theme given in the following 'Theme of the country report'.

2.2.2 Theme of Country Report

1. Recent topics in the nuclear field and related HRD in your country.

2. Historical review of experiences of HRD in the nuclear field corresponding to the stages of nuclear development in your country. Especially clarify the factors which may lead to a lively discussion on the strategy modeling.

3. HRD strategy or the Model as the way of formulating HRD strategy.
   In case of providing the Model, follow items below to make the WS discussion efficient and meaningful with comparable country reports/presentations with the same foundation. Choices and items can be increase and decrease to fit the situations of your country.

   (1) Policy targets of nuclear development in the coming 10 or 20 years in your country. The followings are examples.
      ① Introduction of Nuclear Power Plants. How many NPPs and how much scale, if any. Which is your final target? Development myself or introduce foreign techniques.
      ② Scale of radiation applications for medical and agricultural areas
      ③ Others

   (2) In connection with (1), what kinds of, how many personnel will be needed to achieve the policy targets? The followings are examples.
      ① Specialists and engineers in the nuclear field
      ② Specialists and engineers in the related fields, e.g. Material science, Electric engineering, Mechanical engineering, and so on.
      ③ Specialists in radiation application
      ④ Safety managers of radiation

   (3) In connection with (2), how many personnel will be needed comparing the actual state based on 'Survey data' with your answers for (2)? By when the needs to be achieved?

   (4) In connection with (3), what measure will be needed to cover shortfall of human resources? The followings are examples.
      ① Overseas study: To where? Reason of choice of country? How many

students?

② Public educational institutions: Enhanced training courses are available?

③ Private educational institutions: Enhanced training courses are available?

④ Universities: Any cooperation with outside institutions or private company?

⑤ Associations and societies: Any cooperation with outside institutions or private company?

⑥ Law and Qualification system

⑦ Administrative system

(5) Proposal for securing interested excellent students to contribute to the nuclear field

(6) Issue and solution

4. Mutual support and others

(1) Request and Proposal on education and training of young generation with linkage between FNCA and Asian Network for Higher Education in Nuclear Technology (ANENT).

(2) Investigation of training materials in CD ROM for the purpose of introduction and utilization of e-learning system

(3) Review and comments on the training materials newly posted in the website of FNCA-HRD Project http://www3.tokai.jaeri.go.jp/nutec/fnca/fnca.htm

- List of International and Domestic training courses to be held in 2004

5. "Estimation of FNCA HRD Project" provided by JAIF

6. Request and Proposal on HRD Project and its development

① Way of using the Model

② Development of HRD Project

③ Expectation of FNCA support

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国際単位系 (SI) と換算表

表1　SI基本単位および補助単位

量	名　称	記　号
長　さ	メートル	m
質　量	キログラム	kg
時　間	秒	s
電　流	アンペア	A
熱力学温度	ケルビン	K
物質量	モル	mol
光　度	カンデラ	cd
平面角	ラジアン	rad
立体角	ステラジアン	sr

表2　SIと併用される単位

名　称	記　号
分，時，日	min，h，d
度，分，秒	°，′，″
リットル	l，L
トン	t
電子ボルト	eV
原子質量単位	u

$1\ eV = 1.60218 \times 10^{-19}\ J$
$1\ u = 1.66054 \times 10^{-27}\ kg$

表5　SI接頭語

倍数	接頭語	記　号
10^{18}	エクサ	E
10^{15}	ペタ	P
10^{12}	テラ	T
10^{9}	ギガ	G
10^{6}	メガ	M
10^{3}	キロ	k
10^{2}	ヘクト	h
10^{1}	デカ	da
10^{-1}	デシ	d
10^{-2}	センチ	c
10^{-3}	ミリ	m
10^{-6}	マイクロ	μ
10^{-9}	ナノ	n
10^{-12}	ピコ	p
10^{-15}	フェムト	f
10^{-18}	アト	a

表3　固有の名称をもつSI組立単位

量	名　称	記号	他のSI単位による表現
周波数	ヘルツ	Hz	s^{-1}
力	ニュートン	N	$m \cdot kg/s^2$
圧力，応力	パスカル	Pa	N/m^2
エネルギー，仕事，熱量	ジュール	J	N·m
工率，放射束	ワット	W	J/s
電気量，電荷	クーロン	C	A·s
電位，電圧，起電力	ボルト	V	W/A
静電容量	ファラド	F	C/V
電気抵抗	オーム	Ω	V/A
コンダクタンス	ジーメンス	S	A/V
磁束	ウェーバ	Wb	V·s
磁束密度	テスラ	T	Wb/m^2
インダクタンス	ヘンリー	H	Wb/A
セルシウス温度	セルシウス度	℃	
光束	ルーメン	lm	cd·sr
照度	ルクス	lx	lm/m^2
放射能	ベクレル	Bq	s^{-1}
吸収線量	グレイ	Gy	J/kg
線量当量	シーベルト	Sv	J/kg

表4　SIと共に暫定的に維持される単位

名　称	記　号
オングストローム	Å
バーン	b
バール	bar
ガル	Gal
キュリー	Ci
レントゲン	R
ラド	rad
レム	rem

$1\ Å = 0.1\ nm = 10^{-10}\ m$
$1\ b = 100\ fm^2 = 10^{-28}\ m^2$
$1\ bar = 0.1\ MPa = 10^5\ Pa$
$1\ Gal = 1\ cm/s^2 = 10^{-2}\ m/s^2$
$1\ Ci = 3.7 \times 10^{10}\ Bq$
$1\ R = 2.58 \times 10^{-4}\ C/kg$
$1\ rad = 1\ cGy = 10^{-2}\ Gy$
$1\ rem = 1\ cSv = 10^{-2}\ Sv$

(注)

1. 表1－5は「国際単位系」第5版，国際度量衡局 1985年刊行による。ただし，1 eVおよび1 uの値はCODATAの1986年推奨値によった。
2. 表4には海里，ノット，アール，ヘクタールも含まれているが日常の単位なのでここでは省略した。
3. barは，JISでは流体の圧力を表わす場合に限り表2のカテゴリーに分類されている。
4. EC閣僚理事会指令ではbar，barnおよび「血圧の単位」mmHgを表2のカテゴリーに入れている。

換　算　表

力	$N(=10^5 dyn)$	kgf	lbf
	1	0.101972	0.224809
	9.80665	1	2.20462
	4.44822	0.453592	1

粘　度　$1\ Pa \cdot s(N \cdot s/m^2) = 10\ P$(ポアズ)$(g/(cm \cdot s))$

動粘度　$1\ m^2/s = 10^4 St$(ストークス)(cm^2/s)

圧力	MPa(=10 bar)	kgf/cm^2	atm	mmHg(Torr)	lbf/in^2(psi)
	1	10.1972	9.86923	7.50062×10^3	145.038
	0.0980665	1	0.967841	735.559	14.2233
	0.101325	1.03323	1	760	14.6959
	1.33322×10^{-4}	1.35951×10^{-3}	1.31579×10^{-3}	1	1.93368×10^{-2}
	6.89476×10^{-3}	7.03070×10^{-2}	6.80460×10^{-2}	51.7149	1

エネルギー・仕事・熱量	$J(=10^7 erg)$	kgf·m	kW·h	cal(計量法)	Btu	ft·lbf	eV
	1	0.101972	2.77778×10^{-7}	0.238889	9.47813×10^{-4}	0.737562	6.24150×10^{18}
	9.80665	1	2.72407×10^{-6}	2.34270	9.29487×10^{-3}	7.23301	6.12082×10^{19}
	3.6×10^6	3.67098×10^5	1	8.59999×10^5	3412.13	2.65522×10^6	2.24694×10^{25}
	4.18605	0.426858	1.16279×10^{-6}	1	3.96759×10^{-3}	3.08747	2.61272×10^{19}
	1055.06	107.586	2.93072×10^{-4}	252.042	1	778.172	6.58515×10^{21}
	1.35582	0.138255	3.76616×10^{-7}	0.323890	1.28506×10^{-3}	1	8.46233×10^{18}
	1.60218×10^{-19}	1.63377×10^{-20}	4.45050×10^{-26}	3.82743×10^{-20}	1.51857×10^{-22}	1.18171×10^{-19}	1

1 cal = 4.18605 J (計量法)
= 4.184 J　(熱化学)
= 4.1855 J (15 °C)
= 4.1868 J (国際蒸気表)

仕事率　1 PS (仏馬力)
= 75 kgf·m/s
= 735.499 W

放射能	Bq	Ci
	1	2.70270×10^{-11}
	3.7×10^{10}	1

吸収線量	Gy	rad
	1	100
	0.01	1

照射線量	C/kg	R
	1	3876
	2.58×10^{-4}	1

線量当量	Sv	rem
	1	100
	0.01	1

(86年12月26日現在)

The 2004 Activities and the Workshop of the Human Resources Development Project in Fnca (Contract Research)

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