

## Comparative Study of National Nuclear HRD Policy between Korea and Japan

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### 1. Introduction

#### 1.1. Science & technology policy and HRD

Policy can be defined as an objective which shall be completed in order to solve the problems and a guideline of implementation to realize the objective [1]. In addition, generally speaking, science & technology policy can be defined as systematic research about science and technology having impact on society and economics. In science & technology policy, science, technology and technological innovation have close relations each other and these words cannot be discussed independently or separately since they have dependent characteristics [2].

Education has been thought as one of policy instrument for innovation of science and technology [3]. It has been asked for science & technology HRD policy to set up positive feedback system: <sup>1</sup>talented students selection based on future human resource demand and supply projection, <sup>2</sup>education and training, <sup>3</sup>securing job stability, <sup>4</sup>strong support in order to generate outperforming research result, <sup>5</sup>incentive on outperforming research result, <sup>6</sup>life above poverty line after retirement, <sup>7</sup>talented students inflowing to the field of science and technology. Science & technology HRD policy can be discussed in general with assumption that government shall intervene in science & technology job market in case it has been concerned that science and technology job market is going to be not functioning in working order and it is expected to have serious impact in the national [4].

#### 1.2. Distinctiveness of Nuclear Energy in Science & technology HRD Policy

In Republic of Korea, nuclear energy takes about 30% of total electricity generation and has been base-load energy source for decades. Due to distinctiveness of nuclear energy: major power source in peace and military application in war, national nuclear HRD plan has been one of major pillars in Comprehensive Nuclear Energy Promotion Plan (CNEPP) with strong justification that the Government shall encourage young and talented students to go to nuclear R&D field for stable and sustainable research environment.

Recently, there are several issues in nuclear industry: 4<sup>th</sup> generation Nuclear Power Plant (NPP) development, NPP exports, and strengthened nuclear safety guideline after Fukushima Daiichi NPP accidents. To cope with

current issues in nuclear industry, it has been considered that comparative case study of national nuclear HRD policy can be effective methodology for future policy design since Korea is not only country facing the issues above but also advanced countries like Japan.

In this paper, Korean and Japanese nuclear HRD policy have been compared and analyzed by comparative study methodology proposed by J. Mill: method of agreement and method of difference. It has been set to comparable factors in the Study: <sup>1</sup>Nuclear R&D Policy-Making Process, <sup>2</sup>HRD plan in nuclear R&D policy.

### 2. Comparative Study of Nuclear HRD Policy

#### 2.1. Nuclear R&D Policy-Making Process

In Korea, Atomic Energy Commission (AEC) is composed on the ground of the Atomic Energy Promotion Act which separated from Atomic Energy Act in 2011. Atomic Energy Commission in which Prime Minister is chaired is obliged to make Comprehensive Nuclear Energy Promotion Plan (CNEPP), the primary mater plan, every five years which covers visions, objectives and action plans of nuclear R&D, utilization, HRD, and so on. Based on CNEPP, the Nuclear R&D Plan, the secondary master plan, is made every five years to accomplish CNEPP. Annual Nuclear R&D Project Plan follows up after the Nuclear R&D Plan.

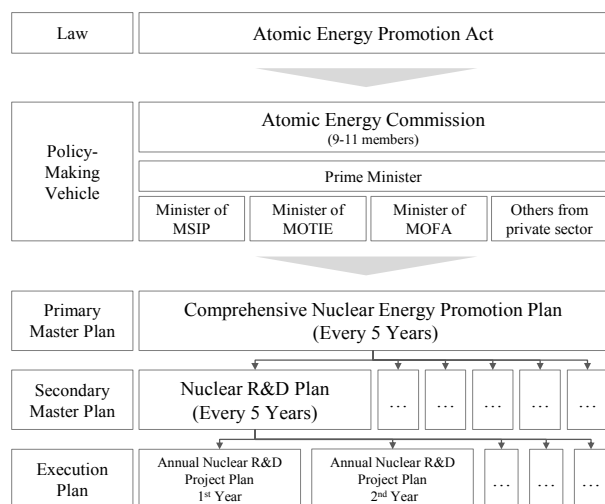


Fig. 1. Nuclear R&D Policy-Making Process in Korea

In Japan, Japan Atomic Energy Commission (JAEC), an advisory group under the Cabinet Office has been set up in 1956 and it has authority of planning, deliberation, and decision of nuclear R&D, utilization and HRD policy (except nuclear safety and regulation). JAEC runs weekly regular meeting and discuss about making basic concept of nuclear R&D, utilization, HRD, making nuclear related budget allocation plan and planning, considering, and decision making of coordinating nuclear R&D and utilization. Based on the recommendations and guidelines initiated by JAEC, Ministry of Education, Culture, Sports Science, and Technology (MEXT), Ministry of Economy, Trade and Industry (METI), and other related Ministries make R&D and HRD plans. There are advisory groups sponsored by each Ministry which perform policy proposals, ongoing R&D and HRD projects evaluation and so on. Nuclear Science & Technology Committee under MEXT is one of examples.

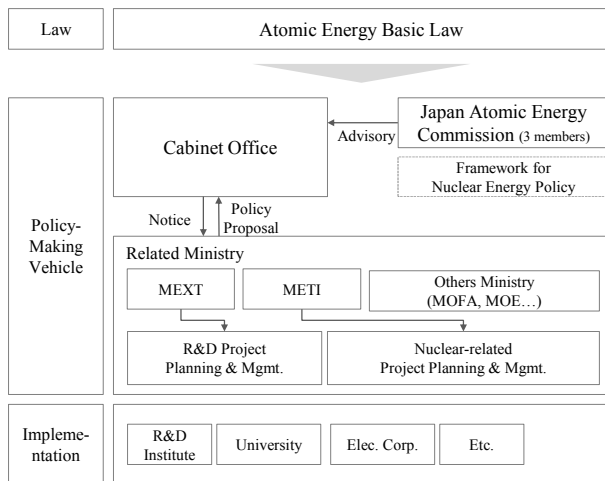


Fig. 2. Nuclear R&D Policy-Making Process in Japan

As we compare a framework of Atomic Energy Commission (AEC) in Korea and Japan Atomic Energy Commission (JAEC), it can be said that both countries enacted *Nuclear Law* for promoting nuclear R&D, utilization and human resource development and each government involved deeply when it developed long-term master plan of R&D and utilization.

Country	Korea	Japan
Name	Atomic Energy Commission (AEC)	Japan Atomic Energy Commission (JAEC)
Scope of authority and function	<ul style="list-style-type: none"> <li>-Comprehensive adjustment for nuclear R&amp;D plan</li> <li>-Commission led by Prime Minister</li> <li>-Authority to request information and attendance on meeting from relevant Ministry and experts.</li> </ul>	<ul style="list-style-type: none"> <li>-Decision-making for nuclear R&amp;D plan (Except for safety regulation)</li> <li>-Report decisions to Prime Minister as an advisory organization from Cabinet Office.</li> <li>-Authority to request information from relevant Ministry in case of needed</li> </ul>
Agenda	<ul style="list-style-type: none"> <li>-Integration and coordination about the utilization of nuclear energy</li> <li>-Making comprehensive plan</li> </ul>	<ul style="list-style-type: none"> <li>-Planning and making a decision about basic policies and strategies for the promotion of R&amp;D and utilization of nuclear</li> </ul>

	<ul style="list-style-type: none"> <li>for promotion of nuclear energy</li> <li>-Making Estimation and allocation plans of nuclear-related budget</li> <li>-Promoting experimentation and research about the utilization of nuclear energy</li> <li>-Fostering and training of researchers, engineers and technicians for the utilization of nuclear energy</li> <li>-Managing radioactive wastes disposal plan</li> <li>-Managing spent fuel disposal plan</li> </ul>	<ul style="list-style-type: none"> <li>energy</li> <li>-Making Estimation and allocation plans of nuclear-related budget</li> </ul>
Commission member and Term	<ul style="list-style-type: none"> <li>-Total number : 9~11 (Commission Chairman, Official member(4), commissioned member from public sector (4~6))</li> <li>-Chairman : Prime Minister</li> <li>-Official member : Minister of MSPI, MOTIE, MOFA,</li> <li>-Term : 3year</li> <li>-Advisory Committee &amp; Working Group can be established for technical support</li> </ul>	<ul style="list-style-type: none"> <li>-Total number : 3 (Commission Chairman, Deputy Chairman, and one member)</li> <li>-Member of Commission appointed by Prime minister with National Assembly agreement</li> <li>-Term : 3year</li> <li>-Advisory Committee &amp; Working Group can be established for technical support</li> </ul>
Meeting	<ul style="list-style-type: none"> <li>-Held by chairman as-needed with condition of over 50% of member's attendance</li> </ul>	<ul style="list-style-type: none"> <li>-Once a week</li> </ul>
Advisory committee	<ul style="list-style-type: none"> <li>-Member : Within 25 participants including Committee president and part-time member of committee</li> <li>-Term : Not Decided</li> </ul>	<ul style="list-style-type: none"> <li>-Member : Within 25 participants appointed by Prime Minister</li> <li>-Term: 2years</li> </ul>
Transcript of Meeting	<ul style="list-style-type: none"> <li>-Not open to the public</li> </ul>	<ul style="list-style-type: none"> <li>-Available on the websites</li> </ul>
Others	<ul style="list-style-type: none"> <li>-Commission should notice CNEPP (Primary Master Plan) to relevant Ministries</li> <li>-The Ministries should establish Secondary Master Plan in alignment with CNEPP</li> <li>-Annual Execution Plan would be made based on Secondary Master Plan</li> </ul>	

Fig. 3. Comparison between Atomic Energy Commission in Korea and Japan

## 2. 2. Nuclear HRD plan in National R&D Policy

Korean Government has been making CNEPP since 1999 and CNEPP guides overall direction of nuclear R&D and HRD for promoting nuclear utilization. Since nuclear science is classified "Big Science" which requires interdisciplinary fusion and sustainable human resource management, nuclear HRD plan has been a one of major pillars in the long-term master plans since 1<sup>st</sup> CNEPP [5].

Comparing CNEPPs by using time-series analysis, it appears that HRD policy in 1<sup>st</sup> CNEPP and 2<sup>nd</sup> CNEPP were more focused on securing nuclear human resource from other engineering field and overseas. However, as time goes by, the government HRD policy has been shifting from quantity securement issues to quality improves issues like manpower globalization. It is closely related to domestic nuclear power plant (NPP) construction and nuclear technology exports such as

UAE NPP exports and Jordan research reactor exports [6].

Before 2009, human resource scarcity in engineering field prevails due to unattractive wages and work environments. (Supply Factor) In addition, there was growing human resource demand for domestic nuclear power plant construction. (Demand Factor) Therefore, it was top-class priority in nuclear HRD policy to secure talented and competitive human resource for nuclear R&D and utilization field.

After 3<sup>rd</sup> CNEPP, there has been growing concerns for enhancing capacity of nuclear manpower as KEPCO consortium awarded UAE NPP contract in 2009 and KAERI/Daewoo consortium won Jordan research reactor contract in 2010. In addition, the number of NPPs planned in Korea has been shrunk due to safety issues after Fukushima Daiichi NPP accident. The Government HRD policy started putting more importance on enhancing capacity rather than securing human resources [7].

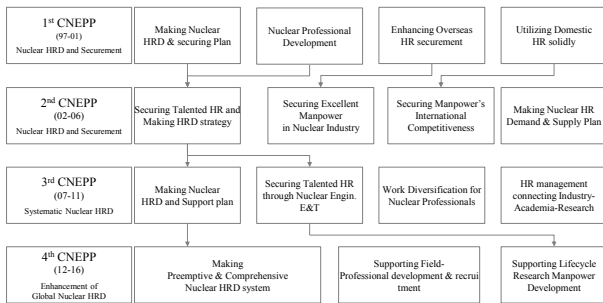


Fig. 4. Changes of Nuclear HRD Policy in Korea

Japanese Government and JAEC had been making “Long Term Nuclear R&D and Utilization Plan” every five years since 1956. In the plan, nuclear R&D and utilization issues such as nuclear fuel cycle, spent fuel recycling, plutonium utilization, radioactive waste disposal, Fast-Breeding reactor, nuclear generation plan, and radiation utilization have been discussed [8]. In November 2005, JAEC revealed new 10-year long term master plan named *Framework for Nuclear Energy Policy* which covers nuclear utilization, nuclear R&D, developing and securing human resource. Japanese nuclear HRD policy in *Framework for Nuclear Energy Policy* can be summarized in five categories [9]:

1. Creating great workplace environment with learning cycle
2. R&D – Creating new technology and knowledge
3. Industry – Establishing technical qualification system and developing educational network
4. Academia – providing various nuclear education programme and developing interdisciplinary fusion education programme
5. Promoting cooperating in HRD between R&D, industry and Academia

In 2010, JAEC showed Initiative Paper named *Evaluation of Basic Concepts for Initiatives to Develop and Secure Human Resource as Defined in the Framework for Nuclear Energy Policy*. This document outlined the expectations of the activities of the Japan Nuclear Human Resource Development Network (JN-HRD) relating to human resource development and associated international cooperation as well as the expected efforts of the concerned organizations, in the form of recommendation. Nuclear-related organizations are expected to continue to respect basic concepts stated in *Framework for Nuclear Energy Policy*

To summarize Nuclear HRD policy in Japan after 2006, major agendas in the policy have close relations with human resource securement even after Japanese nuclear industry matured. Moreover, the importance of nuclear education and training particularly in the field of nuclear safety and regulation has been embossed after Fukushima Daiichi nuclear power plant accident. The key policy agendas in each plan and initiative are as follows: establishment of great work environment (2005), improving work environment and developing human resources for international cooperation and regulatory bodies (2010), developing education and human resources for nuclear safety and security (2012).

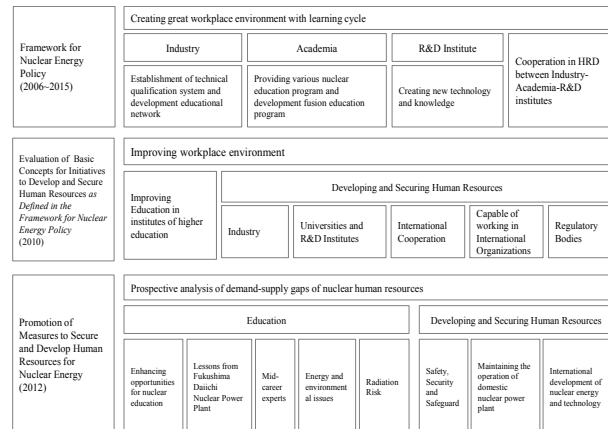


Fig. 5. Changes of Nuclear HRD Policy in Japan

It appears that securing and recruiting good human resource has been still one of issues since 2005. When you see trend of the number of students entering (Japan) / graduating (Korea) nuclear engineering department sorted by academic degree, it is surprising that there are not much difference between two countries students even though Japan may need more manpower majoring nuclear engineering after considering the difference of the number of commercial reactors operating and the annual budget of nuclear R&D in both countries. In the context of this, Japanese government focused in HRD policy in three aspects: R&D, Industry and Academia in long term master plan and follow-up initiatives. It has shown that Japanese Government has interests on improving workplace environment and domestic HRD cooperation among Industry, R&D institutes and

Universities as well for enhancing capacity building. In 2012, new HRD initiative popped up: *Prospective analysis of demand-supply gaps of nuclear human resources*. It is analogized that Japanese Government treats securing and developing human resource as what government should involve and manage [11][12].

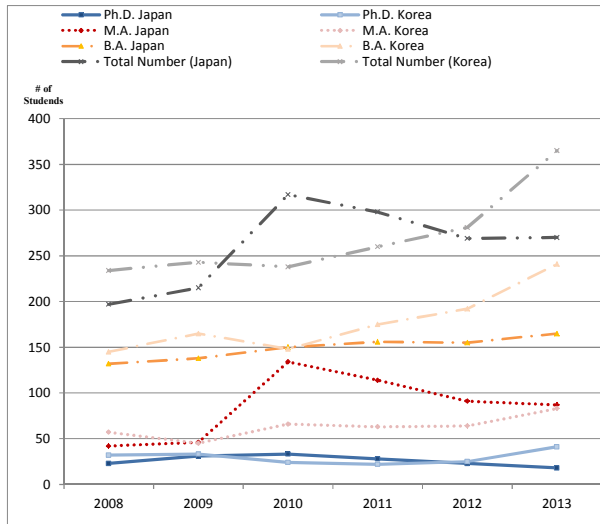


Fig. 6. Trend of the number of students entering (Japan) / graduating (Korea) nuclear engineering department

It seems companies in nuclear industry, R&D institutes, universities and other government-supporting organizations in Japan are implementing nuclear HRD activities with government budget mainly from MEXT and METI after following JAEC's recommendations and guidelines. In addition, Japan put importance on nuclear education "in connection with" research and development. Referring JAEC reports presented at Japan Nuclear Human Resource Development Network (JN-HRD) Annual Meeting in Feb. 10, 2016, it mentioned that each concerned organization in Japan is executing reviews and initiatives according to its role based on the recommendations of the Japan Atomic Energy Commission. Furthermore, it mentioned that efforts focused on the key goals of "University Education", "Continuing Education", and "Knowledge Transfer" and efforts at "integration with R&D" are also vital based on a grasp of current conditions surrounding nuclear energy [10].

### 3. Conclusion

In summary, it is considered that Korean and Japanese Governments have been putting importance on human resource development in strong connection with research and development when national-level comprehensive nuclear R&D and utilization plan is made. In particular, strong linkage between education and R&D is encouraged for innovative technology development, NPP exports, and enhancement of nuclear safety. It is convincing that both countries' governments

have driven nuclear HRD policy in a frame of national nuclear R&D and utilization plan due to distinctiveness of science & technology, particularly nuclear energy, even though there are other ministries supporting employment and general HRD.

Comparative study can be effective methodology providing opportunities for policy development and improvement. Therefore, close benchmarking and comparative analysis for nuclear HRD policy between Korea and other advanced countries like Japan shall be promoted and performed in nuclear society.

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