Program for Educating Nuclear Engineers in Japan
-Partnership with Industry, Government and Academe Begins

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Abstract: Since the beginning of the 21st century, educating the next generation of nuclear engineers has been of interest to groups who are concerned with the recent decline in the number of nuclear engineers in universities and industries. Discussions and proposals have been summarized in independent reports by industry (JAIF; Japan Atomic Industrial Forum), government (Science Council of Japan) and the academe (AESJ; Atomic Energy Society of Japan). In June 2005 a Committee on Education (CE) was established within AESJ with the intention of coordinating the groups interested in nuclear education in Japan. The birth of CE was timely, because the importance of nuclear education was emphasized in “Framework for Nuclear Energy Policy (Oct., 2005)” which was adopted by the Atomic Energy Commission. The Nuclear Energy Subcommittee of the METI (Ministry of Economy, Trade and Industry) Advisory Committee deliberated concrete actions for achieving the basic goals of the Framework for Nuclear Energy Policy and their recommendations were drawn up as a “Nuclear Energy National Plan.” This was the MEXT (Ministry of Education, Culture, Sports, Science and Technology) and METI action plan to create nuclear energy training programs for universities, etc. A task group, consisting of members from industry, government and academe was organized within JAIF to give advice to these training programs. The author of this paper (and chairman of CE) participated in and made proposals to the task group as a representative of the academe. In this paper, the proposals made by CE and the outline of the final program will be reported. Furthermore, the importance of the partnership between industry, government and academe will be emphasized.

Keywords: Nuclear Engineering, Education, Partnership.

1. INTRODUCTION

The nature of society and the economy are changing drastically all over the world. To create a sustainable society where each citizen can enjoy a fulfilling life and pass it on to future generations, it is important to secure energy and to use it efficiently. But is securing energy and being a good energy consumer really enough? The answer to this question seems to be “No.” We have to realize that “human” resources in the field of energy engineering as well as “natural” energy resources are necessary. But, is the importance of attracting talented individuals to the field of energy engineering fully recognized?

In 2005, the report [1] issued by the National Academy of Engineering (hereafter, NAE) raised warnings about engineering education in general, naturally including energy engineering. Let’s look at some quotes from the report “… The external forces in society, the economy, and the professional environment will all challenge the stability of the engineering workforce and affect our ability to attract the most talented individuals to an engineering career.” Though science and engineering degrees holders in the United States 24 year-old population increased from 4.1 in 1975 to 5.5 in 2000 (Fig. 1 [2]), the report points out that the degree holders in the United States are not enough to maintain the leadership in worldwide competition in technology.

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Fig. 1 Science and Engineering Degrees in 24-Year-Old Population by Country (Years 2000 vs. 1975) [2].
The NAE is not necessarily pessimistic as the report continues, "However, amid all these challenges, exciting opportunities also exist if the engineering community takes the initiative to prepare for the future." For example, "Reinventing engineering education requires the interaction of engineers in industry and academe.", and "Engineering needs to develop iconic images that the public immediately recognizes and responds to in a positive way". Aren't these NAE concerns and proposals on preparing for the future similar to what has been discussed concerning educating the next generation nuclear engineers in Japan?

In Japan, educating the next generation of nuclear engineers has been of interest to groups who are concerned with the recent decline in the number of nuclear engineers in universities and industries since the beginning of the 21st century. Discussions and proposals have been summarized in independent reports by industry (JAIF; Japan Atomic Industrial Forum), government (Science Council of Japan) and the academe (AESJ; Atomic Energy Society of Japan). In June 2005 a Committee on Education (CE) was established within AESJ, with the intention of coordinating the groups interested in nuclear education in Japan. The birth of CE was timely, because the importance of nuclear education was emphasized in "Framework for Nuclear Energy Policy (Oct., 2005)" which was adopted by the Atomic Energy Commission. The Nuclear Energy Subcommittee of the METI (Ministry of Economy, Trade and Industry) Advisory Committee deliberated concrete actions for achieving the basic goals of the Framework for Nuclear Energy Policy and their recommendations were drawn up as a "Nuclear Energy National Plan." This was the MEXT (Ministry of Education, Culture, Sports, Science and Technology) and METI action plan to create nuclear energy training programs for universities, etc. A task group, consisting of members from industry, government and academe was organized within JAIF to give advice to these training programs. The author of this paper (and chairman of CE, FY 2005~2006) participated in and made proposals to the task group as a representative of the academe. In this paper, the activity of the CE in the past two years will be briefly introduced. Then, the proposals made by CE and the outline of the final program will be reported. Furthermore, the importance of the partnership between industry, government and academe will be emphasized.

2. ACTIVITY OF CE: FY2005 ~ 2006

The first task of CE was to evaluate the current status of both education and research in Japanese nuclear engineering and drew up a list of problems to be solved. The results are as follows;

Education: The wind that blew against the nuclear engineering community from the 1980s discouraged the younger generation in Japan from choosing nuclear engineering as a major at university. As a result, the average score on the entrance examination for students who entered the nuclear engineering course was gradually getting worse. To solve this problem, universities that have nuclear engineering courses have reorganized the courses so that the students do not have to feel that their career is limited to the nuclear engineering field. One actual countermeasure was to remove the term ‘nuclear’ from the course name.

The environment for faculty has also been changing. Though research in universities should be closely related to education, there are young faculty members who teach but do not do research in subjects related to nuclear engineering. As a result, systematic nuclear engineering education has become difficult.

Research: While the Japanese research budget is increasing, the proportion distributed to nuclear engineering, in relative terms, has decreased. On the other hand, maintenance fees for laboratory equipments and facilities that have been in use since the early days of atomic energy, have been increasing steadily, though budget for maintenance or renewal is rarely expected.

As a result, to continue fundamental and basic research in support of nuclear engineering is becoming more difficult. Examples of research areas specific to nuclear engineering courses are those related to reactor physics, interaction of radiation with matter, fuel and materials. The situation is the same for the traditional research areas for faculty members in the other engineering courses, such as steam power plant engineering, processing (including welding), metallurgy, and corrosion. An extreme example is the case of steam power plant engineering, in which there are no faculty members in Japan who work on steam turbines.

After CE summarized the current status of both education and research in Japanese nuclear engineering, they have been working on the following four tasks. The first three were scheduled tasks and the fourth one was an urgent task to support the “Nuclear Energy National Plan” [3] in the field of nuclear education.

1) Investigation of the Japanese nuclear education programs in the past

We do not deny that there were many programs and tasks running in the past. Some reports are well known, but others are not. We thought that the independence of these tasks was vital for the tasks themselves, but the CE’s mission was to collect and compile the knowledge so that the precious knowledge can be accessed easily by anyone with interest. For this purpose, CE investigated the Japanese nuclear education programs of the past and summarized them in a report [4].

2) Investigation of the foreign nuclear education programs

With a similar motivation as for task 1), CE started to investigate foreign nuclear education programs. The first target was ANS (American Nuclear Society). CE did a comparison between ANS and AESJ in the areas of organization, partnership program between industry, government and academe, student activity, internship, scholarship award, and workshops. The report [5] is scheduled to be published in 2007.

3) Support of rookie engineers

CE published a leaflet titled “Message to rookie engineers [6].” CE recognized that the troubles that rookie engineers encounter in most cases are not related to technical ability. The leaflet is written in a style so that unwritten laws in a business organization that have become natural to elders can be transferred smoothly to the rookies.

4) Concrete proposals for the “Nuclear Engineers Training Program”
During the discussions related to task 1), we reconfirmed that the nuclear education programs of the past were timely and important in one way or another. On the other hand, we were also feeling that more effective programs might be realized if members from industry, government and academe all participated in the same program. We were glad to hear that a task group called “Task group on nuclear engineering education policy”, consisting of members from industry, government and academe, was organized within JAIF in Oct. 2006. The purpose of this task group was to give advice to MEXT and METI on the “Nuclear Engineers Training Program.” The author of this paper (and chairman of CE, FY 2005-2006) participated in and made proposals to the task group as a representative of the academe. Our proposals are as follows;

i) Financial support to individual students and advisors
We believe that a system to attract a large number of talented students is top priority. Though there seems to be an unwritten policy, that travel fees related to field experience, conferences and other off-campus activities are individual issues because the achievements belong to the individuals, we thought a change in policy was necessary. We thought that we have to send a strong and a concrete message to students that “we will support nuclear education.” Specifically we recommended support first for travel fees for off-campus activities, then for scholarships and tuition fees.

The reason for our proposal is that we consider field experience with reactors as mandatory in nuclear engineering education. For example, approximately 90 students majoring in nuclear engineering are enrolled in a reactor course at Kyoto University Critical Assembly (KUCA) every year. This course has been offered every summer to 10 universities since 1975. The subjects offered in the experimental course include: 1) critical-mass measurements, 2) control-rod worth calibration, 3) measurement of the thermal-flux distribution, and 4) reactor operation and fuel handling for educational purpose. As easily imagined, these precious experiences cannot be achieved everywhere, and thus students and their advisors have to travel to KUCA.

Furthermore, we considered that financial support for travel to domestic and overseas conferences, internships with the nuclear power industry (often said to be a closed community) is necessary.

ii) Support of Curriculum
We pointed out that systematic or full menu nuclear engineering education has become difficult. We thought that if it is not possible to provide full menu curriculum in nuclear engineering, then we have to know what subjects are mandatory and support faculty so that students can see a bright future in these “core curriculum.” Specifically, we recommended financial support for a task group to select the core curriculum and publish texts and aids for these high priority subjects.

Considering the possibility of an unfortunate situation where there was no faculty member to teach the subject in the core curriculum in a particular university, we thought an alliance of universities would be effective. If a student cannot attend a class at their own university, they should be allowed to attend other universities which have a class on the subject and receive credit for these courses (This system was originally proposed by a committee in the Science Council of Japan). Accepting retirees as visiting lecturers and providing classes through networks are also worth considering.

In addition, social science is also important in nuclear engineering education. Programs classified in the social sciences should also be supported.

iii) Support on Research
To stimulate research in any area, we thought it important for different groups to compete with different approaches. However, fundamental and basic research related to nuclear engineering is time consuming. So, if a research area is not carried over to the next generation due to retirement of a faculty member, there is the possibility of reduced competition in that research area. The worst case is that no one continues the research. So we recommended making a study of a system in which an important research area will be continued over generations and competition in the field will be maintained. The system should also include the question of how to assess the research activity of a faculty member, and how to continuously fund the research.

iv) Support of Facilities Management
We agreed that facilities such as reactors are mandatory not only for nuclear engineering education, but also for research. However, running a testing facility these days is not so simple, due to the increasing maintenance costs for aged facilities. Another problem is the continuous pressure to reduce labor cost, which usually impacts the filling of technician vacancies. Thus, we recommended support for the maintenance funding of facilities, including safety management expenses and salary of technicians.

Furthermore, we recommended that reactor fuel and waste disposal issues that are difficult for individual universities to handle should be managed as a national issue. The same thing can be said for research facilities. From now on, maintenance of research facilities will become more difficult for individual universities to handle, thus it seems that a system to encourage researchers to share the research facilities will be necessary.

Fortunately, most of our proposals were reflected in the “Nuclear engineering education program”, which was organized by MEXT and METI in 2007.

3. OVERVIEW OF FUTURE
As mentioned in the task 4) of CE, we feel that more effective programs might be realized if members from industry, government and academe all participated in the same program. Our recommendation was accepted and the joint task force on nuclear engineering education, where there is participation from all three parties will be renewed as “Committee on nuclear engineering education” in Sep. 2007. Issues, such as the following will be discussed and CE will participate as a representative of academe again.

1) Road map of nuclear engineering education in medium and long term
2) Quantitative analysis on demand and supply of nuclear engineers
3) Program for attracting U18 (under college) students
We consider all six issues are important. We will make aggressive proposals, from the standpoint that AESJ is a neutral organization.

Personally, the author especially expects that some "iconic image," that can attract and motivate young talented students to the field of nuclear engineering will be proposed under a strong partnership of industry, government and academe in that committee. If nuclear engineering is going to become comprehensive engineering, then it should take leadership as a representative of the broad field of engineering. For this purpose, an icon or a flag seems to be necessary.

For example, there are young people who want to go overseas to be engaged in volunteer works, where their destination might be hazardous. I think this is because a "volunteer icon" attracts them. The author at this time does not have an answer to this issue.

Any way, the partnership between industry, government and academe on nuclear engineering education has just begun in Japan. This partnership could not have been imagined 5 years ago. The author would like to thank all the people who showed enthusiasm in achieving this partnership, and who wish to make continuous contributions to this partnership.

REFERENCES