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Education of Nuclear Engineering in Tokai University

by

Toshiaki OHE*1

Abstract

This article is the summary of the presentation given in the joint seminar held in King Mongkut's University of Technology Thonburi (KMUTT), Thailand, on March 20th, 2009. In the seminar, educational activities carried out by Tokai University for over 50 years focusing on nuclear engineering were presented with introduction of the historical background, and recent information on both the related department of the university and related course of the graduate school. The presentation also emphasized the pioneering efforts in Japan for the education of nuclear engineering led by our founder, Dr. Shigeyoshi Matsumae.

Keywords: Nuclear engineering, Education, History, Recent activity

1. Historical Background

Tokai University is an educational institute with 27,611 students in 10 different campuses. It consists of 14 high schools, seven junior high schools, one elementary school, and four kindergartens. Education on nuclear engineering is provided by both the Department of Energy Science and Engineering of the university and the Course of Applied Science of the graduate school. The university's history of nuclear engineering studies started in April, 1956. That year, the Nuclear Engineering Course, Applied Science Department was established with only 12 students. This was one year after the enforcement of the Atomic Energy Fundamental Law (1955) and slightly before the establishment of the Japan Atomic Energy Research Institute (June, 1956). The first monumental criticality was achieved in 1957 at the JRR-1 reactor. The Nuclear Engineering Course was thus the first educational endeavor related to nuclear engineering in Japan, and since then, Tokai University has been playing a pioneering role in the field of education under the leadership of founder, Dr. Shigeyoshi Matsumae, who also led the enforcement of the Atomic Energy Fundamental Law.

Years later, the Nuclear Engineering Course was expanded as the Department of Nuclear Engineering with 100 students in 1973, two years after the first Oil Shock. This global economic event promoted the incentive for developing nuclear power as an alternative energy source to substitute oil. Tokai University's nuclear engineering educational activities were seen to be stable from the viewpoint of meeting social requirements. However, several serious accidents which had occurred across the world forced changes to these activities: Three-mile Island accident (1979) in the US, Chernobyl disaster (1986) in the USSR, and JCO Criticality Accident (1999) in Japan. In particular, the last accident accelerated the so-called anti-nuclear movement in Japan. This strong anti-nuclear sentiment forced the university to change the department name and reduce its student capacity. Accordingly, the Department of Nuclear Engineering was reorganized as Department of Applied Science and nuclear engineering education was continued as the Energy Science Course (60 students) in the new department. After that, the Energy Science Course once again became independent as the Department of Energy Science and Engineering in 2006. In spite of the frequent changes in its organization, Tokai University has succeeded in continuing its educational endeavors in nuclear engineering for over 50 years now.

2. Facilities

Tokai University has attempted to install a nuclear reactor for educational purpose on campus. We applied for the license twice, first in April 1959 for a tinny reactor with a thermal output of only 10W (North American Co., Type L-77, Boiling-water reactor, Fig.1). Unfortunately, this application had to be withdrawn because of strong opposition from the

*1 Department of Energy Science and Engineering

neighborhood. The second application was attempted in 1960 (American Standard Co., Type-UTR, 0.1W, 90%-enriched U) but failed for the same reasons. Due to such difficulties brought on by the social situation, the university had to postpone its research reactor plans, and turned its focus towards radiological applications instead.

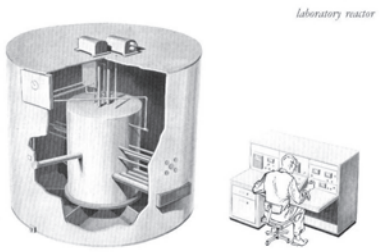

Fig.1 Sketch of laboratory reactor L-77 considered in first license application

In 1980, the university installed the Neutron Research Facility TUCF (Californium-252, 795 mCi, thermal flux 1.5 x 107 n/cm^2·s, Fig.2) and in 1994, a reactor simulator TURS (Fig.3).

Fig.2 Neutron Research Facility TUCF

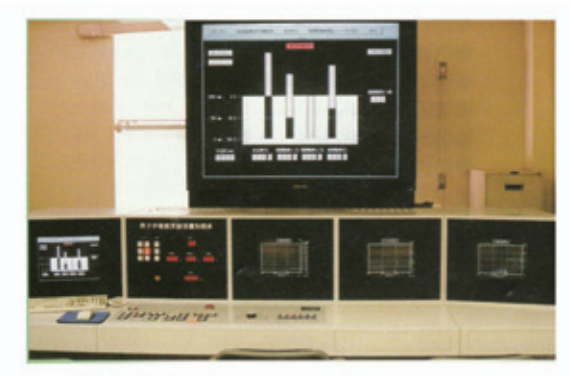

Fig.3 Reactor Simulator TURS

These facilities are now old and only TURS has been updated due to budgetary restrictions. Instead, a new facility for handling radioactive materials was built in the university's Radiation Management Center.

3. Recent Student Interests

Despite the university's strong historical background in nuclear engineering, the subject did not seem to interest the students after the reorganization of the department in 2001. Figure 4 shows the results of a questionnaire carried out at the orientation for freshmen every year. The response to the question "Are you interested in education on nuclear and/or radiological applications?" had been extremely pessimistic for several years, with less than 20% of freshmen showing interest in nuclear energy or radiology. But this tendency has been changing over the recent years. Now, more than 70% are eager to learn about nuclear related subjects. It is not exactly known why nuclear related subjects are becoming increasingly popular. Several possible reasons are:

1. Sharp increase in oil prices due to scarcity of energy resources.
2. Nuclear Power Renaissance is recognized as a response to global warming issues and securing of energy.
3. World nuclear industries are being constructed, led by Japanese companies.

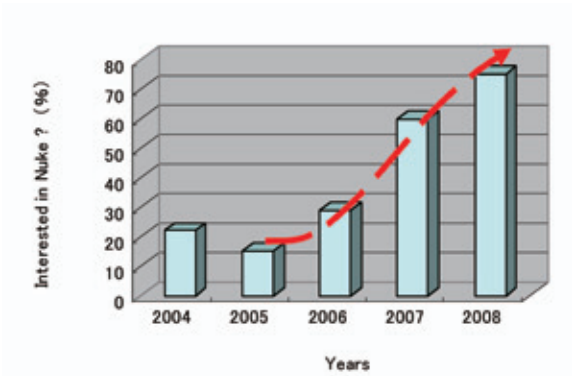

Fig.4 Results of questionnaire for freshmen surveying interest in nuclear/radiological education

Of course, these are somewhat social reasons and do not actually serve as the direct driving force behind the growing interest in nuclear engineering education. It should also be noted that the development of human resources was not taken seriously by nuclear industries during the 80s and 90s in Japan as well as in the world, resulting in the current lack of human resources. The nuclear industry thus hopes to attract the young as potential human resources. From this background situation, the Nuclear Engineering sub-course was established in the Department of Energy Science and

Engineering. This sub-course is an internal activity and has a unique position in the department. To complete the sub-course, there are three requirements:

1. Acquiring national license in radiation protection
2. Meeting specific requirements on nuclear engineering lectures (40 total credits)
3. Acquiring skills in radioisotope handling and reactor experiments

Normally, a total of 124 credits are sufficient for graduation. These requirements imply that the completion of the course is harder than graduation.

4. Applied Science Course in Graduate School

Tokai University also offers a course in nuclear engineering at its Graduate School. The Applied Science Course is composed of two sub-courses for Nuclear Engineering and Applied Physics to foster specialists with basic and fundamental knowledge on promoting the use of the nuclear energy. Lectures given in the course are summarized in Table 1, and 32 credits are required for receiving a master degree in engineering.

Table 1 Lectures given in Applied Science Course of Graduate School

Nuclear Engineering	English	Material Science & New Energy	English
Nuclear Energy	○	New Energy I	
Nuclear Chemical Process		New Energy II	
Advanced Nuclear Energy I		New Energy III	
Advanced Nuclear Energy II		Applied Materials Science	○
Reactor Experiments		Material Science for Energy Conversion	○
Plasma Energy		Electro-magnetic Physics	
Quantum Mechanics		Energy Materials Science	
Radiation Biology		Environment	
Radiation Chemistry		Environmental Pollution Control	○
Radiation Physics		Environmental Engineering	
Radio-isotope Technology		Education	
Nuclear Internship		Educational Physics I	
Global Environment & Energy System		Educational Physics II	
		English Presentation for Engineers	○
Seminor of Study on Master Thesis I～IV			mai-able

* Each lecture has two credits except for seminars.

5. Applied Science Course in Graduate School

Tokai University has a unique program for foreign students from the Asia Pacific region, one of the programs financially supported by the Ministry of Economy, Trade and Industry (METI) and the Ministry of Education, Culture, Sports, Science and Technology (MEXT). Our program is the only one particularly related to nuclear industries.

In the program, high-level industry-academia education and Japanese business education are offered for outstanding foreign students who are interested in working for Japanese companies. The candidates have to enter the Course of Applied Science in the Graduate School of Engineering to complete the master's program. The goals are:

1. Obtaining a master degree
2. Acquiring skills to become the global personnel required by consortium-participating companies
3. Acquiring advanced knowledge on nuclear power and Japanese language ability necessary to conduct business

World-leading Japanese nuclear power-related companies participate in the program to support other activities including factory visits, on-site training and observations, and business Japanese education to foster language abilities. After graduation, graduates function as bridge personnel connecting headquarters and overseas branches of Japanese companies, play central roles in projects and/or overseas offices and take on leadership positions in local enterprises, and contribute to the education and training of local personnel. Currently, we have eight students from Thailand, Indonesia, Vietnam, Mongolia, and Kazakhstan.

6. Promotion by Tokai University

Tokai University actively promotes intellectual ambitions in students and offers opportunities for them to receive the desired education, supported by the university's long history and extensive experience in education for over 50 years, and meticulous efforts to ensure pleasant student life.