

**Lessons Learned on University Education Programs of Chemical Engineering Principles
for Nuclear Plant Operations – 13588**

Jun-hyung Ryu (jhryu@dongguk.ac.kr)

Department of Nuclear & Energy System, Dongguk University, Gyeongju Campus,
Gyeongju, South Korea, 780-714

ABSTRACT

University education aims to supply qualified human resources for industries. In complex large scale engineering systems such as nuclear power plants, the importance of qualified human resources cannot be underestimated. The corresponding education program should involve many topics systematically. Recently a nuclear engineering program has been initiated in Dongguk University, South Korea. The current education program focuses on undergraduate level nuclear engineering students. Our main objective is to provide industries fresh engineers with the understanding on the interconnection of local parts and the entire systems of nuclear power plants and the associated systems. From the experience there is a huge opportunity for chemical engineering discipline in the context of giving macroscopic overview on nuclear power plant and waste treatment management by strengthening the analyzing capability of fundamental situations.

INTRODUCTION - KOREAN NUCLEAR POWER PLANTS

Republic of Korea (ROK, South Korea) has expanded its continuously increasing energy demand with the help of nuclear power generations. This expansion is mainly due to the scarcity of other primary energy resources such as petroleum, coal and natural gas, etc. Because consistent energy supply with affordable price is essential to support the economic development, nuclear power generations have made a significant contribution in terms of massive supply capability.

As time goes on, constructed nuclear power plants (NPP) are getting old and the corresponding human resources involved in NPP are as well. The first generation directly involved in the designing, constructing, operating the NPP have come to the age of retirement. The turn-over of their knowhow into the next generation is another challenge for the sake of secure utilization of NPP. New areas in need of further attention also emerge such as nuclear waste treatment. Thereby providing qualified human resources in nuclear industry deserve more attention than any other time period for the Korean energy industry sector.

There are other issues that make the NPP challenging. Diversified public perception on NPP is one such thing. Generally affirmative public perceptions on nuclear power plants in ROK are affected by Fukushima Daiichi nuclear disaster. More people hope to strengthen the safety of the existing NPP from potential natural disasters. The best way to respond to such hope is to communicate the general public as an effort to minimize the potential communication gap between the public and the NPP governing bodies. With this respect, constructing education programs near actual NPP would help to bring local communities and NPP together.

On the other hand record high electricity demand enforces NPP to be operated for longer with shortened operating periods. The sufficient amount of maintenance times are not expected against the fluctuating energy demands all year round. These issues highlight the importance of the coordination of operation and maintenance systems. The coordination is not easy to accomplish. Normally NPP does not require a large number of human resources of high level expertise. There are many parts involved with engineers of relatively medium or low level of expertise. However it is important to assure that they have the understanding of the overall frameworks. Without the understanding, a minor error might turn out to be serious events that interrupt the operation of the entire plant.

From the above analysis on NPP, it is fully reasonable to address that fostering nuclear energy engineers is an important issue for the successful operation of NPP.

NUCLEAR ENGINEERING EDUCATION PROGRAM IN DONGGUK UNIVERSITY GYEONGJU CAMPUS

Motivated by the above practical need, the college of energy and environment was newly established in Gyeongju campus of Dongguk University. Geographically speaking, Gyeongju is the city near to many nuclear power plants in Korea. The headquarter of Korean NPPs is thereby moving to this city. Although there are many NPPs around the city of Gyeongju, there had been no NPP education program around the city so far. The starting of the program is straightforward. But how to construct a program was another issue. The college of energy and environment started with the departmental title of nuclear and energy system engineering.



Figure 1. Locations of Nuclear Power Plants in South Korea (Yonhan News)

It is always consuming a long time periods at the expense of considerable cost to develop skillful engineers for a specialized industry such as nuclear power plants and associated service providers. In order to educate undergraduates for the industry, university education systems are faced with many challenges. Since nuclear power plants are the combination of many disciplines with a variety of knowledge, various types of engineering resources are needed. Normally new employees with different backgrounds such as mechanical, chemical, electrical, construction engineering bachelor degree are trained for more than a year before they are stationed in the individual position in NPPs.

One may mention that NPP is a simple mixture of such diverse principles. On the other hand it should be highlighted that the NPP is still one system of a large scale. The operation of the large scale system should be approached by uniform systematic framework. With this regards, our education program highlights that it is important for the potential NPP workforce to understand the major concepts of chemical engineering principles.

In a normal education program of nuclear engineering, the major focus would be given to typical nuclear engineering subjects with the fundamental courses such as thermodynamics, fluid mechanics, heat transfer and so on. Some essential mechanical, electrical, chemical engineering courses are incorporated with our program. The key focus is to understand the fundamental chemical engineering principles starting from the material balance, energy balance. The reaction engineering concepts are useful practically as well as conceptually to convey the complex

nuclear reaction mechanisms. Plant Design and operation is an over

We aim to provide the industry fresh engineers with the understanding on the connection of material, parts and system. It is thought that there is a huge opportunity for chemical engineering discipline in the context of giving macroscopic overview on power plant and basic situation analysis.

Our current education program aims to integrate the nuclear, mechanical, material and chemical engineering courses to provide undergraduate fresh engineers with multidisciplinary knowledge. Experiences so far on our current program are thought to be of some help for the graduate students to be involved in the NPP. In order to maintain the role of stable energy supplier, nuclear power plants and the associated service providers should be involved with skillful and qualified engineers. With the decades of hands-in experiences, Koreans has come to understand the major mechanisms of NPP. How to develop education systems that train young engineers the obtained mechanism is the next issue.

It was not a long time for the current NPP program to have a meaningful contribution in training nuclear energy engineers. However it is important to provide engineers who understand the overall framework of NPP based upon the understanding of chemical engineering principles

Concluding remarks

Engineers in NPP should communicate continuously with the customers that are external customers like factory, household while keeping the core nuclear plant operation in the best mode. They are always faced with a new situation that might cause serious situations affecting the entire local community because of external natural disasters. Engineers should be aware of such potential risk and demand and be capable of maintain the delicate nuclear plant operation.

Our current education program aims to integrate the nuclear, mechanical, material and chemical engineering courses to provide undergraduate fresh engineers with multidisciplinary knowledge and in the end convergence. Experiences so far will be reflected as corrective actions for future improvement. It is believed that many of NPP is closed associated with chemical engineering principles.

Acknowledgement

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (2010-0023678).