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# A Study on the Effect of the Training Course on Reactor Core Design Theory and Practice

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## 1. Introduction

The nuclear industry is in need of specialists for the development of innovative and advanced technologies. In accordance with national policies such as national nuclear industry activation and safety, KAERI-NTC(Korea Atomic Energy Research Institute - Nuclear Training & Education Center) has developed and operated educational programs for industry and universities with the aim of national nuclear human resource development. KAERI's advanced technologies have been applied to nuclear education and training programs [1, 2].

NTC has been developing and operating the "Reactor Core Design Theory and Practice" education program since 2015, which is one of the training courses for spreading KAREI’s technologies in cooperation with industry and university. In this study, the effect of the "Reactor Core Design Theory and Practice" education program operated for three years was evaluated.

## 2. Methods and Results

### *2.1 CASMO-3/MASTER Code System*

In this training course, the CASMO-3/MASTER nuclear analysis system for the design and analysis of a pressurized light water reactor core for normal and transient power generation was applied as a practical tool. CASMO-3 was developed by STUDSVIK in Sweden to produce the group constants required for a pressurized light water core analysis. This code performs the depletion calculation of the fuel assembly or the fuel rod using the two-dimensional multi-group neutron transport theory. MASTER is a multipurpose multi-dimensional nuclear core calculation code developed by KAERI for application to a core design simulation and an analysis of a pressurized light water reactor [3].

### *2.2 The education program*

The "Reactor Core Design Theory and Practice" education program consists of theoretical lectures and practice on the reactor core design. The objective is to improve the work capacity of small and medium industry experts related to the reactor design and enhance the capacity of nuclear power industry reserve personnel by focusing on the actual design techniques.

This course was held for four days with theoretical and practical work for industrial workers, college students and graduate students related to the reactor core design. The curriculum consists of 10 subjects and 15 hours. The detailed curriculum is shown in Table 1.

Table I: Contents of “Reactor Core Design Theory and Practice” education program

| Type | Title | Hour |
|---|---|---|
| Lecture | Core Design Overview | 1.5 |
| | Nuclear Fuel Assembly Design | 1.5 |
| | Group Constant Generation | 1.5 |
| | Core Loading Pattern Design | 1.5 |
| | Group Constant Table set Structure | 1.5 |
| Practice | Group Constant Generation | 1.5 |
| | Core Loading Pattern Design | 1.5 |
| | Data generation for Nuclear Fuel Design | 1.5 |
| | Data generation for Thermal Hydraulics Design | 1.5 |
| | Data generation for Safety Analysis | 1.5 |

From 2015 to 2017, 62 trainees participated in this program from 21 public organization, industries and universities. The composition of the trainees is shown in Fig. 1. Both undergraduate and graduate students participated actively for three years.

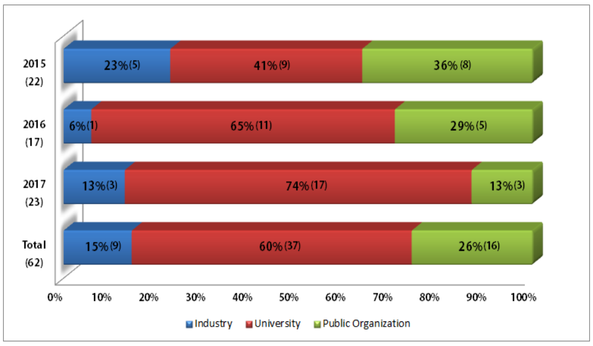


Fig. 1. Composition of trainees of “Reactor Core Design Theory and Practice” education program

### *2.3 Survey Method & Result*

A total of 53 people among 62 trainees responded to the evaluation survey. The survey was conducted after the education processing for the structured questionnaire. The questionnaire consisted of 13 items as shown in Table II.

Table II: Survey Items

| No. | Contents |
|---|---|
| 1 | I participated at this training course with an expectation. |
| 2 | I am satisfied with the overall training course. |
| 3 | The overall time of training course was reasonable. |
| 4 | The contents of training course are made easy to understand overall. |
| 5 | The objective of training course was clear. |
| 6 | I have acquired new knowledge and skills from this training course. |
| 7 | The training course will affect my job performance. |
| 8 | The timing of the training course was appropriate. |
| 9 | I would like to recommend the training course to others. |
| 10 | The instructor and lecture contents of the training course were appropriate. |
| 11 | The learning method applied to the training course was appropriate. |
| 12 | I am generally satisfied with the educational environment. |
| 13 | What is my level of knowledge about the contents of training course?<br>(Before and After training course) |

The survey was evaluated on a 5-point-Likert scale. The scale of questions from No. 1 to No. 12 is as follows scale: Strongly agree (5), Agree (4), Neither Agree nor Disagree (3), Disagree (2), Strongly Disagree (1). The scale of questions from No. 13 means the following scale: Very High (5), High (4), Medium (3), Low (2), Very Low (1).

The expectation level for the training course was 4.24 and the satisfaction level was 4.39 as shown in Fig. 2. Attendees participated with a high expectation. Most of the attendees were satisfied with the training course. The satisfaction level was high for most of the items. The satisfaction level of questionnaire item 4 was the lowest compared with the other items. It was considered that the education level would be difficult for a student who lacked prior knowledge for the reactor design.

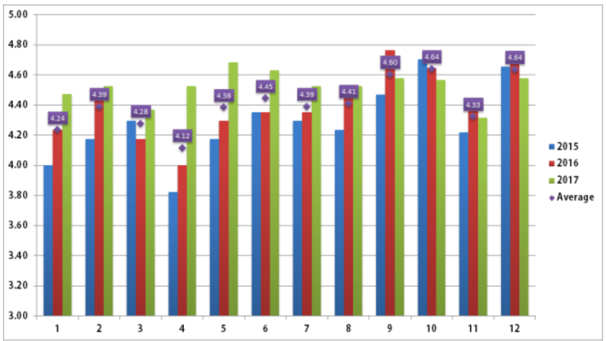


Fig. 2. Survey result for training course evaluation

The knowledge level of the trainees was changed as shown in Fig. 3. The average knowledge level was 50% for the education contents before the training course, and 75% after the post-training. The knowledge level was increased by 25% through the education program.

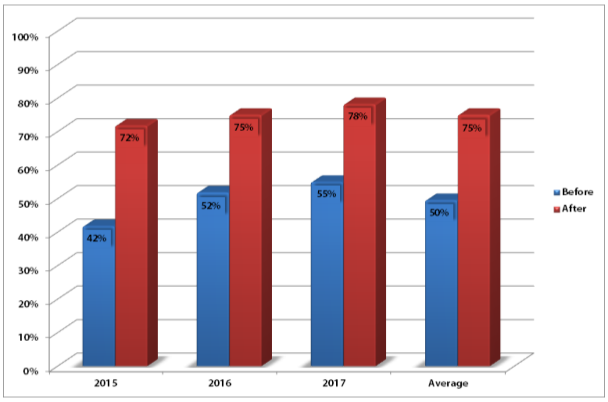


Fig. 3. Comparison of knowledge level before and after training course

The changes in knowledge level of trainees by major subjects are shown in Fig. 4. The background knowledge level of the Core Design Overview was the highest at 54%, and the level of Data Generation for Design was the lowest at 43%. The knowledge level for Core Design Overview was increased by 26%. The levels for Nuclear fuel Assembly Design and group constant Generation, Core Loading Pattern Design, and Data Generation were increased by 28%, 27%, and 27% respectively. It seems that the trainees had the opportunity to learn professional and practical technologies for Reactor Core Design thorough the education program.

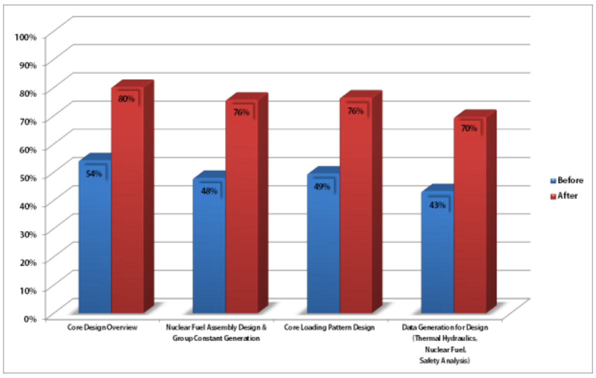


Fig. 4. Comparison of knowledge level before and after by subject

## 3. Conclusions

The "Reactor Core Design Theory and Practice" education program began in 2015, and the program has given participants from the industry and universities an opportunity for an education in reactor design technology. Most of the attendees were satisfied with the training course. The knowledge level of the trainees has increased by 25% through the education program. It will be also helpful for human resource development by sharing professional knowledge and improving the knowledge level of the trainees.

It is necessary to develop and operate curriculum in accordance with the requirements of the industry and universities such as the work type and skill level of the trainees for advancement of practical technology reflecting the survey results. It is believed that we will be able to establish a base not only for producing the industrial specialists but also for developing preliminary human resources in the nuclear industry. The training course can be applied as a tool to support human resource development in developing countries and nuclear technology cooperative nations.

## REFERENCES

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