A Study on the Effect of the Education Program for a Fundamental Thermal Hydraulic Test in Nuclear Power Generation System

Woong Ki Kim [a*] and Hwang Bae [a]
[a]*Korea Atomic Energy Research Institute, Daejeon, 34057, Korea*

[*]*Corresponding author: wkkim@kaeri.re.kr*

Keywords : nuclear, thermal hydraulics, test, education, training, evaluation

1. Introduction

Nuclear power generation has been shown as one of the countermeasures against the global climate crisis. The safety of nuclear power plants has been one of the key issues after the TMI nuclear accident in 1979, the Chernobyl nuclear accident in 1986, and the Fukushima nuclear accident in neighboring Japan in 2011. The public interests have been greatly increased on the safety of nuclear power plants. One of the key areas for safe operation of nuclear power generation systems is thermal-hydraulic system, and persons engaged in domestic thermal-hydraulic field in a reactor safety system need to understand and apply thermal hydraulic safety technologies for a variety of reactor systems such as a passive safety system for the reactor containment cooling system [1].

Based on the demand of education for thermal hydraulic testing program, Korea Atomic Energy Research Institute(KAERI) introduces the latest technology trends in thermal hydraulic testing for nuclear majors and industrial researchers using various thermal hydraulic testing facilities, research and education infrastructure owned by KAERI [2].

In this study, we analyzed the evaluation results for the trainees through the fundamental curriculum of the nuclear thermal hydraulic test course, which has been operated for three times from 2022 to 2024, and tried to come up with a comprehensive reorganization plan for the future curriculum.

2. Methods and Results

2.1 The education program

Among the 41 trainees(16 in 2022, 13 in 2023, 12 in 2024) who participated in the fundamental curriculum of the nuclear thermal hydraulic test conducted three times from 2022 to 2024 at KAERI, 41 (100% response rate) were surveyed.

The research tool is a questionnaire, and the course evaluation survey items are composed of questions that evaluate educational expectations, overall satisfaction, education content, on-the-job application, education environment, and instructors. The Likert scale of five-point was used as a category of responses, ranging from "not at all" to "very much." In addition, the learning achievement survey conducted from 2022 to 2024 compared and analyzed changes in knowledge levels before and after education.

This curriculum is a fundamental course in the field of nuclear thermal hydraulic testing and aims to improve thermal hydraulic testing and analysis capabilities applicable to nuclear power plants through thermal hydraulic testing theory, practice, and field tours.

The training curriculum consists of 13 subjects such as Introduction of nuclear thermal-hydraulics safety research, Nuclear thermal-hydraulics and measuring 2-phase flow parameters, Thermal-hydraulic validation test program on SMR, Test of APR1400 RCP, Practice of SMART CPRSS, field tours of ATLAS and FESTA, etc., as shown in Table I.

Table I: Curriculum of the education program

Type	Title	Time, hr
Lecture	Introduction of nuclear thermal-hydraulic system safety research	2
	Nuclear thermal-hydraulics and measuring 2-phase flow parameters	2
	Observation on boiling characteristics and advanced measuring techniques	1.5
	Experimental fluid mechanics and advanced measuring techniques	2.5
	Separate effect test on the improvement of reactor core safety	2.5
	Separate effect test on the commercial reactor development	1.5
	Separate effect test on the non-light water reactor development	1.5
	Integral effect test on the commercial reactor development using ATLAS	2.5
	Thermal-hydraulic validation test program on SMR	2
	Test of APR1400 RCP	1.5
Practice	Practice of SMART CPRSS	3.5
	ATLAS, FESTA	2

2.2 Survey Method and Results

The training hours of this curriculum were organized into 25 hours in five-day course. Figure 1 shows the satisfaction level of the curriculum between 2022 and 2024, and Figure 2 shows the results of the curriculum

learning achievement evaluation between 2022 and 2024.

As shown in Figure 1, trainees' pre-process average expectations for this curriculum were 4.40 point(out of Likert scale of 5), and their post-process average satisfaction was 4.31, indicating high satisfaction equivalent to their expectations. The satisfaction level of the instructor's overall evaluation was very high at 4.86. Therefore, the instructors of this education were evaluated as having excellent qualities in professional knowledge, lecture development ability, and feedback on trainees. In addition, satisfaction with the evaluation of education contents was 4.57 point and evaluation of on-the-job applicability was 4.38, indicating that it is a meaningful curriculum for field applicability.

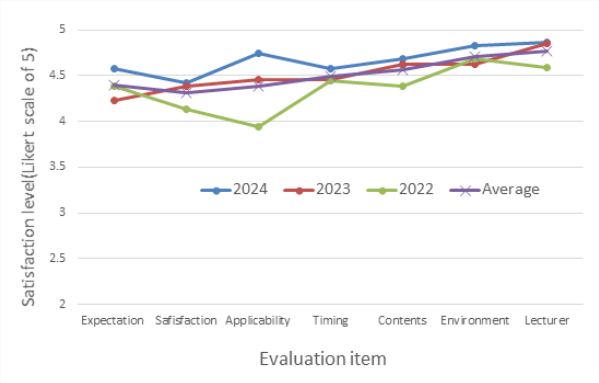

Fig. 1. Evaluation of satisfaction level in the education program in 2022~2024.

As a result of the learning achievement evaluation conducted from 2022 to 2024 as shown in Fig. 2, it increased from 2.2 points (Likert scale of 5) before education to 3.9 after education indicating that this curriculum was meaningful in terms of fostering trainees' knowledge on nuclear thermal hydraulic tests.

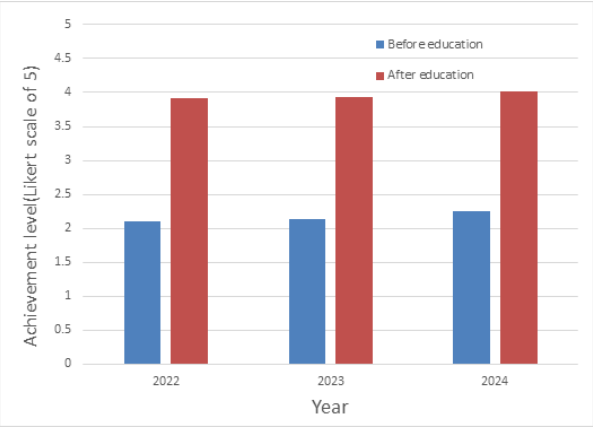

Fig. 2. Achievement level in 2022~2024.

Although the satisfaction of various items is relatively balanced, as shown in the satisfaction trend line, satisfaction tends to increase, the survey shows the feedback views for the improvement. It is believed that there are still parts to be improved in terms of various practical training for a variety of reactor systems, scaling theory, analysis codes, test facility construction, and for measuring system such as PIV etc.

3. Conclusions

In this study, we tried to derive the reorganization of the course through a questionnaire survey on the fundamental curriculum for nuclear thermal hydraulic tests conducted for three years from 2022 to 2024.

The overall satisfaction level was satisfactory with an average of 4.31 point showing an increase in satisfaction, but improvements were continuously exposed in terms of quality and quantity of education content and practice. Based on the evaluation results, the curriculum will be redesigned to reflect some new trends such as SMR in 2025, expand the proportion of practical training hours, and completely reorganize practical training contents into experiment laboratory-linked content.

ACKNOWLEDGMENT

This work was supported by an institutional business funded by the Korean government of the Ministry of Science and ICT.

REFERENCES

[1] Jin-Hwa Yang, et. al., Non-condensable Gas Elimination using CPRSS Return Line in SMART100 CPRSS, Transaction of the Korean Nuclear Society Autumn Meeting, 2023.
[2] Ik Jung, et. al., Capacity Building of Nuclear Professionals -National Nuclear Manpower Education and Training, KAERI/RR-4961/2023, 2023.