

Competence Development of Research Reactors Personnel in Indonesia

Sudi Ariyanto, Rini Rindayani, Rinawati Anwar, Djuartini Saleh

Center for Education and Training, National Nuclear Energy Agency, Jl. Lebak Bulus Raya
No.9, Pasar Jumat, Jakarta, Indonesia

Corresponding author: asudi@batan.go.id

Abstract. Development of human resources is an absolute requirement in order to support the efforts of nuclear power utilization and its supervision so that the utilization of nuclear power contributes in improving the welfare of society. Self evaluation on human resources has been done and the result showed indication of demotivation and decline in employee competence since there are no major programs in the last 25 years, ageing of employees because of moratorium program for new recruitment, limited competency budgets, as well as existence of potential of knowledge lost. The results of the evaluation was also applicable for research reactor personnel. Competence development for research reactor personnel is expected to provide outcomes: government regulations are met, national programs are still in place, critical knowledge loss can be prevented, knowledge retention program can be done, and research reactors can be operated in a safe, secure and sustainable. Planning for the development of competency of research reactor personnel has been conducted, including study of human resource condition, competence map, critical knowledge and potential knowledge loss, and identification area of expertise. The competence development program is conducted using grading approach to set priorities based on national program, cooperative commitment with partners, and potential knowledge lost.

Keywords: Research reactor personnel, competence, training, grading approach.

1. Introduction

In accordance with the Presidential Regulation No. 46 Year 2013, the main tasks of the National Nuclear Energy Agency (BATAN) are to carry out governmental duties in the field of research, development and utilization of nuclear science and technology. Research, development and utilization of nuclear science and technology in Indonesia is directed only for peaceful purposes and for the welfare of the Indonesian people [1]. BATAN's main competence fields are isotope and radiation, nuclear fuel and nuclear materials, nuclear installation & instrumentation, nuclear reactor and energy, and nuclear and radiation safety.

In implementing one of its duties in the field of nuclear reactor & energy, BATAN operates three research reactors i.e. Triga Mark II (now TRIGA 2000) in Bandung (in operation since 1965), Kartini Reactor in Yogyakarta (in operation since 1979) and Multi-Purposes Reactor GA Siwabessy (in operation since 1987).

TRIGA Mark II is the first research reactor operated by BATAN. Construction was started in January 1964 and was officially operated in February 1965 with initial power 250kW. In 1971, the power was increased to be 1 MW, and then increased again to a level of 2 MW in 1996. The reactor was operated with new capacity, and was named TRIGA 2000 in June 2014 by the President of Indonesia. [2]

Reactor Kartini is the second research reactor owned by BATAN. The construction was started in November 1974 and finished at the end of 1978. This reactor construction was done by Indonesian engineers and technicians using reactor core of TRIGA Mark II. The reactor was inaugurated by the President of Indonesia in March 1, 1979 with a nominal power of 50 kW. In 1981 the power of this reactor was increased to be 100 kW. The name KARTINI is an acronym of "Karya Teknisi Indonesia" means "Product of Indonesian Technicians." [2]

The third reactor is Multipurpose Reactor G.A. Siwabessy (RSG-GAS) in Serpong Area. The construction of this reactor started in 1983, and then was inaugurated in 1987. In March 1992, RSG-GAS attained full power of 30 MW. [2]

These reactors are utilized for radioisotope production, material testing, research and utilization of nuclear activation and for training. Radioisotopes and radiopharmaceuticals produced in the reactors are well used for radiodiagnostics as well as radiotherapy in many hospitals. [2]

BATAN has competent human resources in the research, development, and implementation of nuclear science and technology, with various relevant formal educational backgrounds and scattered in various existing functional levels. Some issues in human resources are, among others, increasing average age of personnel, the policy of zero growth and moratorium of civil servants recruitment by the government. These issues of human resources may result in a condition of scarcity and even loss of main competence. With this background, the development of human resources is an absolute requirement in order to support the efforts of nuclear power utilization and its supervision so that the utilization of nuclear power contributes in improving the welfare of society.

Competence development for research reactor personnel is expected to provide outcomes: government regulations are met, national programs are still in place, critical knowledge loss can be prevented, knowledge retention program can be done, and research reactors can be operated in a safe, secure and sustainable.

Capacity Building

The program of capacity building is developed based on the IAEA concept on capacity building [3]

Capacity building in BATAN is a systematic and integrated approach to develop and continuously improve BATAN's organizational and individual competences and capabilities necessary for achieving safe, secure and sustainable nuclear programme for people welfare. In the field of research reactor, capacity building is prepared and implemented so that all research reactors can be operated in a safe, secure and sustainable manner.

There are 4 aspects in capacity building: Education and Training (ET), Human Resource Development (HRD), Nuclear Knowledge Management (NKM), and Nuclear Network (NN). ET is implemented with objectives of building organizational and individual competences, preserving national competences on nuclear science and technology, and public education and outreach. The objective of HRD program is to obtain an effective human capital management. NKM program has objectives of preserving nuclear knowledge, preventing nuclear knowledge loss, and harvesting nuclear knowledge. NN is an important way to get support from external partners and its objectives are building competences, stakeholders involvement, public education and outreach and increasing public support, as well.

Competence building for research reactor personnel is implemented using a systematic and integrated approach covering aspects of capacity building above. Activities in each aspect are programmed based on a self-assessment. The self-assessment was done based on the IAEA methodology for self-assessment of capacity building [4]

The self-assessment addressed four fundamental questions (NAMA): What is needed? (Need), What is available and adequate to meet the needs? (Availability), What is missing or needs

improvement in order to meet the needs? (Missing/gaps) and What actions are needed? (Actions). The results of the self-assessment are attached in the Appendix 1 and Appendix 2. Among others, preparation of a comprehensive training program for research reactors is urgent to implement.

Another self assessment was done based on the NKM concept. [5] The self-assessment covered many aspects: status of personnel, knowledge maps, knowledge sharing culture, critical knowledge and potential of knowledge loss. The results of the assessment showed that most personnel in the research reactor are most that 40 years. The ageing of employees is a direct impact of moratorium program for new recruitment of the Government. It was shown also the existence of knowledges lost. The discussion to elaborate the results showed an indication of demotivation and decline in employee competence since there are no major programs in the last 25 years.

The self-assessments showed that there are main problems needs to be addressed in the near future. The first problem is the existence of critical knowledge: knowledge that is required to implement the functions but there is no one who possess it or only limited number of personnels who possess it. The second problem is the potential loss of knowledge due to the ageing of personnels and moratorium of new recruitment. To overcome this, the Center for Education and Training (CET) has developed Human Resource Development plan based on competence gap analysis data in research reactors, and identified critical knowledge, potential lost of knowledge, and identified required training and modalities of training delivery. For this purpose CET requested data to research reactors management, and also utilized data collected by NKM team of BATAN.

The results of self-assessments are necessary for developing in particular trainings on critical knowledges as well as to prevent knowledge loss in 2-3 years ahead. These trainings should covers all research reactor classification. The regulation of the chairman of BAPETEN Number 6 Year 2013 [6] notes the classification of research reactor (RR) personnels as follows

1. Operator of RR;
2. Supervisor of RR;
3. Technicians of RR Maintenance;
4. Supervisor of RR Maintenance;
5. Radiation Protection Officer of Nuclear Installation;
6. Nuclear Material Inventory Administrator; and
7. Supervisor of Nuclear Material Inventory.

2. Training Policy

Our policy on training is that training activities are planned and implemented based on a basic policy on training, i.e. every personnel who works in nuclear research, development, and application should be provided with adequate training in certain level of competence.” In the field of research reactor, training is mandatory for all research reactor personnel as stipulated by the regulation of the Chairman of BAPETEN, and .the curriculum and syllabus of the trainings are also notified in the regulation [5]. After completing the trainings, personnel have to come into examinations to get license from BAPETEN. The license validity is for 3 years for Operator of RR, and 4 years for Technicians of RR Maintenance, Supervisor of RR Maintenance; Radiation Protection Officer of Nuclear Installation; Nuclear Material Inventory

Administrator; and Supervisor of Nuclear Material Inventory. All personnels have to apply for resertification to BAPETEN before the date of validity of the licenses is over.

The policy on training is elaborated to covers some issues, such as 1) training program is manage for all employees, 2) a grading model is to set priority, 3) modalities of classical and non-classical are blended, as well as 4) utilizing network with partners.

Grading model is used so that competence development of all personnels, in particular of research reactor personnels, provides outcomes: government regulations are met, national programs are still in place, critical knowledge loss can be prevented, knowledge retention program can be done, and research reactors can be operated in a safe, secure and sustainable. The model put training priorities in relation with issues orderly arranged as follows: National Program, Personnel Certification, International Cooperation, Potential Loss of Knowledge, Program of BATAN, Program of Other Centers, Program for Dissemination/Outreach and Other. Based on this grading approach, trainings for research reactor personnel are on very high priorities.

3. Training Methods

There are many methods for capacity building applied by the Center for Education and Training. Capacity building can be done through education in national universities and abroad, training, workshop, coaching in the office and out of office, seminar, developmental assignment, knowledge sharing and others. Training can be done through traditional face-to-face class, blended-learning, and e-learning.

4. Training Scheme

Trainings are arranged on a scheme covering trainings for basics, junior and senior. Basics trainings are prepared for personnels with working experience less than 3 years, trainings for junior are for those with working experience in a range of 3-6 years, while trainings for senior are for those with working experience more than 6 years. Trainings in the competence fields are arranged in categories of basic, intermediate and advance. Table 1 shows the scheme for regular trainings for research reactor personnels. The scheme covers training for specializations of RR Operation, Maintenance and Safety, as well.

TABLE I: Training Scheme for RR Personnel.

Specialization	Topic of Trainings		
	Basic ~ 3 years	Junior 3 ~ 6 years	Senior 6 ~ years
Operation	Radiation Protection	Reactor Operator Reactor Kinetics and Dynamics Thermohydraulics Reactor Heat Transfer	Reactor Supervisor Radioactive waste management Safety of Installation Operation Reactor core modelling
Maintenance	Radiation Measurements Working Health and Safety	Operator of Maintenance Reactor Reactor Instrumentation System Reactor Controlling Technique	Supervisor Maintenance Reactor Safety of Installation Operation Design Reactor Control System
Safety	Basic of Nuclear Safety Safety Culture	Radiation Protection Officer Radioactive waste management Accounting of Nuclear Material Health and Safety Specific (Thermal, Electric, Mechanic etc)	Nuclear Safety Management Safety of Installation Operation Human Performance

Furthermore, training needs have been identified for all competence fields related to research reactors: nuclear reactor as well as nuclear safety and security. These training are implemented through regular training program.

5. Identification of Potential of Nuclear Knowledge Loss

BATAN has been doing identification of critical knowledge as well as knowledge with potential loss. Information obtained from this identification process will be used to define training program and to define training delivery method. Table 2 shows the results of this identification.

TABLE 2. Critical Knowledges and Knowledge with Potential Loss.

RR	Critical Knowledge	Potential Knowledge Loss
A	Reactor core physics (Neutronic and Thermohydraulic Analysis), Radiation safety, Radiometric analysis, Process of radioisotopes (extraction of Tc-99m, Iodine-131, P-32, Br-82 etc.), Marked-substances production, Radiochemistry, Radiometric analysis, Treatment of TRIGA Instrumentation and Control Systems, Calculation of fuel burn-up	Calculation of reactor fuel burn-up, Neutron flux measurement, NDT for ageing management, Analysis and development of Neutronic and thermohydraulics, Nuclear Instrumentation
B	Reactor physics, Neutronic R & D, Reactor dosimetry, Core management, Reactor safety, Instrumentation and control, Reactor system technology, Operation and maintenance and utilization of reactor, Reactor technology, Reactor instrumentation and control.	Reactor Physics, Neutronic R & D, Reactor Dosimetry, Core Management, Reactor Safety, Instrumentation and Control, Reactor System Technology, Operation and Maintenance, and Utilization of Reactor Safety and security of radiation, nuclear and safeguard, Safety of transportation of radioactive substances and nuclear materials,

RR	Critical Knowledge	Potential Knowledge Loss
		Engineering of nuclear devices and facilities, Chemical process engineering
C	Accounting of nuclear materials and reactor irradiation services, Electrical, Mechanical, Instrumentation and reactor control, Waste control of reactor facilities, and Safety of reactor operations	Radioactive waste control of reactor facilities, Pre and post irradiation services

The column of RR means the name of each research reactors that are not to be disclosed here.

In order to handle the possibility of knowledge loss, BATAN takes actions as the following:

1. Education program for pursuing higher academi degrees is focused on subjects of critical knowledges.
2. Training program using the support of the Ministry of Research, Technology and Higher Education is focused on the subjects of knowledge with potential loss.
3. Managing coaching and mentoring on the subjects of knowledge with potential loss.
4. Knowledge sharing by personnels who will be retired in 2-3 years ahead.
5. Intesifying utilization of knowledge network with the IAEA, ICERR and others.
6. Request the IAEA to support the implementation of nuclear knowledge management (NKM).

6. Conclusion

Competence development of research reactors (RR) personnels in Indonesia is very important in order to operate and maintain the research reactors in safe, secure and sustainable manner. The research reactors roles are very important for Indonesian nuclear program. A training scheme for RR personnels has been established and implemented in regular basis to be in compliance with the regulation. A self assessment on human reources has been done and the result showed indication of demotivation and decline in employee competence since there are no major programs in the last 25 years, ageing of employees because of moratorium program for new recruitment, limited competency budgets, as well as existence of potential of knowledge lost.

In order to handle the possible occurrence of knowledge loss, BATAN takes a policy and plan as follows: Education program is done to critical knowledges, Training program is focused on the subjects of critical knowledge and knowledge with potential loss, Managing coaching and mentoring on the subjects of knowledge with potential loss, Knowledge sharing by personnels who will be retired in 2-3 years ahead, Intesifying utilization of knowledge network with the IAEA, ICERR and others, Request the IAEA to support the implementation of nuclear knowledge management (NKM).

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