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Workforce Planning and Capacity Building of Rooppur Nuclear Power Plant

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Abstract

Human Resource Development (HRD) and management is one of the key nuclear infrastructure issues for any nuclear power program especially for a newcomer country. Bangladesh government has taken firm decision to establish a Nuclear Power Plant (NPP) and signed a general contract to construct a NPP of 2400 MWe (two units of 1200 MWe each) at Rooppur under government ownership through technical and financial bi-lateral cooperation with Russian Federation. Both units are scheduled to be operational by 2024. As an embarking country, HRD has led to a vital issue for sustainability of nuclear power program in Bangladesh. Though Bangladesh has many years of experience in operating research reactors, the national nuclear HRD strategies were not well formulated. So, it was a great challenge to start a nuclear power program in Bangladesh. Despite the limitations, a well-structured and well-articulated HRD plan have been developed for Rooppur NPP operation and maintenance with the cooperation of experienced vendor country. This paper is aiming to discuss how Bangladesh as a newcomer country developed the HRD strategy for Rooppur NPP.

Keywords: Nuclear power plant; Human resource development; General contract

Introduction

Energy is considered as one of the crucial factors for socio-economic development. United Nations recently adopted 17 goals for sustainable development emphasized on access to affordable, reliable, sustainable, and modern energy for all [1]. As one of the developing countries, Bangladesh has an aspiration to upgrade as a middle-income country by 2021, but solution of power shortage is a key issue. To meet the growing energy demand, Bangladesh government has taken a firm decision to embark on the nuclear power program to reduce the dependency on the conventional fossil sources and for long term sustainable development [2]. For implementation of nuclear power program, Bangladesh Atomic Energy Commission (BAEC) as a Customer has signed a general contract to construct a Nuclear Power Plant of 2400 MWe (two units of 1200 MWe each) at Rooppur under the Government ownership through technical and financial bi-lateral cooperation with the Rosatom state corporation engineering division JSC Atomstroyexport (JSC ASE) Russian Federation as a Contractor [3]. Both NPP units are scheduled to be operational by 2024. As a newcomer country, human resource development is one of the big challenges for the nuclear power program and according to the general contract, the Contractor (JSC ASE) shall carry out the professional training of the customer's (BAEC) personnel and elaborate the training materials to such extent that they shall acquire required professional skills (competencies) needed for all the areas of Rooppur NPP construction, commissioning, operation, maintenance & repair. To achieve those competencies of the personnel, within the framework of the general contract, the contractor uses the graded Systematic Approach to Training (SAT) applicable at present NPP in Russian Federation and NPP under construction abroad with the Russian participation, taking into account international experiences and International Atomic Energy Agency (IAEA) recommendations [4]. With the cooperation of experienced vendor country, a well-structured workforce and Human Resource Development (HRD) planning have been designed for Rooppur NPP. The main objectives of this article are aiming to discuss the workforce planning & training and how Bangladesh overcomes the difficulties and challenges of HRD for sustainable nuclear power program as a newcomer country.

Workforce Planning for Rooppur NPP

Nuclear industry is widely knowledge-based. It requires different interdisciplinary professionals to design, construct, operation, and maintenance of nuclear power program. It is an obvious constraint for a country that embarked on nuclear power program to provide qualified nuclear professionals. Though BAEC has a long experience to operate a nuclear research reactor since 1986 and several departments have experience on different technological expertise on nuclear reactor design and engineering, health physics, nuclear instrumentation and control, radioactive waste management etc. but were not capable to provide all the qualified professionals for new nuclear power program in Bangladesh. To meet the requirements of the competent manpower for Rooppur NPP construction, commissioning, operation and maintenance activities, a detail workforce planning has been adopted with the cooperation of experienced Russian vendor country and IAEA recommendations. A typical resource requirements profile for NPP operating organization presented as per IAEA guideline is shown in Figure 1 [5].

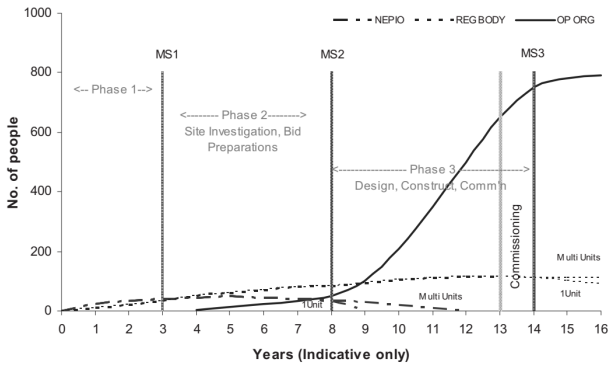

Figure 1: Typical phasing of resource requirements.

To implement the workforce training and HR development of Rooppur NPP, a new company namely Nuclear Power Plant Company Bangladesh Limited (NPCBL) has been established which will act as an operating organization (starting from Commissioning stage to operation and maintenance of the Plant) for Rooppur NPP [6].

The total of 2700 personnel in different categories are primarily identified for NPCBL. Among them, 2535 personnel are being recruited and trained year by year for project management, commissioning, operation and maintenance activities at Rooppur NPP Site and rest for NPCBL head office administration. A total of 1424 key personnel for Main Control Room operation, Fuel-handling, Safety, Chemical and Radioactive waste management, and Automated Process Control System (APCS) training planning have been developed by the vendor at different training facilities in Russian Federation and Rooppur NPP training center under the framework of the general contract. On the other hand, 1111 administrative and common industrial personnel as well as general supporting staffs will be trained as required by the customer's trained instructors at Rooppur NPP training centre in Bangladesh [7]. Detail with categories is depicted in Table 1.

Category	Description of Categories	No of Personnel	No of Personnel
Key personnel to be trained by the Contractor in the Russian Federation under the framework of the signed General Contract	Personnel who provide reactor plant operation, perform the works related to fuel handling, radioactive waste, and substances handling	488	1424
	Common-industrial personnel who provide production electrical and thermal energy.	936	
Common industrial personnel as well as general supporting staffs will be trained by the Bangladesh Atomic Energy Commission's (BAEC) trained instructors in Bangladesh as required	Common-industrial personnel who provide the NPP functioning, production of electrical and thermal energy.	572	1111
	Administrative personnel	236	
	General Supporting Staff	303	
Personnel for Rooppur NPP operation and maintenance		2535	2535
Personnel for Headquarter of NPCBL		165	
Total personnel		2700	

Table 1: Personnel required for the Rooppur NPP operating organization, NPCBL.

The key personnel recruitment and their training programme for NPCBL have been developed by year-wise schedule for the period of 2018 to 2022 under the general contract.

To recruit the required workforce and implement the training program under the scope of the general contract, a rigorous study has been done to find out the suitable education criteria of the trainees based on the educational discipline available at the different academic institutions in Bangladesh which shown in Figures 2-4 [7].

The recruitment for NPCBL is on-going based on the construction schedule of Rooppur NPP and requirements of training programme under the general contract.

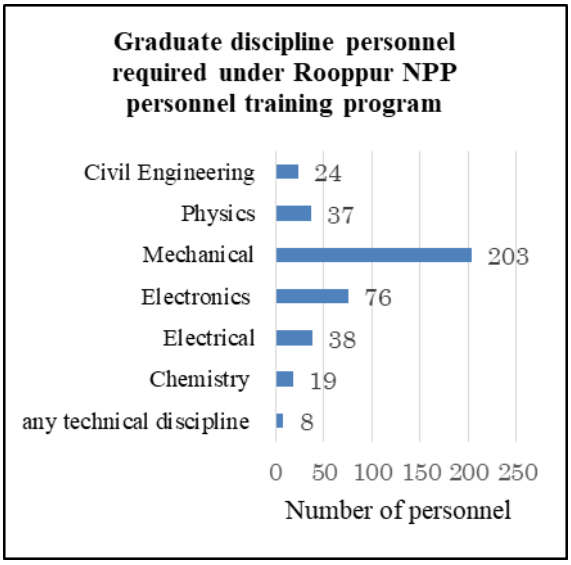

Figure 2: Graduate personnel required Rooppur NPP personnel training program.

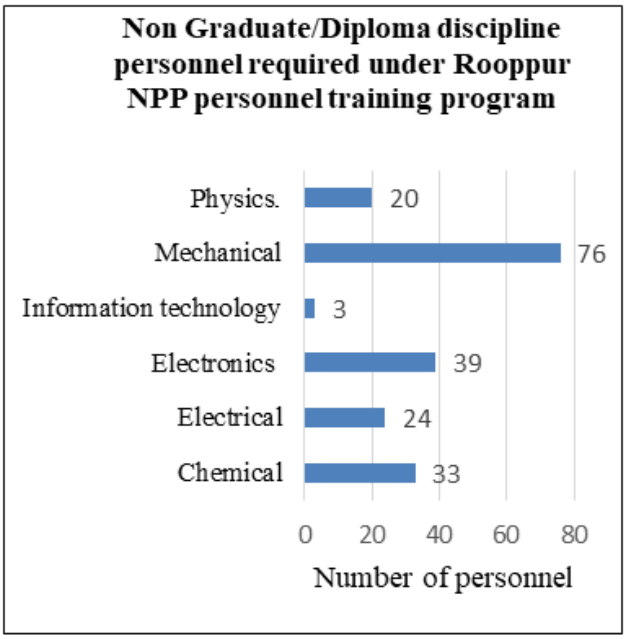

Figure 3: Non-graduate/diploma personnel required for Rooppur NPP personnel training.

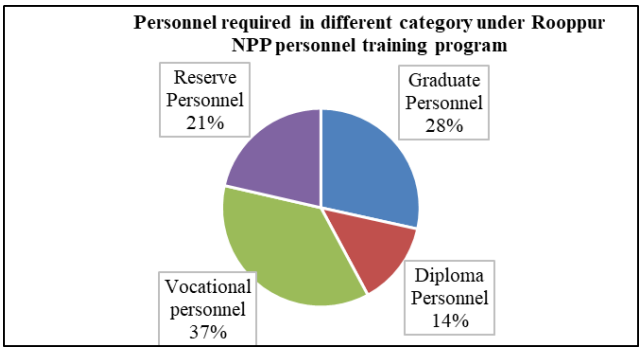

Figure 4: Personnel required in different category under Rooppur NPP personnel training program.

Training Planning for Rooppur NPP

The designed professional training program will develop the necessary competencies of the Rooppur NPP personnel prior to be assigned in NPP job position independently. The training program was developed based on the requirements of regulatory body and operating organization. As an embarking country, Bangladesh has taken Novovoronezh NPP-II as reference plant for Rooppur NPP according to international practices. Training programs for Rooppur NPP personnel based on the reference plant were developed considering the updated Systematic Approach to Training (SAT) methodology [8]. In comparison with training program of reference NPP, following approaches were adopted to develop the Rooppur NPP training program and training materials considering the lack of basic nuclear education and work experience in NPP of the trainees.

- Number of the training courses increased and their content expanded
- Duration of training courses increased
- Technical support of the training courses, including maximum visibility and visualization of training materials increased
- Practical training using the automated training system, full scale simulator and analytical simulators of NPP systems and equipment, local control room's simulators, equipment of classes, workshops on maintenance and repair, on-job-training at the reference NPP under operation increased.

To develop competent manpower for Rooppur NPP, phase by phase training system approach has been adopted, to achieve the required competencies such as knowledge, skill, and attitudes.

First phase training

Necessary competencies (knowledge, skills and attitudes) of the Rooppur NPP personnel shall be developed on reference NPP in the Russian Federation using appropriate training basis which includes following training module:

- Theoretical training including computer training classes
- Practical training
- Full Scale Simulator (FSS) and Analytical Simulator (AS) training including NPP systems and equipment simulators
- On-the-Job training for relevant positions

Second phase training

Training in this phase will be conducted on the differences in design of Rooppur NPP and reference NPP at Rooppur NPP training centre and personnel competencies will be developed by participating in construction, erection, adjustment and commissioning works of Rooppur NPP.

Trained manpower required for different areas such as operation, nuclear safety and reliability, training, maintenance, chemical, technical services, electrical and instrumentation division of Rooppur NPP were identified meticulously which is shown in Figure 5.

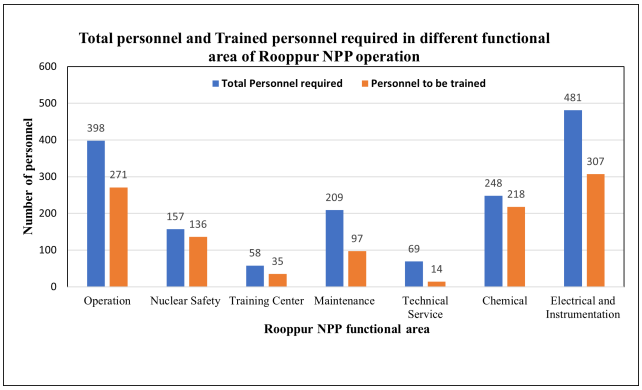

Figure 5: Total personnel and trained personnel required in different functional area of Rooppur NPP unit 1 and 2 operations.

Year-wise training programme for Rooppur NPP personnel training under the general contract is shown in Figure 6

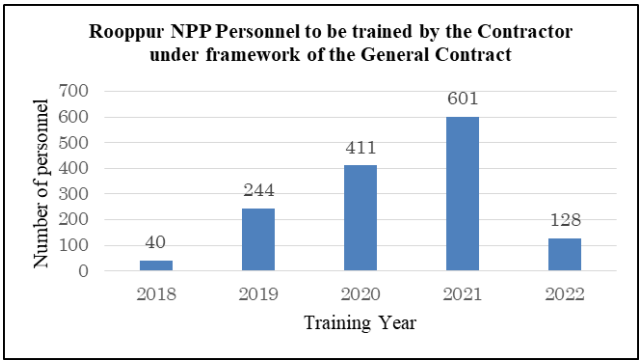

Figure 6: Year-wise training programme for Rooppur NPP personnel training.

Implementation of Training Programme

Status of training programme

As of December 2020, total of 454 personnel has been sent to the contractor's training center in Russian Federation for training. Already 315 of them returned to the Rooppur NPP site after completion of their different stages of training and 139 are presently on the training. Personnel selection and commencement of their training are based on the requirements of construction schedule and duration of the training programme. As per training program, Rooppur NPP personnel has participated training in the following areas of the Rooppur NPP shown in Figure 8 [11].

Figure 8: Personnel sent for training in Russia for different functional area of Rooppur NPP as of December 2020.

- Civil construction and management personnel in 3 different groups have been sent to Russian Federation for training. After completion of their training, they returned and engaged in Rooppur NPP construction work.
- Personnel related to Main Control Room (MCR) operation has been sent and they will complete their training in different stages (at reference NPP and Rooppur NPP). They already completed their first stage and returned to Rooppur NPP Site to participate in the construction and erection works. Those MCR operation personnel will complete their training before the commissioning of Rooppur NPP.
- Personnel for Rooppur NPP training center have been sent in several groups. They will work as manager and instructors. Few of them responsible for training center management have already returned and they are now participating in the erection of training center equipment and acceptance of the training center.

Competency development for commissioning and operation of Rooppur NPP personnel

After completion of training or stages of training in the Russian Federation, the personnel will perform the following task during construction and commissioning stages of Rooppur NPP [12].

- Studying basic design, relevant reference material and regulatory documents and standards.
- Participation in construction and erection supervision.
- Participation in equipment inspection at Rooppur NPP Site and Long-Term Manufacturing Equipment (LTME) inspection at the manufacturing factory.
- Participation in review of respective documentation on commissioning works and operation.
- Participation in supervision of installation works of respective departments.
- Development of job regulation and job description as per organizational structure of the Rooppur NPP.

The personnel having participation in above function would achieve the competency to perform the commissioning and operational activities of Rooppur NPP.

For commissioning works, the contractor shall bear full responsibilities and perform the commissioning of the units by its own efforts in compliance with the requirements of relevant codes and standards with the participation of the Customer's operational personnel. It will be performed according to operating manuals of systems and the equipment of the NPP and Start Up and Adjustment Work (SAW) programme. There will be several tests programme that include equipment autonomous testing, integrated testing and system test programs including cold and hot run. Detailed protocol will be developed for each test program which contains objectives, procedural activities to perform the tests and final outcome with reference values. In this stage, the Rooppur NPP personnel should have enough confidence and knowledge, especially to understand each stage of the test programme and verify the results with the reference data. The commissioning stage will play a crucial role in enhancing the knowledge and skills of the operation and maintenance personnel of the Rooppur NPP.

After successful commissioning, there will be the provisional takeover of the power plant to the customer who will bear its responsibility and the contractor will play supporting role until the final takeover. Detailed job descriptions and regulations will be available for each position of the power plant by that time. Above all, extensive qualification maintenance programme is now going-on to abreast the personnel to refresh their learnt knowledge and skills. It is expected that during the operational stage, the personnel will have enough experience and skills to work independently as their job duties. However, for certain key positions, specialized consultants will be required to help the Rooppur NPP operating personnel for a limited time period.

Conclusion

There are certain difficulties for a country embarking on nuclear power program to provide the adequate skilled manpower for construction, commissioning, and operation of NPP. A knowledgeable and qualified vendor can play a vital role to overcome those shortcomings for a newcomer country. In this situation, Bangladesh got the opportunity to sign the general contract with the experienced Russian vendor who is also responsible for the development of required competent manpower for Rooppur NPP commissioning and operational activities. Moreover, Bangladesh government has a strong political and financial commitment to carry out this highly technological nuclear power program for upgrading the country's economy.

Acknowledgments

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