



## NUCLEAR KNOWLEDGE MANAGEMENT AND PRESERVATION: A CASE STUDY OF PAKISTAN

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The nuclear knowledge management (NKM) has become a major growing issue in the IAEA's Agenda. The use of nuclear technology in variety of application related to sustainable development, demands the preservation of nuclear knowledge. In developing countries the use of nuclear technology is much smaller compared to developed world. The nuclear knowledge management situation in the developing countries are not understood clearly. In case of Pakistan, the nuclear technology is being used in many areas of human need. These include energy, agricultural, medical and industrial applications. Also by the end of third decade, the authorities have set target to go for generating electricity through nuclear technology near to 800 MW. NKM is also vital for the new generation to understand the technology from elder's experiences and through proper knowledge preservation. This could only be done by adopting a proper nuclear knowledge management strategy.

**Keywords :** Nuclear Knowledge Management (NKM), Preservation, INIS, Pakistan

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### 1. Introduction

The preservation of information and management of nuclear knowledge is an important issue as it is useful for the future generation to utilize this technology in befitting manner. This issue has become important in the current agenda of International Atomic Energy Agency (IAEA). In most part of the world, where nuclear technology is being used, many senior officials have either been retired or near to superannuation. These people with vast experience have not transformed their knowledge about the technology in the form of retrievable documents and the information and knowledge remain in their minds and depend on their personality. This tacit knowledge has to be extracted and transformed into same retrievable document format. This is an important task and that is why IAEA has shown its concern over the issue and organized two important conferences on Nuclear Knowledge Management (NKM), so that the concerned people should think seriously about the issue. The Agency has also established NKM part in its Headquarters within the INIS and NKM section, so that the matter related to NKM be handled separately. International Nuclear Information System (INIS) in all member states has every important role to play in this regard.

The use of nuclear technology depends on the technical information in the form of scientific research, engineering analysis, design documents, operational data and regulatory reviews etc. It is also dependent on knowledge and experience embodied in people who are associated with the technology like scientists, engineers and technicians.

The nuclear knowledge did not remain static but kept on growing whereby newer designs for nuclear facilities were introduced; plant life extensions and technical upgrades took place. Research in nuclear sciences and techniques continues to add to nuclear information. All this provides knowledge that falls in the domain of what is called explicit knowledge. In addition, there is the tacit nuclear knowledge that is not documented but remains in the minds of nuclear professionals.

In Pakistan, INIS has already been actively engaged in NKM and preservation matters. INIS centre at SID, PINSTECH, is contributing voluntarily for the input preparation of INIS (IAEA). In recent years voluntary input from Pakistan has increased appreciably. But there is still need to inform people about how to preserve and manage nuclear knowledge. In the following paragraphs, various aspect of NKM problems and strategies

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about this are discussed in detail.

## 2. Definitions of Nuclear Knowledge and Tacit Knowledge

Working definition of Nuclear Knowledge as designed by IAEA:

“Knowledge” can range from technical information laid down on paper or electronically to knowledge embodied in people and their capabilities and skills. Knowledge extends beyond “information” in that knowledge also includes, the value added, that is, expertise required to turn raw (nuclear) information into an understanding of (nuclear) issues, in other words, to give the information a meaning. ‘Nuclear Knowledge’ is specially knowledge about or relevant to nuclear related activities.

One very important problem is to extract the ‘tacit’ knowledge. The tacit knowledge is defined as *the knowledge that is not laid down in any way, e.g. as documents, but sits in peoples minds, possibly not even conscious to people who have it.*

These definitions of NK and tacit knowledge are based on insight gained at the meeting of senior officials on Managing Nuclear Knowledge, IAEA, June 2002 [3].

## 3. Importance of Nuclear Knowledge Management for Future Generation

Nuclear knowledge is varied and extensive as it encompasses results of nuclear related scientific, technical and engineering research done all over the world; design and operational data of nuclear facilities, the maintenance records and regulatory reviews etc. From its very inception, nuclear technology demanded accuracy and precision, which in turn were reflected in higher standards of acquisition, analysis and reporting of data.

NKM is very vital for not only timely retrieval of required information at the stage of applying it, but also important for future generations. In almost all nuclear technology states, somehow nuclear knowledge has been treated semi-open form of education. Most of the techniques which are not used in common nuclear technology are in the form of tacit knowledge within the concerned scientist/engineers. The people possessing such information and experiences are retiring, hence leaving their expertise non-usable for future generations. For the development of nuclear technology, this tacit knowledge cannot be used. It

is, therefore, high time for the preservation of all knowledge related to nuclear science and technology. The important task is to extract all such expertise from the scientists/engineers/technicians and transform these into documents. IAEA has taken initiative in this regard and urged all member states to take concrete steps.

## 4. The Process of Managing Knowledge

### 4.1 *Managing knowledge as a strategic resource*

Many world renowned organizations have proven their long term competitiveness and sustainability through actively managing their core competencies as a strategic resource and much can be learnt from their experience, even within the often smaller domain of the technical cooperation programme between the Agency and its Member States. Whether one is in charge of a new product development programme for a new digital camera with a large multinational company or responsible for the successful implementation and operation of a Sterile Insect Technique programme in developing country, the elements of managing the required knowledge as a strategic core competency, remain essentially the same.

### 4.2 *The knowledge-based organization*

The above approach to organizational learning as a strategic resource, has given rise to the concept of a knowledge-based organization in which decision-making is often radically different from the former hierarchal approach where the Board or executive management delegates decision-making powers according to seniority or position within the organization. In the knowledge based organization, decision-making is placed where it can best be done and this very often leads to significant decentralization of decision-making. To accommodate this more effectively, ‘boundary-less organization’, flexible team-based structures and operating networks within the organization have evolved in many instances. Central to this approach, however, remains the ‘sharing’ of knowledge as a resource base in these organizations.

### 4.3 *Managing ‘organizational memory loss’ through knowledge preservation*

The essence of organizational memory is captured by George Santayana [4] who once said: “Those who cannot remember the past are condemned to repeat it”. Herein lies the greatest danger for us who are still active in the nuclear

world. Will we be forced to go through a second or third cycle of learning by trial and error with often expensive nuclear projects?

Knowledge or expertise associated with a technological project is generally made up from two main components. These are technical information /data and tacit learning/ specialist skills. Each component need to be managed differently as a strategic resource.

## 5. Challenges in NKM

In IAEA 46<sup>th</sup> general conference, member states requested the secretariat that:

- To further increase the level of attention given to activities for preserving and enhancing nuclear knowledge that are and to increase the level of awareness of those activities;
- To assist in their efforts to ensure the preservation of nuclear education and training for peaceful purposes, which is a necessary prerequisite for succession planning;
- To promote the networking of institutions for nuclear education and training;
- To evaluate the relevance of currently on-going programmes and activities aimed at addressing common problems identified by member states regarding the preservation and enhancement of nuclear knowledge and to identify approaches aimed at addressing the problems.

To meet all these challenges it requires strong motivation of member states.

## 6. Nuclear Knowledge Management and Preservation, in Developing Countries; Pakistan's Case

Though with limited resources and meager funds, which can be spared for such activities, Pakistan has tried to maintain all the nuclear related data/information in proper record form. But there is still much required to be done. This is not only the case with Pakistan but all the countries in developing world have almost the same situation.

In preserving knowledge, there should be many stages which need to be followed. Nuclear knowledge has to be managed according to the categories, nuclear power plants, nuclear safety, basic nuclear knowledge and decommissioning of nuclear power plants. Pakistan is supporting all such initiatives of knowledge preservation and

contributing to strengthen INIS database which is a comprehensive nuclear related database for all documents.

### 6.1 Capacity building

To acquire nuclear knowledge, developing countries will continue to look towards the developed countries while concentrating on their own indigenous capabilities [1]. However, a future for nuclear technology in these countries would require capacity building measures like improving general scientific education, providing trade training where necessary, and developing the related infrastructure.

### 6.2 Providing requisite education/training to the new entrants

A major problem faced with introducing nuclear engineering education at the university level is that the students do not foresee a career in nuclear technology and shy away. Pakistan Atomic Energy Commission (PAEC), which is largely responsible for the development of the nuclear programme of the country, has established its own training/education programmes which do not rely on the universities to provide nuclear engineering education. For this purpose, training institutes have been set up and affiliated with the universities. After nearly 30 years of experience and programme expansion, one of the institutes has been granted a degree awarding status while others remain affiliated with one of the leading engineering universities of the country.

### 6.3 Role of INIS in developing countries like Pakistan

International Nuclear Information System (INIS) of IAEA, being very comprehensive nuclear document resources system, can contribute very much in preserving nuclear knowledge and its easy access to the nuclear technologists. The decentralization approach of INIS provides leverage to national INIS centres to select literature to the INIS database that fall under INIS subject scope.

In countries like Pakistan INIS is contributing but there is still much to do. The annual input in INIS database is increasing and voluntarily contribution of Pakistan to IAEA INIS centres is also within the top six countries of the world. INIS can play an important role in countries like Pakistan to aware the people in nuclear sector about the importance of NKM. Modernizing the

INIS centres in developing countries would increase the efficient usage of INIS centres for documenting nuclear related information. INIS, being part of IAEA, has already been part of Nuclear Knowledge Management initiatives of the Agency.

### **7. How National Policies be designed for NKM?**

In an excellent paper presented at International Conference on NKM in France 2004, eminent scientist of Pakistan, Dr. Ishfaq Ahmad emphasized the need of taking initiatives to manage nuclear knowledge. He gave an overview of how nuclear knowledge is different from nuclear information. In developing countries governmental authorities should design policies so that NKM and knowledge preservation issues can be addressed. Human errors in accidents are directly or indirectly related to lack of knowledge of the operator or inadequacies in the process and operational system. In order to realize the nuclear future, which may be the only viable future for us, it is essential to manage and mobilize nuclear knowledge, which is the common heritage of mankind. If mismanaged, nuclear technology can indeed be catastrophic.

In Pakistan, the Pakistan Atomic Energy Commission (PAEC) is the organization mainly responsible for most of the applications of nuclear science and technology. PAEC has already started inducting new younger people so that they may get experience and knowledge from those who are retiring. The necessary attractions to the people joining in nuclear side are being provided. In this regard salary package of the employees have already been revised and made more attractive to the younger generation. Also, PAEC has taken initiative to re-employ scientists/technologist after retirement in the capacity of advisory pool so that the tacit knowledge possessed by them in different area of nuclear science and technology can become available to new scientists. This is a very positive step taken by PAEC in agreement with the

IAEA concerns over preservation of nuclear knowledge.

### **8. Conclusions**

One can conclude from the above discussion that the precise information about the past experiences of the nuclear technological development is essential for the smooth running of present nuclear installations as well as for the future development of nuclear technology, which has variety of peaceful applications for sustainable development. Strengthening of NKM culture, preservation of nuclear knowledge and extracting tacit knowledge from the experienced professionals is the key to success in managing nuclear knowledge for future generation. Another area of focused interest at the IAEA should be strengthening and modernizing of INIS by way of consolidating its data/information base through state of the art linkages with WANO and similar nuclear information resources. National Nuclear Information Services should be strengthened with active support of INIS. Yet another initiative that can be taken would be for the IAEA to forge a closer relationship with the International Nuclear Society as well as national nuclear societies particularly for sharing of tacit Nuclear Knowledge and its conversion into explicit knowledge. Lastly IAEA should help strengthening NKM culture amongst Member States. Special Nuclear Knowledge Fund may be created to support in-house NKM within the Agency and in Member States.

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