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Knowledge Management in Fast Reactors

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Abstract

This paper highlights the work that is being carried out in Knowledge Management of Fast Reactors at Indira Gandhi Centre for Atomic Research (IGCAR) including a few examples of how the knowledge acquired because of various incidents in the initial years has been utilized for the successful operation of Fast Breeder Test Reactor. It also briefly refers to the features of the IAEA initiative on the preservation of Knowledge in the area of Fast Reactors in the form of 'Fast Reactor Knowledge Organization System' (FR-KOS), which is based on a taxonomy for storage and mining of Fast Reactor Knowledge.

Key words: Knowledge management system; fast reactor knowledge organization system

1. Introduction

Knowledge management is an integrated and systematic approach for identifying, managing, archiving, sharing and leveraging an organization's knowledge collectively in order to help and achieve the mission and vision of the organization. Knowledge Management in the context of Nuclear Industry acquires much more important role compared to other organizations, because of the long time scales involved, high technological excellence required, stringent safety regulations, difficulties in attracting and retaining talented work force etc. Added to this, there is always a challenge to improve the safety and reduce the unit energy cost.

The emergence of the knowledge management function as a core discipline is started with Peter Drucker's famous quote in the Post Capitalist Society, "The basic economic resource – the means of production – is no longer capital, nor natural resources, nor labour. It is and it will be Knowledge" [1]. Today all proactive organizations have identified knowledge management as a strategic initiative to create, share and preserve organizational knowledge.

Knowledge is classified into two types. They are explicit knowledge and tacit knowledge. According to Nonanka "explicit knowledge is the knowledge that is easily expressed, captured stored and reused. In contrast, tacit knowledge is highly personal. It is hard to formalize and therefore difficult to communicate to others." [2]. For Nonanka tacit and explicit knowledge are not separate but mutually complimentary entities. They interact with each other in the creative activities of human beings. Nonanka calls this as the knowledge conversion process. This conversion process consists of socialization, externalization, combination and internalization.

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Knowledge management initiatives can be classified into two main types, based on the way the knowledge is shared. One method is called the codification approach where the strategy is people to document and document to people and the other method is called personalization approach, where the strategy is people to people. A holistic approach to knowledge management should address both the methods. This paper discusses both types of knowledge management activities at Indira Gandhi Centre for Atomic Research.

2. Knowledge management initiatives at IGCAR

Indira Gandhi Centre for Atomic Research(IGCAR) is actively engaged in various activities like design and development of 500 MWe Fast Breeder Reactor; operation and maintenance of Fast Breeder Test Reactor; Fast Reactor Technology Development; design, development and characterization of materials for fast reactor technology; nuclear fuel reprocessing; radiological and engineering safety in fast reactors and associated fuel cycle facilities; study of chemical behaviour of fuels, coolants, structural materials; design and development of instrumentation and control systems for fast reactors; design and development of simulator etc.

Currently more than 2500 employees out of which about 1000 scientists/engineers are working in various frontline R&D projects of national importance. Hence collaboration and knowledge sharing among them is of paramount importance, in avoiding the 'reinvention of the wheel', preventing 'silo' and 'not invented here' syndrome and thus achieving excellent synergy, significant improvement in performance and high level of employee morale, satisfaction& loyalty. Also IGCAR is engaged in many collaborative projects with leading academic institutions and R&D organizations. Many leading suppliers are extending valuable support to IGCAR in realizing its mission.

3. Knowledge management policy

In order to meet the growing demands of the Research Centre, through performance improvement by leveraging knowledge, the formal knowledge management activities at IGCAR were started a few years back. Recognizing the importance of knowledge management, IGCAR has formulated and adopted a policy to create, share, utilize and leverage the organizational knowledge to achieve world class leadership in the fields of Fast Reactor Technology and associated fuel cycles. The policy aims to achieve higher quality, productivity and better collaboration through the synergy of knowledge, resources, facilities and employees in spite of attrition.

4. Knowledge management system

A Knowledge Management System(KMS) is implemented to meet the needs of the entire organization, with the diverse activities like research, design, development, project execution, support services etc. by providing the right knowledge to the right person in right time in right form. A task force consisting of knowledge officers from various groups, was formed to oversee the progress in (KMS) implementation. Currently interlinked Knowledge Management Servers are installed in all the Groups. Knowledge modules in the form of design reports, publications, presentations, activities, facilities etc. are made available in the server. Regular knowledge sharing sessions are held in various Divisions/ Groups and those details including the presentations are made available. Elicitation of tacit knowledge from serving and retired senior officials is being done through interviews, report generation, audio/video recording etc. and made available in the KMS. Also links to tacit knowledge in the form of profile, research interests and contact details are made available. The home page of the KM portal at IGCAR is depicted in figure1.

Fig.1.KM Portal Home page

A Knowledge Management System for the preservation and utilization of the construction knowledge of Prototype Fast Breeder Reactor(PFBR) was developed and implemented. Currently the minutes of various task forces are made available with facilities for search by key word, meeting number, Component, Supplier etc. The system is password protected. Facilities are provided for submitting user feedbacks. The feedbacks given by various users were implemented. The utilization of the system can be monitored online.

The experience gained while operating the FBTR is codified and stored in the server, which has helped in avoiding the recurrence of many incidents. Also the knowledge gained in many areas like reprocessing, materials development, engineering development, fuel & material chemistry, safety engineering etc. has given significant inputs for the design of PFBR, Fuel Cycle Facility etc.

5. Fast reactor knowledge organization system

The International Atomic Energy Agency(IAEA) took an initiative to coordinate the preservation of Fast Reactor knowledge in the form of Fast Reactor Knowledge Organization System(FR-KOS), to be established and maintained by IAEA. IGCAR intends to actively participate in the FR-KOS. It is based on the taxonomy intended to guide experts and will help research and development, educational and industrial organizations to facilitate the process of FR knowledge mining [3]. FR-KOS consists of an electronic repository of FR knowledge and experience from various countries with facilities for effective search and knowledge mining. The knowledge in FR-KOS is organized based on the metadata of the original document in a hierarchical structure, as depicted in figure.2. and Table 1

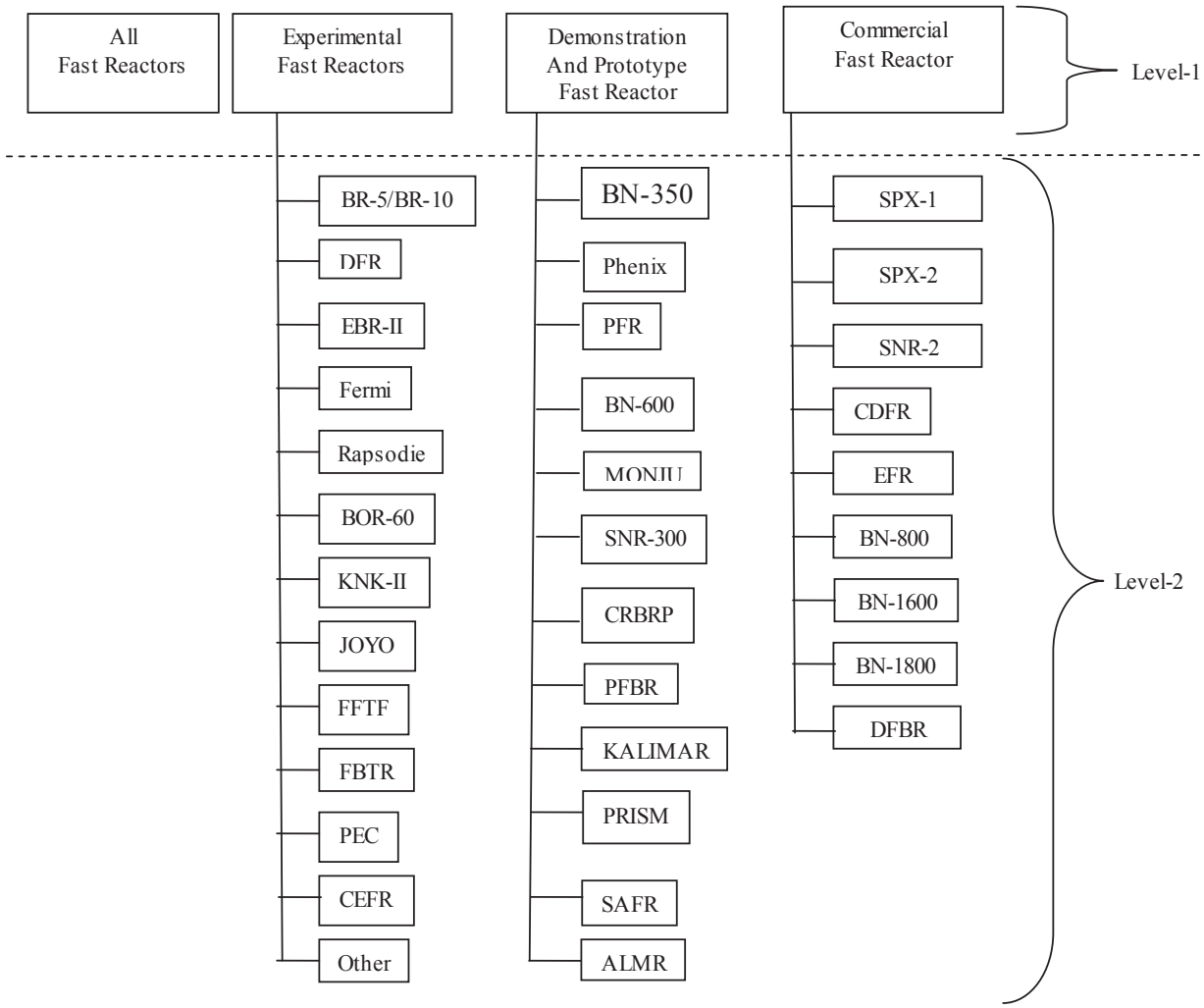

Fig.2.The first two levels of FR- taxonomy (adapted from [3])

Table.1.The structure of the two top levels of the topic-stage matrix(adapted from [3]).

Basic Principles	*R&D*	*Design, Analysis, Licensing*	*Manufacturing and Construction*	*Fuel Cycle*	*Operation*	*Decommiss-ioning*
Fast Fission	Reactor Physics	General System Criteria	Site Development	Waste Management	Cold Startup	Planning
Basic Design and Variations	Fuel and Materials	Codes and Standards	Components manufacturing	Transport	Low Power Commissioning	Experience
Safety Principles and philosophy	Heat Transfer and Transport Systems	Core Design	Plant Assembly		Full Power Operation	
	Pipe Integrity	Dynamic Analysis	Balance of plant		Environmental Impact	
	Seismic Analysis	Environmental Impact	Inspection		Maintenance	
	Accident Analysis	System Design Description	Codes and Standards		Off-normal and emergency Operation	
	Sodium Fire	Demonstration of Safety			Failed Fuel Detection	
	BDB events	Project cost analysis (economics)			Fuel Handling	
	Control Materials	Control Systems				
	Shielding	Failed Fuel Detection				
		Shielding				

The first level classifies reactors into different types like experimental reactor, commercial reactor etc. There is also a general section containing knowledge on all fast reactor facilities, without reference to any particular reactor. The second level lists the reactors under each type. At the third level(Table I), the knowledge acquired in each reactor facility is classified into different stages like basic principles, R&D etc. At the fourth level knowledge in each stage is classified. For example the knowledge in R&D stage is classified into reactor physics, fuels and materials etc. At the fifth level the meta data pertaining to knowledge documents is placed. At the sixth level the available knowledge documents will be placed. The meta data, which is called Information Cards(IC) in FR-KOS is very comprehensive and contains information like, title, authors, type, abstract, key words , reactor facilities, reactor stages etc. which facilitates accurate placement and retrieval of knowledge.

6. Conclusion

Preservation, sharing and utilization of knowledge is a necessity for the sustenance and faster growth of fast reactors. An effective programme to manage the knowledge in the area of fast reactors will safeguard against the growing attrition, retiring workforce and changing priorities. IGCAR had taken many initiatives to preserve and share the valuable knowledge acquired during the operation of FBTR, design and development of PFBR etc. IGCAR also intends to actively participate, in the FR-KOS programme of IAEA.

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