

Strategies to Facilitate Knowledge Codification through Integrated Management System (IMS)

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Managing nuclear safety knowledge is challenging due to the uniqueness of the knowledge itself. It requires specific strategies to ensure it becomes an integral part of all nuclear activities. In general, safety knowledge that need to be managed includes both explicit (documented knowledge) and tacit (subjective knowledge) knowledge. Explicit knowledge is in the form of a formal, easily documented, systematic, and easily communicated within organization. While tacit knowledge is knowledge held by an employees in accordance with the understanding, skills (expertise), and their experience. Therefore, tacit knowledge need to be managed differently to ensure it can be properly captured, preserved and transferred to successors. This is the most difficult steps in the implementation of nuclear safety knowledge management. Tacit knowledge need to go through codification process so that it can be systematically documented and accessible in the organization. One of the strategies to facilitate tacit knowledge codification is through the implementation of Integrated Management System (IMS). IMS for safety and security is established in Malaysian Nuclear Agency (Nuclear Malaysia) to ensure nuclear safety and security matters are incorporated in managing nuclear facilities and activities. This paper looks at the role played by the IMS process in contributing to the knowledge codification within the organization.

Keywords: nuclear safety knowledge, tacit knowledge, Integrated Management System (IMS)

1. INTRODUCTION

Nuclear R&D organization like Nuclear Malaysia is facing critical challenge to maintain efficient and effective management of nuclear facilities. TRIGA PUSPATI Reactor known as RTP is the only nuclear research reactor in Malaysia and fully owned by Malaysian Government. RTP has been safely operated and maintained since 1982. The reactor was designed to provide research and training capabilities in the area of science and nuclear technology. It incorporates facilities for advanced neutron and gamma radiation studies as well as for application, including Neutron Activation Analysis (NAA), Delayed Neutron Activation Analysis (DNA), radioisotope production for medical, industrial and agricultural purposes, Neutron Radiography and Small Angle Neutron Scattering (SANS). Highly skilled and knowledgeable employees are required to ensure RTP is operated safely and securely, comply with licensing and legal requirements and deliver efficient and effective performance. It is obvious that Nuclear Malaysia rely mostly on competent employees who are specialist in their fields. Despite of having competent employees, nuclear R&D facilities also dependent on knowledge to develop new technologies and at the same time to enhance the existing technologies.

In K-economy era, knowledge become the most valuable asset to highly technical agency like Nuclear Malaysia [1] [2]. Managing the knowledge possessed by skilled employees is challenging and requires appropriate methods and strategies. This tacit knowledge can be

described as “things that we know but cannot tell” [12] and thus can only be transferred through interaction. Tacit knowledge is not easily articulated or formalized and difficult to deliver using words, text, drawings or other symbolic forms. It is considered to be more valuable than explicit knowledge and requires more cognitive effort to be transferred [13]. This paper will discuss on role played by quality system to facilitate tacit knowledge conversion.

2. INTEGRATED MANAGEMENT SYSTEM

2.1 Integrated Management System for Nuclear Organization

In general, Integrated Management System (IMS) refers to the combination all related system of management practices into one comprehensive management system for easier administration and operations. The related systems such as quality, environmental, safety, security, economy and health [8]. It provide a single framework and form one integral part of organization’s management system to address all the goals of the organization. According to IAEA, management system is defined as integration of all elements of the organization into one coherent system in order to achieve objectives of the organization efficiently and effectively. These elements include the structure, resources and processes within the organization [9].

The implementation of the Integrated Management System (IMS) was first introduced in IAEA Safety Standards Series No GS-R-3: The Management System For Facilities And Activities (Safety Requirements) in 2006. It aimed to integrate safety, health, environmental, security, quality and economic elements into a management system that focuses on safety as fundamental principle. These requirements must be met to ensure the protection of people and the environment and they are governed by the objectives, concepts and principles of the IAEA Safety Fundamentals publication. The objective of IMS is to define the requirements for establishing, implementing, assessing and continually improving a management system that integrates safety, health, environmental, security, quality and economic elements. This management system is designed in such a way that safety is not compromised and properly taken into account in all the activities of an organization.

Why IMS is so important to be implemented in nuclear organization? Basically, there are two main reasons. The first reason is nuclear organization has to give high priority to safety and security aspects in their operation compared to other organizations. The smallest error or accident that occurred during its operation may have catastrophic effects [7]. Secondly, the operation of nuclear organization also has to be complied with variety of regulation including legal and reinforcement of international and national acts. Due to these reasons, establishment of effective and efficient integrated management system is required to ensure that nuclear safety and security matters are not dealt separately, standardization in operation, persistent regulatory compliance and continual improvement for overall nuclear facilities operation.

2.2 IMS History in RTP

The history of the IMS implementation in Reaktor TRIGA PUSPATI (RTP) started way back as early as during construction period of RTP. During the period in 1979 - 1982, the manual used for the management system at that particular time was QA Program established by General Atomics (GA) of USA. The manual was corresponding to the IAEA Guideline which focused

on safety management. During the early operation period of RTP in 1982 – 2004, first manual quality program was introduced in RTP called Safety Procedure Manual under the purview of Safety, Health and Environment (SHE) Committee and IAEA through its safety missions. This manual includes the safety assurance procedures & mechanisms related to the operation of the reactor.

The dynamic of management system in RTP was shifted in 2004 when the Atomic Energy Licensing Board (AELB) had started to take in charge of licensing activity of RTP. The board had conducted regular inspections to RTP in order to ensure the compliances of licensing requirements. Under the new requirements set by the AELB, a new QA program was developed in RTP in accordance with the general requirements of the IAEA Safety of Research Reactor, Safety Series No. NS-R-4 (2005). The QA Program manual was developed and fully implemented in RTP before it was capped for a new safety series by IAEA in 2008.

Post 2008 to 2012, a new QAP Manual was established based on two main documents of international guidelines and local regulations. The manual describes the guidelines from the IAEA Safety Series No. SS-50-C/SGQ – Quality Assurance for Safety in Nuclear Power Plants and Other Nuclear Installations and the specific requirement by the relevant act, regulation and standards followed such as Act 304, OHSAS 18001 and ISO 9001:2000. It also includes the design, construction and acceptance criteria for various activities involved in the RTP operation.

The Integrated Management System (IMS) for RTP was introduced in 2012, mostly focused on human capital development. It was fully established for implementation in 2014 based on IAEA Safety Standard GS-R-3– The management system for facilities and activities. It was approved by SHE Committee in 2013 and among other activities were IAEA Expert mission, representative from LENA, Italy, fellowship through IAEA TC program, pre-Internal audit at RTP based on IMS manual, introduction of IMS to RTP members and preparation IMS program for RTP new control system called ReDICS.

The establishment of IMS programme for RTP is to ensure that all operation is adequately planned, correctly performed, can be assessed continually and improved accordingly. The program provides a systematic and integrated quality system approach in safety, health, and environment, security, financial and quality for accomplishing work with the ultimate goal of a safe, efficient and effective manner of the operation of RTP. IMS was developed in accordance to the recommendations in IAEA Safety Standards Series No. GS-R-3 (2006) and subsequently modified based on the new requirement adopted in General Safety Requirements No. GSR Part 2 (2016). It provides the main framework for the arrangements and processes necessary to address the mission, vision and goals of the organization and is considered in a coherent manner. It is developed in accordance with the following criteria:-

- i. Identification of processes and their application
- ii. Definition of the sequence and interactions between processes
- iii. Establish criteria and methods needed to ensure the effective operation and effective process control
- iv. Provision of resources and information needed to support the operation and process monitoring

- v. Monitoring, measurement and analysis of the processes themselves
- vi. Implementation of actions necessary to achieve planned results and continuous improvement

The IMS provides outline of the policies, standards and procedures which have been developed and will be adopted and it comply with the safety guidelines established by IAEA, Malaysian laws and related applicable Malaysian regulations as illustrated in Figure 1.

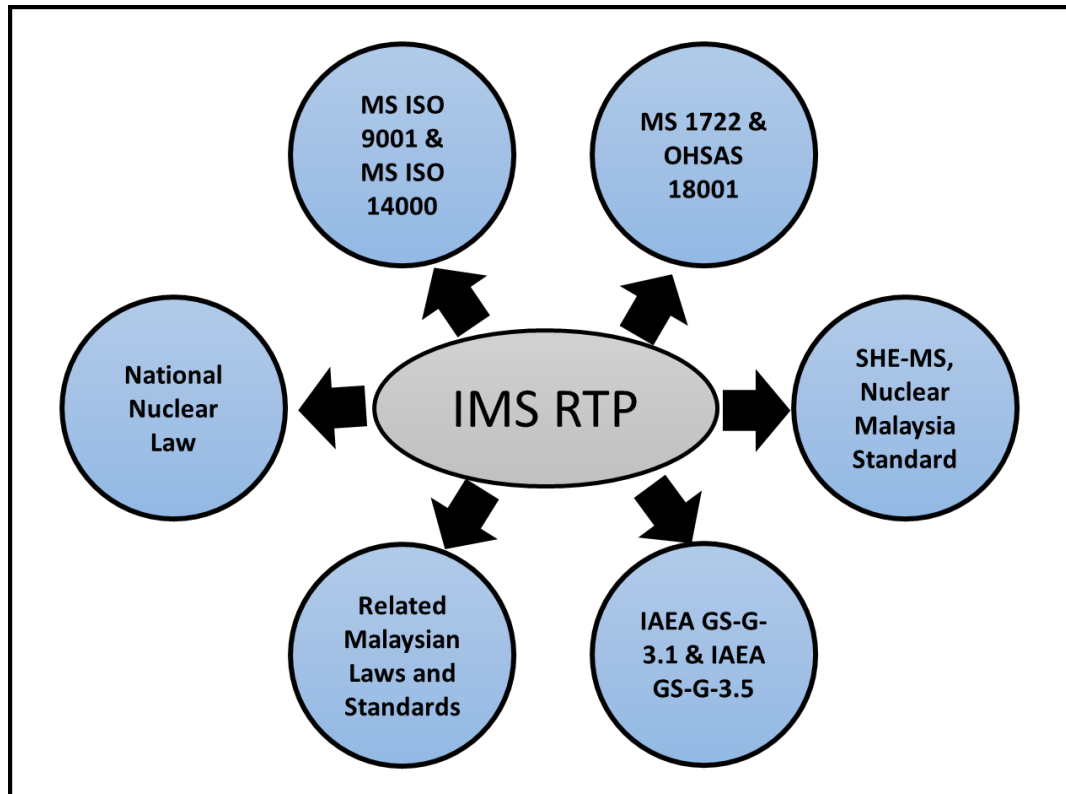


Figure 1: IMS of TRIGA Reactor [10]

One of the key elements that needs to be managed throughout IMS implementation is to manage the accumulated information from integrated system management activities. RTP developed IMS documentation system which consists set of documents that describe the overall measures established by RTP to achieve management goals and objectives. Therefore, RTP is able to organize information effectively and efficiently and at the same time manage to avoid repetition of information. The details of each document are cross-references between certain documents at the different level. A typical level of document structure at RTP is shown in figure 2.

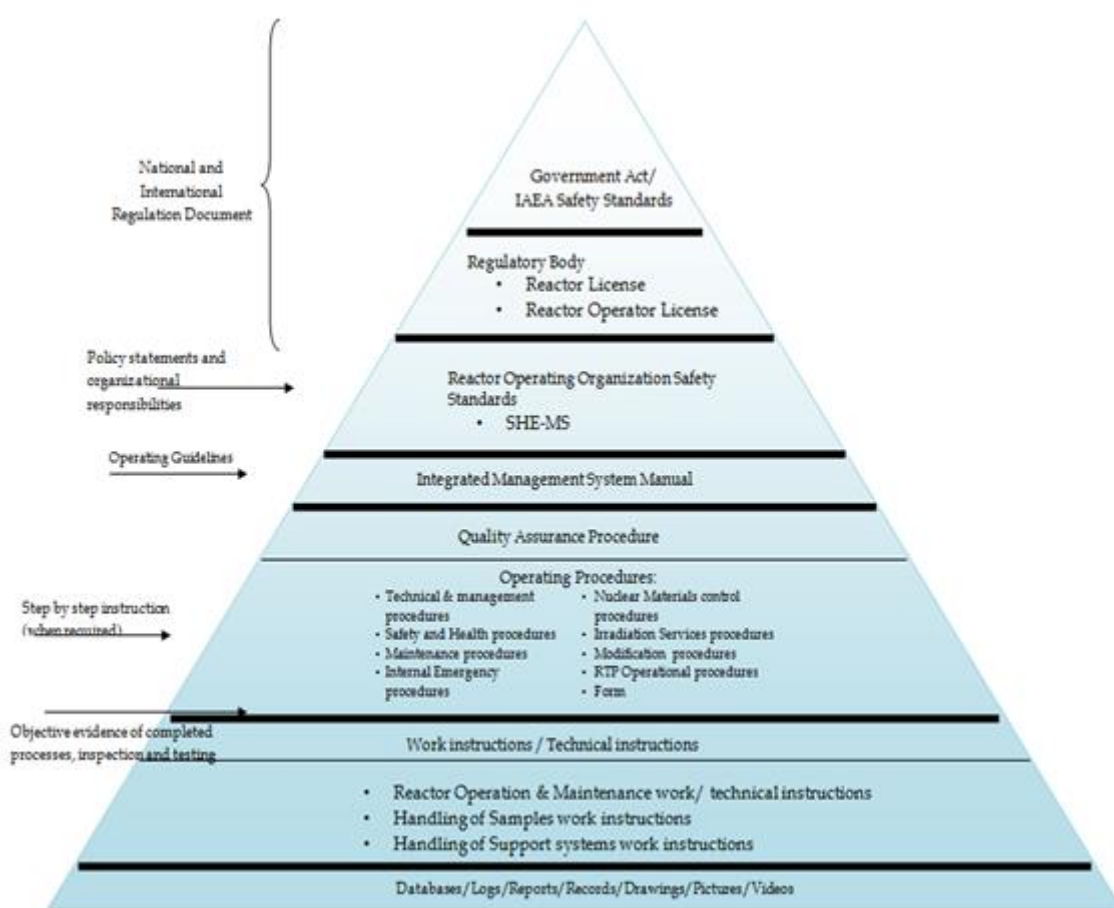


Figure 2: Structure of Quality Assurances document at RTP

3. KNOWLEDGE CODIFICATION PROCESS THROUGH IMS IMPLEMENTATION

There are many definitions of knowledge management given by scholars. In nuclear safety knowledge context, knowledge management is enabler to improve effectiveness and efficiency of nuclear facilities, activities and materials, to ultimately enhance nuclear safety. It also aimed to promote smooth flow of knowledge from where it resides, to where it is required and sharing of knowledge relevant to organization. There are two forms of knowledge namely explicit knowledge and tacit knowledge [11]. Explicit knowledge is in the form of a formal, easily documented, systematic, and easily communicated within organization. While tacit knowledge is knowledge held by an employees in accordance with the understanding, skills (expertise), and their experience. Based on literatures, tacit knowledge has to be codified into a common representation so that it can be systematically documented and accessible in the organization. Before the codification process is implemented, the organization has to consider following principles:

- i. What organizational goals will codified knowledge serve?
- ii. What knowledge exists in the organization that addresses these goals?
- iii. How useful is existing knowledge for codification?
- iv. What is the appropriate medium for codification and distribution?

Based on Nonaka & Takeuchi 1996 [11] Knowledge Transformation Model (Figure 3), there are four mode of knowledge conversion, which can provide us with the direction of knowledge codification process.

	Tacit	Explicit
Tacit	Socialization	Externalization
Explicit	Internalization	Combination

Figure 3: Four Modes of Knowledge Conversion

Table 1: Description of Knowledge Conversion

Mode	Description
Tacit to Tacit	Socialization: Creating tacit knowledge through shared direct experience.
Tacit to Explicit	Externalization: Articulating tacit knowledge through dialog and reflection
Explicit to Tacit	Internalization: Learning and acquiring new tacit knowledge by practice and simulation
Explicit to Explicit	Combination: Systematizing (collecting, reviewing, editing, connecting) explicit knowledge and information

In RTP situation, IMS implementation process is aligned with knowledge codification principles. RTP goal for IMS implementation is in line with knowledge codification requirement. RTP also has identified process, procedures, and work instruction that need to be documented to fulfil IMS requirement and RTP final goals. By using appropriate knowledge transformation mode, tacit knowledge that embedded in employee can be codified and more knowledge sharing can be captured. The IMS documentation platform can serve as knowledge repository so that knowledge can be shared and utilised within organization. The IMS implementation relate to codification process in two ways. Firstly, IMS are used as a codification tool to formalise the codified knowledge within the RTP. This is done by applying combination of knowledge transform. IMS act as enabler to codify tacit knowledge embedded in employees (externalization) and at the same time facilitate knowledge sharing through discussion about the process functioning (socialization). Secondly, the output of IMS implementation (IMS documentation) is ready to be accessed and utilized within the RTP. This will contribute to organizational learning (socialization).

4. CONCLUSION

Over the last decade, the quality system or integrated management system implementation have increased their impact on organization by increasing organization performance and contribute to continual improvement. As IMS implementation include documentation requirement, these standard also contribute to knowledge accumulation within the organization. They promote knowledge codification and formalization. The integrated management system provides guideline to establish efficient standardization and to provide learning effect in the organization.

The completion of the codification depends on several factors. One of the factor is the nature of the organization. The characteristic of nuclear facilities process and activities affect the nature of the knowledge to codify. The complexity of the codification based on the way the organization interpret and adopt the IMS requirement. The completion of codification also depends on active interpretation of the requirement within the organization. All systems involved need to have the same interpretation so that the information and knowledge required to achieve IMS goals can be mapped properly. Commitment and cooperation from other systems also give impact in identifying critical knowledge that needs to be codified to address IMS goals and at the same time to fulfil knowledge codification principle.

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