# Incorporation of nuclear knowledge management into the integrated system of quality- science and technological innovation in CUBAENERGÍA

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**Abstract**

Technical knowledge management and innovation become important tools for organizations to meet the needs and expectations of the market and society in general; especially those related to the peaceful use of nuclear energy. In 2011 and in compliance with national regulations applicable to the sector, CUBAENERGÍA began an integration management process of Scientific and Technological Innovation (UNE 166002:2006) into the already existing Quality Management System (NC-ISO 9001:2008). On the other hand the ISO 9001: 2015 includes a clause that made particular emphasis on knowledge. There is no standard for knowledge management and it does not imply either that it’s mandatory, but to develop tools to certificate a Nuclear Knowledge Management System is strategically important for any organization. This research deals with the theoretical and conceptual framework for the integration of these three systems: Scientific and Technological Innovation (UNE 166002:2006)-Quality Management System (NC-ISO 9001:2008)- Nuclear Knowledge Management System and its practical aspects in CUBAENERGÍA.

**1. Introduction**

Many institutions, such as those applying nuclear technologies, are characterized by complex processes and high social and economic impact. Consequently, the demand to implement management systems to assure efficiency and effectiveness is highly required. This is crucial to achieve their mission; based on the Deming Cycle (PDCA, plan-do-check-act) or the spiral of continuous improvement.

Managing an organization includes quality management, among other disciplines such as environmental, safety and health at work, financial, risk, knowledge management and others.

There are three disciplines that are strategic tools and determine and guarantee the status of an organization in the market: Quality Management (QM) –with the aim of satisfying the necessities and expectations of the stakeholders; R&D resulting in science and technological innovation -to offer new products and improved processes; and Knowledge Management (KM) -to be trustworthy that the involved staff have booth the knowledge and the necessary competence (training, skills and expertise).

Another current trend is to integrate all the applicable requirements to the organizations in one management system, in order to achieve higher coherence and systemic focus in the executions of the mission and its objectives. [1]

An interest for developing a quality system (QS) appropriate for R&D is manifested by various sources, such as accreditation bodies, funding organizations and others in whose interest the research is being performed. This need is conditioned by scientific, economic, human and social factors [2]. Maybe, the most pressing factor that proves the need to focus quality on research is the ever increasing impact of science and technology in modern society.

CUBAENERGÍA, Center for Information Management and Energy Development, manages projects and provides scientific and technological services that promote sustainable energy development in the country and the application of information technology. It is also the representative of Cuba on the International Nuclear Information System (INIS).

In 2011 and in compliance with national regulations applicable to the sector, CUBAENERGÍA began an integration management process of Scientific and Technological Innovation (UNE 166002:2006) into the already existing Quality Management System (NC-ISO 9001:2008).

In addition, under the research project: "PRN 7-1-3 2 Design of a Cuban System for Nuclear Knowledge Preservation and Management" (2010-2012), a knowledge management system was organized to provide a solution to the current and future challenges of nuclear development and its applications in Cuba based on: the identification of challenges of the Cuban Nuclear Program; study and implementation of Integrated Nuclear Knowledge Management Methodology (INKM: 2011) [3]; design and structure of databases to collect and process information on knowledge management and proposal of an action plan for effective management of nuclear knowledge.

During 2015 there were two events that improved CUBAENERGÍA knowledge management. The first: results of the updated INKM (2015) applied to nuclear medicine [4] and the second one: highest recognition given to knowledge management and competence management at ISO 9001: 2015 standard.

Knowledge Management has appeared as a line item in the Quality Standard ISO 9001:2015 and it is time for a KM Standard [5]. There are already various standards for KM: the British Standard Institute Guide [6], published in 2001; the Australian Standard [7], published in 2003 and the Israeli standard [8], published more recently, in 2013, but there is not an ISO standard for knowledge management.

Much work has been done by the IAEA in addressing the knowledge management needs and establishing management systems for facilities and activities of different nuclear organizations, resulting in publications that define the requirements for establishing, implementing, assessing and continually improving a management system. [9] [10] [11]

In absence of an ISO standard for knowledge management, it was necessary to adapt the Integrated Nuclear Knowledge Management Methodology (INKM: 2015), based on IAEA KM (2012), with requirements established in Australian KM Standard (2003), British KM Standard (2001) and Israeli KM Standard (2011), which resulting the indicators to be taking account in the Integrated Nuclear Knowledge Management System (INKM: 2016), as presented in this paper.

This research deals with the theoretical and conceptual framework for the integration of these three systems: Scientific and Technological Innovation (UNE 166002:2006) [12], the Quality Management System (NC-ISO 9001:2008) [13] and the Nuclear Knowledge Management System (INKM: 2016).

**2. Materials, Methods and Procedures**

Main methods and research techniques:

- Observation

- Documentary Analysis  
- Experts Criteria  
- Interviews  
- Teamwork

**3. Results and Analysis**

**3.1. Nuclear Knowledge Management System (INKM: 2016)**

A total of 4 methods were analyzed Australian KM Standard (2003), British KM Standard (2001), Israeli KM Standard (2011) and IAEA KM (2012) [6]- [9]; and ten integrated indicators of KM were established in accordance with the standard's requirements:

(1) Policy/strategy; management's commitment: responsibilities and requirements of the organization's management.

(2) Human resource (HR) planning and HR processes; resource investment-human resources and technological infrastructure required.

(3) Competence development

(4) Methods, procedures & documentation processes for improving KM; documentation- documentation goals; detailing the content documented.

(5) Technical (IT) solutions; current Knowledge Management solutions

(6) Approaches to capture/use of tacit knowledge.

(7) KM culture/workforce culture supporting KM; culture-defining our desired knowledge managing culture, diagnosing our current culture and writing a program that addresses the difference between the two.

(8) Assessing and evaluating- goals and fields of KM

(9) Knowledge Management implication- guidelines for initiation, execution and assimilation of the knowledge according to the process-based approach.

(10) Lessons learned from the organization's KM activities/measurement and evaluation

**3.2. Development of procedures and records required as requirements in standards NC/ISO 9001:2008, UNE 166002, INKM: 2016.**

**Table 1. Points of agreement of the three regulations: NC/ISO 9001:2008, UNE 166002, INKM: 2016.**

| **Requirement** | **UNE 166002:20** | **NC-ISO 9001:2008** | **INKM: 2016** |
| --- | --- | --- | --- |
| **Management system. Terms and Definitions** | 4.1.1 | Field of application.  0.3, 0.4, 1, 1.1, 1.2, 2, 3 | Introduction |
| **Management system, general requirements, documentation** | Management system R & D + i: 4.1.2- 4.1.2.2 | Quality Management system: 4, 4.1, 4.2, 4.2.1, 4.2.2, 4.2.3, 4.2.4 | (4) Methods, procedures & documentation processes for improving KM |
| **Administrator's responsibility** **Management review** | Administrator's responsibility; Policy of R & D + i: 4.2.1, 4.2.2- 4.2.6. | Administrator's responsibility to quality 5.4, 5.4.1, 5.4.2, 5, 5.1, 5.25.6, 5.6.1, 5.6.2, 5.6.3 | (1) Policy/strategy; Management's commitment: responsibilities. (8) Assessing and evaluating- goals and fields |
| **Planning** | Objectives R & D + i, system planning R & D + i 4.2.4, 4.2.4.1, 4.2.4.2 | Quality Planning  5.3, 5.5, 5.5.1, 5.5.2, 5.5.3, | (9) KM implication- guidelines for initiation, execution and assimilation of the knowledge according to the process-based approach. |
| **Resource management. Infrastructure. Work environment.** (human resource motivation, Competence) | Provision of resources  4.3, 4.3.1, 4.3.2.2, 4.3.2.3, 4.3.3, 4.3.4 | Resource management  6, 6.1, 6.2, 6.2.1, 6.2.2, 6.3, 6.4 | (2) Resources and technological infrastructure required.  (3) Competence development |
| **Product** | ProductR & D + i  4.4.1, 4.4.1.1, 4.4.1.2, 4.4.1.3, 4.4.1.4 4.4.6, 4.4.7.1, 4.4.7.2, 4.4.7.3, 4.4.8, 4.4.8.1, 4.4.8.2, 4.4.9 | Realization of the product: 7, 7.1, 7.2, 7.2.1, 7.2.2, 7.2.3, 7.3, 7.3.1, 7.3.2, 7.3.3, 7.3.4, 7.3.5, 7.3.6, 7.3.7, 7.4, 7.4.1, 7.4.2, 7.4.3, 7.5, 7.5.1, 7.5.2, 7.5.3, 7.5.4, 7.5.5 | (5) Technical (IT) solutions (6) Approaches to capture/use tacit knowledge; (7) KM culture/workforce culture supporting KM difference between the two. |
| **Measurement, analysis and improvement** | Measurement, analysis and improvement 4.2.6- 4.2.6.3 4.5.2- 4.5.6, 5.5.5, 5.5.7 | Measurement, analysis and improvement: 8, 8.1, 8.2, 8.2.1, 8.2.2, 8.2.3, 8.2.4, 8.3, 8.4, 8.5, 8.5.1, 8.5.2, 8.5.3 | (10) Lessons learned from the organization's KM activities/Measurement and evaluation |

**4. Conclusions and Recommendation**

The integrated indicators of KM, based on IAEA KM (2012) and in accordance to the standard's requirements of Australian KM Standard (2003), British KM Standard (2001) and Israeli KM Standard (2011), were defined as INKM: 2016.

It was demonstrated compatibility between the requirements of Quality, R&D and Knowledge management systems what allow the integration of those three systems and its inclusion as a unified documentation scheme, based on ISO 9001:2008, (UNE 166002:2006) and IAEA KM (2012) respectively.

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