

New Paradigm in Nuclear Safety from Quality Assurance to Safety Management System

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1. Introduction

The initial concept of Quality Control (QC) controlling the quality of products is now evolving toward the Management System (MS) achieving safety, through Quality Assurance (QA) ensuring the quality of products and Quality Management (QM) managing the quality by a systematic approach. Nuclear safety can be achieved through an integrated MS that ensures the health, environmental, security, quality and economic requirements being considered together with nuclear safety requirements.

MS approach is developed through realizing that most of nuclear accidents had occurred not by the malfunction of hardware or equipment, but by the human error. The MS is a set of inter-related or interacting elements (system) that establishes policies and objectives and which enables those objectives to be achieved in an efficient and effective way [1].

2. The Evolution of Quality

The idealized conceptual model illustrated here to represent the evolution over the last century regard of the approaches applied by organizations in order to achieve good safety performance. QC sorted conforming products by the inspection at the end of the process. QA took systematic measures to prevent defects by using established documents and has also evolved from a compliance approach to one of a more performance based focus. QM introduced the quality mind to everyone, including internal and external customer, involved in the process.

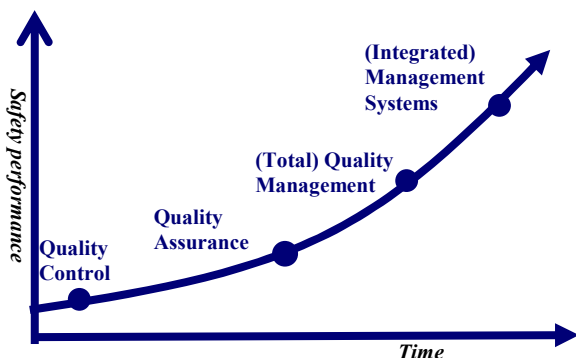


Figure 1. Evolution model to MS from QC also suggests that an MS is not the final solution in the evolution.

Integration of MS was developed where the organizations became increasingly aware of the benefit of quality achievement in their work processes. MS leads to a coherent, harmonious and optimal way of delivering the vision of top management and the goals and objectives of the organization [1].

2.1 Quality Assurance and Quality Management

QA is a planned and systematic pattern of all means and actions designed to provide adequate confidence that items and services meet contractual and jurisdictional requirements and will perform satisfactorily in service [2]. Quality in the industry has been focused on the attributes of a product and its parts during production. QA includes QC. QA program must include details of how work is to be managed, performed and assessed. A QM system approach encourages organizations to analyse customer's requirements, to define the processes that contribute to the achievement of a product which is acceptable to customer, and to keep processes under the control [3].

The focus of QM is to meet and exceed customer's requirements and expectations. Its principle have been identified as customer focus, leadership, involvement of people, process approach, system approach to management, continual improvement, factual approach to decision making and mutually beneficial supplier relationships [4].

2.2 Nuclear Quality Assurance

The objective of Nuclear QA is to enhance nuclear safety by continuously improving the methods employed to achieve quality. Establishment of a quality assurance program is required by the current nuclear regulation. Traditionally, Nuclear QA focused on the function of the installed components, systems and structures in the nuclear facilities. Nuclear QA is defined as an interdisciplinary management tool that provides a means for ensuring that all work is adequately planned, correctly performed and assessed. It provides a systematic approach for accomplishing work with the ultimate goal of doing the job right the first time [5].

An IAEA Code is published to provide basic requirements for QA in order to enhance nuclear safety by continuously improving the process employed to achieve quality. The Code recognizes that all work is a

process that can be planned, performed, assessed and improved [1].

2.3 Integrated (Safety) Management System

The term “Management System” reflects the evolution in the approach from the initial concept of “Quality Control” through “Quality Assurance and “Quality Management” in the new Safety Standard GS-R-3 [1]. The principle goal for MS is to achieve and enhance safety. It brings all the requirements for managing facilities and activities together into one system in a coherent manner and describes the planned and systematic actions necessary to provide adequate confidence that all applicable requirements can be met. And it ensures that health, environmental, security, and economic requirements are not considered separately to safety requirements, to avoid the possibility of their potential negative impact on safety.

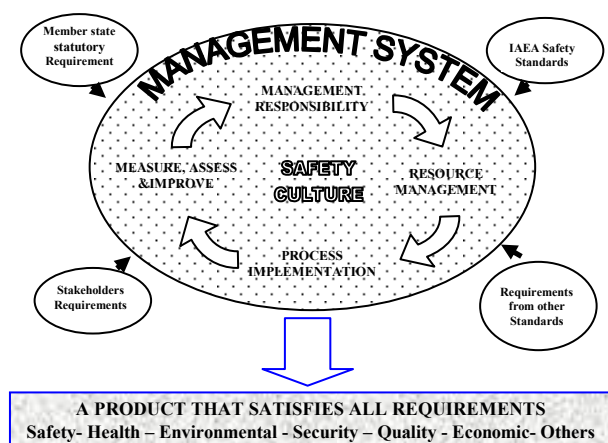


Figure 2. Illustration of MS concept recommended by other international codes and standards such as ISO9001, 14000, ASME and IEEE

3. QA and Nuclear Safety Culture

The primary goal of a nuclear organization is safe operation of nuclear island. This requires the existence of both a sound safety management system and a good safety culture.

Safety culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance [5]. The QA system has a key role to play in ensuring that the safety management system is effective, and that the safety culture is reinforced and strengthened. The components of QA program requirement are relevant to the safety management and safety culture of a nuclear organization. Safety culture has a very large human dimension most people would not think of applying QA methods to do it. There is a deep relationship between leadership, safety management, safety culture and QA [6].

QA (US 10CFR50 App. B)	MS (IAEA GS-R-3)	Safety Culture (IAEA INSAG – 14)
Organization	Safety culture Safety policy and planning Communication	Policy Management structure Communication
QA program	Grading the application Management responsibilities Satisfaction of interested party Responsibility and authority Resource management Human resources Working environment	Authority Responsibility Resources Training Qualification Rewards Sanction
Procurement document control Control of purchased items	Purchasing	
Procedures and instructions Document control QA records	Documentation Record control	
Design control Control of identification Process control Inspection, Test control Shipping and storage Operating status	Process implementation Product control Monitoring and measurement	Safety practices Self-regulation Prudent approach
Control of measuring equipments	Monitoring and measurement	
Nonconformance control	Non-conformances	
Corrective action	Corrective action	Questioning attitude
Audits	Assessment, System review Improvement	Audit Review

Table 1. Comparison of elements for QA, MS and Safety Culture

5. Conclusion

The QA system can help to develop a sound safety MS and a positive safety culture in operating organization of nuclear facilities. The government and regulator should have a role to play in encouraging this contribution by existing QA system and in developing the legal requirements for integrated safety MS. Much of the QA documentation already exists in operating organization.

It is needed to compare the existing sub-systems with QA and MS requirements in order to improve effectiveness of existing implementing procedures.

MS for operation of nuclear facilities could be established through practical implementation of QA system. It is considered that operational practices incorporated into MS in compliance with the requirements of IAEA GS-R-3 could be a good option to achieve desired safety goal.

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