Quality assurance at nuclear power plants: Basing programmes on performance

A look at how QA programmes are being improved

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A quality assurance programme is often incorrectly interpreted as only a regulatory demand and/or paperwork, with no effective impact in the overall performance of the nuclear project. Over the past decade, however, the nuclear industry has experienced a loss of public confidence stemming from real shortcomings in performance. This has led to dramatic changes in the perception of quality and how to achieve it.

In short, the nuclear industry as a whole has found that its traditional perception of quality assurance (QA) was not contributing to plant safety and reliability as meaningfully as it could and should do. The perception has significantly changed in recent years. *(See chart.)*

QA programmes may vary somewhat according to the cultural, historical, and industrial experience of the nations and organizations involved. It is generally agreed, however, that an effectively implemented QA programme governing all aspects of a nuclear power project is an essential management tool.*

Today, new challenges are demanding that QA programmes and their management be improved. This article looks at recent developments, and at the IAEA's role in assisting countries to achieve high levels of quality in the nuclear industry.

Implementing a QA programme

The image of someone inspecting or auditing work being performed by someone else often comes to mind when people hear the term quality assurance. Although partially correct, this image is not the complete picture. The person doing the inspecting or auditing probably belongs to a QA group or unit, but that unit is only performing one part of a properly conceived and effectively implemented QA programme whose final goal is overall quality of performance.

It is generally recognized that quality of performance is achieved in a more effective, timely, and productive manner when it is built into day-to-day operations rather than relying on inspection by another organizational unit after-the-fact. Therefore, it is desirable to have a line unit with an enhanced sense of responsibility for quality of performance. To complement it, effective assessment techniques must also be used to assist in the achievement of safety and other plant objectives.

Management is the key to assuring that the QA programme functions properly. Management's most important and challenging responsibility is to establish and cultivate principles that integrate quality requirements into daily work activities. It must be actively involved in the implementation of all aspects of the QA programme. Only in this way can management demonstrate the necessary commitment and leadership to achieve quality.

In practice, the QA programme works when those individuals in management, those performing the work, and those assessing the work all contribute to quality in a concerted and cost effective manner. QA is used by people throughout an organization, from the top executives to workers, including designers, scientists, welders, inspectors, foremen, operators, craftsmen, and auditors.

The above concepts underline the IAEA's present activities in QA.

* See *Good Practices for Improved Nuclear Power Plant Performance*, TEC-DOC 498, IAEA, Vienna (1989).

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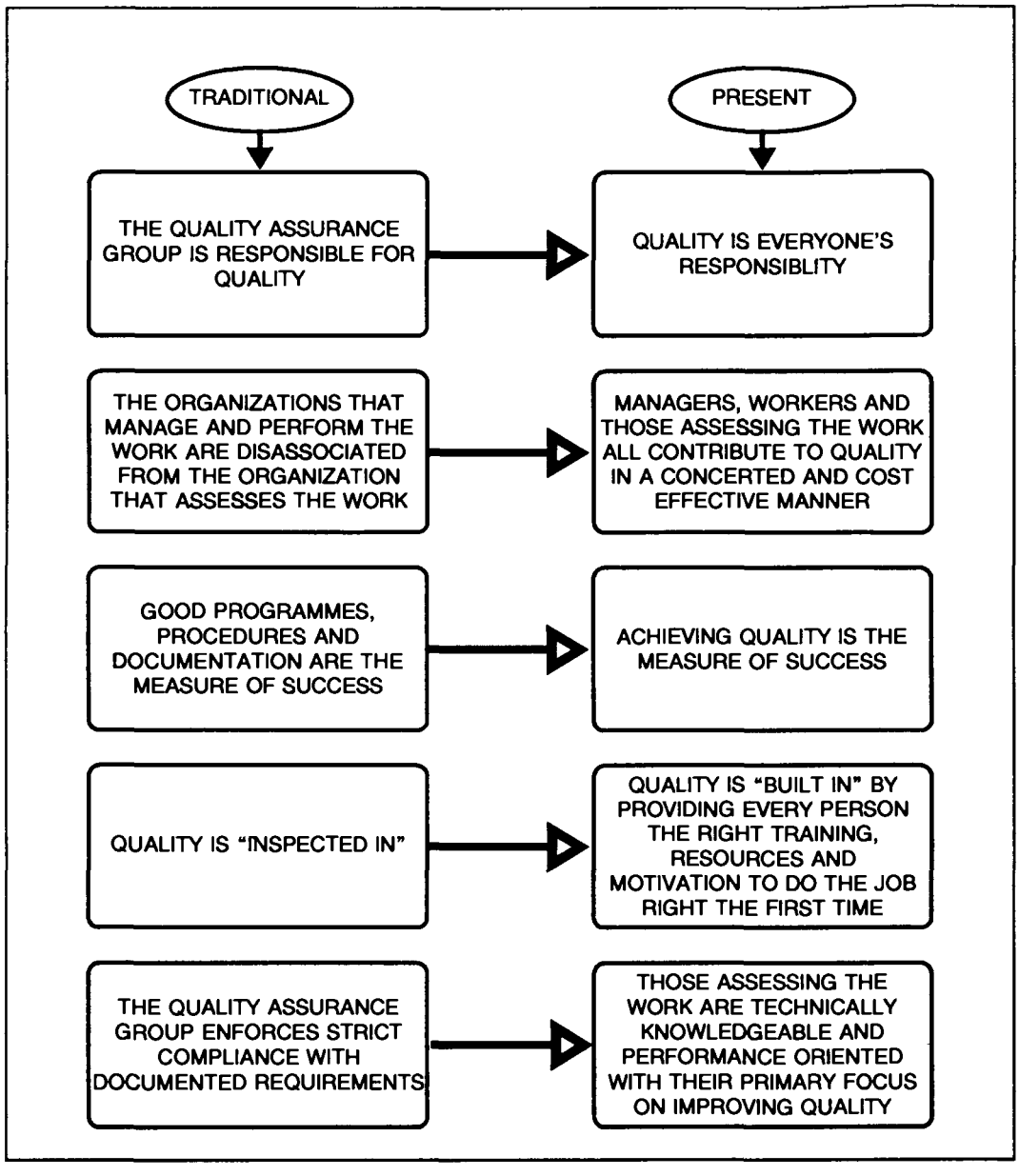


Quality assurance perception

Emphasis on performance objectives

Today's perception of QA focuses on quality of performance and encompasses all managerial, line, and assessment activities. The quality of performance concerns all areas in the nuclear project and therefore safety, reliability, and economics are positively influenced. The overriding principle is that safety shall not be compromised for reasons of production or economics, or for any other reason.

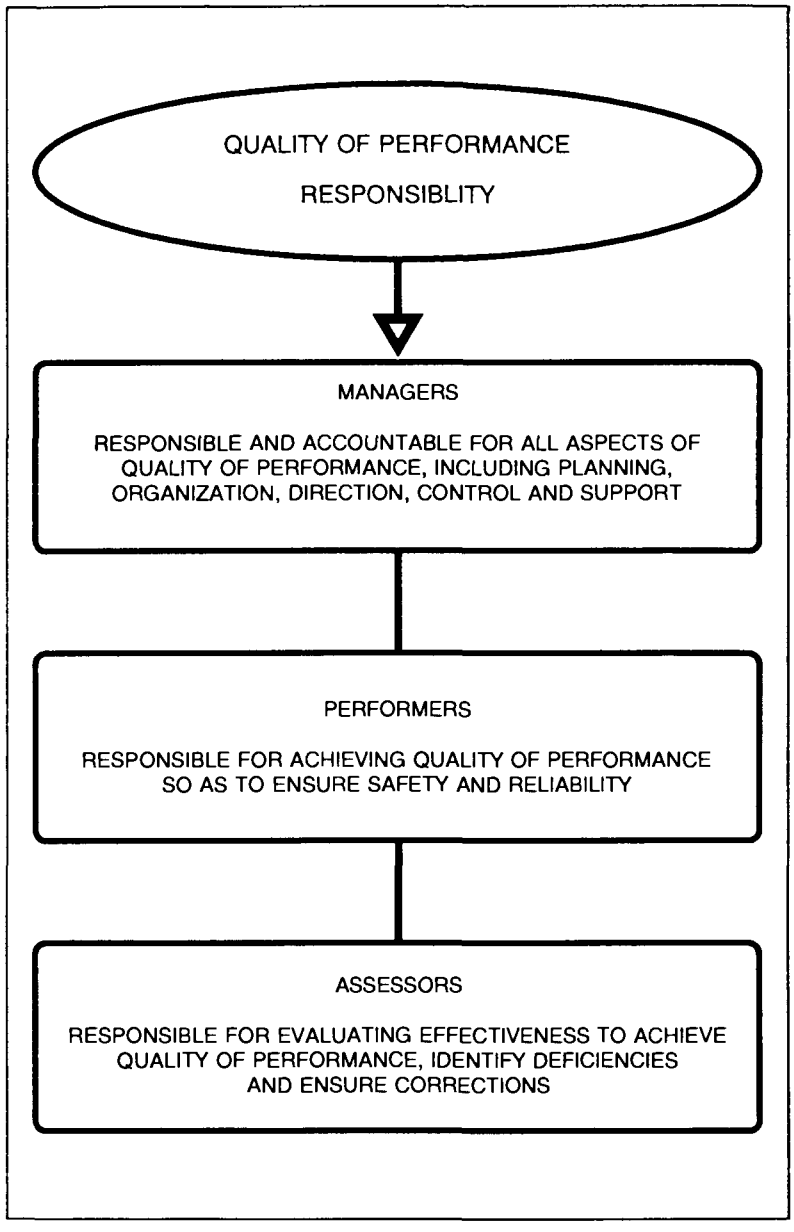
Every organization has performance objectives it strives to achieve. These performance objectives are achieved by way of implementing processes that are defined by the intermediate and subordinate objectives. When properly defined and controlled, these processes provide assurance that performance objectives will be met. The nature of the inherent interrelationship between performance objectives and the processes to achieve them defines an organization's level of success. When the balance between performance objectives and processes is skewed, when the focus on the latter increases while the performance objectives are ignored, this crucial relationship is destroyed. The ability of the organization to achieve its performance objectives — its reason for being — is lost. This has been a problem for the nuclear industry, resulting in the loss of momentum, money, and public confidence.

The nuclear community often tends to separate performance objectives from their processes. Many nuclear organizations become

so absorbed in the "trees" of the processes (intermediate and subordinate objectives) that the "forest" of performance objectives is eclipsed from view. Traditional QA programmes sometime focus on the fine-grained details of activities, not stressing performance strongly enough. Hence, the credibility of the industry is called into question by a public that does not understand, and often fears, its objectives.

For example, a traditional QA programme for maintenance elevates the calibration of measuring and test equipment to the level of a performance objective rather than viewing it as one of a number of intermediate objectives. Although the content of a traditional QA programme and a performance-based programme are virtually the same, in the latter the subordinate objectives of calibration, control of items, performance of work under properly controlled conditions, and the use of instructions, procedures, and drawings is recognized as subordinate to the performance objectives.

As this example illustrates, a pragmatic and meaningful QA programme strikes the appropriate balance between performance objectives and processes. In other words, it focuses on performance objectives but does not abandon the processes needed to achieve them. A successful programme is performance-based at the highest level. This biases the programme toward achieving the organization's performance objectives, which should be carefully defined and limited in number.



Performance-based quality assurance

IAEA developments in QA

Over the past years, the international community has recognized shortcomings in the conception and implementation of nuclear QA programmes. The IAEA is making use of the extensive experience and information resources of its Member States to put in place the beginnings of a new and meaningful QA culture to contribute to improved nuclear power plant safety, reliability, and performance.

In 1990 the IAEA began a planned and systematic programme to enhance nuclear safety by revising and improving its QA code and the accompanying safety guides. Through this revision the QA documents are being updated to depict contemporary principles and techniques for managing, achieving, and assessing quality.

In revising the codes and guides, the IAEA's objective is to instill a new culture in which there is a commitment to achieving a rising standard of excellence. This new culture demands that the performance objectives and the methods employed to achieve them be continuously improved. In the broadest sense, quality is the degree of excellence that an item or service possesses based on the user's needs. It is achieved by consistently meeting the defined requirements. It follows, then, that QA constitutes all those actions that provide confidence that quality is achieved.

The nuclear industry worldwide is reaching beyond traditional QA methods and taking a broader perception of quality where individuals in management, people performing the work, and people assessing the work all contribute to quality in a concerted and cost-effective manner. Recognizing this, the IAEA's main goal is to recommend ways to ensure that nuclear risks are minimized while safety, reliability, and perfor-

mance are maximized through the use of an effective QA programme.

The new QA culture endorsed by the Agency recognizes that it is management's role to establish and cultivate principles that integrate quality requirements into daily work. For this integration to be successful, the individual performing the work has to be provided with the proper information, tools, support, and encouragement to properly carry out assigned tasks. It is incumbent on management to define requirements; properly train, motivate, and empower personnel; provide appropriate resources; and assess performance. Management is expected to demonstrate commitment and leadership through active involvement in the implementation of an effective QA programme. The role of individual employees is to meet established requirements while recommending improvements in item and process quality.

This new QA culture is not an indictment of Member States' existing programmes. On the contrary, the IAEA recognizes Member States' extensive work in the QA discipline and complements them on their accomplishments in this regard. It is the Agency's intent that users of the revised code and safety guides examine their existing programmes to identify areas where enhancements can be made by building in the contemporary quality principles and techniques discussed here. These place greater emphasis on being "right the first time" rather than finding and correcting mistakes later.

Revised IAEA codes and safety guides

The IAEA's documents on quality assurance, issued through the Nuclear Safety Standards (NUSS) programme, are generally recognized and applied in establishing nuclear safety regulations in the majority of countries with operating or planned nuclear power programmes. Approximately 30 Member States have officially adopted or unofficially used the IAEA code and safety guides on QA as their national requirements. In these countries the IAEA documents strongly affect the relationship among regulators, nuclear owners, and their suppliers.

IAEA safety standards on QA (the code plus 10 safety guides) were developed during a period of about 10 years between 1974 and 1984. One safety guide was revised in 1986 and the code was revised in 1988. An integral revision and completion of the IAEA standards to reflect present practices was initiated in 1990 This task is envisaged as the first step in establishing a procedure of periodical revision to maintain the updating of the documents. The intention is to review the standards for their effectiveness and usefulness in the face of changing technology and acquired experience. Without such review, standards would have low practical value, since adherence to them would result in items or services of lower technical value than could and should be achieved. The envisaged review policy attempts to eliminate rigidity of standards, minimize procedures, and provide flexibility to accommodate changes in technology, attitudes, developments, and experiences in all parts of the world. Such flexibility is intended to be built into the standards through planned periodical revisions or replacements of standards every few years.

The second revision of the QA code now being done provides the basic requirements and principles for establishing and implementing QA programmes for the siting, design, construction, commissioning, operation, and decommissioning of nuclear power plants. The code's requirements reflect the modern concept that all work is a process that can be planned, performed, assessed, and improved. The code provides basic QA requirements which comprise the foundation of a comprehensive QA programme. The requirements are broken down into three functional categories: management, performance, and assessment. These categories capture the range of activities common to all work, from organizing and staffing to assessing results and providing feedback to improve the process.

The application of these basic QA requirements extends to all those individuals and entities that are responsible for the nuclear power plant, including plant designers, suppliers, architect-engineers, plant constructors, manufacturers, and plant operators. The requirements reflect a comprehensive way of doing business throughout the life cycle of a nuclear power plant.

The revisions of the IAEA's safety guides on QA establish a new planned and integrated framework to complement the revised code. The guides provide recommendations to fulfill the basic requirements contained in the code. As such, they play an important role in providing Member States with more prescriptive guidance regarding the code's implementation. The details of the safety guides, while not the only way to meet the requirements of the code, represent implementation methods that are generally accepted and proven by experience.

The code and safety guides are intended for use, as appropriate, by licensees, regulatory bodies, and other pertinent organizations. The requirements embodied in them apply to all aspects of work at or in support of the safety of a nuclear power plant, and they can be usefully applied to nuclear facilities other than nuclear power plants.

In pursuing the revision of the QA standards, the IAEA collects the advice on successful practices to be reflected in the documents which are adopted by many countries. In the revision process the documents are critically reviewed and assessed through advisory group meetings which include representatives from nuclear utilities, regulatory bodies, and vendors. In this way all the partners commonly involved in a nuclear power project participate in the development of the standards and ensure that the final result is acceptable and applicable to everyone. Representatives from international organizations such as the Commission of the European Communities (CEC), the European Atomic Forum (FORATOM), and the International Organization for Standardization (ISO) also take part in the revision process. The opportunity is also taken to align the standards more closely with other international quality standards, such as those from ISO, where this is feasible.

Conclusion

Experience has shown that the inherent limitations of the traditional perception of QA have, in part, resulted in mediocre plant performance and instances of compromised plant safety and reliability. Conversely, satisfactory performance is being achieved by IAEA Member States which have already begun implementing the principles discussed here. Their successes attest to the wisdom of implementing a more performance–based approach to QA that emphasizes programme implementation and effectiveness, rather than programme development and documentation as the traditional perception does.

Nuclear power is a well–established part of many countries' energy programmes. While the nuclear industry has generally maintained a good safety record, improvements can always be made. It is with this hope of further improving nuclear safety that revision of the IAEA code and safety guides on QA is being offered to Member States. The Agency is confident that the nuclear option will continue to be exercised as a reliable and clean source of energy if nuclear safety, both real and perceived, can be ensured.

Revitalizing QA through the application of the improved approach will require the constant willingness to re–examine and re–evaluate the status quo. This in turn requires a willingness to accept and implement change, and it is through change that improvements are realized. It is natural human tendency to resist change, but maintaining the status quo is a sure formula for perpetuating the problems of the past and for not realizing future opportunities. It is for the sake of improving safety, reliability, and economics that the challenge to move towards performance–based QA programmes is encouraged.

Water tests by chemistry technicians at nuclear plants help prevent corrosion of components. (Credit INPO)