# AN SME'S QUALITY MANAGEMENT EXPERIENCE

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## ABSTRACT

Small and medium sized enterprises (SME's) that supply services to nuclear power plants have to meet the station's quality requirements. To improve its quality program, Atlantic Nuclear (an SME) adopted the ISO 9001 standard for its management system. Vendor registrations are then achieved by adding specific elements as required by the clients. This paper discusses the experience, both positive and negative, from implementing and continually improving the quality management program for Atlantic Nuclear, a small nuclear engineering service provider. We also discuss how quality management principles are implemented and embraced by the company.

## 1.0 INTRODUCTION

Atlantic Nuclear began offering technical services to the nuclear industry in 1983. Since that time, the company has constantly strived to be a preferred supplier based on a commitment to excellence. As the company grew, processes were developed to ensure quality. These processes were based on various project and client requirements and industry standards such CSA N286 and Z299.

In 2002, a decision was made to pursue ISO 9001 registration. This standard was chosen to:

- provide a framework to tie past quality improvements together in a formal system;
- enable registration thus giving a tangible recognition of our efforts; and
- provide a foundation for on-going continuous improvement efforts.

This decision was made after assessing the available options:

- Although ISO 9001 is internationally recognized by most industries, it has not had widespread acceptance in the Canadian nuclear industry. Standards such as N286 and Z299 still take precedence.
- The use of different standards results in vendor audits to differing requirements.
- Difficulties exist in applying standards such as N286.2 and Z299. CSA N286.2 is a design standard. Since the bulk of our projects are analysis rather than design, the fit is not perfect.
- CAN3 Z299 is a standard which has not been updated since 1985. It is a bit more prescriptive than ISO 9001, which does not allow the flexibility needed by a small organization.

## 1.1 ISO 9001 Advantages

The ISO 9001 standard, which is updated on a regular basis, was first published in 1987. The current, 2000 version of the standard is the second such revision since being published.

The standard provides requirements that any organization can use to implement and improve a quality management system. It also provides principles that organizations should embrace to operate effectively.

The standard is voluntary, with registration performed through third party organizations called Registrars. Upon registration, an organization is issued a certificate. Surveillance audits are performed by the Registrar on an annual basis to ensure continued compliance. The third party registration gives potential clients confidence the company's quality program will meet their requirements.

## 1.2 MOVING TO QUALITY MANAGEMENT

Although quality has been around for a long time, it remains a very subjective aspect of a product or service. Each person or client will have their own definition of the term which makes it difficult for an organization to satisfy everyone. To address this challenge, standards and practices have been developed to assist organizations. Nevertheless, there remains the challenge for an SME meeting the standards developed for the utilities.

At its most basic level, quality can be an inspection function. For example, a characteristic of a machined component is measured and then compared to a drawing or specification. In this case, the component may pass or fail in meeting the desired specifications. At the next level, Quality Control (QC) is used.

Before moving to ISO 9001 registration, Atlantic Nuclear's quality program was at the QC level. For example, deliverables in the form of engineering reports were

"inspected". The problem with inspection and QC techniques is that they are after the fact. This reactive approach can be expensive.

A more proactive approach is to use Quality Assurance (QA). QA builds on QC but adds checks and balances at other key points in the process. For example, a QA system would add activities such as design reviews, purchasing procedures and staff qualification to the mix. The goal being that the sooner a problem is identified, the less impact it will have on the organization in terms of time, resources and money.

Atlantic Nuclear did not implement a QA program before moving to ISO 9001. It was an expense that could not be justified with clients. They saw their programs as applying to the work product of SME's. As a result, a QA program was not seen as adding value.

Expanding quality one step further leads to Quality Management (QM) where concepts such as customer satisfaction and continuous improvement are added to QA. ISO 9001 is a Quality Management standard.

As the nuclear industry adopted Quality Management principles there were new requirements for quality at the contractor/client interface. At this point clients became more demanding of Atlantic Nuclear's program. This lead to the decision to implement and register an ISO 9001 program.

## 2.0 QUALITY MANAGEMENT SYSTEM

The current version of ISO 9001 promotes a "process approach" when implementing and improving a quality management system. The process approach recognizes that for an organization to function effectively and efficiently, it needs to manage numerous linked activities. Figure 1 below shows the ISO 9001 model of a process-based quality management system. It demonstrates how requirements in the Standard are linked together, i.e. often one section provides significant input into the next.

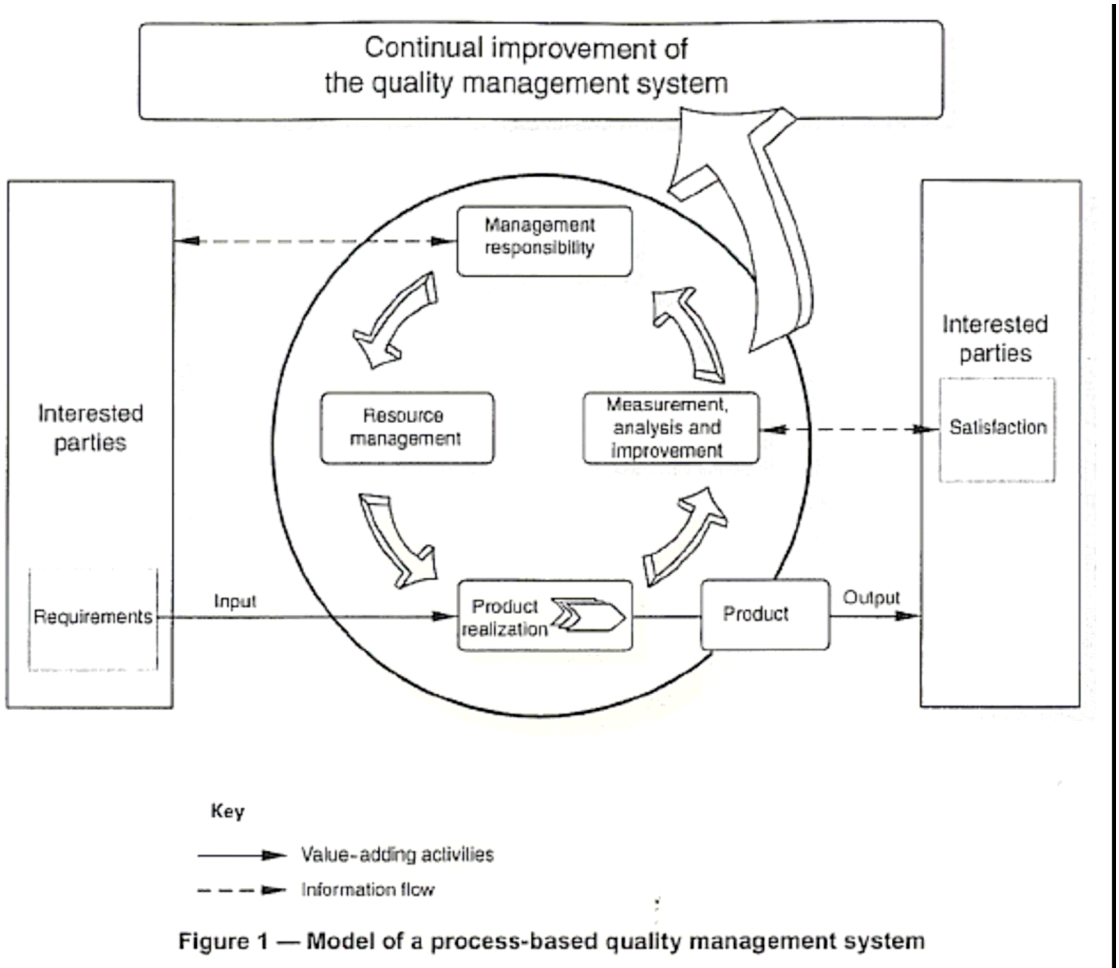


**Figure 1 — Model of a process-based quality management system**

The model closely resembles the Plan-Do-Study-Act (PDSA) cycle invented by Walter Shewart and made popular by Dr. W. Edwards Deming. PDSA is a fairly straight forward concept that emphasizes the need to plan the work, do the work, study the results and act on the results. Each step of the process feeds the next in an never ending cycle of improvement.

As shown in the model, the ISO 9001 Standard breaks the requirements into four main sections. These sections are discussed below.

## 2.1 MANAGEMENT RESPONSIBILITY

A quality system can not be effective without management commitment. In a small organization this is especially important as staff interact with managers very closely on a day-to-day basis.

Atlantic Nuclear maintains an overall quality policy with consistent measurable objectives. Managers perform comprehensive quality system reviews at least twice per year. These reviews help to evaluate performance, identify improvements and set future goals.

## 2.2 RESOURCE MANAGEMENT

For an engineering firm, its key resource is of course its staff. Resource management involves hiring the right people, forming effective project teams and maintaining professional competencies. Project staff is comprised of both full time employees and contract employees. As an extension of Atlantic Nuclear, we also have a short list of approved technical subcontractors that join our team on various projects.

## 2.3 PRODUCT/SERVICE REALIZATION

It can be debated whether an engineering firm provides a product or a service. We find it is difficult to separate the two. If contracted to perform a safety review, the technical work is a service and the final report (deliverable) is a product. Both the service and the product need to be of a high quality to satisfy the client. As a result, systems are established to manage both aspects.

One of the most critical parts of our business is to develop proposals which describe the work to be done as well as cost and schedule. Often, for various reasons, it is difficult to obtain a clearly defined project scope. In these cases, we need to prepare the scope of work as part of the contract.

Procedures for the performance of work have been documented and implemented. These procedures can be divided into two categories: project management and technical guidance. For example, if we are contracted to perform a stress analysis on the shutdown cooling system, we have a procedure for piping assessment. The project would also follow a project management procedure which applies to all projects.

Some of our projects require us to have staff work under a client's quality program. These projects usually involve the attachment of a staff member to the client's work group. Although it might be easy to overlook quality requirements on this type of project, we must maintain certain minimum requirements. As examples, a proposal is required, the person must be qualified for the work and the client must be satisfied upon completion of the work.

## 2.4 MEASUREMENT, ANALYSIS AND IMPROVEMENT

We have a number of processes to collect information used to evaluate and improve our quality system. We use a system to document and correct problems and suggestions for improvement. We perform project evaluations at the end of each project which include client and staff feedback.

On an annual basis, we set objectives for managers. We perform annual internal audits evaluate the effectiveness of the program. Our program is also audited on a regular basis by clients and our Registrar.

All of the information from the above activities is used as input into the management review process.

## 3.0 APPLYING THE QUALITY MANAGEMENT PRINCIPLES

The following is a brief description of the implementation of the management principles. It establishes the framework for discussing our experience.

### 3.1 DEFINE THE BUSINESS

The first four management principles define the business internally and externally.

#### 3.1.1 LEADERSHIP

> "*Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives.*"

The senior managers define the business by its goals and the work environment they create for the staff to achieve the goals. Policies, objectives, plans and procedures must be aligned so that staff can focus on common goals. This principle and its link to other principles are illustrated in Figure 2.

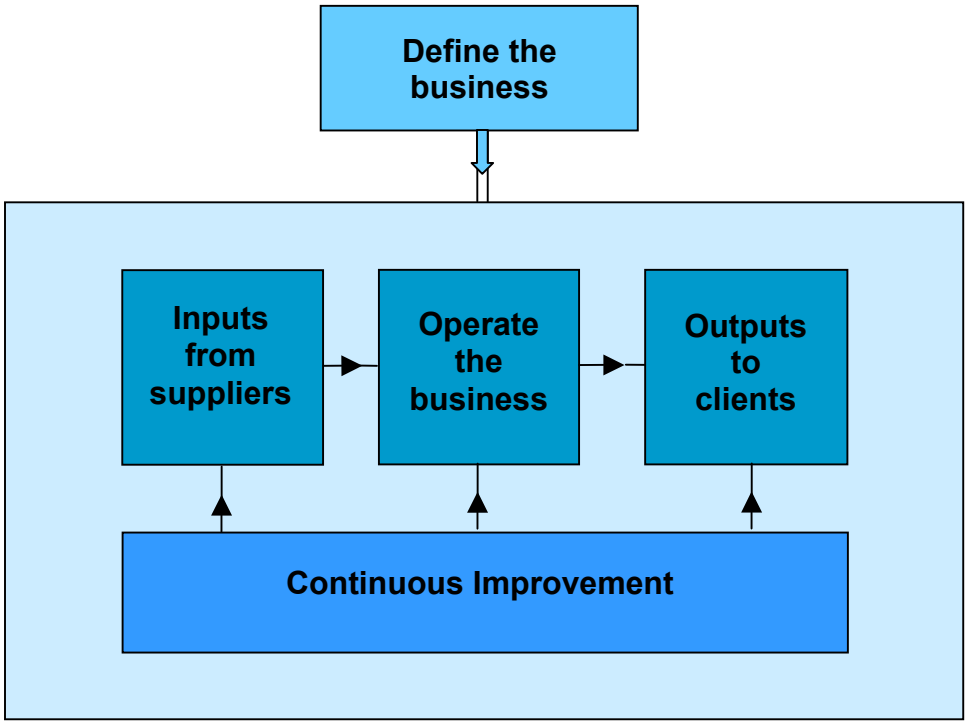


**Figure 2 – The basic business process**

The business is defined as an 'input – output' process. The inputs are transformed into outputs by the operation of the business. At this defining level of the business, leadership is required to implement three more management principles.

### 3.1.2 CUSTOMER FOCUS

*"Organizations depend on their customers and therefore should understand current and future customer needs, should meet customer requirements and strive to exceed customer expectations."*

Managers focus their employees on the only raison d'être for the business – supplying outputs to its clients. As a minimum the outputs have to meet the client's requirements but the goal should be to exceed the requirements.

As a supplier of the clients, the principle of a mutually beneficial supplier relationship applies at the client interface as well. This includes understanding the client's current and future needs. From this the business can better meet those needs to the benefit of both parties.

### 3.1.3 MUTUALLY BENEFICIAL SUPPLIER RELATIONSHIP

*"An organization and its suppliers are interdependent and a mutually beneficial relationship enhances the ability of both to create value."*

The managers of the business and the supplier's business will each achieve greater success through a mutually beneficial relationship. This principle is linked to the client relationship as well. A partnership approach between the client and the service provider is an effective way to realize benefits.

### 3.1.4 CONTINUAL IMPROVEMENT

*"Continual improvement of the organization's overall performance should be a permanent objective of the organization."*

Once the business is established, it needs to continually improve to remain successful. Improvement activities need to be focused on client needs and business goals. There has to be an on-going commitment to cost reduction and performance improvement.

## 3.2 OPERATE THE BUSINESS

The remaining four management principles are implemented in the operation of the business. Figure 3 illustrates the three operating functions that have to be managed for the business processes to be effective.

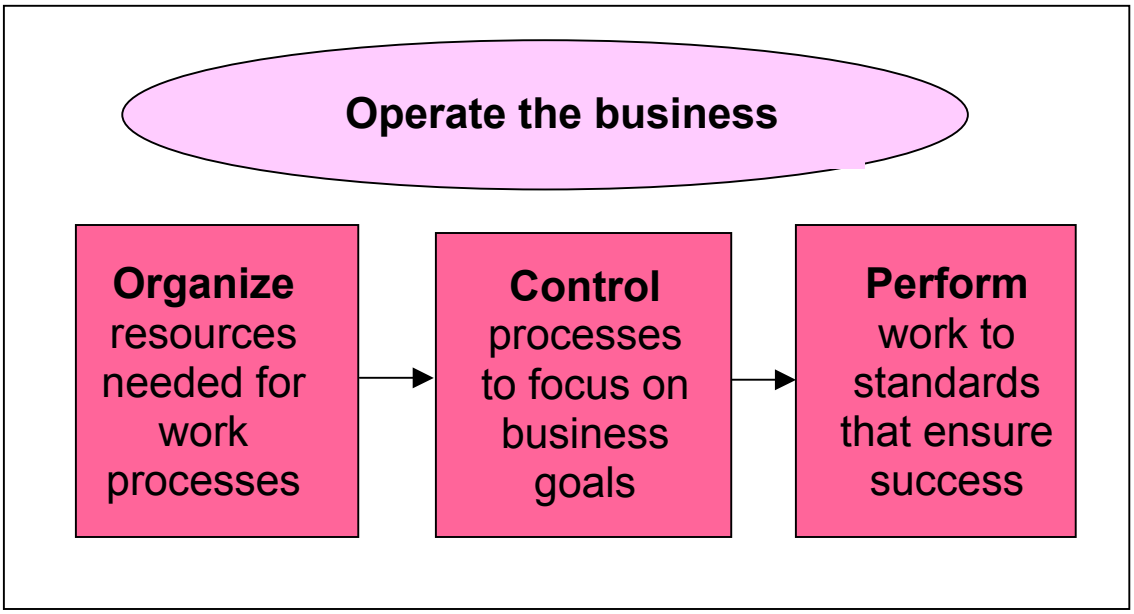


**Figure 3 – Operating functions of the business process**

The three operating functions are

- Organizing the material and human resources needed for the business to be successful;
- Controlling the activities of the business so they are focused on achieving the business goals; and,
- Performing the work to standards that ensure the business objectives are achieved.

The three operating functions are managed as business processes which is the implementation of the next two principles.

### 3.2.1 PROCESS APPROACH

*"A desired result is achieved more efficiently when activities and related resources are managed as a process."*

Work activities are organized as processes which are sets of activities leading from defined inputs to defined outputs. The three operating functions are managed for each process.

### 3.2.2 SYSTEM APPROACH TO MANAGEMENT

*"Identifying, understanding and managing interrelated processes as a system contributes to the organization's effectiveness and efficiency in achieving its objectives."*

The processes are developed systematically to achieve efficiency and effectiveness. Also, they must implement the management of the operating functions at three levels. This is illustrated in Figure 4.

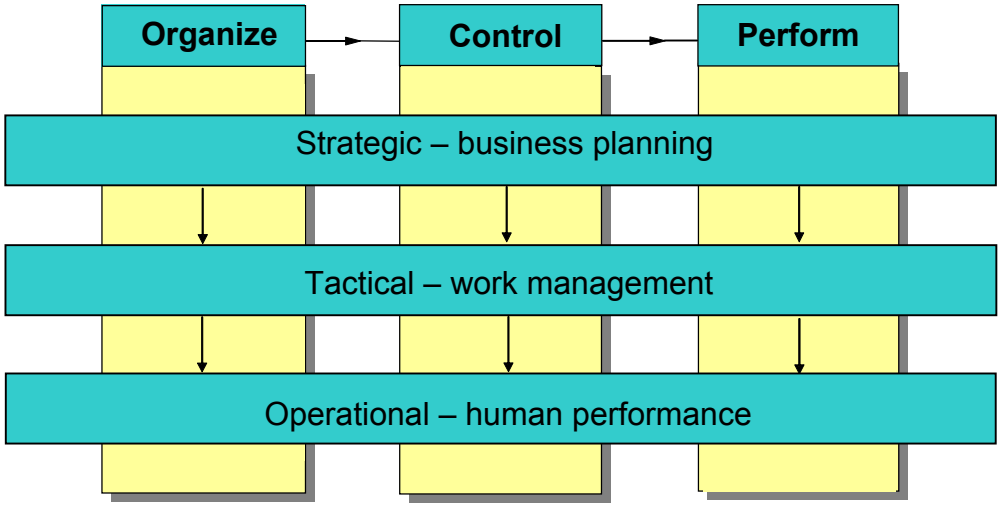


**Figure 4 – Levels of management for the operating functions**

The three levels to the implementation of the management functions are as follows:

Strategic - Develop corporate policies and plans for operation of the business

Tactical - Implement the programs and procedures needed for the business processes

Operational - Address human factors so that the work is performed to the desired standards.

With the management system established for the business processes the staff have to become engaged. This is the implementation of the following principle.

### 3.2.3 INVOLVEMENT

*"People at all levels are the essence of an organization and their full involvement enables their abilities to be used for the organization's benefit."*

Management motivate their staff to become committed to the business goals and use their capabilities fully to the benefit of business. The engagement of the staff at all levels is illustrated as a matrix in Figure 5.

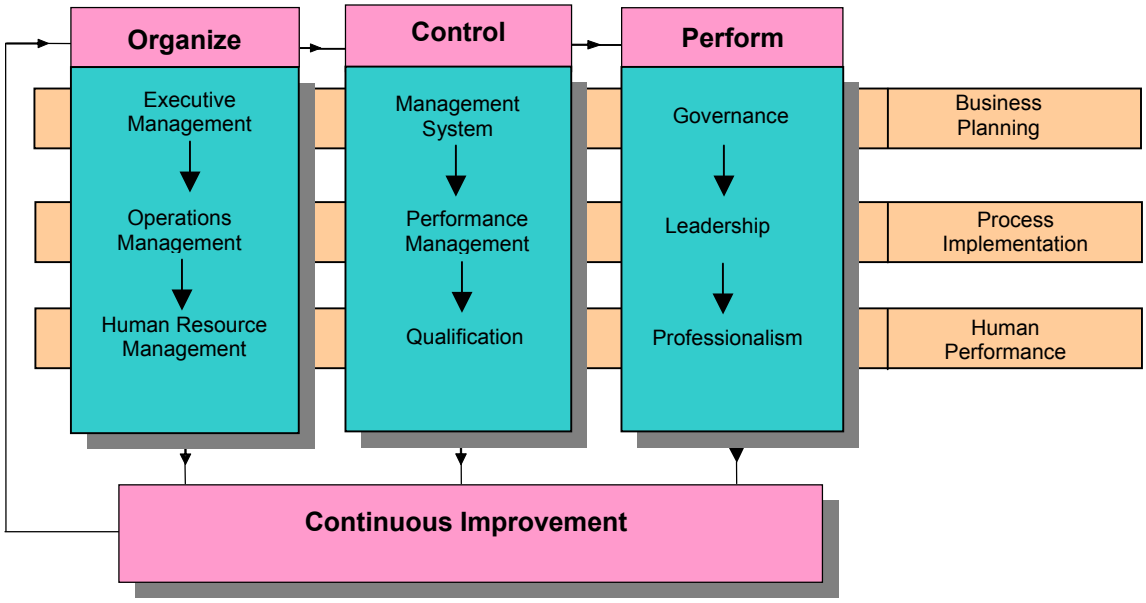


**Figure 5 - Involvement of the staff in operation of the business**

The final principle implemented in the operation of the business is effective decision making.

### 3.2.4 FACTUAL APPROACH TO DECISION MAKING

*"Effective decisions are based on the analysis of data and information."*

Decisions are correct and effective if they are based on a correct assessment of the risk to the business. At all levels, the staff have to have a business focus so they can make effective decisions. Opinions are challenged with facts and information to ensure the correct decisions are made.

## 4.0 EXPERIENCE

## 4.1 CUSTOMER FOCUS

Many of the company's staff have advanced degrees and/or specialized skills. It is always a challenge to focus them on the customers' needs. Their natural inclination is to focus on their technical interests. The structured management system helps to focus attention on the client. However, more is needed.

The emphasis on qualifications is usually on the technical skills. To improve customer focus the qualifications of professionals needs to include soft skills such as business focus and communication.

Due to the nature of our work, the client is usually an integral part of the project. Often, client staff perform technical reviews of the project reports. This has both benefits and drawbacks. It can improve communication between staff and the client, thus allowing continual focus on the client's needs. However, if not well planned and managed, client reviews can cause significant delays in schedule. This degrades our ability to manage resource loading.

## 4.2 LEADERSHIP

The decision to obtain ISO 9001 certification was based on the structure of the Canadian nuclear industry and its standards. The CSA CAN3-Z299 family of standards for quality programs could have been used. However, being a small company, a third party audit and certification was seen as a positive component of business development.

The business goal is to provide engineering and technical services to clients that meet the standards required for the nuclear industry. The purpose and direction of the company is better determined by the systematic structuring of the business activities for ISO 9000 registration. Two examples are the following:

a) The company markets its engineering and technical services with a recognized certification attached.

b) The definition of the role of staff in the company's direction and their performance requirements elevated the importance of professional development (Figure 5). Professional qualifications are now linked to technical knowledge and the level of participation in a project team. This has significantly improved the management of staff and is the basis for performance reviews.

## 4.3 INVOLVEMENT

The company is operated with a very flat management style, with work being performed by individuals and teams. Staff are not organized into functional departments with a hierarchy of management above. Staff report to project managers and the project managers report directly to Executive Management. This allows for clear communication and efficient decision making with all staff involved. Our staff are highly qualified and are given a high degree of responsibility. Staff input is encouraged at all times with formal evaluations upon the completion of each project.

Participation in improving the management system as auditors and auditees has been a benefit. Through this process, employees understand better the purpose and reason for procedures.

## 4.4 PROCESS APPROACH

One the first tasks undertaken when we started to implement ISO 9001 was to map our key processes. This work eventually resulting in our Quality Plan which graphically shows our main activities and how they tie together. From this, procedures were developed that linked outputs of one step to the inputs of the next step. A simplified version is shown below:

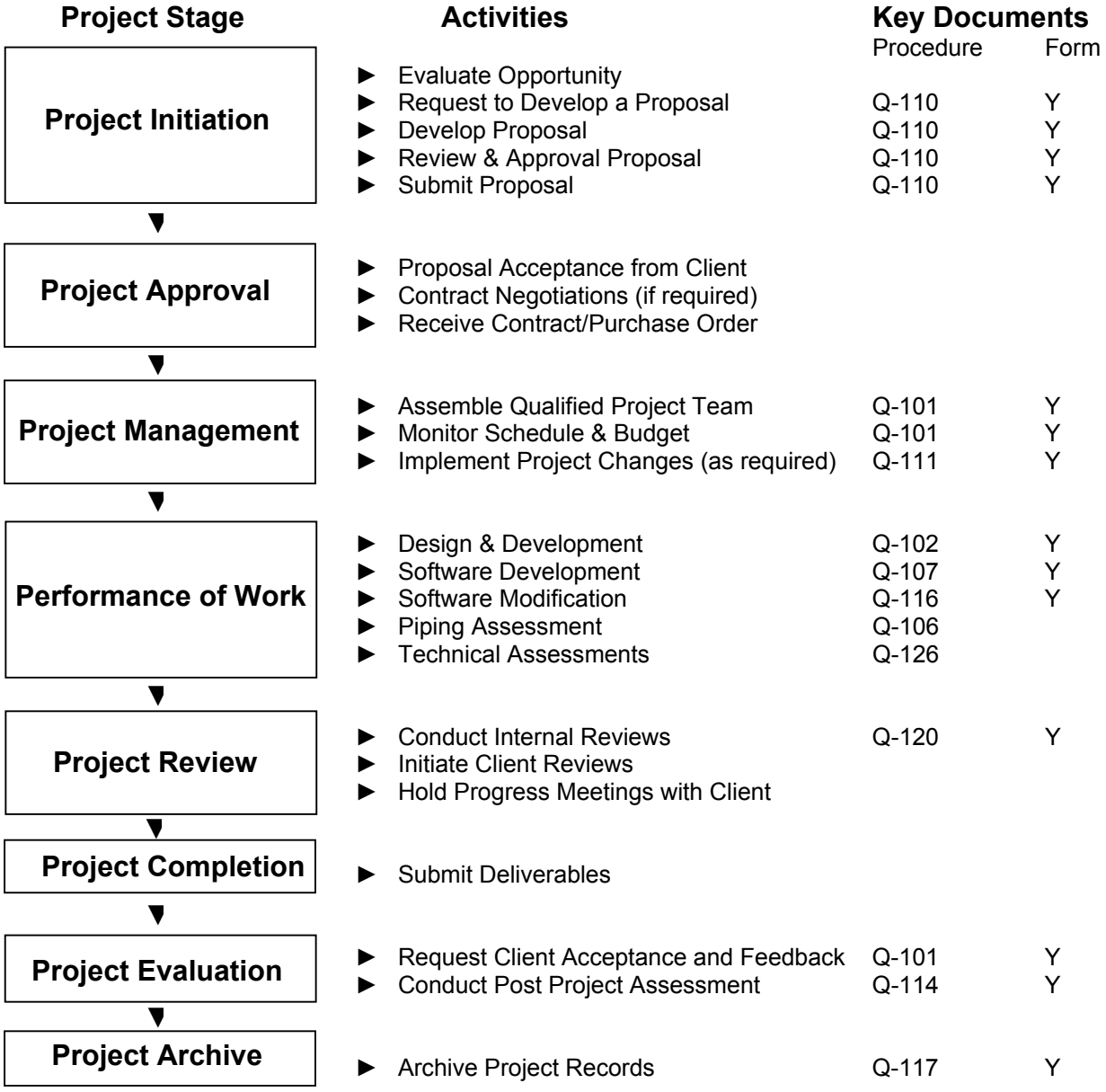


**Figure 6 – Simplified Quality Plan**

This quality plan has helped us to understand our business and focus on the client's needs.

## 4.5 SYSTEM APPROACH TO MANAGEMENT

Atlantic Nuclear provides engineering and consulting services to clients. Work is performed on contracts with a defined scope of work and deliverables. The business processes are then primarily the execution of projects to the satisfaction of clients.

All of the company's work activities are organized as projects. The processes include:

- project execution
- proposal preparation
- business development
- professional development
- business management
- quality management
- office management
- information technology services

Referring to Figure 5, key activities are as follows:

Executive Management is responsible for establishing the management system as well as technical and professional standards.

Operations Management is the project managers. They are responsible for process implementation and the quality of work for the project.

Human Resource Management is the responsibility of both Executive and Operations Management. They organize the material and human resources needed by the business. This includes performance assessment and development. The Project Managers are responsible for ensuring the staff assigned to project work are qualified for their assignments.

## 4.6 CONTINUAL IMPROVEMENT

ISO 9001 provides minimum requirements for a quality system. One issue that we have run into is occasionally we have included self imposed requirements in a procedure which are "nice" things to do. However, when these things are not achieved, problems can arise with our auditors. Repetitive nonconformances are seen as very significant even if the issue is not a standard requirement and even if it does not adversely affect client satisfaction.

## 4.7 FACTUAL APPROACH TO DECISION MAKING

Effective decision making is made easier in an environment where policies and procedures have been previously developed for guidance. If a crisis occurs, it is comforting to know that the policies and procedures used to aid the decision making process were developed when the pressure was not so great.

On a project level, proper planning is a tool that is used to make work run smoothly. Relevant standards and codes are specified to help decision making so that team members do not have to re-invent the wheel. Decisions are made with the input of the project team and are based on facts not assumptions.

## 4.8 MUTUALLY BENEFICIAL SUPPLIER RELATIONSHIP

Managing the supplier relationship at the subcontractor input and client output ends of the business is very challenging. This principle applies to the management of the interface between the two organizations' internal management systems. Examples of the challenges include:

a) The market price differential between a qualified technical service and an individual consultant service is often very narrow.
b) Client preference for contract staff as opposed to contracted services.

The company's management system cannot address these challenges. They will be ameliorated as the industry develops its commercial basis.

There is a tendency for clients to request the services of an individual (subject matter expert) instead of a specific service offered by the firm. This practice makes it more difficult to develop the skills of more junior staff members who are the future of the industry. If we are approaching a renaissance of nuclear power, we will need to pass the torch to qualified professionals.

## 5.0 CONCLUSION

In our experience, implementing an ISO 9001 quality management system has been a positive step. We used this standard as a base and then augmented the system with client specific requirements and additional elements from Z299 and N286. We would recommend this approach to other SME's working in the nuclear field.

## 6.0 REFERENCES

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2. The Management and Control of Quality, James R. Evans & William M. Lindsay, Second Edition.