THE DEVELOPMENT OF QUALITY ASSURANCE SYSTEMS FOR RADIOACTIVE WASTE AT BNFL SELLAFIELD

M. W. Lake, Sellafield QA Manager
British Nuclear Fuels plc,
Risley, Warrington, Cheshire, UK

ABSTRACT

BNFL reprocesses spent fuel at Sellafield, in West Cumbria, where it is a site licence requirement for formal QA arrangements to be established in respect of nuclear safety related plant.

The forms of radioactive waste which are generated on site: HLW, ILW and LLW are made up of arisings which can be solid, liquid or gaseous.

Implementation of the Company's QA policy has been achieved by formally documenting and establishing the controls needed to manage plant, processes and people.

While the introduction of QA principles into different production plants is relatively straightforward the establishment of cross-site arrangements to deal with the management of integrated waste streams is more complex.

The audit arrangements developed at Sellafield start with a comprehensive self-audit system, which is supplemented by independent internal audits.

INTRODUCTION

British Nuclear Fuels plc (BNFL) and its predecessors have been involved in supplying fuel cycle services for more than 40 years. Substantial markets both at home and overseas have been developed.

BNFL produces all the fuel for the UK's current nuclear power program at Springfields near Preston. As well as manufacturing fuel, BNFL enriches uranium at Capenhurst near Chester and reprocesses spent fuel at Sellafield in West Cumbria. The Company also owns and operates two nuclear power stations, Calder Hall, which is situated on its Sellafield site, and Chapelcross in Southern Scotland.

Considerable expenditure by the Company in recent years has been associated with waste conditioning. The current capital investment program at Sellafield amounts to $8 billion and involves the construction of new plants and the refurbishment of existing ones.

The Company is structured into Business Divisions which on the Sellafield site comprises five business units. Three divisions deal with Magnox Reprocessing, Oxide Reprocessing and Reactor Operation, the others being Waste Management and Decommissioning.

The Waste Management Unit (WMU) is responsible for the Drigg (LLW) Disposal Site where the LLW service is well-established and has operated for many years in accordance with the guidelines set by the Department of Environment.

COMPANY QA POLICY

The Company's QA policy requires each business unit to establish and maintain an effective quality assurance system, and encourages each business to tailor its arrangements to suit its own needs in the interests of promoting technical and economic efficiency.

The Sellafield QA Department (see Fig. 1) provides specialist advice on the establishment of management systems and is also organized to monitor their effectiveness by audit and provide an independent inspection service. Additional support includes an electronic publishing service, and a records system.

The Sellafield QA Manager is responsible for supporting and monitoring the systems associated with the five businesses on the site, and has a functional relationship to the Company QA Manager (See Fig. 2).

FORMS OF RADIOACTIVE WASTE

General

This paper describes the QA arrangements developed by BNFL at Sellafield with an emphasis on the application of quality assurance to radioactive waste management.

The waste management arrangements are considered to be part of the site's overall QA System, the objective of which is to ensure safe, efficient and economic operation.

Reprocessing activities on the site generate three forms of waste; High Level (HLW), Intermediate Level (ILW), and Low Level Waste (LLW). LLW is made up of arisings which can be solid, liquid or gaseous.

High Level Waste (HLW)

HLW arises from the reprocessing of spent fuel from nuclear reactors and involves concentration, storage and eventual treatment. The quantity of HLW is quite small and over the past 30 years, the entire British nuclear power program has only produced about 1200 cubic meters of HLW liquor. The Windscale Vitrification Plant (WVP), currently being commissioned, will vitrify this HLW concentrate. Vitrification involves immobilising the HLW by 'fixing' it in borosilicate glass, the vitrified product being contained in a stainless steel canister. The treated HLW will be stored for at least 50 years in the vitrified product store before final disposal.

Intermediate Level Waste (ILW)

All ILW arisings are currently stored without treatment in silos, tanks and ponds. Stored and future ILW waste arisings will be encapsulated in a cement based matrix. The drums of encapsulated waste will be held at Sellafield in

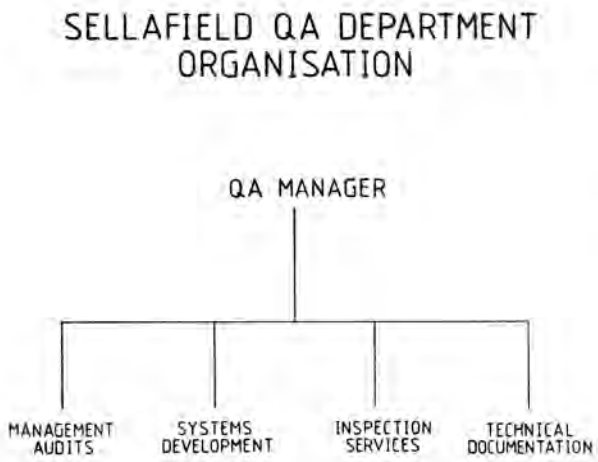

Fig. 1. Sellafield QA Department Organization.

retrievable stores until disposal facilities are available.

The first encapsulation facility (EP1) for the treatment of magnox swarf arisings is currently being commissioned and is planned to come into operation in 1990. Further encapsulation plants are being designed and constructed to deal with wastes from oxide reprocessing and flocs from effluent treatment plants.

Low Level Waste (LLW)

The three forms of low level waste are treated as follows:

1. Solid LLW is segregated, collected and packaged for disposal at Drigg.
2. Low active liquid effluent is treated and after analysis discharged into the Irish sea.
3. Low active gaseous wastes are discharged to the atmosphere.

These LLW streams are controlled through a cross-site QA System which is described later.

THE DEVELOPMENT OF QUALITY ASSURANCE AT SELLAFIELD

General

In the United Kingdom the owners of a commercial nuclear installation are regulated by means of a site licence which is issued by the Health and Safety Executive. The licence requires owners to establish quality assurance systems in respect of nuclear safety related plant which in

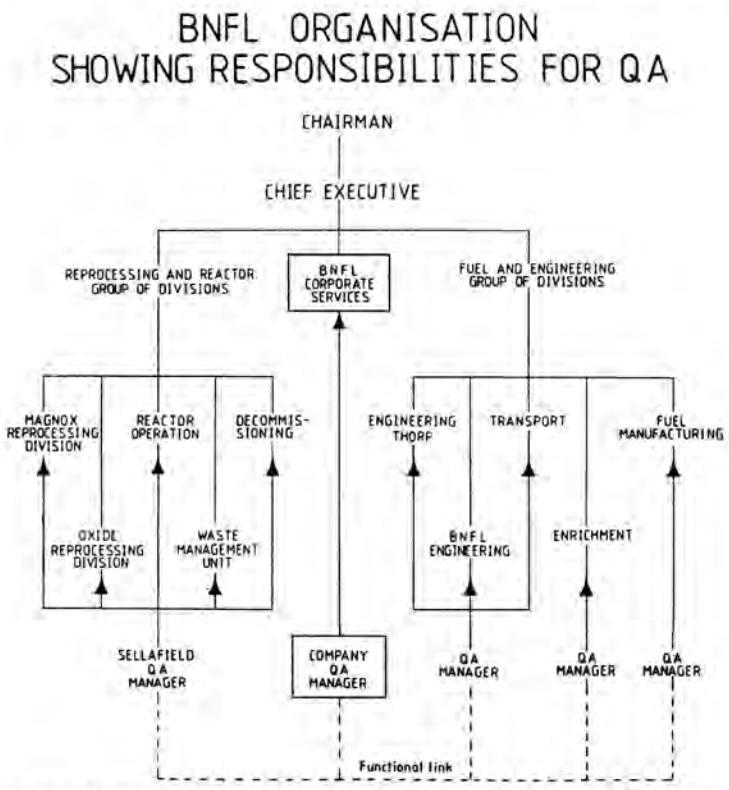

Fig. 2. BNFL Organization Showing Responsibilities for QA.

general complies with the principles and practices of BS 5882:1980, "A Specification for a total quality assurance program for nuclear installations".

The principles set out in this standard require a methodical approach to be used for the control of all items, activities and services.

In compliance with Company QA Policy, the standard is applied to all relevant technical and administrative activities and adapted in a way which ensures a satisfactory level of performance as well as meeting customer and regulatory requirements.

THE DEVELOPMENT OF THE QA SYSTEM

The objective of the quality assurance system has been:

a)to establish good management practices

b)to comply or be compatible with British and International QA Standards

c)to meet regulatory requirements.

The existing management arrangements were initially assessed from which essential controls were identified. Procedures were then developed to ensure that each activity was adequately planned and controlled.

An important element in the development of the system was the recognition of 'significance' since plant, equipment, and services can differ in regard to their importance. This has allowed for controls to be graded and be cost effective.

The QA System ensures that:

1.The importance of each activity, or item in respect of safe and efficient operation is determined.

2.The most effective means of managing and controlling the activity or item is established and documented.

3.The satisfactory performance of each task is supported by objective documentary evidence.

4.The effectiveness of the managerial arrangements is verified by independent audit.

DOCUMENTATION OF THE QA ARRANGEMENTS

A high standard of document production has been achieved by the use of computer aided publishing methods. The formal identification of documents has been met by referencing them within a hierarchical structure shown in Fig. 3.

Responsibility for the content, approval, and periodic review of the documentation is placed with line managers but consistency of presentation, production and issue of documents is delegated to a Central Technical Documentation Group.

The primary quality assurance document associated with each Business is a Quality Manual which sets out the organizational arrangements and managerial responsibilities necessary to meet the business objectives.

The implementation of those arrangements is the responsibility of line management who are required to establish and document the controls which are associated with plant, processes and people.

This provides for flexibility in the implementation but within a basic structure and consistent form of documentation.

MANAGERIAL CONTROL OF PLANT

For those Reprocessing and Waste Treatment plants which are required to be designed, procured and built in accordance with formalized QA arrangements, the responsibility lies with the BNFL Engineering organization.

Each new plant is defined as a 'Project'. Its development from conception through to Project completion and handover is progressed through a series of stages shown in Fig. 4. The quality assurance arrangements are fully documented within each stage.

The Project Manager is responsible for the project through to handover for commissioning, whereas the responsibility for managing the commissioning process is normally with the appropriate Works Manager. This requires functional responsibilities to be established and includes for QA systems for commissioning.

During the commissioning phase Works Managers are required to validate operating and maintenance instructions which are prepared to a standard format.

Once the plant has become operational, measures are adopted to ensure that its operation continues to be safe, efficient and economic. These measures include:

a)The regular review of approved operating and maintenance instructions.

b)The formal identification of the operational and maintenance status of the plant. This is intended to assure adequate control of defective items or items under repair.

c)The identification and recording of significant operational parameters. This ensures that trends and changes are noted and encourages appropriate corrective actions to be taken.

d)Formalizing shift manning, shift logging and shift handover arrangements.

e)The establishment of a routine and scheduled preventative maintenance program.

The maintenance program includes the establishment of maintenance history records which provide an indication of performance. The periodicity of maintenance is also kept under review.

MANAGERIAL CONTROL OF PROCESSES

As shown on Fig. 4 a major aspect of each new plant project involves initial process development, feasibility studies and development of process flow sheets. In some cases a substantial amount of development work is necessary to substantiate the basis of design.

A typical example was the introduction of the vitrification process for HLW. This plant introduced new and novel technology, and was supported by a Full Scale Inactive Facility (FSIF) which replicated all major plant items and

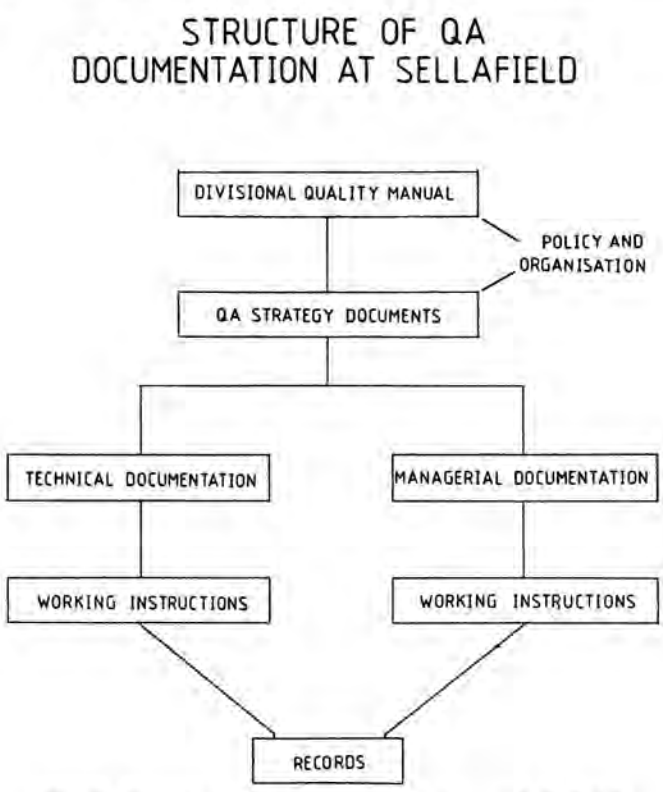

Fig. 3. Structure of QA Documentation at Sellafield.

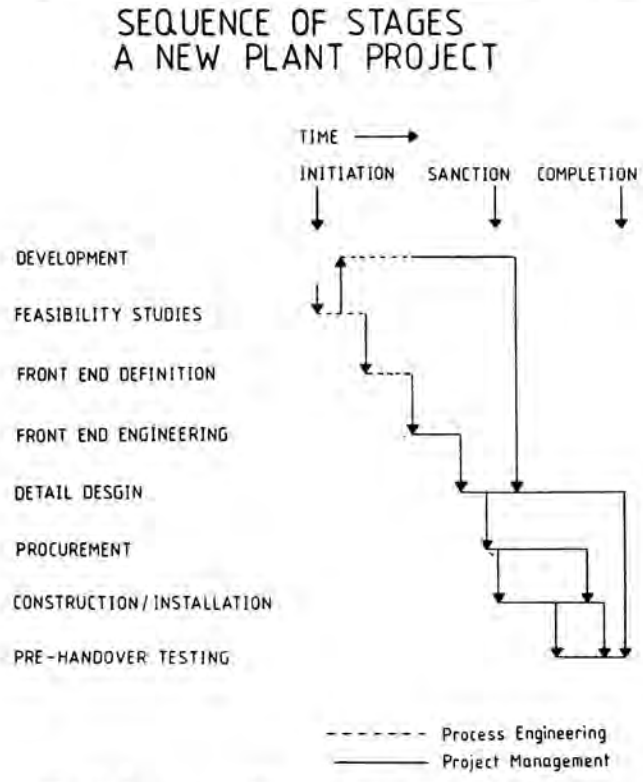

Fig. 4. Sequence of Stages a New Plant Project.

was used to confirm flow sheet predictions. Replicas of containment and handling equipment allowed the reliability of equipment to be assessed and remote maintenance techniques to be checked.

The general approach normally adopted for the control of processes is the development of an acceptable operating envelope from which identified criteria will ensure that the product conforms to specification.

Hold or release points are identified in the process at which checks are carried out. The information recorded during such checks is used to indicate the stability and the effectiveness of the process control system.

MANAGERIAL CONTROL OF PEOPLE

The responsibility for achieving and maintaining quality is placed with the personnel who carry out or supervise the task. Line management are responsible for training personnel, for providing clear instructions and for identifying acceptance criteria by which performance standards can be judged. Such an approach develops the right attitudes and quality awareness.

All staff are trained to know their duties and responsibilities and are qualified on the basis of appropriate education and/or experience.

Like most large organizations, BNFL staff attend a range of training courses. At Sellafield, these cover all the relevant aspects of human behavior at work, the management of safety, radiological health and safety, dosimetry, emergency procedures, good operational practices, an introduction to quality assurance and other associated subjects.

TRANSLATION OF SITE POLICIES INTO CROSS SITE WASTE MANAGEMENT QA SYSTEMS

The managerial controls previously described allow for the establishment of QA systems to suit the specific needs of individual plants. However, no plant is an island. Where plant operations generate process wastes these wastes have to be properly managed and controlled in an integrated manner. Solid, liquid and gaseous wastes are controlled on a site-wide basis through separate QA systems.

A QA program identifies the form of waste arising and the measures to be adopted for operational control. A Quality Plan describes the step-by-step procedures for the control of each waste stream.

Similarly, in the case of aerial effluents, the control arrangements deal with the interaction of plants and the various discharge points.

The Waste Management Unit is responsible for the operation of the Drigg Site. Consignors of low level solid waste are required to prepare a QA document package which describes the waste management arrangements. These include for its collection, and how it is measured and packaged for transport to the Drigg Site. Each consignor has also to comply with the IAEA regulations in respect of transport. The scale of solid waste transport management may be judged from the fact that there are about 90 non-BNFL consignors throughout the UK.

AUDIT OF THE QUALITY ASSURANCE SYSTEM

Self Audit Arrangements

To ensure that the local QA arrangements are working satisfactorily a 'self-audit' system has been developed whereby each line manager is required to establish procedures which comprise a formal self-evaluation of the control arrangements and involves them carrying out specific checks on activities within their own area of responsibility. The self-audit system includes a requirement for a corrective action program to be implemented.

QAD Audit

QAD Audit Staff establish and carry out a program of internal audits on each individual QA System. The objective of these audits is to verify compliance of the QA arrangements with the documented arrangements. Completed audit reports are presented to the appropriate Senior Manager and identify corrective actions and put forward recommendations for improvement.

SUMMARY

BNFL has developed quality assurance systems for the management of radioactive waste. In doing so it has sought to ensure that:

1. Statutory and regulatory requirements are fully complied with.
2. Plant operations are safely, efficiently and economically carried out.
3. Customer needs and expectations are fully satisfied.