PRESERVATION AND RE-USE OF NUCLEAR KNOWLEDGE IN THE UK NUCLEAR INDUSTRY

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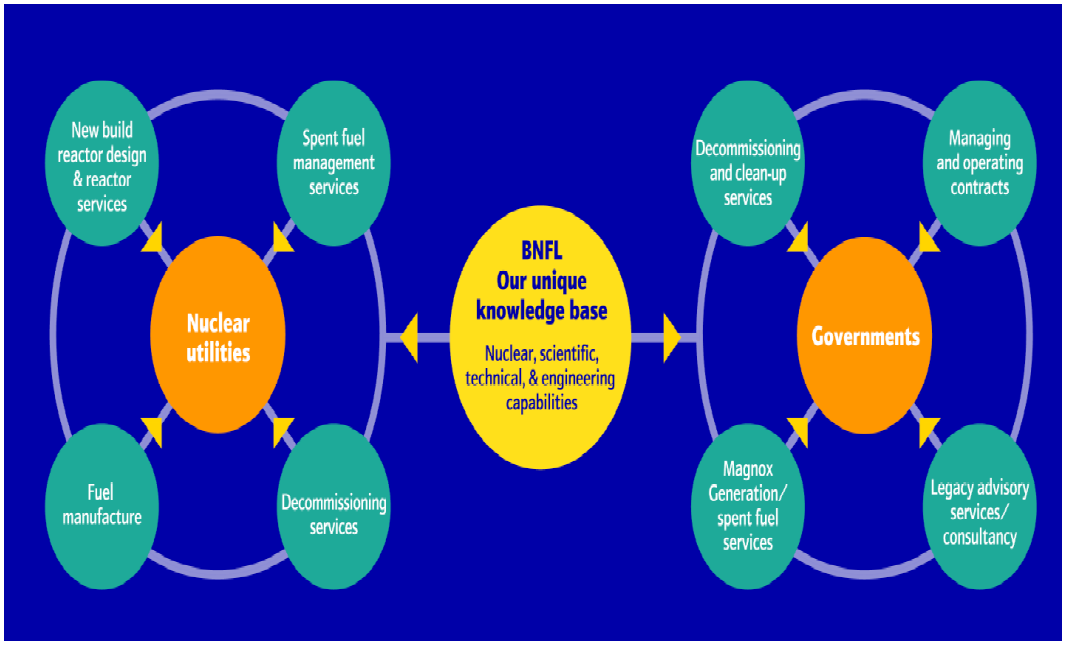
Abstract
This paper addresses the need for the UK nuclear industry to preserve knowledge generated during the 6 decades of its existence for re-use by future generations. It outlines the major government restructuring of the industry and its impact on knowledge preservation. Work within British Nuclear Fuels plc to meet the knowledge preservation requirements of its business is described. The focus is shown to be the alignment of tacit knowledge – gained through interviews with key specialists – with the explicit knowledge contained within the major knowledge base (Corporate Memory). The creation of knowledge packages to hold key knowledge on core technologies and nuclear plants is described. The paper also covers developments in securing the nuclear skill base through University Research Alliances and the Dalton Nuclear Institute. Returning to the major new challenges ahead it is shown how a knowledge portal could be implemented, linking the knowledge repositories present within the organisations that will feature in the restructured UK nuclear industry in 2005.
The UK nuclear industry is facing its greatest challenge in terms of its organisation and commercial interests, at a time when the technical challenges presented by the decommissioning of old nuclear plants and the remediation of its nuclear sites are building up. In terms of knowledge preservation there has never been a greater need to ensure that knowledge associated with the key technologies that underpin the nuclear plants, and the plants themselves, is made available for use now and in the future.
The Nuclear Decommissioning Authority [NDA] – a new government body that will come into being in April 2005 – will own the liabilities (the nuclear plants). Those organisations bidding to operate and decommission plants on the UK nuclear sites will utilise the assets to best effect as Site Licensing Companies [SLC] under contract to the NDA. The key asset is knowledge. Knowledge is present in explicit forms within documents in knowledge repositories and tacit form within individuals. There is also a strong element of know-how, so difficult to capture within formal systems, but often providing the key to unlock a particular operational problem.
British Nuclear Fuels plc [BNFL], as it moves towards the new dawn for the UK nuclear industry in April 2005, is re-shaping itself to meet the challenges presented by this major change. It has re-structured in order to be able to focus on the business needs of nuclear decommissioning and site remediation. However, BNFL recognises that there is still a need to ensure that the UK government keeps the new nuclear build option open. This has resulted in the establishment of a small Energy Unit, looking into different aspects of energy policy.

2.0. Figure 1 BNFL Knowledge Generation



"The real assets of BNFL are, indeed, its people and their extraordinary technical expertise."

Rt. Hon Patricia Hewitt MP, Secretary of State for Trade and Industry, 2001

The need to preserve knowledge within the UK nuclear industry was recognised from the outset through the creation of large libraries on the main sites. These libraries housed traditional library materials, as well as reports generated within their organisations. Card indexes, then computer indexes, were used to manage this information. However, when the governmental organisations involved in nuclear matters changed direction, the libraries and their collections were mostly disbanded and the indexes were not maintained.

In BNFL - within 11 years of the formation of the company - there was the realisation that there was a need to build a computerised knowledge base covering not only its own scientific and technical work, but also to capture collaborative work with those other organisations in the UK nuclear industry. The focus was the need to develop a core of knowledge in support of plants and processes at the UK's nuclear reprocessing facility at Sellafield. This development was concentrated on the largest Research and Development workforce in Europe at that time. Recording their written output from work on a new generation of plants at Sellafield was crucial. Equally important was the acquisition of knowledge, mainly in report form, of work previously undertaken on the older plants at Sellafield. Many of the earlier nuclear plants were researched, designed, built and commissioned during an era when there were no sophisticated information systems to store, manage and retrieve documents.

Explicit knowledge has many formats, ranging from scientific or technical reports, to a plant manual or a safety case. They will contain knowledge that moves from research to design, utilising technology from the science base and integrating safety factors, then on to commissioning, operation and, ultimately, decommissioning and site remediation. Knowledge that encompasses all facets of the nuclear fuel cycle from the manufacture and enrichment of fuel, through its utilisation in reactors, to eventual reprocessing and disposal.

The main company knowledge base that was developed to meet this need – Corporate Memory – is utilised to capture explicit knowledge and underpins the knowledge preservation process. Corporate Memory contains over 250,000 scientific and technical reports written

over the last 6 decades. These reports, written mainly by BNFL staff, cover company plants and projects. The knowledge base has been being developed to encompass the UK nuclear industry, and includes reports from organisations such as UKAEA and AEAT that have worked in partnership with BNFL. Corporate Memory also preserves material published by BNFL in the public domain, typically conference papers and journal articles, which often present state-of-the-art descriptions of plants, processes and technologies.

There occurred some subtle changes in the nature of this repository during the late 1990's. The first major event was the merger of Magnox Electric into BNFL. The net result, in information management terms, was the acquisition of a rudimentary information system, not designed for sophisticated information retrieval. It was converted to bring it in line with Corporate Memory and, indeed, to start to function as an integral part of that system.

The next major event to arise was, quite simply, an awareness of knowledge management – as a term, a concept, a tool and much else besides. As a consequence, organisations began to freely associate with the ideas that lay behind managing something beyond information. A new paradigm took shape.

The sheer size of such knowledge bases towards the end of the 1990's was becoming a problem for effective retrieval of information. There was a need to re-introduce a non-machine element to highlight knowledge of paramount importance to the industry as it moved into a new phase of its development from 2000. There was the capability to re-package knowledge on key technologies in order that it could be re-used at any stage in the future when other nuclear options may be opened up.

Within BNFL's science and technology function two aspects of knowledge management came together synergistically. There had been recognition for some time (of a world wide problem) that the flow of new graduates into the company would be insufficient to meet with future challenges. Also external R&D work was being funded through a disparate scattered collection of universities and other bodies. There was clearly a need for a new strategy.

The strategy that developed took shape in two distinctive, progressive ways. Firstly key technical areas of work within selected universities was jointly funded within centres of excellence in the form of University Research Alliances. This injection of capital and facilities enabled university departments to grow and develop where once there had been gradual decline.

"Universities such as those forming these Alliances have an important role in supporting research and development in the nuclear industry. The BNFL University Research Alliance not only invests in the research base but also ensures there is a good knowledge transfer system into industry so that investment in research on a science base does produce visible returns."

Professor David King, Chief Scientific Advisor to the UK Government and Head of the Office of Science and Technology.

BNFL was able to commission research projects from those departments, managed and supported by experienced staff from its own in-house science and technology function. New graduates have started to emerge from this process to work in the company, bringing with them a working knowledge of BNFL and its applications of nuclear science and technology.

The next step in securing the future skill base was to see the development of a school of nuclear science and engineering. This school – the Dalton Nuclear Institute, named after one of the forefathers of modern atomic theory – is scheduled to open in September 2004 as part of the new University of Manchester. Building on the success of the University Research Alliances, the Dalton Nuclear Institute will focus on supporting the implementation of government policy for nuclear site clean up and energy generation, by establishing research and education programmes to fill identified skill gaps. The aim is to produce graduates

qualified in nuclear science and engineering, with practical experience of UK nuclear plants, processes and associated technologies. Their learning curve will be greatly reduced when they commence work within the nuclear industry itself.

"The Dalton Nuclear Institute is a fantastic opportunity for the new University of Manchester to establish nuclear science and engineering as one of its core capabilities. By working closely with the nuclear academic community, industry, government and regulators we are confident that Dalton can help to maintain the UK's position as a leader in nuclear skills and technology."

Professor Richard Clegg, Director of the Dalton Nuclear Institute.

The other aspect of knowledge management that has been inextricably linked to this academic development, has been the desire to preserve tacit knowledge along with the explicit knowledge amassed within the Corporate Memory. The first targets for this new process were the 4 core technologies of radiochemistry, particle science and technology, waste immobilisation and materials performance for the University Research Alliances.

There was simultaneously an acknowledgement of the need to preserve knowledge on technologies that were not being taken forward, as well as those that were actively under development. So it became a logical step to ensure that the key technologists, associated with these technologies within BNFL, participated in the initial stages of this programme of work.

The knowledge preservation process commences with the strategic identification of key specialists within each technology or nuclear plant. This is followed by an interview with the nominated individuals, who typically have 20-30 years experience within the UK nuclear industry. Each individual is asked during the course of a one hour interview to identify, from within their written output, those documents which contain knowledge regarded as being key for the future of the industry. By adding their specialist knowledge to the key documents, a permanent marker is inserted within Corporate Memory entries, which will assist future generations to identify important work undertaken by their predecessors. Specialist knowledge sets the context within which the work was carried out, along with the particular significance of the findings described.

Company reports represent one facet of knowledge. Knowledge of other sources of printed material, such as books, journals and external reports, are also elicited during the interview. It is believed that the IAEA, through INIS, have the resources to produce a more comprehensive identification of key international work [NB. This matter will be further discussed during the INIS Session of this conference].

Links may also be made to internal information systems or external web-sites that contain valuable additional sources of knowledge.

The people issue can prove critical. Often it is those individuals within a specialist field, who can be relied upon to provide expert advice or consultation, that are most valued in terms of their own tacit knowledge or know-how. They may still work within the organisation itself, but are just as likely to have retired or to be employed by other organisations in the field.

All the knowledge extracted via the interview process is linked together within a knowledge package covering a particular technology or nuclear plant. A knowledge package is a simple information system containing links to the sources of knowledge that have been identified during the knowledge preservation interview. It is possible to customise the knowledge package template to provide the most effective working system for each subject. Knowledge packages, like Corporate Memory, are made available for use throughout BNFL via the Lotus Notes IT infrastructure.

Compiling knowledge packages from the relevant sources provides a comprehensive collection of knowledge on particular subjects, which can be utilised within the learning organisation. This knowledge can be re-packaged into modules for study, as BNFL seeks to

broaden its knowledge base and to attract high calibre scientific and technical staff. Then the concept of a Virtual University starts to take shape, potentially encompassing staff at all levels within the company.

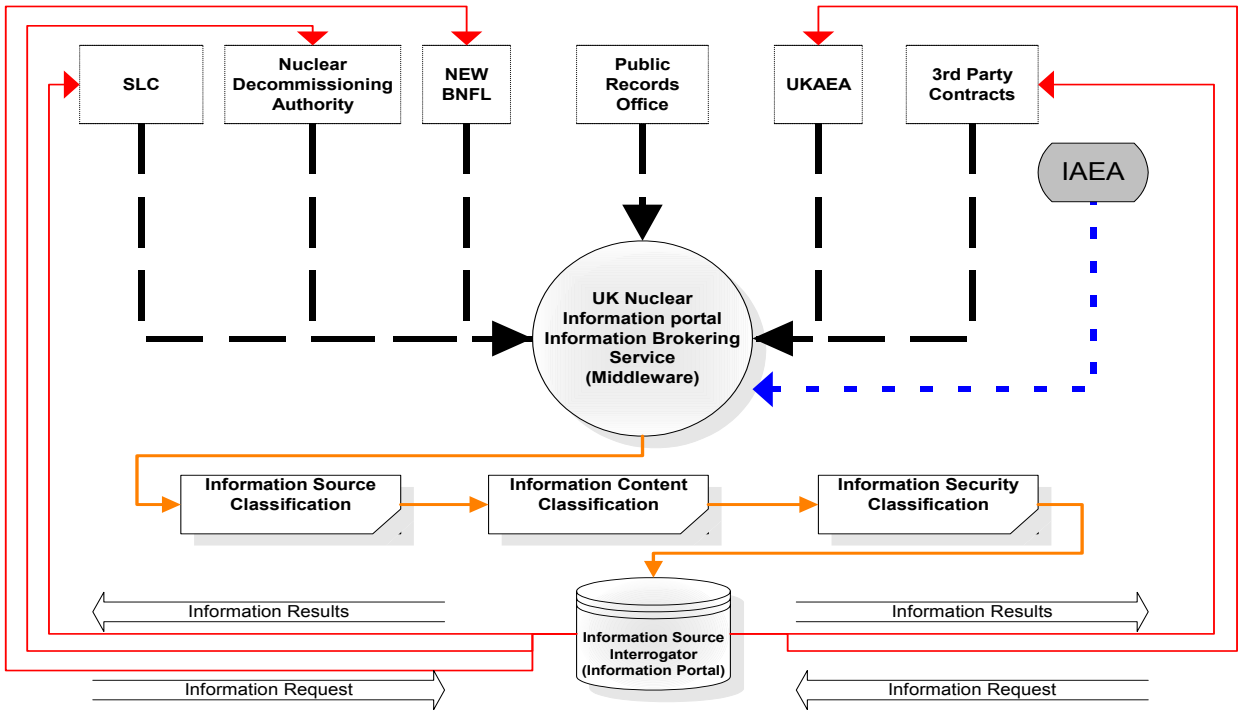
There are external beneficiaries from the knowledge preservation process. As BNFL concentrates its university contacts in key areas such as radiochemistry, particle technology, waste immobilisation and materials, an opportunity arises to extend involvement in the process. Knowledge packages are shared with those academics that have joined with BNFL to populate its University Research Alliances (URA), through the development of e-rooms. The universities are encouraged to contribute their own published material, along with lecture notes and associated reading lists. Events, such as technology conferences, are captured on video. This generates a permanent record of the event, and the knowledge shared during presentations and poster sessions, which can be linked into the appropriate knowledge package.

Over the 3 years that this programme of work has been undertaken almost 300 interviews have been conducted, resulting in the identification of over 2,500 key documents and the creation of 45 knowledge packages. The knowledge packages are updated through ongoing liaison with interviewees. Input is also provided by the original customers, who have taken over ownership of the knowledge packages.

The knowledge preservation process continues to be refined in response to the new challenges within the UK nuclear industry. A programme of peer review is under development that seeks to create new knowledge around certain core technologies. New graduates will produce state-of-the-art reports and commentaries on earlier work from this review process.

Finally, as the knowledge management requirements of the Nuclear Decommissioning Authority gradually emerge, it is becoming evident that there will need to be a greater sharing of knowledge. A working group is currently investigating the option of installing a knowledge portal [Figure 2] which would facilitate a greater sharing of nuclear knowledge between organisations than has hitherto proved possible.

2.1. Figure 2 UK Nuclear Industry Knowledge Portal



BIBLIOGRAPHY

Fast Reactor Knowledge Preservation work within British Nuclear Fuels. R Workman and B Moore. Paper presented to the ANS Special Session on 13 November 2001 : Passing on Fifty Years of Fast Reactor Knowledge to a New Generation in Nuclear Research and Development.

University Research Alliances – brochure. British Nuclear Fuels plc.

The Corporate Memory : a profitable and Practical Approach to Information Management and Retention Systems. BN Weaver and WL Bishop. Wiley, 1974.