DECOMMISSIONING THE WINFRITH TECHNOLOGY CENTRE - ENVIRONMENTAL RESTORATION WITH A PURPOSE

M S Barents
United Kingdom Atomic Energy Authority (UKAEA)
Winfrith Technology Centre

ABSTRACT

The nuclear industry needs to demonstrate that it can remediate major nuclear sites when no longer required and restore them for continued use by the local communities. The nuclear facilities at the Winfrith site, owned by the United Kingdom Atomic Energy Authority, are now all shut down. A strategy has been developed to remediate the site and create a new science based business park creating high quality jobs within the local community. The essential elements of this are:

- Decontamination and conversion of buildings for re-use.
- Removal of redundant facilities and remediation of the land for further development.
- Removal of remediated areas of the site from regulatory control (delicensing).
- Sale of land no longer required in a manner consistent with its future environmental management needs.
- The retention of those facilities that cannot be decommissioned in a short timescale, in a safe state.

Significant progress in implementing this strategy has been made. The majority of the major site facilities have either been decommissioned to a suitable state, or have contracts in place for decommissioning to start. Redundant facilities have been converted for occupancy by new tenants. Already some 1200 paying tenants are on site, the majority working outside of the nuclear industry. It is planned that the majority of the site will move from a Government owned nuclear research and development centre, to a privately owned business park by 2008 to 2010.

This project demonstrates that the UKAEA is able to complete its missions of restoring the environment, to the benefit of the public.

INTRODUCTION

Much has been written, and is being published, about the decommissioning of individual nuclear or radioactive facilities. However, such projects cannot generally be an end in themselves and will be being undertaken in the context of a wider strategy regarding the management of the local environment. The useful life of many nuclear facilities, a significant number of which were conceived and constructed some decades in the past, is now coming to an end. The public will expect, and probably will demand, the restoration of the land associated with these facilities to enable it to put to beneficial use for the community as a whole. The "nuclear industry" needs to demonstrate that the restoration of major nuclear sites is both technically and economically feasible.

One such site is the Winfrith Technology Centre, in Dorset in the South of England. This is owned by the United Kingdom Atomic Energy Authority (UKAEA) and was a major centre for reactor physics research and reactor development. It occupies some 1130 acres, of which some 343 acres is within the site security fence. The site's nuclear facilities are now shut down. This paper describes the future plans for the site and describes what actions are planned to restore the environment for beneficial use for the local community.

WINFRITH HISTORY

The United Kingdom Atomic Energy Authority (UKAEA) was created by Act of Parliament in 1954 to develop the use of atomic energy in the United Kingdom. The headquarters was established at a previous airfield in Harwell, Oxfordshire. Within a few years it was clear that a new site was needed with sufficient space for the construction and operation of a number of experimental and research reactors and supporting facilities. Out of a list of some 70 sites in the UK an area of heathland in Dorset, known as the Winfrith Heath, was chosen. The main qualifications for this was its remoteness from large population centres, good communication links by road and rail, and a large supply of fresh water for cooling purposes. Work started on construction in September 1957. For the literary minded, the area was immortalised in the novels of Thomas Hardy as Egdon Heath.

The design of the site allowed for the siting of a number of "nuclear islands" around a central area containing support facilities (such as engineering workshops), laboratories and administrative buildings. A general overview of the site layout is shown in figure 1.

Construction work on the new facilities proceeded very quickly (particularly by todays standards), and by the end of 1959 the first low energy reactor (ZENITH) was completed and in operation. This was quickly followed by two others (NESTOR) in 1961 and (DIMPLE) in 1962. NESTOR was a water cooled high flux reactor of the Argos series produced by Hawker Siddely, used primarily for reactor shielding studies. DIMPLE was an experimental facility able to work with a variety of fuel and moderator configurations and was mainly used for criticality validation studies. (These two reactors in fact being the last two reactors operating in the UKAEA, and were only finally shut down in 1995.) A third zero energy breeder reactor, ZEBRA, followed shortly afterwards. This was used to study the physics of large plutonium fuelled fast reactors and operated at about 1kW. Two further low power reactors were also built, HECTOR, in 1963 and JUNO in 1964.

Regarding power reactors, two have been built at Winfrith. The first was DRAGON, a high temperature gas cooled reactor generating some 20 MW(th) of a type first studied at the UKAEA headquarters at Harwell. This was first proposed in 1958 as a European inter-governmental Research and Development project, and in 1959 formal agreement between the EURATOM partners was reached to have DRAGON at Winfrith. The reactor was completed in 1964 and achieved first criticality in August of that year. The second main reactor was the Steam Generating Heavy Water Reactor, SGHWR (sometimes known as the Winfrith Reactor). This was a light water cooled, heavy water moderated, vertical pressure tube reactor with a direct cycle steam turbine. The maximum power was some 330 MW(th) and for many years was the

largest water cooled reactor in the United Kingdom. Construction was started in 1963 and first criticality achieved in September 1967, almost 10 years to the day after the first turf was cut on the Winfrith site.

As well as reactors, other facilities were also built to support the site operations. A plutonium fuel manufacturing facility was built to produce research reactor fuel, both for Winfrith and other sites. A suite of shielded cave lines was also built, primarily for the post-irradiation examination of SGHWR and other fuels. In addition, laboratories, waste stores and an extensive radioactive liquid effluent system were also constructed.

Thus throughout the 1970's and 1980's, Winfrith was a thriving major nuclear research and development site, operating a significant number of nuclear reactors and support facilities.

By the mid-1980's a number of the site's facilities had become redundant, and the long term future of those still operating was uncertain. In addition, a significant quantity of radioactive waste and other materials had accumulated on the site. The cost of dealing with these was recognised as being significant in relation to the operating budget of the site. Long term plans were developed in order to define the forward budget necessary to keep the facilities safe and decommission them at an appropriate time. The major nuclear facilities on the site by 1990 are summaries below:

Table 1

Summary of Significant Site Facilities in 1990

Name	Type	Operational Dates	Status
Steam Generating Heavy Water Reactor (SGHWR)	330 MW(th)	1967 - 1990	Shut down
DRAGON, High Temperature Gas Reactor	20 MW(th)	1964 - 1976	Shut down and defuelled
Zero Energy Breeder Reactor (ZEBRA)	Low Power Reactor	1962 - 1982	Shut down and defuelled
"Argos" type Low Power Reactor (NESTOR)	Low Power Reactor	1961 -	Operational, but future uncertain
Reactor Physics Critical Assembly (DIMPLE)	Zero Power Assembly	1962	Operational but future uncertain
Active Handling Building (A59)	Shielded Cave Facility	1963	In use for waste processing
Fuel Manufacturing Facility (A52)	Fuel Manufacture	1962 - 1985	No operational use foreseen
Radioactive Liquid Effluent System		1960 -	In use

Some of these facilities are shown in figure 2.

STRATEGIC ISSUES FOR SITE REMEDIATION

In the early 1990s, due to the closure of the majority of the nuclear facilities, decommissioning activities increased significantly. The initial strategy for site decommissioning was based around achieving the lowest total lifetime cost whilst maintaining appropriate levels of safety and environmental protection. Inevitably, this resulted in most progress on the largest facilities (see ref. 1), since these had the largest economic impact on the site.

The defined mission of the UKAEA is now to restore the environment. This is to be undertaken in a way that is:

- Safe
- Sensitive to the environment
- Publicly acceptable
- Gives value for money

Consequently, a strategic plan for the remediation of the whole site was developed in the late 1990s.

Previous papers have discussed the safety of the decommissioning at Winfrith (see for example references 1 and 2). This paper concentrates on the other aspects given above. The following issues are seen as important drivers behind the development of a restoration strategy for the site.

- When operational the site employed up to 2000 people and was a major employer and economic influence in the local community. Many of the staff were highly qualified with a scientific and technical background. With the closure and run-down of facilities there will inevitably be a run-down in employment requirements on the site, with limited local re-employment opportunities. Thus an objective exists to develop new buisnesses on the site and to restore the original 2000 jobs.

- The site was originally built on heathland and was a true "Greenfield" site having had no previous history of economic development. The site is still ecologically sensitive, and significant areas are designated as a "Site of Special Scientific Interest". (This reflects its importance as a habitat for flora and fauna - rather than its scientific achievements.) The Dorset Heathlands are designated a special protection area for the conservation of wild birds because of the European ornithological importance of the area. The area is used regularly by the following rare birds:

Table 2

Rare Birds at Winfrith

Species	% of UK Population
Dartford Warbler	38%
Nightjar	13%
Woodlark	9%
Hen Harrier	3%
Merlin	1%

The Dorset Heathlands are particularly good examples of wet heathland habitat characteristic of the Atlantic bio-geographical region of Western Europe. As such the site is of international importance regarding its rarity and nature of vegetation. It supports a wide variety of invertebrate fauna, nearly 30 species of which are listed as endangered. These include beetles, moths, butterflies, damselfly, grass hoppers and spiders. The whole habitat and associated flora and fauna is essential to the maintenance of the bio-diversity of south east Dorset, which is one of the most biologically rich areas of the United Kingdom. Approximately one half of the land owned by the UKAEA at Winfrith is included within these designated areas.

The future strategy for site remediation takes account of the above issues and includes the following elements:

- Decontamination and conversion of buildings for re-occupation for new businesses.
- Removal of redundant facilities and remediation of the land for site development.
- Removal of remediated areas of the site from regulatory control (delicensing).
- Sale of land no longer required in a manner consistent with its future environmental management needs.
- The retention of those facilities that cannot be decommissioned in a short timescale, in a safe state.

Ultimately this will lead to the setting up of a science based business park and a smaller, separate area containing any remaining nuclear facilities awaiting decommissioning. The timescale currently planned to complete this is 2008 to 2010. A plan of the site at this stage is given as figure 3.

PROGRESS TO DATE

Significant progress has been made with the various elements of the strategy, particularly in the areas of:

- Decommissioning and land remediation
- Development of facilities for new businesses
- Removal of the site licence
- Sale of land

Taking each of these in turn

Decommissioning

Table 1 shows the status of the main facilities as at 1990. The significant tasks achieved since then have been the stage 1 decommissioning of the SGHWR, the removal of the alpha materials laboratory and the start of the removal of the NESTOR and DIMPLE reactors.

The stage 1 decommissioning of the SGHWR took place between 1990 and 1996 and involved the removal of the fuel from the Winfrith site, the emptying and decontamination of the fuel ponds, the draining of fluid circuits and general rationalisation of electrical, control and ventilation systems.

The removal of the alpha materials laboratory represented the first complete decommissioning of a major plutonium facility in the United Kingdom. Following removal and size reduction of the contaminated glove-boxes and equipment inside the facility, the building structure and services were progressively decontaminated and removed over a two year period. Decommissioning was

completed in March 1999. The NESTOR and DIMPLE reactors dismantling started early in 1999 and will be completed later in 2000.

Work has also started to decommission some of the laboratories on the site that have been used for radioactive work. In particular, a suite of laboratories used to handle plutonium have been decontaminated and converted into offices for use by a site tenant.

The major facility still in use is the active handling building, where some of the shielded caves are being used to package intermediate level radioactive wastes. This work is however nearly complete and a contract has been let for its decommissioning, due to start early in 2001.

Development of Facilities for New Business

The development and adaptation of old facilities for occupancy by new tenants, is an important part of both the mission to create a science park and the economics of the site. The site is recognised as a development area by both local and regional planning authorities who are giving their support to appropriate new business development. Conversion of redundant facilities to a new use has been successful in attracting new organisations to the site as paying tenants. In particular the engineering workshops were converted to office accommodation for the Defence Evaluation and Research Agency, and the previously mentioned plutonium laboratories have been converted to offices and laboratories for the National Environmental Research Council. The stores receipt and storage building is currently being converted for another tenant in the defence industry. Together, these new facilities house in excess of 900 tenants out of the sites total of some 1200. Examples of such conversions are shown in figure 4.

The site is actively co-operating with the local government authorities in providing small "start-up units" for rent to new businesses. This will hopefully help these businesses to grow and develop and then take larger rented space on the site in due course.

Removal of the Site Nuclear Licence

The existence of the nuclear licence on parts of the site imposes the requirement for the regulator (Her Majesties Nuclear Installations Inspectorate) to formally agree to and approve certain activities. These include agreements with third parties that might inhibit the UKAEA to properly control all activities being undertaken on the site. It is a legal requirement that the UKAEA is able to control all activities being undertaken on the licensed area of the site. This does not provide for the best commercial environment for site development, and therefore removal of the licence is seen as a very important aspect of securing the best commercial return from the land and facilities.

The legal basis for delicensing is defined by statute in the Nuclear Installations Act of 1965. To date, there have only been a few applications to delicense parts of nuclear sites and therefore the processes and precedents are still immature and being developed. Thus the ability to delicense is seen as a potential risk to the future strategy, which will need to be managed by close co-operation with the regulators.

A programme to delicense parts of the site, phased with the decommissioning and removal of the nuclear facilities, has been developed. Each delicensing application will have a justification demonstrating the following:

- No activities involving the use or storage of radioactive material are being undertaken.
- The history of the use of the land has been adequately researched to indicate any likely areas of contamination.
- All radioactive or contaminated facilities have either been removed or decontaminated to a level sufficient to demonstrate "no danger" from ionising radiation.
- All the land area has been remediated, surveyed (and sampled if appropriate) to demonstrate that all residual contamination has been removed. Generally, this will demonstrate that no significant levels of contamination remain with respect to the local, natural background.

The first application to delicense approximately 20 acres, is already lodged with the regulatory authority.

Sale of Land

The majority of the land associated with the Winfrith site was originally purchased by the UKAEA to provide an exclusion zone around the site of the major facilities. Much of this is natural heathland, protected from development as already discussed. The value of this land is not high and the UKAEA is sensitive to the need to ensure that it passes to owners prepared to maintain the necessary management and conservation measures. The first block of land has recently been sold to the Dorset Wildlife Trust. This is a local environment protection organisation who already own other land in the area. By this means the UKAEA hopes to ensure that the land will be managed in the most appropriate way for the benefit of the local communities.

CONCLUSIONS

A coherent future strategy for the management of the whole Winfrith site has been developed, and is being enacted. This will involve the remediation and development of the site into a science based business park to ensure the economic future of the local area. At the same time the environmentally sensitive habitat, of both European and International importance, is being sensitively managed.

Significant progress has been made with the decommissioning of the major nuclear facilities to allow this development. All have either been decommissioned or have contracts in place for their removal in the near future. Plans to remove the nuclear licence from parts of the site, to give best commercial benefit from the land area, have been developed and the first delicensing application has been submitted to the regulatory authorities. It is anticipated that the majority of

the site will move from a Government owned nuclear research and development centre, to a privately owned business park by 2008 to 2010.

In summary, this paper demonstrates the practicability of turning a major redundant nuclear research centre into a facility providing continuing employment for the local communities, and protection of the local environment. This effectively proves that the UKAEA is able to complete its mission by restoring the environment for the benefit of the public.

REFERENCES

1 Progress with Stage 1 Decommissioning of the Steam Generating Heavy Water Reactor. M S Barents, P Andrews (AEAT). Proceedings WM ’96.

2 Decommissioning and Removal of the Fuel Manufacturing Facility at Winfrith. M S Barents, D Smith (UKAEA). Proceedings WM ’99.

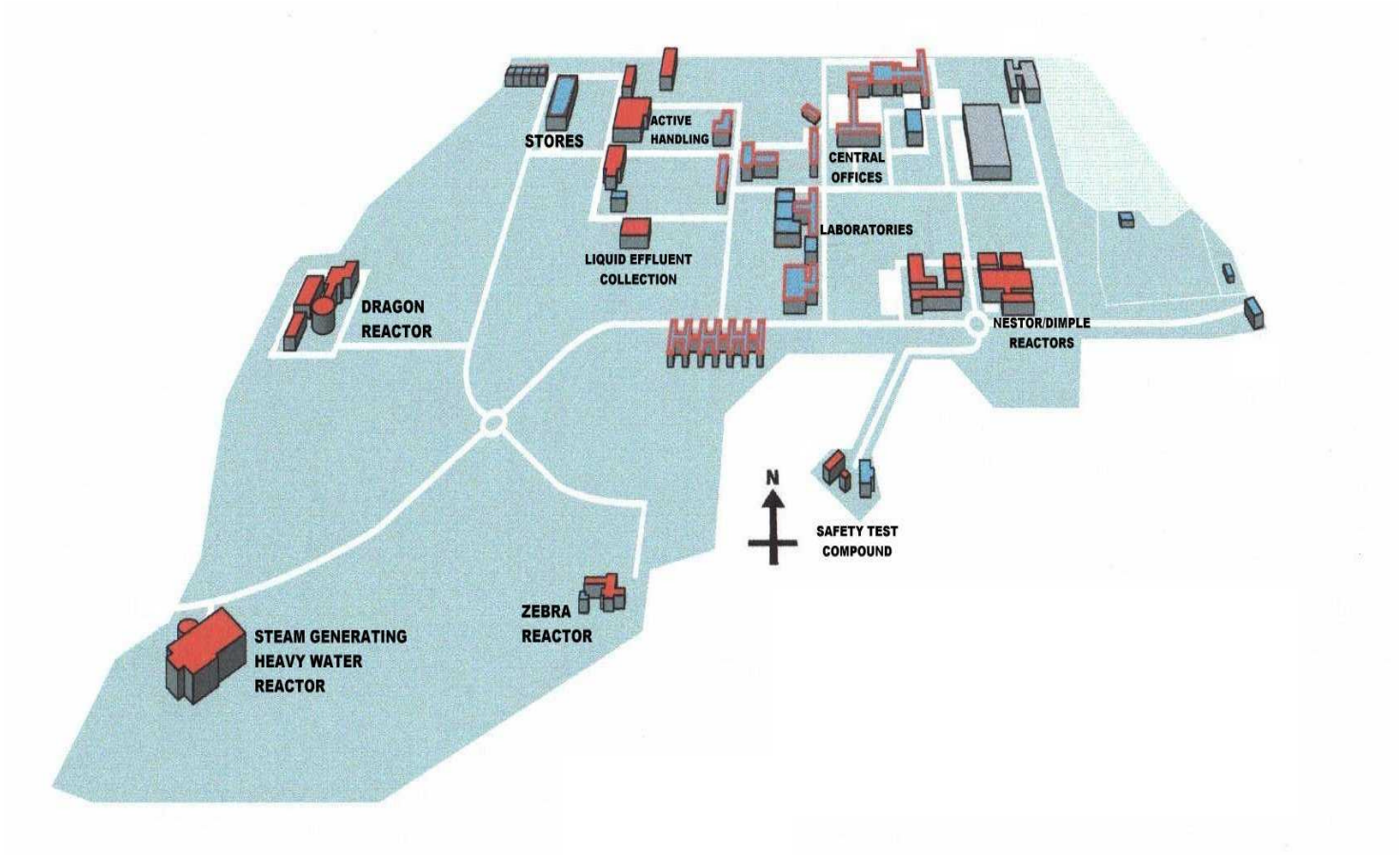

Figure 1

Layout of Winfrith Technology Centre

ZEBRA Reactor

Steam Generating Heavy Water Reactor

DRAGON Reactor

PIE Facility

Figure 2

Winfrith Facilities

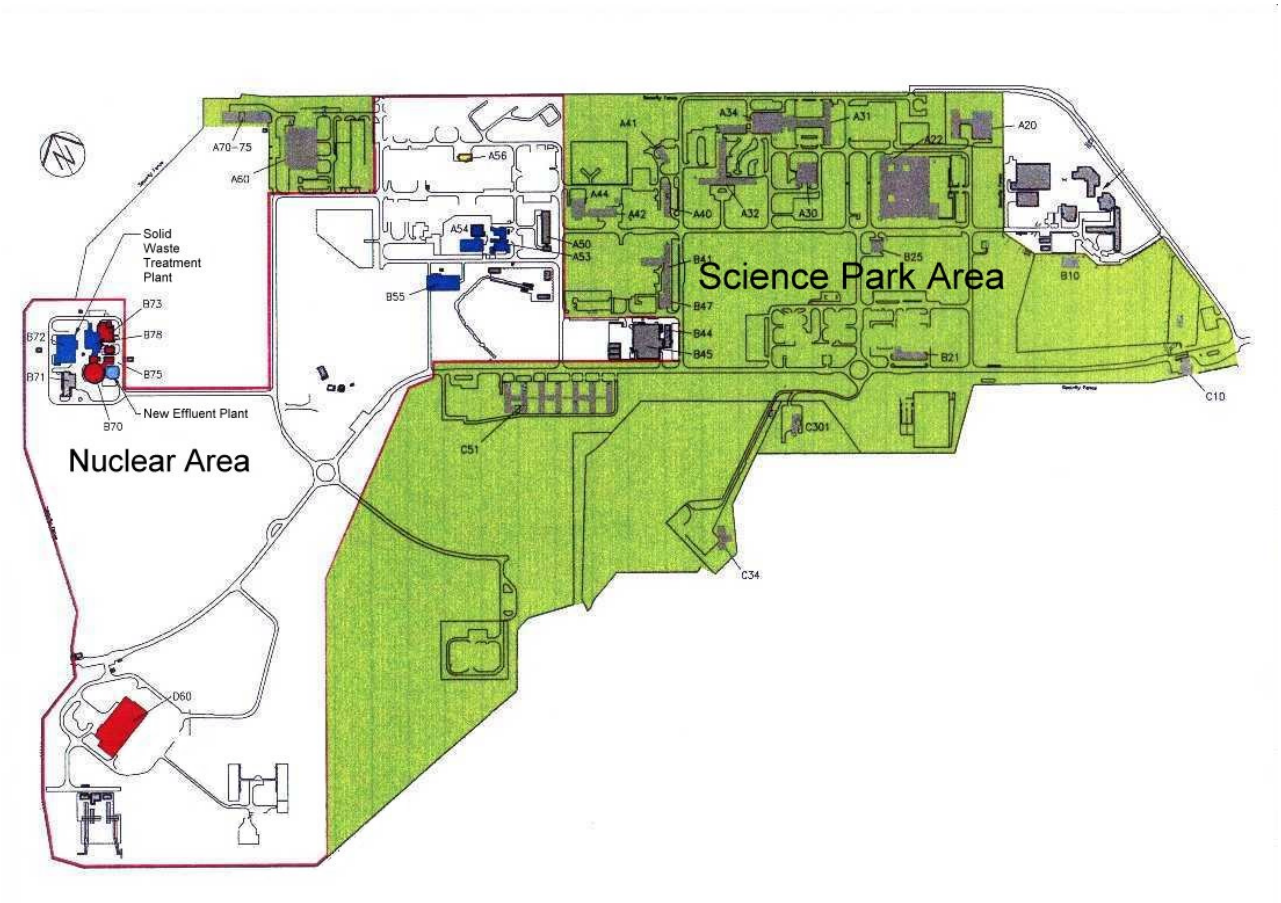

Figure 3

Future Site Layout in the Year 2010

Before **After**

Figure 4

Example of Building Conversion for New Tenant