Dounreay Site Restoration Ltd

Dounreay Heritage Strategy:

Delivering a cultural legacy through decommissioning

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Dounreay Heritage Strategy

	Name and Organisation	Signature	Date
Prepared By:	J B Gunn, DSRL A Croft, Atkins Heritage		
Checked By:	D Graham DSRL Environment Team Leader		
Endorsed By:	S Middlemas, DSRL Managing Director		

HISTORY SHEET

VERSION	DATE	HISTORY
1st Full Draft	October 2008	Endorsed by Dounreay Environment Committee & Issued to Historic Scotland for comment in Nov 2008.
2nd Full Draft	October 2009	Revised to take account of Historic Scotland comments. Endorsed by NDA & DSRL senior management. Issued to Historic Scotland for comment in October 2009.
3rd Full Draft	December 2009	Amended to take account of Historic Scotland's comments on DFR care and maintenance costs post Interim End Point.
Issue 1	June 2010	Amended to take account of stakeholder engagement and views of DSRL and NDA management.
Issue 2	August 2010	Amended to take account of Historic Scotland comments on Vulcan's exclusion from scope and analysis of engagement process.

Contents

Appendices

Figure List

Photographs

Various past and present photographs of Dounreay.

Foreword

In 2007, Historic Scotland met with UKAEA to discuss the significant historic legacy at Dounreay. Together, we recognised the importance of the site and its place in engineering and broader history. However, unlike many historic sites, the decommissioning of nuclear power facilities brings with it very significant challenges. Should buildings or structures be preserved? What criteria should be applied when assessing significance and do they differ from the ones used for historic buildings more generally? Where significant levels of contamination exist, how does this affect the case for preservation? How does one measure public benefit when the site may not be available to the visiting public for decades if not many generations? What artefacts, records and photographs should be preserved and should this be on site or elsewhere? Given the challenges that such sites present, and the importance of reaching decisions in a clear and transparent manner, we agreed that the options for protection could most sensibly be discussed within the context of a wider heritage strategy for the site.

The strategy was undertaken by Atkins Heritage, and they in turn drew in contributions from a wide range of bodies including Historic Scotland, the National Museums Scotland, Caithness Horizons, English Heritage and the local community through the Dounreay Stakeholder Group.

This work began in 2008 and this report is one of the key outputs of the study. The process of developing the heritage strategy has been immensely constructive and informative. In addition to helping us take decisions relating to Dounreay, we hope that it provides a model of wider applicability to similarly unique and complex sites throughout the United Kingdom and elsewhere. The consultative approach adopted has ensured that key issues were identified. For example, it was advisable to consider how other nations had handled their decommissioned sites. While the EBRI in Idaho is now a National Historic Landmark the Big Rock Point Nuclear Plant in Michigan is now in a natural state with memorial. A future initiative will consider if Dounreay's contribution can be memorialised with some physical representation or art installation on the ground.

The importance of the site can be read at an international level but it has also had a key impact on the locality and its communities. The nuclear plant at Dounreay has shaped present day Caithness well beyond the confines of its coastal site. The 'Atomics' housing in Thurso by the Scottish Special Housing Association, for example, attests to its impact. There is much to celebrate and to study in the Dounreay resource, from its inception to the decommissioned site, in the fields of history, science and social geography. DSRL is to instate a panel of interested bodies to explore further research and dissemination in these areas.

We have been delighted to have been involved in this innovative project. It seems entirely fitting to us that the spirit of innovation that underpinned the development of the reactors at Dounreay remains at the site - both in terms of the current decommissioning programme and in particular in terms of developing new approaches to deciding how best to celebrate and commemorate such a key site.

Malcolm Cooper
Chief Inspector
Historic Scotland

Executive Summary

1. Introduction

Dounreay is no longer in operation and Dounreay Site Restoration Ltd (DSRL) is licensed to undertake the programme of decommissioning and clean-up of the site, on behalf of the Nuclear Decommissioning Authority (NDA).

The ‘End State’ of the Dounreay site is becoming better defined after the Dounreay Stakeholder Group (DSG) carried out public consultation in 2007. One of the conditions attached was for:

“*An open and transparent decision on the future of the DFR sphere, taking into account its ‘national heritage significance*”.

DSRL has worked with the NDA and Historic Scotland to establish a way forward for creating a lasting cultural legacy of the site. This document has been prepared by DSRL, with support from Atkins Heritage, and describes the activities that will be undertaken to retain the heritage of the Dounreay site for public benefit beyond the Interim End Point (IEP).

The brief was to consider the whole of the site and heritage in the widest sense. Whilst NDA & DSRL recognise the significance of retaining industrial heritage, this must be balanced to discharge the NDA’s key mission to decommission the site, and can be done in a number of ways which does not rely on the retention of key buildings.

Discussions with the NDA, Historic Scotland, National Museums Scotland, Caithness Horizons and the Dounreay Stakeholder Group have taken place on a regular basis and these organisations have contributed to the shaping of the strategy.

The strategy has been developed in line with best practice approaches to conservation management planning; in that it is founded on a robust understanding of the site and its cultural values and on a clear recognition of the issues and factors relating to decontamination, waste management, decommissioning, safety and security. The strategy’s development has been an interesting challenge as such work has never been previously done for a complete nuclear site in the UK.

The NDA provides funds and is strategically responsible for the decommissioning programme and ultimately determines the extent of heritage activities to be undertaken. The decommissioning and clean-up of the site in a way that it is safe, environmentally acceptable and provides value for money to the taxpayer remains the NDA’s priority. Socio-economic considerations, in line with NDA policy, are among the key factors in any decisions on heritage.

A stakeholder engagement process was undertaken from 10 December 2009 to 8 March 2010 and 38 responses were received. While a variety of views were submitted, the analysis of the responses confirmed that the main strategic themes remained the same.

2. The Heritage of Dounreay - Statement of Values

Dounreay’s heritage significance can be divided into evidential, historical, aesthetic and communal values as follows:

Evidential Value

While Dounreay is unique in the UK, internationally it represents a similar, short phase of nuclear development of fast breeder technology. This phase did not achieve widespread adoption. Dounreay is not typical, nor, in evidential terms, representative of the nuclear power industry.

Dounreay's extensive and well-catalogued archives – reports, documents, design drawings, site plans and photographs - cover all periods and parts of the site and document the innovative processes and general working conditions. The visitor books contain the signatures of high-profile visitors such as Prime Ministers, royalty, MPs, journalists and international scientific delegations. There are also symbolic and personal commemorative items, such as plaques and artworks, pamphlets and personal ephemera.

Historical Value

As an experimental nuclear establishment Dounreay claims a number of significant achievements in the history and development of nuclear technology, including:

- The Dounreay Fast Reactor (DFR) was the first fast breeder reactor in the world to produce electricity for public consumption (1962)
- The first criticality in Scotland took place in the uranium test rigs (1957)
- Dounreay chemists developed highly accurate analysis techniques for uranium and plutonium which are now used as the international standard.
- Dounreay has been and still is, at the forefront of the development of nuclear decommissioning technologies and methods, particularly in the destruction of alkali metals where PFR operated a world class facility.
- Dounreay created the first modern apprenticeship in Nuclear Operations and Decommissioning in the UK (2003).

Aesthetic Value

A key aspect of the site's aesthetic and visual quality is the contrast between the industrial dense complex, with the primary shapes of sphere, boxes and vertical lines and the surrounding rural landscape. Arguably, the visually and aesthetically most notable feature of Dounreay for some is the DFR sphere, which, like all the structures was an architectural response to engineering and technological requirements.

Communal Value

Dounreay seems to figure in the collective memory of the UK. For some, Dounreay, particularly the instantly recognisable sphere, is a symbol of modernity, progress and discovery, at a time when Britain was at the forefront of science and innovation. For others, it is the darker side of human endeavour with a legacy of contamination and associations with an era of secrecy. The sphere is an image which is often used in the media, incorrectly, as an archetype of the nuclear industry or the nuclear age.

The development of Dounreay transformed the rural economy and social life of the communities of Caithness and North Sutherland. There is an interest in the social history of those who worked on and lived near, the site. In common with other industrial communities, a deep sense of history-in-the-making has been a characteristic of Dounreay from the earliest days. There are many plaques, signs and artworks which commemorate key events on the site.

3 Creating a Cultural Legacy – The Strategy

Creating a cultural legacy for any site rarely depends entirely on preservation. A cultural legacy comprises a mix of components and entails the selection of the most appropriate and feasible opportunities for:

- Physical conservation and retention of buildings and objects
- Retention of evidential material about the site and history
- Communicating and celebrating the heritage – the historical events, processes, achievements and individuals

The Lifetime Plan (LTP) for Dounreay describes the scope, schedule and cost of the decommissioning activities, from the present condition to the End State and beyond. The objective is that the End State should be a "restored site, with early release of land". The NDA requires that the End State should be a "radiological and industrial brown field" and by then most of the physical works on the site will be complete, although institutional control will continue up to 2078 and probably well beyond.

Thus the heritage of Dounreay cannot be considered in isolation. There are some key assumptions that must be taken into account in the formulation of a lasting cultural legacy:

- The priority is to restore the environment in a safe manner which gives best value to the UK taxpayer – for the environment and human health, through the interrelated tasks of decontamination, waste management and decommissioning.
- The need to maintain the decommissioning programme – which has considerable technical challenges and financial restrictions and is subject to regulatory requirements.
- The need for security and safety. The decommissioning of facilities and the construction of new ones for dealing with the generated waste, residual ground contamination, together with the need to keep radioactive materials secure, means that the licensed site at Dounreay is not, and cannot be, fully open to the general public. Any access will be limited and highly controlled. This situation will last until at least 2078 and probably well beyond.

There are also other issues that must be considered:

- The very considerable cost of care and maintenance for some of the structures, many of which are already unsound. The NDA budget must give highest priority to features and projects which address high hazards and associated risks.
- The projected low level of likely visitors to Dounreay, even if a visitor attraction was developed.
- The unavoidable reduction in heritage value of what would remain of the assemblage of structures, once essential decontamination, demolition and removal has occurred.
- The cost of maintaining structures which will fall to future generations.
- The impact of Corporate Social Responsibility (CSR) policy, value for money and affordability in the current state of government finances.

In this context, DSRL explored a diverse range of possible actions, activities and initiatives that could deliver a viable cultural legacy for the site. Taking stakeholder views into account, NDA/DSRL have concluded that a number of options are not feasible. These are:

Rejected Options

Option	Main reasons for rejection
1. Retention of the site in its entirety	• Safety & security issues • Decontamination costs • High long-term maintenance costs. • Extent of ground contamination in Fuel Cycle Area (FCA) • Facilities must be removed due to contamination and structural issues
2. Retention of PFR and FCA in their entirety	• As above, plus PFR external cladding is deteriorating
3. Retention of DFR sphere and DMTR	• Removal of contaminated plant & equipment will only leave the metal shells, this would almost entirely remove evidential and technological value • Metal shells will never be 100% clear of radioactive contamination as engrained in metal surfaces, thus a hazard remains • Cost of care & maintenance and no identified funding. Painting sphere costs c£0.5M every 10 years. • Limited public access due to safety and security issues with proximity of waste stores
4. Retention of buildings and conversion for other uses in the short term	• Restricted public access due to safety and security issues • High costs for conversion and maintenance • Lack of a sustainable market
5. Preservation of all objects	• Many are radioactively contaminated and there are associated health, safety and cost issues in cleaning these • Lack of suitable storage space
6. Development of the site or part of the site as a visitor centre	• Restricted public access onto the site due to safety and security issues • Low level of projected visitors • Funding issues

Proposed Way Forward – The NDA/DSRL Components

While it is not possible, nor desirable, to retain the Dounreay site in its entirety, there remain real opportunities to ensure that many of the identified heritage values can be conserved and communicated to present and future generations.

The following sets out what DSRL is already delivering and will continue to deliver between now and the Interim End Point:

	Heritage Activity	Cultural Legacy
1	Retention and conservation of objects of historic or technological significance	Evidential value
2	Provision of temporary storage facilities for objects (office space which is limited for storing larger items)	Evidential value
3	Identification of appropriate long term custodians for objects and their capacity to provide appropriate storage	Evidential value
4	Management of technical archive and collation of representative sample of reports, documents, drawings, film and photographs	Evidential value
5	Recorded interviews with past and current employees and members of the public	Historical and Communal value
6	Recording of buildings and structures prior to and during clean-up and demolition (in reports, photos and video)	Evidential value
7	Social history publications	Communal value
8	Expanded development of online/virtual material	Communal value
9	Continuing the role of the Heritage Officer to manage heritage activities	Implementation

Prior to the IEP, the spend on these proposals is planned to be up to £60,000 per annum and must be covered in the site's annual decommissioning budget. Overall, NDA/DSRL believes that this is a contribution to the implementation of the strategy that would deliver a real and substantial cultural legacy.

This strategy does not envisage the retention of the DFR sphere or any other non-functioning buildings beyond the IEP. It has been reluctantly concluded that factors such as radiological contamination, restrictions on land use and the technical and economic requirements of decommissioning outweigh the arguments for retention of the sphere, and the long-range decommissioning plans will be amended to include provision for its dismantling. Retention of the DFR sphere would not deliver significant benefits on a local or national scale and greater public benefit can be achieved through other measures.

Other possible opportunities – components to be implemented in partnership

The strategy also identifies a number of possible opportunities that could contribute to the cultural legacy. None can be funded within the context of existing LTP budgets and most of these opportunities fall outwith the expertise of DSRL and the NDA to fulfil. However, they present important opportunities for other heritage organisations to take the lead in implementing substantial elements of the Dounreay heritage strategy.

The possible opportunities, with the feasibility issues and estimates costs are set out below:

Opportunity	Cultural legacy	Feasibility issues	Costs
1. Funded academic study	Historical and Communal value On-going high-quality research on the site and its technological or social history	Partnership would be needed with a university and / or local institution to develop an active research programme. This could include technical as well as heritage-related subjects. Educational grants could help minimise cost.	c.£20k-£180k
2. Off-site Exhibition	Communal value Communication and celebration of history of Dounreay Major off-site gallery relating to Dounreay and / or the wider nuclear industry housed and delivered by a national museum. Alternatively a touring exhibition	Would need development of partnerships with other organisations, such as the National Museum of Scotland (NMS). DSRL contribution would be 'in kind' loan of objects etc. Touring exhibition would be less expensive option.	c.£0.5M - £3M
3. International Conference relating to Dounreay and nuclear heritage issues.	Communal and Evidential value Communication and celebration of Dounreay. Raising of profile of history and contribution to national or international audience Furthering and sharing of research on nuclear industry history	Venue would need to be commensurate with international interest and likely participants - major metropolitan centre to encourage attendance. Costs could be partially recouped through attendance charges, sponsorship and external funding.	c.£50k to £100k
4. Commemorative Installation	Communal value Commemoration of Dounreay e.g. on-site sculpture / marker or a "gate guardian"	Best delivered by DSRL / NDA in partnership with local communities. The scale of ambition and nature of installation would largely govern costs.	c.£10k - £100k

4 Summary

A combination of loss of cultural value due to essential decommissioning activities, radiological risk and the lack of public access, has led NDA/DSRL to conclude that the retention of the DFR sphere or any other facility, would not deliver significant benefits on a local or national scale. Greater public benefit can be achieved through other measures that record and preserve Dounreay's heritage.

Following the stakeholder engagement process held between 10 December 2009 and 8 March 2010, a statistical summary of the 38 engagement responses is detailed in the table below;

No.	Summarised Question	Yes	No	Undefined
1	Agree with broad approach?	79%	13%	8%
2	Agree to demolish all?	45%	55%	0%
3	Current activities sufficient?	50%	21%	29%
4	Stop any current activities?	8%	47%	45%
5	Include the listed additional opportunities?	39%	24%	37%
6	Any other opportunities to suggest?	32%	32%	36%

It is apparent that most agree that the current heritage activities should continue to be developed. Accordingly, the role of a Heritage Officer is included in DSRL's long term programme.

The additional opportunities of academic research studies, international conference, off-site exhibition and a commemorative installation, will be pursued, with external organisations and supported by DSRL if external funding is identified.

While the majority of responses did not change the main strategic themes, i.e. demolition of all non-functioning facilities with recording of heritage by a wide variety of methods, DSRL has considered the views and, where possible, broadened out the recording. The following additional activities have taken place or are planned, as a direct result of views expressed by the public;

- A Heritage Advisory Panel of recognised experts will be set up
- Dedicated heritage pages have been launched on the Dounreay website
- Dundee University has successfully gained funding from the Scottish Arts Council to produce an artistic heritage film about Dounreay
- The latest innovative laser scanning technology has been used to accurately record the condition of Dounreay Castle

DSRL is already implementing a number of components of the heritage strategy and will continue to expand the activities through an implementation plan, including programme, partnerships, responsibilities, policies, standards and the mix of community, employee, external and professional inputs.

1 Introduction

Britain's experiments with fast breeder reactors are over and Dounreay is shutting down. Around 300 facilities and structures built at Dounreay are now redundant and in the process of being cleaned out and demolished.

By the Interim End Point all redundant facilities will have been cleared, all that will remain are those radioactive wastes and other nuclear materials for which no disposal route or alternative storage is available. These will be kept in secure, modern storage on the existing site. Radioactive contamination of parts of the ground will be allowed to decay naturally requiring access to these areas to be controlled for up to 300 years.

The licensed nuclear site and surrounding land today belongs to the Nuclear Decommissioning Authority (NDA), a non-departmental public body of the UK Government. The site closure programme is being implemented by a site licence company, Dounreay Site Restoration Ltd (DSRL), which works under contract to the NDA.

The NDA and DSRL recognise the iconic status of Dounreay during the 20th century, particularly in the 1950s and 1960s. Both are mindful of the social responsibility of capturing appropriate aspects of the site's heritage over all phases, so that future generations will be able to grasp the importance of Dounreay to the modern history of the UK, once the clean-up activities are completed.

The "End State" is defined by the NDA after public consultation carried out in 2007 by the Dounreay Stakeholder Group. One of its recommendations was for:

"*An open and transparent decision on the future of the DFR sphere, taking into account its national heritage significance*".

DSRL has worked with the NDA and Historic Scotland to establish a way forward for creating a lasting cultural legacy of the site. This document has been prepared by DSRL, with support from Atkins Heritage, and describes the activities that will be undertaken to retain the heritage of the Dounreay site for public benefit beyond the interim end point.

The brief was to consider the site's heritage in the widest sense. Whilst NDA & DSRL recognise the significance of retaining industrial heritage, this can be done in a number of ways. Such cultural heritage work has never been previously done for an entire UK nuclear site.

Completing the decommissioning and clean-up of the site safely and in a way that is environmentally acceptable and provides value for money to the taxpayer will remain the NDA's priority. Socio-economic considerations are among the key factors in any decisions on heritage.

1.1 Purpose of the Heritage Strategy

The decommissioning of Dounreay has raised a number of issues in relation to how nuclear sites should be treated in terms of their potential cultural value. The purpose of this strategy is to set out the activities that DSRL will undertake in order to maintain the site's heritage.

The need for such a strategy was recognised and promoted by the NDA, DSRL and Historic Scotland. All have played a key role in the development of the methods and approaches to the strategy. Ultimately, DSRL and the NDA have responsibility, albeit with differing remits, for the implementation of the strategy. The long-term support of Historic

Scotland and National Museums Scotland will be critical to assisting in the implementation of the strategy.

The decision to formulate a strategy now, rather than later, enables a clear way forward for the decommissioning of the site and included consideration of the fact that decommissioning is gathering pace with over 100 facilities already demolished, ranging from small shelters to a large fuel manufacturing plant. The number of workers and locals with memories of Dounreay's early days is decreasing each year. Without a strategy and resulting management plan, opportunities for recording and retaining Dounreay's cultural heritage may become lost forever.

The decision on the fate of DFR needed to be agreed to identify a clear way forward to allow the decommissioning activities to progress according to schedule.

1.2 Geographical Scope of the Strategy

The heritage strategy focuses on the Licensed Site at Dounreay (see Figure 1). This includes the Fuel Cycle Area, the Dounreay Fast Reactor (DFR), Prototype Fast Reactor (PFR) and numerous ancillary buildings and structures. NDA-owned land, outside the Licensed Site was considered, but only in the margins of the strategy (see Figure 3). Similarly the strategy does not consider the adjacent Vulcan Naval Reactor Test Establishment in any detail, although it is mentioned.

The NDA own the land that Vulcan is located on and it is leased to the Ministry of Defence. Rolls Royce manage the naval reactor test programme for the MoD and has done this ever since the site construction started in 1957. Dounreay and Vulcan are two separate, but adjacent sites. Some services are shared, such as for waste disposal and emergency response, but essentially the sites have totally different objectives.

Vulcan is still in its operating phase, has differing security issues to Dounreay and so was not approached to participate in the heritage study.

If, however, the future of the Vulcan site becomes a decommissioning one and responsibility of this falls within the NDA's remit then there may be an opportunity to further develop the heritage strategy to include the Vulcan site.

The Vulcan management team has been made aware of the efforts to capture Dounreay's heritage and has indeed donated objects to Caithness Horizons' permanent exhibition about Dounreay.

1.3 Aims and objectives of Strategy

The primary aim of the strategy is to set out a clear approach to the management of Dounreay's heritage, based on a robust understanding of the cultural values associated with Dounreay and the realities of the nuclear decommissioning process. In this context DSRL identified a number of broad aims and objectives for the strategy,

- to inform the treatment of all the heritage of the site during the lifetime of the decommissioning process;
- to facilitate engagement with key internal and external stakeholders, and to develop a broad consensus on the treatment and way forward with Dounreay's heritage;
- to secure a viable and sustainable cultural legacy for Dounreay;
- to support DSRL's mitigation of the impacts of the decommissioning processes on the Site's cultural and environmental value;

- to ensure the future plans for Dounreay's heritage provide the greatest level of sustainable public benefit to all the communities, as far as possible within the context of the existing long-term decommissioning plan;
- to establish processes for making decisions on preserving fabric, facilities, artefacts, records, history (covering technical, cultural and oral), drawings and images (still and moving);
- to provide guidance on the appropriate treatment of associated intangible heritage issues;
- to identify the general types of features, including fabric, artefacts and other material that should be considered for conservation;
- to develop an action plan for cultural heritage issues; and
- to identify the manpower resource needed to manage current and future heritage issues.

The conservation of Dounreay's heritage for public benefit cannot be considered in isolation and actually forms part of the decommissioning programme with its technical challenges and financial restrictions. Heritage issues must, therefore, successfully interface with an array of other activities, including project management, budget limitations and regulatory compliance.

1.4 Methodology

The strategy has been developed in accordance with best practice methods of conservation management planning in the UK. It is founded on a robust understanding of the site and its cultural values and on a clear recognition of the issues and external factors relating to decontamination, waste management and decommissioning and their interaction. The following sets out the broad stages of the strategy's development:

Stage 1: Understanding Dounreay

This was the starting point for the strategy involving extensive analysis and research to develop a clear understanding of the site's history, current form and characteristics. The results of this analysis are presented in Chapter 2 and Appendices 1 and 2 of this report.

These present an overview of Dounreay's historic development, its current character and the nature of surviving buildings, places, archives and objects. It also touches upon its social history and some of the defining non-physical characteristics of the site.

Stage 2: Exploring Cultural Value

The concept of Cultural Value has long underpinned approaches to the management of places of cultural and heritage significance. Chapter 3 of this report explores the values associated with Dounreay. The core of the chapter is based on standard approaches to assessing the historic and cultural significance of a place. It, therefore, begins with an exploration of Dounreay in the context of the national and international nuclear industry (Section 3.2) followed by a Statement of Significance that addresses the historic, evidential, aesthetic and communal values associated with the site (Section 3.3). The chapter then goes on to explore two other views of Dounreay and its "values". Firstly a Change and Creation approach (Section 3.4) and finally a "View from the Future" (Section 3.5) which attempts to provide a speculative review of how the site may be viewed from a more distant historic perspective.

Stage 3: International Comparators

Dounreay is not the only nuclear installation facing the challenge of combining decommissioning and closure with the celebration and conservation of heritage value. A key stage of the development of this strategy has involved research into and contact with a number of establishments across the world, which are moving through this process. Section 4.1 outlines what others have achieved and are seeking to achieve, elsewhere.

Stage 4: Exploring Possible Approaches to developing a cultural legacy

The commissioning of this strategy clearly indicates that Dounreay and its history are worth celebrating, conserving and communicating to future generations. A key stage of the strategy relates to what should be celebrated, conserved and communicated and how this might be safely and cost effectively done.

In terms of identifying what is it about Dounreay that we, as a society, should seek to celebrate, conserve and communicate, the Values set out in Chapter 3 (Stage 2) provided a starting point for developing and assessing ideas for the creation of a cultural legacy.

In terms of identifying how such a legacy could be safely and affordably achieved in the context of the lifetime plan, DSRL, in consultation with NDA, has determined the viability and acceptability of various different approaches. This included examining assumptions in the current lifetime plan and undertaking further analysis of possible ideas relating to conservation and retention. All of this occurred within the context of the operational environment (see Section 1.6 for details) and the contamination (and other) issues facing the site.

Sections 4.3, 4.4 and 4.5 explore three broad themes (physical conservation and retention of buildings and objects; retaining evidential material in the form of archives, records and oral history; and communicating and celebrating Dounreay's achievements and wider context) and identify possible options and ideas that, based on available evidence, may be deliverable and other ideas and options that, for a variety of reasons, are not feasible.

Stage 5: Options

A key aim of the strategy is to ensure a broad consensus on the way forward. Chapter 5 sets out the activities that will be undertaken to deliver the strategy in the context of the LTP.

The strategy also identifies a range of other opportunities that cannot be funded directly by the site, but, are technically feasible if external organisations wish to work in partnership with DSRL and external funding sources are identified (see Section 5.3).

Stage 6: Implementation

Feedback from all interested stakeholders has been reviewed and while no major changes were identified for the main strategic themes, some suggestions have enabled DSRL to broaden the scope of some of the planned activities.

1.5 Engagement

The development of the strategy was informed by a process of engagement with the following bodies:

- Historic Scotland
- Dounreay Stakeholder Group
- Nuclear Decommissioning Authority

- National Museums Scotland
- Caithness Horizons
- Royal Commission on the Ancient and Historical Monuments of Scotland
- The Highland Council
- English Heritage
- Cadw (Welsh Heritage)
- Dundee University
- North Highland Tourism
- Caithness Chamber of Commerce
- Caithness & North Sutherland Regeneration Partnership

Additionally, wider stakeholder engagement on the broad direction of the strategy was undertaken between 10 December 2009 and 8 March 2010 with 38 responses received.

1.6 The legislative and regulatory environment associated with operations and decommissioning

Like many other nuclear establishments in the UK and world-wide, Dounreay presents generic and site-specific challenges during decommissioning. The condition of redundant nuclear plant, the presence of limited contamination, the need for high levels of security and the legal requirements relating to its clean up and decommissioning, all need to be taken into account when considering its future and the development of a cultural legacy.

The following sets out the legislative and regulatory environment associated with the decommissioning and operation of Dounreay. Additional material can be found in the associated appendices.

1.6.1 The Nuclear Decommissioning Authority and DSRL

The Nuclear Decommissioning Authority (NDA) is a non-departmental public body, set up in April 2005 under the Energy Act 2004 and is funded by the UK Government. The NDA operates in partnership with a number of key stakeholders and is sponsored by the Department of Energy and Climate Change (DECC) and is responsible for some aspects to Scottish Ministers.

The organisation was set up by the Government to provide the first ever UK-wide strategic focus on decommissioning and cleaning up of nuclear sites. The NDA's mission is to deliver a world class programme of safe, cost-effective, environmentally responsible decommissioning of the UK's civil nuclear legacy in an open and transparent way and with due regard to the socio-economic impacts on communities. The core objective is to ensure that the 20 civil public sector nuclear sites are decommissioned and cleaned up safely, securely, cost-effectively and in ways that protect the environment for current and future generations.

Dounreay Site Restoration Limited (DSRL) is one of a number of Site License Companies contracted with operating and decommissioning the NDA's sites.

1.6.2 Major Statutes

The major statutes concerning the safe handling, use and disposal of radioactivity on the nuclear licensed site at Dounreay are the Nuclear Installations Act 1965 (as amended) (NIA65) and the Radioactive Substances Act 1993 (RSA). These are discussed below:

Nuclear Installations Act 1965 (as amended) (NIA65)

All UK nuclear sites operate under the Nuclear Installations Act 1965 (as amended) (NIA65). This sets up a special regime of sole and no fault, but financially limited, liability for the nuclear operator in respect of nuclear damage as required by the Paris Convention of 1960 and the Brussels convention of 1963 to which the UK is a signatory. The Act provides a legal basis for the licensing and inspection of nuclear installations and places an absolute duty on the licensee to prevent injury and damage in relation to nuclear matter and / or ionising radiation.

Dounreay has a Site Licence granted by the Nuclear Installations Inspectorate (NII) on behalf of the Health and Safety Executive (HSE). The Site Licence is a legal document.

SCHEDULE 1 is specific to each site. It specifies the site location and the type of plant and equipment used on the site.

SCHEDULE 2 consists of 36 Conditions (see Appendix 4) which cover design, construction, operation and decommissioning. These Conditions are common to all nuclear sites throughout the country. The essential feature of these Licence Conditions is that they require DSRL to make adequate Arrangements to ensure compliance. These Arrangements therefore, in some way, affect everyone on the site as they carry out their daily work. The clarification notes under Condition 35 – Decommissioning, state that:

"It is important that when a nuclear facility reaches the end of its operational life it is decommissioned in a safe and controlled manner and not left to pose a hazard for current and future generations. The purpose of this Condition is, therefore, to require the licensee to have adequate arrangements for the safe decommissioning of its facilities. It also gives HSE the power to direct the licensee to commence decommissioning of any plant or facility to prevent it being left in a dangerous condition or to ensure decommissioning takes place in accordance with any national strategy. The Condition also gives HSE the power to halt any decommissioning activity if HSE has concerns about its safety."

This clearly places an onus on DSRL and the NDA to ensure that Dounreay poses no hazard for future generations.

SCHEDULE 3 is a list of continuing valid approvals where a licence has been reissued.

Maintaining compliance with the Licence is critical to operation of Dounreay.

Radioactive Substances Act 1993 (RSA93) Authorisations

The RSA established controls on the keeping, use and disposal of radioactive materials and requires DSRL to register and seek authorisation from the Scottish Environment Protection Agency (SEPA). On Licensed Sites (e.g. Dounreay) operators are exempt from requirements to register the keeping and use of radioactive materials but authorisations are required for disposals of radioactivity to the environment as a result of gaseous, liquid and solid waste discharges.

However, in the same way that the Nuclear Site Licence requires 'adequate arrangements' be made to justify the safety of operations, an Authorisation under the RSA requires operators to apply and justify that 'Best Practicable Means' (BPM) to minimise radioactive waste arisings and discharges are being applied. BPM justifications are made within the framework of overarching Best Practicable Environmental Options (BPEO) studies, for site wastes as a whole and site Integrated Waste Strategies. Addressing these issues forms a key part of the decommissioning efforts at Dounreay.

1.6.3 UK Government Policy: Command 2919, 1995

Command 2919 titled "*Review of Radioactive Waste Management Policy: Final Conclusions*" is the UK Government's policy on radioactive waste management. It was amended in 2004 to take account of the formation of the Nuclear Decommissioning Authority (NDA), and the government is currently carrying out a review that may lead to a new White Paper to replace Command 2919.

Under Command 2919 producers of radioactive waste (e.g. DSRL) have to ensure that they:

- can deal with the waste they create using current techniques;
- characterise and segregate the waste and store it "in accordance with the principles of passive safety"; and
- plan and develop programmes to dispose of accumulated waste and for the decommissioning of redundant plant.

Command 2919 also emphasises strongly the principle of sustainable development in relation to radioactive waste management policy. DSRL's policy on decommissioning and radioactive waste management is written to comply with Command 2919.

1.6.4 Other statutes and regulations

DSRL also operates under a range of other statute relating to safety, environment and security. The key acts / regulations are:

- Euratom Treaty 1958 (as amended), in particular Article 37
- The Health and Safety at Work Act 1974
- Nuclear Installations Act 1965
- Management of Health and Safety at Work (Amendment) Regulations 2006
- Ionising Radiations Regulations 1995
- Radioactive Substances Act 1993
- Environmental Protection Act 1990
- Environment Act 1995
- Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999
- Environmental Impact Assessment (Scotland) Regulations 1999
- Town and Country Planning (Scotland) Act 1997 (as amended)
- Contaminated Land (Scotland) Regulations 2000
- Nuclear Safeguards Act 2000
- Waste Management Licensing (Scotland) Regulations 1996
- Anti Terrorism, Crime & Security Act 2001
- Nuclear Industries Security Regulations 2003
- Radioactive Contaminated Land (Scotland) Regulations 2007

These all place considerable restrictions on operations at Dounreay and are critical considerations in terms of planning activities or works.

1.6.5 The current Lifetime Plan for Dounreay

Overview

The Lifetime Plan (LTP) for Dounreay is produced and updated regularly by DSRL for the NDA. The plan describes the scope, schedule and cost of the activities to be undertaken to take the site from its present condition to its End State, with the End State defining the overall objective and direction of the work carried out on the site (see Appendix 3 for further details).

In 2006/2007, the End State of the Dounreay site was the subject of a public consultation carried out by the Dounreay Stakeholder Group (DSG). The DSG recommended four actions on the way forward with the preferred end state and one of them was to allow for *"An open and transparent decision on the future of the DFR sphere, taking into account its' national heritage significance*". The NDA has accepted the overall end state recommendation of the DSG and, whilst still subject to review, national reconciliation and incorporation into their strategy, DSRL has been instructed to pursue the aspirations of the DSG selection.

The objective of site restoration is that the site End State should be a "*Restored Site, with Early Release of Land*". The NDA strategic goal for the Dounreay site is that the end state should be "*radiological and industrial brown field*".

The Dounreay clean-up covers an extended period up to the end point for the decommissioning process by which time the bulk of the physical works on the site will be complete. The timetable for the decommissioning programme is set out in the Lifetime Plan.

The Dounreay Lifetime Plan (LTP) outlines four phases of work (see Appendix 3 for details of each phase and the nature of the site during those phases). The following provides a brief summary of each phase:

Phase 1: Decommissioning [2010 to Interim End Point]

Based on current assumptions and long-term funding levels, the site's LTP gives top priority to decommissioning including the removal of the major hazards. Major hazard reduction includes alkali metal removal / destruction, liquid Intermediate Level Waste (raffinate) immobilisation, historic waste retrieval and treatment and facility decommissioning. To achieve this, substantial new construction of facilities is required.

After the major hazards have been removed, the plan is to remove all non-essential buildings, condition all low-hazard wastes and package any remaining waste and nuclear material on site for interim storage. The current LTP envisages that the only buildings remaining on site at the Interim End Point (IEP), would be the DFR Sphere, stores for conditioned Intermediate Level Waste (ILW) and packaged nuclear materials, along with the infrastructure to service the safe operation of the stores e.g. security infrastructure. Following the decision to dismantle the DFR sphere, this will be factored in to the next iteration of the LTP.

Other areas of the site will be cleared and some could be covered with up to 2m of overburden to contain residual contamination e.g. in the Fuel Cycle Area. Stakeholders were consulted on the site end state. The chosen option is geared towards delicensing up to ~30% of the site area at this time, predominately around the current entrance and in a limited number of open areas. The remaining area would contain the waste stores and higher levels of residual contamination, which could be managed in-situ through natural attenuation and radioactive decay.

Phase 2: Interim Storage [IEP to 2050]

Beyond the Interim End Point conditioned ILW and packaged nuclear material will be in storage.

This phase will involve the safe operation of these stores and the upkeep of the infrastructure supporting them, until the conditioned ILW and packaged nuclear material can be transferred to a final resting place, subject to national policy and to an agreed national schedule. This remains to be determined (see below).

In addition, there will be a programme of environmental monitoring of disposed radioactive waste and residual contamination on the site, in order to provide reassurance that the disposal facilities perform as anticipated.

Phase 3: Off-site Transfer and Final Demolition [2050 to 2078]

As instructed by NDA, it is assumed that the conditioned ILW and packaged nuclear material will be transferred to the Geological Disposal Facility, noting that the Scottish Government policy, for radioactive waste in Scotland is to support long term ‘near surface, near site’ storage and/or disposal facilities. This will involve a significant number of flask and container transfers. As stores become empty following the transfers they will be demolished. All other infrastructure will also be decommissioned apart from that which will support the final phase of Care, Surveillance and Site Closure from 2078.

At this point it is currently expected that all or nearly all structures would be removed from the site.

Phase 4: Care, Surveillance and Site Closure [2078 to 2300 approximately]

This period has been assumed to last up to 300 years to allow for the radionuclides in any residual contamination in the ground to decay to insignificant levels. Work will be undertaken to confirm that the engineered disposal facilities perform as predicted. Subject to Scottish Government policy, this could lead to a point when the site or parts of the site may be deemed to be restored and the site can be opened for unrestricted or restricted use.

1.6.6 Budgetary considerations

The UK’s nuclear decommissioning programme is funded by the Government through the Nuclear Decommissioning Authority (NDA). The NDA decides how the annual allocation is split between the nineteen nuclear sites and uses a prioritisation process. This process gives higher priority to sites / projects which have high hazards and associated risks. This is because the NDA’s aim is to reduce the UK’s nuclear liabilities as quickly and safely as possible with due regard for the environment and socio-economic issues.

The current LTP budgets are set out in Appendix 3. The total cost for the decommissioning of Dounreay is anticipated to be in the order of £3.6 billion undiscounted (c. £2.7 billion discounted).

Heritage activities require funding which must be sought from the overall site budget. Because heritage is not directly concerned with reducing liabilities it cannot be the highest priority for DSRL and the NDA. Consequentially, funding for heritage work from the site budget is, and will remain, a challenge. Justification must come from a socio-economic viewpoint with emphasis on public benefit / value and in line with NDA’s socio economic policy.

1.6.7 Security Requirements

Security at Dounreay falls under the Nuclear Directorate's Office for Civil Nuclear Security (OCNS), the security regulator for the UK's civil nuclear industry. This body is responsible for approving security arrangements and enforcing compliance. Civil nuclear operators must have site security plans dealing with the security arrangements for the protection of nuclear sites and nuclear material on such sites. The Nuclear Industries Security Regulations 2003 (as amended 2006) require certain approved persons within each nuclear operator to maintain 'adequate security standards' to comply with directions from the Secretary of State and to report security incidents to him. Dounreay therefore, has an approved security plan.

As with all other nuclear licensed sites in the UK, security at Dounreay is the responsibility of the Civil Nuclear Constabulary, an armed force whose role is the protection of civil nuclear sites and nuclear materials. Under the Anti-terrorism, Crime and Security Act 2001 it is a criminal offence to 'intentionally or recklessly' disclose sensitive information concerning nuclear plant and materials.

The licensed site at Dounreay is not, and cannot be, fully open to the general public. The decommissioning of facilities and the construction of new ones for dealing with the waste this generates, together with the need to keep radioactive materials secure means that access is restricted to persons with legitimate business needs to enter the site. This situation will continue up to at least 2078 dependent on Scottish Government's policy for the storage/disposal of ILW.

Beyond the IEP it may be possible to deliver access to some parts of the then licensed site in a highly controlled and limited manner. However, it will not be possible to enable any significant level of public access to licensed areas within the site. All access to licensed areas will need to be strictly controlled and subject to security screening and controls. This situation would last until at least 2078 and possibly beyond.

As areas of the current licensed site are fully decommissioned and cleared it is possible that the current perimeter fence (and licensed area) could be reduced and realigned to open up parts of the site for other uses. As discussed above the current LTP is aiming towards delicensing up to ~30% of the site area predominately around the current entrance and in a limited number of open areas but there would still be restrictions on uses in other parts of the site.

2. Understanding Dounreay

2.1 Introduction

Developing a cultural legacy for Dounreay requires an understanding of its past and its current state. This chapter begins with an overview of the site's historic development and then examines the site as it stands today (also see Appendix 2). It then goes on to outline the material evidence at the site in terms of its buildings and spaces; archives and objects and social history and memories. The chapter concludes with a brief examination of the site's key tangible and intangible characteristics.

2.2 Historic Overview

2.2.1 Dounreay Before 1939

The wider area around Dounreay contains many actual elements of the prehistoric and recent past, ranging from Neolithic chambered cairns, Bronze Age burial mounds, stone circles, field systems and settlements to medieval tower houses and post-medieval farmsteads and settlements. This assemblage of material is not unusual in the Caithness context and represents the historic evolution of a wider cultural landscape.

The earliest evidence of human occupation in Caithness is in the area around Wick, and dates from 10,000BC to 8,000BC, during the Mesolithic period, but the oldest known sites close to Dounreay are from the Neolithic period, around 4,000BC. Two Neolithic chambered cairns, Cnoc Urray and Cnoc na h'Uiseig, lie on the rising ground to the north-east and south-west of the site. Their presence suggests that the wider area formed part of the Neolithic cultural landscape, and that it was probably exploited for its coastal and agricultural resources during this period.

The wider landscape contains many Bronze Age funerary monuments, particularly burial cairns. These, together with numerous Bronze Age hut circles including the remains of a settlement excavated close to Dounreay in 1956, suggests that during this period, from around 2,300BC to 700BC, the wider area around the site saw extensive human activity.

The settlement and use of the wider landscape continued through the Iron Age, from around 700BC to AD450[1]. The commonest remains from this period in northern Scotland are brochs, a form of tower-like fortified communal residence. There are several recorded examples of these Iron Age brochs in the landscape around Dounreay, the closest being at Cnoc Urray around 350m south-west of the site.

Several carved Pictish stones dating from the 6th to 10th centuries have been found in the area around Dounreay. A fragment of a Pictish cross-slab was found during construction work at the base of the cliff north of the site, whilst similar fragments and stones have been recorded at Crosskirk Broch and close to Sandside House: there are also two carved stones at Reay. From the end of the 9th century, Caithness was settled by Norse incomers, and for the next four centuries formed a mainland extension of the Norwegian Earldom of Orkney.

The known archaeological sites in the wider area around Dounreay are listed in Appendix 1. No such sites are known to exist within the perimeter of the Nuclear Licensed Site.

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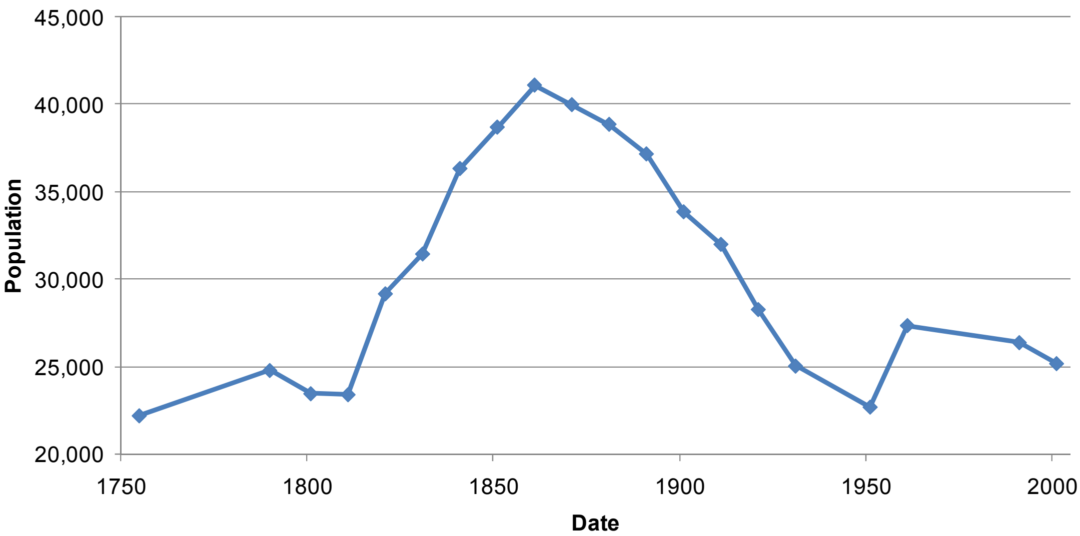
[1] The Roman occupation did not reach Caithness. Therefore, the Iron Age is taken as extending to the start of the Early Medieval period in AD450

Dounreay Castle, an L-shaped tower house just outside the boundary of the Licensed Site on the foreshore midway between DFR and PFR, was built in the late 16th century. Later, during the "Clearances" (roughly between 1790 and 1850), the castle and its attached cottages were reconstructed as Lower Dounreay farm.

Between 1859 and 1875 improvements were made to the lands of Lower Dounreay, including building, draining, fencing and road-making. There is also evidence for small-scale industry from this time, particularly around Dounreay farm, where the sites of two limekilns have been recorded. The population of Caithness reached a peak of over 40,000 in about 1860 engaged mainly in a thriving fishing and farming industry. The wider area would have been sparsely settled by small farming and fishing communities and this pattern of rural occupation and resource-exploitation continued little changed until the Second World War.

Population of Caithness, 1750 – 2001



Source: http://www.caithness.org/links/population.htm

2.2.2 1939-1954

The sheltered anchorage of Scapa Flow, in Orkney, was used by the British Navy during both world wars. This made the far north of Scotland vulnerable to enemy air attack during the Second World War, and Wick was the first mainland town in the British Isles to be bombed in daylight (during which many adults and children were killed). The need for air defences were clear and a number of airfields were constructed, beginning with RAF Wick in 1939 and ending in 1944 with an airfield at Dounreay, planned as a satellite airfield for RAF Twatt in Orkney. However, it was mothballed on completion in April 1944 and apart from short periods of use by the Navy as HMS Tern II and, later, when its accommodation blocks were used as a camp for displaced Polish servicemen[2], it remained essentially unused until 1954.

The Dounreay nuclear site overlies the western part of the airfield. When work started on its construction in 1955, the precise location chosen for the reactor was north of the western end of the airfield's east-west runway (one of three forming a triangle). The eastern end of this runway came close to the adjacent public road, the A836, to which it was then joined by a short link to provide a route for construction traffic. In due course this became, and remains, the site's main access road. At the western end of this

[2] Highland Archives: http://www.iprom.co.uk/archives/dounreay/doun3.htm

runway, a taxiway led off south to a series of dispersal bays. The line of this taxiway survives within the layout of the Licensed Site.

The airfield's longest runway, ranging approximately north-south and roughly 1 mile long, remains largely intact outside the boundary fence of the Licensed Site. Throughout the 1970s and 1980s it was used by UKAEA light aircraft ferrying staff between Dounreay and sites in England. Today, its central section is the site's main staff car park.

The north-western part of the third runway, which ranged approximately south-east to north-west, was built over when the Fuel Cycle Area was constructed; traces of its south-eastern portion remain outside the Licensed Site.

Dounreay Timeline

The following provides brief overview of the key events in Dounreay post WWII history

1954 – Government announces that Dounreay is to become centre of UK fast reactor research and development.

1955 – UK Atomic Energy Authority begins construction of Dounreay Fast Reactor, Dounreay Materials Reactor and associated chemical works.

1957 – First nuclear reaction in Scotland takes place in criticality test cell at Dounreay.

1958 – Dounreay Materials Test Reactor achieves criticality and becomes Scotland's first nuclear reactor.

1959 – Dounreay Fast Reactor achieves criticality.

1962 – Dounreay becomes first fast reactor in world to supply electricity to the grid.

1966 – Government chooses Dounreay as site for larger Prototype Fast Reactor.

1969 – Materials test reactor shut down.

1974 – Prototype Fast Reactor achieves criticality.

1977 – Dounreay Fast Reactor switched off.

1977 – Chemical explosion damages waste shaft.

1983 – First radioactive particles detected in environment.

1986 – Planning inquiry into application by BNFL and UKAEA to build European Demonstration Reprocessing Plant at Dounreay.

1988 – Government announces phased end of fast reactor research and development.

1994 – Prototype Fast Reactor shut down.

1996 – Reprocessing of nuclear fuel ceases.

1998 – Audit of safety by regulators identifies weaknesses.

2000 – Dounreay Site Restoration Plan sets out 60-year plan to decommission site at cost of £4.3 billion.

2003 - Dounreay creates the first Modern Apprenticeship in Nuclear Operations and Decommissioning in the UK.

2004 – Fuel fabrication ceases.

2005 – Nuclear Decommissioning Authority established.

2005 – Civil Nuclear Constabulary replaces UKAEA Constabulary.

2007 – NDA takes ownership of Dounreay.

2007 – Decommissioning brought forward to 2032 at a total estimated cost of £3.6 billion undiscounted (£2.7 billion discounted).

2008 – Dounreay Site Restoration Ltd becomes Site Licence Company.

2008 - Site closure programme accelerated to 2025.

2010 – NDA launches competition process for Dounreay with the aim of letting a contract for a new parent body organisation (PBO) in 2012.

2.2.3 The "Atomic Age" (1954-1960)

The Early Development of Nuclear Technology

The Atomic Age began in 1939, when the first observed nuclear chain reaction took place under laboratory conditions. Over the next seven years the focus of development work was on weapons applications, and was pushed forward by the United States partly against the background of concern that Germany might be following a comparable path. The world's first nuclear reactor, the so-called "Chicago Pile" (code-named CP1), was constructed by the Italian physicist Enrico Fermi and went critical on the 10th of December 1942. Within two and a half years, the USA-led Manhattan Project had developed both the science and the technology to a point where nuclear weapons could be produced in small numbers, as was demonstrated during the attacks on the Japanese cities of Hiroshima and Nagasaki in August 1945.

Early work with reactors used for the production of military plutonium in the USA had suggested the industrial usefulness of the large amounts of heat generated. At the same time, the rapid development work undertaken within the Manhattan Project had identified more than one technological approach to the design and operation of nuclear reactors. These included the "thermal" reactor, where neutrons are moderated and the "fast" reactor, where neutrons are not moderated (hence "fast"). Fast reactors have the capacity to convert the relatively common non-fissile form of Uranium, U-238, into the much rarer fissile Pu239 that forms the fuel for fast reactors, hence the term "Fast Breeder Reactor".

The Start of the UK Nuclear Programme

By the end of World War II, the UK government had decided to develop nuclear energy for the generation of electric power. The first major step towards this was the decision, in October 1945, to establish a UK centre for nuclear energy studies. This had been initiated whilst Winston Churchill was Prime Minister, although it was Clement Attlee who formally ratified the decision to create what became the Atomic Energy Research Establishment (AERE) at Harwell in Berkshire. A key factor in this was the country's chronic and severe shortage of energy, which at the time was largely dependent on home-produced coal.

This also occurred in the context of US legislation enacted in 1946[3] which had ended international collaboration on atomic energy matters, and the UK was left to develop its military and civilian nuclear programmes largely in isolation. Although international co-operation was subsequently restored and is now very much the norm, many of the key decisions that led to the development of Dounreay were taken in the immediate post-war period, when the UK operated alone in its nuclear programmes. Another key influence was the start of what became known as the "Cold War", which reinforced the Government view that the UK should have its own nuclear weapons capacity. As a result, four main study targets were set for the new AERE at Harwell:

- a broad based research and development programme;
- production of fissile material for use in nuclear weapons;
- production of useful power from nuclear sources; and
- production of isotopes.

The urgent requirement was the production of material for use in nuclear weapons. Responsibility was in the hands of the then Ministry of Supply, and the debates that took place over the various technological, cost and location options are a story in their own right. However, the outcome was that the project was placed under the control of Christopher Hinton, who developed plans for the construction of a series of plutonium-production piles at Windscale in Cumbria. His approach was practical, and the team he drew around him at Risley in Cheshire, to handle design and production control for the plutonium piles, became known as the "Industrial" group. Harwell remained responsible for the science, but Risley became the focus for the new discipline of nuclear engineering.

By the end of 1946, the key issues within the plutonium production project had been resolved, and attention could turn to other priorities, and in January 1947 the Ministry of Supply's "Power Steering Committee" held its first meeting. Its terms of reference were "*to consider in detail the various possible schemes for the utilisation of atomic energy for the production of power.*"

Three schemes were considered:

- a natural uranium fuelled pile;
- a thermal neutron breeder; and
- a fast neutron breeder.

With hindsight, this was a key point in the subsequent development of nuclear power in the UK, because it represented the beginning of a division of the ways that became more significant and evident as the years passed. In essence, following from these early considerations of the available technological options, the UK set itself on two parallel strands of nuclear development.

One strand, the "natural uranium fuelled pile", was taken forward into the design and construction of the UK's first nuclear power stations, at Calder Hall in Cumbria and Chapelcross in Dumfriesshire. These were "thermal" reactors, fuelled by U-235 and primarily designed to generate heat, although when operated accordingly they could also produce plutonium, tritium and other isotopes. The design, popularly known as "Magnox" from the magnesium oxide alloy used to make the fuel rod casings, subsequently evolved into power reactors built on many sites in the UK during the 1960s and 1970s.

[3] The so-called "McMahon Act".

The two other options considered by the Committee in 1947 were thermal and fast breeder reactors. These were alternative ways of exploiting the capacity of certain types of reactors to produce fissile material, particularly plutonium and U-235, from non-fissile U-238 or, perhaps more importantly at the time, the depleted uranium by-product of plutonium production piles. At that point the approach was based largely on theoretical physics – Clementine, the world's first *fast* reactor, did not go critical at the Los Alamos National Laboratory in the USA until later in 1947 and, as noted, the USA was at the time following a policy of non-cooperation on nuclear matters. At this early stage, it was also hypothesised that a fast reactor might be arranged so as to be self-sustaining in fissile material. The Committee's decision to follow this second strand in parallel with the development of "thermal" reactors led to the design and construction of Dounreay.

The decision to pursue two different reactor development programmes in parallel reflects the issues relating to the availability, cost, and strategic control of reactor fuel that were present at the time. The planned thermal power reactors were fuelled by U-235. Only a small percentage of uranium ore consists of fissile U-235 (over 99% consists of U-238), and even today it remains a demanding and costly process to "enrich" the refined metal to increase the percentage of U-235 that it contains. Then, as now, the UK had no exploitable domestic uranium reserves and in the 1940s and 1950s world resources of uranium ore were believed to be quite limited and mining and refining was expensive. As a consequence the thermal reactor programme was totally dependent upon the importation of sufficient quantities of a material that was scarce and expensive. In the context of the time, with the convoys and U-boat blockades of the war still in very recent memory, it is understandable that the Government felt it was unsafe to rely wholly upon a material that it could not always guarantee to be able to procure, and where availability depended on the ongoing goodwill of other nations.

Against this background, the "breeder" concept was attractive. In the first place, the theoretical physics indicated that the fast breeder reactor, in particular, would be very significantly more fuel-efficient than thermal reactors, and could thus have the capacity to extend the life of available uranium resources: at the time it was felt that fast breeder reactors could make a 60-fold improvement in this respect. The approach, therefore, seems to have been to construct a mix of thermal and fast breeder reactors, to reduce the UK's dependence on imported Uranium, with the potential that the UK's nuclear programme could to a large extent become self-sufficient.

The two reactor development programmes, therefore, had a common point of historical origin in the work of the Ministry of Supply's Power Steering Committee. From 1947 forwards the two strands increasingly diverged, and were eventually separated, but the initial development work on both strands was in the hands of the same groups of people – the "Scientific" group at AERE Harwell, and the "Industrial" group based at Risley.

Design Development

On 15th August 1947, the Graphite Low Energy Experimental Pile (GLEEP[4]), achieved critically at AERE Harwell; it was the first nuclear reactor in Western Europe. By 1950, experiments with GLEEP and other work at Harwell had enabled UK nuclear scientists to understand the "breeding" process to a sufficient extent for a fast breeder reactor design to be a technically feasible next step.

[4] GLEEP was also exceptionally long-lived. After its usefulness in researching reactor design and operation had come to an end, it had a second life calibrating instruments used to measure neutron flux. It was finally shut down in 1990, and decommissioned in 2003-2004.

Consequently, during 1951 a fast breeder reactor development programme was planned and approved. This proposed the construction of a fast breeder power reactor of around 100MW on a site close to the plutonium production piles at Windscale (now Sellafield). It also authorised the construction, at Harwell, of ZEPHYR (Zero Energy Fast Reactor), a research reactor that would further advance reactor design and operation. At the same time, a choice had to be made between extended study programmes that would in due course lead to a specific design, or whether to move rapidly into the development of a reactor design that could be adapted and adjusted as experience and parallel-running research advised. Christopher Hinton, who had emerged as the key driving force in the project following his proven success in completing the design and construction of the Windscale plutonium piles, argued for a real project rather than a research programme, and this view prevailed.

The first meeting of the Fast Reactor Design Committee took place on 9th October 1951. Over the next five years the Committee made a number of key decisions that influenced Dounreay. One early such decision was that the reactor's fuel would be U-235, possibly plus Thorium (Th-232), and it was accepted that the date for achieving criticality would be determined by the availability of sufficient fissile material. With this being scarce a self-sustaining core was felt desirable, within which fissile material would be bred at the same rate at which it was being consumed. However, it was accepted that this would not be possible in the short term and that the fuel cycle would gradually evolve from one based on U-235 that required regular refuelling into one that was self-sustaining and based on plutonium.

A second early decision was that the reactor would be cooled by liquid metal – either mercury, lithium, sodium or *NaK*, a sodium-potassium alloy. The ultimate choice was NaK, which has efficient heat-transfer properties (the NaK ratio used at Dounreay was 70:30 which solidifies at room temperature and so heat has to be applied at all times). However, NaK is highly reactive with air and water, and a quantity as small as one gram represents a fire and explosion hazard. From the outset, therefore, both reactor design and the site infrastructure at Dounreay had to take account of this risk. This saw the development of containment, separation and isolation systems to ensure that, for example, a minor coolant leak could not cause a major fire or explosion simply by coming into contact with air or water. On the same basis, the site's firefighting equipment has always been distinctive and its firefighters specially trained.

As the work of the Fast Reactor Design Committee progressed through 1952 and 1953, a further concern was with the potential consequences of a major accident involving a reactor design that was still only vaguely defined. One outcome was a decision that the new reactor should not be built at Windscale as originally proposed. A site specification was prepared and passed to the Ministry of Works for action. Key criteria were that the site had to be:

- on the coast where cooling water could be drawn from and returned to the ocean;
- at a sufficient height above sea level to avoid tidal or wind-driven surges;
- on what was felt to be a suitable rock formation; and
- more than five miles from any centre of population greater than 2,500 people.

An additional *de facto* requirement seems to have been that the site should be "available", which probably meant that it would already be in public ownership and/or use.

It has been argued that the actions of the then MP for Caithness, Sir David Robertson, were material in the decision to choose Dounreay as the site for the experimental fast reactor. However, whilst there is no doubt that Sir David's supportive attitude eased the way, particularly with the local authorities and resident population, it is equally clear that Dounreay was one of a relatively limited number of sites identified by the Ministry of Works as meeting the Committee's requirements, and that in due course each of the others was for one reason or another eliminated, leaving the redundant airfield at Dounreay as the final choice.

Another key outcome of the Committee's deliberations for the form of the site today was the decision that the containment for the reactor should be a steel sphere. Initially this was only one of three options considered, with the others being to place the reactor in an excavated underground cavern or under a concrete "igloo". It is not wholly clear from the available sources why a steel sphere was preferred, but one likely factor is that as the reactor design work progressed, the projections of the blast wave and missiles resulting from a major disaster reduced in their severity. Cost may have also been a consideration; steel was a relatively easy material with which to work, whilst spherical containment vessels were established practice in the chemical industry. Indeed, Hinton's known preference for the sphere may well in this respect have been informed by his pre-war experiences working for Brunner-Mond (a chemical company).

Design work on the sphere for Dounreay was underway by September 1954. The fabrication and erection contract was let to the Motherwell Bridge & Engineering Co Ltd, and whilst the detailed design was obviously theirs, the overall arrangement was the product of a Government design office working to the instructions of the Fast Reactor Design Committee.

A final noteworthy decision by the Committee was that plants for the final fabrication of fuel elements and for the chemical separation of irradiated material would be built on the same site as the reactor and managed as part of an integral operation. Hinton argued strongly for this, no doubt drawing on his experiences in the chemical industry, on the grounds that an integrated facility was the best way of achieving accountability and quality control. For a while the matter hung in the balance with some Committee members believing that fuel manufacture and recycling facilities should be centralised at Windscale. In the end, however, Hinton's view prevailed with the decisive issue being the risks involved in a long-term arrangement requiring the transport of new and irradiated fuel elements several hundreds miles between manufacture and processing plants and the reactor.

The pace of the project was rapid. Decisions were being taken about the site, the fuel, the primary coolant and the containment whilst much of the reactor design remained purely theoretical. The ZEPHYR research reactor at Harwell, which was expected to undertake much of the early groundwork, was still under construction when the Design Committee began its work and indeed did not go critical until early in 1954. When in due course its test results started to emerge, they provided enough data to guide initial, but not detailed, design work on the reactor. As a result, a second experimental reactor was built at Harwell: ZEUS, the Zero Energy Uranium Source, which was able to closely simulate the size and composition of what in due course became the Dounreay Fast Reactor (DFR). ZEUS went critical in early 1955, and played a key role over the years that followed both as a source of reactor physics information to support detailed design and, later, to support the early operation of DFR. Both at the time and with historical hindsight, ZEUS (in later years relocated from Harwell to Winfrith) appears to have played a significant part in the design development of Dounreay.

The Dounreay Materials Testing Reactor (DMTR) is not frequently mentioned in the key historical sources. However, it formed part of the plan from an early stage as a heavy water cooled research reactor to test the effects of radiation on materials to be used in the construction of the main reactor and its anticipated successors. These, it is clear, were already being considered before the construction of the main reactor was complete. Design compromises had had to be made to get the programme underway and the main reactor's power output, at around 60MW, was smaller than the 100MW envisaged at the outset, whilst the limited experimental facilities available meant that the reactor itself would be used to test all its own components, incorporating a design so that the entire core could be replaced if necessary.

Indeed, it is clear from the 1960s UKAEA documents that a subtle shift in emphasis took place once the Treasury had approved acquisition of a site and construction works. Although conceived as a power reactor, and from the outset fitted with steam turbogenerators connected to the National Grid, Hinton's determination to focus on a real project rather than a research programme did have its downside in that, ultimately, insufficient test data could be obtained in advance of construction. As understanding developed, it became clear that the next version of the fast reactor (which, a decade later, became the Prototype Fast Reactor, or PFR) would be of very different design, and that the primary purpose of what was in due course named the Dounreay Fast Reactor (DFR) would have to change to being a test bed for the irradiation of fuel and materials rather than its original purpose as a power station prototype.

The DFR was built with three aims;

- To demonstrate the feasibility of a fast reactor
- To gain operating experience with a liquid metal cooled fast reactor
- To have a realistic test facility for fuels and materials for future fast breeder reactors

Building Dounreay

In 1954, UKAEA (which had recently been established as a freestanding body, no longer organisationally part of a Government ministry) purchased the farms of Isauld and Lower Dounreay. The farm buildings were close to or inside the airfield site, and clearly could not continue to be occupied, whilst the purchases provided an area of land that could both provide for future development and serve as a control zone around the reactor site. UKAEA also took over the administrative control of the airfield.

During these early days of nuclear technology, experimentation was key, as no guidelines existed on best practice in construction. A team of designers drew up plans for a site that they expected would meet their needs. When construction commenced, workers arrived from across Scotland's industrial heartland and further afield, to build and operate the new facility. Around 3,000 construction workers were employed. Many of Britain's leading engineering companies were awarded contracts with specifications often unlike anything they had done before, such as the circular Goliath crane required within the reactor containment sphere. This was manufactured by a 50 year old Glasgow pump company, J W Carruthers, that had recently branched out into cranes.

Most challenging however, was the brief given to the Motherwell Bridge & Engineering Company Ltd to construct the steel containment sphere for the reactor. The workforce, most extensively from Whatlings of Glasgow, was accommodated at 'Boston Camp', the accommodation blocks of the wartime airfield on the south side of the main road. Further blocks were built and they also used a former army camp in Thurso. The facilities for around 1,000 residents included a bar that became known as 'the Sphere Club', a cinema and a chapel. Occupants of the camp's neat clusters of buildings included women who, as well as taking on catering duties, were employed in brick-making once it became apparent that manufacture on site would be more efficient than shipment by rail or sea – the nearest brickworks was south of Inverness. The control tower of the old airfield became the headquarters for construction works. The site of Boston Camp is still visible, but little now remains above ground other than some fragmentary concrete and brickwork.

Construction began early in 1955 on both DFR and DMTR. The two reactor containments and their immediate ancillary buildings were the first structures to be built. Construction of the Fuel Cycle Area (FCA) that surrounded the DMTR also began in 1955. By 1956, the DFR reactor vessel had been delivered by Pickfords, causing some damage to Forss Bridge through its enormous size. The foundations for most of the process plants were finished by the middle of the year, and a tunnel dug through rock for the disposal of low level liquid effluent into the sea.

The construction years were a period of immense activity in a quiet farming area of Caithness. For workers involved in construction, 'camp' living arrangements were typical, but the experimental nature of the site and its unusual features and the sheer remoteness of the area made the experience stand out. The camp is still remembered locally by those that lived and worked there, as well as further afield by workers who stayed there during construction.

The impermanence of this camp is contrasted with the physical evidence of the permanent workers housing that was built for those employees who would be staying on at Dounreay. This housing had to be good enough quality, well-placed, and family-friendly to encourage potential employees to stay. A local architect, Sinclair MacDonald, whose work paid close attention to local styles, drew up designs for estates that would house Dounreay's pioneer generation. In all, three estates were built in Thurso, and other houses were built closer to the site. Prefabrication was used, which sped up construction. Those that came to live in these estates were known as the 'Atomics'. Local mythology cites a Thurso milk company's account books for the name; when they had to open a new book for the new residents, they reputedly wrote "Locals" on the cover of the old one and "Atomics" on the new. The impact was more than just residential. Young families boosted the school intake and extra facilities had to be planned for and constructed as the population of Thurso rapidly rose from circa 3,300 to circa 9,000 between 1954 and 1964. The mix of local and 'atomic' families was largely smooth. Dounreay was seen as a boon for the local economy, and many local people benefited from employment and training opportunities at the site.

As the Fast Reactor programme began to accelerate, and buildings and processes became functional, experiments in nuclear technology at last began. In 1957 the first nuclear reaction to take place on Scottish soil occurred in the criticality test cells. By February 1958, the DMTR was finished and in May it achieved criticality. By the end of 1958 the DFR was complete and it went critical in November 1959. In 1962 it became the first fast reactor in the world to supply electricity to the national supply, although the Magnox reactor at Calder Hall had been producing electricity for public consumption since August 1956.

The number of workers during the site's operating period from late 1950s to mid 1990s was around 2,400.

2.2.4 Developing the Prototype Fast Reactor (1960s and 1970s)

In 1966 Dounreay prepared itself for another pioneering complex. The Prototype Fast Reactor (PFR) was to join DFR in providing experimental technology that would feed the grid and also become self-reliant in terms of its fuel cycle (when operated in conjunction with the Fuel Cycle Area). The PFR was by far the largest structure built at Dounreay and it still dominates the western end of the site. A large substation was constructed to the south-west of the PFR, and a complex of ancillary support buildings added. After a sustained construction and testing period the PFR went critical in 1974, and electricity was exported to the grid by January 1975. The PFR provided information for the future design and operation of large commercial fast reactor stations and had an output of 250 MW, which, at the time, was enough electricity to supply a city the size of Aberdeen.

As part of the design research work for the PFR, UKAEA also commissioned a third research reactor to study fast neutron flux technologies. This, located at Winfrith in Dorset, was ZEBRA, the Zero Energy Breeder Reactor Assembly. ZEBRA played a role in the development of the PFR equivalent to that of ZEUS in the development of the DFR.

The DFR and PFR were different in scale, design and arrangement: the DFR was a 'loop' type fast reactor with its coolant circulated in external heat exchangers, whilst the PFR was a 'pool' type with its heat exchangers immersed in the reactor vessel. There were also major differences in the fuel design as DFR had metallic uranium fuel that was vented and the coolant was in direct contact with the fuel to maximise heat transfer. The PFR had uranium and plutonium mixed oxide fuel that was fully sealed in stainless steel pins. Differences in construction were also striking. Boston Camp had been on stand-by for a new generation of construction workers, but prefabrication and panelling, combined with mechanised diggers meant that far fewer workers were necessary. A steel sphere was not required to contain the reactor and PFR's reactor vessel was encased in concrete and steel and sunk into the ground. These differences were also reflected in the team make-up of the two complexes, between which an element of competition developed.

By 1977, PFR was recycling its fuel for reuse, and no longer needed to rely on external fuel supplies. In the same year, the DFR was shut down. The PFR team had learnt many valuable lessons that were of considerable use to the international development of fast breeder technology, such as welding techniques, materials suitability and fuel efficiency.

2.2.5 The Shaft (1977)

The shaft that had been sunk to extract rubble from the construction of the liquid effluent discharge pipeline in the 1950s had been used for the licensed disposal of solid intermediate level waste between the late 1950s and 1977. Fissures in the rock meant that groundwater seepage was occurring, and the build up of sodium contaminated materials led to an explosion in 1977 that allowed some radioactivity to escape. This incident drew external attention to safety procedures at Dounreay. The nuclear industry worldwide had to face up to problems of waste disposal, problems that had not been well planned for in the early days.

2.2.6 Closure and Decommissioning (1980s, 1990s and 2000s)

In 1984 Dounreay became part of a European five-nation fast reactor collaboration[5] (comprising the UK, France, Germany, Belgium and Italy), with interlinked research programmes. The uranium criticality test cells were converted to house various test rigs to study sodium-water reactions arising from leaks. These were known as the NOaH and SuperNOaH experiments, with NOaH a play on the chemical symbols for sodium (Na) and hydroxide (OH).

In 1986, a planning application was submitted to the Highland Council to build the European Demonstration Reprocessing Plant (EDRP) at Dounreay. A public enquiry

[5] United Nations Treaty Collection: http://untreaty.un.org/unts/144078_158780/5/7/13108.pdf

lasting 3 months was held in Thurso Town Hall and the decision to grant planning consent never materialised, as the Government announced in 1988 that it was stopping the funding for developing fast reactor technology. In the UK, nuclear power had become culturally and politically unpopular; whilst within the sector, fast breeder technology was increasingly seen as an expensive solution. As a result of both of these factors, the PFR was shut down in 1994[6]. Failure of a dissolver in the main fuel reprocessing plant led to a decision to discontinue reprocessing in 1998, after which the only work undertaken on the site was initial decommissioning and the processing of waste.

In the 1980s and 1990s, Dounreay was again in the news for its historic mismanagement of waste, as particles of radioactive materials were found washed up on local beaches, most notably, Sandside[7]. Although not considered to be of great harm to humans, a fishing ban was put in place around Dounreay and regular monitoring and testing practices implemented[8]. Further problems with Intermediate Level Waste (ILW) disposal at the shaft and with low-level waste (LLW) storage exacerbated tensions over acceptable standards of waste management.

The suspicion and secrecy surrounding nuclear sites had been much less evident at Dounreay, mainly because the site was not being used to produce plutonium for weapons, and perhaps due to the sites' obvious socio-economic benefits but also perhaps due to its distance from the main seats of the anti-nuclear lobby. However, increased security consciousness did not escape Dounreay and throughout the 1980s, 1990s and 2000s, security measures and presence have increased, from changes in road layouts and entry procedures to the construction of an on-site firing range.

From the 1970s to the present day various buildings and structures were also constructed and removed. With the closure of the PFR in 1994, and the cessation of nuclear fuel reprocessing in 1996 the majority of the site fell out of use for generation and experimentation, and although development work and dealing with waste continued, there was an atmosphere of uncertainty. In the early 1990s a decommissioning directorate was set up to progress the Government's desire to place planning and implementing decommissioning centre stage. A visitor centre was set up in the former airfield control tower (in the early 1960s), outside the site boundary, but weather damage led to its demolition in 2007.

In 2000 it was announced that the site's main focus would be decommissioning and considering that it housed 304 facilities it was clear that this would be a long and careful process. Some of the facilities were straightforward to dismantle, while others require great care due to radiological or chemical hazards, Of the 304 facilities on site, about 50 have a legacy that involve the presence of radioactive materials. Areas of ground within the site have also been polluted by chemicals and radioactive materials which will need to be remediated.

Dounreay is now heavily engaged in this decommissioning programme and there is interest from the world's nuclear industry to observe the outcome of a pioneering process that has turned out to be its last, and arguably greatest, technological and scientific challenge.

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6 http://www.dounreay.com/about-us/history
7 SEPA Dounreay particles research: http://www.sepa.org.uk/radioactivity/dounreay/particles.htm
8 Scottish Government News: http://www.scotland.gov.uk/News/Releases/1997/10/ccbd5adf-2ba1-41cb-98f6-db01fdd3a068

2.3 Dounreay Today

Dounreay occupies a dramatic and relatively remote location on the coastline of northern Scotland. The large-scale buildings contrast with the extensive open rural landscape and seascape that surrounds the site. The buildings are prominent in many views from the wider landscape and the collection of often primary shapes e.g. sphere (DFR), box (PFR and Vulcan), vertical line (stacks/chimneys) give the site simplicity of form and a strongly industrial character. The other particular aspect of its external character is the security fences and infrastructure that demark the edges of the site. These elements clearly separate the site from the wider landscape in which it so visibly intrudes.

To a passer-by it may seem odd that such a large-scale industrial facility would be sited so far from markets and habitation – unless one knows the site is a nuclear facility (or the symbolism of the sphere is recognised) the logic of the location is hard to fathom. Once that knowledge is gained, the logic becomes readily apparent. What would not be apparent from the outside would be the experimental nature of the site that sets it apart from some other nuclear facilities. This and the secure nature of the site only become apparent as the site is entered through the complex of security arrangements.

Inside, all the elements and characteristics of an independent community or academic campus are present – with areas for administration, research and development, amenities and its own emergency services. As well as the three key reactor facilities with their associated ancillary structures. The make up of the site into specialist facilities meant that employees were usually confined to a single work area and spent the majority of their time at work in that location. The nature of the work undertaken on site gives cohesion to this community, which also shares amenities such as the canteen, smoking shelters and other communal areas.

The site covers an area of approximately 60 hectares, which is divided into four main areas; the Administration area facing the A836, the Dounreay Fast Reactor, the Prototype Fast Reactor and the secure Fuel Cycle Area that accommodates the Materials Test Reactor, fuel plants, laboratories, waste processing plants and administration areas associated with the running of the FCA.

The physical and intellectual nature of Dounreay has changed. It is no longer an experimental research establishment concerned with the production of nuclear energy. Today the purpose of Dounreay is almost reversed. It must decommission. The long-term programme began in 2000 with the development of a fully integrated site decommissioning programme and the removal of many of the original 1950s and subsequent buildings and structures; and the construction of new facilities to deal with waste material, both liquor and solids. A number of the original 1950s buildings and the majority of the airfield buildings (3 airfield facilities remain in a refurbished form) have been removed to make way for new facilities and to clear space for future developments.

The decommissioning function does not mean that Dounreay is now a quiet place that is slowly being taken apart. The ongoing decommissioning work means that it remains a busy and vibrant place with around 2,000 workers coming and going. This is most evident in the early mornings and evenings when large numbers of people, cars, bikes and buses make their way to and from the site. Inside Dounreay, work is being undertaking within all the facilities and the administration offices in particular are busy. At lunchtimes, the general activity and buzz in the original canteen blocks in the Administration area and the FCA, has changed little since the site was built in the 1950s.

Dounreay also continues to play a significant role in the development of knowledge of nuclear power technologies that will be used not only in the UK, but by other countries that are in the process of decommissioning their nuclear energy facilities. The lessons learned at Dounreay may assist in the development of Britain's next generation of nuclear power stations, particularly in informing on how they can be designed to facilitate easy decommissioning.

Dounreay is also important for the continued prosperity of Caithness, North Sutherland and northern Scotland. It is a major employer, helping the towns of Thurso and Wick, as well as outlying villages, to overcome the decline in traditional sources of income, such as the farming, fishing and flagstone industries.

Character Areas

To aid understanding of the Site and its development it has been divided into 13 Character Areas. These have been largely defined through their association with different functions or activities. Full descriptions for these areas can be found in Appendix 2, their boundaries are shown on Figure 2.

- **CA 1: Site Entrance** – Group of buildings, security gates, booths, pavements and roads associated with the control of traffic into and out of the site. The earliest buildings were constructed between 1955 and 1956, and there were subsequent additions in every decade except the 1960s.
- **CA 2: Administration** – The area has changed considerably since the mid-1950s but the early offices and a lecture theatre have survived. The area also contains the main canteen for all staff.
- **CA 3: Workshops** – In the 1950s and later, this area held fabrication workshops and contractor's offices. In recent years several buildings have been removed, leaving open areas of concrete hardstanding.
- **CA 4: Health & Safety** – This area contains the Police Station, Fire Station, Occupational Health Centre, health physics offices, laboratories and monitoring rooms. The area was significantly developed in the 1990s and 2000s although the 1950s Fire Station and associated extensions survive.
- **CA 5: Low Level Waste Storage** – This large predominately open area contains two large Low Level Waste (LLW) storage buildings and associated ancillary structures including a small 1950s electrical substation, offices and a recently-constructed laundry. One of the LLW buildings, Whatlings Hangar, is believed to date from the airfield days, although it has undergone significant alterations since then.
- **CA 6: Open Ground** –This open, grassed area, has never been extensively developed apart from temporary buildings for the construction of PFR.
- **CA 7: Prototype Fast Reactor (PFR)** – This area is occupied by the PFR building, associated ancillary buildings & structures and a large electricity substation. The majority of the surviving buildings date from the mid-1960s when the PFR was developed, although many of these have their uses changed in the 1970s and 1980s. The character of the area has altered significantly since decommissioning began with large-scale cleaning and clearance of the interior and the removal of several exterior ancillary structures.
- **CA 8: Effluent Plant** –This comprises a series of 1950s effluent pits, with additional structures built from the 1970s onwards. The area is closely associated with CA9, but the extensive remodelling and removal of original structures means that the two areas now differ in appearance.

- **CA 9: Dounreay Fast Reactor (DFR)** – This area contains the most visually iconic structure within the site namely the sphere that surrounds the 1950s reactor. The remainder of the area is occupied by ancillary buildings associated with the running of the DFR, as well more recent buildings. The original turbine hall has been cleared and replaced with structures associated with the decommissioning programme.
- **CA 10: Firing Range** – This area is separated from the rest of the site by an internal perimeter fence and comprises a 1980s brick-built firing range wall with an associated portacabin.
- **CA 11: Waste Pits** - The area contains the site's disposal pits for solid low level waste (now filled and closed for further disposals) with associated covering buildings. They are separated from the rest of the Site by an internal perimeter fence. The original pits were constructed in the early 1960s, and the covering buildings and monitoring structures added in the 1990s.
- **CA 12: Fuel Cycle Area (FCA)** –The Fuel Cycle Area (FCA) is a high security area that houses the facilities that handled and stored the site's nuclear material and waste. Most of the buildings were built during the early construction phase of the site (1955-1959). The Dounreay Materials Test Reactor was the first operational reactor in Scotland when it went critical in 1958 - it closed in 1969. The area retains much of the feel of the 1950s site, with little obvious external and internal alterations. A key feature of the area is link corridor, which was formerly the longest corridor in Europe. This links all the original laboratory buildings and whilst a number of the 1950s buildings have been removed and new facilities and structures have been added, the core of the area, namely the labs and fuel plants connected by the link corridor, survive relatively unaltered.
- **CA 13: Criticality cells and storage** – This area of relatively open land was previously occupied by the "criticality cells" (concrete structures) and associated structures. The cells were used for experimental work in the early part of the site's life and it was here that the first nuclear reaction in Scotland took place. The uranium test cells were converted in the 1980s to house the test rigs for sodium-water leak studies. The last cell was demolished in March 2009.

In addition, 4 character areas outside of the licensed site have also been described as part of the study; details on these can be found in Appendix 2 and on Figure 3:

- **CA 14: Dounreay Castle**
- **CA 15: Former Airfield**
- **CA 16: Vulcan Naval Reactor Test Establishment**
- **CA 17: Other NDA Holdings**

2.4 Surviving Evidence

The following examines the surviving evidence of Dounreay's development and history in terms of the Buildings and Spaces; Archives and Objects; and Social History and Memories.

2.4.1 Buildings and Spaces

Appendix 1 contains a descriptive gazetteer of the surviving buildings at Dounreay. Given the nature of the site's history; essentially a constant flow of development, decommissioning and demolition; a remarkable legacy of buildings and spaces survive.

The areas most altered by the transformation from nuclear power generation to decommissioning are those which contain the reactors – namely the DMTR, DFR and PFR.

The DMTR has so far been the subject of the most radical change. The reactor was originally served by a number of ancillary buildings, including a fuel pond, post-irradiation examination (PIE) cells, workshops, laboratories, an active handling bay and administrative offices. Most of these have been removed, while the others are in the process of, or are being prepared for, decommissioning. The DMTR itself is currently undergoing decommissioning. The distinctive 'dustbin' containment building and the lightly contaminated reactor housing remain in place, however, all fuel and most equipment and ancillary fittings and fixtures have been removed.

The DFR complex has also undergone significant alteration during decommissioning. The spherical pressure vessel surrounding the reactor remains as well as parts of the reactor and associated pipework etc, but all of the ancillary power generation equipment and buildings have been demolished. Decommissioning of this area began early, immediately after the closure of the reactor in 1977 when the removal of its fuel commenced. The core and inner breeder, and about a third of the outer breeder have already been removed. This work ceased in the 1980s but will recommence in the near future. A breeder removal plant has now been constructed at the base of the sphere to deal with the removal and processing of removing waste and contaminated materials. Within this structure the fuel pin and breeder material will be cleaned of traces of liquid metal, examined, cut up and packed into storage containers. The sphere itself is contaminated with low levels of radioactivity and requires continual maintenance to counter the effects of corrosion. Associated buildings have been demolished and removed, although the control room remains largely intact.

The PFR has undergone a gradual transformation since it closed and is being slowly dismantled. The removal of the main steam stack resulted in the first noticeable change to the Dounreay skyline since the mid-1960s. The steam turbine hall has been emptied and many tonnes of disused steel items have already been stripped out of the plant for disposal. To make way for the sodium disposal plant to allow the destruction of 1500 tonnes of sodium. Also removed from the facility have been the large heat exchangers, evaporators, pumps and expansion tanks, which once formed an integral part of the reactor's secondary sodium circuit. Whilst much of the PFR's superstructure remains many of its internal fittings are or have been removed.

Other buildings and areas of the site have been subject to gradual alteration from the mid-1950s onwards. The administration area contains a number of early buildings and in places still provides an indication of how the early site must have appeared, with the reception building and original administration block still in use. The canteen, lecture theatre and offices from the 1950s remain, and most are still in use. Within the original headquarters building are many original pictures, plaques and objects associated with the early days of the site. There have, however, been many changes, most notably the new administration HQ built in 2003 that now dominates this part of the site. The fire and ambulance centres still occupy original 1950s buildings, whilst the occupational health centre remains in a set of early characteristic single story buildings.

The Fuel Cycle Area has been subject to extensive change and redevelopment and now contains a mix of modern and mid/late 20th century buildings. The core laboratory and working areas remain although these have undergone significant decommissioning and many internal fixtures and fittings have been removed.

The decommissioning process has seen the construction of numerous new buildings including stores, processing plants and ancillary buildings; further buildings are planned and will be developed in the near future. A key example of this recent phase of construction is the police headquarters building which was constructed in 2003. This will remain until the very end of the decommissioning programme. A small number of other buildings will also remain in use through to 2078. These will be used for waste storage and security.

2.4.2 Archives and Objects

In addition to the buildings and spaces, the Site's heritage is also embodied in its material culture: the objects, large and small, within it, and the archives which document its history.

- "Archives" means paper records of all types including engineering and construction drawings, together with photographic negatives and prints, film and sound recordings, and the electronic equivalents of all of these.
- "Objects" means all portable items brought into a building for use or storage, together with any manufactured products made within a building from materials taken in for the purpose[9].

Records and Archives

It is inherent in the nature of the activities and events that have occurred at Dounreay that considerable quantities of paper, photographic records, videos and film have been generated. This will continue to be the case into the foreseeable future. The site has three long-established central, although separately managed, units for the management of such material. These units handle:

- documents and printed papers;
- architectural, technical and other drawings; and
- photographic material, including film.

The Records Unit handles the transition of material from working to managed records and from managed records to historical archives, in accordance with sector standard practices. The separate Drawing Registry follows equivalent processes for archiving drawings.

The Photographic Unit holds approximately 250,000 negatives and an additional number of associated original prints, largely accumulated between the early 1950s and late 1990s. New material is added on an ongoing basis. All the material is considered to be held in perpetuity, on the basis that it was generally "weeded" by the photographer at or around the time of production. Documents, drawings and photographs are present throughout the Dounreay site at places other than the storage locations associated with the management of documents, drawings and photographs. Most of these comprise current material where decisions on its movement to managed records, or its destruction, have not yet been taken. However, all of the site's buildings may also contain:

- Duplicate material held by individuals or within specific locations, for regular use and reference; and

[9] In certain circumstances – typically where a building is to be reconstructed or demolished - an object can also be something that would otherwise normally have been considered part of the building's fabric or decorative scheme or fixed installed plant but which has been rendered portable by its removal. Objects are generally classified according to the use to which they have been put, or for which they were designed to be put (which may or may not be the same thing). They may also be categorised by form and function, for example, tools, furniture, clothing, etc

- Ephemeral material – sometimes of considerable age – that has been passed over for inclusion in the sites managed records.

Objects

Dounreay is full of objects. The largest proportion of these could belong to any site whether office, factory or laboratory. However, there are some characteristic objects which are directly associated with nuclear activities and research in the reactor and FCA areas. These also tend to be radioactively contaminated and fall into the following broad categories:

- specially designed and often installed equipment directly related to particular scientific or industrial processes, for example fuel rods, large 90 ton flasks, and the manipulators in the PFR "cave"
- generic or special tools and equipment associated with past or current work activities undertaken at the location e.g. gloveboxes, fume cupboards and even office furniture
- protective clothing and equipment, both of the type issued to individuals and that held for use by any person as may be required
- the personal effects of those who work or have previously worked there;
- furniture and equipment associated with employee welfare, including the full range of items associated with work-breaks;
- instructional models of plant and equipment e.g. those found in the PFR
- commemorative items such as the plaques in the DFR control room and the commissioning stone a.k.a. the font, in the PFR foyer
- never-used or used samples or examples, or inert replicas, of materials, consumables, components or sub-assemblies associated with past or current work activities undertaken at the location, and which have been provided and/or retained for instructional or information purposes e.g. demonstration fuel rods
- First Aid and decontamination equipment and materials, including consumables;
- unused stocks of consumable materials or components, and spare components
- broken, worn-out, time-expired or redundant items in any of the previous categories, which may have been discarded but which have not been removed from the location
- waste products from manufacturing, machining, processing or other activities; and
- items in any of the previous categories associated by use with other locations, but brought to this location for storage or disposal

Other objects include fixtures, fittings and components, elements or sub-assemblies of installed plant and of the structures themselves that could be rendered portable through disassembly or physical removal in some other way. This latter category covers most of the major engineering processes on the site and many previously installed items of quite substantial size are now "objects". The presence of these around the different buildings in various states of decontamination and storage is one of the defining characteristics of the site at this point in its life.

2.4.3 Social history and memories

One of the most interesting aspects of Dounreay's heritage is its social history, as represented often by the memories of those who have worked and continue to work there.

These people include the pioneering scientists who developed the ideas, the architects and engineers who worked out how they could be implemented, the workers who made them a reality, the scientists, contractors and administrators who are today working on decommissioning the Site, and the local residents who have gained directly or indirectly from the economic benefits it has created.

A sense of heritage has been woven into the fabric of Dounreay and its environs, from the earliest days. The part that the establishment has played in the development of the nuclear power industry in Britain, its role in the lives of many local people, and its contribution to the economy of Caithness and Sutherland, cannot be overstated. This is demonstrated in the many values that people have ascribed to the site. This is no more evident than from looking at the responses from staff to requests for input into heritage matters across the site, and the work of current and past employees who have written books on its history and development.

An ongoing programme of the recording of oral and written histories is currently underway, and this has already been a valuable source of information that might otherwise be lost.

2.5 Defining characteristics and themes

A number of characteristics, themes or traits emerge from the analysis of Dounreay. These all reflect certain aspects of the site's rather unique history and its reasons for foundation. The key aspects identified include:

Constant change and fluidity

It is clear that Dounreay is not a single static entity. It is constantly changing and fluid in nature and it should really be thought of as being a process rather than a place. The "grand" overarching process is one of construction, operation, decommission and demolition but within that smaller sub-processes occur e.g. generation, waste creation, waste treatment etc. At no point in the "process" is Dounreay static. Ever since the arrival of the "Atomics" Dounreay's trajectory has been one of constant creation, alteration, decommissioning and change. This has not occurred in the context of a grand site-wide vision but rather in a responsive manner reflecting changing cultural, socio-economic and technological circumstances. This sense of change, activity and reflexivity is at the very heart of everything that Dounreay was and is.

Experimentation

Dounreay was conceived as an experiment and its development has continued to follow this route. From the DFR and its sphere through to the FCA's laboratories and the application of the evolved fast reactor technology in the PFR; every aspect of the site's earlier history was rooted in experimentation and the development and application of new technologies. This in itself has led to the need for new experimental approaches to decommissioning and waste extraction as many of the early processes used at Dounreay were unique and sometimes poorly documented. A sense of experimentation, exploration and technical advancement underpins the ethos of Dounreay and is manifested in its buildings, archives and places.

Critical Safety

The experimental nature of the DFR's work and the safety concerns that this generated, led to the choice of Dounreay as a location for the new establishment. It can be argued that an obsession with safety underpins the very founding and reasoning behind Dounreay. The fact that the DFR could have gone very badly wrong also led to the installation of a range of infrastructure designed solely to help address "critical" safety events. The dedicated fire engines with their graphite dispensers reflect the unique need to address sodium fires in reactors whilst the weather station mounted on a tall metal tower was installed to enable wind direction to be determined if a release of radioactive contamination accident occurred. These items and many other aspects of the site reflect the critical safety concerns that structured the early development of the site.

Health and Safety

In terms of a person's daily experience of Dounreay it is not the critical safety issues that dominate perceptions of place, rather it is the constant presence of the highly developed health and safety regime that has evolved on the Site. The need to constantly monitor for radiation, to operate on what is effectively a construction site and to ensure safe industrial procedures means that every aspect of life at Dounreay is infused with a health and safety culture. To an outsider this is daunting and alienating; however, to those working at Dounreay it is merely an aspect of their daily lives and their acceptance of it distinguishes them as a group from non-nuclear industry people.

Internal segregation

Dounreay is not a homogenous entity, it is divided into discrete places and these are occupied by often discrete communities of people. Although this is less true in the modern era, there is still a sense of separation and difference on the site between groups working in the FCA, DFR and PFR. This segregation is not uncommon on institutional sites. For example historic military camps, industrial plants and university campuses all display similar characteristics of segregation and separation with internal, often competitive communities emerging. Whilst we on the outside may see "Dounreay" on the inside there are many "Dounreays" each of which reflects part of the greater whole.

Sense of community

Whilst the internal segregation can be seen as a negative by some it in fact creates a sense of community / communities on the site. Each of the "groups" on the site forms part of a wider Dounreay entity and this sense of belonging is an important aspect of the site's identity. In many respects it extends beyond the boundary of the site and from the earliest days the notion of the Atomics as a community within the wider Caithness community has been an important element of the wider regions' identify.

Security

The industrial processes at Dounreay were, and are, considered to be sensitive in nature and the material they produced would have been useful to people with violent intentions. Thus security is an extremely visible and dominant aspect of Dounreay today. From the defended main gate through to the secure fence and patrolling constabulary the entire site is obviously a secure and guarded area. The infrastructure is highly visible; the presence of armed police is always noticeable; and the security culture impregnates every aspect of operation on the site. Within the site itself the FCA is particularly noticeable in terms of the added layers of security; this separation adds to the sense of internal segregation and community.

Commemoration

Finally, there is a tradition at Dounreay, as there is at other comparable sites[10], of commemorating or marking moments in history. Perhaps the most notable example of these at Dounreay is the DFR Control Room with its two plaques: one commemorating it

[10] For example the memorial at RAF Scampton to Wing Commander Guy Penrose Gibson's (VC, DSO & Bar, DFC & Bar) dog which died the day before the famous "Dambuster" raids which Gibson led.

being switched on, the other it being switched off. The memorial goes further though, as the instrumentation has all been left set exactly as it was when the reactor was switched off. This is just one example of many memorials across the site.

3. Statement of Values

3.1 Introduction

The previous chapter has characterised Dounreay, teasing out and describing the constituent elements and areas of the buildings and spaces and summarising the characteristics of the other attributes of the site's heritage: the objects, archives and the social history and memories. The next step is to explore the Site's Values - what matters or is important and why – as the basis for identifying what could form part of the site's cultural legacy.

This section, therefore, examines the numerous values associated with Dounreay. The core of the section is based on standard approaches to assessing the historic and cultural significance of a place (e.g. English Heritage's Conservation Principles (2008), The Conservation Plan: A Guide to the Preparation of Conservation Plans for Places of European Cultural Significance (James Kerr 1996), The Heritage Lottery Fund's guide to Conservation Management Planning (2008), and the National Trust's guidance on Conservation Plans). Consequently, it begins with an exploration of Dounreay in the context of the national and international nuclear industry (Section 3.2). This is then followed by a Statement of Significance that addresses the Historic, Evidential, Aesthetic and Communal values associated with the site (Section 3.3). These two elements form the core of the Statement of Values.

However, Dounreay is not a typical industrial or even heritage site, it presents a challenge to the commonly adopted methods of assessing value. This chapter presents two other approaches to Dounreay and its "values". First, a Change and Creation approach (see Section 3.4 and Change and Creation: historic landscape character 1950-2000 (English Heritage 2004) and finally a View from the Future (Section 3.5) which attempts to provide a speculative review of how the site may be viewed from a more distant historic perspective.

3.2 Dounreay in the Wider Nuclear Context

3.2.1 Worldwide Historic Overview

The world's first nuclear reactor (Chicago Pile 1: CP-1) went critical in Chicago in December 1942. Early efforts following this focused on military outcomes e.g. the Manhattan Project in the USA, and a similar project in the USSR. Following the use of nuclear weapons by the USA at Hiroshima and Nagasaki and after the end of World War II, military concerns remained important and the development of what is termed the Nuclear Deterrent remained central to the aims of the few nations able to acquire this technology.

There was, however, an increasing recognition of the potential civilian benefits of nuclear power and development of power generating reactors began. The first nuclear reactor to produce electricity (albeit a very small amount) was the small Experimental Breeder Reactor (EBR-1) in Idaho, USA. This achieved criticality in December 1951 and survives to this day in a non-operational state. Through the 1950s and 1960s technology developed and numerous different reactor designs were tried including Fast breeder reactors alongside more common light water reactors. The development of commercial reactors accelerated from c. 1959 / 1960 onwards and through the 1960s and into the early 1970s nuclear power stations were commissioned and developed across the world.

This was perhaps the historic peak of reactor production and development. Whilst there was much experimentation with different types of reactors, through time Pressurised and Boiling Water Reactors become the dominant types; with heavy water and fast breeder reactors very much in the minority[11].

From the mid 1970s though to the late 1990s the nuclear industry essentially declined; in that it did not expand considerably and investment lessened. Through this period new reactors were built, and old reactors were shut, but overall levels of output remained relatively stagnant. Since the late 1990s there has been further investment and in recent years the industry has been able to highlight its low carbon credentials and is now seen by many governments as a way of helping to address human induced climate change.

Overall, since 1941, over 1,500 nuclear reactors have been built for a variety of purposes including research, isotope production, electricity generation and propulsion. These include[12]:

- Approximately 690 research reactors, of which c. 280 remain in operation[13];
- Approximately 600 power reactors, of which c. 436 remain in operation[14];
- Approximately 220 small nuclear reactors powering c.150 submarines and ships[15]
- Over 30 reactors which have been used in space vehicles[16].
- Numerous other additional military reactors and test bed applications that are not included in the above figures.

Another feature of the industry in the last two decades has been the need to decommission and decontaminate many of the early nuclear complexes. This issue is being addressed on a world-wide basis and has become an area of significant scientific and technological development in its own right.

3.2.2 Historic overview of the UK's Nuclear Industry

The broad world-wide pattern of historic development and decline and re-emergence is mirrored in the UK. The UK's first nuclear reactors were built at Windscale in 1946 (now part of the Sellafield complex). The Windscale Piles (as they were known) were developed solely to support weapons production. At the same time Harwell (a research campus that eventually housed 5 reactors) was created as the Atomic Energy Research Establishment (AERE) for the development of civil nuclear power, and a partner research site at Winfrith was opened in 1958.

Calder Hall the world's first commercial scale power generating nuclear reactor became operational in 1956; it was, however, primarily a weapons facility until c.1964. Calder Hall had four Magnox reactors capable of generating 50MWe of power each. Chapelcross, Scotland's first electricity producing reactor complex (1959), was essentially a copy of Calder Hall and like that site was focused on producing plutonium for weapons. Magnox reactors were developed by the UK and there are only two other Magnox reactors in the

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[11] currently c.88% of the world-wide generating capacity is from Pressurised and Boiling Water Reactors – this differs from number of reactors.

[12] Figures taken from the International Atomic Energy Agency's (IAEA) Research Reactor Data Base (RRDB), the IAEA's Power Reactor Information System (PRIS) and from the World Nuclear Association.

[13] RRDB – the Research Reactor Data Base, at http://nucleus.iaea.org/NUCLEUS/nucleus/Content/CatalogueOfInformationResources/Specific_Nuclear_Reactors_and_Associated_Plants/Research_Reactor_Database.html

[14] PRIS – the Power Reactor Information System, at http://www.iaea.or.at/programmes/a2/

[15] http://www.world-nuclear.org/info/inf34.html

[16] http://www.world-nuclear.org

world, one in Japan and one in Italy. A further 10 Magnox power stations (containing 22 reactors) were developed throughout the late 1950s and 1960s in the UK.

The design of the gas cooled Magnox reactor was enhanced and developed and the first prototype Advanced Gas Cooled Reactor (AGR) became operational at Windscale in 1962. Further AGRs were commissioned from the mid 1960s through to 1980 and they continue to supply electricity today. As with Magnox reactors the design has not been adopted elsewhere in the world and the UK remains the only place to operate AGRs.

The mid 1950s also saw the establishment of Dounreay and the opening of DFR and DMTR (see Section 2). The development of the PFR in the 1970s was the UK's second and last foray into fast breeder reactor technology. DFR and PFR are the only examples of fast breeder reactor technology in the UK.

The vast majority of the UK's nuclear power generation capacity was built in the 1960s and 1970s. Virtually all the Magnox and AGR reactors date from this period (Magnox reactors mainly in the 1960s and AGRs in the 1970s). Only one reactor was built in the 1990s, a Pressured Water Reactor at Sizewell B in 1995.

As with other parts of the world, the UK is now tackling the decommissioning of its historic and often experimental nuclear legacy.

Whilst it is clear that the UK's historic trend is very similar to that of the wider world; it is notable that the UK followed a different path in terms of its technology. Unlike all other areas of the world, standard light water reactors (e.g. PWRs and BWRs) were not adopted and instead the UK pursued novel gas-cooled solutions. This self-reliance and engineering excellence was a characteristic feature of the UK nuclear industry.

3.2.3 Fast Breeder Reactor Technology in the Nuclear Industry

Fast Breeder Reactors (FBRs) emerged at a very early stage. Clementine, the world's first fast reactor, was built at the Los Alamos National Laboratory in the USA in 1947. In 1951 EBR-1, a breeder reactor, was the world's first reactor (of any type) to generate electricity. Other early FBRs include BR-1, BR-2 and BR-5, USSR (1955); DFR, UK (1959); Enrico Fermi Nuclear Generating Station, USA (1963); EBR-II, USA (1964); Rapsodie, France (1967); BOR-60, USSR (1969). This first phase of FBR development occurred at a time when world resources of uranium ore were believed to be quite limited. Consequently, reactor fuel was both very expensive and believed to be in limited and finite supply. In this context FBRs were very attractive as they were felt to vastly reduce a nation's dependence on imported Uranium or even make it self-sufficient.

During the 1970s the underlying circumstances began to change. Larger Uranium reserves had been identified whilst advances in mining techniques greatly reduced the cost of fuel. However, FBR development continued, examples included BN-350, USSR (1973); Phenix, France (1973); PFR, UK (1974); Joyo, Japan (1977) and KNK-II, Germany (1977). A further few reactors were built in the 1980s including Superphenix, France (1984); FBTR, India (1985); SNR-300, Germany (1985 – never operated); Monju, Japan (1985); and BN-600, USSR (1986).

Whilst these three decades of development have proved the concept of fast breeder reactors, it had also shown that such reactors are difficult and costly to construct and operate, prone to technological problems, and that the electrical power they produced was inherently much more expensive than that from other nuclear and non-nuclear sources. Against this background, four of the nations that had used fast breeder power reactors

(USA, France[17], Germany and the UK) have withdrawn from the field. Only Japan, Russia, India, South Korea and China have active FBR programmes (China and South Korea have yet to open FBR reactors).

In total, of the world's c. 1,500 reactors there were only c.20 Fast Breeder Reactors. DFR and PFR were the UK's only venture into fast breeder technology. Their development mirrors the pattern of FBRs; namely a rapid development of the concept in the 1950s followed by a further refinement in the 1960s / 1970s and then abandonment in the 1980s and 1990s.

3.2.4 Dounreay in context

Dounreay is wholly untypical of the main course of nuclear power generation in the UK and indeed in the world. Fast Breeder technology was only ever employed in c.20 reactors world wide (excluding those few under construction) and the DFR and PFR are the only examples in the UK. Dounreay is not typical or representative in terms of understanding and representing the nuclear industry of the 20th century both globally and in the UK.

It is, however, a good physical example and the only one in the UK, of a technologically significant process that some believe could form an important component of power generation in the future; a belief backed in some countries by continuing development and research. There is, however, little evidence to indicate that the technology developed at DFR and further refined in the PFR had a particular influence on the design of other reactors around the world.

Dounreay is also representative of a particular phase in the development of nuclear technology. The development of the DFR and associated FCA in the 1950s is clearly a response to global political issues (the emerging Cold War and the need to secure stable energy supplies) and mirrors similar developments in the USA and USSR. The later development of the PFR is a legacy of the issues surrounding concerns relating to the supply of uranium and represents, along with other example including EBR-II (USA), an attempt by nation states to develop wholly self-sufficient nuclear power stations. The abandonment of FBR development in the UK and later the closure of the PFR also directly reflects world-wide trends. Dounreay is a representative example of why Fast Breeder technology was developed and then abandoned by many nations.

Whilst Dounreay is unique in the UK as the only FBR site; it is entirely in keeping with the UK's innovative and "*go it alone*" approach to nuclear technology in the 1950s, 60s, 70s and 1980s. As with the Magnox and AGR technologies, the UK developed its FBR technology in relative isolation. Dounreay, therefore, represents the highest standards of UK scientific and engineering in the mid to late 20th century and the pioneering spirit so prevalent in that period.

3.3 Statement of Significance

The following "Statement of Significance" has been structured using the four values set out in the *English Heritage Conservation Principles: Policies and Guidance for the Sustainable Management of the Historic Environment (2008),* these are:

- **Evidential Value** - Value deriving from the potential of a place to yield evidence about past human activity

[17] France still operates Phenix as a research reactor

- **Historical Value** - Value deriving from the ways in which past people, events and aspects of life can be connected through a place to the present
- **Aesthetic Value** - Value deriving from the ways in which people draw sensory and intellectual stimulation from a place
- **Communal Value** - Value deriving from the meanings of a place for the people who relate to it, or for whom it figures in their collective experience or memory[18]

3.3.1 Evidential Value

Dounreay was originally built, and then expanded in the 1970s, to experiment with nuclear technology. The evidence of this experimentation is embodied in much of the built environment, in the objects within and without those buildings, and in the surviving documentary evidence. The highest evidential value accords to those assets that contributed most strongly to, or are evidence of, experimental technology and retain some semblance of their state when they were active in this respect.

The most significant evidential assets in the built environment at Dounreay are those that housed its most significant events and developments: the DMTR, the DFR sphere, the PFR containment and areas of the FCA. The Occupational Health Centre and Fire Station both provide evidence of the health and safety issues that were often unique or specific to Dounreay, and which sometimes required solutions that were as innovative and experimental as the Site's core work.

Another integral part of the Dounreay story is the production and safe processing of radioactive waste, and the evidential remains of waste treatment and disposal are a narrative of technological development. The surviving and adapted pits are currently part of a new generation of waste treatment and provide evidence of these processes. Likewise the adaptive reuse for LLW storage of one of the oldest buildings on the site, "Whatlings Hangar" is evidence of the Site's continuing evolution. Disposal of waste, changing attitudes, and perception of the threats to public safety represented by the nuclear industry are best evidenced by the "Shaft", the historic use of which signifies changes in practice and perception, and which in turn link to the outside world through both reports of accidents and developments in operating procedure.

The evidential value of each of these structures also extends to their contents. The reactor assemblies are of particular significance for their status as the core objects within nuclear fission, whilst the reactor control rooms are evidence of the human role in the creation of nuclear power. Each of these also provides evidence of the control system technologies and the aesthetics of their time. Other types of items that would be of evidential value include those which provided an interface between the personnel and the processes with which they were working, such as glove boxes in the FCA and manipulators in the PFR "Cave", and the measures taken in protecting personnel from the potentially dangerous processes in which they were engaging.

Dounreay's archives are extensive and well-catalogued. Design drawings, site plans and photographs cover all periods and parts of the site. They show working conditions, operating procedures that have now ceased, and much more. Individually and as an assemblage, these archives are of high evidential value. More evidence of Dounreay's importance is represented by the visitor books kept since the site's opening. These contain the signatures of high-profile UK visitors such as Prime Ministers, royalty, MPs

[18] Definitions taken from p.72 of the Conservation Principles

and journalists, alongside those of scientific delegations from other nations and visitors from other UKAEA sites.

Other material on the site also has evidential value, albeit at a lower level than that discussed above. This includes buildings, objects and other material used in support of the site's main activities, such as administration or building maintenance. Beyond this are the symbolic and often very personal commemorative items, such as plaques and artworks, pamphlets and personal ephemera, which evidence the Dounreay tradition of marking personal and corporate milestones.

Overall, Dounreay's buildings, objects and archives provide a rich and complex evidential record of the design, development, operation and decommissioning of a fully integrated mid to late 20th century nuclear power facility that was designed to be self-sufficient and self-supporting in terms of its fuel. The evidential value of the site is constantly changing as decommissioning progresses; a fact that increases the overall importance of the archives and to a lesser extent the artefacts.

3.3.2 Historical Value

As an experimental nuclear establishment, Dounreay claims a number of 'firsts' and other significances in the history and development of nuclear technology:

- the DFR was the first fast breeder reactor in the world to produce electricity for public consumption (14 October 1962) (EBR1 in Idaho, USA, was the first fast breeder reactor to generate electrical power);
- Scotland's first nuclear reaction took place at Dounreay on 13th August 1957 when the small research rig ZETR (Zero Energy Thermal Reactor) went critical following recommissioning after movement from AERE Harwell. This occurred in complex D1249 (now decommissioned and demolished);
- the DMTR was Scotland's first nuclear reactor with criticality on 24 May 1958;
- DFR and PFR have contributed to the advancement of world-wide fast reactor technology;
- Dounreay has been, and still is, at the forefront of the development of nuclear decommissioning technologies, including successful operation of a world-class facility at PFR for the destruction of highly reactive alkali metal.
- Dounreay created the first modern apprenticeship in Nuclear Operations and Decommissioning in the UK (2003); and
- The Dounreay chemists developed highly accurate analysis techniques for uranium and plutonium which are now used as the international standard.

In addition, the site has made a contribution to nuclear science through its ground-breaking work in developing effective chemical processes for use in the preparation and reprocessing of fast-breeder fuel, and subsequently in the field of applied technology: in its construction, its experimental use, and subsequent decommissioning work.

Dounreay also has a place in the historical development of nuclear technology particularly in the UK context. No other nuclear site in the UK had any significant degree of involvement in fast-breeder technology. Dounreay represents a notable episode in the development of the UK's nuclear industry. It would, had not both Europe and the UK taken a step back from the project, have broadened into the development of a larger second-generation prototype, applying the lessons learned from construction and operation of the PFR. Had this occurred and had fast-breeder technology continued to play a role in the UK then the site would be of considerable historic value.

Away from its historic value in relation to the development of the nuclear industry, Dounreay is of historic interest in terms of understanding the Post-war period in the UK. The technology upon which it was based was a response to national issues and perceived threats to future supplies of uranium and energy. The location of the site far from major centres of population also reflects a cultural idiom of the time and a response to perceived accident issues.

More locally the site is of considerable historic value in terms of understanding and shaping the 20th and 21st century history of Caithness. In the mid and late 1950s, one of Britain's most remote counties, Caithness, became home to a new community of physicists, chemists and engineers in pursuit of fast-breeder technology. It transformed the local economy and had major social impacts. The development, operation and decommissioning of Dounreay is a major historic event for Caithness and one that will continue to influence the region for centuries to come.

In summary, the site is undoubtedly of some interest in terms of the UK's and World's nuclear industry and reflects the broad historical trends in that industry. It does not, however, represent the typical mid to late 20th century approach to nuclear power generation; but it is an example of a rare form of nuclear technology that is now largely, but not wholly, extinct. It also has historic value as an element of the UK's response to the Cold War. Finally, it is a major feature of Caithness's 20th and 21st century history.

3.3.3 Aesthetic Value

Dounreay is not in conventional terms a designed aesthetic landscape; it does, however, have an aesthetic quality which is derived from its structured layout, its functionality, landscape location and the physical characteristics of its buildings.

A key aspect of the site's aesthetic and visual quality is the contrast between it and the surrounding rural landscape. Dounreay's massive and overtly 20th century structures present a marked contrast to the rural environment within which it is situated. Prior to construction of the naval airfield in 1941 the pastoral and coastal landscape of area would have changed little since the 19th century and probably before (see Section 2). Seen first from higher ground on the approach from Thurso to the east, both the site's extent and the massive nature of some of its structures dramatically strike the eye. Equally, from the A836 passing the site it presents an impressive vista against the sea and the sky. There are those who find the sight impressive, even awe-inspiring, and those who consider it to be an unwelcome 20th century eyesore, but either way there can be little doubt about the strength of its visual presence.

At closer quarters, the assemblage of buildings is visually interesting, presenting as it does an apparently eclectic mix of cubes, rectangles and a sphere. The form of each structure being dictated by function rather than an overall design. One comparison has been with a set of child's building-blocks abandoned at the end of play. For some, the result lacks coherence and is not visually pleasing: for others it offers a fascinating insight into industrial development on a grand scale. Only in a few can it evoke no reaction at all.

Dounreay's architecture boldly celebrates its engineering functions. In doing so, it preceded the conscious adoption of such an approach within formal architecture. It followed the industrial designs of architects such as Frederick Gibberd at Sizewell A, where monumentality and function are expressed externally with no effort to hide or "prettify".

Perhaps the visually and aesthetically most notable feature of Dounreay is the DFR sphere. The unusual and striking appearance of a very large sphere (135'/41m diameter) in a place where the eye expects to see the conventional lines of "normal" buildings, have made the DFR sphere memorable and recognisable, even if its function and form are not always understood. It is an unusual structure, whose shape and colour (light apple green) ensures that it dominates the site and is a notable local landmark. However, as discussed in Section 2, its design was an engineering response to the perceived need to enclose the DFR within a structure that could physically withstand a blast wave of considerable force following an explosion within the reactor, and/or contain the effects of a fire. An airlocked, spherical, welded steel pressure vessel was, at the time, believed to be the optimum way of achieving this.

The relationship between the layout of the former airfield and the arrangement of the buildings on the site also creates a particular aesthetic quality. The use of the strong lines of the former runways and taxiways to structure the site's internal layout has created a sense of regularity. One particular striking example is the location of the DFR sphere at the end of the one of the airfield's taxiways, which was seemingly used as an access route for construction plant and which then become the site's main access road. As a consequence, the sphere dominates the view from the entrance, creating a vista reminiscent of those in the great landscape parks of the 18th century.

In terms of architectural aesthetics it is clear that a conscious architectural style was applied to the original 1950s buildings within the FCA and administrative area. It is simple, plain, functional and instantly recognisable and essentially ubiquitous on a UK-wide scale. Later buildings, extensions and structures do not follow the stylistic cues of the original buildings and have characteristics that reflect their period of development. There is no dominant "Dounreay" architectural style.

3.3.4 Communal Value

Three aspects require consideration here. Firstly the values associated with the site in terms of the local context; secondly the values associated with it as a part of the UK's nuclear industry and finally the DFR sphere's role in developing the iconic linkages between spherical forms and nuclear technology. These elements are discussed below:

Dounreay and the Local Communities

Dounreay's construction and operation in a remote coastal fringe area of northern Scotland necessitated the transformation of a community, and the construction of a new community. Consequently, Dounreay has acquired social value from its impact over the last half century as a major employer in an area that was previously in economic decline. It was also a social hub to which many people were attached, as employees or as the families and friends of employees. From 1954 the town of Thurso saw relatively large-scale housing developments in order to house the new workers, and school intake was dramatically boosted. The social character of the town was also transformed: sports teams were formed or strengthened, with some people achieving national and international success, and the traditional music scene was invigorated by musicians from other areas. Equally, the relatively high wages received by UKAEA employees cascaded down through the local economy. The social value of the site is thus represented by the impact on the area of the arrival of 'the Atomics' - the nuclear scientists and other staff who came to work at Dounreay.

Dounreay as part of the Nuclear Industry

As a nuclear site, Dounreay has a wide and sometimes challenging symbolism relating to the mix of views and values associated with nuclear power and technology. For some people, i.e. those who remain inspired by the spirit of the age of the white heat of technology[19] this image of nuclear power, and in relation to Dounreay the history of nuclear technology, is positive, a progressive picture of technical development and a way forward for humanity's energy needs. Such people, including some Caithness residents, view past accidents and mistakes as unfortunate: regrettable but inevitable occurrences from which lessons were learned, and view the site's role in the development of fast-breeder technology as a wholly valid approach to the challenge of high cost and scarce supply in relation to fissile uranium. For such people Dounreay is an example of excellence, progress and both local and national pride.

For others, nuclear technology is inherently associated with risk, danger, death and radiation. These social perceptions based on past issues (e.g. Windscale, Three Mile Island and Chernobyl) and current issues relating to long-term waste management and storage can make nuclear sites places of fear and hatred for some people. These inherent issues are intensified at Dounreay due to fuel production capabilities; its location, allegedly "as far as possible from London"; and historic safety management errors such as the release of fuel swarf (particles) to the sea and the explosion incident at the waste "Shaft". For some, these site-related issues are highly illustrative of the inherent dangers and fundamentally unacceptable nature of nuclear power.

DFR Sphere as an image of the nuclear industry

These issues are amplified at Dounreay due to the presence of the DFR sphere. Spherical shapes and the concepts of science & technology and in particular nuclear technology seem to go hand-in-hand in some cultures. For many people and particular those in cultures where there is a history of nuclear technology, spherical forms have come to typify nuclear and scientific institutions; for example the *Atomium* in Brussels (a 1958 expo building with strong science connections) and CERN's new visitor centre which is housed in a partly spherical structure known as the Globe of Science and Innovation[20]. The spherical form was also used as a representation of suspect technologies as the popular representations that have predominated in franchises such as Star Wars (e.g. the Death Star) and James Bond films.

The spherical form reflects the atom and in the early era of nuclear technology was a widely used and recognised symbol; it was also used in the design of nuclear reactors for practical containment reasons as well as perhaps some underlying symbolic reasons. This started at Dounreay with the DFR sphere and was followed by four other fully spherical reactors installations: the prototype AGR at Windscale in the UK, Garigliano in Italy, Big Rock Point in Michigan, USA, and Chinon A1 in France. There are also a large number of partially spherical designs e.g. semi-spheres on top of rectangular buildings. Sizewell B is perhaps the UK's key example of this but other countries used this form as well e.g. Maine Yankee in the USA, Angra dos Reis in Brazil, and Brokdorf in Germany.

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[19] White Heat: At the 1963 Labour Party annual conference, in a speech on the implications of scientific and technological change, Harold Wilson argued that "*the Britain that is going to be forged in the white heat of this revolution will be no place for restrictive practices or for outdated measures on either side of industry*". Although Wilson is commonly misquoted as having spoken of "the white heat of technology" (these were not the words used), the speech struck a lasting chord and, it may be argued, encapsulated the positive spirit of innovation, discovery and progress that characterised the establishment and early work of Dounreay.

[20] http://outreach.web.cern.ch/outreach/en/Globe/Building-en.html

It is the image of a sphere or semi-sphere bisecting the skyline that has come to visually represent the nuclear industry for many people[21][22]. Whilst Dounreay was the first example of the use of a sphere for a reactor there have been more since then. Dounreay has certainly played its role in cementing and developing the already existing representative link between spherical shapes and science / nuclear technology but it is not the reason for that link, nor is the only physical manifestation of the link in the nuclear industry. Currently, in the UK it is probably Sizewell B with its semi-sphere that is the most often used nuclear installation image. The spherical form is, however, instantly recognised and understood by most people and alongside the parabolic curves of the cooling tower is arguably one of the most iconic industrial forms of the 20th century.

3.4 An Alternative View: Change and Creation

3.4.1 Introduction

The preceding sections (3.2 and 3.3) have sought to understand the site in the wider nuclear context and to value the site in terms of a number of defined themes. What follows is an alternative way of thinking about Dounreay; or in fact any other place. *Change and Creation* was originally developed by English Heritage, University College London, Bristol University and Atkins Heritage, to provide a way of addressing the material remains of the later 20th century that did not begin with the question of determining whether somewhere / something was important enough to be designated.

Instead Change and Creation recognised that places, landscapes and sites alter through time. They constantly change and in doing so they create something new. There is never a static 'moment' of history and static preservation is not an inevitable consequence of thinking about the historic nature of a place. Rather places are living landscapes with a trajectory and chronological aspect to their character.

Dounreay is not, therefore, seen a static place, it is a process and cannot be fossilised without losing the very essence of its character and being. This approach recognises that the decommissioning process at Dounreay is simply the most recent chapter in a life that began over half a century ago and which will run for some considerable time to come. In this context Change and Creation does not identify or prioritise 'key' assets or values, but explores a site as a lived landscape through the medium of thematic structures.

At Dounreay, themes that represent particular aspects of the sites' character and sense of being include Movement; Inside and Outside; Communities; and Commemoration.

3.4.2 Movement

People, processes and objects move around the Dounreay site following predictable and sometimes unpredictable paths. These include the day-to-day routine movements of employees: from bus stop to place of work, to smoking shelter, to canteen and back again, in patterns that link places to each other and humanise them. One key pattern of movement that has left a historic imprint on the site was the fuel cycle: from the FCA to the reactor, to the cooling pond and back to the FCA. Another, less immediately evident, was the circulation of water, both steam and condensate, between the reactor heat exchangers and the turbine halls at the DFR and PFR. A third was the work process whereby the site's core operational areas (the reactors, turbine halls and FCA), would

[21] One example of this, noted early in 2008 on the homepage of Yahoo, was the use of a photograph of the DFR Sphere to illustrate a news article about nuclear power in general. Dounreay was not mentioned in the text (and was not relevant to it) and the image was captioned simply as 'a library photograph of a nuclear installation'

[22] See http://www.laka.org/protest/posters/posters.html for examples of anti-nuclear posters that appropriated and re-used the sphere as an instantly recognisable archetype image for the industry

requisition components and consumables from the stores, or commission the manufacture of items in the engineering workshops or glassblowing unit. Time and again the same people would have trodden the same paths, following the task as it moved from place to place.

The decommissioning process has created its own movement cycles and routes, as material is removed and taken for packaging and then decontamination or encapsulation, perhaps passing in the reverse direction over the same route as it did thirty, forty or fifty years before: evidence of this remains in the site's layout and the memories of its people.

3.4.3 Inside and Outside

Dounreay is a bounded site, but its links and pathways tie into a much wider network. Beyond its fences, Dounreay is part of the dynamic growth of Thurso and almost every layer of the town's social and economic existence. Conceptually, the two are linked more closely than the 8 miles distance between the two would suggest. Links reach to nearer and further domestic communities, and include the Boston camp, parts of which remain across the A836 from the site. The stories are those of changing and transient communities, and will continue to be so as the site's life continues. Other links include Dounreay's place in UKAEA's wider network. As part of a number of UKAEA sites and within the international circulation of nuclear knowledge, it also fed technological discoveries into a wider network in areas from theoretical chemistry to welding techniques. Physical networks are also represented. Dounreay fed the National Grid, and a transmission line extends from the site's own substation to a major distribution centre at Beauly.

Inside the fence, the site is in many ways a closed and self-contained community with a different set of rules to the "normal" outside world. Independent emergency services although linked to the national services externally, are equipped and managed to meet site-specific needs. Similarly, the evolution of occupational health services at the site, although linked to community health services outside the site, has had to adapt to a particular set of circumstances. Different networks coexist even within the site, with processes evolving particular routines that appear independent of each other.

3.4.4 Communities

Within Dounreay, distinct communities have developed in specific areas. For example while the DFR and the PFR were both operational there was a spirit of intense friendly competitiveness between the two. Equally, some staff worked for years in one area of the site, rarely encountering others from outside that area (e.g. those working in the FCA); additionally for many employees there were (and remain) parts of the site where they have never been and have no working or social links with. For many employees they stayed where they worked and, unless there is a specific and real need, they did not visit other buildings, a situation that perhaps highlights the significance of the few genuinely shared areas, such as canteens, the Occupational Health Centre and the main offices.

3.4.5 Commemoration

Within a contained institution such as Dounreay, internal events can assume a high level of importance that while perhaps unrecognised elsewhere, are hugely influential within. Examples range from the 'main-event' scale such as the achievement of criticality at a reactor, or the switching off of a reactor, to something more low-key such as the success of a sports team. They are thus often commemorated through physical records or special objects, like the plaques recording the starting up and shutdown of the DFR or trophies recording the success of apprentices. These objects provide both a record of the event-landscape and points of remembrance for employees. They signify broader narratives of successes, and sometimes disasters, often providing otherwise-intangible stories with a physical manifestation.

Over history there had been instances of new working communities being created in remote locations. However, no-one before had attempted the same thing with high-level scientists, engineers and technicians as those involved with Dounreay very well knew. In this respect, it may even be suggested that from the outset, people knew that the Dounreay Experimental Reactor Establishment (DERE) and its community were going to be something unique, different and special. Those involved believed that the project had to be made to work: there was considered to be so much at stake for the government, for the embryonic nuclear industry, and for Caithness. However, achieving that success was hard work, and when it was achieved the feeling was that this should be marked, and once established this practice of “commemoration” remained.

Nowhere is this more evident than the DFR control room where, 33 years after the reactor was shut down, the monitoring instruments still preserve their final readings and the paper rolls are left in place as if waiting for their recorders to be run again. This is an almost sacred place, a shrine to the technological achievement it represented, that was from the point where it became redundant clearly earmarked for retention in the minds of those involved. Why else would a plaque commemorating the shut-down have been carefully affixed to the centre of an array of controls that had just ceased to serve any useful purpose, symmetrically balancing that marking its commissioning?

3.5 A View from the Future

3.5.1 Introduction

All of the preceding discussions were undertaken in the context of current views and understanding of Dounreay. Consequently, it is difficult to predict the long-term perspective that history can bring to bear on understanding the significance of a place. This issue is common to the analysis of all later 20th century sites but is made more difficult at Dounreay by the fact that as a culture there is a closeness to the issues surrounding nuclear technology. Indeed, as this strategy was being prepared, steps are being taken in England and Wales to develop a new generation of nuclear power stations whilst a debate is occurring in Scotland as to whether new nuclear power stations should be developed there at all. This is occurring against a backdrop of ongoing concern about the management and storage of radioactive waste and wider public anxiety relating to the safety of nuclear power and conversely the potential impacts of human induced climate change. This debate is being championed by impassioned advocates on both sides and is as much emotional as it is factual and rational.

These issues affect how people value and judge Dounreay. The following briefly tries to explore how Dounreay may be viewed in the near future i.e. in c.20 or 30 years time. This discussion is understandably speculative and discursive in nature.

3.5.2 Predicting the view from the near future

It is almost certain that over the course of the next 20 or so years, new nuclear power stations will be built across the world and in the UK; and that nuclear power will play an increasing role in managing carbon emissions worldwide. These stations will probably be light or heavy water reactors, with 26 of the 27 reactors currently under construction falling into this category. Long-term issues relating to historic and ongoing waste generation may also be addressed in this timeframe. Assuming that the world avoids another Chernobyl-type incident, public perceptions of nuclear technology may well become more positive and consequently there may be a shift in public attitudes towards our nuclear heritage.

Assuming that the expansion in nuclear power occurs and that public attitudes change, which is by no means guaranteed, would Dounreay be seen in a different light in 20 or 30 years time?

In technological and historical terms Dounreay's importance and value would not have significantly changed. It would still represent a technology that had a minor role in the development of the nuclear industry and it would still represent the basic trend of historic development in the late 20th century. If Fast Breeder technology was widely adopted in the future and the work undertaken at DFR and PFR was shown to have helped develop that technology, then Dounreay's technological and historic significance would be greater.

Only one FBR is currently under construction and the countries that are pursuing the technology (mainly India, China and Japan) are not basing their designs on the DFR or PFR. Given this, Dounreay's technological and historical value is unlikely to be significantly different in the near future. However, the current worldwide Generation IV nuclear reactor project is reviewing and examining six types of nuclear reactors for the period after 2030. Three of the types under review are fast reactors. Of these three, one is a sodium cooled fast reactor which France is leading the early design work on. Should this project develop further then the lessons learnt at DFR and PFR (as well as Phenix and SuperPhenix) and the technology they pioneered will be important. It is, therefore, possible that, in say 30 or 40 years time, DFR and PFR could be seen as early pioneers of one branch of nuclear technology.

It is also possible that by c.2030 or 2040, Dounreay and the wider mid to late 20th century nuclear industry in the UK, will just be seen an example of another British industry that, much like many others, pioneered great technological advances but ultimately failed to sell them to the wider world. The only exception to this in Dounreay's case will be the achievements of the decommissioning team, whose work at Dounreay will by then be a world leading example of the safe clean up of a complex nuclear establishment.

If nuclear power becomes more acceptable and provides a form of safe energy with a low carbon load, then it may become increasingly viewed in a positive light. If this occurs then it is likely that views of Dounreay as a nuclear site and of the role of the DFR sphere as an archetypal image of nuclear power will also shift. Whilst Dounreay has never been the focus of virulent anti-nuclear lobbying, the DFR's spherical shape carries both positive and negative values associated with the nuclear industry. As these become increasingly positive it may be that the sphere will increasingly be seen as a positive image for a technology that is seen as beneficial.

But, will the spherical iconography still be as strong in 20 or 30 years? It is probable that, like current designs, the next round of stations will use rectilinear buildings or domed structures[23] to house their reactors. Given this situation by c.2030 or 2040 it will be 70 or 80 years since a full sphere was constructed to house a nuclear reactor. Is it realistic to expect the media, public and industry to continue to use the sphere as the archetypal image of the industry? More likely another image, perhaps the dome (semi-sphere) or maybe some striking new architectural design will come to visually represent the industry and the spheres will be seen as a stage in the industry's development.

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[23] The new early designs for Hinkley Point seem to include a series of domed reactor buildings – see http://www.bdonline.co.uk/story.asp?storycode=3134866

At a local level, in 15 years or so (assuming that current plans continue) the decommissioning of Dounreay would be relatively complete and it will be relatively quiet. There will still be a security presence and active management of the remaining waste stores, but the hustle and bustle would be long gone. How then will it be viewed? Will we see the slightly sentimental attachment to a golden “Atomic” age – akin to that displayed in some former industrial communities e.g. mining, potteries, steel working, ship manufacturing, or will it be viewed as an increasingly historical event – a period in Caithness’s history when it ceased to be a wholly rural and maritime community? Or will the Pentland Firth become the home to the UK’s next major source of energy and will Dounreay be seen as the predecessor of the Caithness energy industry?

It is almost impossible to predict at the local level how Dounreay will be perceived in the future as there are just too many variables. What is certain, is that there will be some people living in the area who worked on its decommissioning and have memories of taking it down piece-by-piece but few who operated and ran it as a working power plant and research centre. This will ensure that, whatever the outcome for Dounreay, it will be remembered in the local community for at least a few more decades.

3.6 Conclusions

Historically, Dounreay was a pioneer. It was the UK’s only foray into Fast Breeder Reactor technology. A course of action that was undertaken independently from other nuclear nations; consequently Dounreay epitomises the UK’s scientific and technological excellence and innovation during the mid to late 20th century. Many of the buildings and objects on the site are unique and were designed specifically and solely for Dounreay. It is not the product of mass industrialisation and modularisation – it is very much a bespoke place; tailored to fit a very particular need.

As with its construction, its decommissioning is equally scientifically and technologically challenging. The bespoke nature of the site’s construction, the novel technological processes employed and the fact that the design of buildings and facilities tended to evolve as they were built and operated, all pose tremendous challenges to the decommissioning teams. The historic spirit of innovation and technical excellence is very much alive during the site’s decommissioning.

Dounreay’s uniqueness is a direct result of the historical context of its birth in the post-war period. The global politics of this period drove the UK to develop both an independent nuclear energy and an independent nuclear weapons capability. Dounreay is inherently bound into this context and is undoubtedly a child of the post-war period. Its development and decline mirrors the same trends in other early nuclear nations, where concerns about fuel security and independence drove their Fast Breeder programmes.

As a power generation technology, the Fast Breeder concept has yet to enjoy widespread success or usage. Dounreay is entirely atypical of the UK’s, and the world’s, nuclear power generation portfolio. It is no way representative of the UK’s industry, for this we would need to look at Magnox and AGRs, and equally unrepresentative of world-wide reactors which are dominated by various types of light-water reactors, e.g. the PWR technology employed at Sizewell B. As with all but the most recent Fast Breeder Reactors, Dounreay is largely a historical anomaly in the development of nuclear power.

It is, therefore, seemingly surprising that the DFR sphere has been used by the media and anti-nuclear groups to symbolise the nuclear industry. The fully spherical form is a rare type of reactor containment vessel with only five used world-wide. The dome (semi-sphere) and the basic rectangular block, are far more common forms and yet these feature less in the media. The DFR sphere, along with others full spheres such as the

WAGR at Sellafield, has been an archetypal image for the nuclear industry for decades and are as recognisable as a cooling tower, as an image of industrial architecture. Articles in newspapers, on the web and television programmes, still use pictures of now long closed spherical reactors to discuss current issues relating to the industry. How much longer this will continue, is hard to assess and possibly the next round of reactors in the UK, coupled with increasing time, will begin to dissolve this link. However, the link between spheres and nuclear reactors is still embedded in public perceptions, even though no reactors have been built as free standing spheres for over 40 years.

The DFR sphere is the most recognisable structure at Dounreay and forms part of the site's logo and the identity of the wider area. However, its local significance goes far beyond mere visual iconography. Dounreay has transformed the Thurso region of Caithness. The arrival of the "Atomics" and the operation and decommissioning of Dounreay over the last 55 years and for the next 15 or so years, has created wealth, jobs, new social structures and a different way of life in the local area. Dounreay, in its' entirety, is a major element of Caithness's 20th century history.

In summary

Dounreay is not representative of the UK's or worlds nuclear industry, nor is it a particularly important element of the nuclear industry's history. It is instead, a child of the post war era, a place that was designed to address a very particular perceived need at a particular moment in time. Whilst that time has now passed, Dounreay and in particular the DFR, remains an archetypal image for the nuclear industry. As with all archetypes, the imagery is not timeless, but entirely dependent on its cultural context for its continued value. Therefore, for as long as a "sphere" is used by the media, the nuclear industry and anti-nuclear lobby as a symbol, Dounreay will continue to resonate with people as an image of our nuclear world; even though it is in no way representative of that world.

Although Fast Breeder technology was ultimately abandoned by the UK (and mostly elsewhere), Dounreay represents the very highest standards of UK engineering and scientific excellence and the spirit of innovation that characterised the post-war period. Its ongoing decommissioning continues these traditions. Also, Dounreay undoubtedly had a major social and economic impact on the local area and is a highly significant element of the Caithness region's 20th century history.

4. Creating a Cultural Legacy

4.1 International Inspiration

Dounreay is not the only nuclear installation facing the challenge of combining decommissioning and closure with the celebration and conservation of heritage value. The development of this strategy has involved research into and contact with, a number of establishments across the world which are also moving through this process. This section, therefore, outlines what others have achieved and are seeking to achieve, elsewhere.

Over 55 countries now employ, or have employed, nuclear technology in the course of the last 68 years. This has created a legacy of historic nuclear sites. The majority of these sites are in the process of being decommissioned or are being planned for decommissioning and eventual demolition. The majority of the discourse in relation to non-functioning nuclear sites relates to cleaning them up, making them safe and ultimately removing them. This reflects national legislation but perhaps also an underlying cultural nervousness about radiation, accidents and waste. Also with the re-emergence of nuclear power there is an urgency to demonstrate that decommissioning and clean-up can be achieved safely and cost effectively

Aside from the numerous nuclear visitor centres that seek to educate and inform the public about the relative risks and benefits of nuclear power and waste management e.g. Visiatome (France), Ljubljana (Slovenia) and the Sellafield Visitor Centre; there are now some nuclear sites where the discourse has advanced beyond decommissioning and demolition to explore concepts of commemoration, conservation and communication. Examples of these are briefly set out below:

4.1.1 Examples Sites and Initiatives

EBR-1, USA*

This was the first fast breeder reactor to generate electricity. It is a small reactor within a small discrete building. EBR-1 forms part of US Department of Energy's Idaho National Engineering and Environmental Laboratory. This reactor building is conserved and managed by the site operator and a degree of open public access is available[24]; the building includes a number of exhibits. In recent years the site has attracted in the order of 6,000 visitors per annum (open for 5 months a year). Operational and maintenance costs are in the order of $250,000 per annum (source: site curator). The site is designated as a National Historic Landmark on the National Register of Historic Places[25].

Hanford B Reactor, USA*

Hanford B was the first full-scale plutonium production reactor in the world and a key part of the Manhattan Project; it is of international significance. The reactor closed in 1968 although many of its internal features survive[26]. It is also a Historic National Landmark. Hanford B lies within the truly vast Hanford site (c. 1,500 sq km) which is currently undergoing a major long-term decommissioning program. This facility is currently the subject of much debate regarding its future and the nature of any public access. This

[24] Further details can be found at http://www.inl.gov/factsheets/ebr-1.pdf.
[25] See http://www.nps.gov/history/nr/ and http://www.nps.gov/history/nhl/QA.htm for details on the Register and Landmarks
[26] see http://blogs.spectrum.ieee.org/tech_talk/b_reactor-apr05.pdf for a richly illustrated photo essay

issue is being addressed through the US Department of Energy's (DoE) *Manhattan Project Preservation Initiative* (see section 4.1.2 & appendix 5). Currently the wider Hanford site is accessed by a limited number of very strictly controlled public tours. The tours are only open to US citizens and they have to be booked in advance. The tours are predominately bus based but include a walking tour of parts of the Hanford B reactor complex. This arrangement is currently subject to review and no long-term plans for the site have been agreed. Proposals for the reactor complex are diverse and range from maintaining it "as is" and securing public access through to recording the building, collecting artefacts and then entombing it in concrete and steel (this latter approach has been used at other reactors within the wider site).[27]

X-10 Reactor, USA*

X-10 was the first experimental plutonium production reactor and the direct predecessor of Hanford B. It is a small scale facility, similar in size to EBR-1. XP-1 is situated within Oak Ridge National Laboratory which is a major site operated by the Department of Energy. X-10 is the oldest surviving reactor in the world and was designated a historic landmark by the U.S. Department of the Interior in 1966 and by the American Nuclear Society in 1992. It is maintained by the DoE as part of its wider Manhattan Project Initiative. There is limited visitor access to part of building as part of a highly controlled 2.5 hour bus tour that departs from a nearby town. Access is possible for about 3 months a year and visitor numbers are in the order of 2,000 per annum[28].

Chinon A1, France

The distinctive stainless steel spherical shell of the reactor building has been retained with the reactor encased inside. The building has been used to house the Musee de l'Atome, essentially a visitor centre for the remainder of the operational nuclear plant that surrounds the surviving reactor building[29]. This site contains two further closed reactors and 4 operational reactors. It is currently proposed to fully decommission and remove the Chinon A1 reactor and building in c. 2027. Chinon A2 and A3 (also closed) have been more comprehensively decommissioned and are not accessible. They are expected to be fully decommissioned and removed in 2039 and 2044 respectively.

Chicago Pile-1, USA

Nothing physically remains of CP-1, one of the world's earliest and most important reactors. The site is marked with a Henry Moor's sculpture "Nuclear Energy". There is public access to the site and it is designated as a National Historic Landmark.

Nuclear Ship Savannah, USA

This was the world's first nuclear powered merchant ship and it is now a National Historic Landmark. The Savannah operated from 1961 through to 1971. Following cessation of use it was stored until 1981, when it became a museum, this continued until 1994 when repairs and dry-docking were required. Since c.2000 efforts have focussed on decommissioning and it is currently proposed to decommission the vessel by 2028. This would see the reactor and other contaminated materials removed and the superstructure and non-contaminated elements retained. The ship would then be disposed of, most likely by donation to a willing agency or body. A recent options study (2008) also

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[27] Further details can be found at http://www.hanford.gov/ and http://www.atomicheritage.org/ and http://b-reactor.org/.
[28] Further details can found at www.ornl.gov/info/news/cco/graphite.htm, http://www.energy.gov/about/x10graphitereactor.htm and http://www.ornl.gov/ornlhome/visting.shtml
[29] See http://www.edf.fr/html/Emag/ete2005/depliant_musee_atome.pdf and www.franceuc.org/en_sites/cen_chinon_3.htm

identified the possibility of retaining the reactor in-situ; this option is currently being debated[30].

USS Nautilus (SSN571), USA

The Nautilus was the world's first nuclear propelled vessel, of any type. It entered service in 1954 and operated until 1980. In 1982 it was designated a National Historic Landmark. The submarine is still owned and maintained by the US Navy and is displayed at its Submarine Force Museum. The reactor remains intact, but shielded, within the vessel. Given this level of retention and the rapid move from operational service to conserved vessel it is a highly authentic state. Public access is possible into some non-radiological controlled areas of the vessel.

Calder Hall, England

The NDA undertook a series of feasibility studies relating possible options for the long-term conservation and presentation of Calder Hall. Practical and cost considerations ruled out any such approaches and decommissioning continues at the site.

Big Rock Point

Big Rock Point, in Charlevoix, Michigan was a 67-MWe boiling water reactor built in the early 1960s (it achieved criticality in September 1962). The site was the world's first high-power-density boiling water reactor. For the first five years the site focussed on research and development as part of the Atomic Energy Commission's Power Reactor Demonstration Program. This research led to the development of more efficient nuclear fuels for commercial nuclear energy generation. In 1965, it also began producing electricity for commercial use; it was the fifth commercial nuclear power plant in the USA. One of its distinguishing features was the steel spherical containment vessel in which the reactor was housed. This was one of only 5 such spheres (DFR, WAGR, England, Chinon A1, France and the 160ft diameter sphere at Garigliano, Italy, being the other four).

The site operated until 1997 when it was closed down and decommissioning began. The closing down ceremony designed to coincide with the 35th anniversary of the granting of the Site's operating licence. The event was marked by a community celebration and gathering. Since that time the site has been entirely decommissioned and returned to a Greenfield state[31]. No physical remains of the site have been retained. The site is now an open Greenfield site and marked by a small sculptural piece. The completion of the decommissioning process was also marked by another local celebration in 2006.

English Heritage

In 2006, English Heritage published Part 1 of England's Atomic Age: Strategy on the Historic Industrial Environment Report. This initial publication was purely background research on the history and development of nuclear technology in England. It is currently understood that English Heritage will be commencing consultation on Part 2, the actual strategy, some time in the near future. The direction, aims and objectives of this strategy are not currently known.

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30 For further information see www.marad.dot.gov/ships_shipping_landing_page/ ns_savannah_home
31 See http://www.ans.org/pubs/magazines/nn/docs/2006-11-3.pdf, http://www.vqkcom.com/bigrock.html, http://www.consumersenergy.com/welcome.htm?/content/hiermenugrid.aspx?id=299, http://www.michigan.gov/som/0,1607,7-192-29938-159359--,00.html, http://www.consumersenergy.com/uploadedFiles/Environment/BRP_Journey_s%20End%20final.pdf

Belgium and France

Two other European states seem to be at the early stages of developing their approaches to managing and celebrating their nuclear heritage. In Belgium the industrial archaeology association (VVIA) recently organised a seminar on nuclear heritage and is seeking preservation of one of Belgium's reactors. Whilst in France there has been recent industrial heritage publications and Chinon is included on the "*Inventaire general du patrimoine culturel*"; this is a list of sites that offers no legal protection.

To date, no formal measures seem to have been announced and the direction of any future initiatives, should they emerge, is uncertain.

4.1.2 US Department of Energy's Manhattan Project Preservation Initiative and Cold War Preservation Initiative

The most comprehensive of the nuclear conservation, interpretation and commemoration programmes are the US Department of Energy's (DoE) *Manhattan Project Preservation* and *Cold War Preservation Initiatives (http://www.cfo.doe.gov/me70/manhattan/)* (see site's marked with a * in Section 4.1.2). The DoE's initiatives related to the wider US Government scheme called "*Preserve America*" which seeks to promote the protection, enhancement and contemporary use of the historic properties owned by the Federal Government. They also respond to the US National Historic Preservation Act, which requires federal authorities to evaluate the historic significance of their properties to determine their eligibility for inclusion in the National Register of Historic Places. This has to be undertaken before altering or demolishing them.

The DoE's initiatives recognise that the Manhattan Project and some of its Cold War facilities are of historic significance to the USA, and in some instances on a world scale. Through the two programmes, the DoE is seeking to develop a realistic and rational estate-wide (i.e. across all facilities in their care) preservation and interpretation plan for their Manhattan Project and Cold War-era structures and artefacts. This strategic pan-estate approach is a highly distinctive feature of the DoE's approach; this seems to be informing early developments in Belgium, France and England.

Whilst the two initiatives are at differing stages, with the Manhattan project being more advanced, the basic process for each is the same. Firstly, the DoE inventories and evaluates their individual properties. This leads to the development of a list of historic structures and artefacts for each site. Then, based on an estate-wide overview of these lists, the DoE develops a list of "signature facilities" for the Cold War and Manhattan Project Initiative (this is complete for the Manhattan Project). These signature facilities are those that, taken together, provide the core resource for interpreting (in situ or through museums or other interpretive setting) the Manhattan Project and the DoE's Cold War-era role. Once these facilities have been identified an estate-wide preservation and interpretation plan is developed and implemented based on these signature facilities.

The Manhattan Preservation Project Initiative at Hanford

The activities at Hanford are explored in more detail in a paper on the decommissioning of a group of Plutonium Processing Facilities at Hanford (published in 2006). This paper provides an insight into how the initiative operates and what exactly the DoE is seeking to achieve through the project. This is reproduced in Appendix 5 and its key points are summarised below as it reflects many of the challenges and issues facing Dounreay.

The Hanford Site presents the DoE with one of its most substantial challenges. The area is vast, highly contaminated and contains a large number of buildings and objects many of which are of historic significance. As discussed above, the future of some of the buildings (e.g. Hanford B) are also subject to debate and controversy. The entirety of the Hanford Site has been deemed as eligible for listing on the National Register of Historic Places; this places obligations on Federal agencies to mitigate the impacts of their activities – it is not the equivalent of listing or scheduling in Scotland. In this context the DoE developed a programmatic agreement with the relevant external stakeholders. This agreement set out three main commitments:

- That the DoE would prepare a site wide plan to identify important historic buildings and to set out what level of documentation would be required prior to decommissioning and demolition
- That the DoE would produce a detailed and comprehensive history of the Hanford site which would include the documentation of all buildings
- That the DoE would ensure that historic items which could have education or interpretative value would be gathered and maintained in a collection

The first of these commitments was met by a Treatment Plan in 1998, the second by the publication of a book in 2002. The third is addressed through a Curation Strategy for the site which sets out criteria for preservation either by collection or documentation. The agreement did not establish the need to retain and conserve buildings on site as it was recognised that the majority of the affected buildings were too contaminated to safely retain.

In the case of the Plutonium Finishing Plant under discussion in the article (see Appendix 5), it was determined that a number of the buildings were of historic importance and eligible for inclusion on the National Register of Historic Places, but that they were highly contaminated and consequently were to be decommissioned, cleaned and demolished. Consequently, an Interpretative and Curation Plan was developed to support the decommissioning process. This focussed on identifying objects that were still present within the complex which could support the interpretation of the complex and would be of historic significance – these objects included some quite large items. These items were assessed for their significance, their likely contamination and were then identified for further analysis and retention during the decommissioning process. Those that are identified as being safe will be released for display and curation; those are too contaminated will be documented and not released. To date no storage facilities have been identified for those objects.

4.1.3 Observations and lessons for Dounreay

To date only a few reactor complexes have been conserved and all of these are smaller scale facilities. These include the internationally significant X-10, EBR-1 and USS Nautilus. Other reactors and sites such as Chinon 1 have been partially conserved but are still programmed for full decommissioning and demolition (although this may change at Chinon). To date no large complexes have been subject to any significant degree of conservation.

The DoE's initiatives are the most comprehensive in relation to nuclear activity and are addressing the largest sites. They are highly pragmatic and reflect the cultural and legal constraints of the host nation e.g. a less prescriptive approach to designation and management than the UK. The initiatives recognise that whilst many of the buildings and places are undoubtedly of historic significance, the levels of contamination prevent wide scale retention and public access. The initiatives do however, seek to deliver benefits in terms of developing a legacy of knowledge and material that can inform future generations and effectively tell the story of the DoE's role in the Cold War and Manhattan Project.

Issues surrounding the demolition of Hanford B may, force a change in policy and a move towards retention,, however, this remains to be determined.

A number of messages have emerged from the preceding analysis:

- Decisions on conservation and management need to be based on an understanding of a place's significance;
- Contamination levels tend to prevent the retention of large early nuclear complexes where technologies were developed and mistakes made;
- Small and relatively simple reactor complexes and installations can be retained for periods of time, but this has only occurred to date at sites where other nuclear operations are continuing (e.g. Oak Ridge and Chinon). This reflects the need for ongoing monitoring, management and radiological protection measures;
- There are no examples of preserved remains at fully decommissioned sites; and
- Decommissioning should, when appropriate, be accompanied by recording, analysis and object curation to support the interpretation and understanding of a place.

4.2 Addressing Dounreay

4.2.1 Introduction and Approach

Intuitively, it is clear that there is "something" about Dounreay that is worth celebrating, conserving and communicating to future generations. The questions are:

- What should be celebrated?
- How can that be safely and affordably done?

Turning to the first question; what is it about Dounreay that we, as a society, should seek to celebrate, conserve and communicate? Chapter 3 explored the values associated with Dounreay and set out in the conclusion:

Dounreay...represents the very highest standards of UK engineering and scientific excellence and the spirit of innovation that characterised the post-war periods. Its ongoing decommissioning continues these traditions.

Dounreay... undoubtedly had a major social and economic impact on the local area and is a highly significant element of the Caithness's region's 20th and 21st century history.

Dounreay is not representative of the UK's or world's nuclear industry, nor is it a particularly important element of the nuclear industry's history.

Dounreay is...a child of the post war era, a place that was designed to address a very particular perceived need at a particular moment in time.

Dounreay, and in particular the DFR, remains an archetypal image for the nuclear industry...For as long as a "Sphere" is used by the media, nuclear industry and anti-nuclear lobby as a symbol, Dounreay will continue to resonate with people as an image of our nuclear world.

These five broad statements perhaps encapsulate what Dounreay represents; namely:

"*Dounreay is a masterpiece of engineering and scientific excellence which was developed in the post-war social and political climate. Its creation, operation and decommissioning has transformed the Caithness region of Scotland, but ultimately it has not transformed the nuclear industry.*"

This provides a starting point for developing options for a cultural legacy.

Turning to the second question - “how can Dounreay be celebrated, conserved and communicated to future generations?” Approaches are being developed that can address the values associated with the site and, importantly, be delivered in the context of the operational environment (see Introduction) and the contamination (and other) issues facing the site. In this context, the following Sections (4.3, 4.4 and 4.5) explore three broad areas:

- **Physical conservation and retention** of buildings and objects: By retaining, conserving and maintaining buildings and objects it is possible to conserve the numerous values associated with a place and to use the retained objects and / or buildings to communicate the story and values of that place.
- **Retaining evidential material** in the form of archives, records and oral history: Written, photographic, digital and oral history material can all reveal much about a place and provide future generations with the evidence they require to explore that place’s development and history. Retaining this evidential material helps retain the values associated with a place and can form the basis for communicating those values.
- **Communicating and celebrating** Dounreay’s achievements and wider context: Whilst the previous two areas focus on the retention of physical “things” and information, this third element focuses on possible approaches to communicating the story of Dounreay to current and future generations.

The following sections examine these themes and identify a range of options. The approach that will be taken by DSRL is outlined in Chapter 5.

4.3 Physical Conservation and Retention

4.3.1 Approach

Ideally, decisions relating to physical conservation and retention would be based almost entirely on a place’s values. In Dounreay’s case this would relate to keeping objects and buildings that embody its scientific and technical excellence, help tell the story of its development in post-war society and relate to its social and economic effect on the region. However, due to the contaminated nature of the site and the poor structural condition of many buildings this is simply not possible.

4.3.2 General Effects of Contamination

Contamination is a fundamental issue at Dounreay and one that has a major impact on what is and what is not achievable on the site. In broad terms, the hazards caused by radioactive contamination depend on the nature of the contamination and its level and spread. Low levels of radioactive contamination pose limited risk, but can still be detected by instrumentation. In the case of low level contamination by isotopes with a short half-life, the best course of action is often to allow the material to naturally decay. However, longer-lived isotopes need to be cleaned-up and properly disposed of, because even a very low level of radiation can be hazardous through long-term exposure.

In the case of high levels of contamination (regardless of half-life) there are significant risks to humans and the environment. People can be exposed to potentially lethal radiation levels, both externally and internally, from sources involving large quantities of radioactive material mainly inside specialised buildings.

Given Dounreay’s experimental mission and its development and operation over a considerable period there are significant issues relating to radioactive contamination across the site – in buildings and to a lesser extent outwith buildings. These mean that it is not always possible to safely retain an object or structure. In this context, it is clear that the complete retention of either objects or structures cannot be achieved and that a pragmatic approach will be taken to the retention of items of potential heritage significance.

Extra work activities undertaken to preserve facilities or items, will have to be justified from a risk viewpoint e.g. increased risks to health from industrial safety hazards, radiation dose or harmful substances etc. Where radioactive contamination is an issue, there is the added risk that despite best endeavours to clean up the facility / item and checking that it is free of all contamination, people may still be subject to a radiation dose above background levels. This may be through the process where absorbed radionuclides in steels slowly migrate back to the surface, or surface cracks in metal expand to release trapped contamination. As well as the public health issues, the associated public relation consequences would be very damaging to the industry. These serious concerns mean that DSRL and the NDA have a duty of care when deciding to preserve items that are known to be or have the potential to be, activated or contaminated, due to past work activities.

There are also issues in relation to asbestos. As most of Dounreay's facilities were built in the 1950s and 60s, many have some form of asbestos in their cladding structure or pipework lagging. Those with asbestos in their fabric or main structure are not suitable for retention as the removal of the hazard (in accordance with requirements) will leave little of the original building behind.

Additionally, many facilities were built using a design of mild steel frames with sheeted cladding bolted on. A combination of moist sea air, high winds, rain, snow and poor sealing has resulted in substantial corrosion to some building frames. Consequentially these facilities are difficult to retain.

The implications of all of this are examined in the following sections, in relation to the structures on the site and also in relation to the material culture / objects within the site.

4.3.3 Issues associated with buildings and structures

A subjective analysis of each structure on the site (304 in total) in relation to whether they could be decontaminated to safe levels and retained has been undertaken by the DSRL Heritage Officer. Alongside this, the analysis also explored whether buildings had current structural issues or would have structural issues following decontamination. In some cases the works required to decontaminate a building, make safe retention unviable i.e. the decontamination process itself can require the removal of significant amounts of building fabric and hence can compromise the structural integrity of the building.

Appendix 6 contains a tabulated breakdown of the results of that analysis. Appendix 7 looks at the DFR in more detail.

The following summarises the outcomes of this analysis.

Contamination Issues in relation to all buildings

		No. of Buildings - % of total	
Category	**Contamination Issues**		
A	100% decontamination not feasible	28	9.2%
B	Decontamination possible but costly	9	3.0%
C	Decontamination possible at reasonable cost	41	13.5%
D	No contamination issues	226	74.3%

Structural Issues in relation to all buildings

		No. of Buildings - % of total	
Category	Structural Issues		
E	Major structural issues, demolition required	58	19.1%
F	Retention feasible with major cost	5	1.6%
G	Structural issues but can be addressed with reasonable cost	27	8.9%
H	No significant structural issues	214	70.4%

An initial review of these results would seem to indicate that the majority of Dounreay's buildings could, in terms of contamination and structural issues, be retained. However, there are a number of underlying issues that need to be taken into account when examining the above figures.

135 of the above 304 structures are temporary structures ranging from modern smoking shelters through to temporary offices and stores; these are of negligible historic interest and their design means that they are unlikely to survive in a safe condition. Consequently, they are not suitable candidates for long-term retention.

PFR

A significant degree of decommissioning and decontamination has already occurred at the PFR complex with the clearing out of the steam turbine hall and removal of associated infrastructure along with ongoing decommissioning of the main reactor hall. However, much of the reactor infrastructure currently remains in place; although it is scheduled for decommissioning and demolition as part of the requirement to make the site safe.

Whilst contamination is an issue, the most significant problems with PFR relate to structural issues with the concrete panels that were used to build the reactor hall and buffer store facilities. These are suffering rapid deterioration and are crumbling in many places. This process will continue and by the IEP it is anticipated that the panels will be in a critical condition. Consequently, the retention of the PFR would require the re-cladding of the structure. The costs for this would be very substantial.

The estimated cost to decontaminate and demolish the PFR complex is approximately £339M. The tasks are split as follows:

Task	Cost Estimate (to 2025) £k
programme management	£25,672
building services	£66,236
reactor hall - sodium removal	£31,848
reactor hall - reactor dismantling	£76,741
reactor hall - decontamination area	£18,256
reactor hall area - auxilliary	£40,578
irradiated Fuel Cave & buffer store	£28,281
irradiated Fuel Store facility	£23,293
turbine hall	£10,051
ancillary buildings	£17,723
Total	**£338,679k**

Since PFR's reactor is housed in the bedrock and not in a freestanding structure, it is perhaps technically feasible to consider retaining it, even though PFR's main superstructure and associated equipment would need to be removed for structural reasons and also to remove contamination. The retention of the reactor would, however, conserve little additional cultural value as nearly all the authenticity and integrity of the PFR complex would have been denuded and the reactor would not be visible or accessible. Additionally, any such proposal would require detailed feasibility study and safety case testing with the NDA and Health & Safety Executive, as it would not reflect standard practice in the UK and may be contrary to legal requirements. This is, therefore, not considered a feasible or desirable option.

FCA

The vast majority of the facilities in the Fuel Cycle Area (FCA) are contaminated due to the experimental nature of the work carried out in them. Consequently, their decontamination and decommissioning will be a highly intensive process requiring removal of fabric, fixtures and fittings and final demolition. This situation is exacerbated because the ground around the FCA buildings is contaminated to varying degrees and it is known that this has spread underneath some facilities. Characterisation of the ground underneath all of the FCA facilities, including the DMTR, has yet to be undertaken, but the risk of contamination is high. Dealing with this contamination means that all facilities in the FCA must be demolished, volumes of higher contamination excavated and subsequently voids filled and the area capped by up to a 2m high layer of soil and rocks, to manage residual contamination in-situ.

The current estimate to decommission the FCA facilities, excluding DMTR but including the 2m capping layer, is approximately £388M and is split into the following activities;

Task	**Cost Estimate (to 2025) £k**
programme management	£30,536
fuel buildings	£119,198
reprocessing plants	£43,374
cells and labs	£52,485
support facilities	£129,922
capping and remediation	£12,297
Total	**£387,812k**

The FCA was a key element of the Dounreay complex and a critical part of the site's fuel re-cycling capability, which was central to its purpose and reason for development. Without the FCA, the DFR and PFR would not have operated. The contaminated state of the complex does, however, mean that it will be demolished and capped and consequently material evidence of the structures will be lost. This also means that it will not be possible to retain the physical remains of the entire technological process that occurred at Dounreay.

DMTR

The Dounreay Materials Testing Reactor (DMTR) building is contaminated throughout. The current proposals would see the decontamination of the structure to allow its safe dismantling, removal of all operational elements including the reactor and control room, demolition of the main structure and the treatment and disposal of the subsequent waste. The estimated cost to decontaminate and demolish the structure is approximately £11.6M at current prices.

It is potentially feasible to retain the outer shell of the DMTR, following complete decontamination. However, as described in section 4.3.2, despite the most rigorous decontamination efforts, the risk of receiving a radiation dose may never go away.

As for DFR, the justification for preserving an empty shell is weak, and how well the structure can be decontaminated is unknown. Work to fully characterise the ground around and underneath the DMTR has not yet been undertaken, but it is known that the ground around adjacent facilities is contaminated. Early indications are, that contamination around and underneath DMTR is present at levels which exceed the environmental regulations, and it is planned to dismantle the facility. The adjacent DMTR support plants are also contaminated and contain asbestos and an extensive programme of decontamination and demolition is also planned

DFR

In terms of DFR, the following tasks will have to be undertaken to eliminate the major hazards and satisfy the NDA's mandated aim of reducing the UK's nuclear liability:

- Removing and passivating the bulk volume of primary circuit coolant (sodium-potassium (NaK) alloy);
- Removing and packaging the breeder elements and 1 fuel cluster assembly that currently remain in the reactor vessel;
- Removing and passivating the NaK residues located in the primary circuits after the bulk NaK is removed;
- Decommissioning the fuel storage pond;
- Cleaning NaK wetted items currently in storage, including cleaning & removing the underground NaK storage vessels; and
- Removing the primary circuit vessels and pipe work located in the reactor vault.

These essential tasks will result in the removal of significant elements of the workings of DFR, including the reactor and associated plant. These form a key part of the building's significance.

In addition to the above there are further tasks that are required (see Appendix 7 for more details):

- Removing the plant items and systems in the sphere that surround the reactor vault;
- Decontaminating the sphere shell and any other remaining plant such as the Goliath crane
- Decommissioning the ancillary buildings.

The DFR sphere is contaminated throughout and recent core samples from the vault indicate that the concrete has deteriorated more than anticipated and that original construction techniques may have been lax in some areas e.g. use of rounded rather than angular aggregate. As described in section 4.3.2, despite the most rigorous decontamination efforts, the risk of receiving a significant radiation dose may never go away.

It has been reluctantly concluded that factors such as hazards from radiological contamination, restrictions on land use and the technical and economic requirements of decommissioning outweigh the arguments for retention of the sphere, and the long-range decommissioning plans will be amended to include provision for its dismantling. Retention of the DFR sphere would not deliver significant benefits on a local or national scale and greater public benefit can be achieved through other measures.

The retention of the sphere would create a symbol of Dounreay's transformative effect on the local region. However, the evidential value of the structure would be much reduced (even with maximum retention of items such as the Goliath crane) and it would only partly reflect the scientific and engineering excellence of Dounreay and the workings of a Fast Breeder reactor. In essence, the process would create a "shell" both literately and figuratively, with both the central physical asset and its core values removed. Should the concrete vault prove not to be retainable then all that would remain would be the outer shell; this would almost entirely remove its evidential and technological value.

Another significant issue relates to whether it is possible, or desirable, to fund the required care & maintenance costs to maintain the sphere in good condition, given that much of building's authenticity, integrity and hence cultural value would be denuded by the process of decontamination, decommissioning and partial demolition.

Other buildings on site

Some of the permanent buildings on the site can technically be retained as they are either clean buildings with no structural issues, clean buildings with addressable structural issues or buildings capable of being easily decontaminated and with no or limited structural issues (see Figure 5). These buildings include the Main Administration Offices, Fire Brigade Station & Environmental Laboratories, Main workshops & stores, Craig More House [ex-design office] and sub-stations. These buildings are generally well constructed and were not directly involved in the handling or processing of nuclear materials. They encompass many of the essential support functions that enabled Dounreay to operate and include one or two unique elements such as the graphite loading facility for Dounreay's unique and now retired Graphex fire engines.

The following buildings are planned to be in use beyond the IEP (see Figure 6):

- Conditioned ILW store, including Import Export Facility
- Police Command and Control Building

These buildings will remain until all the conditioned ILW, spent fuel and Special Nuclear Material (SNM) is transferred off-site, currently assumed to be in the period 2050-2076. Once emptied, the stores will be decommissioned and all buildings demolished by 2078.

Aside from the buildings that will continue in use through to c.2078, the administrative buildings are probably the easiest to reuse and retain, even though many of them will be 75 years old by 2025. The non-specialised form of the buildings makes them suitable for conversion and re-use as offices, studios etc. It may also be possible to identify some light industry / storage uses for the Main Workshops and Stores. The Occupational Health Centre and Fire Station are relatively unsuitable for adaptive reuse without extensive conversion works that would seriously compromise their historic and evidential value. There may also be issues with their fabric when the IEP is reached. The sub-stations could continue in use (if needed) but do not have potential for re-use.

Whilst the current focus for regeneration activity is on delivering regional programmes rather than site-specific outcomes, some of Dounreay's buildings do have the potential for future industrial and commercial uses. However, only limited areas of the site are likely to be de-licensed and released prior to 2300, significantly reducing the potential for alternative uses and there is also unlikely to be a substantial market for such uses in the area. It is therefore, unlikely that business and commercial re-use of the buildings and spaces on the site will be a significant aspect of Dounreay's future beyond the IEP. This means that it is improbable that many of the buildings could be retained in working condition beyond the IEP and consequently all buildings not required for waste storage and security roles beyond the IEP will, under the current proposals, be demolished.

4.3.4 Buildings and structures: conclusions

As set out in Section 4.2, no large scale nuclear complex anywhere in the world has been conserved in its entirety. Common issues such as contamination, safety, regulatory restrictions, government strategy and policy, security and cost, have prevented this occurring. The decommissioning of Dounreay will not change this trend. Significant issues relating to contamination and poor structural integrity mean that many of Dounreay's important buildings and complexes will need to be decontaminated and demolished to ensure the future safe remediation of the site.

It is theoretically possible to retain a number of buildings (see Figure 6) and these include a range of support facilities such as:

- Main Administration Offices and associated buildings
- Craig More House (ex design office)
- Main workshops
- Main Stores
- Fire Brigade Station & Environmental Laboratories
- Sub stations
- Waste stores (planned for retention until 2078)
- Security facilities (only those required beyond the IEP)

Additionally, while it is possible to retain parts of the DFR and DMTR complex the decision has been made to carry out NDA's primary mission of decommissioning the site and, therefore, all non-essential buildings will be demolished. In the case of DFR and DMTR the majority of the significant elements such as the reactors, cooling pipe work, turbine halls etc have or will have to be removed. This significantly reduces the cultural value of these structures. The main factor for dismantling is the fact that radiological risk will still be present after practicable decontamination efforts.

While it is recognised that it would be possible to retain a small sample of the site's buildings (see Figure 6) NDA/DSRL have come to the conclusion that this will not add value to capturing the heritage of the site. The retention of these buildings would conserve evidence of daily non-reactor based activity and limited evidence of reactor operation and management.

4.3.5 Objects (Material Culture)

Overview

Contamination is a significant issue in terms of whether it is possible to retain or re-use objects and other items of material culture. Clearly, radioactive contamination will significantly limit the possibility of retaining artefacts that have come into close contact with radioactive material. This includes objects related to the storage and handling of fuel rods or other fissile material, many objects associated with waste management and processing and items used for the maintenance of reactor assemblies.

However, items of personal ephemera, archival and documentary material, unused demonstration pieces and models, and much of the day-to-day machinery and objects used on the site will either be entirely free of contamination or any contamination will be at levels low enough to enable them to be easily cleaned.

Very careful decisions on the retention and re-use of objects on the site will need to be taken on a case-by-case basis depending to a large degree on the viability of cleaning them to an acceptable level. DSRL and the NDA must comply with regulatory and legislative requirements.

The Manhattan Preservation Initiative and Dounreay

This issue has also been faced by the Manhattan Preservation Initiative in the USA (see section 4.1.2 and Appendix 5). Here they have developed a system for identifying objects of historic significance, assessing whether they are likely to be contaminated, ensuring that they undergo appropriate levels of testing and that they are then either collected and curated or recorded. This process has been designed to create a curated collection supported by an evidential archive that will enable the interpretation of the sites, either through on-site or off-site means.

Aside from the issues relating to contamination, consideration was given to what should be collected, how it will be curated and stored and where it could eventually be displayed. Looking at these issues in turn:

What should be collected?

Not everything can or should be collected. It is important that object collection is undertaken in a clear and structured way with clearly defined objectives. In the case of Dounreay there are three broad themes that will be used to structure a future collection initiative:

- **Significance and Value**: Is the object of importance in terms of understanding and representing the values associated with Dounreay? See Section 3 and discussion in Section 4.2.1. Is it typical of a particular process, or the result of a notable event that relates to the site's values or place in history? Examples of these types of objects could include everything from plaques commemorating events, through to reactor components and even control rooms.
- **Supporting Future Research**: It is difficult to predict what future generations might consider to be of interest at Dounreay and hence what they may wish to study. It is impossible to conserve all information and material that future generations may want to access, but it is possible to retain a strong representative sample and particular targeted elements. In this context, types of items that may be of significance to future researchers and hence worth collecting, include;
    - selected components from the three reactors (to demonstrate variance and adaptation from blueprinted and documented designs);
    - items of ancillary equipment related to the development and operation of the DFR, PFR and DMTR (which reflect the experimental nature of the facilities);
    - items developed in the course of the decommissioning process to address unique or unusual challenges, some of which may well not yet have been conceived, let alone manufactured;
    - equipment developed specifically for use in the nuclear sector which required its operators to develop a high level of what were essentially manual craft skills.

  This theme is discussed further in Appendix 9.
- **Enabling Interpretation**: Interpretation and education provide the mechanism for the transmission of understanding about a place and the influence of that place upon our world. Dounreay has a number of unusual stories associated with it that could form the base for its future interpretation and for the development of educational programmes. These are discussed in Appendix 10 and include: The Fast-Breeder Experiment; The Creation of a New Community; and Decommissioning Dounreay. The collection of material that authentically illustrates

these themes and provides supporting information for their interpretation will be a key strand of any future anthology.

How will it be curated and stored?

The answers to this question depend on a number of factors including:

- **What quantity of material will be collected?** This will significantly affect the scale of facilities required and requirements could range from a small office (as per the current arrangements) through to a large dedicated storage facility with the necessary climate and security features.
- **What types of material will be collected?** Potential items for collection range from small personal objects through to demonstrative reactor fuel rods or the Graphex fire engines or even full-scale (decontaminated) 90 tonne charge flasks. Clearly, these would require different facilities and different collection outcomes.
- **Who will curate the material in the short and long-term?** A collection for Dounreay and housed at Dounreay, would reach very few people. It is clear that external partnerships with museums and other heritage bodies need to be developed and maintained in order to interpret, store and preserve the material. Between now and the IEP this will occur on-site, but beyond that there will need to be off-site curation and storage facilities near to the responsible body.

These questions have allowed DSRL to develop the activities for the long-term management and collection of Dounreay's material culture.

Caithness Horizons is an example of a facility which provides an avenue for the interpretation, storage and preservation of the material relating to the social and economic history of Dounreay. NMS offers another potential route. There could also be an on-site display/interpretative facility but this would have limited access to members of the public and would, therefore, only benefit staff working on the site. These issues are discussed in more detail in Section 4.5. The nature of future displays will influence what is collected, where it is stored and who manages it. It is envisaged that the proposed National Nuclear Archive due to be built in Wick, will not store artefacts, only records, documents and images etc.

Conclusions and possible options

It is technically feasible and desirable to develop and curate a diverse collection of material from Dounreay. This will be undertaken in a structured and cautious manner to ensure that health risks are minimised to safe and acceptable levels. This may mean that many important items are not released but instead recorded and catalogued prior to being treated as waste; in these cases at least some evidence would be retained.

Where objects can be safely collected, decisions will be taken about the scale and focus of such a collection. Given the interest in Dounreay, its historic significance in terms of the post-war decades and the 20th century history of Scotland, these decisions will be made in partnership with National Museums Scotland (NMS) and Caithness Horizons.

The Heritage Officer will work with these organisations in order to develop their collections relating to Dounreay, in accordance with their Acquisition and Disposal Policies. The actual process of identification and collection will be integrated into the decommissioning process to prevent unplanned loss of important objects. The Manhattan Project Preservation Initiative (see Appendix 5) is one example of how this can work.

If a moderate amount of material is gathered then it may be possible to store this on-site in existing buildings, before being relocated to other museum stores. The additional cost to Dounreay of implementing such a policy would be minimal in the context of the overall site budget. If room in a building is not available, then collected material will need to be moved to suitable stores operated and managed by partner organisations. Ultimately, all collected material will need to be housed in stores owned and operated by external partners, as none can be held on site beyond the IEP and DSRL/NDA do not have other facilities available for storage.

In summary, developing a representative, illustrative and historically valuable collection of objects will be progressed at Dounreay in partnership with Caithness Horizons and NMS. There will be ongoing issues relating to radiological hazards associated with such a collection, which will ultimately limit its scope and breadth. The key decisions in relation to opportunities, concern the scale of collection and its ultimate home. The proposed National Nuclear Archive will only store records and documents to meet statutory requirements.

4.4 Evidential Material

4.4.1 Introduction

Evidential material in the form of archives, records and oral history can reveal much about a place and provide future generations with the evidence they require to explore that place’s development and history. It can also support the interpretation of a place and provide material necessary to tell its story to current and future generations. This material can also help retain some of the values associated with a place. Developing a robust and broad ranging body of evidential material for Dounreay can, therefore, make a significant contribution to its cultural legacy; particularly given the fact that many of the buildings and objects will not be retained due to contamination, hence the evidential material will in many cases be the sole source of information on a given building, object, event or process. This has been recognised by the Manhattan Project Initiative which is collating a robust body of evidence alongside the building and object preservation activities.

Dounreay has already begun the process of developing a collection of evidential material; indeed documenting process events, buildings, modifications, etc is an inherent part of on-site activity. This material will be invaluable to future generations.

4.4.2 Site Archive

Dounreay has a substantial archive of material that is growing as work progresses at the site (see Section 2.4). This archive has been developed in the main to satisfy statutory requirements and consequently is predominately focussed on technical material, and material relating to decisions and key events. Some of the records would probably serve as an element of a broader historical archive. Therefore, the Site Records Office procedure will be modified to include guidance to reviewers about retaining records that have cultural heritage significance.

Whilst access to the site archive is currently restricted, due to its location within the licensed site and its content, the NDA is committed to developing a National Nuclear Archive in Wick. The deposition of the Dounreay Site Archive into this repository will offer a valuable resource for future generations of researchers, historians and the wider public.

4.4.3 Oral History Programme

Dounreay has already started to capture some oral history. This is currently focussed on the early part of the site’s history. This will be developed and expanded to address the whole life of Dounreay, including its ongoing decommissioning and not just its early history would provide a valuable social archive. It should be noted that by the IEP many people at the site would have only worked on taking Dounreay apart; their stories are as important as the stories of those who were responsible for building and operating Dounreay. This expanded programme will also supply valuable material for any future exhibitions, publications or events.

4.4.4 Building and Object Recording

As noted above, the decision has been taken to demolish the buildings and some projects at Dounreay cannot be retained for future research, display or access. Developing a robust body of evidence is, therefore, critical in terms of providing information on these items. It is also important in terms of documenting the development and decommissioning of the site.

A significant amount of building recording work is already undertaken as part of the decommissioning process. This includes photographic records, written records and video material. This material is gathered by individual decommissioning teams and then stored centrally once work is complete.

There is no set format or structure for this information and no single adopted methodology for survey and recording. Consequently, data capture varies across the site. Given the potential significance of these records a robust recording and reporting mechanism for buildings and objects on the site will be developed.

4.4.5 Funded Academic Study

Detailed academic study of the site has the potential to reveal new insights into its social history, development, impact on the region and international status. This type of work can provide new evidence and understanding to inform future generations and interpretation initiatives.

There are a range of possible academic research themes and a number of ways that such research can be developed and delivered. One approach would be an independent “Change and Creation” study of the site’s historic development and decommissioning from 1954 to the IEP. This form of study could be led and managed by a university department and funded through a PhD.

Another approach would be to develop partnership links with colleges and university departments to develop more locally based smaller scale research projects on particular aspects of the site. Although these would not be at PhD level they could still provide some useful material. Funding would have to be identified from academic sources.

4.4.6 Conclusions

It is technically feasible to develop a robust body of evidence relating to Dounreay’s development, operation and decommissioning. The costs involved in doing so are largely embedded within the current LTP and there is an on-site culture of data collection and management already established that will inherently assist the process. Funding for other studies would have to be identified from academic sources.

4.5 Communication, Commemoration and Celebration

4.5.1 Overview

The previous two sections (4.3 and 4.4) focussed on the retention of physical “things” and information, this third element focuses on possible approaches to communicating the story of Dounreay to current and future generations. Four broad areas have been identified for discussion in regard to communicating, commemorating and celebrating the story of Dounreay:

- Academic / Technical Conference
- Disseminated Material
- Public Display and Access
- Commemoration

4.5.2 Academic / Technical Conference

When considering the overall heritage strategy, a possibility was suggested to stage a conference relating to nuclear heritage and its management. This is a subject area that is beginning to attract attention worldwide (see Section 4.1) as the issues associated with decommissioning nuclear sites move from solely technical challenges into the broader arena of cultural value. This form of multi-day conference has the potential to attract speakers and guests from across the world and could focus attention on Dounreay as an example of managing heritage through the decommissioning process.

The costs associated with such an event are difficult to assess and are entirely dependent of the scale of the event. Such an event would need to involve a range of organisations and would best be led by an organisation with experience of such an international event. UK stakeholders and key funders could include Historic Scotland, English Heritage, Cadw (Wales), Institution of Civil Engineers (ICE) and major contractors in the industry; internationally the Department of Energy in the USA, the International Atomic Energy Authority (IAEA), ministerial and departmental bodies in any country with a nuclear estate and private operators may all be interested.

After advice from external organisations, it is believed that a large-scale conference would need to be hosted in a major metropolitan centre to ensure the availability of adequate facilities and accessibility for those attending. However, it is possible that this or a fringe event could be held in Caithness. This would bring economic benefit to the local economy and link in with the wider tourism aspirations of the Caithness & North Sutherland Regeneration Partnership.

If such a conference was successful and if demand was demonstrated, then it could form the basis for a series of academic/technical conferences relating to the history, operation and decommissioning of nuclear heritage sites. The conferences could explore different themes in inter-related sessions and seek to develop a cross-discipline understanding of the wider nuclear industry and its heritage. This would represent a major scaling up of the conference approach and would incur significant additional costs.

It is not possible to accurately estimate costs for the conference, as it is difficult to gauge the scale of such an event. However, it is considered prudent for any organising body to allow a budget of c.£100,000[32] to facilitate the event in addition to the cost of a full time Conference Officer who would develop the conference over a 3 to 4 year period and funding would need to be sourced from external bodies.

[32] This is a broad estimate of c.£300/head for a 300 person conference with a10% contingency. Also see http://goanna.cs.rmit.edu.au/~jz/conferences/runaconf.pdf for a broad ranging article on academic conference organisation

4.5.3 Disseminated Material

One well established and successful approach to communicating and celebrating a place or an event is to create and disseminate prepared material. This is in the form of published material and/or through on-line/virtual routes.

Publications

The recent successful publication of *Fifty Years of Dounreay and Fae Fields to Fuel - Caithness life before & after Dounreay,* plus two earlier publications relating to the history of the site, demonstrate interest for material relating to Dounreay. This has the potential to expand through the preparation of further academic and technical books and other materials, as well as publications aimed at the more general reader rather than just the specialist.

The publication programme would need to be integrated into other components, e.g. conference proceedings, the results of the change and creation work or a book-based version of the virtual material. The oral history programme would also be published in some form.

Online / Virtual Material

The internet provides an opportunity to disseminate information relating to Dounreay to a diverse range of technical and non-specialist audiences. The Dounreay website has already started this process but further development is recognised. This approach has already begun in the oil & gas sector, with existing virtual resources being developed for gas and oil fields in the North Sea[33]. Another example is the 50^{th} anniversary website for BR-1, Belgium's first and still operating reactor[34].

These virtual resources are currently relatively academic and technical in nature but offer some pointers as to the development of a possible "Dounreay Interpretation Portal".

The aim would be to create a resource through which visitors could explore the processes, functions and historic development of Dounreay. This could include access to virtual reconstructions, archival material and publication standard text. Up to the IEP, this can be developed from the existing Dounreay website and would supplement the body of material that is already lodged on that website e.g. the fact sheets, photo galleries and video galleries all of which contain extensive information about Dounreay's past, current activities and future plans.

4.5.4 Public Display and Access

There is something truly remarkable about encountering a place or an object in its raw authentic form. There is simply no substitute for that face-to-face immediacy of contact. In this context, opportunities for enabling physical engagement with Dounreay and its material culture need to be examined and where possible pursued.

However, as discussed in the introduction (Section 1.6), security requirements mean that the licensed site at Dounreay is not, and cannot be, open to the general public before or after the IEP. Beyond then it *may* be possible to deliver access to some parts of the licensed site in a highly controlled and limited manner. However, it will not be possible to enable any significant level of public access to licensed areas within the site. This

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[33] See the following websites for examples: www.abdn.ac.uk/historic/energyarchive/ - www.kulturminne-ekofisk.no/ - www.kulturminne-frigg.no/ - http://www.capturing-the-energy.org.uk/
[34] http://www.sckcen.be/BR1/EN/index.shtml

situation will continue up to at least 2078 and possibly to 2300. Any access after the IEP would need to be strictly controlled and subject to ever increasing security screening and controls.

Given this constraint, all on-site interpretative approaches requiring public access to Dounreay, have been discounted by the project team due to the fact that they could not be guaranteed. During the development of the strategy, a number of possible ways to delivering on-site interpretation were explored as part of the background work and options development. Whilst all of these have been discounted they are briefly discussed In Appendix 11 for completeness.

Given the security issues, the following, therefore, examined off-site approaches to display and access that could be delivered before or after the IEP. Any of these options could be delivered alongside the retention and continued updating of the display boards that are situated just outside the current fence line by the site of the former control tower / visitor centre. These boards were developed and installed by DSRL and provide visitors with an overview of the site.

Off-site Opportunities

Until 2007, Dounreay operated a small visitor centre within the former WW-II airfield control tower. This was closed in 2007 and demolished due to storm damage and poor condition. Following this, the then site operator, UK Atomic Energy Authority, and the NDA, provided £500,000 of funding to support the Caithness Horizons project in Thurso. Caithness Horizons is a regionally important museum in the North of Scotland which opened to the public on 1st December 2008. It has a permanent exhibition which tells the story of Dounreay and explores its social and economic impact on Caithness and North Sutherland as well as describing the significance of its scientific and technical achievements. This is currently the primary off-site interpretation resource for Dounreay. DSRL also has a public information office in Thurso, Dounreay.com, which presents and displays information about the site's current activities. Dounreay.com and Caithness Horizons work together closely.

In its first year of operation, Caithness Horizons had 92,000 visitors (not unique visitors) this figure includes educational visits, repeat visits by local residents and community groups and visits by tourists**.** This is over 10 times the c.9,000 visits per annum that the former Dounreay visitor centre received. As set out in Appendix 12, these numbers make it by far the most visited attraction in the Caithness region. Caithness Horizons also provides a wide ranging programme of lifelong learning activities through which Dounreay's legacy is being explored.

The next significant step up from a local exhibition, would be a national exhibition (or exhibitions) examining Dounreay's experimental history, social history and the technical aspects of decommissioning (see Appendix 9 for an outline of possible interpretative themes for such an exhibition). These exhibitions can be housed in a gallery at a major museum or as part of a temporary display (e.g. travelling or touring). The exhibitions would allow far larger visitor numbers to encounter Dounreay and learn about its story. They could also provide a major educational venue for primary, secondary and tertiary levels.

One approach in this context would be the development of a gallery at a major museum in Scotland. This gallery would tell the full story of Dounreay and be cross linked and referenced to Caithness Horizons, to encourage visitors to head north or even just to raise awareness of what the region has to offer. The development of a gallery in a major city centre museum would certainly enable large numbers of people to visit the exhibition and engage with Dounreay's story. Another similar and perhaps more realistic option for the national or UK scale, would be the development of a Nuclear Energy / Technology Gallery which presented the story of the nuclear industry in Scotland or the UK. Dounreay would certainly have its place in this gallery and the objects collected on site (see Section 4.3) would be important to this or the Dounreay gallery.

In terms of cost estimates, the size, location and quality of any gallery are critical considerations. Assuming a 500m^2 space as a starting point (this is sizable and a smaller space maybe more appropriate) costs have been estimated at £3,000m^2 for fit out, plus all fees and VAT etc. The quality of fit-out would be high; but not world class. It is assumed that the gallery would be sited in a suitable building in a city centre location and that consequently conversion costs would be kept low e.g. c.£2,000 / m^2 exc VAT and fees. The total cost for a large permanent gallery in an established building would, therefore, be c. £3.4million including fees but exc VAT. This is a significant capital cost. It could be engineered down through the provision of a building not requiring much conversion and through a scaling back of the size and / or quality of the exhibition.

Another approach would be to establish a touring or temporary exhibition. The exact scale and size (and hence cost) would need to be determined following extensive consultation with possible host organisations. This consultation has not occurred as partnerships for delivering any such touring exhibition, have not been established. The costs would, however, be significantly less than a permanent gallery. For example for a temporary c. 150 to 200m^2 gallery of reasonable quality, a cost estimate of c. £500,000 for design and build exc VAT, should be achievable.

All of these off-site exhibition options are outwith DSRL's and the NDA's remit or funding allocation. They would have to be delivered by other major organisations e.g. NMS. DSRL has had discussions with NMS about object curation and collection. Over the longer term, options for display will also be explored.

These off-site exhibitions do, however, offer a technically feasible way of engaging and educating large numbers of people about Dounreay, its role in the nuclear story and the history of the wider nuclear industry. They could be delivered before or after the IEP.

4.5.5 Commemorative

Dounreay, like many other institutions, has a culture of commemoration. It is, therefore, appropriate to consider ways in which the achievements of the site can be celebrated. There are three options (based upon what happens elsewhere) for this:

DFR Sphere as memorial:

As previously stated it has been reluctantly concluded that factors such as radiological contamination, recurring costs, restrictions on land use and the technical and economic requirements of decommissioning outweigh the arguments for retention of the sphere, and the long-range decommissioning plans will be amended to include provision for its dismantling. Retention of the DFR sphere would not deliver significant benefits on a local or national scale and greater public benefit can be achieved through other measures.

Gate Guardian:

Another possibility would be to create a gate guardian. This is commonly seen at military bases where a defunct aircraft, artillery piece or tank, is mounted beside the main gate to "guard" it and mark it out. A significant and representative object from Dounreay could be placed at the site's main gate. However, contamination issues will restrict the options and replicas could be expensive.

Sculpture / marker:

The option that will be investigated in the years leading up to the planned dismantling of the sphere will be the installation of a commemorative sculpture to reflect Dounreay's achievements. The design will take the form of a competition, open to any organisation, business or individual.

5. Options

5.1 Introduction

The preceding chapter explored a range of choices for celebrating, conserving and commemorating Dounreay's achievements to allow the development of the strategy. Following a review of discussions with external organisations and feedback from the engagement process, the options were re-considered.

It is apparent that most responses agreed that the current heritage activities should continue to be developed and that additional opportunities should be pursued with external organisations, to explore other sources of funding.

As previously stated, the retention of some or all of the buildings had been considered and because of a number of factors, which have been described in earlier chapters, the decision has been taken that all buildings, including the DFR sphere, will be dismantled at the appropriate time. Therefore, the following options have been rejected and will not be taken forward in the context of this strategy.

Rejected options

- Retention of the site in its entirety
- Retention of the Prototype Fast Reactor (PFR) and Fuel Cycle Area (FCA) in their entirety.
- Retention of DFR sphere and DMTR.
- Retention of buildings and conversion for other uses in the short term.
- Preservation of all objects
- Development of the site or part of the site as a visitor attraction.

DFR sphere

Of the 38 responses received to the stakeholder engagement, 17 agreed that the decision to demolish buildings, including DFR, was the correct thing to do, this was against the backdrop of jobs and economic value. 21 responses stated that the DFR sphere should be retained.

During a stakeholder workshop in Edinburgh, there was a request for further review of the options for retaining the sphere and the result of the review is detailed in Appendix 7.

5.2 Activities to be taken forward by DSRL

Dounreay has a long and established tradition of celebrating and commemorating achievements and key events in its history. The activities that will be carried out by DSRL as part of retaining the heritage of the site and continuing to capture the decommissioning story will be:

Heritage Officer

A Heritage Officer role has been created as previously identified by the site. This role will continue and will now focus on the development and co-ordination of the activities agreed and will, importantly, provide a single point of contact for all heritage issues in the future.

The post will cover:

- Delivering the activities identified in this strategy

- Collation of historical artefacts and technical, social and cultural histories
- Developing partnerships with key external agencies to learn of best practices
- Developing funding applications to source external funding packages
- Sharing the knowledge gained on nuclear heritage issues with other interested parties
- Co-ordinating a diverse range of activities.

As a result of discussions with key organisations, an Advisory Panel will be set up consisting of representatives from various organisations which will advise DSRL on heritage matters to implement the strategy. The Advisory Panel will ensure that the heritage issues receive a more focussed review.

Object collection and recording

DSRL's aim is to develop a safe, comprehensive and high quality collection of artefacts that can be used to commemorate and interpret Dounreay for the future, as well as the provision of material for any future research.

A partnership will be established with National Museums Scotland (NMS) and Caithness Horizons to develop an acquisitions policy and a Memorandum of Understanding relating to the long-term care and ownership of objects. The acquisitions policy will include provision of detailed supporting documentation to accompany objects that are to be retained. This process has started with over 100 items of historical value being collected. Appendix 8 provides more detail.

Temporary storage facilities will be made available on site for objects. Where objects with particular conservation requirements need storage, DSRL will work with partners to identify suitable storage facilities off-site.

DSRL will continue to identify alternative custodians for objects when the partner organisations cannot accept them and when the objects are considered to be of historic, technological or social significance. An example of this is the donation of the two Graphex Fire Tenders to vehicle preservation groups in 2009.

Consideration will be given to looking at innovative ways of capturing the site's history. Two on-going examples are laser scanning of the Dounreay Castle and an artistic film by Dundee University Art & Media department. Existing models of key buildings were built in the past and these will be available for public display as part of the object collection.

For reasons described earlier, some artefacts will never be released for public show due to contamination issues. In these cases, steps will be taken to record and document such objects with partner organisations to ensure the detail retained is of benefit.

Site archive

DSRL will continue to develop and manage its technical archive which covers reports, documents, photographs, film and drawings. This will be expanded to ensure that a representative sample of social history material is also collated.

The NDA is developing a new National Nuclear Archive (NNA) which will be located in Wick, Caithness and the Dounreay Site Archive will be transferred to the NNA. Information contained in the NNA will become available to the public in the future.

Oral History programme

DSRL will expand and formalise the initial work carried out on capturing its oral history to encompass all phases of the site's history. The programme will include providing facilities and training, for staff and volunteers, in the art of interviewing. Development of how memories are captured in a way which would capture people's imaginations will be explored, i.e. in written form and/or podcast type media.

The information which had been collected previously in an ad hoc way, will now be formalised and all material, past and present, will be archived and stored as part of the Dounreay Site Archive. Actions will be taken to ensure that people retiring or leaving the site will be asked to record their memories. This will form part of the procedure for leaving the site.

This information would be made available to any interested researchers and organisations, including Caithness Horizons, which is already using oral history to add another layer of interpretation to the Dounreay story.

Building recording

Given the decision to demolish all structures at Dounreay as part of the NDA's mission to decommission the site, the recording of buildings will be a vital component of the heritage strategy. Proposals will be developed to ensure there is a standardised process across the site, which will be embedded into the lifetime plan, to ensure that structures, fixtures and fittings are appropriately recorded prior to decommissioning commencing and during the process of cleaning and demolition. These standards and approaches will be developed in partnership with the proposed Advisory Panel who will provide valuable expert knowledge.

As part of the recording of buildings it will be important to produce a formal report at the end of the decommissioning process which will ultimately be deposited in the archives.

Publications

DSRL and the NDA have done much to communicate the story of Dounreay to current and future generations. The site has provided support to the publication of recent books, including Fifty Years of Dounreay and Fae Fields to Fuel, Caithness before and after Dounreay, as well as other historical and social history publications.

This will continue as DSRL will consider proposals for publications relating to the history of the site and the decommissioning story and where appropriate, will provide in-kind support for the supply of information.

Online and virtual material

DSRL already maintains a website – www.dounreay.com – and, after review of the responses of the engagement process, a dedicated heritage micro-site has been developed.

This will continue to be developed to provide opportunities to disseminate information to a range of technical and non-specialist audiences. The aim will be to create a resource through which visitors can explore the processes, functions and historic development of Dounreay and will include virtual reconstructions, archival material and publications.

The use of professional photography has always been part of the site's culture and, more recently, video footage has been used. This will continue and be further expanded.

Public Display and Access

Various suggestions on ensuring that information is publicly displayed and accessible were considered as part of views submitted to the draft strategy. As part of its commitment to the local community, NDA, via the site budget, provides significant funding to assist the operating costs of Caithness Horizons where the history of Dounreay is exhibited. DSRL and the NDA believe that continued support to Caithness Horizons ensures that the information is publicly displayed and accessible and helps to sustain an established facility.

5.3 Developing partnerships to progress further opportunities

During the development of the strategy, opportunities were identified that DSRL would not be able to fund nor deliver, as part of the site activities. However, these opportunities can be pursued by working in partnership and looking at alternative sources of funding, which would allow these to be taken forward with support from DSRL as required. Views received from the stakeholder engagement were supportive of this and these opportunities will be explored with the aid of the proposed Advisory Panel.

Funded academic study

DSRL will provide support to an academic body if there is an interest to consider an academic study/qualification on the subject of Dounreay and its heritage. Initial discussions have already taken place with the UHI Millennium Institute which is keen to become involved. DSRL would not fund such a study, but will offer assistance and support in relation to the access of information, photographs and possibly interviews with staff if appropriate. DSRL would also encourage that the results of any research was widely disseminated and also deposited within the Site Archive.

Off-site exhibition

The option was to explore the possibility of developing a major off-site gallery relating to Dounreay and/or the wider nuclear industry. This would need to be developed in partnership with other organisations and costs, which could not be borne from the site budget, are expected to be substantial. Most local stakeholders who responded were keen that the benefits of such exhibitions should remain in the county.

DSRL already significantly support Caithness Horizons and therefore, involvement in an off-site or mobile exhibition, would be a small contribution of staff time and support, through loans or donations of objects and access to information.

International conference

The development of an international scale conference relating to nuclear heritage management has the potential to advance understanding in this field. Expert advice was that a conference should be held in a major Scottish city to attract worldwide participants, but there were strong local views on bringing the benefits of such a conference to Caithness.

DSRL would not organise nor fund such an international conference. However, if other organisations wished to take this forward, and this can be explored through the Advisory Panel, site support would be provided.

DSRL would also explore ways of attracting participants of a conference, or at least part of one, to Caithness. One option is to incorporate a specific ‘fringe’ programme of activities, which would allow attendees to visit the site, the National Nuclear Archives, Caithness Horizons etc. This could be explored as an ‘additional’ option to the main conference programme.

Commemorative installation

The decision to demolish all buildings on the site, which includes the DFR sphere, leaving little of significance standing prompts the question that a commemorative installation or ‘gate guardian’ should be seriously considered. Dounreay played a central part in the social, cultural and economic history of Caithness and also had an impact on the wider nuclear community. It is only fitting, therefore, to commemorate the site's contribution in some appropriate way.

Following stakeholder views, DSRL believes the community should be involved in deciding how to commemorate the site and its achievements. Costs would also be a factor in what the eventual outcome of this would be, but if costs were reasonable, a contribution from the site budget would be identified for the installation. If costs far exceeded expectations, then external funding sources would need to be secured. Other factors such as value for money, care & maintenance, economic benefit, etc would need to be considered before making a final decision.

5.4 Stakeholder Engagement

The objective of the stakeholder engagement which was carried out between 10 December 2009 and 8 March 2010, was to try and reach a consensus view on the totality of a heritage strategy, which is acceptable to the appropriate Government bodies as well as the NDA, DSRL, internal and external stakeholders. For the purposes of the heritage strategy, stakeholders were divided into four categories:

- Regulatory stakeholders, including NII, SEPA, OCNS, Highland Council
- Heritage organisations, including Historic Scotland, National Museums Scotland, Caithness Horizons
- Internal stakeholders (DSRL staff and site contractors)
- External stakeholders, including local community groups and organisations/ individuals

Before launching the stakeholder engagement process a number of activities were organised. These were:

- Meetings with Historic Scotland, National Museums Scotland and Caithness Horizons about the content of the strategy
- A presentation and exhibition at the Thomas Telford event in Wick (Celebration of Industrial Archaeology in conjunction with the Institute of Civil Engineers)
- Regular articles published in Dounreay News, the site magazine
- Various articles published on website and in the local and national press. DFR's 50th anniversary press days in early November 2009 provided good coverage about heritage and the engagement process.
- Regular updates at Dounreay Stakeholder Group &DSG Environment sub group
- Information display at DSG public meeting.

The engagement process was officially launched on 10th December 2009 and finished on 8th March 2010. During that time, DSRL:

- Provided presentations to site staff and contractors.
- Designed a dedicated webpage on the Dounreay website about the engagement process which enabled the public to view/download the full draft strategy document, an executive summary, a newsletter and an on-line electronic questionnaire. In addition numerous articles were posted on the website's front page about the engagement process, with hyperlinks to the heritage webpage.

- Held information displays in the site's central restaurant and placed copies of the newsletter in tea bars around the site.
- Sponsored a High School debating competition on the future of the DFR sphere.
- Held a national workshop in Edinburgh with interested heritage organisations, including Historic Scotland, National Museums Scotland, Royal Commission on the Ancient & Historical Monuments of Scotland, Highland Council, English Heritage & Welsh Heritage representatives.
- Held a local workshop with interested organisations, including Caithness Horizons, Caithness & North Sutherland Regeneration Partnership, North Highland Tourism, Caithness Chamber of Commerce, National Nuclear Archive, & Dounreay Stakeholder Group representatives.
- Sent out over 80 invitations to local community groups offering presentations and provided presentations to Dounreay Retirement Fellowship, Thurso Community Council, Strathy, Melvich & Bettyhill Community Councils.
- Distributed an e-bulletin to 1400 registered stakeholders with website link to heritage questionnaire and strategy.
- Sent out over 800 hard copy newsletters/questionnaires to local addresses.
- Distributed an electronic Christmas card to 1400 registered stakeholders with heritage theme and reminder to complete questionnaire.
- Displayed information in Caithness Horizons and Dounreay.com (public information office) over the whole 3 month period.
- Placed advert in local newspaper.
- Posted reminders on the site's intranet noticeboard during the last week.
- Published articles in the local press and in Dounreay News, the site magazine
- Sent details to the Caithness Community website - www.caithness.org

The statistical summary of the 38 responses received is detailed below:

No.	**Summarised Question**	**Yes**	**No**	**Undefined**
1	Agree with broad approach?	79%	13%	8%
2	Agree to demolish all?	45%	55%	0%
3	Current activities sufficient?	50%	21%	29%
4	Stop any current activities?	8%	47%	45%
5	Include the listed additional opportunities?	39%	24%	37%
6	Any other opportunities to suggest?	32%	32%	36%

The responses received have been published on the website. While the majority of responses did not change the main strategic themes, i.e. demolition of all non-functioning facilities with recording of heritage by a wide variety of methods, DSRL has considered the views and, where possible, broadened out the recording. The following additional activities have taken place or are planned, as a direct result of views expressed by the public;

- A Heritage Advisory Panel of recognised experts will be set up
- Dedicated heritage pages have been launched on the Dounreay website
- Dundee University has successfully gained funding from the Scottish Arts Council to produce an artistic heritage film about Dounreay

- The latest innovative laser scanning technology has been used to accurately record the condition of Dounreay Castle

Three suggestions with replies are detailed below.

Produce a national strategy for nuclear heritage

DSRL could not take the lead in developing a national strategy for UK nuclear sites. This would be a decision for the NDA and if taken forward, DSRL would provide support and share the lessons learnt whilst developing the strategy for Dounreay.

Retain the airfield as a heritage site

The airfield is outside the licensed fence. NDA-owned land outside the licensed site was considered, but only in the margins of the strategy. The airfield land belongs to the NDA and there are no plans to do anything with that ground, thus the main runway will remain.

Widen the strategy to cover the setting and impact of the site on the development of Caithness

The opportunity of academic study, as detailed in section 5.3, would cover this aspect. The published books about Dounreay have highlighted the economic impact and any future books are likely to do the same. The Caithness Horizons museum also covers this.

5.5 Next Steps

The strategy provides the overarching approach to capturing and preserving the heritage of the site. There are now a number of tasks that will need to be managed to ensure that processes are in place to underpin this. An implementation plan will be produced and will include development of:

- Site heritage policy
- Site procedures & guidance notes for heritage activities
- Roles and responsibilities, including those of an Advisory Panel
- The heritage programme, including resources required
- Site protocols for activities, including partnership arrangements

The range of topics that the heritage work will cover, includes;

- Policy
- Procedures
- Guidance notes
- Roles & responsibilities
- Programme
- Resources
- Risks
- Advisory panel
- Collections
- Oral history
- Training and development
- Benchmarking & learning from others

- Sharing knowledge
- Building recording
- Publications
- On line/virtual material
- Recording decommissioning
- Communications
- Opportunities with outside funding
- Commemoration
- Innovation

To get in touch with the Heritage Officer on any aspect of Dounreay's heritage, an email can be sent to; heritage@dounreay.com

6. Bibliography

6.1 External documents

Bradley, A., Buchli, V., Fairclough, G., Hicks, D., Miller, J., and Schofield, J. 2004, *Change and Creation: historic landscape character 1950-2000*. London: English Heritage

Brunel, G., Rabbe, J.P. 2006 Visiatome: The French Discovery and Information Centre on Radioactive Waste Management paper at *WM'06 Conference, February 26-March 2, 2006* Tuscon, AZ

Caithness Socio-Economic Strategy Group: *A Strategy for Caithness and North Sutherland* 2006

Cashmore, S 1998 *Dounreay: the illustrated story* North of Scotland Newspapers ISBN: 1871704219

Cocroft, W. 2006 England's Atomic Age Strategy on the Historic Industrial Environment Record Desktop Investigation and Assessment: English Heritage

Cocroft, W., 2007 'England's atomic age', in *Conservation Bulletin: Modern Times, Issue 56, Autumn 2007*; London: English Heritage

Deyo, Y., & Pauling, T. 2006 Community Involvement as an Effective Institutional Control at the Weldon Spring Site, a U.S. Department of Energy Office of Legacy Management Site paper at *WM'06 Conference, February 26-March 2, 2006* Tuscon, AZ

do co.mo.mo 2003 *Dounreay: evaluating site significance*

Dounreay Stakeholder Group: *Defining the Dounreay Site End State Results of Consultation*

Efimenko, V., O'Hara, F. & Lau, H. unknown World status of fast reactor development in *IAEA Bulletin, VOL.26, No.4*

Guizzo, E 2005 The Atomic Fortress That Time Forgot in *IEEE Specturm April 2005*

HMS Tern II RAF Map (RAF Museum)

Hopkins, A., Minette, D., Soresonm R., Heineman, M., Charoneau, S., & Bond, F. 2006 The Challenges of Preserving Historic Resources During the Deactivation and Decommissioning of Highly Contaminated Historically Significant Plutonium Process Facilities paper at *WM'06 Conference, February 26-March 2, 2006 Tuscon, AZ*

Houston, T 1998 'False Dawn of the Nuclear Age' in *Motherwell Bridge: The First Hundred Years 1898-1998*

Idaho National Laboratory unknown *Experimental Breeder Reactor-I* Pamphlet produced by Idaho National Laboratory

Kirkdale Archaeology, 1998 *Dounreay Castle Ground Remediation*, 1997-98 (GN19563) [unpublished monograph]

Lunning, WH 1967 DMTR - a survey of progress, *Reactor* Vol 6 No 2, 1967

Sayes and Associates Company, 2008 N.S. Savannah Post Shutdown Decommissioning Activities Report on behalf of U.S. Department of Maritime Transport Administration

Sutherland, I 1990 *Dounreay: an experimental reactor establishment* Wick

Taylor, B and Freer, B 2002 Containing the Nuclear Past: The Politics of History and Heirtage at the Hanford Plutonium Works *Journal of Organisational Change Management* Vol 15, No. 6, 2002

Taylor, B.C., and Freer, B., 2002 'Containing the nuclear past: The politics of history and heritage at the Hanford Plutonium Works', in *Journal of Organizational Change Management*, Vol. 15 No. 6. pp563-588

The Highland Council: *Dounreay Planning Framework*, draft - for consultation

The History of the Vulcan Naval Reactor Test Establishment, Dounreay

The Surveyor and Municipal County Engineer (magazine): Building the fast reactor group at Dounreay, 1957

Williams, P. 2007 *Plan B for a Nuclear Reactor: After Production Comes Preservation.* Piece produced for The Inaugural Conference on the Inclusive Museum – see http://blogs.nyu.edu/projects/materialworld/2007/10/plan_b_for_a_nuclear_reactor_a.

6.2 UKAEA and DSRL documents

50 Years of Dounreay, Draft 2008

DFR Options Study PR leaflet

DFR Options Study Report and background spreadsheets - Draft 1c

Dounreay and the Fast Reactor Story

DSRL & NDA 2008 *A Guide to Dounreay* (http://www.dounreay.com/UserFiles/File/PR%20First%20time%20Visitors%20Booklet%20V2%20Comb.pdf)

Fraser, A 2007 *Boston Camp* Internal UKAEA document

Fraser, A 2007 *Fast reactor - 50 years of building*. Internal UKAEA document

Guidance on selecting items of historic significance - Draft D

Gunn, J: The Immediate Effect of the Dounreay Nuclear Establishment on Thurso and the Surrounding Area; March 1990

Harrison, N & UKAEA Delivering for the Nuclear Decommissioning Authority

Hurst, Dr R 1962 *The Dounreay Experimental Reactor Establishment* [internal UKAEA publication]

UKAEA & AOC Archaeology Group 2003 *Dounreay Site Wide Environmental Statement (SWES): Archaeology and Cultural Heritage Baseline Report* [internal UKAEA publication]

UKAEA & Atkins *Site wide Environmental Study* - ecology baseline report

UKAEA 1957 Dounreay 1957 Information issued for the press visit, May 1957 [internal UKAEA publication]

UKAEA 1966 Opening Ceremony on the site of the Prototype Fast Reactor [internal UKAEA publication]

UKAEA Decommissioning Dounreay: Edition 5, 2007 issue

UKAEA Dounreay Review 2006/07

UKAEA Environmental Statement for the New Intermediate Level Waste Cementation Plant & Store at Dounreay: Non Technical Summary July 2006

UKAEA Monitoring of Beaches near Dounreay, 2006 information sheet

UKAEA Socio-Economic Development Plan 2005/06, Dounreay, Caithness

UKAEA/NDA A Guide to Dounreay

UKAEA/NDA Dounreay Site Summary: Near Term Work Plan FY 2005 to 2008

UKAEA: Dounreay Experimental Reactor Establishment Information Booklet, 1961

6.3 UKAEA and DSRL information sheets

Dounreay and the Environment info card

Dounreay Castle Remediation card

Dounreay Cementation Plant information card

Dounreay Materials Testing Reactor info card

Low Level Liquid Effluent Treatment plant, Dounreay information card

PFR Raffinate card

Radioactive Waste Management - Low Level Waste, Dounreay info card

Sodium Disposal Plant card

The Decommissioning of Supernoah, Dounreay info card

The Dounreay Fast Reactor info card

The History and Achievements of UKAEA Dounreay info card

The Prototype Fast Reactor, Dounreay information card (2004)

Waste Receipt Assay Characterisation & Supercompaction Facility info card

WRACS (Waste Receipt, Assay, Characterisation and Supercompaction Plant) card