nuclear's wastelands

part 3 – sellafield, britain's nuclear heartland

In the third of a series of articles on the local and social legacies of nuclear energy, Andrew Blowers looks at the search for a solution for radioactive wastes in the UK

I still possess a lapel badge acquired back in the 1980s with the simple legend 'I've been to Sellafield!'. The badges were issued as part of a publicity campaign designed to lure tourists to Britain's notorious and (in)famous nuclear complex – the largest industrial site in the UK. The ironic challenge of the message was underlined more explicitly by a contemporary cartoon bearing the invitation to 'Visit Sellafield before Sellafield visits you'. Such messages endorsed and even promoted an image of Sellafield as distant but dangerous. Other soubriquets such as 'Sellafield – the nuclear laundry' or 'Britain's nuclear dustbin' hint at its mysterious and unglamorous purpose at the heart of the country's nuclear operations.

Cartoon: Martyn Turner, Irish Times

Sellafield lapel badge, and 'Visit Sellafield…' cartoon

The most dangerous place on earth?

So what is Sellafield? Fundamentally, these days, it is the UK's primary nuclear waste-processing, management and clean-up facility. Concentrated on a compact site of 1.5 square miles is a jumble of buildings, pipes, roads, railways and waterways, randomly assembled over more than half a dozen decades, which together manage around two-thirds by radioactivity of all the radioactive wastes in the UK. The Sellafield radioactive waste component includes all the high-level wastes (less than 1% by volume, over half the radioactivity) held in liquid form or stored in vitrified blocks, and half the volume of intermediate-level wastes (the other half being held at various sites around the country). The bulk of the nation's low-level wastes (90% by volume, 0.1% radioactivity) are disposed of in a nearby shallow repository at Drigg.

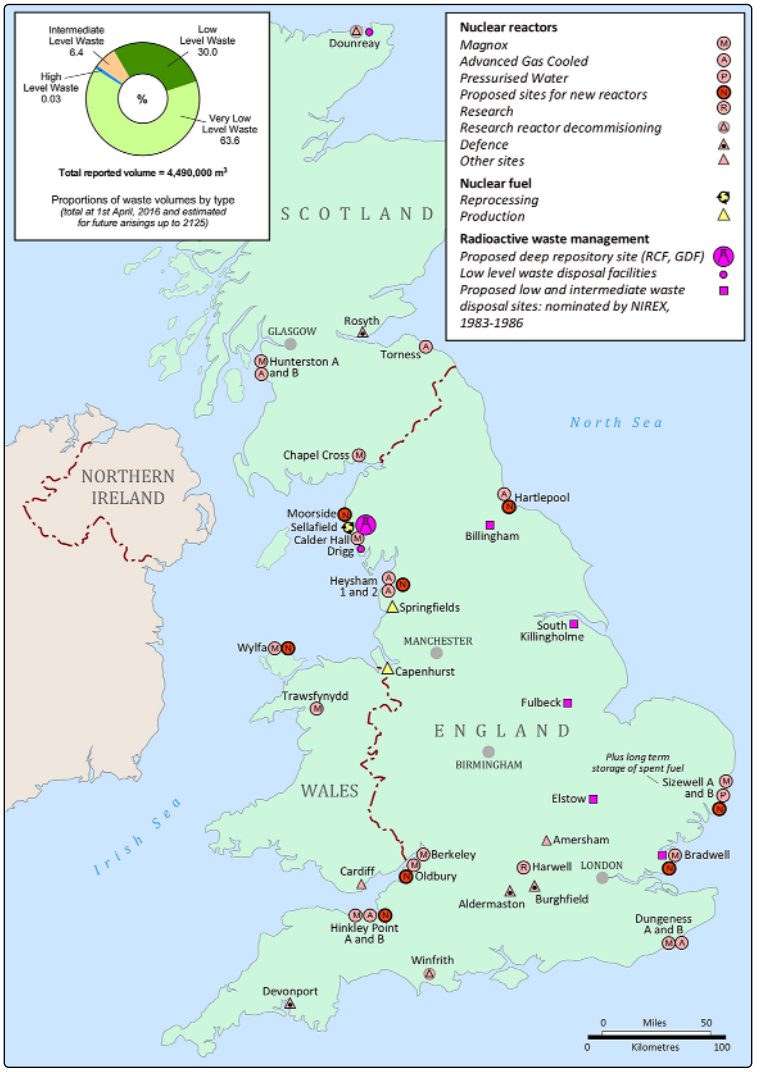
In addition, Sellafield hosts the spent fuel from the Magnox reactors due to be reprocessed by the end of the decade, as well as some spent fuel from AGRs (advanced gas-cooled reactors) awaiting reprocessing or storage. Sellafield also has the world's

largest single stockpile of plutonium, amounting to 123 tonnes in 2013 and rising to 140 tonnes by 2020, including around 15 tonnes currently foreign owned and formally due for repatriation in some form.

These wastes arise from the range of nuclear activities carried out since Sellafield (then Windscale) began operations in the early post-war years. They comprise wastes arising from the plant's initial military function of producing plutonium for the atom bomb and subsequently wastes mainly derived from reprocessing spent fuel from the civil nuclear programme (Magnox and AGR) and those originating from reprocessing foreign fuels.

In the early years, in an atmosphere of trust in technology and pride in being in the vanguard of both military and civil nuclear development, far less attention was paid to waste management. Wastes, liquids, metals, fuels, sludges and debris, uncharacterised and often unrecorded, were literally dumped into poorly constructed ponds and silos and left to stew. These structures include building B29, an open, single-skinned storage pond, and B30 ('Dirty Thirty'), considered by some to be 'the most dangerous industrial building in Europe' but rivalled for the epithet by B38, containing cladding and fuels mixed in with other wastes. These and other legacy ponds and silos have deteriorated over the years, and now 'there is increased urgency to reduce the intolerable risks they pose'.[1]

The probability of a major radioactivity incident may be very low indeed, but the possibility persists, a fact brought home to me some years ago when standing on a platform above a massive concrete shield below which were highly active liquor (HAL) tanks containing 99% of the radioactivity from spent nuclear fuel. I turned to my colleague, a renowned radiation scientist, and asked him how safe we were. He looked up at the miles of cables and pipes above us, indicating their exposed vulnerability in the event of disruption which could affect the cooling of the liquors



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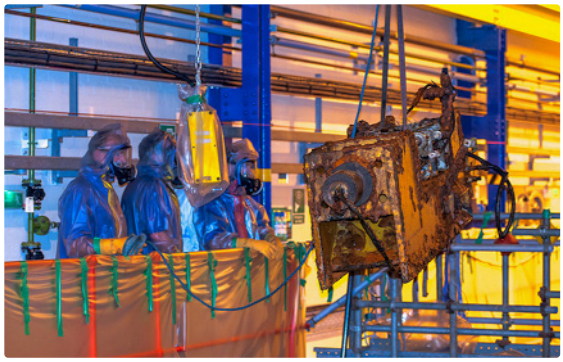
Map of nuclear facilities in the UK

Legacy waste pond at Sellafield



Clean-up – legacy pile fuel removal from a storage pond at Sellafield

Photo courtesy of Sellafield Ltd

below, releasing a massive burst of radioactivity, and commented: 'You could say we are standing on the most dangerous place on earth.' In rather less hyperbolic language the Office for Nuclear Regulation (ONR) considers HAL 'the most significant hazard on the plant' and its containment a priority.[2]

Safe management of the legacy wastes is by far the most important and challenging function of Sellafield today. The long-term plan is to retrieve, characterise, encapsulate or vitrify the Sellafield inventory in preparation for deep burial in a Geological Disposal Facility (GDF). But that prospect is a far-off possibility; the reality is that for the foreseeable future the bulk of Sellafield's wastes will have to be managed at the surface.

A community at the periphery

Sellafield is a physical reality in a social context. Like Hanford in the USA,[3] it is a classic example of a peripheral nuclear community, revealing all five characteristics associated with the concept. It is, first, geographically remote, in the sense that it is, in UK terms, relatively far from major population centres, founded on a wartime Royal Ordnance factory, offering safety, security and secrecy for the clandestine operations of the nation's military nuclear project. It is situated in West Cumbria on a plain between the iconic Lake District landscape and the Irish Sea, far from motorways, airports or mainline railways.

Its physical isolation has inspired a second social characteristic, a perception of distinctiveness on the part of West Cumbrians, whom, according to a sociological study in the early 1990s, 'saw their area as 'different' and separate from the rest of society'.[4]

This peculiar cultural identity, which may be described as a 'nuclear culture', has been attested to in several studies of Sellafield and West Cumbria.[5] It is a complex combination of feelings, values and attitudes, pervasive yet contradictory. Within this culture is a sense of resignation, an acceptance of Sellafield as a place of risk and rejection. This inferiority is tempered by a contrary resilience – an assertion of its role as guardian of the nation's dangerous radioactive materials and waste. Overall, there is a sense of realism 'about uncertainties, about lack of power and control... mitigated by positive recognition of the industry's vital role in the area'.[4]

The third peripheral characteristic is economic, a condition of dominance and dependence. Sellafield is unquestionably the dominant economic activity in West Cumbria, with around 10,000 people directly employed and the local economy substantially dependent on the income and investment in related research and local economic projects that the plant produces. This dominance has some negative effects, notably the deterrent effect of Sellafield's high wages and its monopoly of available skilled labour. This is reflected in the quite stark inequalities of income and evidence of deprivation in some parts of the area, a paradox of poverty in the shadow of a nuclear leviathan.

Nevertheless, the priority given to Sellafield's clean-up pretty well guarantees an annual state investment (through the NDA – the Nuclear Decommissioning Authority) approaching £2 billion per year, and it is estimated that Sellafield will absorb around three-quarters (£120 billion) of the total of £164 billion discounted provision for future clean-up liabilities of the nation's nuclear estate over the next 120 years. Sustainable employment is assured for at least 30 years, with slow decline thereafter.

The uneven development of the West Cumbrian economy is reflected in a fourth characteristic: the inequalities of power relations encountered in the region. At one level West Cumbria evinces powerlessness, an industry and an area at the periphery where key decisions affecting wellbeing and welfare are taken outside the region, in corporate headquarters, government ministries, and regulatory bodies. A sense of paranoia is understandable from the recurrent exposures of Sellafield's poor financial management, escalating costs, under-performance, technical failures, accidents and incidents, cover-ups, and organisational deficiencies. But Sellafield seems to hold much of the local community of West Cumbria as some kind of fiefdom, such is its

economic, social and political sway over the region. In the context of its national significance and regional importance, Sellafield exercises political leverage that confounds its apparent subordination.

Sellafield draws power from the fifth characteristic of peripheral communities: the fact that the community is living with environmental risk that is unwanted but unavoidable. Rather like Hanford, community and industry have developed a relationship built on a mixture of defensive pride and reluctant recognition of their role and responsibility in bearing a burden on behalf of the nation. Over the years this combination has enabled the community to endure the adversities and respond to the possibilities as it undergoes the vicissitudes of its long transition from production to clean-up.

The long transition

In the frenetic post-war years Sellafield (then Windscale) was almost wholly dedicated to the production of nuclear materials, first for military purposes, later for a range of prototype and experimental facilities. The inevitable accompanying production of waste was of little interest or account. The fundamental function, reprocessing, was initially for plutonium production, using spent fuel from the first reactors.

The scope of reprocessing widened as it became necessary to reprocess Magnox spent fuel, and, later, the Thermal Oxide Reprocessing Plant (THORP) began operating in 1997 to reprocess spent fuel from the second-generation AGR reactors as well as foreign spent fuel (mainly from Germany and Japan). THORP marked a turning point in the transition from production to clean-up at Sellafield as its function, viability and performance were challenged, and subsequently the plant experienced delays, cost overruns, technical problems and chronic under-performance, leading to failure to meet its domestic and foreign business expectations. The plutonium stockpile grew far beyond its military needs and its use in mixed-oxide fuel (MOX).

The Sellafield MOX plant proved an even more abject failure, opening in 2001 with a capacity of 120 tonnes a year, producing only 5 tonnes in its first five years and declared failed and closed down in 2011.

By the end of this decade reprocessing at Sellafield will have finished. Effectively, Sellafield will then have become, like Hanford, almost wholly a waste management and clean-up complex. The transition from nuclear laundry to nuclear dustbin will be complete. Its future was summed up by Adrian Simper, the NDA's Director of Strategy and Technology, during our conversation in 2014:

> *'There is a hundred years of going forward. A commitment to clean-up and an important mission to carry out. There is no future in reprocessing. Employment is stable and the new priority is clean-up.'*

Searching for solutions

Storage of nuclear wastes at Sellafield and at other sites around the country for however long is regarded as an *interim* solution. The search for a *permanent* solution to the problem of managing these wastes began in earnest after the Flowers Report pronounced in 1976 that there should be no further commitment to nuclear energy unless it could be demonstrated that long-lived highly radioactive wastes could be safely contained for the indefinite future.[6]

During the 1980s, efforts to find suitable sites, whether for deep disposal of high-level and long-lived intermediate-level wastes (ILW) or for shallow burial of short-lived ILW and low-level wastes, met with trenchant opposition, both within and between the communities, sufficient to force withdrawal of the proposals. These efforts were focused on finding suitable geology for deep disposal or available locations such as an abandoned mine at Billingham, disused airfields, munitions dumps, or sites in public ownership. They all had in common a classic exercise of 'decide, announce, defend', leading inexorably to abandonment in the face of determined opposition.[7]

The technical focus of these efforts had signally failed to take into account the social context. A new approach was inaugurated, combining economic and scientific criteria to identify a range of possibly suitable sites, but this time involving the public to assist in developing acceptable proposals. By this means Sellafield emerged as the most favourable site where consultation had found a measure of public support. Despite the effort to combine scientific rigour and public acceptability, the selection had all the hallmarks of a predetermined solution concocted through a closed process of decision-making and relying on Sellafield as the path of least public resistance.

Sellafield the solution, or not?

The selection of Sellafield proved premature, as the case put forward unravelled in the face of opposition at the public inquiry into the proposed underground laboratory known as a Rock Characterisation Facility (RCF). The proposal was rejected in 1997 on three counts: local environmental impacts; scientific uncertainties and technical deficiencies; and the site selection process itself. The rejection was comprehensive and decisive, forcing the government, once again, to rethink and regroup.

The turn of the century was a propitious time for a new approach. Nuclear energy had seemingly run its course in the UK, and the discourse had shifted from conflict over nuclear projects to a mood in which co-operation and consensus was possible. This was invigorated by a surging interest in participative democracy, with its emphasis on openness, transparency, partnership and engagement, backed by a panoply of processes and techniques to facilitate public and stakeholder involvement in policy-making.

Photo courtesy of Sellafield Ltd

Sellafield landscape

Nowhere was the opportunity for dialogue more enthusiastically seized upon than in radioactive waste management. In order to find a way out of the policy impasse a new Committee on Radioactive Waste Management (CoRWM) was established, charged to inspire public confidence by finding the best method for the long-term management of the UK's legacy wastes, the bulk of which were at Sellafield.

In the course of its deliberations (during 2003-06) CoRWM integrated different knowledge streams, including an elaborate multi-criteria decision analysis (MCDA) and an extensive public and stakeholder engagement (PSE), as well as drawing on overseas experience and evaluating ethical principles and perspectives. Its main recommendation was carefully crafted: 'Within the present state of knowledge, CoRWM considers geological disposal to be the best available approach for the long-term management of all the material categorised as waste in the CoRWM inventory'[8] – i.e. the legacy wastes at Sellafield and elsewhere and future known arisings. But it was carefully qualified by further recommendations emphasising the long-term nature of the process through a programme of interim storage, research and development into geological disposal, flexibility to consider other options, and a staged process of implementation.

CoRWM also set out its proposals for implementation, based on the 'three Ps' – principles of participation, partnership, and packages – to ensure acceptability, facilitate involvement, and provide the resources to encourage commitment.

The government adopted the approach in its White Paper, *Managing Radioactive Waste Safely*, and was keen to put these theoretical ideas into practice, to turn concepts into a process that would deliver a site for a deep underground repository (called a Geological Disposal Facility). A general invitation was issued to communities in England, Wales and Northern Ireland (Scotland had adopted storage as its long-term policy) 'to express an interest in opening up without commitment discussions on the possibility of hosting a geological disposal facility at some point in the future'.[9]

Predictably there was no rush of volunteers but, as might be anticipated, West Cumbria was the first, and only, community to enter into a modulated exercise in participatory democracy managed by the West Cumbria Managing Radioactive Waste Safely (WCMRWS) Partnership, including councils, the voluntary sector, and business and trade union interests, and working over three years (2009-12).

The WCMRWS process founded on the tide of voluntarism eventually foundered on the rocks of geology. The claim that there were potentially suitable areas for deep disposal within the region was vigorously challenged. Uncertainties over the issue, along with other concerns including the absence of comparative strategies, combined to create a lack of trust, leading the partnership to reach a tentative conclusion: 'at this stage we are fairly confident that an acceptable process can be put in place to assess and mitigate negative impacts and maximise positive impacts'.[10]

This underwhelming outcome left the decision-makers – the local councils – to reach their own conclusions. The two district councils in pro-nuclear West Cumbria voted to proceed; Cumbria County Council, covering also the wider region further from Sellafield, voted against. The process had stalled in what seemed its most promising location.

Once more into the breach

With this setback the government once more had to regroup and review its policy for geological disposal. There appeared to be three areas where a revised approach was necessary.

First was the fact that site selection had given pre-eminence to voluntarism over geology, giving rise to concerns that a site would be chosen on grounds of what was acceptable to a community rather than what was the best available on scientific grounds. This would be addressed by a process of national geological screening, based on known geological information. While this would not identify specific sites, it would indicate potential geological suitability in areas where interest was likely to be expressed and provide more detailed geological information to those communities who wished to pursue their interest. While voluntarism remained the primary principle of site identification, it would now be within a context of voluntarism and geology.

Second was the question of who should be the decision-making body. Although the WCMRWS Partnership was an exercise in participative democracy to achieve consensus, the formal decision on whether to continue was in the hands of the representative authorities, the county and district councils, who had agreed that a decision should be agreed by both tiers. Thus Cumbria's reluctance to proceed was decisive. To avoid such an override in the future, the government stated that all levels of local government should have a voice in the process and that no one level should prevent the participation of another. The revised process would be managed by the government and led by the state-owned developer, working with communities. The crucial underlying principle was that the final decision-making role would sit with people in communities.

A more subtle approach to the issue of 'what is a community?' and 'who should decide?' was devised whereby communities would be 'identified' over time as the siting process evolved and the options were refined to specific locations. The fact that a repository has a 'physical existence' meant that an emerging community would ultimately need to be identified based on a geographical area. The principle that the 'community' decides would be enacted by a right of withdrawal during the process and by confirmation of the decision to develop the repository in a test of public support. The hope was that this elaborate, extended, even elegant approach to voluntarism in practice, backed by a package of community benefits, would have the flexibility and incentives to attract communities to engage willingly in achieving a site for the disposal of the nation's wastes.

Photo courtesy of Irene Sanderson, North Cumbria CND

Protesters against the proposed Geological Disposal Facility in West Cumbria

Time to decide

The third area concerned the timescale of decision-making.

The technical and scientific challenges involved in making a safety case for a repository with engineered barriers within a host rock capable of ensuring containment of radionuclides for up to a million years were formidable. The key reason for Cumbria's decision to pause the process was that it would be premature to proceed; that uncertainties suggested the risks were too great, certainly in the Cumbrian geological context.

Another uncertainty was the nature and scale of the inventory ultimately destined for the repository. The CoRWM recommendations had been confined to the legacy wastes – those mainly at Sellafield and those arising from existing and known nuclear programmes. A new nuclear programme of uncertain scale being promoted by government would result in spent fuel and other wastes on the sites of new reactors, creating an indeterminate inventory extending over unknowable timescales. Storage of the nation's legacy wastes already at Sellafield was one thing, permanent disposal, including wastes from new build, was quite another. As Martin Forwood of the protest group CORE (Cumbrians Opposed to a Radioactive Environment) put it to me: 'It would be ludicrous to move it from Sellafield given the risks of transport. It would be absolutely ridiculous. But Sellafield shouldn't necessarily be taking more.'

There was also resistance to the government's importunity in seeking a decision to move forward, thereby locking West Cumbria more firmly into the process.

And there we have it. The government's view that 'effective arrangements will exist to manage and dispose of the waste that will be produced from new nuclear power stations'[11] is speculation at best. The problem is that effective arrangements scarcely yet exist for dealing with the legacy wastes which, for the foreseeable future, will be stored at Sellafield and other sites, let alone wastes from any new build which would have to be stored well into the next century on fragile, crumbling or inundated coastal sites.

Progress towards identifying an acceptable and suitable site for disposal will inevitably take time. The revised arrangements leave West Cumbria in the ring, probably still the favoured location. The new, evolutionary, self-defining approach to site identification is flexible, placing the veto, test of public support and distribution of investment funds in the hands of the community and not the representative political bodies. This opens up the opportunities for voluntarism, and it is highly likely volunteers will come forward from West Cumbria. Conversely, the geological screening process and the emphasis on suitable geology acts as a potential constraint on finding a suitable site in West Cumbria.

The revised process might tempt other communities into the frame, areas where public support and geological conditions are favourable. There may be potential volunteers with the requisite peripheral characteristics, but few will be likely to maintain commitment over the long timescales involved.

The inescapable fact is that the large volumes of wastes at Sellafield will not be in a fit condition for disposal for decades to come. And it would seem impossible, irresponsible even, to contemplate moving three-quarters of the nation's highly active wastes miles across the country, requiring security, transfer, surveillance and logistical arrangements.

The nation's radioactive waste is mainly held at Sellafield and there it must remain, at least until the programme of management and clean-up is concluded. New production facilities such as for MOX or reprocessing are exceedingly improbable, the proposed new reactors at nearby Moorside are doubtful, and although a GDF, if one is ever developed, might yet be located in West Cumbria, Sellafield will for long be caretaker of the nation's wastes.

Where and when the undertaker will come to bury them remains unclear, and may remain so for the foreseeable future.

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Notes

1 *Nuclear Decommissioning Authority: Strategy*. Nuclear Decommissioning Authority, Apr. 2016, p.27. www.gov.uk/government/uploads/system/uploads/attachment_data/file/512836/Nuclear_Decommissioning_Authority_Strategy_effective_from_April_2016.pdf

2 *Sellafield – High Level Waste Plant – Waste Vitrification Plant – Lines 1 and 2 – Containment System*. Office for Nuclear Regulation, Jun. 2014. www.onr.org.uk/intervention-records/2014/sellafield-14-018.htm

3 Hanford in the Pacific North West of the USA was the subject of the previous article in this series: A Blowers: ''Nuclear's wastelands. Part 2 –The nuclear frontier'. *Town & Country Planning*, 2017, Vol. 86, Sept., 364-69. The characteristics of peripheral communities were discussed in the first article: A Blowers: 'Nuclear's wastelands. Part 1 – Landscapes of the legacy of nuclear power'. *Town & Country Planning*, 2017, Vol. 86, Aug., 303-8

4 C Waterton, B Wynne and R Grove-White: *Public Perceptions and the Nuclear Industry in West Cumbria – Report to Cumbia County Council*. Centre for the Study of Environmental Change, Lancaster University, 1993 (amended version, 2007, available at http://csec.lancs.ac.uk/docs/Public%20Perceptions%20Nuclear%20Industry.pdf)

5 Paul Loeb used *Nuclear Culture* as the title of his book on Hanford (New Society Publishers, 1986). Among the studies of Sellafield and West Cumbria are: C Waterton, B Wynne and R Grove-White: *Public Perceptions and the Nuclear Industry in West Cumbria – Report to Cumbia County Council*. Centre for the Study of Environmental Change, Lancaster University (see note 4); H Bolter: *Inside Sellafield*. Quartet Books, 1996; S Macgill: *The Politics of Anxiety: Sellafield's Cancer-Link Controversy*. Pion, 1987; J McSorley: *Living in the Shadow: The Story of the People of Sellafield*. Pan Books, 1990; and H Davies (Ed.): *Sellafield Stories: Life in Britain's First Nuclear Plant*. Constable & Robinson, 2012

6 *Nuclear Power and the Environment*. Cmd. 6618. Sixth Report. Royal Commission on Environmental Pollution. HMSO, 1976. http://webarchive.nationalarchives.gov.uk/20110322144120/http://www.rcep.org.uk/reports/06-nuclear/1976-06nuclear.pdf

7 For a brief history of early efforts at site selection see A Blowers: 'A geological disposal facility for nuclear waste – if not Sellafield, then where?'. *Town & Country Planning*, 2014, Vol. 83, Dec., 545-53

8 *Managing our Radioactive Waste Safely*. Committee on Radioactive Waste Management, Nov. 2006

9 *Managing Radioactive Waste Safely: A Framework for Implementing Geological Disposal*. Cm 7386. Department for Environment, Food and Rural Affairs. TSO, Jun. 2008. www.gov.uk/government/publications/managing-radioactive-waste-safely-a-framework-for-implementing-geological-disposal

10 *The Final Report of the West Cumbria Managing Radioactive Waste Safely Partnership*. West Cumbria Managing Radioactive Waste Partnership, Aug. 2012. p.6. www.westcumbriamrws.org.uk/images/final-report.pdf

11 *Draft National Policy Statement for Nuclear Power Generation (EN-6)*. Department of Energy and Climate Change, Jul. 2011. www.gov.uk/government/publications/national-policy-statements-for-energy-infrastructure