The Royal Academy of Engineering

Management of the UK's plutonium stocks

Department of Energy and Climate Change

May 2011

Introduction

The Royal Academy of Engineering responded to the Nuclear Decommissioning Authority (NDA) consultation on credible options for the management of UK Pu stocks on October 2008. The engineering assessment of the options has not changed over the last 3 years. The Academy's original response to the NDA can be accessed on the Academy's website[1].

In the current geopolitical environment, with recent events such as the Fukushima plant incident following the Japanese earthquake, new spotlights have been thrown on nuclear policies across the world, management of plutonium being one of them. Internationally, states with civil nuclear power programmes are increasingly awakening to the concept that spent nuclear fuel is not waste, but a resource. Both Russia and the USA are currently pursuing policies to use stockpiles of weapons grade plutonium in mixed oxide (MOX) fuel in light water reactors (LWRs).

While there is a policy distinction in terms of civil and nuclear derived stockpiles of plutonium, the use of MOX fuel provides a credible route to disposal of all plutonium stockpiles. The DECC consultation recognises that significant uncertainty exists surrounding the future demand of MOX and therefore the return that can be obtained from its sale to commercial generators. However, the technology of manufacturing MOX fuel is mature and the sale of MOX fuel represents a contribution to costs in dealing with ultimate waste forms.

1. ***Do you agree that it is not a realistic option for the UK government to wait until fast breeder reactor technology is commercially available before taking a decision on how to manage plutonium stocks?***

There have been assumptions made that Fast Reactors (FRs) are 20 to 30 years away from commercial deployment for a number of decades. While that has usually been implied to be due to technological issues, it is not strictly the case. While some FR prototypes did encounter technical problems with the integrity of the Na/water systems, the main factor opposing widespread commercial deployment hitherto has been economics and specifically the higher capital cost and associated financing of the reactor, making it some 25-30% more expensive than a LWR of equivalent output. A European consortium of utilities and vendor companies (including the UK's NNC, CEGB, BNFL and UKAEA) developed a European FR to design maturity and placed the designs 'on the shelf' under the custodianship of EDF in the late 1990s.

The rapidly evolving international energy market suggests that FRs should not be entirely written off in terms of becoming commercially attractive in the future. However, in the context of making strategic decisions about the handling of UK plutonium stocks, we cannot wait for FRs. It is important to take action now to address the 100t plutonium stockpile as its existence politically 'erodes' the UK position over non-proliferation and safeguards for nuclear material.

[1] http://www.raeng.org.uk/societygov/policy/responses/pdf/PlutoniumV6.pdf

2. ***Do you agree that we have got to the point where a strategic sift of the options can be taken?***

The UK is certainly at a point where a clear strategic direction on the management of plutonium stocks is required. In broad terms, the credible options are; reuse as fuel, disposal, and long term storage. However, none of these options completely negate the need for the others. For example, if plutonium is reused as fuel in MOX, the final disposal of the ultimate waste is still an issue and the rate at which MOX is manufactured and used by commercial operators will mean that there will still be a need for decadal, if not truly long-term, storage.

3. ***Are the conditions that a preferred option must in due course meet the right ones?***

The conditions set for the preferred options are, for the most part, clear and appropriate. When considering how each option is of overall benefit to the UK, the benefits of preserving high value technical skills, maintaining (or re-establishing) the UK's position as a credible international partner on civil nuclear power and the options for developing UK technological leadership in the field should all be taken into account alongside value for money.

4. ***Is the UK government doing the right thing by taking a preliminary policy view and setting out a strategic direction in the area now?***
5. ***Is there any other evidence government should consider in coming to a preliminary view?***
6. ***Has the UK government selected the right preliminary view?***

The way forward for the management of the UK plutonium stockpile should now be clear. Reuse via MOX is clearly the best option both in terms of utilising it as a fuel and putting the plutonium into a matrix suitable for disposal. Additionally, there is the deterrent effect of locking it into spent fuel with the attendant non-proliferation benefits. Not all plutonium can be re-used as fuel but technology (developed by NNL) for encapsulation of 'out of spec' material exists.

Setting out the use of the plutonium in MOX fuel as a preferred option in a preliminary policy view is the right thing to do. However, this does not mean that the UK should not pursue advanced reactor and fuel cycle technology in parallel. Such technology will be required in the future and, again, unless the UK is active, its potential international standing as a low carbon economy will be eroded.

Despite the above it is still important that the UK continues to retain its capability in understanding plutonium. There are many aspects to this such as chemistry, material properties and physical characteristics among others. Currently, the UK is not suitably investing in long term capability that should be generated through the NNL with hands-on research on active materials.

The MOX option does require investment in a replacement MOX plant. There were fundamental design issues with the current Sellafield MOX Plant (SMP) but this need not mean that MOX as a concept is flawed since it is adequately used in other countries such as France. Allied to this, it should be recognised that the current PUREX reprocessing flowsheet is not good when applied to high burn-up fuel, particularly MOX (and specifically ex FR MOX). A new recycle flowsheet is possibly long overdue as PUREX was first patented in 1947.

7. Are there any other high level options that the government should consider for the long-term management of plutonium?

Along with decommissioning and new-build, the current uncertainty over the cost and availability of a UK geological disposal facility, affects the viability of all plutonium management options. The CoRWM process is currently underway to identify suitable sites for geological disposal, but no final options have yet been identified. Any policy which can help reduce the uncertainty surrounding final disposal options will reduce uncertainty throughout all current nuclear programmes.