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| Respondent Details |                          |
| Name:              | Dr David Kingham         |
| Organisation:      | Tokamak Solutions UK Ltd |

Please select the category below which best describes who you are responding on behalf of.

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|-------------------------------------|---|
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## **Response to the DECC consultation on the long-term management of UK owned separated civil plutonium**

May 2011

This response is presented by **Tokamak Solutions UK Ltd** and supported by our Scientific and Environmental Advisory Board

1. Tokamak Solutions UK Ltd is a new company based at Culham that aims to develop commercial applications of spherical tokamaks and fusion neutron sources. Tokamak Solutions has recently secured investment from Sir Martin and Lady Audrey Wood, the Rainbow Seed Fund, Oxford Instruments plc and investor members of the Oxford Early Investments network.
2. Tokamak Solutions has been able to assemble a distinguished scientific and environmental advisory board chaired by Lord Julian Hunt, FRS (ex-fusion researcher and proponent of fusion-fission hybrids) and including Sir Martin Wood, FRS (co-founder of Oxford Instruments plc); Jack Connor, FRS (one of the most influential theoretical plasma physicists in the international fusion programme), Professor George Smith, FRS (emeritus professor of materials at the University of Oxford) and Professor Bill Lee (professor of ceramic engineering and deputy Director, Centre for Nuclear Engineering, Imperial College).
3. Tokamak Solutions is working on designs for a spherical tokamak as a plasma research and training facility and for a fusion neutron source for transmutation of nuclear waste. Tokamak Solutions is also keen to progress the idea of a fusion neutron source as a "user facility" for materials research.
4. We note that the International Atomic Energy Agency (IAEA) has recently shown interest in fusion neutron sources and that there should be good scope for international collaboration to accelerate the development and application of such sources. The UK is in a good position to play a leading role in any such international collaboration.
5. We are pleased to address the key questions posed on the Government's proposed approach to the longer term management of the UK's plutonium stocks.
6. Our main point is that the Government should "keep its technology options open". Given the uncertainty surrounding nuclear fission technologies, including safety and environmental concerns, it would be irresponsible of Government not to do so.
7. Our secondary point is that at least one of the technology options should be based on science and technology where the UK already has a world-leading position. In this case the UK has a leading position in fusion and a fusion neutron source is a potentially viable way of transmuting plutonium.

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| No       | Question  |
| Q1       | Do you agree that it is not realistic for the Government to wait until fast breeder reactor technology is commercially available before taking a decision on how to manage plutonium stocks?  |
| Response | Yes, because fast breeder reactor technology may never become commercially available on sufficient scale to use a significant amount of plutonium.  |
| Q2       | Do you agree that the Government has got to the point where a strategic sift of the options can be taken?   |
| Response | No. The possibility of using fusion neutron sources to transmute plutonium has not yet been considered. Until this option is seriously considered, it would be premature to undertake a “strategic sift” of the other options   |
| Q3       | Are the conditions that a preferred option must in due course meet, the right ones?   |
| Response | Two additional conditions should be taken into account: <ul style="list-style-type: none"> <li>i) the extent to which the preferred option relies on science, technology and engineering where the UK already has a strong track record.</li> <li>ii) the “spin-off” benefits of the preferred option, eg the potential for it also to deal with other radioactive waste including minor actinides and/or the potential for the technology to be exportable to other countries</li> </ul> |
| Q4       | Is the Government doing the right thing by taking a preliminary policy view and setting out a strategic direction in this area now?   |
| Response | It is right to take a preliminary policy view as soon as soon as all the plausible options for dealing with the plutonium stockpile have been considered.   |

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| Q5       | Is there any other evidence government should consider in coming to a preliminary view?  |
| Response | <p>Yes. The government should consider the growing evidence that fusion neutron sources can be useful for transmuting nuclear waste and commission one or more studies into the potential use of fusion neutron sources to transmute plutonium.</p>  |
| Q6       | Has the Government selected the right preliminary view?  |
| Response | <p>There is an inconsistency in this report between the assertion that “The reuse as MOX option... ..is based on proven mature technology that could be deployed on a reasonable timescale” and the fact that “the Sellafield MOX plant has produced a small fraction of its original target with around 15 tonnes, as completed fuel assemblies, produced in its 9 years of operation against an original target of 560 tonnes over an expected 10 year operational life.”</p> <p>No doubt many lessons can be learned from the astonishingly poor performance of the Sellafield MOX plant, but it would be wise for the Government to consider alternative technologies now and to keep alternative technology options open until any new MOX plant is operating reliably.</p> <p>The Government has not yet considered the possibility of using fusion neutron sources to transmute plutonium. Until this option is seriously considered, it would be premature to select even a preliminary policy view.</p> |
| Q7       | Are there any other high level options that the Government should consider for long-term management of plutonium?  |
| Response | <p>Yes. The Government should consider the possibility of using fusion neutron sources to transmute plutonium.</p> <p>Tokamak Solutions UK Ltd has produced a preliminary conceptual design of a fusion neutron source that could be suitable for transmutation of nuclear waste, including minor actinides (and for other applications such as materials research and production of medical isotopes).</p> <p>Initial scoping calculations have led us to a preliminary conclusion that</p>   |

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|  | <p>such a neutron source might be technically capable of transmuting plutonium.</p> <p>However, we recognise that there would be significant challenges in:</p> <ul style="list-style-type: none"><li>i) demonstrating technical feasibility at pilot scale,</li><li>ii) the engineering design of the fusion neutron source</li><li>iii) the engineering design of the transmutation “blanket”</li><li>iv) proving that this transmutation technology could be cost effective and deployable at sufficient scale to deal with all of the plutonium stocks</li></ul> <p>This proposed fusion neutron source is based on science, technology and engineering where the UK already has a world lead. There could be additional benefits of such a fusion neutron source including the potential for it to transmute minor actinides and produce medical isotopes. There is also the opportunity for international collaboration on the development of fusion neutron sources and for the technology to be exportable to other countries for various applications.</p> |
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