Monograph:
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Written Evidence: Priorities for nuclear research and technologies

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Responsibility for long term policy for civil nuclear activity

1. Responsibility for ensuring that the UK has a coherent and consistent long term policy for civil nuclear activities lies with Government and should continue to do so, to ensure that it remains focused on strategic national priorities but responsive to changing external drivers. In developing policy, Government should ensure it is able to call on independent evidence based advice, as set out in 21-23, and continue to consult on major policy developments. Co-ordination of activities and international collaboration in support of realising policy objectives should be undertaken by an independent advisory body (succeeding NIRAB) reporting to Government.

Industrial strategy green paper

2. The nuclear sector is well placed to benefit from a "sector deal" as defined in the Green Paper, through: long term investment and co-ordination of research and facilities development; boosting skills and high value jobs; and increasing commercialisation of research and export of technology, products, and intellectual property – particularly in nuclear decommissioning and waste management for which the global market is projected to be £50 billion per annum by 2020.[1]

3. The reformed Nuclear Industry Council could be well placed to lead, consult on, and facilitate, the specification and articulation of a "sector deal". Key leadership organisations to be engaged would be those with relevant strategic advisory, regulatory, and executive responsibility, such as the National Skills Academy Nuclear, the Nuclear Decommissioning Authority and Office for Nuclear Regulation.

Small modular reactors: benefits, disadvantages and risks for the UK, and more widely

4. The primary potential benefit of SMR technology to the UK is the opportunity to design, demonstrate, licence, and manufacture, an indigenous reactor which would be of interest to the international market. Production of SMR units in the UK would create high skill and high value employment and revenue. The more affordable up front capital cost of SMRs would facilitate deployment, compared to large scale LWR reactors. Potential disadvantages of SMR technology relate to the multiple smaller units required to produce a given generating capacity, which may lead to comparatively higher operating costs and lower fuel resource efficiency.

5. Conceptually, future decommissioning of SMRs could be achieved at comparatively lower cost, if assisted by the modular nature of construction. However, it is not apparent that this would achieve a net reduction in the quantity of associated radioactive waste, compared to conventional Gen3+ LWR systems, normalised to usable energy output. Further research is required to assess this issue.

6. The key risk to SMR deployment is that the capital, financing and operating costs of SMRs remain the subject of considerable uncertainty and commercial privilege. Government commissioned research is addressing this knowledge gap, however, a lower levelised cost of electricity is not readily apparent. The distribution of many SMR units and spent fuel storage facilities across multiple nuclear licensed sites, would pose enhanced risks of security, safeguards, and emergency planning.

Global market opportunity for SMRs

7. A recent analysis estimated the global SMR market for electricity production to be 65-85 GW of installed capacity to 2035, with an undiscounted market value of £250-400bn.[2] However, this opportunity should be consider with caution, because: i) there is fundamental uncertainty concerning the economics of SMRs (5); and, ii) the indigenous market in nuclear-capable nations (e.g. China, USA) may be a barrier to UK exports. The key opportunity for the UK is to be amongst the first providers to the international market in delivering an SMR product, which will maximise the economic benefit in terms of employment and revenue. Alternatively, the UK may exploit the opportunity of the global market, at lower risk, by creating saleable intellectual property or providing services such as licencing, operations, and fuel design, fabrication, management and recycle.

Research and development on SMRs

8. At present, there is a lack of clarity concerning the objectives of the national strategy, and overall economic advantage, of SMRs, which Government should address. If the opportunity is development and export of a UK SMR design, then considerably more investment will undoubtedly be required for technology development and demonstration, and creation of a supply chain.

Development of Gen IV technology

9. There should be strong involvement and leadership of technology development, if Gen IV technology can be demonstrated to be essential for operation of a sustainable UK fuel cycle, or the foreseeable export opportunities are plausible. Arguably, the current evidence in support of both drivers is weak, given that disposition of the current plutonium stockpile via a Gen IV sodium cooled fast reactor has not been shown to be a compelling option.

10. In the absence of clear strategic policy drivers, Government should ensure: i) that there are no barriers to UK innovation related to Gen IV technology or the partnership of historic UK strengths in high temperature gas cooled reactors and sodium cooled fast reactors with current international projects; and ii) research is primarily focused on generic issues which underpin more than one specific technology, including the participation in test reactor development.

Remit and role of the National Nuclear Laboratory

11. Overall, NNL can be considered to making a positive contribution to overall UK strategy and research effort, together with other public and private sector organisations. However, there is an obvious tension between the public, commercial, and beneficiary role of NNL in nuclear fission research, and potential conflict with its stewardship role, which would be worthy of review.

12. Evidence presented to a previous inquiry highlighted the need to provide greater access to enable access to the national research infrastructure managed by NNL.[3] Progress has been made on this issue, however, much more needs to be done in order to meet the demand of high quality research ambition. Access to facilities at the EC Joint Research Centre and US National Labs has proven more straightforward, in my experience, and has delivered timely and quality research outcomes.

13. As highlighted above (11), NNL is well placed to deliver a substantial proportion of research required to support the UK's future energy policy. Effective partnership with other organisations should be strengthened and nurtured to deliver some aspects of its role, in terms of engaging expertise and facilities, for example in waste management technology.

Funding and governance of the National Nuclear Laboratory

14. The remit of the NNL is suitable to provide research and development support to the UK nuclear sector. The strong resonance of the strategic remit with the £250M national research programme, should ensure that NNL is well placed to secure substantial funding, in addition to its commercial business, without the need for additional intervention.

15. In terms of governance, extending the length of the NNL management contract (e.g. 10 years, consistent with National Physical Laboratory) should enable the organisation to develop its infrastructure and strategy to deliver longer term research objectives, as previously recommended.[3]

Oversight of the whole nuclear R&D landscape

16. Over the last three years, NIRAB has exerted the only effective oversight over the whole nuclear R&D landscape, as far as its remit permitted, as set out in 17-20. This ended with its term of office.

Nuclear Research & Innovation Advisory Board and its successor

17. With respect to the remit of NIRAB, as set by Government, it must be considered as highly effective in delivering its role. Examples include: development of an integrated national innovation programme, and allied business case; timely advice presented to Minsters on Small Modular Reactors; and facilitating investment in research infrastructure realised by in-year expenditure opportunities, which have already had a transformative positive impact on UK research, as summarised in the UK Civil Nuclear R&D Landscape Survey 2017.[4] As an example: investment of £800k by DECC in the MIDAS Facility at The University of Sheffield has supported of a research portfolio in excess of £15M, with grant awards to use the facility in excess of £8M.[4]

19. Co-operation and co-ordination of government, public and private sector organisations, was very effectively facilitated by NIRAB, through Board and sub-group meetings, enabling research plans and priorities to be shared and effectively targeted. An important example, is co-ordination of capital facilities expenditure planned through direct DECC grants, the Henry Royce Institute, and National Nuclear Users Facility. It would be highly beneficial to maintain such a forum for communication in any future Governance arrangements.

20. Fundamental to the success of NIRAB, was an independent, authoritative, and influential Chair and Secretariat. It is highly desirable that in future Governance arrangements, the position of NIRO as an independent Secretariat, with no conceivable conflict of interest, should be preserved.

21. A successor body to NIRAB is certainly justified and desirable, the risk of not constituting such a body would be disintegration of the research landscape, adversely impacting research outcomes and benefits. The NIRAB approach to co-ordination was successful and could continue to be effective either as a time-limited or permanent successor body. Voluntary participation of members on NIRAB proved effective in managing commercial interests which might be difficult for paid appointment.

22. A successor body to NIRAB would require adjustment of remit, to reflect the shift in focus from defining to delivering the national research programme. The key function should address the need for co-ordination of nuclear research strategy, with a view to advising Government on shaping publicly funded research to ensure that near and long term policy objectives are realised, including international collaboration. The body could be tasked with oversight of the quality and impact of outcomes from the BEIS sponsored national programme, but this would need to be carefully tensioned against the strategic advisory role. The constitution of the body should ensure that leading research organisations are engaged, appropriate to the scale of its remit. In order that co-ordination can be effectively managed, this could be achieved with greater use of focused sub-groups.

23. Irrespective of the nature and remit of the successor body, the need for independence cannot be over emphasised; the body should therefore be commissioned by Government, not a third party.

21. Notwithstanding the success in development and funding of the national research programme (**17-20**), two areas are highlighted for improvement. First, enhanced prioritisation and co-ordination of international engagement activities is required, both to deliver research objectives and as a route to the global market. Second, the recommended prioritisation the national research programme is focused on rather near term and commercially driven objectives, to the detriment of a fully integrated approach in some areas. For example, the recommended balance of research resource allocated to

waste management versus fuel recycle (which will generate future higher activity wastes, that are outside the remit of NDA), may not be sufficient to fully underpin delivery of future fuel cycle scenarios – see Figure 1.[5] Whilst it can reasonably argued that early revenue generating research opportunities should be prioritised, the risk of not pursuing a proportionate waste management technology programme is an escalation in final clean-up costs which fall to the tax payer.

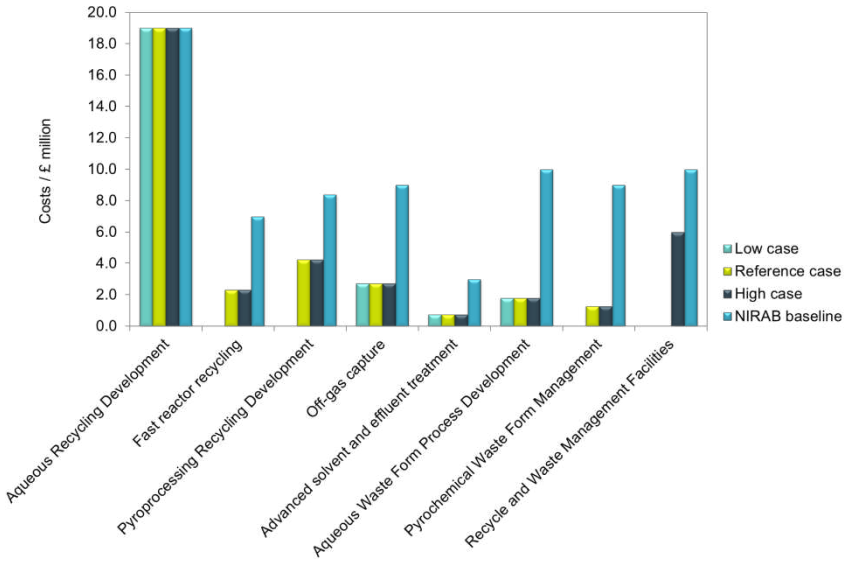

Figure 1: Prioritisation of recycle and waste management R&D from NIRAB 124-1 (with permission).[5]

Exiting the European Union

28. The following additional issues are highlighted due to relevance and timeliness: exiting the European Union and plutonium management.

31. UK nuclear research and innovation programme is at risk of disproportionate adverse impact arising from the leaving the EU due to close collaboration on, and integration of, strategic research priorities and facilities. The EC Joint Research Centre, at Karlsruhe, provides access to research infrastructure not available or accessible in the UK - and which is unlikely to be available in the next decade (e.g. research with weighable quantities of plutonium-238). Research in the UK is at risk of being curtailed in its ambition and significance if access to the EC JRC is not maintained.

32. The UK has a respected and influential role in the two relevant EU technology platforms (IGDTP and SNETP), ensuring that research is well aligned with our national needs. Leverage of the financial resources, expertise, facilities and expertise associated with EU framework and Horizon 2020 programmes, has proven pivotal in sustaining the UK's own endeavours in geological disposal of radioactive wastes, such as the CAST and REDUPP consortia projects.

33. Whilst Government has provided welcome assurance that financial commitments to existing Horizon 2020 projects will continue after leaving the EU, there is an urgent need to address the uncertainty of funding future UK engagement in EU nuclear research projects and access to facilities.

Plutonium management

34. Government policy is that *any remaining plutonium which is not converted into MOX fuel, or otherwise reused, will be immobilised and treated as waste for disposal*.[6] Since commitment to this policy in 2013, the technical maturity of the MOX fuel option has been called into question, given that the US MOX Fuel Fabrication Facility is heavily delayed and over budget.[7] A review of the credible options for plutonium management would seem appropriate and timely, in particular, to ensure stockpile immobilisation is technically underpinned, should this be required.

24 February 2017.

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