Nuclear Institute response to the House of Lords inquiry into priorities for nuclear research and technologies

22nd February 2017

The Nuclear Institute

- The Nuclear Institute (NI) welcomes this opportunity to respond to the Committee's inquiry into the priorities for nuclear research and technologies. This submission has been supported by our professional members.

- The NI is a charity registered in England. Its objectives relate to:
    a. the advancement of education relating to nuclear energy;
    b. the advancement of nuclear science, engineering and technology;
    c. in the interests of public safety, the promotion of high standards of education and professional performance amongst those engineers, scientists and others working within the nuclear industry;
    d. the promotion of the public understanding of nuclear sciences and the impact on society and the environment.

- It is also a professional and learned body with over 2000 individual members, made up of engineers, scientists, other professionals and a number of individuals who have an interest in the NI's objectives. The NI is licensed by the Engineering and Science Councils to register qualified members as Chartered Engineers and Chartered Scientists.

- The NI has ten regional branches across the UK. It also has two national networks: the Young Generation Network; and Women in Nuclear, which seeks to address the industry's gender balance and improve the representation of women in leadership roles across the sector.

- The NI has established a Special Interest Group (SIG) focused on the development of Small Modular Reactors (SMRs).

- The NI is not a trade association and does not directly take account of its company members' views, instead relying on individual members' views and its charitable objectives to come to an independent position.

The NI's response to the Inquiry

1. Where if anywhere do you believe that responsibility should lie for ensuring that the UK has a coherent and consistent long term policy for civil nuclear activities including international collaboration and, within the UK, for cost-effective and efficient articulation of the different elements of nuclear work?

The NI believes that the UK Government has responsibility for establishing a long term policy for civil nuclear activities and research and development. As has been the case historically, it is important that this is done in conjunction with industry, academia, professional institutes and national laboratories. We see the current development of an industrial strategy as an important vehicle that will help align and integrate nuclear R&D; the nuclear industrial strategy with wider governmental objectives.

2. The Government's industrial strategy green paper discusses a possible 'sector deal' for the nuclear sector. How might the nuclear sector benefit from such a sector deal? What might a deal involve and who would be the leadership organisations within the sector for such a deal?

We believe that there is a significant opportunity for the UK industry to collaboratively develop a potential 'sector deal' to help increase UK exports, commercialise UK nuclear expertise and improve value for money in the UK industry. It is important to build on the relationships built through the Nuclear Industry Council and NIRAB, and ensure that there is representation from across the sector in developing the sector deal (including SMEs).

3. What are the potential benefits, disadvantages and risks from the deployment of SMRs in the UK and more widely?

Members believe that the development of a UK design and the associated accumulation of Intellectual Property generated through the deployment of a SMR could;

- significantly enhance the UK's nuclear capability both at home and internationally
- improve UK security of supply of electricity and
- improve the economics of financing nuclear power.

The UK's current advanced manufacturing capability means it is well placed to preserve its world technology leadership role in the development of SMR technology led by British based business to develop civil designs based on military and civil reactor experience.

Small modular reactors lend themselves to series production and do not require the very large forgings and fabrications characteristic of large nuclear power reactors. They represent a great opportunity for established British businesses to compete with foreign suppliers based on the UK's long experience and demonstrated capabilities.

SMRs have many advantages over large power reactors. These include:

- Low unit capital cost
- Low demands on local electricity distribution infrastructure
- Suitability for series production in a "factory" environment leading to economies from better productivity and multiple orders
- Lower potential release terms reducing worst case accident consequences
- Potential for inherently safe design using natural convection decay heat removal and use of partially buried containment to improve shielding and resilience to external hazard
- Potential for siting close to remote communities or industrial consumers reducing transmission costs and losses
- Ability to be "multiplied up" in a nuclear power park as demand grows.
- Greater flexibility to match nuclear capacity to demand by adjusting the number of reactors on load at any time.

- In theory SMR reactors can be removed from their operating site for maintenance and decommissioning provided appropriate transport arrangements are in place.

SMRs do however have disadvantages:

- Overall they are unlikely to have either the thermal efficiency or the fuel efficiency of a large reactor with optimised secondary design and fuel zoning etc.
- They are likely to be more expensive per installed MWhr than large reactors.

The above issues are particularly significant for smaller capacity power generating units - less than 200MW(e).

- Finally, there is no currently available commercial civilianised design for GDA, nor an obvious UK manufacturer ready to undertake design and construction.

An additional challenge for the industry is to ensure that there is sufficient capability and pipeline skills and knowledge to successfully deliver current and future nuclear programmes. We believe it is essential and critical to success that there is continued investment in the nuclear skills, training and leadership arena through the appropriate recognised bodies e.g. National College for Nuclear, NSAN and other training providers and through professional learned bodies such as the Nuclear Institute. The drive to improve the number of quality apprenticeships in the nuclear industry (EdF Energy, Sellafield Ltd, NNL, supply chain etc.) is a positive move that will also help address the capability and capacity risk.

4. What is the scale of the global market opportunity for SMRs? What would the cost be if the UK does not take full advantage of the opportunities of SMRs?

As described in NNL's feasibility study (2014), the potential global market for SMRs is of the order of £250-400 billion.

We believe that not taking full advantage of the opportunities of SMR technologies would be a wasted opportunity through lost revenue from potential exports, as well as the additional burden on the balance of payments deficit.

The UK does not provide any offering (vendor) for the current generation of nuclear reactors and is unlikely to do so in the medium-term for large scale reactors. There is currently a gap in the market for SMRs and the opportunity for the UK to participate in developing and deploying a SMR could provide the UK supply chain with the opportunity to generate a viable offering to the international nuclear community. A "UK product" SMR offer can also be augmented by a "UK services" SMR offer with lifecycle professional services and engineering and science expertise being deployed over several decades. The UK offer can also extend to final decommissioning.

We believe that the capability exists across the UK nuclear sector to meet the requirements of deploying and marketing an SMR proposition, however, there is a risk that this capability diminishes if not utilised on nuclear programmes. There will likely be additional competition for these capabilities across the nuclear and other sectors over the coming decades.

It is important that the UK is a leader in the development and deployment of SMR technology from the outset such that the country and our unique nuclear capabilities can capture a proportion of the significant potential global market.

5. Is the Government doing enough to fund research and development on SMRs, and to stimulate others to do so? Should it be doing more to coordinate UK actions including international engagement on SMR development and future deployment?

We welcome the government's commitment and allocation of at least £250M investment over 5 years in an ambitious nuclear research and development programme, including the competition for best value SMR design. However, investment needs to be sustained over the longer term to realise the wider benefits of this programme.

The development and industrial demonstration of a SMR in the UK would be a positive statement to the industry and supply chain. The NI believes that the UK government should enable and encourage companies to move swiftly to industrial demonstration of the technologies to help build confidence and commitment from the supply chain to see this ambitious programme through to completion.

It is important that UK companies are utilised in research and development and design programmes to ensure that intellectual property is held by the UK and an ability to deploy and maintain these systems is maintained within the UK.

6. Are the criteria set out by the Government for the SMR competition appropriate? If not, what should the criteria be? What timescale should the Government be working to in choosing an appropriate SMR design for the UK?

We support the criteria as set out by the Government for the SMR competition.

7. Should the UK be involved in the development of Gen IV technology? If so, what funding and support should be put in place to place to help the UK establish a world leading position? Should our activity include development of one or more test reactors?

The UK has ambitions of making a return to the top-table, and establishing itself as a world leader in the nuclear sector. This will require involvement and active participation in the development of Generation IV technology. This type of international collaboration will become of paramount importance as the UK seeks to re-position itself on the international agenda post-Brexit.

The UK is currently a non-active member of the Generation IV International Forum (GIF). Having withdrawn from the 2005 Framework Agreement, we are not an active participant in the development of one or more Generation IV systems selected by GIF. The NI believes that collaboration with this international research and development programme is paramount to ensure that a skills base is created in the UK prior to future deployment.

We believe that research into Fast Breeder Reactors should be a priority as it is in other countries. The UK has historic capability and expertise in this field. In addition the UK has the world's largest civil stockpile of plutonium which can be used as fuel in FBRs and has the potential to contribute to meeting the UK's energy needs, as well

as safeguarding the fuel. By linking the research and development with a potential test reactor, this could help maintain and grow the UK capability as well as support the UK to re-establish itself in the international community.

Governance

8. Is the NNL fulfilling its remit appropriately? Can it deliver the required research to support the UK's future nuclear energy policies? How does it compare to equivalent organisations in other countries?

Whilst we believe that NNL has the right capabilities to deliver the required research to support the UK's future nuclear energy policies and fulfil its remit, we believe that the funding and governance arrangements limit its ability to deliver optimum value for money for UK plc. This is discussed more in response to question 9.

9. Is the remit of the National Nuclear Laboratory (NNL) suitable to provide research and development support to the UK nuclear sector? Is the current funding and governance model for the NNL appropriate to its role and remit?

NNL's mission is:

> "To be the key UK civil nuclear fission R&D provider by:
> - Delivering high value independent, authoritative advice and a quality service to our customers
> - Creating value for stakeholders by maintaining the commercial basis for our business and sustaining a strong positive cashflow for reinvestment in programmes and capabilities
> - Increasing our influence on the UK nuclear research agenda."

NNL has a need to be 'profitable' and a commercially viable organisation. This forces the organisation to provide a service that can provide a suitable return on investment to support its operations. Whilst this is a strong basis for any business, it does mean that the unique skills and capabilities of NNL aren't necessarily being optimised to develop the UK's nuclear capabilities and develop a broader return on investment for UK plc. Whilst the organisation can offer the necessary capabilities to support the UK's future energy policies to fulfil its remit, it is unlikely to be able to deliver these through current funding arrangements as the free market is unlikely to request this service/capability.

We believe it is important to have integration across the nuclear sector to ensure a successful development of any future reactor across its lifecycle. Whilst certain bodies play a more active role at certain stages (e.g. NNL would likely play a key role in the early research and development), it is important that there is collaboration across the lifecycle of the programme(s).

10. Is there sufficient co-ordination between the bodies involved in nuclear research and, if not, how should it be improved? Who has oversight of the whole nuclear R&D landscape, including international activities?

We believe that there is still greater opportunity for collaboration across the public and private sector in aligning and collaborating on nuclear research. Whilst there have been positive developments and some good examples of cross-sector collaboration and innovation, this is largely by luck rather than conscious choice. We believe that there is potential for greater alignment and synergies between nuclear defence, nuclear fusion and the civil nuclear sector.

11. Was the Nuclear Innovation and Research Advisory Board successful in carrying out its role? Is a permanent successor body to NIRAB required? If yes, what form should this body take and what should its role and remit be?

We believe NIRAB was a welcome addition and brought greater alignment across the industry with regards to research and development. We would welcome a successor body being established with a clear role and purpose, including the intent of recommendation 3 in NIRAB's final report:

"Government should implement a transparent and effective mechanism to coordinate and, where necessary, direct, all publicly funded nuclear R&D activities in order to achieve the desired industrial impact and maximise value for money."

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