Review of the Balance of Competences - Research and Development Call for Evidence

Response from the UK National Nuclear Laboratory

August 2013

The UK's National Nuclear Laboratory (NNL) is a Government-owned body, operating as a commercial business providing nuclear analysis, research, technology solutions and insight to customers in the UK and overseas. With over 10,000 man-years of accumulated nuclear industry experience, NNL hosts a large portion of the UK's nuclear research & technology knowledge.

This note summarises NNL's involvement in European Union funded R&D programmes, and provides evidence and opinion against the questions posed by BIS for the Balance of Competences review.

Background to EU nuclear fission R&D and UK involvement

International collaborative research projects are fundamental to the development of both the current and next generation of nuclear technologies, and for the long-term management and disposal of nuclear waste. In the EU, nuclear energy research is managed by Euratom, previously through the Euratom Framework Programme (FP7) and in the future through Horizon 2020. The nuclear fission FP7 budget was ~€300 million and Horizon 2020 is set to be ~€355 million over 5 years. Supporting and coordinating this research are three forums that bring together leaders from industry, academia and national research and safety organisations to plan and carry out research more strategically.

- Sustainable Nuclear Energy Technology Platform (SNETP)
- Implementing Geological Disposal Technology Platform (IGDTP)
- Multidisciplinary European Low-Dose Initiative (MELODI)

Each has a Strategic Research Agenda which guides the research conducted. The UK is represented on each forum by a number of universities, companies and national bodies, such as NNL and the Nuclear Decommissioning Authority.

The level of UK engagement in collaborative research programmes over the past decade has been low compared to other nations, and there has not been a UK nationally funded or coordinated approach to EU R&D involvement between academia, industry and national laboratories.

To address this issue, UK Government has stated in its recently published Nuclear Industrial Strategy a change of role and remit for NNL to one that is more nationally strategic – at present NNL operates purely as a commercial entity. NNL's future remit will involve coordinating and representing UK industry and academia in international fora, and leading UK national R&D programmes on behalf of Government through a new Nuclear Innovation Research Office (NIRO). The aims are to increase the international profile of the UK's nuclear sector, to maintain key domestic capabilities and ultimately to contribute to energy security and economic growth. A recent indication of the UK's increasing reputation is that NNL were

asked in March 2013 to chair the NUGENIA Executive Committee (one of three SNETP initiatives), and to host the 2014 NUGENIA General Assembly.

It is NNL's view that the UK should maximise the possible benefit from the EU funded programmes into nuclear fission related technologies on a greater scale than we do presently. To do this the UK will need to have its own national programmes which make a valuable financial as well as technical contribution to international collaborative research.

NNL response to BIS consultation questions:

Impact on the national interest

1. *Where has EU action had a **positive impact** for the UK on research, technological development, innovation or space? What evidence is there for this? Has EU action encouraged national action in any areas?*

   EU research funding under the Euratom Framework Programme (FP7) has allowed NNL to participate in cutting edge nuclear fission research using the UK's active nuclear R&D facilities. A number of examples are given in the annex to this note. Each project has resulted in its own specific benefits which are listed, the general themes of which are:

   - Developing people and attracting new entrants into the industry.
   - Generation of valuable research networks on an individual and organisation to organisation basis.
   - Increasing the UK's capability, both in technical knowledge and expanding the research facility base in areas that "UK only" funded research would not do. This includes gaining access to and knowledge from major international nuclear fission research facilities and programmes.
   - Increasing the UK's international reputation in making valuable contributions to collaborative nuclear research.
   - Leverage UK funding giving access to much larger research projects that would not have been possible from a "UK only" position, allowing the UK to collaborate on level terms with other EU R&D institutions and industry.
   - Innovation being seen to be led by the UK, allowing the UK to influence the future direction of research.
   - Conducting research that can underpin future UK national energy policy.

2. *Where has EU action had a **negative impact** for the UK in these fields? What evidence is there for this? Has EU action prevented potentially useful national action in any areas?*

   NNL can identify no specific negative impacts on UK Nuclear Fission research

3. *How, and where, has UK engagement with partner countries or international bodies, both within and outside the EU, been helped or hindered by EU involvement?*

Collaboration with other EU R&D institutions and industry is facilitated by the involvement in EU programmes allowing the UK to market its talent, expertise and cutting edge facilities. The only hindrance is in relation to the level of funding achievable for nuclear research through the Euratom treaty arrangements where anti-nuclear nations block funding increases and limit the scope of research called for under the fission framework calls.

4. *What benefits or difficulties has the objective of a European research area (ERA) delivered for the UK?*

   NNL is not aware of any specific benefits or difficulties associated with ERA, and believe the objective is more linked to academia and their European research alliances.

5. *How has the EU sought to coordinate the policy instruments at its disposal across different policy areas to create an enabling environment for researchers and innovators? How successful has this been?*

   This has been well coordinated by SNETP and its underpinning R&D strategy groups to enable the best environment possible.

Future opportunities and challenges

6. *What could the EU most helpfully do to promote scientific and technological progress and innovation (including in the space sector)?*

   - *How could the EU use its existing competence differently to deliver more in your area?*

   - *How might a greater or lesser degree of EU competence deliver more in your area?*

   - *How could improvements to existing EU activities make them more effective and efficient?*

   The EU could use its processes and support arrangements to better align the R&D calls with member states' national programmes (where these fit) to maximise the benefit of EU wide collaboration.

   It could also streamline the bidding/competition process to reduce the time between proposal submission and project start dates.

7. *Where might future EU level action be detrimental to your work in this area?*

   NNL are not aware of any specific areas where this is likely.

8. *Where might action at national rather than EU level be more appropriate / effective?*

   A structured and funded UK Nuclear research programme, alongside an EU programme, would allow the UK to take a more leading role internationally, and direct EU research in areas that are relevant to the UK.

   In the bidding/competition process, the UK could provide support to groups developing project proposals in the pre-contract phase. The current proposal process is considered

cumbersome and may be too costly for industry to justify, resulting in missed opportunities.

As with a number of sectors the nuclear research area is subjected to Export Control regulations. This controls the export of strategic goods and technology that are subject to national legislation and typically in the civil nuclear research area applies to items that could have a dual use. Action therefore at a national rather than EU level may be more appropriate for some areas of civil nuclear research.

9. *How could EU and national policies and funding streams interact better?*

   Better coordination of the national programmes and their interaction with and development of the EU programmes would help to maximise the overall value of the projects.

10. *What impact would any future enlargement of the EU have on this area of competence?*

    It would increase the potential for collaboration between member states and allow cross border learning opportunities.

11. *Are there any other points you wish to make which are not captured above?*

    None.

NNL would be happy to discuss any of the points raised above in further detail.

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Annex – Examples of NNL involvement in EU R&D programmes

The following are examples of EU R&D projects under the 7th Framework programme that have been beneficial to NNL and the UK. NNL are currently involved in or have submitted proposals for over ten R&D programmes, and further details of these can also be provided if necessary.

ACSEPT - Actinide Recycling by Separation and Transmutation

The ACSEPT project ran between 2008 and 2012. The project focussed on developing aqueous and pyrochemical processes for advanced actinide separations, moving R&D towards pilot scale demonstrations. Actinide recycling by separation and transmutation is considered as one of the most promising strategies to reduce the inventory of radioactive waste as part of a more sustainable future nuclear fuel cycle.

ACSEPT was the largest single project in the EURATOM 7th Framework Programme. It had a budget of €24 million, €8 million of which was from EU funding, with over 20 partners drawn from numerous universities and research institutes across Europe; this included all of the major European national nuclear laboratories as well as CRIEPI and ANSTO.

The benefits for the NNL and the UK are:

- Developing people – A total of 25 NNL staff were involved, resulting in a significant level of learning and development, with networks between researchers (both internally & externally) developed or enhanced. The project allowed the UK to maintain a skill base in fuel reprocessing science and engineering R&D against the backdrop of a difficult funding environment in the UK.
- Increasing the UK's capability – ACSEPT has driven the development and commissioning of NNL's glovebox capability for fuel cycle chemistry within its PuMA Laboratory. The gloveboxes have since been used for projects supporting Sellafield Ltd, NDA, DECC and the European Space Agency. Without ACSEPT, NNL would not have been in a position to support these customers.
- An increased international reputation for the UK - UK was seen as a leading partner in the project, and has established close collaborations with EU universities and research institutes. This has led to new opportunities for NNL and UK universities in European level projects (SACSESS, ASGARD, TALISMAN). 11 papers have been submitted to scientific journals and publications with a further 10 planned. 11 presentations have been made at international conferences.
- Innovation - NNL have led development of a new, innovative GANEX (Group Actinide Extraction) process that has now been hot tested with Spent Fuel at ITU, Karlsruhe. This process is being developed further through a DECC funded R&D programme.
- Underpinning future UK energy policy – ACSEPT has enabled the UK to demonstrate the technical feasibility of innovative options for future closed fuel cycles that can be objectively evaluated against likely future scenarios in order to scientifically underpin UK nuclear energy strategy and policy decision making by Government.

ASGARD – Advanced Fuels for Generation IV Reactors: Reprocessing and Dissolution
ASGARD is a four year programme which began in 2012; funding is provided by the EU, NNL and NDA. It focuses on advanced/novel nuclear fuel for Generation IV reactors focussing on their fabrication and respective reprocessing issues. ASGARD seeks integration between reactor, fuel and recycling communities and is an international effort of 16 institutions from 9 European countries. NNL's involvement is with the fabrication and reprocessing of carbide fuel.

The benefits for the NNL and the UK are:

- Developing the UK knowledge of fuel fabrication techniques for future generations of reactors. This will allow us to retain a capability that the UK were world-leaders in several decades ago, and are still highly considered, but are at risk of losing if no action is taken.
- Understanding where opportunities for UK research, development and ultimately commercial involvement may lie in fuel fabrication in the European and wider markets.
- Underpinning the direction of future UK energy policy.

GoFastR – Gas-cooled Fast Reactor

GoFastR is a three year programme that began in 2010 and will conclude in 2013. Funding is provided by the EU and NNL through the NNL's internally funded Reactors and Fuels Signature Research Programme. The Gas-cooled Fast Reactor (GFR) is a Generation IV reactor design that is being developed through international collaboration in order to be safe, sustainable, economic and proliferation resistant. In particular, GFR could be capable of operating at very high temperatures (higher than other fast reactors) thus allowing for more efficient electricity generation and the supply of process heat for other applications such as hydrogen gas production.

The GoFastR project has focused on the development of the designs for GFR and the ALLEGRO demonstrator reactor with contributions from 22 institutions across 9 European countries. NNL has contributed a strategic assessment of the potential impact of GFR in the fuel cycle, a fuel performance assessment of the MOX fuel proposed for the first lower temperature core of ALLEGRO and a review of advanced cladding materials for the subsequent higher temperature ALLEGRO cores.

The benefits for the NNL and the UK are:

- Increasing the UK's international reputation – the UK contribution to the development of the design has been significant. The project has also provided a platform to showcase the UK's world-leading capability in fuel cycle modelling through NNL's ORION code.
- Providing the technical underpinning to direct future UK national energy policy decisions with regards to possible future nuclear fuel technologies.
- Developing the UK's knowledge of high temperature fuel cladding material through an extensive (3000 document) literature survey.

CARBOWASTE

CARBOWASTE was a European collaborative research project into the 'Treatment and Disposal of Irradiated Graphite and other Carbonaceous Waste'. It commenced in 2008 and completed in March 2013. The aim of the project was to develop best practices in the retrieval, treatment and disposal of irradiated graphite, addressing both existing legacy waste as well as waste from graphite-based nuclear fuel resulting from a new generation of nuclear reactors. The consortium was led by Germany and involved 28 partners from Europe and South Africa.

The benefits for the NNL and the UK are:

- Access to a wide knowledge base of the behaviour of irradiated graphite, which is essential for us to be able to manage and dispose of graphite safely in the UK.
- Increasing our international reputation by successfully leading the Integrated Waste Management Work Package.

Space Batteries

In 2011, NNL was awarded a contract from the European Space Agency (ESA) to carry out research into the potential use of americium extracted from UK civil plutonium to power future spacecraft. This built on an initial scoping study carried out under contract with ESA in 2010, involving a number of UK companies and universities. The project focused on the feasibility and plant requirements to carry out the extraction of americium, and used material from the UK civil plutonium stocks for testing in the NNL Central Laboratory located on the Sellafield site.

Whilst the research was focused on the needs of the ESA, the research carried out is very relevant to future work expected to be required to manage UK civil plutonium stocks. The project has therefore had benefit to the UK in supporting this future work and the decisions that will need to be taken. It has also developed skills in the specialist area of radiochemistry, and supported the ongoing development of capability at the NNL. The project has also linked with UK universities and furthered research links between industry and academia. Through involvement in this project, NNL has expanded it links into other technology sectors. This has enabled previously unseen technology transfer opportunities to be identified and exploited, providing benefit in reduction of cost or improvement of efficiencies to existing NNL customers in the UK.

(Note: this project was not funded through the EU FP7 framework, but directly from ESA).