nuleaf
nuclear legacy
advisory forum

Note of the meeting with Rolls Royce to discuss their Small Modular Reactor (SMR) programme held 9th October 2020 on Microsoft Teams.

See Appendix 1 for delegate list.

1. Welcome

1.1 Phil Matthews welcome everyone to the meeting and ran through online meeting protocols. He then handed over to Martin Goodfellow (MG) of Rolls Royce.

2. Presentation by Rolls Royce

Mr Goodfellow gave a short presentation, of which key points are:

2.1 Rolls Royce (RR) is part of a consortium of businesses (UK SMR) developing an SMR programme. Its approach centres around a vision of future clean energy which is reliable and cost effective. They are mindful that they need to have a clear view of how SMRs will integrate with other technologies such as solar and wind.

2.2 The consortium has looked at who will want to use this technology. Cost is a huge driver and a lot of early work was carried out in understanding what the cost of nuclear is. While they cannot predict all the challenges, UK SMR has done what it can to identify risks and issues and design them out where possible.

2.3 As a concept SMRs are not new and have been around as far back as the 1950s. RR has been involved in a number of programmes over the years which has taught it the benefits of the SMR.

2.4 Why the focus on small reactors? A smaller project is financially attractive to a wider selection of potential funders. The construction is also more manageable. There is an advantage in a design which you know you can build repeatedly on time and to budget.

2.5 Most big nuclear power plants were designed in the 1980s. There has been a big leap in technological development since then and UK SMR has an advantage in that the range of technology and knowledge at their disposal is far greater than that available to their predecessors.

2.6 A station which starts generation in 2030 is likely to be on-grid until the 2090s or perhaps even into the 22nd century. There is a need to design in the ability to incorporate new technology as it develops in the coming decades.

2.7 The focus is not solely on electricity generation. The real challenge for industry and governments is decarbonising heat and transport. At present electricity is not a practical fuel source for air travel and hydrogen or synthetic kerosene are more likely to succeed. Production and use of these is technically possible, but they will be driven by demand. Electricity will be required to produce these fuels and nuclear has the potential to be the generator, but we need to deliver a product which is safe, which people have confidence in and which is cost effective.

2.8 Development of RR's SMR is evolving. Unit cost is £1.8bn and depending on what financing package is put in place we could be looking at a price of £40 MWh for the electricity generated. Early units will have higher charges, but costs will come down as more units are constructed.

2.9 Other uses could be to power district heating or cooling systems, or desalination plants.

2.11 The SMR programme could attract UK export finance from the government which would lower costs.

2.11 The concept is a conventional Pressurised Water Reactor (PWR) in a non-conventional station. We are focussing on innovation in construction, deployment and through lifetime asset management.

2.12 The footprint of the shell containing the reactor is 1.5 football pitches, plus the surrounding berm which contains support facilities. The shell sits within a seismic bearing. Most of the components can be constructed in a factory, and the factory can be located near the site. The site has enclosed construction which limits light pollution and also mitigates the impact of weather on the site allowing an increase in shift patterns and therefore an increase in productivity.

2.15 The majority of the cost of the project is contained within the shell building: 90% of the cost in the plant and 10% in digging the hole to contain it.

2.16 There are a number of very specialist nuclear components which need specialised production facilities, but the majority of the plant can be produced in a factory and shipped to the site for assembly. Laing O'Rourke, one of the consortium members, is able to make modular concrete in a workshop which can be shipped to site, though some further work on this is required to make it compliant with nuclear regulations. Where possible we will move away from concrete. Steel can be used in a more modular and repeatable fashion.

2.17 UK SMR entered Phase 1 in November 2019 when UK government awarded £18 million of match funding which will take UK SMR through to completion of the conceptual design and entry into the Generic Design Assessment process. Further funding will take UK SMR though the GDA process. Phase 2 will begin in April 2021

with completion of the design and establishment of a factory to deliver the power station. That phase will end in late 2024 with the start of construction on the first unit. Our goal is a baseline of 16 units. We have significant international interest, with MoUs signed with countries around the world. There are competitors such as Russia and China, but these products tend to come with political strings.

2.18 The export potential is large and sustained production through the 2030 and 2040 would secure 40,000 jobs and add £50 billion to the UK economy.

3. Q & A session

3.1 Q: What cooling system do you use?

A: The cooling demand is scaled to the size of the plant. The baseline solution we are considering is an indirect cooling system i.e. mechanical cooling tower. It would have a low profile (5-8 metres high) and be integrated with the site layout. If we have multiple units then cooling requirements increases, but we do have a range of options and can take a scaled approach.

3.2 Q: Who will select the site and who will operate it? Are the old Magnox sites a priority?

A: UK SMR is the consortium of which Rolls Royce is a partner. It is setting up a joint venture company to take this aspect forward. UK SMR will be a reactor vendor, and the consortium will seek someone to come forward as a developer. We are currently in dialogue with one UK and one international operator. Magnox sites are of interest as they have communities and an ecosystem around the site which is familiar with nuclear and has a level of skill and capability available which would support SMR deployment. We have begun discussions with NDA but they are in an early stage.

3.3 Q: What are the safety aspects of the SMR programme.

A: Safety is paramount to what we do. It is a very safe design with both passive and active safety features. We have a good team working on safety case with a lot of experience. All reactor designs have to go through the generic design assessment approval process with UK regulators.

3.4 Q: Does the £1.8bn build cost you gave include site purchase?

A: The £1.8bn is the cost of building the power station and does not include the cost of the land.

3.5 Q: If your SMRs are as well designed as they appear, as cost effective as you say, why have we waited until 2020 to consider this as option?

A: Nuclear design has been an evolutionary process. It costs £1.5bn to design a new nuclear plant, and as a result there are only three or four designs which have evolved over the years. Because of the cost implications the preference has been for

large scale reactors; the instrumentation control system is the same whatever the size of the plant and the bigger the plant the cheaper it becomes by comparison.

As projects have got bigger we haven't been able to keep up with the project management requirements of what are super complex projects where a minor issue can cause delays costing £millions. Economies of scale look good on paper, but the cost of the build and the project management complexity are stumbling blocks. As a result, attention has turned to small plants where factory production techniques can be employed thus reducing the cost.

3.6 Q: Why do you not need to found the reactor on bedrock? Is this not an IAEA requirement for new build?

A: SMRs are smaller and therefore lighter than full-sized reactors. They still have to be anchored properly but the requirements should be easier to achieve (in general) with a smaller lighter power reactor.

3.7 Q: Is there government backing for your programme? Wylfa and Moorside have failed due to lack of finance.

A: The government has conducted a lot of due diligence in what we are doing and why we are doing it, and we have had an unprecedented level of engagement over the last 18 months. Our feeling is that things are moving in a positive direction. Recent media storied about the SMR programme have not come from us, so are arising from thinking elsewhere.

Comment from Vishal Shethwood, BEIS: Government is keen to identify options which will help it meet its net zero carbon agenda. We are interested in how SMRs can help with decarbonisation. We learnt from the HPC deal and are now looking at the Regulatory Asset Base (RAB) concept of financing; whether that will provide a better balance of funding for the taxpayer.

3.8 Q: What is the profile of the site above ground?

A: The site will sit about 15 metres below ground and rise to 25-30 metres above ground level. We are working on optimising this at the moment as we would like to reduce the height if possible.

3.9 Q: Trawsfynydd has been flagged up as a potential site for the deployment of SMRs, and it has been promoted as a site in the Welsh Government national development framework. Are you aware of any other sites coming forward?

A: A number of sites are on the current list of those identified by UK government for new nuclear build, though this was carried out with large reactors in mind. UK SMR is a reactor vendor and it would fall to site developers to bring potential operators to the table to discuss siting options. NDA would need to be involved with discussions for any of their sites. There is a lot of potential in north Wales, some sites in NDA ownership and some not. We are also having active dialogue in Cumbria. This will not be a simple journey and there are lots of bits of the puzzle to get in place.

3.10 Q: How would deployment of an SMR sit on a decommissioning site? Would you need to wait until the site was fully decommissioned or could it be put on unused land?

A: Although it will be dependent on the size of existing sites as these vary, our understanding is that we could go alongside the decommissioning station. Some sites are quite large so there would the opportunity for deployment of multiple units. We are engaging with NDA to get a better understanding of their sites and decommissioning timeline. It would not be practical to wait for a site to fully decommission.

3.11 Q: What is the actual physical size of the site you will need?

A: I will need to come back to you regarding size, the current design phase will not conclude until February/March 2021 and while we know what the station will look like the final decision has not yet been made whether we go for direct or indirect cooling, each solution has pros and cons.

3.12 Q: When you deploy multiple stations what effect does this have on the layout? Are multiple reactors housed in one building so enlarging the building and footprint around the reactor building, or are there multiple buildings and berms?

A: Each reactor is housed in its own building with surrounding berm, so a site with multiple reactors would have multiple bumps in the landscape.

3.13 Q: Do you have particular locations in mind for the development of technology and manufacturing capacity?

A: At present we have the capability to produce the majority of components within the UK. An example of an exception would be the steam turbine. Our aim is to produce 2-3 units per annum, which is the level required to justify the business case. We have looked at the manufacturing capability and need to address how we can produce at this rate. In terms of job location, for every three jobs in the factory there will be one constructing the site. There will inevitably be a patchwork of manufacturing locations, but that will benefit a range of regions rather than everything be located in one place.

3.14 Q: How do you see the skills capacity you will need being developed?

A: We are engaging with the nuclear skills group in mapping the skills we require. We are also looking at how we can improve the diversity of the workforce. It is important that we are efficient in our production and construction techniques.

3.15 Q: Can you tell us about the waste produced by the station?

A: Our aim is to design a station that is easy to decommission and remediate as quickly as possible. The Pressurised Water Reactor (PWR) technology this is based on is easier to handle than Advanced Gas-cooled Reactors (AGRs) because of the materials used, the construction of the plant and its configuration. Although

decommissioning won't take place until the 22nd century we are trying to make the design as decommissioning friendly as possible.

In terms of fuel, the station will use a standardised fuel form with a shortened assembly. Waste produced will be on a scaled down version of a large reactor. Used fuel will be stored onsite. In terms of disposal to a geological disposal facility (GDF) our fuel is a known product. This is quite important as if a developer uses more exotic technology then there are more issues around waste disposal: the waste our sites will produce will be in keeping with current waste management routes.

3.16 Q: Would an SMR be capable of plugging into existing grid power network or would it require a new plug in?

A: If the station is producing electricity for electricity purposes, then some sites would have a grid connection already, others might need more work than that. If there is a need to lay down new power lines, then the impact of the project is greater and more costly. If the station is coupled to, for example, a synthetic fuel production facility then the bulk of the power would be dedicated to running that facility, and in those cases we may not need grid connection, though this needs to be confirmed that this is technically possible and we are exploring this with partners.

3.17 Q: Are you aware of what the socio-economic impacts of an SMR station will be: how many local jobs will be created in the construction and operational phases? What are the timescales for planning consent and will it by DCO?

A: We have developed an outline overview for regional job creation. The level of jobs created depends on what is being built: a single unit power station, multiple unit power station, power station plus manufacturing unit, all these create different employment opportunities. We have a top-level understanding and we would welcome opportunities to discuss what this would look like for different regions.

In terms of planning and consenting, we have an overview programme in development from a reactor vendor's perspective. Paul Littler from Atkins has worked on this. He ran the programme for NuGen and understands what site development and the consenting process looks like. We are starting to engage with potential operators and funders for first nuclear power station; we have to bring together quite a diverse group together e.g. stakeholders, site owner, technicians and funder and will be actively ramping up this workstream for the rest of 2020 and in to 2021.

3.18 Q: Is there a concern that there will be a disconnect between the timing of construction and operation of a facility.

A: We are aware of this issue and it is symptomatic of why the factory programme lags the reactor design: we have to know what the product looks like before we can determine the best type of factory to make it in. We understand what a nuclear power station will look like and the costs involved. We want to avoid a disconnect between the location of the factory and the siting of the station.

Comment to RR: You shouldn't underestimate the importance of having the social license to operate and the support of a host community. If you have it then many problems can be resolved.

3.19 Q: The role of the site licensee is absolutely crucial in a nuclear project in the UK and is key from the point when sites are being nominated. What have you done about this so far?

A: We are trying to bring together the different elements right now. It is not just a case about getting the right people in at the right time, we also need to have the right legal constructs. SMRs are different in their construction but planning and permissioning are no different to other nuclear projects. We are looking at this and may need to bring in an operator at an early stage and the operator would take on that role. We need to map out roles, responsibilities and the legal framework, and this may change as we move through the process. We would like to establish a number of different ways of working as different sites may require different models e.g. different operator, different funding model, different units deployed and different purpose.

3.20 Q: What considerations have you given to transport of materials by rail rather than road. Will the factories be connected to the site by rail?

A: We are looking at all the transport options. The majority of components are designed to be transportable down a standard UK road on an articulated lorry and certain items, such as the reactor pressure vessel, would not be suitable for rail transport because rail bridges do not have sufficient clearance.

4. Close

4.1 Mr Goodfellow thanked NuLeAF and NNLAG for the opportunity to engage with their members. RR is mindful that it needs to manage expectations: there have been many projects in the UK which have not come to fruition and they don't want to raise expectations only to have them dashed. However, it is important to have two-way engagement with communities about what they are trying to achieve and for RR to understand what communities want.

4.2 Dylan Llewellyn-Jones thanked Nuleaf for organising the meeting and giving NNLAG members the opportunity to participate.

4.3 Phil Matthews thanked everyone for their attendance. Nuleaf would continue to engage as appropriate as the SMR programme developed.

Appendix 1: Attendance List

Rolls Royce

Martin Goodfellow, Strategy & Business Development Manager, SMR

NuLeAF & NNLAG

Phil Matthews, Executive Director, NuLeAF (Meeting Chair)

Catherine Draper, Director's Assistant, NuLeAF

Marion Fitzgerald, Councillor, Allerdale Borough Council

Richard Griffin, Policy Manager Nuclear, Allerdale Borough Council

Steve Smith, Nuclear Projects Manager, Copeland Borough Council

David Southward, Councillor, Cumbria County Council

Guy Kenyon, Programme Lead Infrastructure Planning, Cumbria County Council

Craig Rivett, Councillor, East Suffolk Council

Bethany Rance, Graduate Planner for Energy Projects, East Suffolk Council

Terry Burns, Principal Planning Officer, Essex County Council

Mark Woodger, Principal Planning Officer, New Settlements, Essex County Council

David Monk, Leader, Folkestone & Hythe District Council

Dave Illsley, Romney Marsh Partnership Co-ordinator, Folkestone & Hythe District Council

John Idris Jones, Energy Adviser, Gwynedd Council

Nia Carys Bowden, High Value Jobs Scheme and Snowdonia Enterprise Zone Manager, Gwynedd Council

Carwyn Jones, Councillor, Isle of Anglesey County Council

Dylan Llewellyn Jones, Energy Island Programme, Isle of Anglesey County Council

Kieran Keane, Chief Executive, Lancaster City Council

Jason Syers, Director for Economic Growth & Regeneration, Lancaster City Council

Gavin Kingsnorth, Bradwell B Planning Lead, Maldon District Council

Georgina Button, Bradwell B Programme Lead, Maldon District Council

Charlotte Rushmere, Principal Planner, Major Projects Team, Sedgemoor District Council

Sion Roberts, Planning (Policy) Officer, Snowdonia National Park Authority

Joanna Whitehead, Service Manager – HPC Programme, Somerset County Council

John Burton, Specialist (Hinkley Point C & Major Infrastructure Projects), Somerset West and Taunton Council

Matthew Riddle, NuLeAF Chair and Councillor, NuLeAF/South Gloucestershire Council

Gillian Ellis-King, Strategic Projects Manager, South Gloucestershire Council

Nigel Riglar, Director for Environment & Community Services, South Gloucestershire Council

Cameron Clow, Senior Planning and Growth Officer, Suffolk County Council

Phil Watson, Strategic Energy Projects Lead, Suffolk County Council

Paul Warmington, Energy Skills Development Coordinator, Suffolk County Council

BEIS

Keith Duncan, Head of Decommissioning and Radioactive Waste Policy

Vishal Shethwood, SMR Policy Lead

NDA

Jonathan Jenkin, Stakeholder Relations and Socio-economics Manager – Magnox

Neil Smith, Business Manager – Economic Development

Frank Wigley, Remediation Strategy

MAGNOX

Nigel Houlton, Head of Future Programmes