ROLLS-ROYCE SMR LTD RESPONSE TO THE SECOND NATIONAL INFRASTRUCTURE ASSESSMENT BASELINE REPORT:

EXECUTIVE SUMMARY

- If we are to have the reliable low carbon power at the scale we need by 2035, the UK needs significant amounts of clean, baseload electricity from Small Modular Reactors (SMR).
- Unlike conventional large nuclear reactors, SMRs are flexible and introduce optionality to the grid. SMRs are designed to provide baseload grid electricity, deliver carbon-free electrical and thermal power direct to industry or they can load follow by diverting power to hydrogen or synthetic aviation fuel production.
- We agree with the Commission on the importance of hydrogen. We see the main challenge to the creation of a hydrogen economy to be the provision of clean electricity and the tremendous scale up required to produce it at scale and cost competitively. Only SMRs can create cost-competitive hydrogen at the scale required and envisaged by a range of future energy scenarios.
- The previous developer-led model for new nuclear has failed. For SMRs to play the pivotal role that the climate emergency demands, we must learn from that failure and ensure HMG and industry work on a deployment model that will succeed.
- The first Rolls-Royce SMR will be connected to the grid by 2031.With the factory footprint established, we are able to deploy 2 units per year– 1GW per annum – each of which will have an on-site construction programme of four years. This is a different model to stick-build large scale nuclear.
- We are using proven reactor technology, learning the lessons of 60 years of reactor submarine development and construction and innovating in our deployment, through modularisation to reduce or remove construction risk.
- The Rolls-Royce SMR is designed to ensure investability and we are confident in our ability to secure capital from the markets to deploy our SMRs and limit any cost to Government.
- Pace is vital to achieve net-zero: we must work in parallel and not in series on regulatory, planning and consenting processes to deploy SMRs in the timescale required.
- There needs to be accountability between Government and the private sector for delivering a certain number of gigawatts over a specific time period.
- Rolls-Royce SMR Ltd would welcome the opportunity to provide further information to the Commission and to support the vital work of the Second Infrastructure Assessment in any way we can.

Question 2: What changes to funding policy help address the Commission's nine challenges and what evidence is there to support this? Your response can cover any number of the Commission's challenges.

This answer focuses upon funding policy to address the Commission's second challenge on how a decarbonised, secure and flexible electricity system can be achieved by 2035. As we set out in our response to Question 8 below, we believe Small Modular Reactors are key to achieving a decarbonised electricity system in this timeframe.

The Rolls-Royce SMR is designed to ensure investability. It is a standardised, commoditised product that makes nuclear power affordable, deliverable and, therefore, investable. We are confident in our ability to secure capital from the financial markets to deploy our SMRs as we have demonstrated through the match funding process which brought £280 million of equity into the business alongside £210 million of Government grant funding. From our experience, the capital markets see a tremendous potential to invest in the UK's decarbonisation plans when the opportunity is right. We are therefore speaking to the financial community on the basis of deploying SMRs with long term revenue support from a Contract for Difference (CfD) and securing all funds to enable this from the equity markets.

Nuclear power plants are 60-year assets and longer-term bankability does need to be built into the contracting structures. To provide investors with the certainty needed to finance SMRs it is, therefore, necessary to have a long term Government agreement through a CfD for SMRs. Furthermore, in order to deliver SMRs in time to be able to contribute to the 2035 target we are seeking to minimise changes to the existing architecture of CfD contracts to ensure we are not slowed down by a protracted negotiation process and learning from the many successful infrastructure projects that have been enabled by CfD contracts.

We are confident that with the certainty provided by a CfD that we can secure the private capital that is required to deploy. This would enable an SMR to generate power for the grid at around £50/60 per megawatt hour, roughly half of the cost of Hinkley (the underlying evidence of these figures can be provided separately and has been shared with UKRI and BEIS previously). Many analysts consider that energy prices may well actually be significantly higher than this by 2035. If the expectation is that prices will be above £60 per megawatt hour in the 2030s and beyond, by setting the CfD threshold relatively low we are setting a very cost competitive starting point for an SMR.

We also believe that there is the potential for Power Purchase Agreements (PPAs) to be used for SMRs. By combining a number of PPAs with a CfD we can further reduce the burden on the Government from the CfD exposure. In all cases our goal is to minimise and avoid the impact on the Government, whether it is by maximising private capital to finance an SMR unit or by supplementing a CfD with multiple PPAs.

It is worth saying that a significant market intervention like the Regulated Asset Base is not required for the delivery of an SMR. We understand that RAB is necessary for £20+ billion, large scale reactors that face long lead times and commensurate risks. Our SMR will, however, cost around a tenth of this at around £2bn per unit, can work within existing CfD architecture and so does not necessarily require funding via a RAB.

Question 5: What are the main opportunities in terms of governance, policy, regulation and market mechanisms that may help solve any of the Commission's nine challenges for the Next Assessment? What are the main barriers? Your response can cover any number of the Commission's challenges.

This answer focuses upon the governance, policy and regulation changes needed to address the Commission's second challenge on how a decarbonised, secure and flexible electricity system can be achieved by 2035. As we set out in response to Question 8, we believe SMRs are key to achieving a decarbonised electricity system in this timeframe.

The vision and scale of ambition set out by the Government is absolutely right. Sovereign signals from the Government, such as the Ten Point Plan, Energy White Paper and Net Zero Strategy are very important to overall market and investor confidence. Capital markets see a tremendous opportunity to invest in the UK's decarbonisation plans and our Rolls-Royce SMR business is testament to that. The challenge is maintaining the pace of Government decision making and policy change so investors can move at the speed the climate crisis demands.

There are two fundamental policy pillars that will enable SMRs to be deployed at pace. As made clear at question 2 – the agreement to enter CfD negotiations is a fundamental tenant and demonstrates a commitment to deployment. Secondly, there are two routes to securing a site for the deployment of an SMR, through commercial negotiations with an owner of a nuclear site, or through negotiation with the Nuclear Decommissioning Authority to acquire land suitable for deployment. BEIS is able to instruct the NDA to enter these discussions now and this would further enable our route to market.

We have confidence that the Secretary of State at BEIS, and wider Government see the benefits of SMR deployment and the consequential job creation through manufacturing growth. It is important that the development of 'roadmaps' for SMR deployment do not delay simple policy decisions that can be taken now to enable the deployment of a UK SMR solution.

In the coming weeks, the Rolls-Royce SMR will be the only European SMR design in a regulatory review process, on a pathway to deployment. The UK must not squander this first mover advantage and the jobs and growth that can be secured through fleet deployment.

Further, our view is that there needs to be direct accountability between Government and the private sector for delivering a certain volume of clean energy from SMRs over a specific time period. This gives accountability – on Government and business for the rapid deployment of new nuclear – which has been missing in the developer led model which intended to deliver 16GW of new nuclear but has thus far only brought Hinkley Point C forward. We understand the Government may be developing this form of delivery architecture and would support this outcome if realized.

Regulatory barriers in the nuclear sector are particularly onerous around deployment, specifically the interplay of the planning processes and permitting. There are aspects of this which are inefficient and engender duplication across numerous regulators. By way of example, it will take longer to secure a Development Consent Order and the supporting licensing than it will to build the SMR power station. We set out our concerns in these areas in our answer to Question 8.

Challenge 2: Decarbonising electricity generation – the Commission will consider how a decarbonised, secure and flexible electricity system can be achieved by 2035 at low cost.

Question 8: What are the greatest risks to security of supply in a decarbonised power system that meets government ambition for 2035 and what solutions exist to mitigate these risks?

By the 2030s increasingly there will be large volumes of renewables on the grid. Commensurately, this means there will be a more important role for baseload technologies to provide the grid stability needed to ensure that a stable power supply is available 24/7 to provide consumers with access to clean energy when the wind does not blow and the sun does not shine.

By 2035, HMG forecasts that the UK must generate 20% more electricity than it does today[1] as we electrify and decarbonise substantial parts of our economy such as transport, heating and industry. There are various scenarios which set out how quickly we can decarbonise and how much larger the electricity grid needs to become to host technologies such as electric vehicles and heat pumps. In all scenarios, while the absolute consumption of energy might vary, the absolute need for clean electricity is significantly greater than it is today.

The UK currently has 15 existing nuclear reactors, generating about 8.9GW, about a fifth of our electricity. However, five existing plants are due to be shut down in the next three years, removing more than 5.2GW from our system. If we look further forward to 2035, there is a clear gap in the provision of stable, clean baseload power. By then coal plants will also have been shut down and the existing nuclear assets, with the exception of Hinkley Point C, will all be in the decommissioning stage – leaving just 3.2GW of nuclear on the grid.

The risk of a shortage of baseload power in a decarbonised power system can only effectively be addressed by nuclear generation. Nuclear is the right solution to meet the need for stable, clean baseload power; there is no better source today of clean energy that is available 24/7 than nuclear energy. For nuclear to play this pivotal role at low cost and in the timescale that the climate emergency demands, we cannot deliver nuclear in the way we did in the past; it will simply take too long and cost too much.

The Rolls-Royce SMR is designed specifically to address this difficulty with conventional nuclear power. A factory-built, commoditised approach to nuclear is how Rolls-Royce SMR have addressed this challenge. Our SMR is designed to be low cost, deployable, and scalable. Creating a product that is factory built - by which we mean that 90 percent of our SMR is completed in factory conditions - radically reducing the construction risk and cost.

The Rolls-Royce SMR proposition is radically different to how large scale, conventional nuclear is delivered. This repeatable, standardised approach generates huge efficiency gains to make it a commoditised product. Rolls-Royce have been making submarine reactors for over 60 years and the civil development builds on that knowledge, heritage and expertise. Innovation is centred around deployment, not in the nuclear technology which is a standard pressurised water reactor (PWR) using standard fuel and standard fuel assemblies – all known quantities to the UK supply chain and regulators.

The innovation is centred around the way that we deploy the reactors – using modern modularisation techniques to take out construction risk. We have done this to make it deliverable

[1] Energy & Emissions Projections Net Zero Strategy Baseline: Oct 2021: https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2019 Annex M for other price and demographic assumptions.

and therefore also investable. The Rolls-Royce SMR will cost around a tenth of a conventional nuclear project and can be deployed at the pace required to support global decarbonization aims.

As set out in the Commission's challenge, a decarbonised electricity system will also need to be flexible. Unlike conventional nuclear reactors, SMRs with multiple units of 470MW introduces optionality and flexibility into the grid. Power produced by SMR units could be used for alternative applications during periods of high renewable supply and generate power again for the grid when renewable supply falls or demand is high. For example, power from a Rolls-Royce SMR that is not required for the grid could be used to manufacture green hydrogen to help decarbonise energy intensive manufacturing processes like steel or cement production or to produce synthetic fuel to decarbonise aviation and other forms of transport.

Another approach is to leverage our plant's small footprint and design which allows more siting flexibility. This siting flexibility allows heavy industry to be co-located with a SMR completely removing the need for that industry to be connected to the grid. Not only does this de-stress the wider grid, it also gives these industries guaranteed 'always on' carbon free power.

We are clear that Rolls-Royce SMR is ready to contribute to the energy system needed to meet net zero. More than this, we believe SMRs are actually critical to reaching the Government's 2035 target for decarbonising the UK's electricity system. We expect the first SMR unit will be on the grid by 2031 with a further 15 reactors - 7.5GW of clean power – being deployed immediately after that, if we can make sufficient progress Government over the course of 2022 with on the CfD mechanism (See answer to Question 2).

Once the factory footprint is established, SMRs are produced through a production line methodology, meaning we can produce two complete SMR units a year – 1 GW of power – from our factory footprint. If demand is greater, then we simply double our factory footprint enabling us to produce up to four units as we scale up the numbers of factories as we deploy a domestic and international fleet of SMRs.

To meet this timescale will require compressing the normal delivery timeline and doing things in parallel rather than in sequence. While we are completing the Generic Design Assessment (GDA), we can be preparing the sites that host this technology, and in parallel we can also be building the factories.

The developer led model designed to bring forward 16GW of large scale new nuclear has failed. Companies such as Hitachi and Toshiba spent £1-2 billion of upfront investment on planning, licensing, permitting before any consideration of funding was developed, this model has only brought Hinkley Point forward. We must therefore learn the lessons of that era and ensure a deployment model that is targeted at working in parallel and developing the funding proposition is agreed and clear from the outset.

On siting, there are existing communities in the UK that have hosted nuclear assets for the last 50 years. Those communities are strong advocates for nuclear power. They understand it, see the economic benefits and want SMRs in their communities. We believe that a lengthy multiyear planning process to build an SMR on a site that has had a nuclear asset for the past 50 years is not necessary. The DCO process for sites such as Trawsfynydd, Anglesey and West Cumbria could be accelerated.

Finally, clarity should be given to the NDA that they have a mandate from HMG to enter negotiations on the transfer or leasing of NDA land to Rolls-Royce SMR. This could potentially create value for the taxpayer but more importantly would delvier growth and investment into regions that are currently reliant on decommissioning.

Question 11: What barriers exist to the long term growth of the hydrogen sector beyond 2030 and how can they be overcome? Are any parts of the value chain (production, storage, transportation) more challenging than others and if so why?

There are several key challenges facing the hydrogen sector, each of which has the potential to limit growth.

The first is matching supply and demand. The hydrogen sector requires i) new producers, i) new consumers, and iii) the infrastructure and equipment required to inter-connect the value chain. Significant amounts of investment and R&D are required in each of these areas to bring the value chain into reality, and this requires a degree of confidence in the market.

Last year HMG published its Hydrogen Strategy which has encouraged the sector and will help keep producers and consumers in lockstep. To maintain this cohesion, continued policy support alongside targeted investment pots will be necessary building upon the success of competitions such as 'Low Carbon Hydrogen Supply 2 Competition'.

The second challenge for the sector is to ensure the cost of hydrogen is competitive in its potential markets, each of which will have a different price point. Cost of power is one of the major cost contributors to green hydrogen, and Rolls-Royce SMR will answer this challenge by delivering significant amounts of carbon free and affordable power to centralised large-scale electrolyser facilities.

In addition to the advantages of mass production, our plant can provide heat as well as electricity direct to the hydrogen plants. This allows access to the electrolyser technologies (e.g. Solid Oxide Electrolysis Cell (SOEC)) that use heat which gives an efficiency boost over pure electric electrolysis systems greatly increasing the amount of hydrogen that can be produced.

The SMR's compact size also allows the plant to be co-located with the hydrogen plants removing the need for costly transmission, both in terms of its financial cost but also the power losses associated with large-scale transmission.

There is continual focus today on reducing the cost of green hydrogen, but there will be certain segments of the market such as its largest – residential heating – where hydrogen struggles to compete due to the low cost of the incumbent fossil fuel. Even by 2030 use of a methane boiler for heating is forecast to still be 30% - 50% the cost of using a hydrogen boiler[2]. While there has been some increase recently, the cost of methane does not reflect the true impact its use has on the environment and policies such as a carbon tax could be considered. This would i) disincentivise fossil fuel use, ii) it would make green hydrogen competitive in more markets hastening the transition to a carbon free future, and iii) it would make the largest hydrogen market segment accessible to green

[2] Path to hydrogen competitiveness; Hydrogen Council; January 2020 https://hydrogencouncil.com/wp-content/uploads/2020/01/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf

hydrogen attracting more entities into the value chain, increasing competition and further reducing green hydrogen costs.

The third challenge facing the sector is ensuring the necessary infrastructure exists to transmit the hydrogen produced at scale with its end users. While tests are being carried out to allow hydrogen to be blended into the gas network, more government and commercial investment is required to allow widespread storage and transportation that would ensure those who would use hydrogen can access it.

ABOUT ROLLS-ROYCE SMR LTD

Rolls-Royce SMR Ltd was established in 2021 to deliver clean affordable energy for all. The business is capitalised by Rolls-Royce Group, BNF Resources UK Limited, Exelon Generation Ltd, the Qatar Investment Authority and through UK Research and Innovation (UKRI) grant funding.

A Rolls-Royce SMR power station will have the capacity to generate 470MW of low carbon energy, equivalent to more than 150 onshore wind turbines. It will provide consistent baseload generation for at least 60 years, helping to support the roll out of renewable generation and overcome intermittency issues.

A single power station will occupy around one tenth of the size of a conventional nuclear generation site and power approximately one million homes.

Rolls-Royce SMR will draw upon standard nuclear energy technology that has been used in 400 reactors around the world. Rolls-Royce has been a nuclear reactor plant designer since the start of the UK nuclear submarine programme in the 1950s.

Rolls-Royce SMR uses established nuclear technology and know-how to offer a low cost, deliverable, global and scalable and investable solution, that can be rolled out around the world.

When fully operational the Rolls-Royce SMR business is forecast to create 40,000 regional UK jobs by 2050 and generate £52bn in economic benefit.