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To whom it may concern

**ONR Consultation Response: Justification Application - Rolls Royce SMR**

Thank you for consulting with ONR on the justification application received for Rolls-Royce SMR (RR SMR). The application relates to the generation of power from nuclear energy, using oxide fuel of low enrichment in fissile content in a light water cooled, light water moderated thermal reactor (currently known as the RR SMR and designed by Rolls-Royce SMR Limited (RR SMR Ltd)). As per our correspondence of 17 July 2024, ONR agrees that, as described, this constitutes a practice that is not within a class or type of practice that has been previously been justified in the UK under the Justification of Practices Involving Ionising Radiation Regulations (JoPIIRR).

ONR is the UK’s independent nuclear regulator for safety, security and safeguards. Our mission is to protect society by securing safe nuclear operations. We deliver five statutory purposes to ensure safe nuclear operations now and in the long term:

* nuclear safety;
* nuclear site health and safety;
* nuclear security;
* nuclear safeguards; and
* safety of transport of nuclear and radioactive materials.

We have the legal authority to regulate nuclear safety, nuclear security and conventional health and safety at the 35 licensed nuclear sites in Great Britain (GB). Our nuclear security regulation ensures the adequacy of security arrangements for dealing with special nuclear material and special nuclear information within the civil nuclear industry and we also regulate the safety and security of the transport of civil nuclear and radioactive materials by road, rail and inland waterway, extending our regulation across a large number of dutyholders.

On 1 January 2021, we became the UK nuclear safeguards regulator for the domestic standards regime and began to operate the UK State System of Accountancy for and Control of Nuclear Materials (SSAC). Our duty is to ensure that the nuclear industry controls its hazards effectively, has a culture of continuous improvement and maintains high standards.

With regard to the application received from the Nuclear Industry Association (NIA) on behalf of RR SMR Ltd, we have responded to areas that are relevant to ONR’s purposes. We note that the applicant has confirmed its intention that the proposed practice will meet all applicable laws, regulations and standards.

As a general comment, in the application the NIA has not sought to define what an SMR is and currently there is no widely accepted definition. We note the Justification application states the intention to deploy multiple units of the proposed practice at an installation. We also note that previous non-nuclear justifications have been based on the health detriment by the class or type of practice as a whole and not on the basis of each facility (for example the rejection of Justification for small radioactive sources in domestic gas meters where a single installation posed almost negligible health detriment but installation of a few million across the UK was not justified). In the case of nuclear Justification applications this could mean considering the health detriment per Gwh potentially produced by the class or type of practice.

Potential radiological health detriments

The NIA Application, made on behalf of RR SMR Ltd, makes few estimates of radiological health detriment that are specific to the class or practice, and in the main makes claims of health detriments in the form of radiation dose to the representative person of current nuclear power generation and supporting activities or reactor designs that have previously been assessed under GDA. The application demonstrates a good understanding of the regulatory requirements with respect to public and worker doses in normal and accident conditions. The application provides dose data reported in the main from operating experience of other commercial pressurised water reactors (PWRs) and associated lifecycle activities stating that these PWRs and the associated activities are technologically and operationally similar to the RR SMR with a broadly similar risk profile.

The application considers radiation exposure from fuel fabrication, enrichment, transport of fresh and spent fuel and radioactive waste, and radiographical inspection of welds during construction to be existing practices not requiring Justification. ONR considers this to be reasonable as the novel part of the application relates to the reactor design, but what is considered to be within the whole lifecycle is a policy matter for Government.

The RR SMR design has just completed step 2 of the GDA process[[1]](#footnote-1). The purpose of Step 2 of GDA is the fundamental assessment of the generic design and safety, security and safeguards cases, to identify whether there are any fundamental shortfalls that would prevent permission being granted for construction of a power plant based on the design. In doing so ONR has, in some cases, assessed the methodologies, codes and standards adopted to demonstrate compliance with UK legislation and relevant good practice. During Step 3, ONR will be examining in more detail the application of these methodologies and codes with a view to gaining greater confidence in the still maturing design.

For the purposes of Justification it would be reasonable to expect a description to be included describing *how* claims that the RR SMR is similar to currently operating PWRs are justified, with reference to the generally understood design and operating differences. We would therefore advise DEFRA, to seek high level descriptions of:

* collective and maximum individual occupational exposures for normal operations and accident scenarios;
* representative person public radiation exposures for accident scenarios; and,
* radiological risks to the most exposed members of the public for accident scenarios.

These should be provided for all parts of the lifecycle applicable to justification.

In relation to the first bullet above, RR SMR Ltd provided ONR with sufficient information for occupational doses under normal operating conditions within its GDA submissions. A description of the general ways in which doses will be minimised within the design is described in section 10.12 of the application. However Defra may decide to request further information about “normal conditions”, noting that other consultees participating in the RR SMR Justification process will not have access to the information seen by ONR through the GDA process.

Table 9 in the application provides an estimate, based on modelling, of the annual dose in microSieverts to the representative member of the public (representative person), as compared to other reactor designs and when normalised for power output. This is taken from a document (reference 49) presented during GDA Step 2. ONR focused its GDA assessment on the methodology used to determine the value, noting that the value itself was modelled without considering all the exposure pathways that would be necessary to determine a reasonably accurate modelled dose (for example, doses were not included from waste storage, spent fuel storage, activated reactor components etc).

One of the supporting documents for ONR’s [Step 2 Generic Design Assessment Statement for the Rolls Royce SMR](https://www.onr.org.uk/generic-design-assessment/assessment-of-reactors/rolls-royce-smr/step-2-gda-statement-for-the-rolls-royce-smr/)[[2]](#footnote-2) focuses on [Radiological Protection](https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fwww.onr.org.uk%2Fmedia%2Fcxsd4tug%2Frr-smr-step-2-ar-radiological-protection.docx&wdOrigin=BROWSELINK)[[3]](#footnote-3) and states that ‘further work will need to be undertaken in Step 3 of GDA by [Rolls-Royce] to develop the underlying evidence supporting the radiological protection claims and arguments’.

As for the Justification application, for Step 2 of GDA, comparison was made and data drawn from operating experience from PWRs of larger size and power output. ONR’s assessment concluded that it is not yet clear how comparable the data is with respect to worker dose, for example how the more compact design would impact the doses received whilst carrying out maintenance activities in close proximity to the source term.  The suitability to make direct comparisons will be determined when occupancy data, i.e. the amount of person hours required to be present adjacent to a reactor, is available. This occupancy data will be informed by an understanding of maintenance activities and frequencies, as well as a well-defined source term, i.e. the radioactivity of the reactor core through its life and at different times such as re-fuelling.

There is also limited available operational experience and data relating to radiation doses from reactors that are boron free and make use of potassium hydroxide in the primary circuit. Therefore, we would propose a question to RR SMR Ltd such as:

* Please also detail whether the RR SMR has particular design/layout/features

(including the implications a highly compact design, of boron free and the use of potassium hydroxide in the primary circuit) that may give rise to greater occupational and/or public exposures in comparison to the other existing reactor technologies referred to in the application e.g. shine paths and radionuclide fingerprint/dominant exposure pathways.

According to the current schedule for Step 3 of the RR SMR GDA, much of this information and evidence to support the claims will be made available to ONR in quarter two of calendar year 2025, and therefore may be available on request to Defra and other consultees in advance of any Justification decision. Furthermore, Step 3 of GDA will seek to assess a design-specific approach and substantiation to demonstrate that the RR SMR design ensures that radiation doses to be kept as low as reasonably practicable, in accordance with UK legislation.

As part of GDA step 2 ONR raised a regulatory observation that RR SMR Ltd strategy to deliver a full-scope modern-standards Probabilistic Safety Analysis (PSA) was inadequate at Step 2. The PSA is required to inform whether a number of numerical target doses for people on or off the nuclear site. RR SMR Ltd have committed to further work to address this following Step 2 and ONR have stated it is confident through the updated development strategy that an adequate PSA can be produced during GDA.

Radioactive Waste and Decommissioning

The application shows an understanding of the UK legal basis and policy for spent fuel, waste management, discharges and decommissioning. There is limited detail provided on specific methodologies and practices, and although some data is provided, the link to health detriment is not made clear. Useful comparisons to current PWRs in operation are however provided.

The application states that approximately ten tonnes of fuel assemblies containing spent fuel will be produced every 18 months of operation, and that this will form the majority of radioactivity produced during the operation of the reactor. Limited detail describing how spent fuel would be managed is provided in the application. ONR’s assessment at Step 2 of GDA concluded that the overall approach to fuel management for the generic RR SMR design is consistent with UK and international PWR designs. ONR’s assessment did not however seek verification of the claims and figures presented regarding spent fuel arisings, which amounted to a small percentage more per MW(e) generated compared to other PWR designs, as this will be further sought at GDA step 3 alongside detailed design and fault analysis, storage capacity and criticality fault analysis.

The application proposes that the predominant decommissioning wastes from this design are likely to be structural steel, which can be decontaminated and re-used in accordance with the waste hierarchy, with no unusual or significantly high volumes of wastes proposed. Other radioactive wastes will be produced either through neutron activation or by contamination with radioactive substances, for example filters which are expected to be the main contributor to operator radiation dose. The application states that RR SMR will aim to minimise the generation of radioactive waste and activation of materials using inherent design features including the use of indirect steam generation to prevent the activation of turbine components, filters in coolant lines to remove radioactive particulates and boron-free water chemistry that reduces tritium production. The application refers to further radioactive wastes which will be produced during decommissioning but does not provide details.

To further understand the arguments made, we refer to ONR’s assessment of the RR SMR Step 2 GDA in which ONR noted that:

‘the requesting party has developed estimates of the expected amounts of radioactivity that will be generated and distributed throughout the plant for use […] that will be refined using relevant plant OPEX and expanded […] during Step 3 including modifying to account for the specifics of the Rolls-Royce SMR design.’

The report also concluded that further evidence will be required in Step 3 to support claims relating to chemistry controls in the primary circuit which will inhibit the formation of certain wastes. Further justification for the use of Stellite or other high cobalt hard-facing materials within the design is required as these may be a significant source of radioactivity.

Overall however, ONR concluded in the Step 2 summary report that the requesting party:

‘has documented an appropriate Integrated Waste Strategy based on the extant design, with OPEX used to derive waste estimates. This includes due considerations of minimising the generation and accumulation of waste at a strategic level. Further work is necessary to fully substantiate that the approach in the IWS is achievable. The overall approach to waste management is consistent with regulatory expectations, and includes matters such as interim storage, waste processing, decay storage and management of damaged fuel and non-fuel core components.’

ONR’s Step 2 assessment of the requesting party’s approach to decommissioning stated that a number of the high level documents including a strategy and optioneering report had been produced, but that these would require further development in Step 3 as the design matures. The majority of the plant is comparable to existing PWRs so no significant challenges are expected for decommissioning, although some areas of novelty require further consideration.

The application provides an estimate of annual gaseous and aqueous discharges in Tables 13 and 14, and compares these to discharges from other UK PWR reactors, stating that values are conservative and will be refined as the design progresses. Whilst tritium discharges are notably lower than other UK PWR reactors, the iodine-131 discharges are several times higher per GWe, as are other gaseous radionuclides classed as ‘other’.  Iodine is a minor component to dose to the representative person for HPR-1000 so this is unlikely to be an issue (EA Assessment report Independent dose assessment of General Nuclear System’s UK HPR1000 2022).

Other Potential Detriments

The information provided in Chapter 8 on non-proliferation and security is high level and generic. There is nothing to note that is specific or special to the RR SMR.

Safeguards and security considerations were an integral part of the Step 2 GDA completed by ONR, alongside nuclear safety (and environment protection considered by EA and NRW).

The published Step 2 GDA Statement on the [RR SMR](https://www.onr.org.uk/media/snbjfukt/rr-smr-gda-step-2-statement.docx)[[4]](#footnote-4) states that we have not identified any fundamental reason why this design could not be built in GB, is just as applicable to safeguards and security as nuclear/radiological safety.

We hope you find this helpful.

Yours sincerely

Sarah Brown

Head of Policy

Office for Nuclear Regulation

1. <https://www.onr.org.uk/generic-design-assessment/> [↑](#footnote-ref-1)
2. <https://www.onr.org.uk/generic-design-assessment/assessment-of-reactors/rolls-royce-smr/step-2-gda-statement-for-the-rolls-royce-smr/> [↑](#footnote-ref-2)
3. <https://www.onr.org.uk/media/cxsd4tug/rr-smr-step-2-ar-radiological-protection.docx> [↑](#footnote-ref-3)
4. <https://www.onr.org.uk/media/snbjfukt/rr-smr-gda-step-2-statement.docx> [↑](#footnote-ref-4)