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Dear Ms Lorenz and Dr Dorfman

### **Regulation of Small Modular Reactors (SMRs): HPGE202111063**

Thank you for your enquiry of 26 November 2021 regarding Small Modular Reactors (SMRs). By way of background, as stated in your letter, SMRs are high on the nuclear industry's agenda. However, there is a lot of variation in what this term is applied to. Different proposals have different implications for regulation:

1. There are SMR models that utilise well-established light water reactor technology, which are intended to provide several 100MWs of electricity to grid. Their developers claim they are close to starting both the initial construction of the first unit and subsequent fleet deployment of identical units.
2. There are so called "Generation IV" SMRs (sometimes called advanced modular reactors) which adopt "novel" approaches e.g. lead or sodium coolants, TRISO fuel or molten salt fuel. Each technology has its own safety benefits and challenges for its proponents to address.
3. Some vendors are proposing Generation IV designs that are sized to provide several 100MWs of electricity for the grid, whilst others are proposing designs for 10MWs for local power and perhaps other applications (heat, hydrogen production etc.).
4. Most Generation IV designs are further away from being constructed than the SMR designs. Even those that are close to construction are focused on building an initial proof-of-concept demonstration unit as a first step to a final design that can be replicated on a commercial basis.

Further to this, we have answered each of your questions in turn below:

#### **SMR specific questions:**

- **Does the regulation of the development of SMR concepts imply any different organizational models compared to development of larger units?**

We are aware of a range of different organisational and delivery models which vendors are considering for potential future deployment of SMRs. We are confident that our regulatory framework will allow us to effectively regulate for the range of foreseeable models we are aware of and we would adapt our approach in future if new unforeseen models required it.

- **Would ONR contemplate SMR reactor designs running on HEU?**

We are unaware of any civil reactor designs that are proposing to use highly enriched uranium. We do not prohibit the use of high-assay low enriched uranium but operators and designers will need to demonstrate safety (in particular, criticality safety) and security.

- **Do you have already defined specific safety issues regarding potential multi-unit sites for SMR?**

With funding from BEIS, we have reviewed our regulatory processes and guidance to ensure they are appropriate for the technological and deployment challenges of SMRs. We considered multi-unit sites in our review and are content we have an established approach for assessing the adequacy of developers' proposals. **It is worth noting we already regulate multi-unit sites in the UK.**

### **Licensing:**

1. **Do you have national licensing regulations for SMR already in place?**

Yes we have legislation in place, the Nuclear Installations Act 1965<sup>1</sup>, which requires the licensing of sites which are to be used for the installation or operation of nuclear reactors including SMRs. **The UK does not have a prescriptive regulatory regime**, instead we operate a goal-setting, outcome focused approach. The objectives of a safety demonstration remain the same but a designer/operator may need to take a different approach to achieve those safety objectives.

2. **Do you consider it necessary to develop specific SMR licensing conditions? 2A) If so, when may these conditions be available and applicable in the UK?**

We currently attach 36 standard conditions to site licences, independent of whether the facility is a large GW-scale reactor under construction, a fuel fabrication facility or a decommissioning site. **We have identified no reason why these technology-neutral conditions will not allow for effective regulation of SMRs.** For more information please see Licensing nuclear installations<sup>2</sup>.

3. **Which new issues do you expect the SMR licensing process might involve compared to conventional larger reactors?**

As previously stated, safety and security has historically been ensured by an established licensee controlling all activities on a particular site. **The business models for SMRs propose significant portions of design, construction and testing of modules undertaken off-site, in the factory, under the control of the manufacturer rather than the licensee.**

4. **Do you expect that SMR's could be licensable with reduced regulatory approaches? 4A) Is some kind of simplified approach possible which may lead to significantly lower licensing efforts and faster licensing procedures?**

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<sup>1</sup> <https://www.legislation.gov.uk/ukpga/1965/57>

<sup>2</sup> <https://www.onr.org.uk/licensing-nuclear-installations.pdf>

The standards for licensing will not be reduced. If the industry can achieve its objectives of replication (in terms of design, deployment and documentation), there could be efficiencies for the nth of a kind compared to the first of a kind, but the robust safety and security standards remain the same.

#### **Internal and external events and accidents:**

- 5. Do you expect that the range of internal or external events and accidents might significantly differ from those usually applied for licensing conventional reactors? 9A) In addition to obviously similar events such as SBO (Station Black Out), internal fires, loss of pumps, containment integrity as foreseen in international safety guides (WENRA, IAEA etc.); do you expect that external issues such as earthquakes, flooding, acts of terrorism and sabotage could be treated differently for SMR licensing? Could possible SMR sites differ from large LWR sites by having a lower burden of proof of rules for external events, especially climate-driven events?**

SMRs will need to demonstrate the same high standards of safety and security as expected for existing reactors, including a robust consideration of the external hazards and climate-change driven factors. Depending on design of the SMR, it is possible that the identified hazards will provide different challenges to the reactor. The designers may be able to demonstrate safety in an alternative way or with different safety features. However the safety and security objectives will be unchanged.

#### **Emergencies:**

- 6. Are you aware of any assessment showing that reduced emergency planning zones are possible for potential SMR sites?**

There is an expectation that all new nuclear power plants, whether GW-scale or SMRs, demonstrate that large or early off-site releases (that would require off-site mitigation actions) are 'practically eliminated' (see, for example, [IAEA SSR2/1 Revision 1](#)<sup>3</sup>). In the UK, the requirements for emergency planning are established in [REPPiR19 legislation](#)<sup>4</sup>. It would be a matter for the local authority to have an adequate emergency plan in place, informed by information from the licensee, before the reactor went to power. No SMRs have reached that point yet.

We hope you find this helpful but please do get in touch via [Contact@onr.gov.uk](mailto:Contact@onr.gov.uk) should you require further clarification.

Yours sincerely

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<sup>3</sup> <https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1715web-46541668.pdf>

<sup>4</sup> <https://www.hse.gov.uk/radiation/ionising/reppir.htm>