What are the prospects for small modular nuclear reactors coming to Wylfa or Trawsfynydd?

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Steve Thomas (stephen.thomas@gre.ac.uk)
Emeritus Professor of Energy Policy
PSIRU (www.psiru.org), Business School
University of Greenwich

Greg Jaczko

Advanced nuclear has become the catch-all for the knight-in-shining-armor reactors that promise to address issues that have kept nuclear a marginal electricity player since its inception. But we need more than this open-ended definition. The Biden administration should support projects only if they can compete with renewables & storage on deployment cost & speed, public safety, waste disposal, operational flexibility & global security. There are none today.

Gregory Jaczko, Former Chair US Nuclear Regulatory Commission, Feb 2021

Hyman Rickover (1970)

An academic reactor has the following basic characteristics

1. *It is simple*
2. *It is small*
3. *It is cheap*
4. *It is light*
5. *It can be built very quicky*
6. *It is very flexible in purpose*
7. *Very little development is required. It will use mostly 'off the shelf' components*

A practical reactor has the following characteristics

1. *It is being built now*
2. *It is behind schedule*
3. *It is requiring an immense amount of development on apparently trivial items. Corrosion is a problem*
4. *It is very expensive*
5. *It takes a long time to build because of engineering development problems*
6. *It is large*
7. *It is heavy*
8. *It is complicated*

What are Small Modular Reactors (SMRs), Advanced Nuclear Technologies (ANTs) & Advanced Modular Technologies (AMTs)?

- IAEA defines SMRs as smaller than 300MW (cf Hinkley Point C, 1600MW)
- SMRs comprise range of technologies from scaled-down versions of the type widely built, Pressurised Water Reactors (PWRs), through designs built as prototypes but not pursued (Fast Breeder Reactors), to designs never built Molten Salt Reactors (MSRs)
- Comprise a range of sizes from 4MW (U-Battery) to 470MW (Rolls Royce SMR)
- UK government invented Advanced Nuclear Technologies to cover SMRs of whatever size – to include Rolls Royce?
- Advanced Modular Reactors are expected to operate at 800+C to make hydrogen & other fuels
- Modular can mean largely factory built & transported to site for assembly, and/or built as a cluster of, say 12 reactors sharing central facilities

What is their rationale?

- Building components in large numbers on production lines will make them much cheaper, more than compensating for lost economies of scale, ie building bigger

- Doing more of the work in factories means quality is easier to control, & schedules & costs less likely to overrun

- Will the safety requirements be less because they are small, eg evacuation zones, sharing of facilities?

The 10-point plan (Nov 2020)

- £385m for Advanced Nuclear Fund, comprising £215m for SMRs and £170m for Advanced Modular Reactors plus £40m for supply chains & regulatory capacity
- First SMRs & AMRs to come online by early 2030s
- Previously announced £222m to build a fusion reactor by 2040 plus £184m for infrastructure/skills
- 3 AMRs receiving funds, U-Battery (4MW high temperature reactor), Westinghouse (450MW lead-cooled fast reactor) & Tokamak (fusion)
- AMRs unlikely to be available before 2045 if ever. No more to say!

The Rolls Royce SMR

- RR design only announced 2016, so still in early development phase. Claimed to be modular in construction but not promoted as clusters

- Consortium comprises: Assystem, Atkins, BAM Nuttall, Jacobs, Laing O'Rourke, National Nuclear Laboratory, Nuclear Advanced Manufacturing Research Centre, Rolls-Royce & TWI.

- Slightly larger than the first unit at Fukushima (470MW vs 439MW) & much larger than Trawsfynydd reactors, 250MW

- It will only proceed if the risk to RR money is minimal. That means RR will only put serious effort into design development with government guarantees given now, before design exists, before it has been reviewed by ONR, before a demo plant has been completed and before costs are known

RR's guarantee demands

https://old.parliament.uk/business/committees/committees-a-z/lords-select/science-and-technology-committee/news-parliament-2015/nuclear-research-technology-report-published/

- Exclusive access to UK market
- Matched funding (minimum) up to end of Generic Design Assessment
- Sharing of costs for production line facilities (to produce 2 reactors per year)
- Guaranteed orders for 7GW (16 reactors)

- The first plant must be made using production lines so all 16 reactors must be ordered now & by the time the first is completed, another 8 will be on their way

- No interest in the RR SMR outside the UK (despite RR's claims)

Costs & Times

- RR claims construction time of 4 years & costs (after 5 units) of £1.8bn (£3800/kW). Power cost £40-60/MWh
- Hinkley Point is currently expected to take about 10 years to build and cost £27bn (2020 money), (£8400/kW)
- 40-45% of the time and cost of Hinkley. Is that plausible?
- Who would own the plant? Utilities not interested, RAB unlikely, so UK government?
- Only about £18m from government approved, next phase much more expensive
- RR claims first reactor soon after 2030 but hard to see how this can be achieved

NuScale SMR

- Jan 2021, UK company, Shearwater, announced partnership with US NuScale to develop 3GW hybrid off-shore wind/SMR plant to produce electricity & hydrogen
- Details vague but Wylfa seen as ideal location
- Hydrogen touted as replacement for natural gas in heating & as a transport fuel
- But retail price of electricity is 5 times that of gas & nuclear is not cheap electricity so hydrogen produced will be very expensive
- NuScale SMR would not operate anywhere near 800C

NuScale SMR

- NuScale SMR a more advanced PWR than RR, under development since 2003
- Designed as cluster of 12 interdependent reactors
- Initially 45MW, then 50MW, then 60MW, now 77MW so cluster = 924MW
- Major US government funding ($0.5+bn) plus support for demo project
- 50MW version submitted to US regulator in 2017 & approved in 2020 but many issues outstanding
- It didn’t matter because 50MW version not marketed and 77MW version needs major new investigation

NuScale SMR

- Only potential project Utah Associated Municipal Power Systems (UAMPS). USDOE funding for part of the project but not sufficient investors yet for rest of project

- Target cost $2800-3600/kW, power price $50/MWh, first power 2030

Trawsfynydd

- Previously housed 2 Magnoxes, each 250MW. Entered service 1965, closed 1991
- Decommissioning not expected to be complete before 2090
- Is the site big enough, does it have enough cooling water, is the surrounding infrastructure good enough, e.g. for evacuation routes?
- Would it command local support?

Wylfa

- Previously housed 2 Magnox reactors, each 550MW. Entered service 1971/72, closed 2012/15
- Decommissioning not expected to be complete before 2090
- Widely characterised as UK's best site for new reactors, good access, limited local opposition, good transmission links
- Horizon Wylfa project finally abandoned in Jan 2021 before Planning Inspectorate ruling but Examining Authority was recommending refusal

Wylfa

- Terrestrial Ecology
- Considering EN-1 (Overarching National Policy Statement for Energy), the benefits of the development at this site would not outweigh the broader impacts on the national network of SSSIs; ▪ with respect to Tre'r Gof SSSI, the proposed development does not comply with the assessment given in EN-6 Volume II;
- the provision of compensation sites has the potential for moderate benefits in terms of biodiversity;
- due to insufficient scientific evidence, it cannot be demonstrated beyond reasonable scientific doubt, that the tern colony would not abandon Cemlyn Bay and with reference to 5.3.17 of EN-1, substantial weight should be given these potential adverse effects;
- there is doubt that there would be a net gain in Section 7 habitats and therefore is not compliant with EN-1, TAN 5 or Part 1 of the Environment (Wales) Act (2016) in this respect; and
- there is probability that the nationally important CHEG grasslands may be lost and not able to be re-created, so not being compliant with 5.3.17 of EN-1 or TAN 5(nature conservation and planning.
- **The Examining Authority (ExA) advises that terrestrial ecology and biodiversity are matters which should weigh substantially against the Order being made.**

- HRA - The SoS is the competent authority under the Habitats Regulations, the ExA finds that in its view, the proposal would adversely affect European sites, species and habitats which the ExA has taken into account in reaching its recommendation.

- Socio-Economic impacts ....However, the additional pressure that would be placed on accommodation within the KSA during the construction period could even with the proposed mitigation, adversely affect tourism, the local economy, health and wellbeing and Welsh language and culture.

- Air quality - The ExA remains concerned that there is no secured mitigation to ensure against adverse effects from air quality during operation.

- Good design - taking the precautionary approach while the ExA concludes that the National, Welsh and local policy tests have been met for individual elements and for the physical design of the project overall, it cannot, due to the impact upon designated sites, make the conclusion for good design for the project overall. On balance the ExA concludes that the Application would therefore not follow good design principles, and this should be given limited weight against the Application.

- PLANNING BALANCE SUMMARY 22.20.1. Having regard to all the matters referred in Chapters 6-21 of this report, the ExA's conclusion is that, on balance, the matters weighing against the proposed development outweigh the matters weighing in favour of it. The ExA therefore finds the case for development is not made and it recommends accordingly.