A MISSED OPPORTUNITY TO INVEST IN NEW NUCLEAR TECHNOLOGY WHICH IS INHERENTLY SAFE AND WHICH USES UP HIGH LEVEL NUCLEAR WASTE RATHER THAN PRODUCING MORE OF IT

The latest government Climate Change strategy (1) has included very significant plans for Nuclear. These include the development of pressurised water reactors (PWR) at both large scale such as Sizewell C and at small scale as Small Modular Reactors (SMR) manufactured by Rolls Royce. These reactors should be operating in the early 2030s. The government plans also include the longer-term development of Advanced Modular Reactors (AMR) for potential deployment by 2040.

However the really significant changes in future nuclear technology will be in AMR's (for which UK government support is less specific and longer term) because:

- They offer offsite production line manufacturing (which SMR's also do)
- AND can, though very much dependent on which AMR technology, in addition deliver
  a) <u>fundamentally</u> safe operations
  b) NO production of highly radioactive waste - in fact using existing waste as fuel
  c) 'load following' ability to quickly ramp up and down in power to match demand fluctuations (some capability with Rolls Royce's proposed SMR's for this)
  d) very significant cost reductions.

How many of these benefits are delivered will depend on the AMR technology used. Unfortunately the NIRAB (Nuclear Innovation and Research Advisory Board) current advice to Government (2) is that the best way forward is to use the HTGR (High Temperature Gas Cooled Reactor) variety of AMR - which does NOT deliver the benefits a), b), d) and delivers less of c) above. The NIRAB advice seems to have given too little weight to the need to address the primary objections to all Nuclear Power worldwide - that the safety of nuclear reactors, even if very high, depends on systems which can fail; that they produce waste for which disposal remains an unresolved problem; and that experience proves them to be extremely expensive. By prioritising the experience the UK does have with gas-cooled reactors above these other key benefits (in 3), they are proposing government support for HTGR technology which will be overtaken in time by other AMR technology with these benefits.

The NIRAB analysis (2) ranked HTGR above other AMR options (Sodium-cooled, Lead-cooled and Molten-Salt cooled reactors). These AMR options do address in part the benefits a) to d) above. However NIRAB did not include in their assessment another AMR - the Stable Salt Reactor (SSR) which is designed by Moltex (a UK company that is rapidly expanding in Canada) - which has safety and cost advantages over these other options. A

Stable Salt Reactor is being built in Canada and a similar design could be built in UK by 2032 - as a possible alternative (but certainly a successor) - to the Rolls Royce SMR's.

In some more detail there follows a comparison of the Stable Salt Reactor with the HTGR.

1 Safety

The SSR would be inherently safer than the HTGR as it does not produce pressurised fission gases so it isn't possible for the SSR to spread radiation across large areas of land. The SSR is not pressurised so there is no danger of overheating due to loss of coolant pressure. When the temperature of an SSR increases above the designed temperature the nuclear fission reduces and the reactor cools due to the physics of the design – no operator intervention is required. The HTGR would require active safety systems to operate continuously in order to keep it safe and it would require a large safety exclusion zone around the reactor.

2 Treatment of waste

The SSR uses a pyro-processing technique to turn existing nuclear waste into useful fuel leaving the waste in a much cleaner form. This is a highly efficient process such that the UK's existing waste stockpile would provide enough fuel to power 100% of the UK's electrical needs for hundreds of years. The HTGR would not only produce more waste but that waste would be in a form that is particularly difficult to re-process and would therefore have to be stored for hundreds of thousands of years.

3 Cost

As the SSR is small and simple with no pressurised components the construction is simple and cheap. Both build and operating costs have been assessed by Atkins (a British multi-national company with nuclear engineer expertise) to be lower than those for a coal power station. The HTGR would be much larger and more difficult to construct for the same power output as the SSR. The HTGR would require large, pressurised systems which have to be assembled on site.

4 Implementation timescales

Moltex have already started the first SSR project in Canada and Moltex have stated that the first SSR could be operating in the UK by 2032 thereby not only beating the expected timescales for a HTGR but also removing the need for the PWR based Rolls Royce SMRs.

A video explaining The Stable Salt Reactor is available at
A Revolution in Nuclear Power - YouTube https://youtu.be/B_y0yKJVtLQ

SUMMARY and CONCLUSIONS

In summary we think that in progressing AMR strategy the Government should be ambitious and look for reactor designs that provide 'walk away' safety through passive systems (not dependent on active safety systems operating continuously); and which use closed cycle fuel processing (re-processing of spent fuel) in order to reduce nuclear waste stockpiles and provide practically unlimited fuel supply. Designs such as the Stable Salt Reactor can provide these features combined with very low build and operating cost and could be available on a similar timescale to the proposed Rolls Royce SMR.

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References:

1) British energy security strategy - GOV.UK (www.gov.uk)
2) Advanced Modular Reactors Technical Assessment (nirab.org.uk) (Table 3)
3) Development opportunities for AMR in UK https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/899661/nnl15156-key-points-development-opportunities-for-UK-capability.pdf