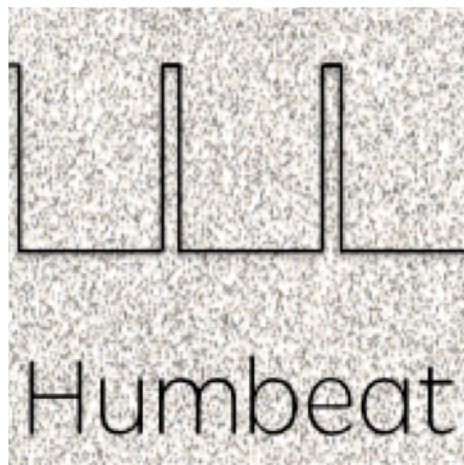


Let's build an SMR

Humbeat explores why a rigorous approach to identifying future market requirements is critical to selecting "the best value ... SMR design for the UK"



Fast-paced modern life extends to all disciplines. **Humbeat Limited** seek out recent developments and regularly comment on those which are most important to you. What do you think?

Si.Gillett@humbeat.co.uk

September 2016

Let's build an SMR

The UK Government have generated considerable interest among nuclear reactor designers by signalling, earlier this year, an investment of £250m in an “ambitious nuclear research and development programme, enabling the UK to be a global leader in innovative nuclear technologies.” This programme includes a competition to “identify the best value small modular reactor (SMR) design for the UK.”

Global reactor vendors and UK nuclear industry focus has so far rightly been prioritised on understanding the capability and capacity of a future UK nuclear supply chain to manufacture SMRs for commercial deployment. The summary: the UK will be capable, but any successful SMR “ecosystem” must drive down unit production costs and deliver return on investment for the UK by:

- Delivering affordable technology;
- Being UK-based with UK IP; and
- Attracting an international order book.

The roadmap for SMR deployment in the UK includes Generic Design Assessment completion by the early 2020s; an FOAK reactor being operational from 2030; and NOAK reactors rolling out from 2035. This roadmap is predicated on an evolution of light water reactor technology. More evolutionary designs may take longer to come to market, because they are less able to capitalise on technology-specific design, licensing and construction experience.

Regardless, one design, allowing for modular manufacturing and construction, will be vital to achieve the licensing and manufacturing efficiencies required for a multiple-unit, affordable, SMR manufacturing programme.

The SMR which is designed this year, will be licensed this decade and built and operated in energy markets in 10, 20 ... 50, 60 years time. i.e. in a market which (as will be explained shortly) is likely to be very different to today's. Further, the likely requirement for an international order book to make the technology cost-competitive, means that the chosen SMR design must meet the needs of at least multiple national electricity systems, not just (or maybe not even at all) the UK's domestic system.

So: what are the market-driven opportunities and constraints for a reactor operating in a future energy system? Or ... what should an SMR be able to do? This is an important question to answer because of disruptions within traditional electricity systems; and many possible pathways for future electricity needs. However it is now, that deep, robust views of future markets must be developed in order to build the right SMR.

Disruptions within traditional electricity systems

Dispatchable generators, connected by high-voltage transmission systems, have for over 50 years served the electricity needs of their countries. Power plants with different characteristics have helped match electricity supply to demand, and have provided the system services needed to maintain electricity supplies to customers. Baseload power has a role in large, interconnected electricity transmission systems, where the annual system minimum load is known and foreseeable. Today, nuclear power is generally considered to be a source of low-carbon baseload power.

Significant capacities of renewable assets have disrupted this traditional view. Intermittent power plants are already providing a large share of electricity to end-users; more are in the connection pipeline. Cost reduction in micro-solar and wind generators, coincident with favourable incentive frameworks and economic conditions, has enabled the installation of many tens of GW of capacity of intermittent renewable generation across very many sites.

While clearly driving down carbon emissions, small renewable power has also fundamentally changed the characteristics of many regional electricity transmission systems. Electricity flows are now more consumer-centric than in the recent past, and the role of an electricity transmission system in an increasingly consumer-centric world is uncertain.

In extremis, if local consumer generation levels are able to match local consumer demand levels most of the time, through use of clever technology, storage or other means ... Could transmission systems become a relic of the past? And if so, what might that mean for SMR designs?

Future Electricity Needs

Electricity markets are becoming more complex. The rules are not always certain, placing a challenge to revenue certainty within traditional electricity markets. Future revenue certainty is so important for a high-capital cost technology like nuclear.

Industry change (whose rate seems to outstrip that of nuclear development) provides both opportunities and threats to the future success of nuclear power.

One opportunity, the future electrification of heat and transport (which may yet underpin an enduring need for baseload generation) still seems quite far away. Two threats though – electricity storage and increased localised generation (which together may make small, isolated and efficient consumer-centric electricity systems possible) – are very much more real.

As market conditions and environmental policies continue to upheave the industry, nimble technologies (storage, demand services, micro-generation) are well placed to cause more disruption, driving further acceleration into the pace of industry change ... but not necessarily in the favour of baseload, low-carbon nuclear power.

What should an SMR be able to do

The nuclear industry must therefore secure its own future success by delivering solutions to the problems of tomorrow. We must foresee future worlds an SMR would operate in, to work out how it might successfully play an important role in future electricity generation.

Commercial-by-design, multi-use reactors (i.e. meeting market needs in more than one energy vector to hedge against revenue uncertainty in any one niche – heat and power, for instance) may be more expensive than targeted-use reactors in the short term. Yet meeting broader needs may underpin success in the long term as well as easing financing concerns.

To choose the appropriate technology, we must answer: where would the reactors be located? How will they connect to markets? How will they be required to operate? How will their revenues be achieved? Siting, flow-to-market, contracting, plant operation, safety justifications and public acceptance all inter-relate in this “wicked” problem.

A “One size fits all” solution looks to be a tough ask, yet the adaptability of SMR designs for local-fit competes with their economic requirement for a single, modular design, which enables “cookie-cutter” type manufacturing and construction. A balance must be struck.

By following the trends of today’s markets to the far horizon, it will be possible to identify future markets in which SMR services might bring low-carbon value. Vendors and UK Gov must both complete this analysis, to provide assurance that the technology which is selected and built works for vendors, customers and government, and remains valuable throughout its commercial life.

Only if the needs of those markets have shaped the SMR design of today, can we then be certain that we will have identified “the best value ... SMR design for the UK”.