SMALL MODULAR NUCLEAR REACTORS: THE OUTLOOK FOR DEPLOYMENT

SMRs –financing the projects

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Rothschild Nuclear Credentials

Hitachi & Horizon

Advisor in relation to Wylfa UK new nuclear project

Current

Hungarian Government

Advisor in relation to new nuclear project

Current

CGNPC

Advisor to CGNPC in relation to its 33.5% investment in Hinkley Point C and two additional UK nuclear projects

Current

Fennovoima / Rosatom

Advice on the project financing plan for a new 1.2GW Hanhikivi-1 nuclear power plant in Finland

Current

Urenco

Sole financial advisor to the Company

2013 - 2016

CGNPC

Advisor to CGNPC on Turkish New Nuclear Project

2012 - 2015

Advent International GmbH

Acquisition of NUKEM from RWE. Restructuring and disposal in five transactions

2006 - 2013

Extract Resources

Advisor in relation to A$2.2bn takeover offer by CGNPC-URC and CADFund

2012

VAE

Advice on regional (4 nations) new nuclear project and selection of Hitachi as strategic investor

2009 - 2012

GDF Suez

Advisor to GDF Suez on UK site acquisitions

2009

British Energy

£12.5bn recommended sale to EDF

2009

Constellation Energy

Advice to Constellation Energy in relation to EDF's US$4.5bn acquisition of a 49.99% stake in Constellation's nuclear generation assets

2009

BNFL

US$5.4bn disposal of Westinghouse to Toshiba Corporation and five further transactions

2006 - 2009

Suez

€11.2bn cash and share offer on the remaining 49.9% shares in Electrabel

2005

Merger between Suez and Gaz de France Combined EV €102bn

2008

EDF

Advice on the privatisation of EDF

2005

SMRs: an opportunity to expand Private Finance in nuclear?

Until recently most NPPs were built and financed in the public sector

- Typically by state owned monopoly utilities on balance sheet e.g. China, Russia, Korea, France and Abu Dhabi
- In newcomer countries often supported by G2G finance e.g. Russian exports

Private sector utilities could build nuclear only if the market / regulatory environment facilitated full cost pass-through (e.g. investor-owned utilities in USA and Japan)

- This environment has drastically changed, imperilling not just new, but existing nuclear

Governments across the world now seek to procure that new nuclear is financed through the private sector

- This has proved very difficult

Can SMRs facility private financing of new nuclear?

Why is private sector financing of new nuclear so difficult?

At c. USD5,000+/kW capital cost overwhelms private utility balance sheets

- Nuclear is simply “too big” for a single utility company
- Project size can also overwhelm the balance sheet of contractor

The risks are too great

- The construction period is too long and construction is subject to cost and time overrun
- This has a knock-on effect of enhanced abandonment risk
- Liquidity risk is an issues for refinancing and insurance
- High-cost, inflexible offtake agreements are too onerous

Recent European experience illustrates the difficulties

Recent European experience of private sector newbuild

Okiluoto (Finland)

- Financed on TVO balance sheet, supported by its other cash flows and beyond that by its Mankala members
- Construction risks underwritten by Areva. Cost over-run has forced the restructuring of Areva

Hinkley Point C (UK)

- Financing on the balance sheets of EDF and CGN, both public sector companies but acting like private companies outside their home markets
- Construction cost over-run and other completion risk borne by EDF and CGN equity
- Consumers underwrite the offtake risk though a high cost CFD (92.50 GBP/kWh)

New NNB projects in Hungary, Finland and UK offer the chance to redeem nuclear's reputation

Why persist with private sector finance?

Governments are constrained and the cost of nuclear is high

- Short-term macroeconomic constraints should not derail a strategic energy choice

Private sector financing exposes nuclear to the market test

- Developed countries made enormous nuclear mistakes while industries were shielded from market pressures
- EDF's capital opening has subjected French nuclear to the market test and demonstrated nuclear's successes as well as its problems
- The current US nuclear industry crisis shows that poor market and regulatory design can cripple energy policy on nuclear

Private sector involvement enhances efficiency

- In nuclear, safety must always be paramount
- Regulation prioritises safety above economics
- But cost minimisation is crucial to the future of nuclear and the private sector can bring efficiencies

The optimal public-private solution should combine private with public sector financing

Combining public and private involvement: construction contracting

Time and cost overrun

- The conventional solution to construction risk is fixed price contracting backed by contractor guarantees
- Okiluoto and Westinghouse show the drawbacks. Who in future will accept these risks?
- A prudent contractor facing a fixed price turnkey contract may over-inflate the turnkey price to mitigate cost over-run risk
- Absent compelling turnkey offers, risk optimisation suggests fixed price for controllable items like the NSSS supply and target/incentive risk-sharing mechanisms for less predictable items

Optimising capital structure

- Optimised cost/risk is not consistent with maximising debt. Risks best borne in the project should be be borne by equity
- This implies lower gearing, potentially with D/D+E below 50%
- To add more debt would require more fixed price elements, increasing EPC cost and potentially killing project economics

Intelligent risk sharing leads to lower costs

Impact of SMRs on construction contracting

Increased scope for offsite fabrication increases ability to fix NSSS etc. costs

- Increases proportion of fixed costs

Smaller footprint reduces local construction issues and should allow greater certainty re local costs

- Further increase in proportion of fixed costs

Smaller capex cost reduces financial burden on EPC contractor

- Increases potential scope for contractor to take turnkey price risk

Less construction risk means higher debt capacity

- Lenders are particularly adverse to construction risk

SMRs lead to lower construction risk

Combining public and private involvement: source of finance

Sources of equity

- Increased need for equity may strain the private sector's capacity
- Possible sources are the sponsor, the EPC contractor and third party nuclear utilities (especially if linked to an operations role)
- EPC contractors' government may wish to support its "champion" with equity
- More speculative sources are private equity and potential entrant utilities seeking nuclear expertise
- If/when these sources prove insufficient, the host government may need to provide equity support

During the construction stage, equity is exposed to significant risks

- The construction period returns need to be commensurate – possibly in the 15-20% equity IRR range?

Equity can be a constraint in financing large NNB

Impact of SMRs on construction finance

By increasing debt capacity, need for equity is reduced

- Increases potential pool of equity

Smaller equity requirement diminishes need for government equity

- Private sector appetite more likely to be sufficient

Lower construction risk reduces cost of equity

- Less and cheaper equity means a lower Weighted Average Cost of Capital

Shorter construction period further reduces financing costs

- Lower interest during construction (IDC) and earlier equity returns

SMRs can lower the cost of finance

Combining public and private involvement: operations and offtake

Operational expertise and excellence is paramount both for safety and economics in a nuclear project. This experience rests within nuclear utilities

- Nuclear-entrants lack domestic skills so foreign support is essential – e.g. a utility or experienced operator associated with the EPC contractor
  - Contractors who cannot bring such a partner may be seriously disadvantaged
- Optimising incentives means that the operator should have equity exposure
- Offtake agreements should provide sufficient financial cover for equity investors and debt
- A government-underwritten tariff is not necessarily required
  - Mankala members in Finland accept market risk
  - Private investors in European utilities today accept implied nuclear operating risk at 6.7% WACC
  - Only if nuclear is expected to be above market price is government offtake support necessary

Government offtake support may be necessary even in a wholesale market

Impact of SMRs: operations and offtake

The smaller size of SMRs raises the possibility of a larger fleet and more scope for standardisation of operations

- Over time this should broaden the pool of operating experience and make it easier to acquire operating skills in the market
- Contractor will find it easier to bring a partner

The smaller size of SMRs will reduce the impact of nuclear on grid reliability

- Nuclear will “fit” into new markets

Possible ability to re-locate SMRs will reduce the need for long-term contracts

- Less need for market risk to be borne by offtakers

SMRs can enter new markets and can bring in new players to operation

Combining public and private involvement: refinancing during operations

From first re-load, a project is significantly de-risked, facilitating refinancing

- Other than sponsors and the operators, remaining equity participants may wish to exit
- Other equity investors (e.g. pension funds, infrastructure funds and long-term investment funds) may seek entry. Market evidence suggests c.7.5% ungeared equity IRR as a conservative benchmark return
- The de-risking facilitates increased gearing, lowering the cost of capital further
- After government exit, a hybrid public-private project can become genuinely private
- Liquidity of insurance markets and need for funds of last resort remains a possible problem

Operations provides a refinancing opportunity to transform the project into a genuinely private project

Impact of SMRs: refinancing during operations

The likely size of an SMR fleet should increase lender familiarity over time

- This will make refinancing easier and lower cost

The size of conventional reactors means that liquidity of capital and insurance market remains an issue throughout their life

- The smaller size of SMRs will reduce this liquidity pressure

SMRs can be easier to refinance, reducing further the cost of capital

Combining public and private involvement: back-end costs

Back-end costs should be borne by the generator (and thus by consumers)

- To do otherwise would distort cross-technology economics

The ideal mechanism is a ring-fenced sinking fund financed by annual provisions

Key decisions include

- Discount rate applied to calculate size of provisions
- Safeguarding independence of the fund
- Possible sculpting of payments to facilitate debt repayment during early years of operations

Back-end costs are subject to future government and inherently unpredictable

- Government needs to take the residual risk - in any event it will inevitably do so
  - Assurance on this is a condition of the refinancing assumption

Government has ultimate liability in any event. Flexibility in sculpting provisions can help to maximise private sector participation

Impact of SMRs: back-end costs

Mobile SMRs can transform the back-end

- Floating reactors can be removed from the host country
- Both decommissioning and waste management can be expatriated to the reactor manufacturer
- Potential to “fix” both uncertain back-end cost and to mitigate political / environmental and public acceptance concerns

SMRs can help to mitigate back-end concerns

Combining public and private involvement: development

Although construction periods are long, development periods can also be very long

- Site acquisitions and site licensing and design approval are among major items
- For nuclear entrants, creating regulatory institutions is also a major task
- Five years plus and a billion dollars plus are very conceivable

Without a guarantee of success, such risks are expensive for the private sector to assume

- Developers would expect a healthy developer's fee or equivalent in a country with an existing programme
- In HPC these risks are borne in the tariff and in TVO they are borne internally
- Other development risks (e.g. government-related) may need to be squared off first

For nuclear entrant countries, the development risks for the private sector is even higher

- It makes no sense to privatise this risk
- Development (including the choice of technology) should be undertaken in the public sector
- Private sector can still be introduced, from construction onwards

For new entrant countries, development should be undertaken in the public sector, but to facilitate private sector involvement from construction onwards

Impact of SMRs on development

SMRs reduce, but may not remove, the requirement for host country regulation

- Potential scope for exporting country to export the required regulatory expertise

Local planning and environment process can be significantly reduced

- Especially if offshore reactors are deployed

More cost certainty reduces development risk

- Increases potential competition and reduces development costs

SMRs can simplify the development process

Conclusions

1 **Private versus public finance is a false dichotomy in nuclear new-build**

2 **There is a role, but limited, for the private sector, but it brings significant potential benefits**

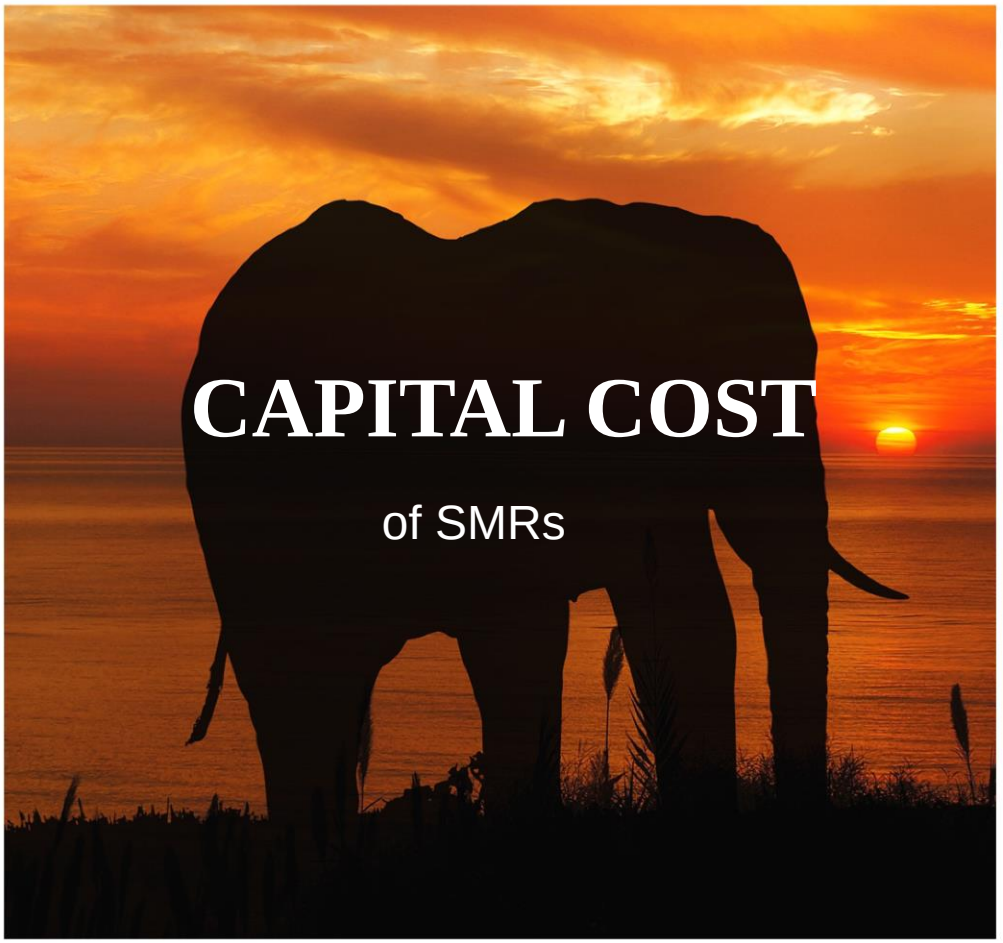
3 **Intelligent construction risk-sharing is likely to deliver the lowest construction cost**

4 **Post COD refinancing, rather-than up-front private financing, is the key to extracting the best value from the private sector**

5 **SMRs significantly mitigate the problem of private sector-financing**

- Construction risk
- Equity requirement
- Flexibility of offtake
- Cost of capital
- Cost of refinancing
- Export of back-end costs
- Easier development process
- Lower IDC
- Faster returns

But the elephant in the room is Capital Cost


CAPITAL COST
of SMRs

Thank you

Rothschild