LSEG

State procurement of nuclear power plants - Project Finance International

01 Jul 2025 10:38:08 AM

The international market for large nuclear power plants has recently gained traction both within countries that have existing nuclear power resources as well as non-nuclear power countries, which have announced an intention to implement, or have already begun the implementation of a national nuclear power programme.1 By Kelly Malone of King & Spalding LLP and Helen Cook of GNE Advisory

This article focuses on the procurement of newbuild LNPPs by the national governments of such countries and/or the state-owned companies tasked with the responsibility to procure, develop, finance, construct, own and operate a new-build large nuclear power plants. Prior to developing a national strategy for the procurement of LNPPs, the host country and LNPP owner may wish to consider the following factors:

Nuclear technology vendor market

Five nuclear technology vendors (NTV) – Kepco/KHNP of Korea, EDF of France, Westinghouse Electric Corporation of the US, CGN/CNNC of China and Rosatom of the Russia – currently participate in the international LNPP procurement market. AtkinsRealis of Canada, which holds the exclusive licence to export Canada deuterium uranium (CANDU) reactor technology, may emerge to become a sixth-market participant.[2]

But the market share of these vendors varies widely. Of the 52 nuclear reactors that have started construction worldwide since 2017, 25 reactors incorporate technology designed and owned by Chinese NTVs and 23 reactors incorporate technology designed and owned by Rosatom and/or its affiliates.[3] Construction has also recently begun on the Bailong and Lufeng LNPPs in China, located in Guangxi Province and Guangdong Province, which will incorporate a total of four Westinghouse AP 1000 reactors, two per project.[4]

Equally relevant is that:

* Rosatom has secured a significant share of the global nuclear reactor export market, offering a comprehensive range of services across the entire nuclear fuel cycle and plant lifecycle, flexible business models and strategic partnerships with host countries. While international sanctions imposed on Rosatom’s board members as well as JSC Rusatom Overseas may have had some limited effect on Rosatom’s commitments outside Russia, a number of host countries have recently announced new LNPP projects, based on VVER-1200 reactor technology, supplied by Rosatom notwithstanding these sanctions.

* While EDF has suffered major cost overruns and completion delays during the supply of LNPP projects, such as Hinkley Point C in the UK and Flamanville 3 in France, the lessons learnt from these projects and the rebuilding of supply chains as well as a pool of highly

skilled personnel will likely lead to much greater cost and schedule control for new LNPP projects – especially if these projects adopt the same EPR reactor technology. At 1,650MW of capacity per unit, the EPR reactor technology is best suited for baseload operation in larger electricity markets with fully developed grid systems.

* Kepco and KHNP, Kepco's subsidiary, work together in a collaborative manner for the export of their nuclear reactor technology, the APR1400, and have successfully delivered four units as part of the Barakah LNPP project in the UAE. These companies recently settled their ongoing intellectual property dispute with Westinghouse, which will likely remove a significant impediment on their ability to deploy nuclear reactors outside South Korea. KHNP has recently withdrawn from participating in ongoing LNPP procurement programmes in the Netherlands, Sweden and Slovenia, following this settlement, which may signal the absence of the South Korean technology in the EU other than the Dukavony II LNPP project in the Czech Republic.[5]

* Westinghouse has supplied the technology for approximately 60% of the operating fleet of LNPPs in the US and approximately half of the world's operating LNPPs have incorporated their technology. Westinghouse currently exports their AP1000 reactor technology, a Generation III+ reactor with fully passive safety systems and a modular construction design. Building on their previous work at the Vogtle LNPP in the US where Westinghouse also deployed AP1000 reactors, Westinghouse collaborates with Bechtel for the supply and installation of LNPPs in the EU.[6]

* CNNC and CGN have led the extraordinary buildout of LNPPs within China, mostly within the high electricity demand areas along the East Coast, and have jointly developed the indigenous Hualong One (HPR1000) nuclear reactor technology for export. While CNNC has supplied two Hualong One reactors to Pakistan, these companies have encountered significant hurdles exporting this technology to Western countries due to political and security concerns.[7]

The recognition by many countries of the role that nuclear energy can play, in both the decarbonisation of energy systems and energy security, has led to a resurgence of demand for nuclear energy and a plethora of new nuclear programmes and projects, many of which are currently in the planning or procurement phase. This, combined with the constraints within the vendor market, both in terms of the number of NTVs and expected supply chain capacity, has created a paradigm shift away from the previous LNPP owners' market where NTVs offered very aggressive and ambitious pricing and contract terms to win projects, to a situation where heightened demand now works in favour of NTVs in procurement processes.

Supply package options

In addition to the supply of nuclear technology and EPC services for LNPPs, host countries may wish to solicit up to three other supply packages as part of their procurement programme, depending on the status of the host country as a new nuclear country or an existing nuclear country. As part of their procurement programmes, new nuclear countries will often request that the winning bidder, or its designee, co-invest in the LNPP owner, known as co-investment support.

This supply package option reduces the equity funding commitments of the host country and helps align the commercial interests of the winning NTV bidder with the owner and the host country as the ability of the owner to repay senior debt service and distribute dividends during commercial operation will depend on the timely completion and performance of the LNPP.

The solicitation by the host country of co-investment support from NTVs carries with it the need for the preparation of investment agreements, which effectively implement a state/non-state partnership akin to a public-private partnership with the host country, and

typically includes a shareholder's agreement and one or more other legal instruments – ie a power purchase agreement or contract for differences – which stabilise forward electricity prices from the scheduled date of commercial operation of the LNPP.

In lieu of stabilising electricity prices transactionally, at least one host country, the UK, has adopted an alternative funding approach, called the regulated asset base model, for an LNPP project, which requires electricity consumers to fund eligible project costs together with a return on the shareholders' investment from the beginning of construction.[8] Host countries may also wish to solicit some level of debt financing support from NTVs when procuring an LNPP.

In all cases other than Rosatom, the NTV would typically coordinate with the export credit agency of one or more of the countries of origin of the nuclear technology, material and equipment, which an NTV and its sub-suppliers will export to the host country, to make available debt financing that will fund the purchase by the owner of such technology, materials and equipment.

Rosatom has also historically made available debt financing support as part of the procurement of their nuclear reactors but in the form of a government-to-government loan, governed by terms and conditions set forth in a bilateral treaty, called an intergovernmental agreement, between the host country and Russia. Finally, many LNPP owners will likely want to procure support during the commercial operation of an LNPP, particularly the first LNPP, which typically includes operation and maintenance services and a long-term supply of nuclear fuel.

Forms ofLNPP investment structure

Host countries have generally structured their LNPP investments in one of the three forms, shown in the table below, along with the key features of each structure.

TABLE 1 - FORMS OF LNPP STRUCTURE

Investment structure form	Key features
Full state-ownership	1. Maximum level of state-control over strategically important, national infrastructure;
(e.g, Czech Republic, Dukovany II)	2. No long-term alignment of commercial interests between state and NTV; and
	3. Maximum state funding commitments and exposure to LNPP cost overrun and delay risk.
State/non-state partnership	1. Significant level of state-control over strategically important, national infrastructure where state holds a majority of shares in owner of LNPP;
(eg UAE, Barakah/UK, Sizewell C)	2. Significant long-term alignment of commercial interests between state and NTV; and
	3. Reduction of state funding commitments and exposure to LNPP cost overrun and delay risk as level of co-investment support increases.
Build-own-operate	1. Minimum state-control over strategically important, national infrastructure;
(eg, Turkey, Akkuyu 1 & 2/UK, Hinkley Point C)	2. Maximum long-term alignment of commercial interests between state and NTV; and
	3. No state funding commitments and minimum state exposure to LNPP cost overrun and delay risk (ie, state only pays for power production of
	NPP or wholesale electricity market strike price differences).

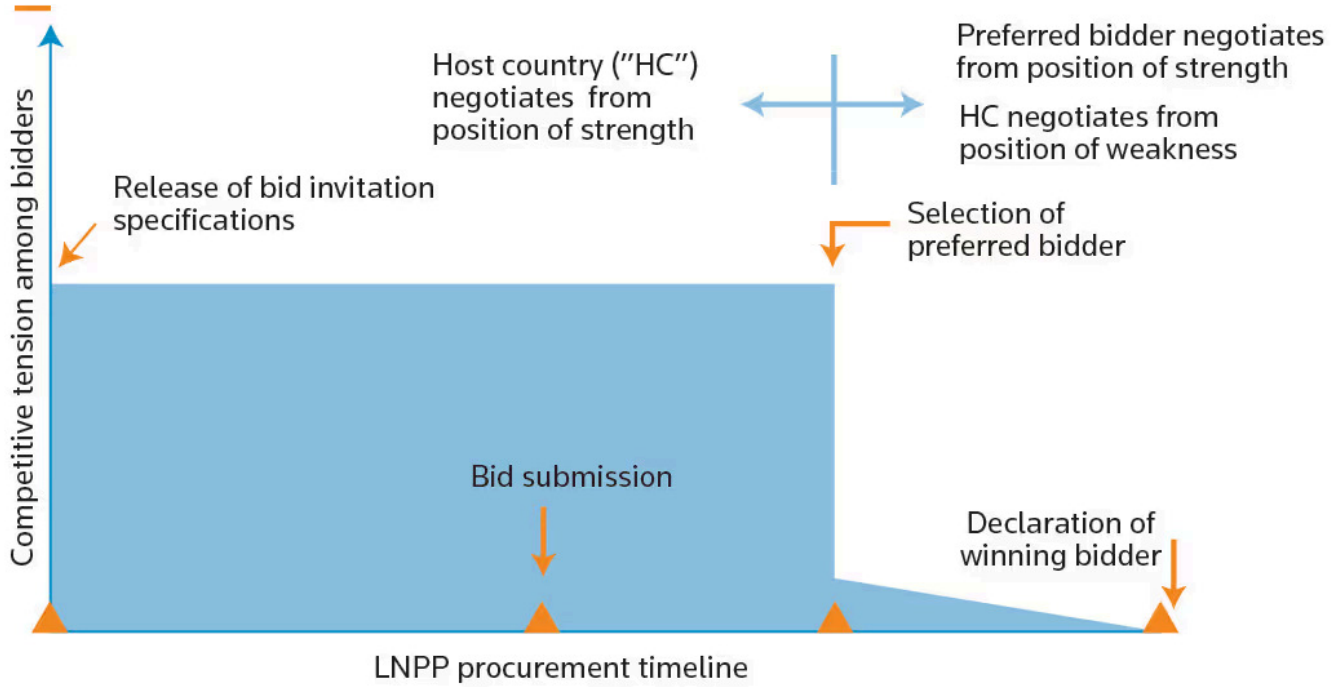
State control over an LNPP, level of state-funding commitments and exposure to LNPP cost overruns and completion-delay risk all factor into a host country's selection of an investment structure for an LNPP.

Importance of competitive tension

Competitive bidding tension among two or more NTVs often plays an important role in the success of a host country's LNPP procurement programme. Because a competitive procurement process gives a host country different options for the selection of a preferred bidder and eventually the declaration of a winning bidder, the presence of competitive tension forces NTV bidders to accommodate requests by the host country for cost reductions and contractual terms that favour the LNPP owner as much as possible prior to the selection of a preferred bidder.

The actual selection, however, often involves an extensive bureaucratic (and even political) decision of national importance, which makes the likelihood of a host country reversing such decision very low and, therefore, opens an almost exclusive pathway for the preferred bidder to realise the prize. This new post-selection dynamic shifts negotiation leverage from the host country to the preferred bidder as illustrated in the schematic in Figure 1.

FIGURE 1 - POST-SELECTION DYNAMIC SHIFTS



For this reason, host countries and their state-owned corporations, tasked with implementing national LNPP procurement programmes, should (to the maximum extent possible) finalise the commercial terms and conditions for each supply package other than debt finance support (if any) prior to the selection of the preferred bidder (at the latest) and ideally prior to bid submission.

This recommendation highlights the main problem with bilateral LNPP procurement programmes for host countries – the absence of competitive tension. While a host country may enter into a "competitive dialogue" with multiple NTVs at the front-end of a procurement

programme, the programme very quickly converts to a bilateral process upon the selection by the host country of one NTV as a preferred bidder following the submission and evaluation of non-binding price estimates and technical proposals by all NTV bidders.

This means the host country will likely conduct negotiations of commercial terms and conditions from a position of weakness often starting from the NTV's inhouse, standard template terms and conditions, which will allocate much of the project risk to the LNPP owner – a deeply unattractive position for the host country. The adoption of a strategic partnership between the host country and the NTV country, however, may help to reduce the disparity in negotiation leverage.

Mitigation of LNPP cost overruns and completion-delay risk

Host countries and LNPP owners should tread carefully when a NTV proposes first-of-a-kind (FOAK) reactor designs. LNPP owners have encountered substantial completion delays and cost overruns during the supply and installation of seven out of eight LNPPs which have begun construction since 2005 and incorporated Western reactor designs. The eight LNNPs are Olkiluoto-3 in Finland, Flamanville-3 in France, Vogtle 3&4 in the US, VC Summer 2&3, cancelled during construction, in the US, Hinkley Point C in the UK, Shin Kori 3&4 in South Korea, Taishin 1&2 in China, and Barakah 1-4 in the UAE.

Importantly, all of these LNPP projects incorporated FOAK reactor designs other than Barakah 1-4 in the UAE, which incorporated four APR1400 reactor technology and which the nuclear industry largely views as a successful delivery of an LNPP outside of Russia and China during the past 20 years. The safety regulator in South Korea had previously approved this reactor technology for construction as part of the Shin Kori 3 & 4 LNPPs supplied in South Korea.

While Akkuyu 1&2 in Turkey, which will soon start commissioning the first unit, has experienced some completion delays due to the pandemic (and possibly international sanctions), Akkuyu may eventually join Barakah as another successful example of the delivery of an LNPP, during the past 20 years, outside of Russia and China.

Like the Emirates Nuclear Energy Company in the UAE, Turkey also chose to use proven nuclear reactor technology for Akkuyu (four VVER-1200 reactors) in lieu of an FOAK design, which a safety regulator in another country had previously approved for construction of an existing LNPP (in this case, the Novovoronezh 2-2 LNPP in Russia). In procurement terminology, each of these existing LNPPs is known as a reference plant.

So, what lesson can host countries and LNPP owners draw from the history of nuclear power procurement during the past 20 years outside of Russia and China?

While multiple factors contributed to the cost overruns and delays during the supply and installation of many recent LNPPS, including atrophied supply chains, safety rule changes arising out of the Fukushima incident in 2011 and other changes to regulatory requirements, and an insufficiently large pool of experienced, construction-ready personnel within the US and Europe, the utilisation of FOAK nuclear reactor technology (ie technology not previously incorporated into one or more reference plants) stands out as a key contributor.

For LNPP owners, particularly in new nuclear countries, the selection of nuclear reactor technology which has been previously licensed for construction and, ideally, entered commercial operation is recommended. Each bidder should identify a reference plant during the procurement phase and the winning bidder should commit to the delivery of the newbuild LNPP with nuclear reactor technology previously adopted in the same reference plant under the EPC contract.

Export controls

Host countries and LNPP owners will need to assess the applicable legal requirements that will apply to the export of equipment, materials and technology by each of the NTV bidders as well as their suppliers to the host country. Called export controls, these legal restrictions usually involve laws of multiple countries hosting the supply chain. Because the host country will solicit technological information, subject to export controls, from each NTV bidder participating in a procurement programme prior to selecting an NTV as the preferred bidder, the country of origin of each NTV bidder will likely require nuclear non-proliferation and nuclear security commitments from the host country through bilateral agreement.

Additional authorisations may be required from export control authorities of the country of origin, as well as other countries, depending on the origin of the relevant technology. For example, the US requires a specific type of bilateral treaty, called a 123 Agreement with the host country for certain types of exports.

The US and European Atomic Energy Community (Euratom) have a 123 Agreement in place which sets forth the government-to-government assurances needed to facilitate certain exports from the US to a Euratom member country and vice versa.

US export control laws also authorise US companies to transfer certain civil nuclear technologies to approved foreign countries referred to as generally authorised destinations which in almost all cases have a 123 Agreement in place. But transfers of civil nuclear technologies to countries that do not fall into the category of generally authorised destinations, require the prior specific authorisation of the US Secretary of Energy.

Host country support/state aid

The table below sets forth the common forms of support for civil nuclear power programmes, also called state aid within the EU, that host countries can make available for LNPP projects, which will depend in part on the form of LNPP investment structure, adopted by the host country. To attract co-investment support, a host country would need to make available some level of revenue support for the LNPP project in one of the forms described in the table, which gives the foreign investor a reasonable likelihood of recovering its investment and a target internal rate of return, and a mechanism that allows the foreign investor to divest, and exit the project, upon the occurrence of certain political risk events, caused by or relating to the host country, which usually takes the form of an option for the foreign investor to put its shares to the host country.

To minimise the cost of electricity produced by the LNPP, the host country may grant guarantees to commercial lenders, which make available senior loans to an LNPP project, and such guarantees would generally apply until the completion of construction of the LNPP. Finally, virtually all LNPP investment structures other than a build-own-operate structure require significant state equity funding.

TABLE 2 - HOST COUNTRY SUPPORT

Common forms of host country support	Method/application
Revenue support	1. Contract for differences, power purchase agreements and/or bilateral power supply contracts
	2. Regulated asset base
Loan guarantees	Shifts credit risk for lenders from project to national balance sheet reducing cost of debt financing
Equity funding	Contribution by host country to state-owned company or joint venture company, designated to procure, own and operate an LNPP
Put options/indemnities	Protects private investors from changes in nuclear policy by the host country and other political risks

Within the European Union, EU law regulates the form of state aid which an EU member country can make available for the supply and installation of an LNPP. The Czech Republic, for example, notified the EU Commission in March 2022 of its plan to make state aid available for the construction and operation of the Dukovany II LNPP in the form of a remuneration mechanism (akin to a contract for difference), which effectively levelised forward electricity prices for this project, during the first 60 years of commercial operation.

The European Commission subsequently opened an investigation to assess whether this state aid proposal would unduly distort the functioning of the electricity market, overcompensate the LNPP owner, and create electricity market concentration. Following the conclusion of this investigation, the Commission approved a modified version of the Czech Republic's state aid proposal, which included a reduction to the timeline for the remuneration mechanism from 60 to 40 years.[9]

In a related development, EDF has opened a new front on the lawfulness of state aid made available for LNPP projects within the EU by non-EU host countries. Following the decision by the Czech Republic to select KHNP for exclusive negotiations in 2024, during the procurement of the Dukovany II LNPP, EDF unsuccessfully challenged this decision before the Czech Competition Authority and the Czech courts arguing that KHNP, a Korean state-owned NTV had accepted contractual terms that fixed construction costs and guaranteed a completion schedule for the Dukovany II LNPP, and could have never accepted the risk imposed by such contractual terms without receiving foreign subsidies from South Korea in violation of the EU Foreign Subsidies Regulation. Dukovany II Power Plant, the LNPP owner, dismissed these arguments as "speculation by the unsuccessful bidder".[10]

In conclusion, by working through the front-end considerations, host countries and LNPP owners can develop and implement a strategy to procure an LNPP that provides enhanced energy security, boosts the economy through job creation and investments, reduces carbon emissions and ensures a stable and affordable energy supply.

Footnotes

1 - Emerging Nuclear Energy Countries, World Nuclear Association, Country Profiles, 26 April, 2024

2 - Key Cernavoa 3 and 4 engineering contract signed. World Nuclear News,15 November, 2024

3 - A new era for nuclear energy beckons as projects, policies and investments incrase, IEA, January, 2025

4 - Four Additional Westinghouse AP1000 Reactors to be Built in China, Westinghouse Nuclear, 26 April, 2022

5 - KHNP's European Exit: Prioritizing Czech and SMR Innovations. Business Korea, 13 June, 2025

6 - Bechtel and Westinghouse Seek to Expand Partnership with Czech Republic with Proven AP1000 Reactors, Bechtel, 31 October, 2023

7 - Nuclear Power in Pakistan. World Nuclear Association, Country Profiles, 4 February, 2025

8 - Green Light for Sizewell C, The First Majority British-Owned Nuclear Power Plant in Over 30 Years, 10 June, 2025

9 - Commission approves State aid to support construction of nuclear power plant in Czechia, European Commission, 30 April, 2024

10 - EDF 'just seeking to ensure Czech project meets EU rules", World Nuclear News, 30 May, 2025

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