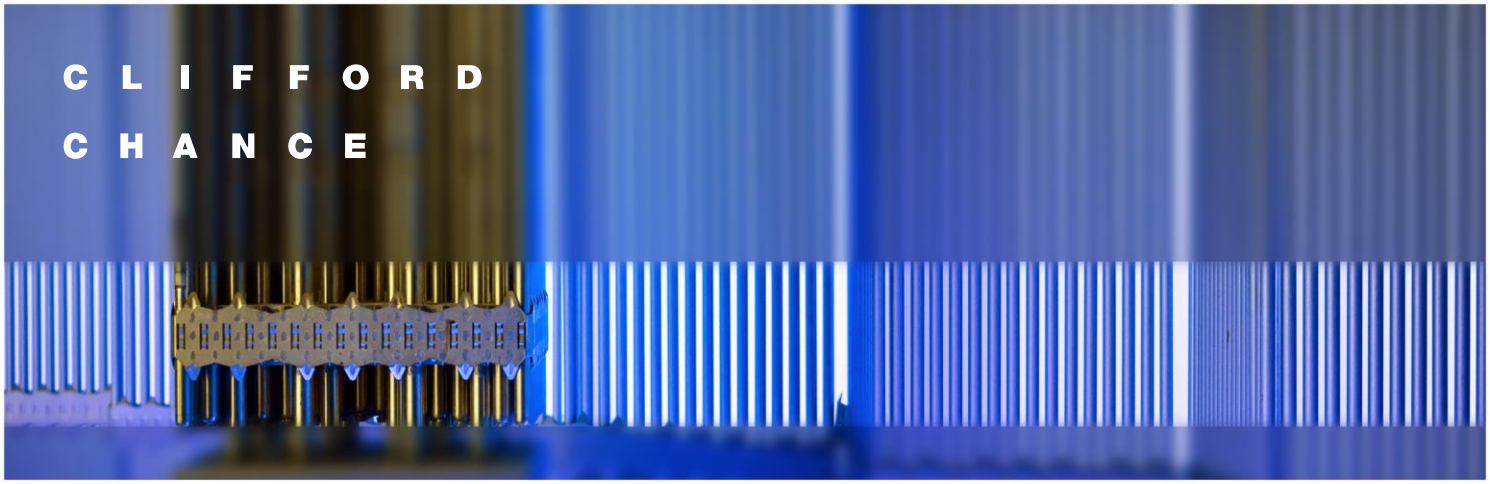

NEW NUCLEAR BUILD: MEGA-CONSTRUCTION COMES OF AGE (WITH MEGA-PROJECT ISSUES)

Nuclear power plant (NPP) construction is a complex and capital-intensive undertaking and its history is unfortunately littered with prominent examples of major delays, cost overruns, disputes and abandoned schemes. Reasons for this vary from changes in cross-border and national political policies, affordability concerns and technology and safety-related issues as well as more simply the scale and complexity of construction.

In light of these challenges, this paper considers some of the key issues relating to procurement and construction contracts in the emerging new NPP market.

Key issues

- Procurement – EPC vs disaggregation
- Early contractor involvement and budgetary control
- Pricing options for contracts
- Quality warranties
- Nuclear liabilities
- Limitations on overall contractual liability
- Regulatory Interventions
- Length of Construction Period

OVERVIEW

Interest in constructing new NPPs remains strong, notwithstanding the inherent challenges, in light of projected demands on energy infrastructure. Some countries are embarking on a nuclear programme for the first time, others have decided to restart construction after a hiatus of decades. According to the Power Reactor Information System (PRIS) of the International Atomic Energy Agency (IAEA), currently 57 nuclear reactor projects have been launched or are being considered worldwide.

Starting new build is very demanding. Circumstances are quite different from the 1970s when most of the plants currently operating were constructed. Then unlike now, governments and vendors alike had large numbers of experienced engineers in-house. In addition, there was no shortage of skilled manufacturing capacity in the market, and designs were often based on work done in similar ongoing or completed projects. Accordingly, lessons learned from the current path-finding NPP projects will be very important for those that follow.

PROCUREMENT

EPC vs disaggregation

The procurement of new NPP projects tends to follow one of two models. In those countries where private plant ownership is available, private sector bidders will typically bid for a concession or licence from government to build and operate a new NPP and will procure the construction contracts

themselves, subject to regulatory approvals and oversight. Elsewhere, the procurement is typically run directly by a state department or state-owned nuclear agency.

Irrespective of the procuring entity, the choice of construction procurement route tends to be either an EPC arrangement or disaggregated into a few key large contracts (nuclear reactor; thermal island; civil works; earthworks) plus some specialist elements (e.g. marine works and earthworks may be separately contracted). Such disaggregation may be labelled as EPCM, although the larger value contracts will look and behave like EPC contracts for the respective elements in their own right. There may also be a further design integration and construction management contract akin to an EPCM appointment either with an external engineer or in-house with the owner/developer if it has the appropriate expertise.

However, even where the "EPC" label is applied, a number of important sector-specific factors combine to make some conventional power EPC risk allocation norms less feasible (or even unfeasible) for new NPP projects. These include:

- **Early contractor selection** – by their nature, new NPP projects require early selection of technology and thus contractor. This may be a formalistic requirement of a government bid process but will also be needed to enable design assessment and development; to allow for lengthy regulatory approvals and consents to be obtained; and to allow long lead items to be ordered sufficiently in advance of construction commencement. This leads to an inevitable reduction in the competitive tension available to owners in negotiating pricing and risk allocation in construction contracts (see the following section on some ways to address this).
- **Pricing risks** – construction contracts for new NPPs may include a greater degree of overall price uncertainty (irrespective of the degree of opportunity for subcontract budgeting) because of the risks involved.
- **Project scale** – new nuclear projects are among the largest single site construction projects and the size/value of an EPC (and even individual disaggregated contracts) means that contractors cannot offer the same proportionate level of liabilities and recourse as seen in other sectors.
- **Contracting consortia** – an EPC approach may attract consortium bids, albeit (depending on prevailing market conditions) with consortium members unwilling to adopt a classical joint and several liability position – alternative approaches may be required.

The procurement conundrum – balancing budgetary drivers and the need for early contractor involvement

NPP developers will look to use a range of mechanisms and incentives to mitigate the loss of negotiating leverage associated with early contractor selection.

Typically, these will take the form of an evolving process agreement signed/refreshed at various stages to guide the parties through to final agreement. The process contract will typically include:

- exclusivity terms;
- the owner's project control process;

- the engineering design specification and programming process (including any reference plant and use of 3D information models with integrated programming);
- heads of terms/the process for agreeing contractual heads of terms and the main contracts themselves – this may include reference to an industry or in-house standard form but any standard form is likely to attract considerable bespoke amendment on any NPP project to deal with e.g. country, nuclear legislation and liability, regulatory oversight and intervention, commissioning and testing and intellectual property (to mention just a few items);
- the pricing process, including any transparency requirements to validate subcontract pricing and/or compete major component suppliers as well as pricing expiry dates;
- key personnel clauses - availability of experienced team members is critical during the pre-contractual phase as well as the execution phase;
- data security and communication protocols – these should be established early on; and
- termination and exit terms (including bid cost allocation) – in the event of project cancellation, if the project is no longer economically viable or if a contract is not concluded by a longstop date.

Process agreements may contain elements which are not legally enforceable but simply provide a framework for future agreement and/or are of moral persuasive effect (e.g. in many jurisdictions, "agreements to agree" and 'lock-in' arrangements are not enforceable).

In some countries, it is commonplace to provide for on-demand bid bonds in order to evidence a financial commitment and provide a compensatory mechanism should the contractor seek to withdraw from or renegotiate accepted or agreed terms (indeed, in some countries, this may even be mandatory for branches of government). Whilst we are not aware of there being a history of inappropriate calls on such bonds in the nuclear sector, this approach has been criticised as being costly and heavy-handed, not least because departures from process arrangements are rarely unilateral and allocation of responsibility is extremely difficult to demonstrate. Moreover, given the level of costs that need to be incurred by contractors bidding for nuclear projects, no contractor party is likely to seek to exit from a nuclear bid process lightly. Even without a bid bond there will invariably be ample financial and reputational motivation not to withdraw.

The other common method for managing pre-contractual relationships is the use of long-term alliancing, joint-venture and/or framework agreements but these work best where multiple projects are in prospect for the parties. They provide an opportunity to set out e.g. long-term licensing arrangements, efficiency objectives and standard terms and sections to apply to contracts from a precedent project, although project-specific adjustments would invariably still be needed as individual NPP projects commenced.

Where private sector ownership of the plant is possible, sponsors may ask contractors to take an equity piece. Industry views differ on whether such equity investments help align counterparty interest (as is the oft-stated intent) and some major contractors expressly seek to avoid this and retain a contractor/vendor only model.

PRICING OPTIONS

The prevailing approach is to seek fixed/firm pricing but there will be a greater number of exceptions than might be seen in most other power sectors, including for:

- **Regulatory interventions and variations** – this is a negotiation 'hotspot'. The contractor must be responsible for producing a safe design but will seek to be protected against the regulator's discretion to require variations, intervene at various stages and require additional tests.
- **Consent conditions** –contractors will seek pricing and programme protection for conditions imposed as part of the consenting process.
- **Site risk** – contractors will typically look for site conditions information to be treated as 'rely-upon data'. Suitable NPP sites are limited given e.g. cooling requirements (they are invariably close to water), public concerns about safety, and the ability of a site to handle the containment structure and foundations. In most cases, the final location is determined by the host government and contractors will usually expect time and cost relief if site conditions are detrimental to physical progress. Unlike on other thermal plants, NPP contractors are not expected to undertake detailed site surveys in order to fully price and transfer site risk. All contractors will also legitimately seek protection from unforeseeable risks and in respect of existing structures and contamination.
- **Financial risks** – contractors may not be able to hedge against currency fluctuation, indirect and sales tax and import duty risks and material pricing inflation.

It is not unusual to see at least some work elements priced on a cost/measured rates plus fee basis often with 'target cost' or 'guaranteed maximum price' arrangements providing bands of gain-share and (in the case of target cost) pain-share incentives. Indeed this may be the natural approach for all payments on certain disaggregated contracts where pricing can be effected on a quantities or rates basis (such as earthworks, civil works and marine packages). Key issues with such mechanisms include the treatment of corrective 'rework' and the adjustability of any target cost.

Advocates of this pricing method would argue that it helps create greater alignment, avoids unrealistic margins being built in to protect against unaffordable cost overrun risks (even where on another project those risks might typically be allocated to a contractor) and to produce a less adversarial approach to contract management. However, these arrangements may also be viewed by prospective investors and lenders to the project as creating a higher degree of budget uncertainty.

KEY ISSUES

Scope and quality

The usual need for construction contracts to contain clear terms and appropriate risk allocation applies equally to NPPs, regardless of the procurement strategy adopted, although there are a number of sector-specific techniques and nuances which should be considered:

- **Warranties** – contractors are likely to resist fitness for purpose-style and absolute service-life warranties particularly in a disaggregated procurement structure where the detailed design and technical specification elements

may have been carried out by someone other than the contractor. Contractors can be expected to warrant compliance within the specifications applicable to their packages but not necessarily over the interfaces – this falls short of an overall fitness for purpose standard.

- **Reference plant** – project contracts will usually contain a 'reference plant' concept, benchmarking the engineering design and safety features of the NPP against a precedent plant that has already been licensed by an experienced regulator. This benchmarking process is also an inherent part of the industry's lessons-learned culture. However, there are inevitable conceptual limitations where the reference plant is itself a first of a kind or early design, as this may inadvertently transfer undetected failures.
- **Owner involvement** – NPP construction contracts tend to allow for greater owner involvement in the appointment of suppliers and subcontractors than in other sectors, to ensure that there is appropriate technical and financial strength as well adherence to strict quality assurance requirements throughout the supply chain.
- **Contract management** – as recent NPP projects have shown, the clear potential for costs and delays to escalate massively if problems are not quickly analysed and resolved, we would expect the contract to include early-warning mechanisms and proactive project management procedures.
- **Technology** – the constant drive for safer and more efficient reactors has driven developments in reactor technology. This leads to increasingly challenging risk assessments for insurers to evaluate deductibles, sub-limitations of indemnity and the level of design cover. Vendors of Generation III reactors (which will be deployed in most new NPPs) will assert that new technology has followed an evolutionary, rather than revolutionary, path. This should be scrutinised by technical advisers to inform whether enhanced contractual protection (such as extended and serial defects protection and insurer of last resort provisions) is necessary.
- **Staffing** – the availability of skilled labour remains a critical consideration, especially for overall project management, auditing the quality assurance systems and during the cold and hot commissioning phases. In countries which are new to NPP (or coming back to it after a long hiatus), key personnel provisions are important. A requirement to train specialist operational staff and to transfer knowledge is also a typical feature.

Liability for death, injury and damage

Attention on the indemnity regime for nuclear incidents is inevitable.

In countries which are signatories to the relevant nuclear conventions, the first tier of liability for a nuclear incident is 'channelled' to the NPP operator on a strict liability basis and specialist nuclear insurance (or other security) will need to be in place for operators in response to this.

For present purposes, we note only that:

- this should not impact on the indemnities for death, personal injury and property damage to the extent not occasioned by exposure to radioactive material;
- depending on the jurisdiction, the parties may also be free to contract for a sharing of nuclear liability risk and, whilst this is invariably a contentious area of debate, there is a school of thought that the nuclear steam supply system contractor should share some of the first tier of this liability. The

logic here is similar to the offshore oil and gas industry's reaction to the Deepwater incident where operators re-examined the industry norm of full indemnification of contractors in respect of well blow-out risks; and

- the parties will still need to consider the risk of suit in neighbouring countries which are non-signatories to the nuclear conventions.

Contractual liability

As mentioned above, the scale of large new NPPs (the position may adapt with SMRs) means that the overall liability cap under EPC or the disaggregated contracts tends to be considerably lower than 100% of the contract price – most contractors will not have the balance sheet capacity to absorb larger liabilities and may also look to apply sub-caps to specific liabilities. In this regard, parallels can be drawn with massive capital expenditure construction contracts on natural resources extraction projects, petrochemical complexes and refineries.

When assessing the commercial adequacy of the proposed aggregate cap, it is therefore important for owners to consider the critical liabilities (such as, in most cases, post-completion defects rectification) that will fall subject to capping arrangements and those that will not. For example, indemnities for fines and penalties arising from breaches of law/HSE and indemnities for non-nuclear incident third party claims for personal injury and third party property damage and IP infringement do not usually fall within the overall cap. Owners may consider that a view needs to be taken on the likelihood of termination remedies being exercised and the absence of effective rejection remedies.

Time and duration

Owners should be prepared to expect broader contractor entitlements for time and cost relief when compared with conventional thermal plants due to:

- **Regulator discretion and interventions** – although part of a regulator's essential remit, regulator intervention can be particularly disruptive where long lead items have already been manufactured or installed to an approved standard, only for a stricter requirement to be retrospectively applied. The knock-on effect can be significant and the risk of changes cannot be accepted by contractors or otherwise mitigated (e.g. through insurance). The uncertainty that is retained by the owner is one of the biggest obstacles to true non-recourse project financing for NPPs.
- **Timing of transfer of responsibility for the plant to the owner** – a further consequence of active regulatory processes is that risk in the NPP works is likely to transfer from the contractor to the owner upon readiness for hot testing (i.e. at the point where cold testing has been completed and the reactor is ready for fuel loading). Whilst it may be possible technically to re-impose some delay liability after this time, in practice it may be difficult to attribute fault given the different parties that will be involved in the hot-testing processes.

In addition, there are a number of other risks that should be considered by parties in light of the lengthy construction period:

- **Bottlenecks and early reservation agreements** – the vast scale of equipment and components required for a NPP and the fact that much of this has to be delivered to site ready for installation presents a major logistical challenge. It is essential to reserve capacity down the supply chain through early reservation agreements for critical materials (e.g. the

high grade steel for the containment building) and specialist equipment (e.g. the cranes for dome lifting). Naturally, contractors are unwilling to do this prior to the main contract award without the owner sharing some of the potential cancellation costs.

- **Storage** – it is imperative that equipment and materials are properly stored to maintain the integrity of sub-supplier warranties and insurance cover. Contracts should set out clear obligations for storage on site and intelligent programming is essential to balance timely delivery with the need to avoid items sitting idle for an extended period prior to installation.
- **Insurance** – despite having heard views to the contrary, our experience is that there is a well developed market to place usual (i.e. non-nuclear) construction insurances for NPPs, even though the lengthy duration may place stress on being able to secure a single policy to cover the entire build period. The alternative is to legislate for reinsurance risks and, whilst there is precedent for this on mega-projects, an incident on NPPs anywhere in the world can have a significant impact on the premiums and other policy terms, particularly if the same technology is involved – this poses a greater possibility of cover ceasing to be available on commercially feasible terms.
- **Credit risk** – the financial stability of owners and contractors is susceptible to change over time and has already been witnessed in the sector.
- **Interfaces** – where there are multiple contracts, programme management becomes critical to mitigate delays and costs accumulating.

CONCLUDING THOUGHTS

The new nuclear market has regathered much of the impetus lost following the Fukushima disaster and the cancellation of programmes in leading economies. Perhaps this was inevitable given the projections of global electricity demand make uncomfortable reading in the face of an ageing fleet of existing plants. However, projects remain subject to political and economic sensibilities (as has been seen with Toshiba-Westinghouse) and there is enormous pressure on manufacturers to start delivering efficiencies and for projects overall to start delivering within reasonable budgetary limits. Looking forward, SMRs offer an interesting route to mitigate a number of the industry's concerns but, until these designs become fully available, the opportunity remains for the current generation of NPPs to prove themselves.

The scale and complexity of NPP construction does not naturally lend itself to a contract standardisation process and, whilst contracting alliances will begin to develop their own standardised approach to risk and contract terms, the current range of procurement and pricing approaches and risk allocation is best described as broad. That reflects the absence of non-recourse finance in the sector – itself arguably partly a product of construction and technology risks but perhaps, to a greater degree, the inevitable result of political uncertainty and wider long-term economic concerns. At its core, however, the new NPP sector remains set for a decade full of exciting challenges.

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