# NUCLEAR EPC SOLUTIONS: UNLOCKING EFFECTIVE CONSTRUCTION RISK ALLOCATION TO SUPPORT BANKABLE NUCLEAR POWER PROJECTS

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**Abstract**

The resurgence of new build nuclear power plants in the past decade has led to what some have termed a nuclear renaissance, with more than fifty nuclear reactors under construction globally as of August 2018.(1) However, the successful financing of a new build nuclear power plant presents significant challenges. These projects are capital intensive, have long project schedules and significant fixed operating and maintenance costs, are subject to a rigorous regulatory framework and must contend with the fluctuating tide of political and public opinion. In this article we outline some of the challenges faced in structuring effective contractual arrangements for the construction of new build nuclear power projects and suggest methodologies, based on our extensive experience in structuring these large and complex projects, to mitigate these challenges through appropriate and effective risk allocation.

Peace | Crowell has extensive experience in the successful structuring of new build nuclear power projects, in particular through representing the borrower and the host country developer on a nuclear power plant in the Middle East and advising a privately-owned developer in connection with all aspects of a new build nuclear power project in Europe, including the structuring of the prospective financing for that project.

## Part I
## The construction challenges faced by new build nuclear projects

As with any project, the development and financing challenges are particularly amplified during the construction phase where the risks of delays, cost overruns and litigation are arguably at their highest. Nuclear projects pose particular challenges in this regard due to their protracted construction periods, typically ranging from five to seven years. In addition to simply presenting a massive project management/logistics challenge in seeking to meet scheduled completion dates on such an extended schedule, this long construction schedule also places significant strain on any fixed-price elements of the contract and provides an unusually long period of time in which construction risks could manifest

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themselves. This facet of nuclear projects calls for a flexible and, ultimately, a highly commercial approach to risk allocation, as outlined further in this article.

Although these challenges do represent a significant bankability hurdle for new build nuclear projects, they can be overcome, and we have outlined in this paper some of the key structuring and risk allocation methodologies that we recommend to the construction phase of such projects which we view as key to structuring a new build nuclear project. Our particular focus here is structuring those risks in a way that will best enable bankable financing options for the project. As outlined below, that approach includes challenging and re-assessing some fundamental tenets of the traditional engineering, procurement and construction ("**EPC**") contracting model.

The key to successfully structuring the construction arrangements for a new build nuclear power project is a solid understanding of the various risks associated with projects of this complexity and establishing a contractual framework that appropriately allocates those risks among the key project stakeholders particularly during the construction phase. The successful financing of nuclear construction depends on developing a structure that shares risk clearly and equitably among stakeholders and incorporates appropriate incentives (both positive and negative) for each project party to fulfil its responsibilities. A contractual framework based on these principles is an essential foundation for a new build nuclear project to succeed.

If mismanaged, these challenges can prove insurmountable and can even bring the contractors involved to the verge of insolvency. The most recent example being the woes that Westinghouse Electric Company LLC ("**Westinghouse**") and its parent company Toshiba Corporation ("**Toshiba**") faced in connection with two nuclear power projects in the United States, for which Westinghouse was the technology supplier and contractor and Toshiba provided parental guarantees, namely Vogtle in Georgia, and Virgil C Summer in South Carolina.

Westinghouse was responsible for the design, manufacture and procurement of the nuclear steam turbines and generators for these projects alongside CB&I Stone & Webster Inc. who was responsible for on-site construction and procurement. The EPC contract guaranteed substantial completion of the first AP1000 reactor for the Vogtle project by 1 April 2016 and the second AP1000 reactor by 1 April 2017. Similarly, the EPC contractor guaranteed substantial completion of the first AP1000 reactor for the VC Summer project by 1 April 2016 and the second AP1000 reactor by 1 January 2019. Progress was slow however, mired by numerous, well documented issues, resulting largely from the challenges of delivering the new AP1000 technology. As a result of the compounded project delays, the consequential liquidated damages liability and associated litigation on both projects, Westinghouse filed a petition for reorganization under Chapter 11 of the United States Bankruptcy Code on 29 March 2017. In addition, Toshiba, who had provided parental guarantees in respect of these projects was forced to make billions of dollars in payments to the owners.(2) Toshiba was ultimately forced to sell off key parts of its business (including its lucrative memory chip business, and Westinghouse itself) to shore up its balance sheet as a result.

This is not the first example of the liabilities under a turnkey EPC contract on a nuclear project bringing the contractor to its knees. The fixed price contract on the Olkiluoto 3 project, which began in 2003, almost caused Areva, the majority contractor in the consortium delivering the project, to go insolvent prior to completion, had it not been for a €5 billion bailout from the French government and a forced takeover by EDF of Areva's reactor business.(3) Professor Stephen Pekka Lindmark (the Chief Executive of Fortnum, the Finnish power company which owns a 26% stake in Teollisuuden Voima

("**TVO**"), the consortium behind Olkiluoto) has said of the project, "If the nuclear industry wants to have a future it cannot afford more projects like this".[4] The latest timetable indicates that completion of the plant will ultimately be delivered over a decade late (with completion forecast for May 2019) and three times over budget (at €8.5 billion).[5] The delays have also triggered the seemingly inevitable swathe of litigation as the contractor consortium and TVO entered into arbitration, with both parties claiming billions of dollars in compensation from the other, claims that ultimately involved the contractors paying a €450 million settlement to TVO.[6]

## Part II
## The Demands of New Build Nuclear Challenge the Traditional Model

***Turnkey EPC contracting models are not the answer***

The traditional turnkey EPC contracting model is commonly perceived in project finance as the "ideal" in terms of risk allocation during construction establishing, as it does, the main EPC contractor as the single-point of accountability, responsible for all major construction risks and thereby theoretically providing price certainty to the owner. Under this model the EPC contractor provides a full engineering, design, construction, supply and installation service, turning the project over to the owner once it is complete. The only real sponsor concern with such an arrangement is traditionally whether the premium payable to the contractor for taking the risks associated with delivering a turnkey, price certain project (particularly delay and cost overrun risk) is acceptable. However, for nuclear projects, that view needs to be challenged, particularly in light of the Westinghouse, Toshiba and Areva examples noted above which highlight the fact that the magnitude of the potential problems and the scale of these projects mean that the risks in question present an enterprise risk to even the most financially robust contracting group.

In that context, a traditional approach to EPC contracting risk-allocation will not hold up in practice where the contractor is unable to bear the losses. Where the contractor fails, it is the project company, its shareholders and, potentially, ultimately, the host nation that is left to deal with the consequences.

***EPC management structures are not a bankable alternative***

The examples above illustrate, at one end of the spectrum, the risks for both the sponsor and the contractor of the single-point, turnkey contracting model for new build nuclear projects. At the other end of the spectrum is the construction management model, and other more collaborative approaches to risk sharing, as employed on the Hinkley Point C project in Somerset, England. Those constructs however commonly do too little from a bankability perspective to ensure that the risk and reward profile of the nuclear construction project is sufficiently aligned among the contractor, the project sponsors and the ratepayers/electricity consumers.

Hinkley Point C is the most recent example of a new build nuclear power plant, and is currently estimated to cost £20.3 billion to construct.[7] To develop Hinkley Point C, the British government has entered into an agreement with Électricité de France ("**EDF**"), which is 83% owned by the French government, and China General Nuclear Power Group ("**CGN**"), a state-run Chinese energy company. EDF is funding two-thirds of the project, and CGN is investing the remaining £6 billion.[8] Although the original plan was for Hinkley Point C to utilize limited-recourse project financing, the project will instead proceed based on EDF's and CGN's balance sheet corporate funding.

Despite having evidence of a steady stream of revenue in the form of a Contract for Difference ("**CfD**"), Hinkley Point C was not a bankable project. Although there were a number of reasons for this, one of the major bankability issues was that it did not have a simple risk allocation with a single EPC contractor responsible for overseeing multiple subcontractors, but rather the owner entered into many individual EPC contracts which it was accordingly responsible for managing. Examples of the range of contracts involved include a contract with Areva for the European Pressurised Reactors, a civil works contract worth £2 billion with a joint venture of Bouygues TP/Laing O'Rourk[9], a tunneling and marine works contract with Balfour Beatt[10], and a turbine island contract with General Electric[11]. From a lender perspective such a contracting structure does not adequately divest the project of construction risk, with each individual contractor bearing responsibility only for their specific part and, ultimately, bearing insufficient risk in respect of any consequential impact on the overall project development should their portion of the project be delayed.

***Are nuclear projects simply too big to be bankable?***

It is often argued that nuclear new builds are too big to be successfully financed. However, if we turn to other sectors of comparable scale, size is not in of itself considered an impediment to bankable financing. For example, projects of similar magnitude can be found in particular in liquified natural gas ("**LNG**") projects which can cost tens of billions of dollars to finance. The decisive factor is not the size of the loan involved but whether the prospective lenders believe the project risks have been appropriately allocated to those best able to manage them and the adequacy of any completion support offered to underpin those arrangements (if required). Indeed, the vast majority of the construction work involved in a nuclear project represents standard construction work that is typical for other comparable conventional projects.[12]

Traditionally, due to their size and unique features, major LNG projects have received some form of completion support under which the borrower's shareholders either guarantee the timely completion of the facilities or, more usually, agree to underwrite debt payments until completion has occurred. In recent years, however, as the number of successfully delivered LNG projects has increased, the necessity of completion support for a successful financing has decreased. The Freeport project in the Gulf of Mexico is a good example of this where the sponsors Osaka Gas Co., Inc., Chubu Electric Power Co., Inc and Freeport LNG Expansion were able to secure $3.8 billion of aggregate debt financing, without sponsor completion guarantees, based solely on a robust risk allocation package and thorough lender due diligence.[13]

This trend is also beginning to emerge even on the larger more complex projects. The Yamal LNG project in Sabetta, Russia, represents one of the biggest LNG financings in recent years with an estimated project cost of $27 billion.[14] Full capacity of the three LNG trains will reach 16.5 million tons per annum and the project includes construction of a seaport, airport and power plant. Notwithstanding the size and complexity of this project and the heightened construction risk resulting from the harsh geography of the Yamal peninsula and the lack of widespread market production of certain key components of equipment, the full sponsor debt service undertaking that was required by the lenders and the export credit agencies on this project was actually the result of the unique challenges of transporting LNG across the northern sea route to Asian markets and to transshipment facilities in Zeebrugge, including the need for a fleet of new-to-market ice breaker vessels to be constructed, in combination with the heightened sanctions regime in place at the time.[15] Absent those unique features, it is possible that full completion support may have been avoided.

In our view, there is no reason why this form of evolution, towards more traditional limited-recourse structures, could occur in the nuclear sector once the technology has sufficiently matured and the number of successful new build nuclear projects reaches the required levels.

***Nuclear – a uniquely challenging project***

Although, as noted above, the scale of nuclear projects is not unique, at present, we would identify three unique factors that present particular challenges to the successful financing of these projects:

*The regulatory challenge*

As is to be expected, the regulatory compliance of nuclear projects is also significant, given the understandably overarching essential primacy afforded to nuclear safety. The strict standards applied by nuclear regulators greatly increase the pressure on contractor's compliance processes as well as significantly exacerbating the impact should any breaches arise. A notable example of this heightened regulatory risk was the six-month delay experienced at the Westinghouse project in Georgia where half of the material used to back-fill a 3.6 million cubic yard section of the site failed to meet regulatory approval and had to be replaced.(16) Similarly, when a weakness was discovered in the steel housing the reactor core at a nuclear plant under construction in Normandy in 2015, the French Nuclear Safety Authority ordered not only that the relevant issue be fixed before the project could continue but also required the manufacturer, Areva, to conduct a further round of destructive testing on a similar component, resulting in a 116 ton pressure vessel head, once earmarked for another planned reactor, being destroyed.(17)

The Hinkley Point C project has also already faced significant regulatory issues with inspectors from the Office for Nuclear Regulation ("**ONR**"), the UK nuclear regulator, opining in late 2017 that EDF's supply chain management was below standard.(18) In particular, the ONR found that EDF had failed to provide proper oversight over the Creusot nuclear forge in France, where significant items of equipment are produced and where records have been found to be falsified.(19) Moreover, the ONR found that EDF did not undertake an internal audit of its quality control processes in 2017, an exercise that may have identified these errors in management. An underlying theme of the ONR's findings was that EDF's mismanagement of the supply chain could potentially affect safety.(20)

The regulatory environment can also lead to project delays and cost overruns arising out of external factors that are outside of the contractor's control. On the VC Summer and Vogtle projects noted above, Westinghouse faced significant issues modifying its designs to meet the evolving safety requirements of the Nuclear Regulatory Commission ("**NRC**"). Most materially, the NRC issued new standards in 2009 requiring that the shield building, which protects against radiation leaks, be sufficiently strong to withstand a crash by a commercial jet. The need for this new standard was the direct result of the September 11 attacks in New York, United States. Then, in 2011, as a result of the accident at the Fukushima Dai-Ichi Nuclear Power Plant ("**FNPP**") in Japan, new NRC requirements and safety measures were enacted regarding tornado and earthquake resistance. Westinghouse noted in its bankruptcy court submissions that these new standards created additional, unanticipated design challenges which resulted in increased costs and delays, including a delay in issuance of the regulatory licenses required to commence operation.(21) Similar issues were faced by Areva on the Lockouts 3 project where the Finnish regulator, the Radiation and Nuclear Safety Authority, imposed more stringent demands on the design of the EPR reactor resulting in additional, extremely expensive safeguards having to be added to the design, including a concrete dome over the reactor, strong enough to withstand an aircraft strike, exacerbating the cost overruns and delays already faced by that project.

The materiality of the regulatory risk should not be underestimated, and that reality further supports taking a more pragmatic approach to the wider risk allocation profile, through allowing the contractor avenues (such as those outlined below) to mitigate its risks while maintaining appropriate incentives to ensure the contractor is still adequately motivated to minimize those risks where it is within its gift to do so.

*Third Party Nuclear Liability*

Another unique challenge for the development of new build nuclear projects is the appropriate allocation of risks associated with nuclear third party liability ("**NTPL**"). The established international conventions on nuclear liability (principally the Vienna and Paris Conventions) channel nuclear liability to the operator of the project. That liability is absolute, and therefore the question of fault is irrelevant in most cases brought under those regimes.[22] However, cross border damage represents an uncovered risk vis-à-vis contractors to any nuclear project and contractors are increasingly considering their exposure to the risk that parties outside of the host country, if impacted by a nuclear incident arising out of or relating to the project, could seek recourse against the contractor in a jurisdiction which is not a signatory to the applicable conventions on nuclear liability and therefore would not require that liability be channeled to the nuclear operator.

The contractor concerns with regard to this risk have not been helped by the recent cases that have been brought in the United States in connection with the 2011 accident at the FNPP against General Electric Company ("**GE**") who designed and constructed the boiling water reactors at the FNPP and was responsible for their on-going maintenance. In two such cases GE was added as a co-defendant alongside Tokyo Electric Power Co., Inc. ("**TEPCO**"), as the owner and operator of the FNPP, and in another case they are the lead defendant.

The first such case is *Cooper v. Tokyo Electric Power Co. Inc.*[23], where members of the U.S. Navy, who were sent to Fukushima to provide humanitarian aid in the aftermath of the tsunami which damaged the FNPP, have alleged that they were exposed to radiation and have brought claims in the United States against TEPCO, for negligence in both operating the FNPP and reporting the extent of the radiation leak. The plaintiffs were subsequently permitted to amend their complaint and in doing so named GE as an additional defendant, alongside three other manufacturer defendants.

TEPCO filed a motion to dismiss the case for a number of reasons, namely that the Convention on Supplementary Compensation ("**CSC**") strips U.S. courts of jurisdiction over the claims and further that the doctrines of international comity and forum non conveniens favor dismissal of the case. The government of Japan filed an amicus brief to support TEPCO. The Ninth Circuit analyzed arguments from both TEPCO and Japan and rejected them, allowing the claimants' case to proceed. TEPCO's arguments were principally threefold:

- *Article XIII of the CSC* - Japan is a member of the CSC, a U.S. led effort that sets forth a global nuclear liability regime and features the creation of an international fund to supplement the amount of compensation available for certain nuclear incidents. Article XIII of the CSC establishes that "jurisdiction over actions concerning nuclear damage from a nuclear incident shall lie only with the courts of the Contracting Party within which the nuclear incident occurs." As such, TEPCO argued that the case should, accordingly, be heard in Japan. The court however held that TEPCO could not rely on the CSC because the CSC did not come into force until two-and-a-half years after the plaintiffs' claims were filed and refused to give it retroactive effect.

- *Comity* – International comity is the limit of domestic jurisdiction based on international duty and convenience. While the Ninth Circuit recognized Japan's desire to maintain a uniform compensation program for the Fukushima incident, understanding that it would prefer that all victims be treated the same - if some claims are allowed to be heard in Japan and some in the U.S., there is a great potential for different outcomes for similarly situated victims - the Ninth Circuit reasoned that the U.S. had a stronger interest in exercising jurisdiction over the case because in doing so, the U.S. would be promoting the CSC's widespread acceptance and other countries would be encouraged to join the CSC and strengthen the global nuclear liability regime.

- *Forum non conveniens* – "The doctrine of forum non conveniens allows a court to dismiss a case properly before it when litigation would be more convenient in a foreign forum." Here, the court noted that the plaintiffs brought the claims in the U.S. and that TEPCO had a "heavy burden" to present a compelling argument as to why the plaintiffs' chosen forum of the U.S. was not appropriate. Ultimately, the court rejected TEPCO's argument noting, among other things, that the plaintiffs were "U.S. citizens, and their decision to sue in the United States must be respected."

*Cooper* therefore potentially sets a precedent for U.S. courts to exercise jurisdiction in connection with U.S. claimants who are injured by nuclear incidents in non-CSC countries. Since the CSC was not in force at the time the suit was brought, TEPCO was not allowed to rely on its exclusive jurisdiction provisions. Therefore, U.S. companies that supply parts and services and lenders that provide financing to nuclear installations in non-CSC countries must be cognizant that there is a precedent case that allows U.S. courts to exercise jurisdiction over U.S. claimants who are injured by nuclear incidents in non-CSC countries. We note that, at this point, *Cooper* has focused on jurisdictional limits and has not addressed any substantive issues such as liability channeling. Accordingly, *Cooper*, as it currently stands, does not provide any insights into how U.S. courts would evaluate liability channeling issues that may arise if, for example, the country where the nuclear incident occurred is a Vienna or Paris Convention member. We can only make a qualified conclusion that there is a precedent case that allows U.S. courts to exercise jurisdiction over U.S. claimants who are injured by nuclear incidents in non-CSC countries.

It is notable however that a second case, *Bartel v. Tokyo Electric Power Co., Inc.*(24), with virtually identical facts and claims to *Cooper* (and filed against TEPCO and GE while *Cooper* was stayed during the appeal) was recently dismissed on the basis that a San Diego courtroom is not the appropriate place for the case. A central part of that decision being the question of whether the defendant "purposefully direct[ed] his activities" at the forum state, applying an "effects" test that focuses on the forum in which the defendant's actions were felt. A purposeful direction analysis typically consists of evidence of the defendant's actions outside the forum state that are directed at the forum, such as the distribution in the forum state of goods originating elsewhere. In this regard the judge wrote, "There is no targeting here. Plaintiffs' allegations that the effect of TEPCO's conduct were felt by American citizens while on U.S. ships, one of which with a home port of San Diego, are too attenuated to establish purposeful direction." The judge also said that the sailors "have provided no information to support an assertion that TEPCO knew its actions would cause harm likely to be suffered in California."

Both of the above cases are on-going however as the court hearing *Cooper* has granted TEPCO's motion for certification of interlocutory appeal and, as at the date of this article, that appeal is still pending and *Bartel* has recently been re-filed.[(25)]

In late 2017, a new class action, *Imamura et al. v General Electric Company and Does 1-100*[(26)], was brought in the U.S. District Court for the District of Massachusetts by plaintiffs comprising a group of Japanese business and property owners and physicians who are alleging that GE was negligent in the design of the reactors and related systems involved in the accident at the FNPP, including a lack of safeguards to prevent the spread of radiation. GE's corporate headquarters and principal place of business is located in Massachusetts. The plaintiffs are bringing the action on behalf of themselves and more than 150,000 Japanese residents and hundreds of businesses. The case is on-going.

These cases serve to highlight the potential concerns contractors face when working on nuclear projects. As a result, we are increasingly seeing contractors requesting indemnification for this risk. As the potential exposure under such an indemnity could run into the billions of dollars this is an area where host governments are potentially the only stakeholder capable of bearing that liability. Precedents for such support exist, including those provided in respect of certain decommissioning sites in the UK such as Magnox.[(27)] Of course there is a significant distinction between a nuclear decommissioning site and a privately-developed new build nuclear facility, however, the liabilities such indemnities address are just as real for contractors in a new build nuclear facility, particularly in light of the recent cases noted above.

*Scarcity of successful precedent transactions*

Finally, the relative lack of new build nuclear projects that have been successfully developed in recent years (and in particular in the post-Fukushima era) presents its own bankability challenges. Much of the well-publicized delays at the Westinghouse projects in Georgia and South Carolina, for example, were the result of issues arising out of the innovative modular construction techniques employed on those projects. Until multiple, repeat, new build nuclear projects are being routinely delivered, these sort of technology and logistical issues will continue to be a feature of nuclear projects and risk appetite will be impacted accordingly.

## Part III
## Tackling the Challenges of New Build Nuclear

***Hybrid structure that promotes collaboration and flexible risk allocation***

As outlined above, the traditional hard and inflexible risk allocation of the traditional "fixed price turnkey" EPC contract can result in an allocation of risk which is unsustainable. Our preferred approach is to acknowledge this reality and provide more flexible, bespoke options for risk allocation that seek to maximize the alignment of interests of the parties while avoiding the blurring of risk and responsibility between the owner and the contractor as can occur under purely collaborative contracting models.

As with any well-structured project, risk should be allocated to the stakeholder that is best placed to take that risk. However, in the nuclear context, given the magnitude of the construction risks involved, sponsors are encouraged to broaden their perspectives beyond seeking to simply maximize risk transfer to the contractor and instead look, from the earliest stages of structuring discussions, at opportunities to spread that risk across all key stakeholders.

The key to an effective hybrid solution for EPC contracting is to consider which entity is best placed to manage the particular risk and also to consider the quantum of the risk and the extent to which that entity is able to bear such risk in worst case scenarios. It should also be considered whether traditional risk allocation mechanisms, such as delay and performance liquidated damages, are fit for purpose in the nuclear context and the parties are encouraged to explore alternatives that might unlock greater value for all concerned.

We discuss below potential approaches in four key areas of construction risk: (i) cost overruns; (ii) performance issues; (iii) delay; and (iv) handover.[(28)]

*(i) Cost Overruns*

As noted above, the traditional model for cost overruns is to maximize the fixed price element of the contract and minimize the scope for price adjustments. However, the reality of nuclear construction is that when cost overruns arise, the contractual rights of the owner to insist on delivery without increased cost can ultimately come up against the harsh fact that, as with the examples noted earlier, the contractor is unable to bear those costs in full and risks insolvency before the project can be completed.

This approach also raises the risk that is all too common on fixed price contracts that projects which enter difficulty quickly descend into disputes with the contractor seeking to avoid liability over potential change orders and claims for "out of scope" work. These disputes can distract the parties from seeking a collaborative solution, exacerbating the issue and further draining the resources of both sides to resolve the actual issue at hand.

In this context we would also note that, in our view, a full cost reimbursable model is also a sub-optimal arrangement for new build nuclear projects. Unlike fixed-price EPC contracting, where the risk of cost overruns sits solely with the EPC contractor, under the cost reimbursable model, this risk is primarily allocated to the owner, as the owner is required to reimburse the contractor for all eligible costs. Under this paradigm, the EPC contractor bears limited responsibility for cost management since any costs that it incurs are eligible for reimbursement by the owner and, accordingly, Contractor is not properly incentivized to manage costs even where those costs are effectively under its control and therefore most appropriately managed by it.

The solution, in our view, is to conduct a detailed analysis of the full scope of work under the contract to establish which aspects are most appropriately allocated to a fixed price arrangement, and those where a more flexible pricing structure would be beneficial. For example, fixed priced arrangements are most appropriate for those matters where the contractor has the greatest degree of control, such as the proprietary nuclear components of the plant. More flexible pricing arrangements can be appropriately reserved for those aspects where significant external risks are prevalent, such as complex civil works where host country dynamics, specific local labor conditions and supply chain issues can create a much greater risk of cost overruns. Indeed, past history has demonstrated that these areas do present a risk of very substantial cost overruns and delays.

If this analysis is conducted correctly, and different pricing models applied intelligently to the most appropriate discrete aspects of the overall EPC scope, the proportion that is price certain can be maximized (to the benefit of the owner) without placing a potentially unsustainable risk onto any individual stakeholder.

These structures can include more balanced, pragmatic approaches to cost reimbursable elements of the contract such as pain-gain sharing mechanisms that incentivize the contractor to properly manage costs while not exposing it fully to the downside risk of cost overruns and also allowing the owner to share the benefit should the contractor out-perform on this portion of the contract. Such mechanics allow for significant flexibility, retaining an incentive for the contractor to complete the project in the face of significant cost overruns, and to continue to manage those costs to the greatest extent possible, while also providing sufficient funding to enable it to do so.

For those areas for which complete price certainty is not achievable, and consequently a degree of pricing risk is retained by the owner, each of the other stakeholders can play a role in mitigating the impact of those arrangements. For example, in respect of any additional costs incurred over the anticipated budget, the sponsors could offer committed contingent support, lenders could extend flexible, supplemental funding options and the offtaker could provide a tariff-adjustment mechanism that would allow for a re-opening of the offtake price to recoup cost overruns.

From the perspective of potential offtake price adjustments to mitigate the risk of cost overruns, the Regulated Asset Base model currently under consideration by the UK government as a potential funding model for new build nuclear[29] would potentially provide one solution. Under such a mechanism, the regulated payments payable to the project could be adjusted based upon actual capital (in contrast to the relatively fixed pre-agreed cost reimbursement under the existing CfD scheme).

*(ii) Performance Issues*

The traditional model for performance issues upon completion testing is to give the contractor a liquidated damages liability, subject to a minimum performance threshold, which is sized at a level that is intended to compensate the owner for the reduced performance. The scale and longevity of nuclear projects (with an operating life that can exceed sixty years) however means that the impact of even minor performance issues over the life of the plant would require a quantum of damages that is significantly more than contractors are traditionally willing to accept and potentially are able to bear. As such, performance liquidated damages are, in the nuclear context, more appropriately viewed purely as an incentive for the contractor to achieve the contracted performance, rather than a true compensatory sum.

Given the scale and complexity of nuclear projects however, and the strict regulatory context noted above, performance issues can be notoriously lengthy matters to resolve. As such, rather than continue to incur delay liquidated damages, depending on the complexity of the performance issue contractor may instead prefer to crystalize its loss and pay performance damages rather than remedy the performance issues. In those circumstances however, the sponsor's long-term interests may have been better served by the contractor continuing to work to resolve the performance issues.

In that context, mechanics which continue to incentivize the contractor to work on performance issues have real value and can potentially result in wins for both sides to the contract. Such structures can include, for example, allowing the contractor the opportunity to achieve substantial completion, thereby stopping the accrual of delay liquidated damages notwithstanding the known performance issues, subject to contractor posting appropriate security in lieu of performance damages and undertaking to continue to work on those issues (and thereby potentially reducing the final quantum of performance damages due) under a mutually agreed remediation plan that is designed to satisfy regulatory requirements and minimize disruption to operation. By incentivizing contractor to continue to work towards a solution to the performance issues owner can potentially avoid the long-term consequences of accepting an under-performing plant. Offering such flexibility can also potentially unlock a higher overall quantum of performance damages that the contractor would be willing to bear given the increased scope it has to mitigate the risk of ultimately being required to pay those damages.

*(iii) Delay*

The traditional model for delay is, of course, a per day liquidated damages provision, sized to keep the owner whole for the costs it will incur due to that delay, including any financing costs it will otherwise be unable to service due to the delay in revenue generation. However, as with performance damages, the reality of nuclear projects is that significant delays are commonplace and that, combined with the sheer scale of these projects, means that it is often impossible for the quantum of delay damages to be set at a genuine compensatory level.

As with the question of under-performance of the project noted above, delay liquidated damages again therefore simply become a matter of seeking to incentivize the contractor to complete on time. Once that reality is accepted, the parties should ask themselves whether other arrangements may achieve a better overall incentive. One option, for example, could be the foregoing of liquidated damages in favor of a contingent equity structure which would allow the contractor to treat its payments as an investment, allowing recovery, over time through an equity return, on that investment. This construct can have a number of advantages. First, by allowing contractor an equity return on the amounts paid (rather than treating the sums purely as a damages payment) contractor may be able to offer a larger overall payment and charge less under the contract price for that liability. Also, by having this contingent equity being contributed at a point in time when the project is distressed, this helps align the interests of contractor with those of the owner (as they both have an investment in the project the performance of which is dependent on the relevant issues being resolved effectively and as quickly as possible). Finally, this contingent equity construct would ideally be structured so as to be payable upon any project delay, irrespective of fault – i.e. it would be available to the project company in the event of any delay in achievement of completion rather than only where the contractor is at fault. That construct further improves alignment of interests of contractor and owner and helps reduce the very real risk of finger-pointing around the causes of delay. This construct is easier to structure where the contractor is themselves already a JV partner in the project company.

*(iv) Handover*

Traditional EPC contracts focus on providing a clear transition point when the plant is accepted by the owner and risk and responsibility is transferred to it from the contractor. Typically, this takes place after successful completion of appropriate performance testing. However, this simple arrangement does not work in the nuclear context where the regulatory regime will require that care, custody and control of the facility must pass into the hands of the licensed operator from the point of fuel loading, a point in time that necessarily precedes the undertaking, let alone completion, of performance testing of the plant. Furthermore, for reasons of safety, and particularly on sites where multiple units are to be commissioned in series, transition of care, custody and control will occur in stages. As such, handover is not a single moment but rather a material period of time. As such, it is vital that particular consideration be given to the arrangements for such transition, satisfying the requirements of both sides and the regulator. The respective rights and responsibilities of the parties during that time must be carefully prescribed. From an owner's perspective this is critical to ensure that the contractor is not provided with an excuse for failure in the performance testing, or delay in commissioning of subsequent units on site, for example, simply by reason of a failure to accurately document the shared responsibilities during this transitional period. A lack of clarity in this regard will also inevitably lead to regulatory issues around the operator's responsibility to ensure it is in control of the live plant at all times.

***Managing public engagement and local impact***

Although applicable to all large-scale developments, the need for the developer to manage engagement with the local population and the impact that the construction phase of the project will have on those people is particularly important on nuclear projects. This is a function of not only the scale and extremely long construction timescales involved in their development but also the particular safety concerns that arise when a nuclear project is proposed in an area. As such, the developers of a nuclear project will be particularly sensitive to the need to properly manage local relations, in a way that contractors, if not suitably incentivized may not prioritize. Furthermore, given the particularly long operating life of a nuclear power plant (the period from commencement of construction to completion of decommissioning can be over 100 years), it is even more important that the contractual arrangements do not allow, or inadvertently incentivize, contractors to put short term gains over long term relationships.

Nuclear projects also have the potential to provide extremely beneficial local development opportunities which can be leveraged for local as well as governmental support if properly realized. These considerations will often result in the owner taking a larger than usual involvement not only in the *what* of the contractors work but also in the *way* it is undertaken. Managing this interface properly requires a great deal of up-front planning and negotiation of detailed requirements between contractor and owner to build-out the contractual obligations of the contractor in this regard in substantially more detail than would typically be the case of equivalent non-nuclear projects. This approach should also involve ensuring that contractors are appropriately incentivized to better align their interests with the longer-term interests of the developers.

***Subcontractor and vendor management***

Subcontractor and vendor management is another key area where the regulatory requirements of nuclear can clash with the traditional contracting model. Under a single-point turnkey EPC contract, sub-contractor and vendor management is often left to the main contractor as they bear the sole responsibility for ensuring that those sub-contractors and vendors deliver their part of the scope of work consistent with the requirements of the main EPC contract. However, in the nuclear context, control over quality of work and equipment (particularly in connection with the risks of counterfeit, fraudulent or suspect items ("**CFSI**")) is paramount and is ultimately the responsibility of the licensed operator. It cannot delegate that responsibility to its contractors. Accordingly, the owner must have a significant degree of visibility into, and control over, the activities of the contractor's sub-contractors and vendors, right down the supply chain. This is particularly the case in connection with any nuclear fuel being provided by a contractor where clear allocation of responsibilities and liabilities in connection with its transshipment are especially important and, again, a matter where regulatory and legal obligations abound.

A very careful balance needs to be struck. On the one hand the owner needs to have sufficient rights to reach into the subcontracting arrangements of the main contractor (including in particular with regards sub-contract/supply contract awards, inspections, record audits and CFSI-related controls) to allow it to effectively discharge its regulatory responsibilities. On the other hand, however, the main contractor will want to control the risk of disruption, delay and cost impacts of this intrusion by the owner and/or ensure that appropriate mechanisms to provide relief are available under the EPC contract. There are many ways in which this interface can be appropriately managed, but the key message here is simply to highlight the need to reach agreement on the rights, and reliefs, available, the boundaries of each party's responsibilities and ensure that this is all properly and clearly contractually documented.

## Part IV
## The Future

The traditional EPC contracting models are not sufficient for the challenges of new build nuclear projects, however, bankable contracting structures can be achieved where a collaborative, bespoke commercial approach is taken to risk allocation, building-in appropriate support from all key stakeholders. This collaborative approach must not only encompass the EPC contractor and project company but also tap the strengths and resources of its sponsors, the lenders, the offtaker and the host government, with each shouldering their appropriate portion of risk.

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21 Chapter 11 case filing: United States Bankruptcy Court Southern District of New York in re Westinghouse Electric Company LLC, et al., Debtors dated March 29, 2017.

22 Exceptions in respect of nuclear accidents resulting from war, civil war or other conflicts exist in certain circumstances. In Japan, a nuclear plant operator can be granted an exemption from paying damages if an accident was caused by "a grave natural disaster of an exceptional character", however, this exemption was given a very narrow interpretation, with "exceptional" being treated in this context as synonymous with mean "completely beyond all imagination". On that basis the exemption was deemed not to be available in connection with the 2011 accident at the Fukushima-Daiichi Nuclear Power Plant as the scale and magnitude of the earthquake and resultant tsunami were deemed to not have been sufficiently exceptional by that standard.

23 860 F.3d 1193 (9th Cir. 2017); 12-CV-3032-JLS-WMC.

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27 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/ 461620/Parent-Body-Agreement-Execution-Version-Redacted.pdf.

28 This list is clearly by no means exhaustive given the myriad of potential issues and risks that apply to a new build nuclear power project but are provided as illustrative of the approach being outlined in this article.

29 https://www.gov.uk/government/speeches/statement-to-parliament-on-horizon-project-at-wylfa-newydd.