# Procurement and Construction in the Nuclear Setting—An Analysis of the Key Risks in Light of the Unique Features of Nuclear Developments

**Nicholas Gould***
*PARTNER AT FENWICK ELLIOTT LLP, VISITING PROFESSOR AT KING'S COLLEGE LONDON, LLM FCIArb MCIOB*

**Giuseppe Franco****
*ASSOCIATE AT FENWICK ELLIOTT LLP, FCIArb MSc*

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## Abstract

*In spite of the reservations that followed the Fukushima accident and, later on, the Russo-Ukrainian conflict, nuclear energy continues to play an important role worldwide in achieving national net zero targets and securing energy supply. Nevertheless, nuclear developments present unique challenges which have not yet been fully overcome. This article discusses the strategies that parties adopt, both at the procurement and contract drafting phases, for managing such challenges. Additionally, the authors explore the potential offered by framework alliance contracts. By leveraging a collaborative approach and integrating project stakeholders along the supply chain, framework arrangements can help achieve targets that would otherwise be very difficult to fulfil. Among these targets, compliance with safety standards and reduction of carbon emissions probably are the most relevant ones. Moreover, thanks to their "umbrella" function, framework alliance contracts can help bridge gaps between project contracts, allowing parties to exploit the benefits of full integration.*

## Introduction

Construction megaprojects have been defined as large-scale, complex ventures that typically cost one billion or more; take many years to develop and build; involve multiple public and private stakeholders; and impact millions of people.[1] Considering the remarkable size and complexity involved in their development, and how they ambitiously aim to change the lives of millions, nuclear projects fit well into the category of megaprojects.

This article attempts to navigate this complexity by exploring the main issues connected to the regulation and procurement of nuclear projects, and the drafting of contracts for the construction of new nuclear plants. In particular, this article will first introduce the main stages of the British licensing process for the development of new nuclear power plants. Secondly, the authors will analyse the key risks faced during nuclear procurement and show how these are commonly managed by developers and contractors. Thirdly, the article will delve into the provisions of contracts for construction of nuclear power plants, looking in particular at the typical amendments that parties negotiate during the drafting process. Lastly, the authors will consider whether nuclear procurement can be improved through the implementation of framework alliance contracts.

## The regulatory framework for the development of new nuclear power plants

In the UK, the main regulatory powers are vested in the Office for Nuclear Regulation (ONR), which is notably responsible for issuing nuclear site licences. The Environmental Agency (EA) and the Natural Resources of Wales are the leading environmental regulators in England and Wales, respectively. In particular, they are responsible for regulating the disposal of radioactive waste and for issuing the environmental permits to nuclear installations.[2] Together, the ONR and EA also carry out the generic design assessment for new nuclear power reactors. Alongside these two bodies, the Nuclear Decommissioning Authority oversees the plans for the safe decommissioning of old nuclear plants.

In spite of the UK leaving the EU and Euratom, the UK Government committed to maintaining the same high standards as before. This is ensured by the Nuclear Safeguards Act 2018 and the EU-UK Agreement,[3] whose compliance is supervised by the ONR.

* Partner at Fenwick Elliott LLP. Email: ngould@fenwickelliott.com.
** Associate at Fenwick Elliott LLP. Email: gfranco@fenwickelliott.com. The opinions and views expressed in this article do not reflect in any way those of Fenwick Elliott LLP. Any omissions or errors are those of the authors.
[1] B. Flyvbjerg, "Introduction: The Iron Law of Megaproject Management" in B. Flyvbjerg (ed), *The Oxford Handbook of Megaproject Management* (Oxford: OUP, 2017), p.3.
[2] The Scottish Environmental Protection Agency has similar functions in Scotland.
[3] The EU-UK Agreement for cooperation on the safe and peaceful uses of nuclear energy, entered into force on 1 May 2021.

### An extended clearance process

The construction of a new nuclear plant requires adequate consideration of a number of social, economic, environmental and safety factors. To make sure that all are considered, the British Government conducts the so-called "justification process". Among the many factors, the justification process also consults on carbon reduction since currently, nuclear energy is regarded as a key tool to assist the UK in achieving its net zero target.

Projects for new nuclear plants must then go through the generic design assessment (GDA). This process enables the ONR and EA to assess the safety and environmental implications of each type of reactor's design. This second assessment gives developers an indication of the likelihood of obtaining further authorisations—nuclear site licence, planning permission etc—before they commit to investing significant sums. If successful, the GDA concludes with the issuance of the "design acceptance confirmation" by the ONR and the "statement of design acceptability" by the EA. Both are valid for 10 years and are used by project companies as the regulatory basis to obtain the nuclear site licence.

Under the Nuclear Installations Act 1965, a nuclear site licence is required in order to operate nuclear reactors. Granted by the ONR, this licence imposes an absolute duty on the licensee to secure that no person is injured and no property is damaged as a result of nuclear occurrences.[4] The licence is issued for the full life cycle of the nuclear facility.

Another major step required of British nuclear projects pertains to planning permission. As a plant with a power output of over 50 MW,[5] a nuclear station is classified as a Nationally Significant Infrastructure Project (NSIP). For NSIPs, planning permission is obtained through issuance of a development consent order (DCO) by the relevant Secretary of State. The application process for a DCO allows to combine the procedure for obtaining the planning permission with a range of other consents, including environmental permits and other licenses for wildlife protection.[6]

## Key risks in the procurement of nuclear projects

Even without considering further licences and permits,[7] obtaining all required authorisations may take many years. For example, the project for the new Sizewell station in Suffolk underwent the first community consultation in 2012, obtained its DCO in 2022, and has been only recently granted the nuclear site licence. Considering the length of the clearance process, one of the main challenges in procuring new nuclear plants is to arrange an adequate financing plan. Indeed, nuclear power projects not only require significant capital investment throughout the entire duration of the project; they also need considerable upfront payment with little assurance about when exactly the investment will start to pay off. This is usually when the plant starts generating electricity that can be sold to the national grid. On top of that, if the developer opts for external funding, the cost of borrowed capital will depend on the funder's assessment of the risks of the project. On nuclear projects, funders are particularly attentive to risks that are associated with the stability of the regulatory and political framework. Therefore, the cost of borrowed capital can rise or fall depending on how strong (or weak) the country's political commitment is.

Moreover, nuclear procurement has to cope with a good deal of project issues. First, as is the case for any megaproject, developing a nuclear power station means longer lead times setting back the point in time in which the project will start generating the owner's profits. Secondly, a nuclear project implies a further level of complexity due to the greater attention to safety culture and security requirements. The level of complexity can further increase if the project relates to the deployment of a first of a kind reactor technology. In such a case, additional testing and safety procedures will need to be carried out in order to ensure that the new reactor is safe.

### Procurement routes: EPC and multi-contracting

The sharing of working spaces between multiple contractors and suppliers triggers another project risk, known as the interface risk. Inadequate interface of both on-site and off-site works might translate into poor coordination and ultimately, lead to delays and cost overruns. The interface risk increases in the so-called multi-contract scenario.[8] Here the developer contracts, often through the interposition of a special purpose company, with several tier 1 contractors, each responsible for the design and/or construction of a specific work package. Whilst this option allows the developer to avoid the premium that a single EPC contractor is likely to charge, it implicates increased workload (and cost) for coordinating and supervising the many engaged contractors. In addition, in case of a dispute, the piecemeal nature of multi-contracting makes it more likely that liability be shared between two or more project participants, thereby forcing the developer to commence a multi-party legal action.

However, multi-contracting often is the only viable option on nuclear developments because a single contractor may be unwilling or unable to accept risk for

[4] Under the Nuclear Installations Act 1965 s.7, a "nuclear occurrence" can arise out of the radioactive properties of nuclear matter, or the ionising radiations emitted from anything that is not nuclear matter. Section 26 then defines "nuclear matter" to include certain nuclear fuels (fissile materials) and radioactive by-products of the production or use of such nuclear fuel.
[5] In the UK, there are currently nine operating commercial nuclear reactors in five different plants (Hartlepool, Heysham 1 and 2, Sizewell B, and Torness). Their output ranges from a minimum of 575 MW (Heysham 1) to a maximum of 1191 MW (Sizewell B).
[6] For an example, see the Sizewell C (Nuclear Generating Station) Order 2022 (SI 2022/853), which relates to the DCO granted in 2022 to the planned Sizewell C station.
[7] e.g. another important permit is the generation licence required under the Electricity Act 1989.
[8] Also known as disaggregation or letting of work packages.

the whole project.[9] Moreover, letting work packages separately allows for more flexibility, especially when developing the programme, and for a deeper engagement of the supply chain. Indeed, so long as the developer is capable of managing interface issues, it will have the upper hand when imposing its conditions down the chain of sub-contracts, leading to more competitive prices and improved compliance with safety standards.

Multi-contracting is being used for the construction of the Hinkley Point C power station, which is estimated to complete between 2029 and 2030. Here the owner, a joint venture of EDF Energy and China General Nuclear Power, identified the key work packages—reactors, civil works, steam turbines and generators, earthwork, electrical works, marine works and balance of plant—and assigned each of them to a different tier 1 contractor.

## The drafting of construction contracts in a nuclear setting

Regardless of the chosen procurement option, NEC[10] and FIDIC[11] standard forms are likely to be used as the footprint for contracts for construction of new nuclear power plants. As nuclear projects entail tendering of multiple contracts, NEC and FIDIC can also co-exist. Indeed, this seems to have become the preferred approach on British nuclear projects.[12] The way NEC and FIDIC forms are put to use can be explained in light of the different scope of work that each contract aims to deliver. Due to their focus on joint risk management, NEC forms are usually perceived as being more suited to regulate works that require the parties to adopt a more proactive and collaborative approach. These are usually the contracts that involve a substantial amount of on-site work, such as those involving local suppliers, where interface issues are an everyday concern. On the other hand, since FIDIC forms are regarded as the standard on international projects, parties from outside of the UK are more familiar with them. For that, they are predominantly used for contracts concluded with foreign contractors, such as those for procurement of specialist technology (e.g. the nuclear reactors). These contracts also usually involve a greater amount of off-site work, namely the design and manufacturing of the particular technology. Accordingly, on-site work is limited to the installation and commissioning of the technology into the nuclear power plant.

### *Typical amendments*

While the scope of the particular contract guides the initial choice between NEC and FIDIC, the final draft is likely to resemble a bespoke agreement containing a number of amendments. Akin to the procurement strategy, ad hoc amendments of construction contracts in the nuclear setting aim to address the nuclear setting as well as specific project issues.

### Extensions of time and pricing options

Contract provisions are first heavily negotiated to manage the longer lead times. Such provisions need to deal with the regulator's intervention and the design review process, both of which may lead to design amendments and additional testing. During contract negotiation, these causes of delays frequently prompt contractors to push for a broader entitlement to extension of time. At the same time, to guard themselves against additional costs, contractors may seek to expand the reimbursable part of the contract price at the expense of the lump sum part of it. Additionally, they seek to include mechanisms for price escalation as well as hardship clauses dealing with unexpected changes of circumstances.

### Variations

Construction contracts always require clear provisions that permit the easily allocation of risk among the parties, and thus the additional cost, resulting from the implemented variations. However, while variation provisions frequently allow contractors to defer the implementation of a change until parties fully agree on the terms of the variation agreement, on nuclear projects, this may result in further extending the already long lead times. It is therefore common for developers to retain a right to request contractors to immediately proceed with implementation of the variation pending finalisation of the variation agreement.

### Warranties and indemnities

Other extensively negotiated provisions deal with warranties and indemnities. As to the former, contractors are likely to resist fitness for purpose or life service provisions. This is particularly true in case of multi-contracting, where a design may be provided by an entity different from the building contractor. As to the liability regime, contractors are likely to seek indemnity from developers in respect of risks associated with nuclear incidents. Owing to these indemnity provisions, the developer may not be able to pass on the risk for absolute liability associated with the nuclear site licence.

[9] To compensate for the lack of expertise, the single EPC contractor is likely to be a consortium, or a joint venture, of two or more companies, each contributing with its own expertise. This is also known as the EPC split package approach.
[10] New Engineering Contract.
[11] From the acronym of the French name *Fédération Internationale Des Ingénieurs-Conseils*, which stands for International Federation of Consulting Engineers.
[12] It is reported that both NEC and FIDIC forms have been used for the construction contracts at Hinkley Point C. At the FIDIC International Contract Users' Conference of November 2022, Paul Merrett of EDF reported that the project uses FIDIC on around half of the 300+ contracts. The rest of the contracts is mainly the domain of NEC contracts, as maintained by NEC on their official website, see S. Fullalove, "NEC plays a key role on Hinkley Point C project" (November 2016), *https://www.neccontract.com/news/nec-plays-a-key-role-on-hinkley-point-c-project*. Reportedly, a similar contract structure will be adopted for the construction of the new Sizewell C power station.

## Dispute avoidance and resolution

Finally, thoroughly negotiated provisions are those concerning the resolution of disputes. On long-term construction projects, the concept of "dispute resolution" requires some fine-tuning. Indeed, the long-term commitment of the parties calls for the addition of the concept of dispute *avoidance*, whose aim is to provide the contract with mechanisms allowing the parties to tackle any issues as soon as they arise. This can be achieved through the implementation of mechanisms of joint risk management. For example, during the pre-construction phase, the contract could mandate the developer to attend regular meetings with as many contractors as possible (at least with tier 1 contractors). This would allow the identification of any project risks prior to commencing the works and, where appropriate, to set up instruments for handling such risks at a later stage should they actually materialise.

During the construction phase, the focus should be on mechanisms for information reporting. To overcome the natural parties' tendency to withhold key information, early warning mechanisms and other systems of enhanced information sharing may be of great help. It must be borne in mind, however, that any such system remains idle if the contract does not set out follow-up processes by means of which the parties can react to the reported information. For example, whilst the 2017 FIDIC forms provide for a mechanism of advance warning,[13] they fail to deliver a follow-up mechanism ensuring that the reported issue is actually dealt with. NEC4 ECC also provides for a mechanism of early warning. In this case, however, the system is enhanced by a risk register, namely a log where all notified warnings are recorded, and by a follow-up process whereby parties are required to meet in order to seek after concrete solutions.[14]

Another tool of dispute avoidance and resolution is the dispute board, whose procedure is usually embedded in a multi-tiered dispute resolution clause.[15] For example, 2017 FIDIC forms provide for the appointment of a dispute board at the inception of the parties' relationship, namely when the contract is concluded—the so-called "standing" dispute board. A standing rather than an ad hoc dispute board is a better option on long-term construction projects because a panel that is already familiar with the contract documentation will arguably be better equipped to resolve the issues as they arise during the construction phase.

## An umbrella agreement that links the project contracts: the framework alliance contract

At this point it should be clear that nuclear projects retain certain unique features, among which it is worth recalling: the severity and length of the clearance process; the extended lead times; and the involvement of multiple project participants exacerbating interface issues. These features, combined with substantial front-loading and capital expenditure, make it necessary for the project to reach profitability at the earliest possible moment. To allow for that, adequate contractual machinery should be put in place to prevent the escalation of claims into fully fledged disputes.

As stated above, this can be achieved through the implementation of mechanisms of joint risk management.[16] The basic idea is to move away from the conventionally adversarial nature of the construction industry and shift the focus on parties' co-operation. Applying this concept to contract drafting implies that contract terms should not just aim to *transfer* the risks from one party to another. Instead, the focus should also be on setting up processes that allow parties to *jointly manage* the risks. When such mechanisms underpin the execution of a contractual arrangement, the agreement becomes known as a partnering contract.[17]

However, no matter how prescriptive they can be, partnering agreements remain contracts that are designed to be entered into between only two parties, with no provision for strategic integration between multiple project participants and supply chain members.[18] As such, they may not be suited to deal with the major interface risks of nuclear projects. Arguably, the resolution of interface issues can only be delivered through a full integration of all contractors, specialist subcontractors, design consultants and strategic suppliers. To fully fulfil the potential of integration, parties may use a framework alliance contract. This additional procurement route functions as an umbrella contract that integrates the bilateral contracts entered into by the various project participants. In this way, each participant becomes known as an "alliance member". The idea is that through the alliance, each member will take responsibility, in addition to the obligations related to its own work package, for the delivery of certain pre-agreed objectives that concern the project as a whole.

A framework alliance contract can be used from the pre-construction phase. This ensures that all alliance members participate in the development of design, selection of key suppliers, and most importantly, in the

[13] Sub-Clause 8.4.
[14] Core Clause 15.
[15] On nuclear projects, such clauses usually require the parties to seek after the determination of the contract administrator (e.g. the Engineer in the FIDIC contracts), followed by a cooling-off period where parties have to attempt to settle the dispute amicably. A sophisticated contract will usually set out the conditions for this amicable settlement period specifying the meeting's timetable and the parties' representatives who shall attend those meetings (e.g. senior managers). The aim of involving managers in the dispute resolution process is to allow for issues to be seen from a more commercial, and less technical, perspective. If amicable settlement is not successful, construction contracts usually provide for claims to be referred for adjudication by an independent pool of experts (such as a dispute adjudication board). Multi-tiered dispute resolution procedures normally conclude with a final and binding mechanism of dispute settlement, such as international arbitration or litigation.
[16] This article has addressed some of these mechanisms, but it should be stressed that the topic of joint risk management is broad and encompasses many more instruments.
[17] Examples of partnering standard forms are PPC2000, NEC4 Alliance Contract and Option X12 in NEC3 and 4 ECC.
[18] D. Mosey, *Collaborative Construction Procurement and Improved Value* (Hoboken: Wiley-Blackwell, 2019), p.63.

identification of the risks that might disrupt the construction phase. Then, based on the outcome of the pre-construction phase, the framework contract will embed the objectives that the alliance wants to achieve. In this way, the performance of the members throughout the construction phase will be measured against this set of shared objectives. On nuclear projects, this is particularly relevant because certain objectives could not be achieved unless all participants, especially down the supply chain, are equally engaged. One example can be the compliance with health and safety requirements which, on nuclear projects, are particularly strict. Another example is the reduction of the carbon emissions released during construction operations. Setting these as overarching objectives of the alliance would allow for better monitoring and, possibly, for better delivery.

Moreover, on international projects, framework alliance contracts offer an additional advantage on international projects. Outside of the UK, contracts that put the emphasis on joint risk management, such as the NEC contracts, are not frequently used. On the contrary, as seen, contracts like FIDIC are often used in the international arena, where parties tend to resist the introduction of new forms of procurement. The want or scarceness of joint risk management represents a substantial downside because, on nuclear projects, certain outputs are unlikely to be achieved without adequate integration and collaboration. In such a context, a framework alliance contract may help bridge the gap. On the one hand, parties would still be free to use their preferred standard form. On the other hand, thanks to its function as an umbrella agreement, the framework alliance contract would bridge the gaps between the multiple project contracts, allowing parties to exploit the benefits of full integration.

## Conclusion

Procuring and drafting construction contracts for the development of megaprojects is always a challenging task. This is particularly evident in the context of nuclear projects, where the usual project risks combine with unique features like the severity of the licensing process, extended lead times, enhanced safety requirements and interface issues. Moreover, substantial front-loading and capital expenditure, combined with the instability of the regulatory and political framework, may not make for an attractive and easy investment. Yet today, nuclear projects constitute, both in the UK and in other countries, a fundamental part of the strategy for reduction of carbon emissions. Accordingly, the appetite for the development of new nuclear power plants is likely to increase.[19]

In such a scenario, new avenues for project procurement and contract drafting should be pursued in order to ensure the successful completion of the nuclear development. When it comes to the drafting of construction contracts in a nuclear setting, parties are likely to base their arrangements on NEC and FIDIC forms. However, when choosing the form, parties should carefully consider whether the chosen form suits the kind of work that will be carried out. In any case, in the context of nuclear projects, standard forms will be heavily amended during the parties' negotiations, and the final draft will likely resemble a bespoke agreement. Among others, adequate care should be taken in the drafting of mechanisms of joint risk management to ensure that claims do not result in fully fledged disputes.

With regard to construction procurement, nuclear projects require the participation of multiple parties. Indeed, one of the most arduous challenges is to cope with the interface risks that arise from the vicinity of multiple participants. In this context, multi-contracting can be a viable option, but it should only be used when the developer is capable of adequately dealing with interface issues. In addition, multi-contracting is a procurement route in its traditional sense and therefore entails the co-existence of numerous, but only bilateral, contracts. Therefore, it does not provide for an all-encompassing arrangement which brings all project participants together. In such a scenario, parties may tend to drift away from each other driven by opportunistic behaviours. To avoid this, framework alliance contracts, as umbrella agreements that link the individual project contracts, can offer a possible solution. By agreeing on the overarching project's targets, the alliance members are held accountable for the delivery of such targets and their performance is measured against this set of shared objectives. Yet, even in the context of framework alliance contracts, care should be taken during the contract drafting process. First, it is important that such contracts contain sufficiently legally binding obligations. Otherwise, too loosely worded provisions may risk being unenforceable as mere agreements to agree or negotiate. Secondly, parties should be careful in coordinating the provisions of the framework contract with those of the project contracts, ensuring that there are no discrepancies between the two levels.

[19] As demonstrated by the UK Government's recent purchase of the Wylfa site on Anglesey and by the proposed nuclear power stations (Bradwell B and Moorside).