IAEA Nuclear Energy Series

No. NG-T-4.6

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MANAGING THE FINANCIAL RISK ASSOCIATED WITH THE FINANCING OF NEW NUCLEAR POWER PLANT PROJECTS

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IAEA NUCLEAR ENERGY SERIES No. NG-T-4.6

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FOREWORD

One of the IAEA's statutory objectives is to "seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world." One way this objective is achieved is through the publication of a range of technical series. Two of these are the IAEA Nuclear Energy Series and the IAEA Safety Standards Series.

According to Article III.A.6 of the IAEA Statute, the safety standards establish "standards of safety for protection of health and minimization of danger to life and property". The safety standards include the Safety Fundamentals, Safety Requirements and Safety Guides. These standards are written primarily in a regulatory style, and are binding on the IAEA for its own programmes. The principal users are the regulatory bodies in Member States and other national authorities.

The IAEA Nuclear Energy Series comprises reports designed to encourage and assist R&D on, and application of, nuclear energy for peaceful uses. This includes practical examples to be used by owners and operators of utilities in Member States, implementing organizations, academia and government officials, among others. This information is presented in guides, reports on technology status and advances, and best practices for peaceful uses of nuclear energy based on inputs from international experts. The IAEA Nuclear Energy Series complements the IAEA Safety Standards Series.

Given the large capital expenditures involved in nuclear new build projects, managing the various risks that can lead to financial losses is a key to project success. Perceived failure to mitigate and allocate risk effectively will ultimately lead to excessive and potentially prohibitive costs of financing, since funders will demand a higher return on the funds they commit to a project if they perceive that risks have not been mitigated and shared appropriately. As a result, a lack of understanding of the basics of FRM on the part of project sponsors may result in their failure to secure sufficient funding to allow their project to proceed.

Despite the importance of FRM in the nuclear new build process, this is an area in which many project proponents, particularly nuclear newcomers, lack extensive experience. Although proponents can — and almost always do — hire specialist financial advisers to help them in this area, it is clearly desirable that they have a basic understanding of the topic themselves. Newcomers should be aware of the broad relationship between financial risk and the cost of capital, and that FRM is typically not something that is engaged in after having signed contracts with vendors, engineering, procurement and construction contractors and others, but rather an area in which project proponents should engage from the outset of any new build project.

This publication is designed to enhance new build proponents' understanding of the key concepts of FRM. It is intended that the report will be accessible to readers from Member States with little or no experience of financing a nuclear project (as well as to those from Member States with more experience). It covers the major aspects of FRM, including the identification and mitigation of financial risk, its optimal allocation, the ways in which FRM will influence the cost of capital and sources of funding for nuclear new build projects. Member States contemplating an expansion in their existing nuclear fleets can be expected to benefit from this publication, but it will likely be even more valuable for Member States with limited (or non-existent) experience of financing nuclear power projects (i.e. newcomers).

The IAEA officer responsible for this publication was P. Warren of the Division of Nuclear Power.

CONTENTS

1. INTRODUCTION

1.1. BACKGROUND

The process of financing a new nuclear power plant (NPP) project can be thought of as a negotiation of a sequence of agreements, such as those illustrated in Fig. 1. A new NPP project will be initiated by a project developer — a legal entity that will seek to put together a set of agreements (contracts) on terms that ensure a financially viable project at financial close. This project developer will often retain a significant ownership stake in the project at financial close, i.e. it will become at least a partial owner, with the right to receive a share of project revenues and the responsibility to pay a share of costs arising for as long as it retains that stake, which is potentially over the entire project life cycle. It may, of course, retain a 100% share of these, i.e. it may become the sole owner of the project. Figure 1 illustrates the relationships between a project developer or owner, its commercial counterparties (represented by the three entities shown on the left of Fig. 1) and financial counterparties, i.e. those parties providing finance to the project (debt provider(s) — here assumed to be commercial banks — and equity providers) shown at the top and on the right of Fig. 1; these may be regarded as project stakeholders. At this point, the 'operator' role is ignored — it is not assigned to the project developer or owner, and no operator contract is shown in Fig. 1.

Each of the commercial relationships between the entities shown in Fig. 1 and the owner will be governed, as shown, by a contract (in Fig. 1 an electricity off-take agreement, an engineering, procurement and construction (EPC) contract and a fuel supply agreement are shown). For the purposes of illustration, a project developer can be thought to first negotiate a set of broad principles and terms with the electric utility (e.g. reaching a preliminary high level agreement — or term sheet — on the range within which the price per kW·h that the utility will pay the NPP owner must lie), moving next to reaching a similarly high level agreement with an EPC contractor, and then with a fuel supplier. Crucially, each of these high level agreements / term sheets may be regarded as essentially being arrangements to allocate risk and reward between the respective parties to that agreement.

The terms of the electricity off-take agreement will largely determine the revenues for the project over its life cycle, and the EPC contract and the fuel supply contract will largely determine the project's costs over its life cycle. Taken together, these contracts will set expectations regarding the residual income (the remaining part of project revenues after project costs have been met) available for division between debt providers (lenders) in the form of debt service (repayment of principal and payment of interest) and shareholders.

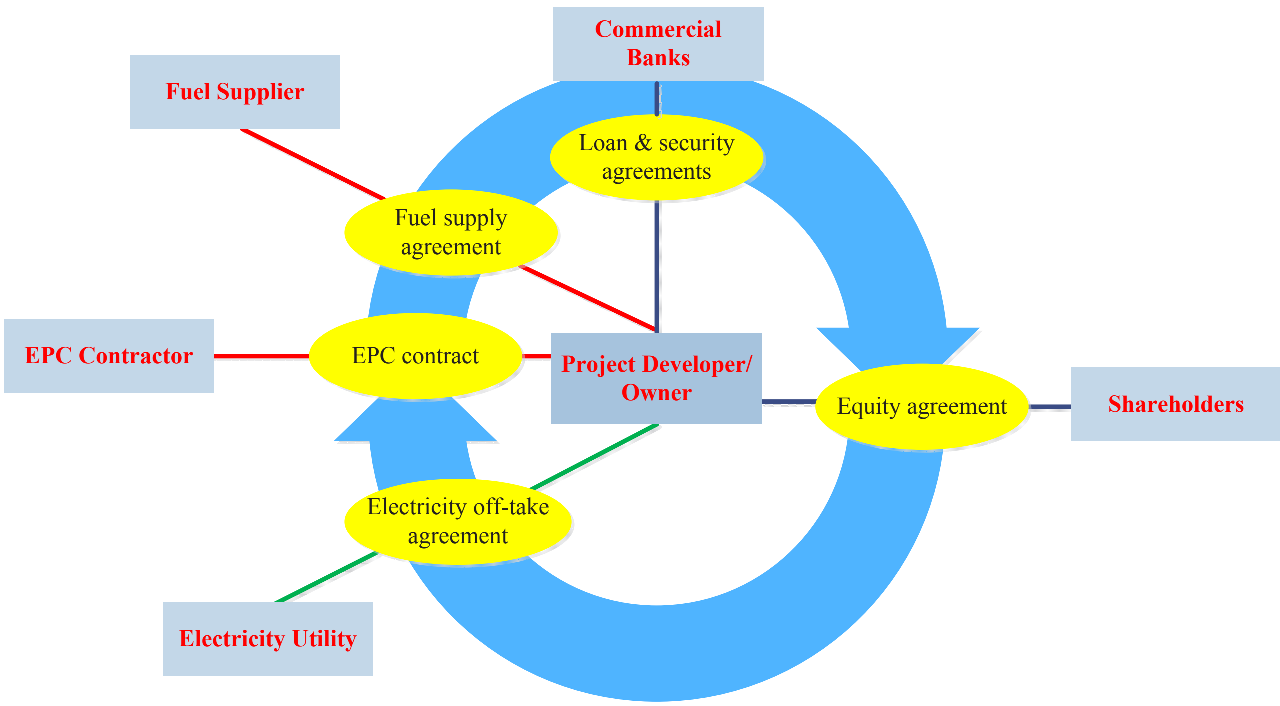

FIG. 1. Allocating risk and reward between stakeholders.

This residual income will be more volatile if the project developer has managed to 'push' less risk on to the commercial entities, or less volatile if more risk has been pushed. However, it will also likely be expensive to push risk on to a particular party as the party being asked to take ownership of the risk in question will likely demand additional payment (a risk premium) to do so.

In the example shown in Fig. 1, the project developer will seek to reach a high level agreement with the commercial banks involved in the project regarding the division of this (volatile) residual income. These banks will, of course, wish to avoid taking the risk arising from the volatility of the residual income. Once again, it can be imagined that a high level agreement (or agreements) could be reached that will allocate claims on residual income to the banks in return for their providing loans and taking (likely a rather small amount of) risk.

At this point in the cycle, the project developer will be in a position to evaluate whether its share of the residual income (and the residual risk) arising from the project is broadly acceptable. If it is acceptable, or close to acceptable, a further cycle of discussions will take place with the stakeholders shown in Fig. 1 to increase the detail of the high level arrangements, and potentially revise the risk and reward sharing arrangements to make them acceptable to the other project stakeholders.

As these arrangements become more detailed (e.g. as the initial range of electricity prices in the electricity off-take agreement becomes narrower), the economics of the project will become clearer, and stakeholders will attain sufficient clarity on the key metrics in which they are interested (e.g. the price of electricity for the utility, the internal rate of return (IRR) on debt for banks), as well as on the risks to which these metrics will be exposed, to allow them to decide whether to participate. Stakeholders' decisions may be thought of as being based on a comparison of what they expect their participation in the project to deliver (based on financial modelling) versus their own boundary values for those metrics [1].[1] For example, a utility may not be willing to agree to an electricity off-take agreement under which the electricity price will exceed a certain threshold (e.g. US \$0.12/kW·h) or a potential equity investor may require an IRR that exceeds its own weighted average cost of capital (WACC) of, for example, 14%.

To summarize, for illustrative purposes the project development process can be considered as consisting of the developer iterating around the cycle shown in Fig. 1, sequentially attempting to reach an agreement with its counterparties that delivers a value to them that satisfies their boundary values (or comes close enough to ensure that those counterparties continue to negotiate rather than simply walking away) while retaining for itself a risk–reward profile that meets its own requirements.

Of course, the process outlined above is a very simplified and stylized model of reality. For example, in real life, negotiations between the owner and several project stakeholders will likely proceed simultaneously rather than sequentially (and one of the key challenges for the project developer will be to integrate the various agreements under development as the project development process evolves). However, this simplified and stylized model provides a framework within which several key themes will be explored in this publication.

1.2. OBJECTIVE

This publication addresses the financial risk management challenges that must be addressed over the course of nuclear new build projects. Its main aims are to:

- Supply a framework within which Member States, both newcomers and those expanding existing nuclear generation fleets, can think about issues of risk allocation, project structure, project financing and project economics, and the linkages between them;
- Provide an understanding of the relationship between risk allocation or mitigation within a new build project and the cost of capital for that project;
- At a practical level, provide an insight into the concerns, modes of thinking and language that a nuclear new build proponent may expect to encounter within the financing community as it seeks to develop its project.

[1] In general, financial modelling will be crucial at all stages of the process of securing finance from potential sources. At an early stage in the development of a nuclear new build project (for example, during the energy planning exercises that are typically carried out to determine whether nuclear can and should be part of a nation's energy mix) such modelling can be carried out using off-the-shelf tools such as the IAEA's Model for Financial Analysis of Electric Sector Expansion Plans (FINPLAN) model [2]; at later stages it is likely that a project developer will commission financial advisers to develop a customized (i.e. project specific) financial model.

1.3. SCOPE

This publication outlines the challenges associated with nuclear new build projects, and the way in which the various risks associated with such a project over the course of its life cycle can be viewed as financial risks. It introduces the linkage between efficient risk allocation or mitigation and the cost of capital and sets out a number of tools and mechanisms that can be used to manage and allocate risks efficiently, thereby minimizing the cost of capital. It stresses the importance of project structure as a key factor in determining the practicality of different risk management and allocation or mitigation strategies, and provides a number of examples of such structures (and their implications for the cost of capital). As noted in Section 5.1.2, much of the discussion and presentation of key financing ideas is presented in a project finance context; however, it is important to recognize that the ideas are more broadly applicable (see, for example, the models presented in Section 4.3).

Guidance provided here, describing good practices, represents expert opinion but does not constitute recommendations made on the basis of a consensus of Member States.

1.4. STRUCTURE

The structure of the remainder of this publication will largely reflect the framework introduced in Section 1.1. Broadly, the report is arranged in three parts. Sections 2 and 3 introduce some of the key features that make the challenges associated with a new build NPP investment project different from those associated with, say, a coal-fired generation project, and describe some key concepts in the area of risk. Section 4 starts by setting out the key steps in the process of identifying, assessing and monitoring financial risk (including the tools that are available to carry out these tasks effectively). It should be noted that many of these risks are not — in the first instance — purely financial in nature. Typically, a nuclear new build project offers a broad range of risks (e.g. technical, political, reputational, contractual, construction related, operational); however, insofar as the crystallization of some, or all of these risks will ultimately have financial consequences for the economics of the investment under consideration, they will be the focus of keen interest from potential finance providers.[2] Section 4 goes on to explore the idea of risk allocation in some depth: how it is carried out via contract language, and the limits to efficient risk allocation. It goes on to outline four potential structures or approaches for allocating risk, before providing a number of illustrative examples. Section 5 then addresses the cost of financing a nuclear new build power plant, including the types and sources of such financing. The link between the second and third broad themes of this publication is, of course, that successful risk allocation and mitigation will reduce the cost of such financing.

Finally, the Appendix addresses the role of one key source of finance for new build NPP projects in practice: export credit agencies (ECAs). The Glossary provides definitions of the financial terms used in the publication.

2. INVESTING IN A NUCLEAR NEW BUILD PROJECT

Nuclear power generation projects represent particularly capital intensive investment proposals. NPPs are relatively distinctive assets, economically speaking, and their typical cost structure is driven by costs and risks arising from, inter alia:

— An exhaustive, lengthy and expensive permitting and licensing regime;
— Long construction periods (5–7 years) with numerous interlinked sequences of work and testing;
— A complex contractual environment, with the potential for a high degree of construction delay and/or cost variance compared with the base case scenario;
— Very large upfront capital investment costs.

[2] There is a very real sense in which all risk is financial risk: in seeking support from potential investors and/or lenders, a project developer will be asked to demonstrate (via financial modelling) the sensitivity of investor/lender returns and risk measures to the key risks that attend the project, including completion delays, performance shortfalls, etc.

In this context, new build NPP projects are typically not undertaken purely on least-cost-of-electricity grounds; there are other key factors that motivate the construction and financing of a new NPP, including political considerations (e.g. a search for greater energy supply independence, or aspirations to develop a national nuclear industry) and the pursuit of sector related policies (e.g. diversification of energy sources to rebalance existing energy mix, decarbonization of the energy sector).

Nevertheless, the pure cost characteristics of new build NPP projects, and the ways in which their unique characteristics will impact cost implications, should be well understood at the outset of any project.

The remainder of this section will highlight the importance of a key determinant of the cost of the electricity generated by an NPP project, namely, the cost of capital employed in the project. Sections 2.1 and 2.2 will stress the importance of two key features of a typical nuclear project: long construction periods and high capital intensity, and the resultant sensitivity of nuclear projects to the cost of capital. For the purposes of exposition, it will be assumed in Sections 2.1 and 2.2 that the project is financed purely from borrowing; in such an instance, the cost of capital is essentially equal to the interest charged by lenders (or, to be a little more sophisticated, to the debt IRR explained in the internal rate of return definition in the Glossary).

In Section 2.3, the discussion is broadened — and made more realistic — by recognizing that in general a new build NPP project will be financed (like any other project) by a mixture of debt and equity. Given this mixture, in calculating the overall cost of capital for the project, the different proportions of these two sources of finance — and their typically different costs, which reflect their relative riskiness to their respective providers — must be reflected. This is done by assessing the WACC. It is important to note that the WACC will play two roles in this publication. It is introduced in Section 2.3 as a measure of the cost of capital for a new build NPP project, and thus a key determinant of overall project economics; later in this publication — particularly in Section 5.3 — the importance of project financiers' *own* WACCs as their bases for determining the returns they will require to induce them to invest in a new build NPP project will be examined.

Finally, Section 2.4 provides a step-wise description of an (illustrative) investment screening process — from fatal flaw analysis to the final investment decision.

2.1. PROJECT DURATION AND CONSTRUCTION DURATION

From the early days of its development to the start of associated decommissioning works, a new nuclear project spans a 100 year economic cycle horizon, which is a considerably longer timeframe than for, say, a coal-fired thermal power plant with a typical 3–5 year construction phase and a 40 year operating life. Furthermore, as shown in Fig. 2, such a timeframe consists of four discrete phases, namely: a development phase (10 years are typically assumed for that period); a construction phase of between 5 and 7 years (depending on the technology or the size of the reactor, and assuming no delays); a 60–80 year operation period; and finally, a period of transition in order to prepare for the decommissioning and the dismantling of the assets (currently estimated to comprise between 10 and 20 years). Again, the number of discrete phases and their respective duration make a nuclear power project a very specific investment proposal.

A particular challenge is posed by the need to finance the construction phase of the overall project life cycle before the first revenues accrue to the project. Because nuclear projects are highly capital intensive (see Section 2.2), the interest on funds borrowed to finance this construction — interest during construction (IDC) — can compound into very large amounts. The longer the construction period, the higher the IDC, other elements (particularly interest rates) being equal. Unexpected construction delays translate directly into unexpected costs.

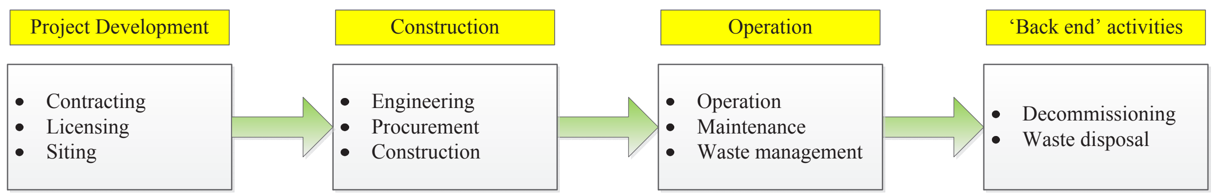

FIG. 2. Typical project cycle for a nuclear new build.

Figure 3 compares the relative amounts of IDC incurred by two hypothetical projects that are of identical value (US $5.75 billion) in terms of overnight costs — costs of materials, equipment, labour, etc. — but that differ in terms of project duration and the rate of interest paid on financing. For simplicity it is assumed that the project is 100% debt financed; in reality, it is more likely that a project might be 70% debt financed — this would not alter the substantive point being illustrated, however.

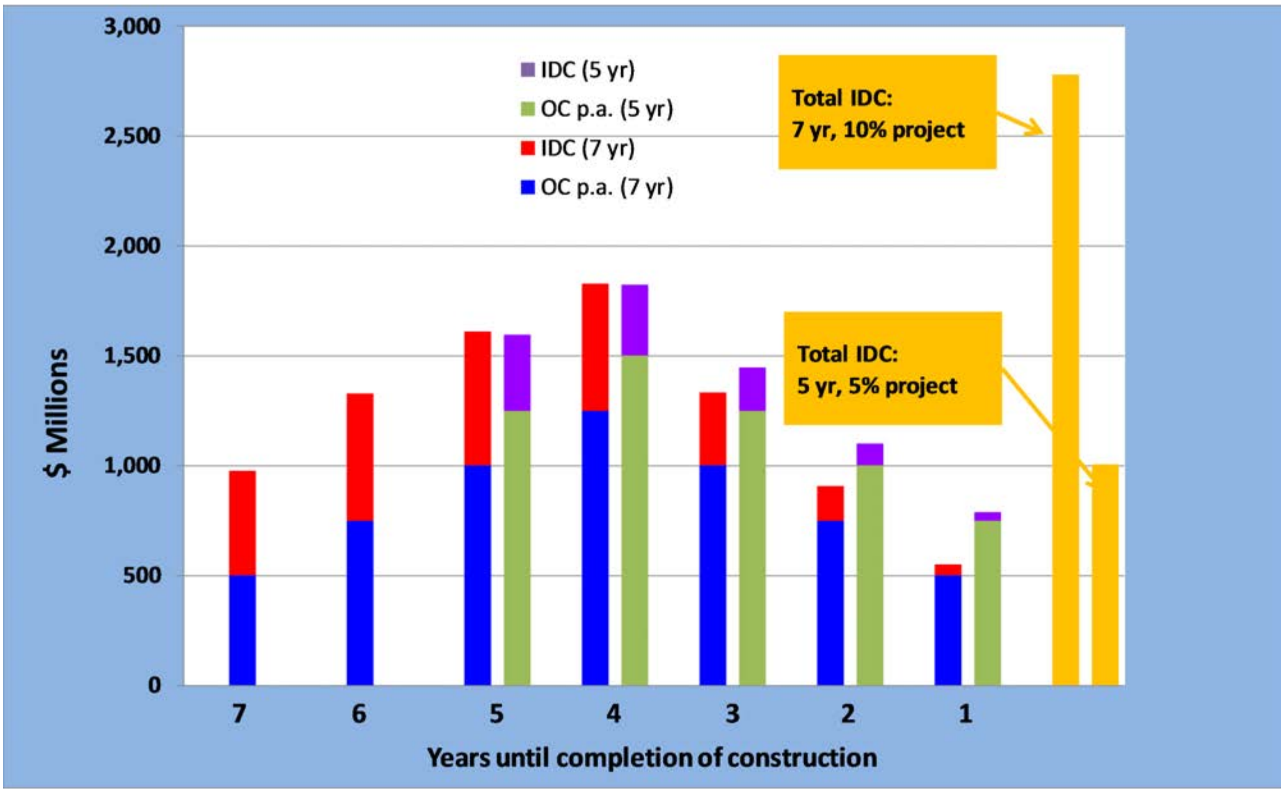

FIG. 3. Sensitivity of IDC to interest rate and construction duration. Each bar is composed of two 'stacked' parts. For the '7 year construction period/10% interest' case, the blue part represents the overnight cost expenditure in a given year and the red part represents the total IDC that will have been incurred on that expenditure by the time the project is complete; for the '5 year construction period/5% interest' case the pale green part represents overnight cost expenditure in a given year and the purple part represents the total IDC that will have been incurred by the time the project is complete. The orange bars on the far right compare the total amounts of IDC incurred by these two projects: US $2.8 billion in the 7 year/10% case, versus US $1 billion in the 5 year/5% case.

2.2. CAPITAL INTENSITY

Although nuclear plants enjoy relatively low and stable operating costs, the upfront capital investment costs can be considerable. It is extremely challenging to obtain reliable figures on nuclear plants' capital costs for various reasons, including:

— Commercial confidentiality;
— Site specific conditions, which can invalidate comparisons even if they are made between the same technologies (e.g. if such site conditions require differing cooling approaches between sites);
— Market conditions;
— Bilateral circumstances (i.e. strength and warmth of relationship between vendor's and host's respective governments);
— Numbers quoted on different (unstated) bases (e.g. with versus without contingency; with versus without owner's costs; quoted on overnight cost basis versus total cost basis).

Notwithstanding the relative paucity of detailed capital cost data, there is no doubt that that the construction of a new NPP is an capital intensive venture: the magnitude of the financing requirements is much greater (on the basis of cost per installed MW) than that of most alternative investment options that are available at present to develop thermal and/or renewable power generation projects.

The life cycle cost profile for a new build NPP project will typically differ from that for, say, a combined cycle gas turbine (CCGT) as a result of the heavily capital intensive and front end loaded nature of NPP cost and on the long construction durations discussed in Section 2.1. Figure 4 compares the cost breakdown for a typical NPP with those for a CCGT plant and a supercritical pulverized coal plant (data are for the United States of America [3]).

In conclusion, the most important points made in Sections 2.1 and 2.2 is that new build NPP projects will be particularly sensitive to the cost of capital, as opposed to, for example (in the case of a CCGT), the cost of fuel. Indeed, the cost of capital available to a project will be a key driver of overall project economics, and may well decide whether a project will proceed.

2.3. EQUITY, DEBT, COST OF CAPITAL AND PROJECT ECONOMICS

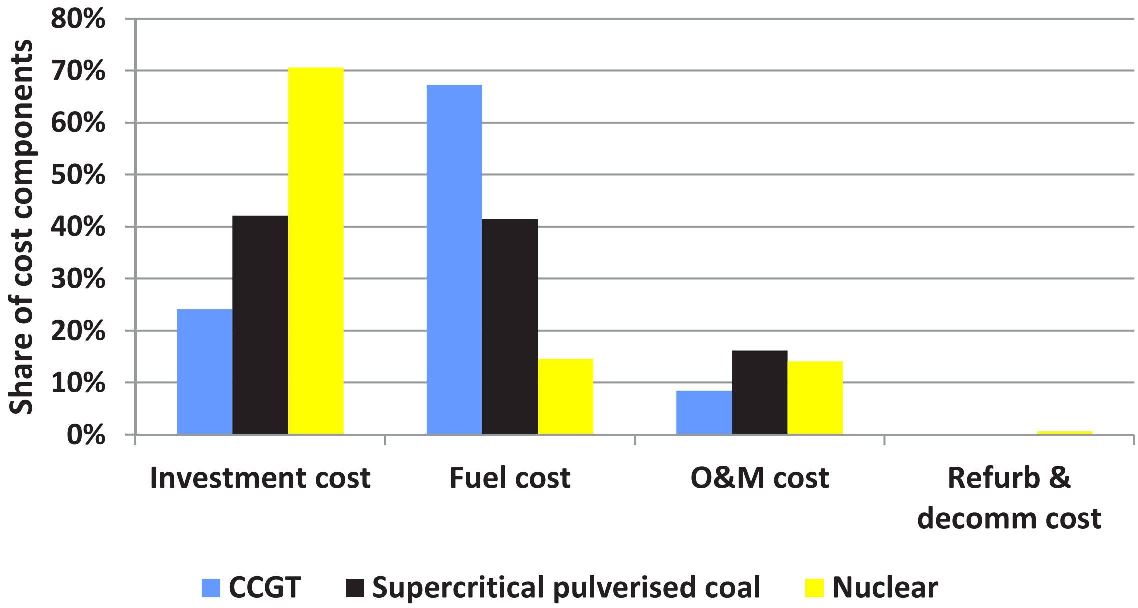

FIG. 4. Relative importance of investment (capital) cost by generating technology [3].

As with any capital intensive investment, a major challenge in the development of a new NPP is the mobilization of the resources to finance it. A key factor that may make the financing process very intensive in terms of time and effort process is the sheer scale of the financing required. An additional factor is that the financing payback periods for a new build NPP project are typically relatively long, creating a requirement for similarly long term financing (which may not be readily available); in this context it is important to note that although refinancing (or even phased financing — see Section 5.9) of the debt incurred to finance a project is a possibility, it results in additional risk, in the form of a lack of clarity as to the terms and availability of replacement financing when any current facility expires.

Notwithstanding the particularities of the new build NPP financing challenge, the ultimate sources of financing for a nuclear new build remain those typically tapped for infrastructure projects in general; they are based on a combination of equity and (long term) debt funding. Depending on the ownership and commercial structure that is chosen to develop a new NPP, the proportion between these two components (i.e. the debt to equity ratio) will vary. However, the availability of both sources is ultimately critical to fund the investment.

Crucially, the cost of equity is typically higher than the cost of debt: this is to reward the higher level of risk associated with equity compared with that usually taken by the debt providers, in particular the senior lenders. The relative riskiness of these two broad types of financing reflects the fact that ‘priority lenders’ (i.e. debt providers) have priority in being repaid over the equity shareholders if the borrower goes into liquidation.

Given that debt is more expensive than equity as a source of funding, it is unsurprising that developers of a new build NPP project will (and should) expend substantial effort in order to finance as much as possible of their project through debt (i.e. to maximize the debt to equity ratio) when preparing a funding plan for their investment proposal (although such attempts may face limits, depending on the ownership structure chosen to develop the investment proposal).

A useful metric for gauging whether such efforts have been successful is the WACC [4], which is often calculated on an after-tax basis. It is based on Eq. (1):

$$\mathrm{WACC} = (k_E \times C_E) + (k_D \times C_D) \times (1 - t) \quad (1)$$

where

C_D is the cost of debt
C_E is the cost of equity
K is equity + debt
k_D debt divided by K
k_E is equity divided by K

and t is the corporate tax rate.

To summarize, given the sensitivity of new build NPP project economics to the cost of capital (as captured, for example, using Eq. (1)) it is crucial that project developers should seek to secure as low a cost of capital as they can. Typically, this will involve maximizing the debt to equity ratio in overall project financing.

2.4. THE INVESTMENT SCREENING PROCESS

The decision to invest will typically be based on a set of key basic principles and steps with regards to the identification, assessment and structuring of the investment opportunity. A phased and rigorous analysis process needs to be undertaken in order to review and assess the merits of an investment opportunity before a final decision can be made by the future owner, its shareholders and various other key stakeholders (including the government of the host country).

This is usually a lengthy process, which is based on a detailed and comprehensive analysis of a broad range of characteristics of the investment proposal. The fact that the asset under consideration is an NPP makes the exercise even more exhaustive and complex owing to the specifics of the nuclear sector; the project development phase for a new NPP typically takes several years once the key principles of a base case have been identified and validated, and the feasibility of the investment proposal established.

This analysis is typically divided into a succession of steps, each punctuated by key milestones, on the occasion of which various series of facts and/or assumptions need to be validated, and thresholds met before moving to the next stage in the development process. The overall objective of this iterative approach is for the owner of the new NPP and its equity shareholders to eventually define and assess in detail the investment proposal through a rigorous process. It is also to have a number of occasions during the year-long review cycle to filter, test and challenge the merits of the investment proposal, before an informed decision is made to carry it out. In particular, there are various stages embedded into that process, during which the owner of the new NPP, and ultimately any equity investors, has the option to go (or not to go) to the next level in the project analysis. Although each investment proposal has its own particularities, Table 1 provides a high level illustration of the path that is traditionally followed by an equity shareholder when screening an investment proposal.

TABLE 1. ILLUSTRATIVE EXAMPLE OF AN INVESTMENT SCREENING PROCESS

Step No.	Stage	Primary objective(s)	Outcome	Move to next step?
1	Project concept review	— Screening of any fatal flaw and identification of the most onerous requirements/features of the potential investment. (Scope of high level review to be relatively narrow and to include: political environment, legal environment, technology options, technically related constraints, reputational issues.)	No go	✗
			Go	✓
2	Preliminary feasibility study	— Analysis of the key features of the investment project under consideration and preparation of a business plan. (Scope of review to be broader and to include: social, legal and regulatory environment; technology, industrially, site and technically related options; identification of corporate and commercial options; assessment of reputational issues, as well as preliminary assessment of project costs, financing options.) — Definition of a framework to assess the investment's profitability and resilience to risk.	No go [1]	✗
			Go [1]	✓
3	Detailed feasibility study	— Detailed analysis of the investment project under consideration and finalization of an investment plan. (Scope of review to be exhaustive and comprehensive, including: detailed analysis of social, legal and regulatory environment, technology, industrially, site and technically related aspects, as well as assessment of project costs; identification of most relevant corporate and commercial structure(s), procurement and contracting strategies; reputational issues.) — Detailed testing of the project's economics and resilience to risk, leading to the finalization of the financing plan and of the investment case.	No go [1]	✗
			Go [1]	✓
4	Investment decision	— Review of the investment case and the underlying business plan (including sensitivity cases).	No go [1, 2]	✗
			Go [1, 2]	✓
5	Project development	— Negotiation and finalization of the project's costs and underlying contractual structure, including the various financial arrangements. — Finalization of the key underlying assumptions (costs, prices, etc.) for the investment case.	No go [1]	✗
			Go [1]	✓
6	Final investment decision[3]	— Review of the final investment proposal.	No go [1, 2]	✗
			Go [1, 2]	✓

[1] A 'go' decision takes the assessment and the analysis of the investment proposal to the next step; a 'no go' decision results in the termination of the analysis process, and ultimately the abandonment of the investment opportunity.

[2] Although it is most likely that the senior management and the board of the owner of the new NPP and its equity shareholders would be consulted and informed regularly owing to the sensitivity attached to a new build project opportunity, formal board approval would be sought for a selected number of milestones only, when the allocation and/or the commitment of important financial resources would be sought.

[3] A positive final investment decision leads to financial close, the trigger point for debt to be available for drawdown and construction of the NPP to start.

3. FRAMING THE FINANCIAL RISK ASSOCIATED WITH NEW NUCLEAR POWER PLANT PROJECTS

3.1. FINANCIAL RISK AND COST OF CAPITAL

The high upfront capital cost of an NPP means that the cost of capital is a fundamental factor in determining whether such an asset will be economically competitive in a country's energy mix (this has been explored in terms of IDC in Fig. 3). All other things remaining equal, the lower the cost of capital, the more competitive a new plant will therefore be. In turn, it may also be noted that the cost of capital of an NPP is a function of the financial dimension of the risk associated with the investment project. This is because said risk will exert a major impact on the availability of capital (e.g. equity and debt) and subsequently on its pricing.

In the rest of this publication, it is proposed that financial risk be defined as the combination of different risks associated with the financing of an asset, the occurrence of which would increase the probability of a financial loss that would subsequently impair the ability of the investment to provide an appropriate return to its key stakeholder(s).

Insofar as financial risk is perceived as being a major threat to profit making for an NPP investment proposal — both during the construction and the operation periods — it will negatively impact project economics. The impact of two key risks on project profitability and the cost of capital are illustrated in Fig. 5.

The financial risks illustrated in Fig. 5, if not managed properly and actively, may result in financial risk having a particularly dramatic impact on a new build's profitability during the construction phase, principally by increasing the upfront cost of the investment and/or impairing its ability to generate sufficient cashflows during its

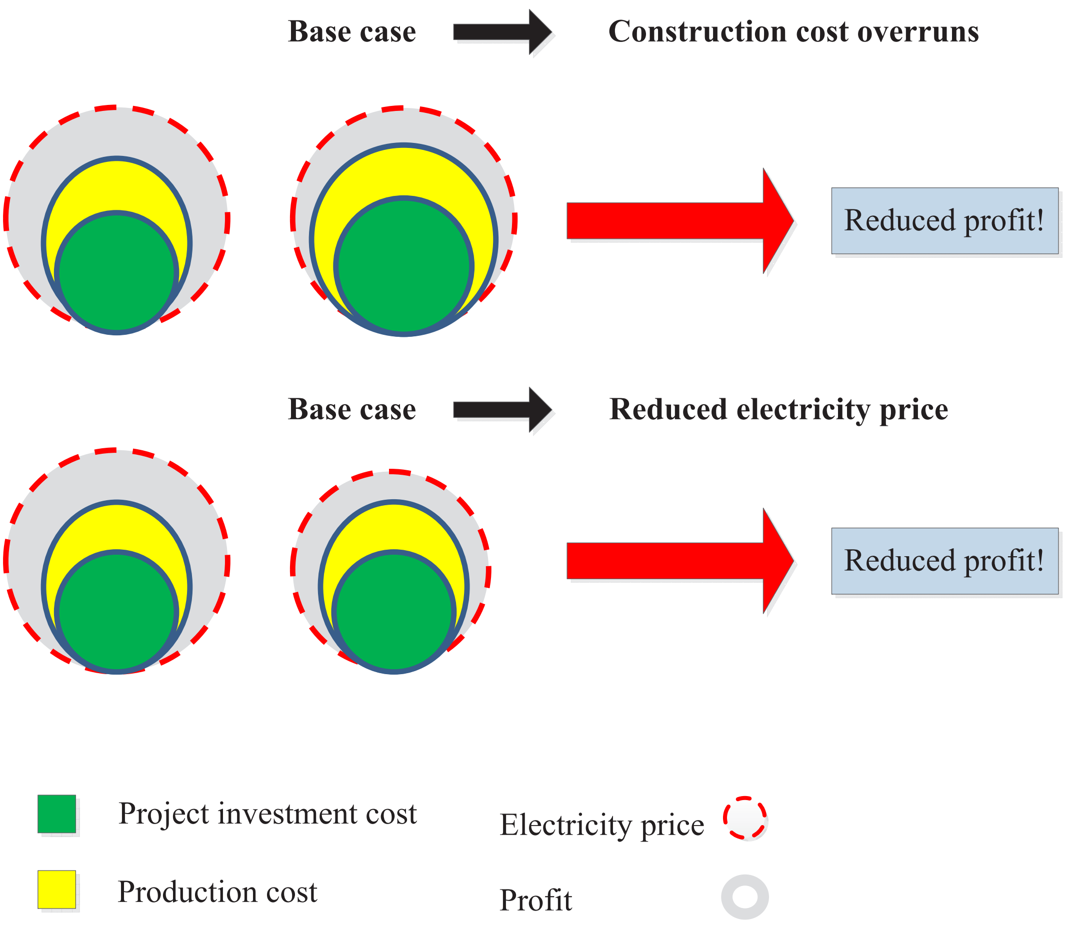

FIG. 5. Illustrative examples of the impact of financial risk on profit.

economic life. In the case of a new NPP, that would typically be the consequence of either an increase in the cost of construction (including increases in prices of supplies of goods and/or services, and additional works), or delays (including delays in supplies, poor management of construction schedule, themselves leading to extra costs). As a result of such additional expenditures (all pointing towards increased funding requirements), it is very likely that the cost of production of the electricity delivered by the NPP from the commercial operation date (COD) onwards would be higher than the price originally envisaged in the investment's business case. Subsequently, it is also to be expected that the price at which electricity would need to be sold in order to recoup the investment while preserving the economics of the investment would eventually need to be increased.

Such pressure points and requirements have to be set in the context of the specificities of the electricity markets. Arguably, such markets do not support an automatic pass-through of such additional costs, for the following reasons in particular:

- Public authorities recognize that electricity sale prices carry a high social impact. As a result, governments have traditionally been cautious with policies supporting or leading to tariff increases, which would affect the public. They have therefore proven to be prompt at exerting some form of control, directly or indirectly, in order to cap electricity price hikes as a way of addressing issues of energy poverty (notwithstanding the fact that the removal of such caps coupled with the targeting of support to vulnerable customers might arguably be a preferable approach). Similarly, governments are also mindful not to excessively burden their industrial actors with high electricity prices, which would penalize them against their international competitors in both their home and export markets.
- During the past 20 years, many countries have experienced some form of liberalization of their electricity markets, with prices being set (or sometimes partially set) by market forces. As a result, there are various instances where full cost recovery is not — or cannot be — considered or cannot be achieved for an investment facing cost overruns. This is primarily because the price at which the electricity would need to be offered would not be cleared on the market.

3.2. A PRELIMINARY VIEW OF THE NATURE OF FINANCIAL RISK

The list of risks typically associated with the development, construction and operation of capital intensive investment projects in the infrastructure sector is a long one; insofar as all risk is financial risk (i.e. all risk will impact the quantity and variability of income streams available to finance providers, as described below), equity and debt providers will be concerned about all the risks on that list. This is one of the reasons why public authorities were originally regularly and actively involved in the development and financing of infrastructure assets.

However, private sector involvement in the development, construction, operation and financing of such projects has also been successfully mobilized in parallel to procure and deliver this kind of large investment. As a consequence, there exists an established track record of complex capital intensive projects successfully delivered, with good understanding and management of their risks — including financial risk — by the various stakeholders from the public and the private sectors involved during their procurement and throughout their economic lives.

In the case of a nuclear new build project, the risks exerting an impact on the feasibility, deliverability, procurement and delivery of an investment proposal are numerous, but they fall into a number of already well identified categories that apply to most projects. These include: the political, legal and regulatory risk; the permitting and licensing risk; the construction risk; the risk relating to electricity sales (e.g. volume and price being less than predicted); and the funding risk. In that context, the following can already be noted at this stage for the financial risk associated with the development and the financing of a new NPP:

- Financial risk is to be found at the level of:
  - The asset itself (e.g. performance of construction works, for example);
  - The corporate and commercial structure carrying the project (the selection of a funding strategy, or of suppliers of equipment or services, for example);
  - The contractual framework supporting it (e.g. choice of construction arrangements or of electricity sale contracts).

— Its occurrence is to be expected throughout the life cycle of the investment, for example, during the three typical phases identified for an NPP (the construction, the operation and the back end periods).[3]
— Its occurrence may have, in the context of the magnitude of the financing requirements of an NPP, a dramatic impact on the financeability and the bankability of the investment.

It is important to recognize that, in essence, all risk is financial risk. This includes risks that might more typically be thought of as being of a purely technical or engineering nature, such as the risk of poor turbine performance. Such poor performance will lead to poor project economics (perhaps an electrical capacity somewhat less than was expected) and result in a poorer financial risk profile (viewed from the perspective of potential financial stakeholders); Fig. 6 should be viewed in this context.

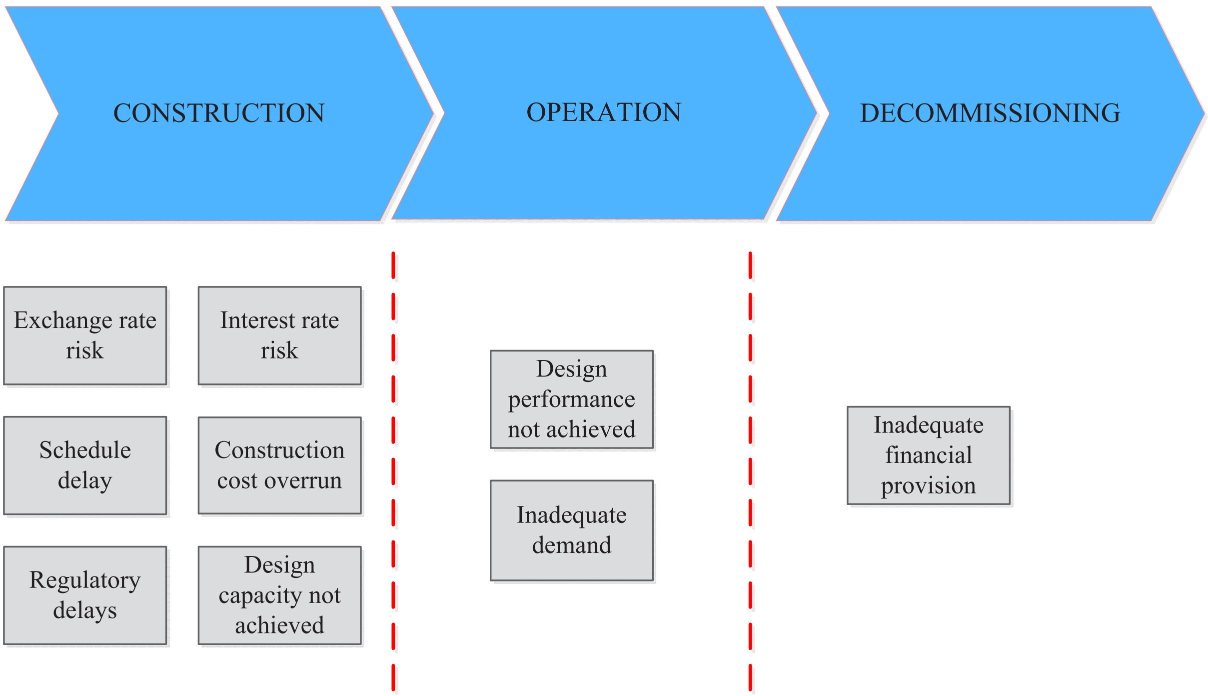

FIG. 6. Extent and reach of financial risk over the project life cycle.

3.3. CONTROLLABLE VERSUS UNCONTROLLABLE RISK

In considering risk allocation between a new build NPP's stakeholders (as will be done in Section 4.2) and in discussing the general principle underlying such allocation — that risk should be borne by the stakeholder best able to manage it — it is important to recognize that some risks are inherently outside the control of any of the stakeholders typically found in such a project. Such uncontrollable risks include those due to natural phenomena (such as flooding or earthquakes), civil societal phenomena (such as general strikes or revolutions) and, perhaps most interestingly, those that involve exposure to volatile prices set in global markets.

Figure 7 illustrates the placement of a range of potential risks along a notional continuum of controllability. In principle, the risk of, for example, schedule delay is controllable (by careful planning and management by the EPC contractor); in contrast, it is unlikely that any of the stakeholders in a new build NPP project will be able to influence the volatility of global interest rates in any way (though stakeholders may be able to reduce the impact of such volatility using the instruments outlined in Section 4.2.5).

[3] Indeed, a number of risks are present during a phase which may be thought of as preceding the construction phase, namely the (project) development phase.

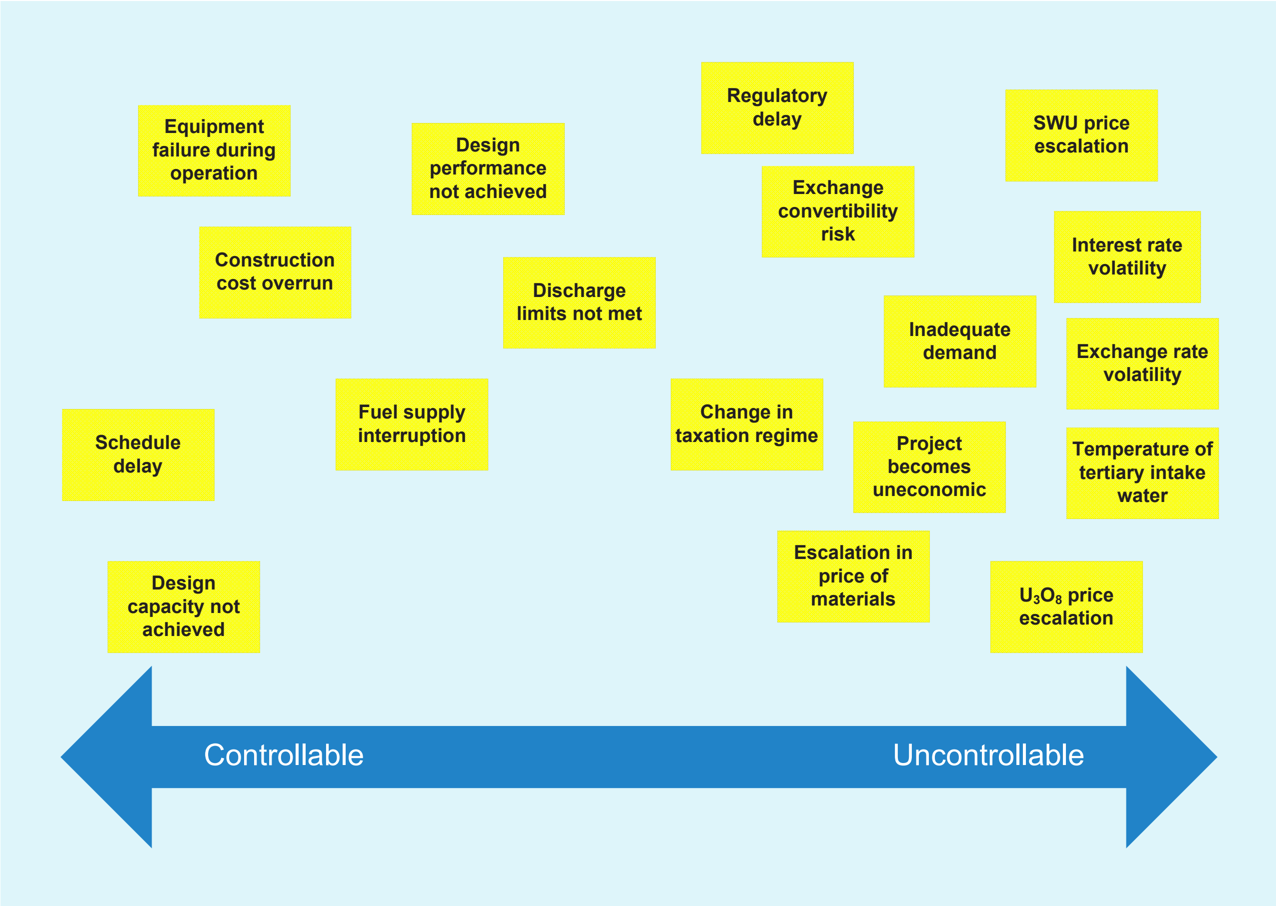

FIG. 7. Controllable and uncontrollable risks.

An important takeaway from any consideration of the relative controllability of any particular risk associated with a nuclear project is that it may only be the very largest stakeholders (in terms of financial capacity) who are willing and able to bear such risks. In the case, for example, of exchange rate volatility, if a project developer succeeds in inducing a counterparty to a contract to bear the exchange rate risk associated with that contract (in the first instance), it is likely that the counterparty will then seek to shift that risk (via hedging, etc.) on to participants in global foreign exchange markets.

In general, the larger and more uncontrollable the risk (e.g. prices set in global markets) the more likely that only parties with very high financial capacity will be willing to bear it at a price that allows the project to remain economic (see the discussion of risk premiums in Section 4.2.2. for more on this point). Such parties will likely include:

— Host governments (with recourse to their domestic tax base);
— Off-takers (with recourse to their customer base via an electricity off-take agreement or contract for difference type of arrangement);
— Multilateral agencies;
— Vendors with strong national support;
— Financial markets such as exchange rate markets (via hedging instruments).

3.4. IMPORTANCE OF RISK ASSESSMENT

Financial risk is a function of the other risks related to an investment, irrespective of their nature and magnitude. It affects the availability on the market of competitively priced long term capital (measured, among other methods, via the WACC) enabling an NPP project to compete with other sources of long term electricity supply for access to funding.

Whatever the ownership and commercial structure chosen to deliver the investment, financiers of a nuclear new build will, as a matter of principle, rely upon the NPP's ability to generate a stable and predictable cashflow over its lifetime, in order, inter alia, to pay interest and repay the principal of any debt element within the capital structure, and to provide an adequate rate of return or yield on the equity or equity-like element of the capital structure. Analysis of the risks in their broadest form is, therefore, fundamental for all finance providers, who will rely extensively on various risk analysis tools, such as the risk register and the findings of their due diligence. Their line of enquiry typically focuses on understanding — and arguably, challenging — the financial metrics of the project that have been prepared for the investment case, based on a full understanding of the assumptions supporting those metrics. Financial analysis aims to identify and examine the project related risks or events that could impact the base case forecast and cashflow profile of the NPP. Financiers will therefore rigorously scrutinize the risk profile of a project investment proposal before they are in a position to provide a meaningful view on the terms, conditions and pricing of their capital, let alone make a commitment to invest in or lend to the project.

For any external investor or lender, the risk assessment will, by nature, be comprehensive, thorough and potentially intrusive. It will most likely involve obtaining independent advice and due diligence reports from a combination of expert technical, legal, market and industry, and financial consultants. Armed with a risk register and quantification of key project risks, investors and financiers will be keen to know what strategies can be implemented by the owner of the NPP and its shareholders in order to mitigate and manage those risks. Given this information, they will be in a position to assess the degree of residual risk exposure, undertake scenario analysis in relation to those risk events and consider the implications for the project's financial structure and hence its cost of capital. As noted, all risks are financial risks, which means ultimately that the risks involved in the development, construction and operation of an NPP will manifest themselves in the project's capital structure and associated pricing if they are not fully mitigated or transferred to competent third parties. As such, the economic competitiveness of an NPP is arguably a direct function (via its WACC) of the final level of risk it retains.

4. MANAGING AND ALLOCATING FINANCIAL RISK

The primary focus of Section 4.1 will be on the set of tools that can be used to carry out one of the key risk management functions, that of risk mitigation. Risk mitigation can be defined as the introduction by a risk 'owner' (i.e. an NPP project stakeholder who is exposed to the risk in question) of specific measures aimed at minimizing or even — to the extent possible — eliminating it. In general, these measures may be aimed at the reduction of: the impact of risk materializing, the probability of the risk occurring, or the owner's own exposure to risk.

It should be borne in mind that at the outset of the NPP project, all risks will by default be owned by the project developer. Over the course of the project development process, the project developer will seek to induce other project stakeholders to take ownership of the risks for which they might appear to be the natural owners — those that they are well placed to manage and control. The type of tools outlined in Section 4.1 can be employed by the project developer as it inventories risks prior to their allocation, by project stakeholders as they manage the risks they come to own and by the project developer (again) in managing the risks that it retains.

It should be noted that risk mitigation does not only rely on the 'one off' identification of risk and the introduction of control measures to mitigate it. Rather it is a dynamic process, which also implies a constant and consistent monitoring of risk in general, including: the tracking of risks already identified; the identification of new risks, if any; and the evaluation of the effectiveness of the risk process throughout the economic life of an asset.

In Section 4.2 the focus shifts to risk allocation. The way in which particular risks are allocated to different project stakeholders (who then become the ‘owners’ of those risks) and the nature of the inducement that must be given to those stakeholders in order to persuade them to accept responsibility for those risks (and the financial exposure that comes with such responsibilities) are discussed in Sections 4.2.1 and 4.2.2, respectively. The notions of efficient risk allocation, and the (closely related) topic of project stakeholders’ differing objectives — and how these shape their risk ‘appetites’ are the subject of Sections 4.2.3 and 4.2.4, before attention switches in Sections 4.2.5–4.2.8 to different approaches to allocating particular risks. Finally, Section 4.3 provides examples of risk allocation possibilities within a number of different project structures.

4.1. IDENTIFYING, ASSESSING AND MONITORING FINANCIAL RISK

As noted, a nuclear new build project offers a range of risks (e.g. technical, political, reputational, contractual, construction related, operational), the crystallization of some or all of which will ultimately have financial consequences for the economics of the investment under consideration.

It is therefore very important at the outset of an NPP new build project for the developer of the new NPP to identify and define the various risks associated with the project (each of which is a ‘project risk’), which will need to be analysed and dealt with. An exhaustive list of the project risks will typically be drawn up, and will constitute the basis for performing a comprehensive analysis of the project in order to develop a business case in support of the investment proposal for the new NPP.

At a later stage, a more detailed review of each project risk is typically undertaken by the new NPP developer with a view to: assessing the probability of its occurrence and identifying and assessing the financial consequences associated with it. The outcome of such analysis is incorporated into a document (the project risk register (PRR)) where each and every risk related to a new build project is consigned, analysed, and rated (typically for likelihood of occurrence and/or likely impact in the event of occurrence). The PRR constitutes a very valuable tool to assist the owner of the new NPP in the planning of the discussions and the negotiations with the various additional stakeholders involved in the development and the management of the project (e.g. equity shareholders, suppliers, contractors, finance providers, government of the host country).

Later still, the owner of the new NPP often uses the input of the PRR in order to: identify and define the party (or the parties) best able to competitively manage any given project risk at each stage in the life of the investment; identify the tools and/or outline any contractual option that may be considered in order to deal with or mitigate a project risk; subsequently plan for the efficient and economic allocation of the project risks between the various stakeholders throughout the economic life of the NPP; and monitor said allocation throughout the life of the project. This results in the preparation and regular updating of a risk allocation matrix — effectively an augmented PRR — that is tailor-made for the investment. This will remain a key document after the decision to invest has been made by the equity shareholders with its regular update to assist the owner of the new NPP to monitor the procurement and the delivery of the NPP. This is particularly the case throughout the period leading to financial close. This is because the relevant stakeholders will negotiate the various contractual arrangements in connection with the construction of the NPP and the supplies of equipment and services etc. during that period. The risk allocation matrix will also be a powerful tool providing critical assistance to the owner of the NPP in its discussion and negotiations of the finance documents with the finance providers (e.g. equity and debt sources). The preparation of that critical document requires, therefore, the greatest attention from the various stakeholders involved in the planning and development of an investment case in a new NPP. The party or parties originating such investment proposals typically start this process at an early stage.

4.1.1. Identifying project risk

As a matter of principle, the process for identifying risk is the same for a new NPP as it is for the financing of any large (greenfield) infrastructure project. While certain broad risk categories are common for every project (e.g. cost overrun, delay, operational performance, revenue), the individual risk components for each sector (e.g. rail, road, power generation) and indeed for each project can be very different.

From an investor's or lender's perspective, a typical list of generic key risks for a new build NPP will most likely include those listed in Sections 4.1.1.1–4.1.1.4.

4.1.1.1. Development and construction related project risks

Design and technology selection: For a new NPP, the owner can choose an established design and a technology that has an operational track record at at least one reference plant domestically or internationally, and is proven to be fit for purpose. Alternatively, it may strive for improved operational performance and/or safety by selecting a new type of reactor, which incorporates technological enhancements or design adjustments based on the experience of existing plants, but is not broadly commercialized, licensed or implemented in the relevant market. The risks associated with first-of-a-kind (FOAK) units can be significantly greater than for follow-on units.

Permits and licences: A delay to the start of operations related to permits and licence issues may, in principle, have a significant impact on the economics of an NPP. This is principally because capital costs (and associated financing charges) are a large part of the overall investment budget. The risk events of an NPP project suffering from delays in the issuing of permits and licences (for construction and/or for operation) are multiple, including situations where the legal and regulatory framework in the host country are not sufficiently developed and clear; the level of unpredictability of the regulatory process makes external challenge and the over-turning of decisions possible (likely); and the approval process remains untested or has not been used for a number of years.

Site characterization: Site selection poses technical, environmental and planning risks. Features such as seismicity, availability of cooling water, proximity to population centres and environmentally sensitive issues, inter alia, will impact on the detailed design, licensing and safety requirements, as well as on the level of public acceptance. Furthermore, construction related considerations (e.g. availability of access roads and local infrastructure) will also have important effects on the risk profile of a new investment.

Cost overruns: The length, complexity and magnitude of the construction works to be performed, and the nature and volume of the equipment to be supplied for a new NPP make its procurement a major industrial challenge, the costing of which remains a very difficult exercise. Furthermore, it is not only important to ensure that the capital expenditure (CAPEX) budget is adequately detailed and sized, but also to define an appropriate level of contingency in order to deal with the type of variations that typically tend to happen during the construction period of any large infrastructure project. The fact that the economics of a new NPP are particularly sensitive to the quantum of upfront CAPEXs and associated financing costs puts, therefore, a fresh focus on the potential for cost overruns and their dramatic impact on the investment proposal.

Delays in construction: In addition to the series of construction and supply chain challenges to be typically expected in the context of a large, capital intensive investment project, additional causes for delays can be encountered, which are more specific to a nuclear new build. These include legal challenges, delays in the issuance of permits or licences, and political events. As for cost overruns, the impact of a delay in construction is particularly significant for an NPP. This is because additional costs, including capitalized IDC or financing costs, are likely to be incurred for the period of the delay on the total amount of CAPEXs already incurred.

Plant completion: The completion of the commissioning, startup and testing of an NPP is a critical milestone, during which the plant's technical and operational performances are thoroughly tested. When such a completion test has been passed, a formal handover of responsibilities can take place on the COD, which transitions the asset from construction to the start of the commercial operation phase. Any failure to reach that milestone as originally planned will have adverse effects on the investment's profitability; such failures include delays or re-rating of available capacity (e.g. reduced), which in turn are likely to lead to losses of revenues for the owner of the NPP.

Availability of associated infrastructure: The availability and reliability of the necessary infrastructure required to support a new NPP — notably adequate grid capacity (through the rehabilitation of the existing grid system, or the construction of new high voltage transmission lines) to dispatch the plant's electrical output — are critical components of plans to develop and finance a new NPP; any delay in dispatching a new NPP would lead directly to a loss in sale revenues.

Project procurement and project delivery: The nature, complexity, length and magnitude of the development and construction programme for a new NPP makes its procurement and the underlying contracting framework to be developed a very challenging and critical matter. A different contracting approach to conventional power projects is subsequently required, in particular with the signing of a 'fixed price, fixed term' EPC contract being a relatively remote prospect. Ultimately, a comprehensive and cohesive contracting strategy needs to be developed and implemented in order to, inter alia, establish prices and price escalation mechanisms; avoid any disruption in construction activities (e.g. performance of works, deliveries of equipment and services), which could create delays and/or cost overruns; and allocate the rights and obligations of the various relevant parties involved during the period in question.

4.1.1.2. Operation related project risks

Plant performance: Although various completion tests need to be passed for an NPP to be completed and to formally start its commercial operations, poor plant performance or management may subsequently occur during operations, which may lead to loss of revenues. The risk of such underperformance can be increased if new (modified) technology is employed, or if operating personnel are insufficiently experienced, for example.

Sales of electricity (volumes and prices): The (long term) contracting of electricity off-take is a key factor supporting an investment proposal in a nuclear new build. Long term electricity off-take agreements have traditionally offered a route to market, with a relative certainty as to the quantities of electricity to be sold and predictability as to the price at which they will be sold. These contractual arrangements largely depend, however, on the structure and regulation of the energy market in which an NPP operates. Any regulation or de-regulation that would, in effect, increase merit order competition and priority dispatch for other technologies could, therefore, shift an NPP into an increasingly load-following mode, which is characterized by lower dispatch levels and weaker plant efficiency. As a consequence, its income would be put under pressure and the underlying profitability of the investment proposal would be challenged.

Fuel supplies: The availability and stability of fuel supplies on a long term basis is critical for an NPP, particularly in the context of the duration of the economic lives envisaged for the most recent reactor types (e.g. Generation III). As with long term electricity off-take agreements, fixed term fuel supply agreements have traditionally been used to ensure a relative certainty as to the quantities of fuel to be supplied and a predictability, in this case as to the price at which these quantities will be purchased. However, these contractual arrangements also usually incorporate certain particulars of the nuclear fuel market, which may have an impact on the economics of the NPP and subsequently challenge the underlying profitability of the investment proposal.

4.1.1.3. Commissioning and operating related project risks

Insurance and insurability: As for any large scale investment in the infrastructure sector, a series of events can occur during the construction or operation of an NPP, for which insurance coverage is available and, in certain instances, even required. During the development, construction and operation phases, the insurance market will typically provide similar types and levels of coverage as it would for insuring 'conventional' risk during the same periods. However, certain risks to be covered by insurance arrangements change dramatically in nature, extent and quantum as soon as nuclear fuel arrives on-site and is loaded. Nuclear risk exclusion clauses then apply for the conventional market, and the national or international (re-)insurance pool takes over all nuclear and fire perils. Such handover risk provides a potential exposure to coverage gaps, which may adversely impact on the appeal of an investment proposal for a new NPP. Similarly, a nuclear new build project developed in a country where the depth of insurance (and re-insurance) capacity available from the pool of insurers on the market (nationally or internationally) would become insufficient could face large additional insurance related costs for its operations, which would eventually put its margin from operations under stress, limiting its profitability.

Nuclear liabilities: Nuclear liability legal frameworks channel the responsibilities and liabilities for a nuclear accident solely to the operator (e.g. the holder of the operating licence), exonerating other stakeholders, such as vendors and contractors, from financially punishing nuclear liabilities in case of a nuclear accident. However, national frameworks tend to differ with respect to liability thresholds and claims practices, which contribute to developing the risk of insufficient or uncompetitively priced insurance capacity available worldwide. Under such circumstances, the operator of an NPP could find it difficult to secure adequate insurance coverage for its operations, and any such limitation would be likely to have a negative influence on the assessment of the investment proposal by potential finance providers.

Commercial counterparties: In common with most investment projects, an important element of risk management is, in principle, the sharing of risks, or the allocation of certain risks to third parties (e.g. contractors, insurers or even financial markets) via contractual arrangements, depending on the nature of the risks and which party is best able to manage them. However, such an approach is only effective if the party to which a particular risk is transferred has not only the necessary technical capability and the relevant experience to fulfil the transferred obligations (the nature, complexity and specificities of a nuclear project mean it would be challenging in most cases to replace key contractors or suppliers easily, in particular during the construction phase), but also the financial capacity to fulfil the financial commitments attached to these obligations (in particular, a key difference betwen an NPP project and other projects relates to the quantum of risk transferred and the length of the obligations undertaken).

Political risk: The specific exposure of an NPP to a broad range of events associated with, inter alia, discriminatory changes in laws, regulations, policies and taxes means that, in addition to any readily available political risk cover that may exist on the market, there is often a requirement for greater 'tailor-made' involvement of the government (including quasi-governmental agencies and regulatory bodies) of the host country in the context of a nuclear new build project, in particular in countries starting a nuclear programme. As a consequence, the potential level of disruption to the development and the operations of an NPP — and thereby to the economics of the underlying business case — that may result from the crystallization of any risk of a political nature can, therefore, be dramatic.

Reputation: Public debate about nuclear energy remains polarized in many countries. It is also still considered insufficiently mature (or developed in certain instances) by various stakeholders that are involved, directly or indirectly, in the life of a nuclear project, in particular representatives of civil society and non-governmental organizations. As a result, developing a new NPP usually triggers a broad range of discussions and debates in connection with the reputational aspects of the project, both during its construction and its operation phases, including the compliance with and the monitoring of strict health, social and environmental requirements. Ultimately, a change in public attitudes can drive a change in a country's (long term) energy policy, which can have a severe impact on the long term economics of an NPP, or even on the whole industry itself, as illustrated recently after the accident at the Fukushima Daiichi nuclear power plant in March 2011.

Force majeure: Force majeure events include in particular: war, acts of terrorism, civil unrest, general strikes, earthquakes, flooding, etc. These events usually have heavy consequences for an investment, which could not be foreseen in advance, and no particular stakeholder can be held directly responsible for their occurence.

4.1.1.4. Financing and funding related project risks

Capital structure: Whatever the model of funding structure pursued by the entity developing a new build project, meeting the funding requirements of a new NPP is typically achieved through a combination of equity and (long term) debt financing. The choice of an appropriate debt to equity ratio is, therefore, a critical structural decision, which will not only exert an influence on the level of approach to the debt market needed, but will also have an impact on a variety of key project indicators, including the WACC of the investment and its long term profitability. Conversely, a misreading of the status of the markets (e.g. debt capital and banking markets) may lead to a miscalculation of this ratio, which could leave a project exposed to a misallocation of the resources available on the market and hence subject to funding stress, higher than expected profitability requirements, etc.

Availability of funds: Without fully committed funding in place at the outset and an adequate source of contingent funding available, a new investment project can suffer from funding shortfalls during construction, leading to programme delays and a deterioration in the economics of the project, or, at worst, an inability to complete the plant. As noted, this risk is accentuated in the case of a nuclear new build project because of the long construction periods involved and the magnitude of the overall funding requirements, the subsequent risk of delays or cost overruns, and multiple extraneous factors, which can impact on the original commitments of the project's funders (both equity and debt).

Equity availability: Equity infusion by equity investors (e.g. shareholders) depends on their own ability to pay their equity commitment in a timely manner and hence to access the necessary funds through corporate banking or the capital markets, as and when needed and on acceptable (e.g. competitive) terms. Therefore, a credit and market risk exists, which may have an impact on the economics of an NPP and subsequently on the attractiveness of the underlying investment proposal.

(Long term) debt provision: Similarly, the commitment from debt providers is only as good as their ability to lend to a project and the terms of the loan agreement(s). Even a fully committed debt plan from a group of strong relationship banks remains subject to an element of financial risk until financial close. For example, a change in the social and environmental policy or in the financial standing of a bank could see it take a very different view on a nuclear project, including a revision of the level of its commitment, the financial terms and conditions it requires to meet its internal profitability objectives, and the terms of its in-house approvals.

Foreign exchange and interest rates: The typical features of a large, capital intensive investment project in infrastructure naturally point towards the need to assess the risk generated by (sudden) variations in currency foreign exchange (FX) and interest rates, and their impact on the overall quantum of investment. For a nuclear new build project, such risk arguably carries a bigger importance, in particular because in most cases the host country will rely on imports of foreign technologies and services, as well as on foreign debt financing, to develop a new NPP. As a result, it is likely that a substantial proportion of the total capital cost of the new NPP will be denominated in a different currency from that of the host country; this may have a critical impact on a project's long term economics and hence on the underlying project investment proposal.

4.1.2. Developing a risk matrix

Risk may usefully be viewed as the combination of the probability of an event and its consequences, and in particular, its financial impact. This combination can form the basis for the development of a risk matrix such as that shown in Fig. 8. This shows a very common graphical approach to identifying the risks that are of particular concern in the project. Clearly there is a sense in which the most critical risks to a project (those that should be the focus of the most monitoring and mitigation efforts) are those that are both likely and damaging — i.e. those found towards the top and right of the risk matrix. This is reflected via the coloration of the risk heat map, which depicts the upper right hand of the matrix in red.

Those risks that, after consideration, are categorized as falling in the red area of the risk matrix would be the primary focus of a prudent project risk management team. In the example in Fig. 8, Risk No. 12 is shown to be judged such a risk. A typical risk matrix associated with a project would have a large number of risks (represented by their numbers) scattered across the matrix shown, rather than just a single number.

4.1.3. Risk register I

Although the risk matrix shown in Fig. 8 is a simple intuitive tool for focusing attention on key project risks, more information can be presented and acted upon in the form of risk register(s). The PRR, as shown in Table 2, draws on the information in the risk matrix but provides more detail on the nature of the risk.

4.1.4. Risk register II

Based on, inter alia, the commercial and contractual environment envisaged for building and financing a new NPP, the PRR shown in Table 2, the results of the financial projections and the various sensitivity tests derived from the financial model, an allocation of the project risk needs to be developed between the various stakeholders in order to define a base case for the investment proposal.

The development of an augmented PRR such as that shown in Table 3 — quantifying an economic allocation of the various project risks between the stakeholders — is therefore a critical milestone in the path towards structuring an investment in order to be in a position to raise long term financing in due course. It might also include initial guidance for mitigating each high level risk, and the costs and responsibilities of the prescribed mitigation strategies. As a consequence, the augmented PRR will evolve and be amended throughout the development and preparation phase, with changes and modifications being incorporated as and when required (for example,

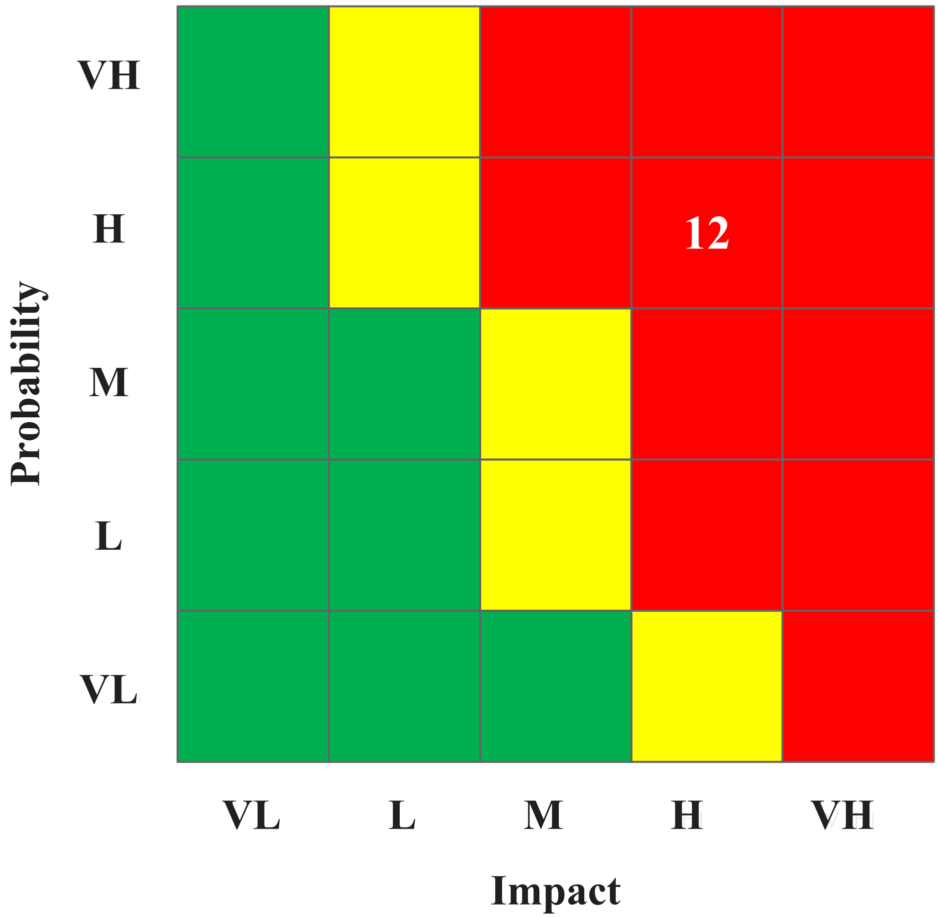

FIG. 8. Example of a risk matrix; in this example, Risk No. 12 is being evaluated. (Key: VH — very high; H — high; M — medium; L — low; Vl — very low.)

depending on the progress made during negotiation with suppliers, contractors, etc.). Ultimately, the augmented PRR would usually include:

— An outline description of each project risk, and how it will affect the investment proposal;
— An identification of the parties that should be responsible for managing each project risk and of the party or parties best able to absorb the residual risk attached to such project risk (where the residual risk is any risk left after allocation and mitigation of a project risk through contractual arrangements and/or the use of risk management instruments; an example of such an arrangement is an ECA, which typically provides up to 95% insurance cover for commercial and political risk, leaving 5% residual risk);
— The strategy and/or the various tools available in principle to mitigate each project risk.

Table 3 illustrates how an augmented PRR might be used to capture some of the high level risks of a new NPP project.

Text cont. on p. 32

TABLE 2. EXAMPLE OF A PRR

Category	Risk	Probability rating	Impact on project costs
DEVELOPMENT PHASE			
Licensing, permitting	Substantive issues with generic design leading to licensing and/or permitting related issues (including delays, extra costs, etc.)	Medium to high	Medium to high
Site characterization	Substantive issues with selection of site	Medium	Medium
Social and environmental	Substantive issues (including process related) with social and environmental aspects of the project	Medium to high (depending on political environment and attitudes of general public)	Medium
Reputational	Substantive issues with reputational aspects of the project (including nuclear proliferation, underperforming technology)	Medium to high (depending on political environment and attitudes of general public)	High
Reservation of long lead materials, production slots	Delayed availability of long lead materials (including extra costs) Delayed availability of production slots	Low	Low (but could have cost impact, if decision is made to purchase critical components early, as expenditures will be moved forward in the project schedule)
Political	List of events to be agreed by the parties, but to include discrimination against supplier of foreign technology, foreign investments	Medium to high (depending on political environment, attitudes of general public and of surrounding countries)	Medium
Commercial and contractual structure	Substantive issues with regard to the integration and management of various contracts for the construction phase (and also of contractors), leading to onerous project procurement and challenging project management	Low to medium	Medium (but very adviser intensive and a critical area for project success, in order to create proper management and commercial structure to attract foreign investors)
CONSTRUCTION PHASE			
Design	Substantive issues with detailed design choices leading to construction or operation related issues (including extra costs, lower performance, etc.)	Low (if reference plant) to medium	Low (if reference plant) to medium

TABLE 2. EXAMPLE OF A PRR (cont.)

Category	Risk	Probability rating	Impact on project costs
Technology	Substantive issues with choice and/or combination of technologies selected	Low (if reference plant) to high	Low (if reference plant) to high
Technical	Higher than expected costs and/or longer time to completion, leading to higher borrowing requirements, lower returns, etc.	Low (if reference plant) to high	Low
Cost overruns	Higher than expected costs leading to higher funding requirements, lower returns, tighter debt service cover ratios, greater exposure for the government of the host country, etc.	Medium (subject to reference plant experience and execution model, if it can be replicated) to high (given nuclear power's overall history)	High
Delays	Longer than expected time to completion, leading to higher costs, higher funding requirements, lower returns, greater exposure for the government of the host country, etc.	Medium (subject to reference plant experience and execution model, if it can be replicated) to high (given nuclear power's overall history)	High
(Equity) funding	Lack of sufficient funds for reaching completion	Medium to high (if seeking foreign equity — project structuring will be critical in attracting 'outside' equity)	High Lower (if looking to refinance after COD)
FX	Adverse movements in local currency and/or other currencies	Low to medium	Low to medium (appropriate hedging strategies to be implemented)
Interest rates	Higher than expected all-in interest rate leading to larger investment costs (e.g. IDC), higher than expected borrowing requirements and thinner cover ratios	Low to medium	Low to medium (appropriate hedging strategies to be implemented)
Insurance (business and property)	Higher than expected insurance costs and/or non-availability of proper insurance cover (excluding acts of terrorism) Higher than expected insurance costs and/or non-availability of proper insurance cover (acts of terrorism)	Low	Low

TABLE 2. EXAMPLE OF A PRR (cont.)

Category	Risk	Probability rating	Impact on project costs
Political	List of events to be agreed by the parties, but to include in particular discriminatory changes in law, including changes in taxes or project abandonment	Medium to high (depending on political environment, attitudes of general public and of surrounding countries)	Medium
Force majeure	List of events to be agreed by the parties, but typically including events outside the control of either party such as catastrophic weather related events such as flooding and earthquakes	Low (common risk for all major infrastructure projects)	Low to medium
Social and environmental	(Non-nuclear) incident (during construction or testing phase)	Medium to high (depending on political environment and attitudes of general public)	Medium
Reputational	Substantive issues with reputational aspects of the project in connection with construction (including poor monitoring of health, social, environmental requirements)	Medium to high	Medium to high
Nuclear incident	Major pollution and/or hazard to population	Low (very unlikely at this stage)	Low (very unlikely at this stage)
Construction completion	Reduced performance (capacity available, plant efficiency) of the newly built units, leading to lower than expected cashflows stretching the overall profitability of the completion project	Low to medium	Medium
Commissioning (e.g. period between plant completion and start of commercial operations)	Authorizations not all being granted on time by the relevant control/safety authorities etc.	Low to medium (given proven technology, but depending on prior experience of nuclear regulatory authority)	Medium

TABLE 2. EXAMPLE OF A PRR (cont.)

Category	Risk	Probability rating	Impact on project costs
OPERATION PHASE			
Operation (reduced availability and/or reduced dispatch)	Reduced performance, leading to lower than expected level of electricity generated and/or increased operation and maintenance (O&M) expenses stretching the overall profitability of the completion project	Low	Low
Fuel supply (quantities and prices)	Increased fuel related expenses stretching the overall profitability of the completion project	Low	Low
Electricity sales (quantities and prices)	Lower than expected cashflows stretching the overall profitability of the completion project	Medium to high	Medium to high
FX	Adverse movements in local currency and/or other currencies	Low to medium	Low (appropriate hedging strategies to be implemented)
Interest rates	Higher than expected all-in interest rate leading to more important debt service obligations and thinner cover ratios	Low (appropriate hedging strategies to be implemented)	Low (appropriate hedging strategies to be implemented)
Insurance (business and property)	Higher than expected insurance costs and/or non-availability of proper insurance cover (excluding acts of terrorism) Higher than expected insurance costs and/or non-availability of proper insurance cover (acts of terrorism)	Low	Low
Insurance (civil liability for nuclear damage)	Higher than expected insurance costs and/or non-availability of proper insurance cover	Medium	Medium
Political	List of events to be agreed by the parties, but to include in particular discriminatory changes in law, including changes in taxes or project abandonment	Medium to high (depending on political environment, attitudes of general public and of surrounding countries)	Medium to high

TABLE 2. EXAMPLE OF A PRR (cont.)

Category	Risk	Probability rating	Impact on project costs
Force majeure	List of events to be agreed by the parties	Low	Low
Social and environmental	(Non-nuclear) incident (during operation phase)	Medium	Medium
Reputational	Substantive issues with reputational aspects of the project in connection with operations (including poor monitoring of health, social, environmental requirements)	Medium to high	Medium
Nuclear incident	Major pollution and/or hazard to population	Low (proven Gen. III technology, with experienced operator (assumed))	High
Spent fuel / waste management	Ultimately, higher than expected financial obligations	Low (as long as being performed in accordance with international best practices)	Low to high
Decommissioning	Ultimately, higher than expected financial obligations	Low (as long as a plan is developed in accordance with international best practices)	Low to high
International professional externalities	Changes in (international) standards	Medium	Medium (as it is an unknown and could result in additional project costs)

TABLE 3. EXAMPLE OF (AUGMENTED) PRR

Category	Risk	Parties likely to be best positioned to manage and mitigate risk	Risk mitigation tools available
DEVELOPMENT PHASE			
Licensing, permitting	Substantive issues with generic design leading to licensing and/or permitting related issues (including delays, extra costs, etc.)	— Vendor (e.g. supplier of nuclear steam supply system (NSSS)) — Safety authority of vendor’s country and/or safety authority of host country	— Procurement strategy — Project management
Site characterization	Substantive issues with selection of site	— Owner/Owner’s engineer	— Project management
Social and environmental	Substantive issues (including process related) with social and environmental aspects of the project	— Owner of the NPP — Vendor	— Procurement strategy — Project management — Communication strategy — Financing strategy (close relationship with ECAs in order to raise long term debt financing)
Reputational	Substantive issues with reputational aspects of the project (including nuclear proliferation, underperforming technology)	— Owner of the NPP (shareholders may also be instrumental) — Vendor — Government of host country — Safety authority of host country and/or safety authority of the vendor’s country	— Procurement strategy — Project management — Communication strategy — Financing strategy (close relationship with ECAs in order to raise long term debt financing)
Reservation of long lead materials, production slots	Delayed availability of long lead materials (including extra costs) Delayed availability of production slots	— Owner of the NPP — Vendor/supplier of turbine island — Supplier(s) of key components	— Procurement strategy — Project management — Insurance coverage
Political	List of events to be agreed by the parties, but to include in particular discrimination against supplier of foreign technology, foreign investments	— Vendor — Owner of the NPP — Insurers (including ECAs) — Government of host country	— Insurance coverage — Comfort, undertakings, etc. provided by the government of the host country

TABLE 3. EXAMPLE OF (AUGMENTED) PRR (cont.)

Category	Risk	Parties likely to be best positioned to manage and mitigate risk	Risk mitigation tools available
Commercial and contractual structure	Substantive issues with regard to the integration and management of various contracts for the construction phase (and also of contractors), leading to onerous project procurement and challenging project management	— Shareholders of the owner of the NPP — EPC contractor (if any) — Vendor (if relevant) — Government of host country (if contractual structure derived from its requirements/demands)	— Procurement strategy — Commercial strategy — Contracting strategy — Financing strategy — Comfort, undertakings, etc. provided by the government of the host country
CONSTRUCTION PHASE			
Design	Substantive issues with detailed design choices leading to construction or operation related issues (including extra costs, lower performance, etc.)	— Vendor — EPC Contractor (if any) — Owner of the NPP — Safety authority of host country — Government of host country (if design faults resulting from changes ordered by host country's agencies)	— Choice of reactor type
Technology	Substantive issues with choice and/or combination of technologies selected	— Owner of the NPP — Government of host country (if choice resulting from demands by host country's agencies)	— Procurement strategy
Technical	Higher than expected costs and/or longer time to completion, leading to higher borrowing requirements, lower returns, etc.	— Vendor — EPC contractor (if any) — Owner of the NPP — Shareholder(s) of the owner of the NPP — Financiers — Insurers	— Procurement strategy — Project management — Contractual arrangements (including provisions for penalties, liquidated damages (LDs)) — Financial products (including letters of credit, suppliers' guarantees, standby equity and loans) — Insurance coverage

TABLE 3. EXAMPLE OF (AUGMENTED) PRR (cont.)

Category	Risk	Parties likely to be best positioned to manage and mitigate risk	Risk mitigation tools available
Cost overruns	Higher than expected costs leading to higher funding requirements, lower returns, tighter debt service cover ratios, greater exposure for the government of the host country, etc.	— Vendor — EPC contractor (if any) — Owner of the NPP — Shareholder(s) of the owner of the NPP — Financiers — Insurers	— Procurement strategy — Project management — Contractual arrangements (including provisions for penalties, LDs) — Financial products (including letters of credit, suppliers' guarantees, standby equity and loans) — Insurance coverage
Delays	Longer than expected time to completion, leading to higher costs, higher funding requirements, lower returns, greater exposure for the government of the host country, etc.	— Vendor — EPC contractor (if any) — Owner of the NPP — Shareholder(s) of the owner of the NPP — Financiers — Insurers (including ECAs) (relevant insurance coverage)	— Procurement strategy — Project management — Contractual arrangements (including provisions for penalties, LDs) — Financial products (including letters of credit, suppliers' guarantees, standby equity and loans) — Insurance coverage
(Equity) funding	Lack of sufficient funds for reaching completion	— Shareholder(s) of the owner of the NPP — Financiers — Insurers — Government of host country (funding of local portion)	— Contractual arrangements (including provisions for standby equity and loans, shareholders' loans) — Financial products (including letters of credit, shareholders' guarantees) — Insurance coverage
FX	Variations of local currency and/or other currencies	— Contractor(s) — Shareholder(s) of the owner of the NPP — Owner of the NPP — Financiers	— Procurement strategy (including maximized portion in local currency in contractual arrangements, match between currencies of sources of funds and currencies of expenses) — Contractual arrangements (for purchases and sales, if any) — Financial products (including FX hedges, currency swaps)
Interest rates	Higher than expected all-in interest rate leading to larger investment costs (e.g. IDC), higher than expected borrowing requirements and thinner cover ratios	— Contractor(s) — Shareholder(s) of the owner of the NPP — Owner of the NPP — Financiers	— Contractual arrangements (possibly) — Financial products (including interest rate hedges, interest swaps)

TABLE 3. EXAMPLE OF (AUGMENTED) PRR (cont.)

Category	Risk	Parties likely to be best positioned to manage and mitigate risk	Risk mitigation tools available
Insurance (business and property)	Higher than expected insurance costs and/or non-availability of proper insurance cover (excluding acts of terrorism) Higher than expected insurance costs and/or non-availability of proper insurance cover (acts of terrorism)	— Contractor(s) — Shareholder(s) of the owner of the NPP — Owner of the NPP — Government of host country (in particular for insurance against acts of terrorism)	— Insurance strategy and insurance coverage
Political	List of events to be agreed by the parties, but to include in particular discriminatory changes in law, including changes in taxes or project abandonment	— Insurers — Independent safety authority and/or regulator in host country — Government of host country	— Insurance coverage — Comfort, undertakings, etc. provided by the government of the host country
Force majeure	List of events to be agreed by the parties, but typically including events outside the control of either party such as catastrophic weather related events, e.g. flooding and earthquakes	— Insurers — Government of host country (subject to contractual arrangements)	— Insurance coverage (to some extent)
Social and environmental	(Non-nuclear) incident (during construction or testing phase)	— Vendor — Owner of the NPP — Insurers	— Project management — Insurance coverage (if any)
Reputational	Substantive issues with reputational aspects of the project in connection with construction (including poor monitoring of health, social, environmental requirements)	— Owner of the NPP — EPC contractor (if any) — Vendor — Government of host country — Safety authority of host country and/or safety authority of the vendor's country	— Project management — Communication strategy
Nuclear incident	Major pollution and/or hazard to population	— Owner of the NPP — Insurers — Government of host country	— Project management — Insurance/re-insurance strategy and insurance coverage — Potential recourse to the government of the host country under certain circumstances

TABLE 3. EXAMPLE OF (AUGMENTED) PRR (cont.)

Category	Risk	Parties likely to be best positioned to manage and mitigate risk	Risk mitigation tools available
Construction completion	Reduced performance (capacity available, plant efficiency) of the newly built units, leading to lower than expected cashflows stretching the overall profitability of the completion project	— Vendor — EPC contractor(s) — Owner of the NPP — Insurers	— Project management — Procurement strategy — Contractual arrangements (including provisions for performance guarantees, LDs) — Insurance coverage
Commissioning (e.g. period between plant completion and start of commercial operations)	Authorizations not all being granted (on time) by the relevant control/safety etc. authorities	— Vendor — EPC contractor (if any) — Owner of the NPP — Insurers — Safety and/or regulatory authority	— Project management — Contractual arrangements (including provisions for performance guarantees) — Insurance strategy and insurance coverage
OPERATION PHASE			
Operation (reduced availability and/or reduced dispatch)	Reduced performance, leading to lower than expected level of electricity generated and/or increased O&M expenses stretching the overall profitability of the completion project	— Owner of the NPP — O&M service supplier	— Contractual arrangements (for O&M, with provisions for penalties, LDs) — Insurance strategy and insurance coverage
Fuel supply (quantities and prices)	Increased fuel related expenses stretching the overall profitability of the completion project	— Owner of the NPP — Fuel supplier(s)	— Contractual arrangements (for supplies, with provisions for penalties, LDs) — Insurance strategy and insurance coverage
Electricity sales (quantities and prices)	Lower than expected cashflows stretching the overall profitability of the completion project	— Owner of the NPP (diversification of sales arrangements)	— Contractual arrangements (for sales, with provisions for penalties, LDs) — Insurance strategy and insurance coverage
FX	Variations of local currency and/or other currencies against units of account	— Owner of the NPP — Insurers	— Contractual arrangements (for sales and purchases, including diversification of purchase/sales arrangements to match currencies of revenues with currencies of expenses) — Financial products (including FX hedges, currency swaps) — Insurance strategy and insurance coverage — Dividend policy (flexibility in dividend requirements)

TABLE 3. EXAMPLE OF (AUGMENTED) PRR (cont.)

Category	Risk	Parties likely to be best positioned to manage and mitigate risk	Risk mitigation tools available
Interest rates	Higher than expected all-in interest rate leading to more important debt service obligations and thinner cover ratios	— Owner of the NPP	— Contractual arrangements (possibly) — Financial products (including interest rate hedges, interest swaps)
Insurance (business and property)	Higher than expected insurance costs and/or non-availability of proper insurance cover (excluding acts of terrorism) Higher than expected insurance costs and/or non-availability of proper insurance cover (acts of terrorism)	— Owner of the NPP — Insurers — Government of host country (in particular for insurance against acts of terrorism)	— Insurance strategy and insurance coverage
Insurance (civil liability for nuclear damage)	Higher than expected insurance costs and/or non-availability of proper insurance cover	— Owner of the NPP — Insurers — Government of host country	— Insurance/re-insurance strategy and insurance coverage
Political	List of events to be agreed by the parties, but to include in particular discriminatory changes in law, including changes in taxes or project abandonment	— Insurers — Government of host country — Independent regulator	— Insurance coverage (including ECA, PRI cover) — Comfort, undertakings, etc. provided by the government of the host country
Force majeure	List of events to be agreed by the parties	— Insurers — Government of host country (subject to contractual arrangements)	— Insurance coverage (to some extent)
Social and environmental	(Non-nuclear) incident (during operation phase)	— Owner of the NPP (well specified O&M guarantees) — Insurers (relevant insurance cover)	— Contractual arrangements (including well specified O&M guarantees) — Project management — Insurance coverage (if any)
Reputational	Substantive issues with reputational aspects of the project in connection with operations (including poor monitoring of health, social, environmental requirements)	— Owner of the NPP — O&M service company (if any) — Government of host country — Safety authority of host country (and/or safety authority of vendor's country)	— Project management — Communication strategy

TABLE 3. EXAMPLE OF (AUGMENTED) PRR (cont.)

Category	Risk	Parties likely to be best positioned to manage and mitigate risk	Risk mitigation tools available
Nuclear incident	Major pollution and/or hazard to population	— Owner of the NPP — Insurers — Government of host country	— Insurance/re-insurance strategy and insurance coverage — Potential recourse to the government of the host country under certain circumstances
Spent fuel / waste management	Ultimately, higher than expected financial obligations	— Owner of the NPP — Insurers — Government of host country	— Project management — Financing strategy — Insurance strategy (subject to any relevant insurance cover being available on the market) — Potential recourse to the government of the host country under certain circumstances
Decommissioning	Ultimately, higher than expected financial obligations	— Owner of the NPP — Insurers — Government of host country	— Project management — Financing strategy — Potential recourse to the government of the host country under certain circumstances
International professional externalities	Changes in (international) standards	— Owner of the NPP — Financiers (flexibility in coverage ratios, granting extension of mitigation periods, etc.) — Government of host country	— Contractual arrangements (including flexibility in commercial and contractual structure)

Finally, it may be noted that beyond the search for the 'best' allocation of the project risk possible between the various stakeholders, the owner of the new NPP — and also to a great extent, its equity shareholder(s) — must acknowledge early in the new build development process the need to develop a bankable investment proposal. Under current market circumstances, such a proposal is 'typically' most likely to be supported by a robust ownership and commercial structure backed by an appropriate mitigation plan. In most cases,[4] bankability is a critical hurdle that needs to be overcome.

4.2. RISK ALLOCATION

Risk sharing and risk allocation are key aspects of the developing and the financing of a nuclear new build project, in particular during the period running up to the completion of the NPP — as well as during the early years of commercial operations, during which 'typical' teething problems for a new NPP are rectified. In that context, a key principle when allocating risk is to transfer all, or part of it to the party best able to manage it. Based on that underlying principle, the party to which a risk is transferred takes ownership of it, e.g. becomes responsible for the performance of the underlying rights and obligations, including any of the financial liabilities attached to them. This notion — of efficient risk allocation — will be discussed in Section 4.2.2.

A typical approach towards risk mitigation relies on the combined use of a set of different tools, namely: (a) financial instruments; (b) appropriate procurement strategies; and (c) tailor-made contractual arrangements in connection with the delivery of the investment (discussed in greater detail in Section 4.2.8.).

4.2.1. Risk allocation via contract language

In discussing the allocation of risks between different stakeholders in a new build NPP project, it is clearly important to understand how these risks are allocated — i.e. the use of contract language to identify the 'owners' of particular risks.

The following (annotated) language may be found in a contract between a project developer and an EPC contractor:

> *The contractor undertakes to construct a power plant with a (net) capacity of 900 MW(e)* [Point A in Fig. 9] *for the sum of US $4 billion* [Point B in Fig. 9].
>
> *The contractor will pay for replacement power for each day in excess of ten in any year in which unplanned outages exceed 10 days* [Point C in Fig. 9].
>
> *The contractor will also pay for replacement power for every day on which the plant is not synchronized to the grid after 1 January 2025* [Point D in Fig. 9], *except for delays caused by unreasonable regulatory performance* [Point E in Fig. 9].

The way in which contract language is used to define risk ownership (i.e. who is exposed to a particular risk under the terms of the contract) may be understood by referring to Fig. 9, which illustrates the allocation of several risks between a project developer (who may also take on an owner–operator role after the commissioning of the new NPP) and an EPC contractor. As reflected in Fig. 9, the risk that the 900 MW(e) design capacity envisaged for the NPP is not achieved is assigned to the EPC contractor via the language that precedes [A] in the pro forma contract language above. The risk of construction cost overruns is also assigned to the EPC contractor, via the 'fixed price' language marked [B].

The risk that design performance is not achieved is allocated to the EPC contractor via the requirement that they pay for replacement power in the circumstance described in [C]; the EPC contractor also owns the risk of schedule delay [D] except insofar as such delay is due to regulatory delay (per the 'carve out' in [E] which assigns

[4] With the exception of the sovereign model, the other ownership and commercial models have recourse, either directly or indirectly, to (long term) debt in order to part-finance the investment.

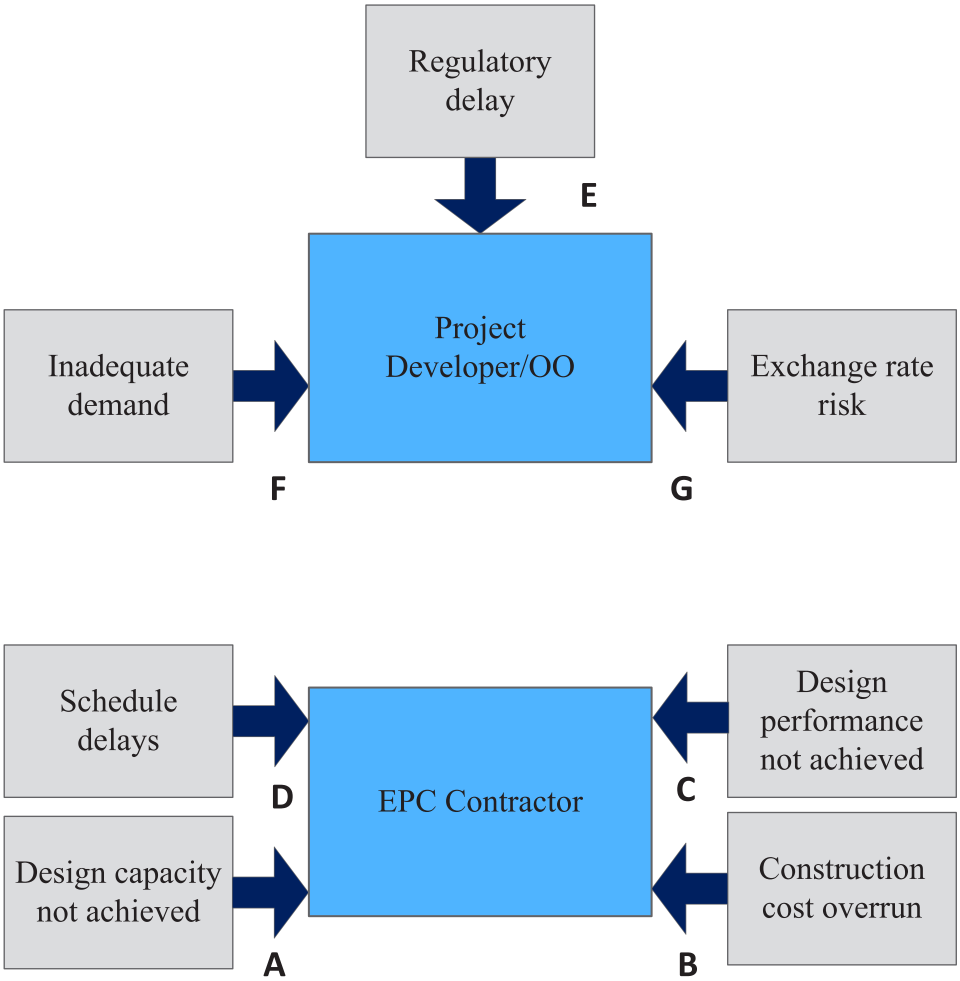

FIG. 9. Allocation of EPC risks. (OO — owner–operator.)

this risk to the project developer). Insofar as they are not mentioned in the contract language, demand (market) risk and exchange rate risk default to the developer, as shown by [F] and [G].

4.2.2. Concept of the 'risk premium'

The idea that a project developer who seeks to allocate risk to another stakeholder in a new build NPP project will have to pay a risk premium in order to do so is best introduced by way of an example.

An example is the development of a 15 year agreement between a project developer (who intends to own and operate the NPP, at least initially) and a nuclear fuel supplier. The price of U_3O_8 (as well as the prices of separative work units during the enrichment process, the price of zirconium etc.) is somewhat volatile; if the developer were to insist on a price for fuel that was fixed throughout the duration of the contract, the fuel supplier would demand a risk premium. This risk premium would be reflected in the fuel price. Supposing that the U_3O_8 price for the duration of the contract was projected to average US $100/kg, and that this was consistent with fuel price of p^* per fuel assembly, if the fuel supplier agreed to own the risk it would insist on a price of p' where $p' > p^*$. In this example, $p' - p^*$ is the risk premium.

Typically, the size of risk premium demanded by a party will depend on a range of factors, including:

- — The size of the risk (in terms of its volatility and absolute monetary value);
- — The financial capacity of the potential risk owner's relative size of the risk;
- — The potential risk owner's ability to control the risk (discussed further in Section 4.2.3).

In the course of the canonical negotiation process that was shown in Fig. 1, it is important for the project developer to recognize that although a small stakeholder with limited financial capacity might be willing to bear a large volatile risk that it cannot control, it will demand a large risk premium for doing so. In that context it would likely be preferable for the developer to retain that risk itself. In general, the developer should avoid forcing ownership of particular risks on to reluctant stakeholders if it wishes to avoid incurring a set of risk premiums which are so large as to render the project's economics non-viable.

4.2.3. Efficient risk allocation

A frequently quoted principle of risk allocation is that a given (type of) risk should be allocated to the stakeholder best able to manage it. For example, as far as schedule delay risk is concerned, it should be borne by the EPC contractor as the project stakeholder best placed to ensure that the project is delivered on time (and, hopefully, on budget). However, in practice, schedule delay risk is often shared between the EPC contractor and others (typically the project developer).

One instance in which this 'golden rule' of risk allocation may be broken is discussed in Section 3.3; sometimes risks are simply unmanageable or uncontrollable by any of the stakeholders in a project. In addition, three other circumstances can arise in which the usual rule of efficient allocation may have only limited applicability.

Firstly, the nature of some activities that will determine the success or failure of a project is such that the outcomes are jointly determined. For example, both the EPC contractor and operator will determine post-completion operational performance, through the quality of the construction carried out and the operating practice, respectively. In this circumstance, it may be challenging to induce the contractor to agree to be held generally responsible for, for example, the frequency of unplanned outages. More broadly, it could be argued that in fact it would not be desirable to have the EPC contractor solely at risk of financial loss (through, for example, the inclusion of liquidated damage provisions in the EPC contract language). Where joint effort is necessary for a project activity to be carried out successfully it is often desirable for all parties to be exposed to at least some financial risk, i.e. to be incentivized (through potential financial loss) to carry out the subactivities for which they are responsible in a diligent fashion.

Secondly, it may be possible that even where a project activity is in principle controllable by a project stakeholder, the potential losses that may fall to the risk owner in the event of the potential harm occurring are so great as to lead to significant financial distress, or even bankruptcy. This may lead to reluctance on the part of, for example, EPC contractors and/or the nuclear steam supply system (NSSS) vendors with whom they often form consortia, to carry out a project to stake their organization's future on projects being completed on time and on budget.

Thirdly, where the costs likely to arise from activities to be carried out during the life cycle of a project are extremely uncertain — defying quantification, perhaps because no data exists that would allow such quantification — stakeholders may be very reluctant to own them. One example of such uncertainty may be said to surround the costs of spent nuclear fuel disposal. While a preferred technical approach to this problem has enjoyed considerable support (deep geological repository approach), no civilian deep geological repository has yet been constructed, and the costs of such an approach are highly uncertain. Fear of potentially being exposed to such unknown costs has been suggested as a factor underlying the reluctance of some commercial banks to become involved in new build NPP projects; the innovative waste contract approach of the Government of the United Kingdom may be viewed as an attempt to address this reluctance by placing an upper limit on potential spent nuclear fuel disposal costs.

4.2.4. Key stakeholders' objectives and risk appetites

In addition to the factors outlined in Section 4.2.2, differences in key stakeholders' willingness to bear risk — as reflected in the size of the risk premium that they will require in order to induce them to bear that risk — will be driven in part by their differing objectives in participating in an NPP project, as well as the different nature of such participation. For example, a long term equity investor has a different economic rationale when investing in a nuclear new build than a contractor providing a defined service on a fixed term basis has; the former can expect to share in the project's success if it proves more profitable than anticipated, while the latter has no such expectation. Similarly, utility and non-utility investors (such as vendors, electricity off-takers and suppliers) will have different objectives and hence will demand different risk premiums in return for bearing particular risks.

The basic relationship between different stakeholders' objectives and their willingness to bear risk is relatively straightforward: insofar as stakeholders aim and expect to receive benefits of a non-financial nature from participating in a project, they will be willing to accept somewhat reduced financial benefits (including lower risk premiums) for bearing a given share of a particular risk, or to accept a greater share of that risk, or both. For example, an NSSS supplier that wishes to sell its technology into a particular jurisdiction or region for the first time — thus demonstrating its acceptability or perceived safety — may be more willing to demand a lower risk premium for providing short term financing to an NPP project than would a commercial bank that stands to benefit at best from interest payments and the return of the principal.

Acknowledging the objectives of different key stakeholders — and the likely limits of their risk acceptance and return requirements — will help the developer (and potential future owner–operator) of the new NPP to define and predict the overall cost of capital of the investment under consideration. Such an understanding will generally be of assistance to all potential stakeholders during the project development phase when the investment proposal is structured and the roles and responsibilities of the various stakeholders are defined and subsequently contracted.

A brief outline of the broad range of objectives that can be pursued by various key stakeholders is provided in Table 4 for illustrative purposes.

TABLE 4. EXAMPLE OF SELECTED KEY STAKEHOLDERS' PRIMARY ECONOMIC CONSIDERATIONS

Selected key objectives/requirements	Key stakeholders				
	Shareholders	Debt providers	Owner of NPP	Contractor	Host country government
Dividends	✓				✓[1]
Capital appreciation	✓				
Interest payment		✓			
Technology transfer					✓
Security of supplies	✓				✓
Asset diversification	✓		✓		✓
Construction works				EPC contractor	
Supplies (goods and services)				Vendor, equipment suppliers	
Management services				O&M operator	
Fuel services			✓	Fuel supplier(s)	
Supplies of electricity			✓	Off-taker	✓
Waste management services				(service provider)	✓[2]
Decommissioning services				(service provider)	

[1] The government of the host country can also be a shareholder.
[2] It is assumed here that the government of the host country is ultimately responsible for the final disposal of waste.

4.2.5. Risk allocation via international financial and insurance markets

Certain classes of risks, particularly those that are typically thought of as being the most purely financial in nature, such as the risk of adverse exchange rate or interest rate movements, may be most efficiently allocated to participants in international financial and insurance markets. To accomplish this, the NPP project developer — or any project stakeholder who has assumed this type of risk — may enter into contracts (‘instruments’) such as those that are typically traded on major international exchanges. A broad range of insurance and financial instruments are readily available on the market, including forward contracts, futures contracts, swaps and options (these terms are defined in the Glossary).

The selection and use of appropriate tools to mitigate risk is a complex task, which depends not only on the particulars of a project, but also on, inter alia: the nature of the risk to be mitigated; the overall ownership and commercial structure selected to develop and procure the investment; the contractual obligations of the various stakeholders and their risk profile; and the contractual arrangements agreed to support the delivery of the investment.

It is, therefore, challenging to define generic guidelines for combining appropriate products and strategies that would be applicable in all instances. However, when focusing on selected a number of risks of an arguably ‘purer’ financial nature, the use in principle of the relevant instruments may become more straightforward, as shown in Table 5. This is primarily because instruments have been developed and standardized to that effect, and these are traded on various market places, thereby commoditizing them. Table 5 provides an outline of the different approaches that may be followed to mitigate risks of a more purely financial nature; procurement and contractual strategies will be discussed in Section 4.2.8.

TABLE 5. EXAMPLES OF RISK MITIGATION TOOLS

Risk mitigation tool	Risk covered
Off-the-shelf products	
Financial products such as forward contracts, futures contracts, swaps and options Insurance products	— Changes and variations in: ● Commodity prices ● Interest rates ● Foreign exchange rates ● Credit standing — Currency transferability (repatriation) — Change in legal, regulatory and political environment with a financial impact (e.g. change in tax regime, etc.)
Tailor-made products	
Escalation formulas	— Changes and variations in: ● Commodity prices ● Interest rates ● Foreign exchange rates
Procurement and contractual strategies	
Procurement strategies Commercial and contractual arrangements	— Changes and variations in: ● Commodity prices ● Interest rates ● FX rates — Currency transferability (repatriation) — Financing (sourcing) — Delays in investment delivery — Funding shortage — Change in legal, regulatory and political environment with a financial impact (e.g. change in tax regime, etc.)

4.2.6. Risk allocation via ownership

As already mentioned, there are various factors and circumstances that have an impact on the degree of risk transfer that can be sought, and that is actually achieved between the parties, and hence on the allocation of the financial risk between the various stakeholders. Among them, the choice of an ownership and corporate structure to develop and finance a new project is a critical decision with important consequences, in particular the decision on the commercial and contractual environment to be put into place in order to deliver the investment proposal. The choice to opt for a corporate based financing structure, or for a transaction based ('project finance' type) structure is, therefore, a structural decision.

In principle, there are three models of ownership and commercial structure that can be envisaged for an investment in a nuclear new build project: (a) the sovereign model; (b) the corporate model; and (c) the project finance model. A brief description of each is provided below.

Under the sovereign model, the investment proposal for a new NPP is undertaken under the leadership of the government of the host country. The investment is financed through contributions from the state budget and/or national borrowing. In most cases, any borrowing will take place as part of the government's overall borrowing programme (by selling medium to long term bonds to institutional investors), rather than being tied to a specific project. Government debt has traditionally been regarded as being 'safe'.[5] This is because most governments are highly likely to repay their debt, since they have the power to raise (increase) taxes, hence ensuring an uninterrupted access to a reliable source of stable revenues. Under the sovereign based model, the financial risk that the investment will not generate revenues sufficient to cover its costs and deliver a return is ultimately borne by the taxpayers in the host country. A relatively straightforward contractual framework is needed to structure an investment proposal in that context.

Under the corporate model, the investment proposal is undertaken by a corporation, which can be public or private. The new investment will most likely be financed through a combination of debt and equity, and the investment will appear on the balance sheet of the owner of the new NPP. Under that model, debt will be raised on commercially driven terms, and the lenders will most likely have a claim against the company's entire cashflow, unless it is secured against a particular asset. As a result, the financial risk that the investment will not generate sufficient revenues to cover its costs and make a profit is borne by the various finance providers (although such risk is borne primarily by the shareholders, since the lenders have a priority claim on the revenues and the assets of the borrower). Similarly to the sovereign based structure, some contractual framework is needed to structure the investment proposal. It may need, however, to be more comprehensive and detailed than in the case of a sovereign structure.

Under the project finance model, a special purpose vehicle (SPV) is established by a group of shareholders in order to procure and finance the investment: the new NPP will be the main asset on the SPV's balance sheet. As with the corporate based model, the project will typically be financed through a combination of (long term) debt and equity. However, a key difference is that during the operation phase the lenders will only have recourse to the revenues generated by the new NPP and the assets of the project company. They will not have access to other revenues and/or assets of the shareholders of the SPV, although some form of (limited) recourse to said shareholders is often be found during the construction period. This ring fencing is achieved through a set of detailed contractual arrangements whereby the lenders have no right, in any circumstances, to revenues or assets other than those of the project itself. The contractual environment to be considered under that model needs, therefore, to be comprehensive and very detailed in order to define exhaustively and precisely the rights and obligations of the various stakeholders. It is important to note that no NPP in the world has ever been project financed to date owing to, inter alia, the complexity of this corporate model and the difficulty to put it into place for a nuclear new build project.

It should be noted that the ownership and commercial structures presented above are neither definitive nor exclusive. Combinations and/or variations may be considered, which may provide some flexibility and room for a degree of financial innovation in order to suit the specific requirements of a particular investment.

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[5] Until 2008, sovereign debt was seen by investors as 'safe' as a matter of principle (although there was obviously a different perception of the credit quality, and hence of the risk, of e.g. the government of a stable developed country when compared with that of an emerging country); as a consequence of the financial crisis that has been shaking the financial markets since then, investors have rediscovered the reality of the sovereign risk, and have subsequently re-priced it.

It should also be noted that the economic, legal and regulatory environment in which the owner of the new NPP will operate and in which the new build project must be developed places de facto limits around these models. This is because such an environment directly frames the contractual relationship between the different models relative to risk, hence impacting on the possibility to freely allocate risk between the stakeholders in a project. This is illustrated in Fig. 10.

Depending on the degree of unbundling (i.e. separation of the different functions typically to be found in a vertically integrated utility, e.g. the electricity generation, transmission and distribution activities) and liberalization of the electricity market in the host country, a new build investment proposal may (or may not) be more likely to be developed based on the sovereign or the corporate model, rather than on an ownership and commercial structure shaped by project finance techniques — although it is important to note that no new NPP has been project financed to date.

Depending on the level of risk that can be transferred from the public to the private sector, a new build investment proposal may (or may not) be developed based on the corporate model, rather than on the sovereign model. Furthermore, more risk transfer could be considered, depending on whether the corporation in charge of such investment would be state owned (or controlled) or owned by shareholders in the private sector.

The degree of recourse to shareholders is also a strong marker, with the corporate and sovereign based models supporting, as a matter of principle, less transfer away from the shareholders (with the government being viewed as a shareholder in the sovereign model) towards external parties (e.g. contractors, suppliers, debt providers) compared with a project based ownership and commercial structure.

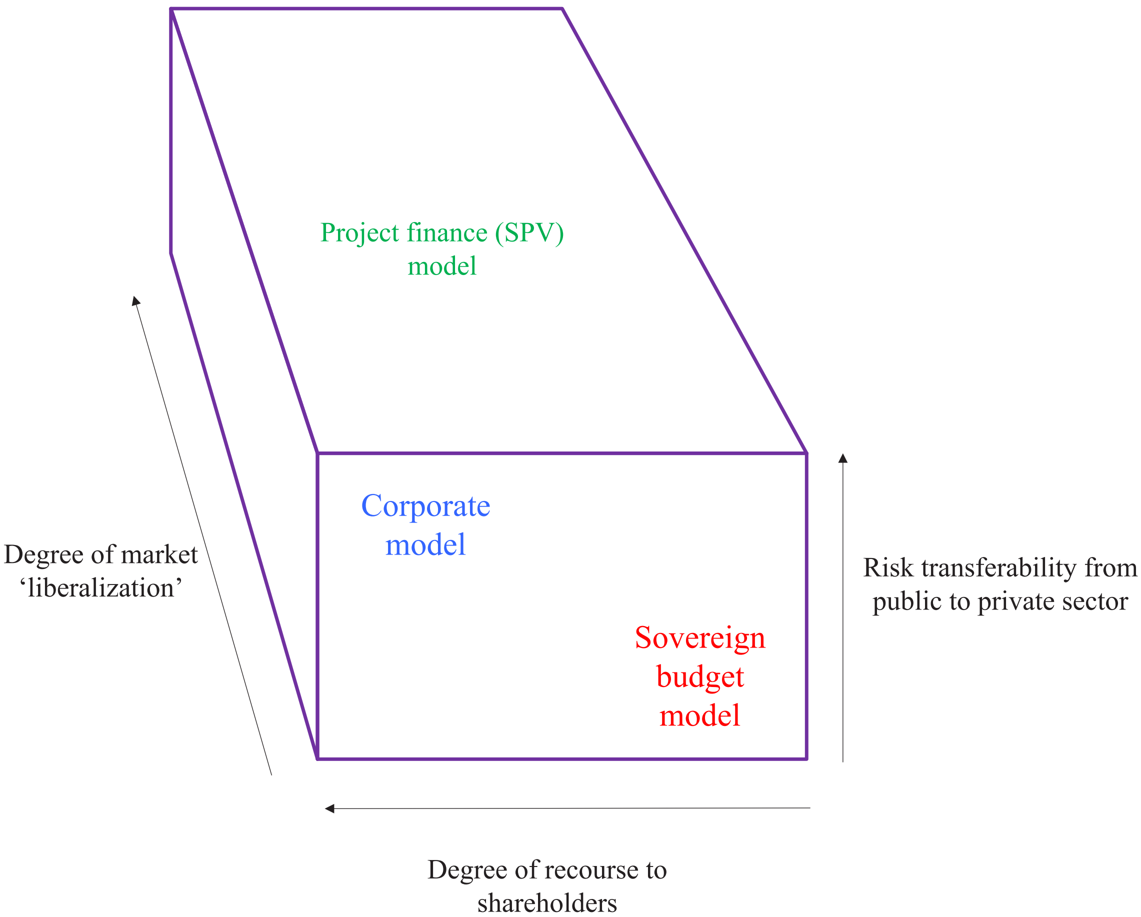

FIG. 10. Different ownership and commercial structures.

4.2.7. Risk allocation via credit enhancement

Credit enhancement is the process whereby a financially stronger party (one with an ability to meet financial demands on it) stands behind a financially weaker party (whose ability to meet such demands is less certain) in the sense of agreeing to be ultimately responsible for that party's liabilities. In other words, if the weaker party defaults — wholly or in part — on its financial obligations, its creditors will be able to recover what they are owed from the stronger party. A successful credit enhancement, by enhancing lenders' confidence in their ability to recover what they are owed, can lead to lower cost of capital for a project, and thus improved overall project economics.

Sovereign credit enhancement can be crucial to a new build NPP project. This is where a host government undertakes to act as the ultimate guarantor of the financial liabilities of, for example, a project developer. Such a host government might, alternatively, act as guarantor for an off-taker's liabilities, thereby giving reassurance that obligations incurred by that off-taker under the terms of an electricity off-take agreement or contract for difference (CfD) arrangement (perhaps as outlined in a 'take-or-pay' clause that guarantees the plant's owner a steady revenue stream, thereby reassuring its creditors) will be met.

Regardless of the exact nature of a given credit enhancement, it is important to recognize two things. Firstly, the credit enhancement is only as valuable as the perceived financial strength of the enhancer, as measured, for example, by the rating afforded to its bonds by rating agencies. An agreed willingness by a host government whose own rating is no better than that of the off-taker, for example, might do little to reassure potential lenders to a project.

Secondly, while a host government's willingness to provide credit enhancement to a project will likely have benefits in terms of improved project viability (as a result, for example, of reduced cost of capital), the improved viability comes at a cost: the exposure of that government's taxpayers to the risk that they will be held liable for creditors' claims in the event of poor project performance.

Notwithstanding these caveats, credit enhancement by a host government (a 'sovereign guarantee') of some form is commonly discussed and addressed in the course of the new build NPP project development process, and can be a strong factor in realizing such a project.

4.2.8. Risk allocation via commercial contracting

Careful commercial contracting can be a way of achieving successful risk allocation between the various stakeholders in a new build project.

Early consideration needs to be given by the owner of the new NPP to the overall objective pursued when calling for bids to deliver, build and possibly finance a new NPP. This is because it will have an influence on the expected results of a tender: in some instances, this is all about building a new power plant in order to correct an imbalance in the energy mix of a country; in other cases, this may be the beginning of a long term national effort to develop a new national industry basis. Furthermore, this is because it will also have a critical influence on the choice of the underlying requirements of a tender. For example, the development of a request for proposals (RfP) may subsequently be based on input or on output based specifications.

During the preparation of RfPs for the supply of equipment and/or services, the owner of the new NPP needs to consider the merits of requiring quotes based on fixed or variable prices, or dates. Similarly, detailed consideration should be given to any sourcing and localization requirements, particularly if these may affect the choice by would-be suppliers of the currency they would choose for quotation purposes. This might not fit well with the funding and financing strategies retained by the owner of the new NPP; for example, any resulting currency mismatch might impact negatively on the economics of an investment proposal over the medium to long term, or prove to be challenging to manage.

During the discussion about long term contractual sales or purchase arrangements, the owner of the new NPP should give proper consideration to the definition and the negotiation of any price setting and/or price escalation mechanism or formula, and ensure that their long term effects on price (cost) variations are fully understood and duly mitigated, as and when required.

Whatever the ownership and commercial structure retained to develop a new NPP, numerous and detailed contracts — as shown in Fig. 11 — are a typical standard feature of the general contractual framework supporting the development of large, capital intensive investment projects. This is principally because a large number of parties are involved in the supplying of equipment, goods and/or services at all stages during the life of the NPP,

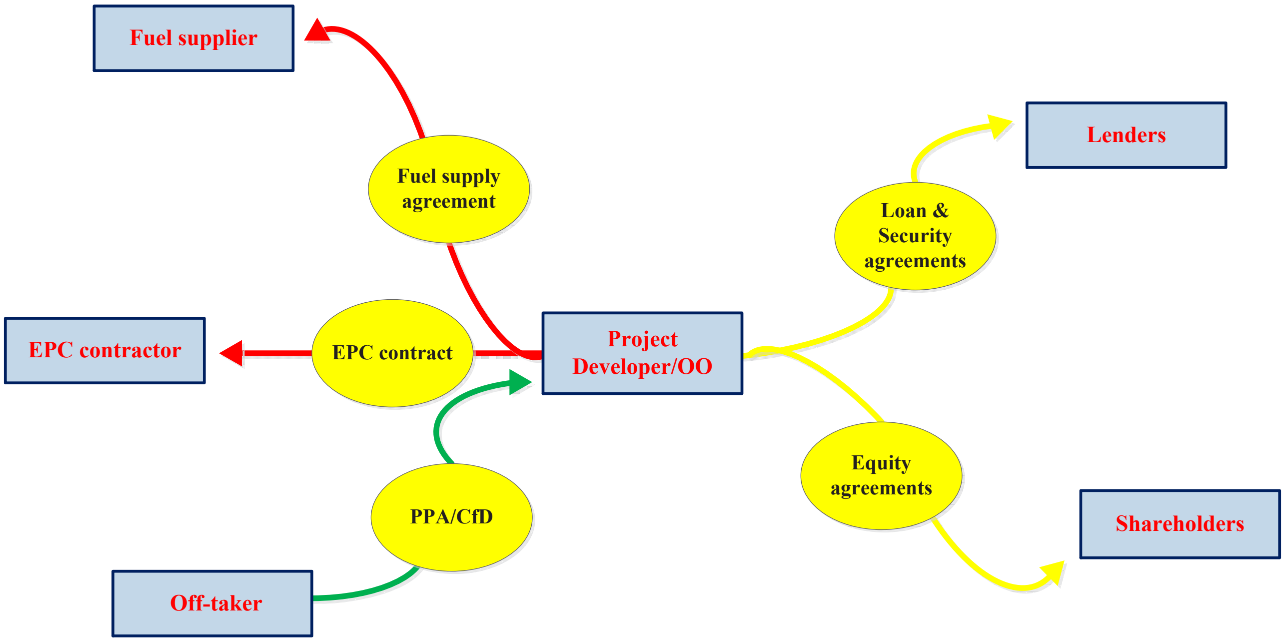

FIG. 11. Outline NPP project contractual environment. Key: revenues (green), commercial costs (red) and returns to lenders and shareholders (yellow).

making it necessary to establish appropriate contractual arrangements in order to properly and accurately reflect the nature and extent of their involvement (e.g. rights and obligations) over time. Figure 11 illustrates an example of a standard contractual arrangement; it is similar to Fig. 1 but indicates the different flows — revenues, commercial costs and returns to lenders and shareholders — that will occur through a project's life.

The contractual obligations of the parties described above (and the financial liabilities attached to them) are also stretched over (very) long periods of time. This is principally because nuclear power generation assets have long life cycles, with extended construction phases and operation periods spanning many decades. It is also because, from a funding provision point of view, the economics of an NPP require that long term financing solutions be put in place in order to support the investment base case. As a result, financial risk remains a constant parameter for the owner of the NPP to monitor throughout the life of an NPP, from its inception to its decommissioning (and arguably beyond, owing to the time horizon to be considered for spent fuel storage). As the overall risk profile of a new build project varies over time, such fluctuation needs to be incorporated and reflected in the wording of the various (long term) contracts negotiated to support the procurement of the investment. In this context, the room for financial risk to materialize is broad and needs to be carefully factored into the contractual discussion and negotiation surrounding the allocation of risk and responsibilities between the parties. This is to ensure that appropriate mitigation and monitoring measures are duly incorporated in the agreements ultimately contracted.

Finally, in addition to the mitigation of risk through contracting, it is also worth taking note of the fact that a degree of financial risk can be generated by the architecture of the overall contractual structure itself. From a technical and a practical point of view, this is particularly the case during the construction phase, where hundreds of contracts have to be integrated in order to ensure seamless performance of the various workflows involved in the building and delivery of an NPP. It is also to be noted that the same applies from a financing related standpoint: the funding of the investment is generally of a different nature (e.g. equity and debt) and usually comes from various sources (e.g. equity capital markets and shareholders' own funds for equity; debt capital markets and banks for (long term) debt). The timely availability of all funding sources therefore also needs to be ascertained.

4.3. EXAMPLES OF FINANCING STRUCTURES AND RISK ALLOCATION

As explained above, risk allocation is impacted by various factors, including the ownership and commercial structure developed by the owner of the new NPP in order to finance and procure the investment.

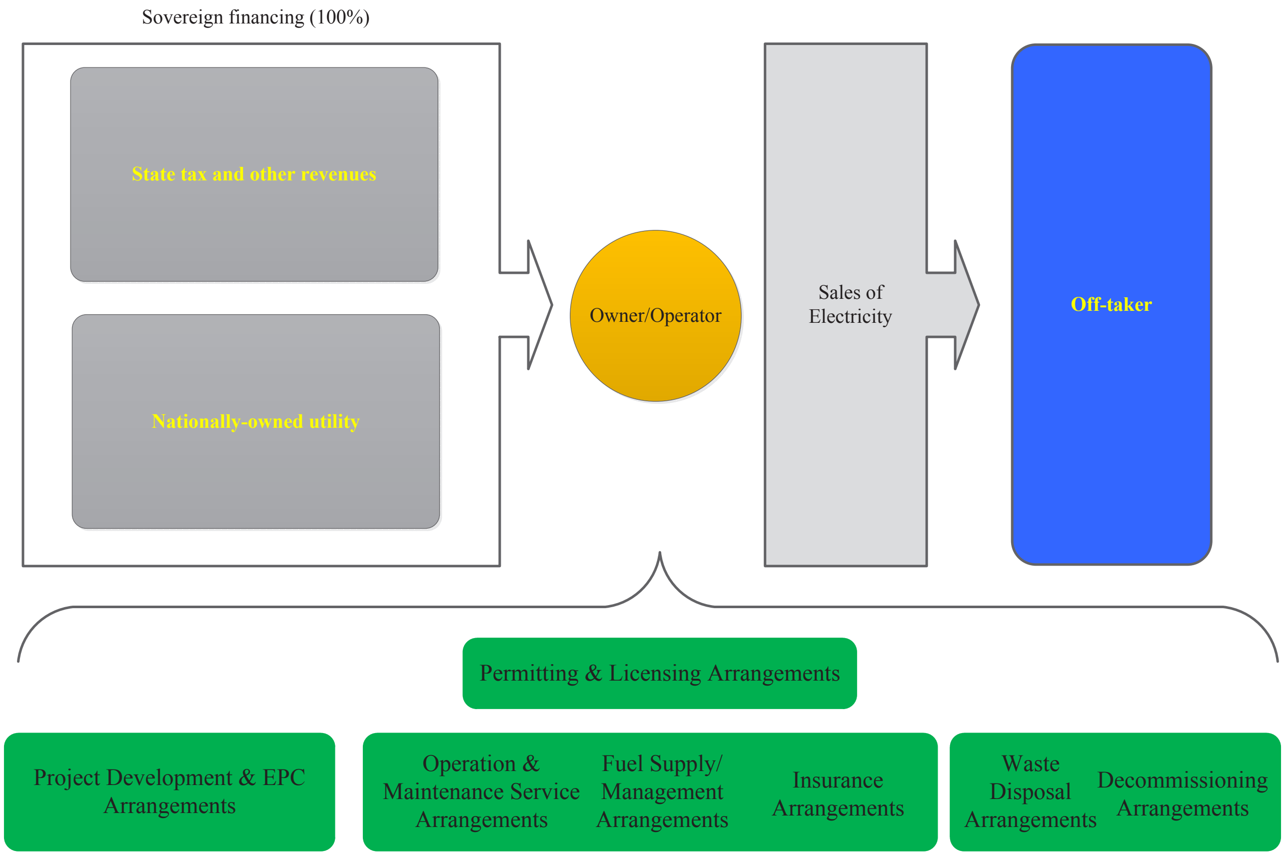

FIG. 12. Illustrative sovereign ownership and commercial structure.

Based on an augmented PRR (Table 3) and the ownership and commercial models introduced in Sections 4.2.6 and 4.2.8, respectively, the high level allocation of the project risk between the key stakeholders developing a nuclear new build investment proposal may typically vary as described in Sections 4.3.1–4.3.3 and in Ref. [5]).

4.3.1. Sovereign model

In the example outlined in Fig. 12, a new NPP is entirely developed, built and operated by a State controlled entity, and the investment is financed based on allocations from the State budget. The electricity output is sold on the market to one or more off-takers, which can be entities from either the public or the private sector.

Under this scenario, although the owner of the NPP practically bears the primary responsibility for the development, construction and operation of the NPP, the overall financial responsibility for delivering the investment lies with the State, acting as the main (sole) shareholder of the owner of the NPP. In that context, the government of the host country ultimately bears all (or most of) the project risks, and the financial liabilities attached to these are borne by the state budget. Risk transfer is, therefore, kept at a minimum, in particular when it comes to the financial risk.

4.3.2. Corporate based model

In a variation of that model, shown in Fig. 13, the new NPP is developed, built and operated by a corporate entity operating along (market based) commercial principles.[6] The owner of the new NPP is, therefore, in charge of

[6] Such a corporation could be controlled by the public sector, or have shareholders from the private sector. Furthermore, such a corporation could be a utility with an ongoing business activity, or a joint venture company established by its shareholders for the purpose of developing a new NPP. (However, that joint venture company would not raise its debt financing on a purely project finance basis, but on a more classical corporate finance basis).

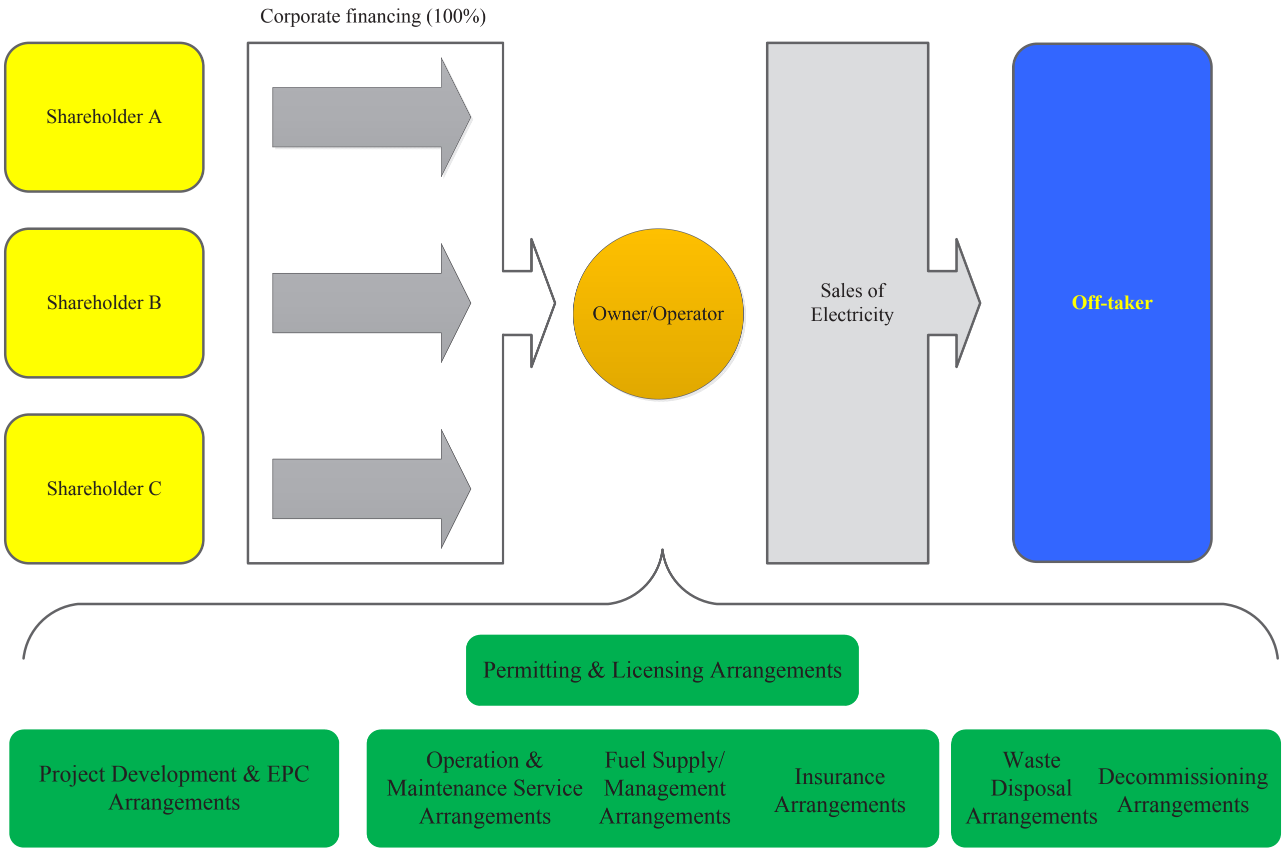

FIG. 13. Example of a corporate ownership and commercial structure.

the overall preparation and the delivery of the new build asset. Subsequently, it is its responsibility to procure and finance the investment plan associated with it.

In that context, the owner of the NPP will likely bear arguably the largest proportion (if not the entirety) of the overall project risks, particularly the financial risk during the construction phase. However, during the operation phase, sales of the electricity output to one or more off-takers under long term arrangements are likely to mitigate to some extent the electricity price and the volume risks. Ultimately, the degree of risk transfer achievable remains relatively constrained under that scenario.

Another variation of that model, illustrated in Fig. 14, may be envisaged, whereby the new NPP is developed, built and operated by a corporation, the shareholding and operating principles of which are organized as a cooperative.[7] Again, the owner of the new NPP remains in charge of the overall preparation and the delivery of the new build asset and is responsible for the financing of the investment.

In this example, the owner of the new NPP also bears a large proportion of the overall project risks, including the financial risk during the construction phase, and the degree of risk transfer achievable during the operation phase remains relatively limited. However, the risk of variations in the electricity price and/or the volumes of output sold are mitigated to some extent from the debt providers' standpoint, with the shareholders' long term commitment to off-take the electricity generated at cost.

4.3.3. Project based model

A typical example of the project based approach can be derived from the independent power producer (IPP) model that was successfully developed in the 1990s and has been used since then to build and finance new thermal capacity on a worldwide basis. However, as noted earlier, it is to be recalled that no NPP in the world has ever

[7] It is assumed that such an entity would also operate along commercial principles.

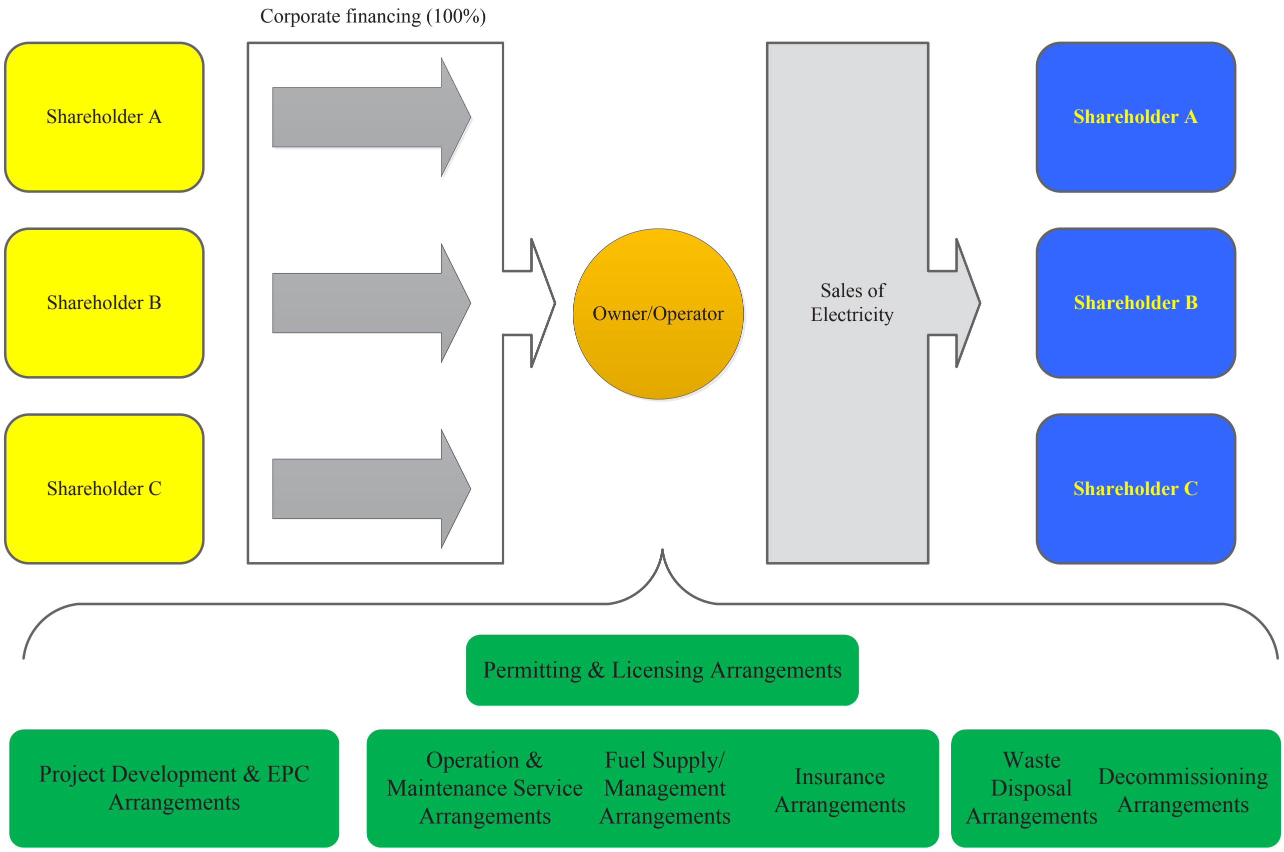

FIG. 14. Illustrative corporate (cooperative) ownership and commercial structure.

been project financed to date. This is due to, inter alia, the contractual complexity of this corporate model and the difficulty of putting it into place for a nuclear new build project.

Under the project based model, illustrated in Fig. 15, a new NPP is developed, built, financed and operated by an SPV, which has been established for that purpose. Therefore, the SPV (e.g. the owner of the new NPP) is in charge of the overall preparation (including the financing) and the delivery of the new build asset.

In this scenario, the degree of risk transfer ultimately achievable remains subject to the SPV's capability to allocate and mitigate the project risks through the various project agreements to be signed to implement the project based ownership and commercial structure (including the contractual arrangements for the construction of the NPP, the supply of fuel and the sales of electricity). Although never implemented in practice, the various attempts to date to develop variations of this model have clearly exposed the difficulty in satisfactorily allocating the financial risk between all the parties, a measure of any such satisfaction being the ascertaining of the bankability of such a structure.

An alternative project based ownership and commercial structure is illustrated by the concession model shown in Fig. 16, whereby the government of the host country outsources the procurement, and possibly the operation, of a new build NPP. Under such a scenario, the government of the host country typically defines the obligations and contractually grants the rights to build, own and transfer (BOT) or build, own, operate and transfer (BOOT) a new NPP to a corporate entity that has the skills, resources and experience to procure and deliver the investment within the context of a concession agreement. At the end of the contractual period envisaged in the agreement, the NPP is transferred to the government of the host country, or to the entity identified in the concession arrangements, according to a contractually pre-agreed transfer mechanism including the payment of a transfer price, which would be in line with the residual value of the asset.

Under this scenario, the concessionaire is contractually in charge of the overall preparation and the procurement of the new build asset. Subsequently, it is its responsibility to manage and allocate the project risks (including the financial risk) to the various stakeholders involved in the delivery of the investment, including the government of the host country. The three main types of ownership and commercial structure summarized in

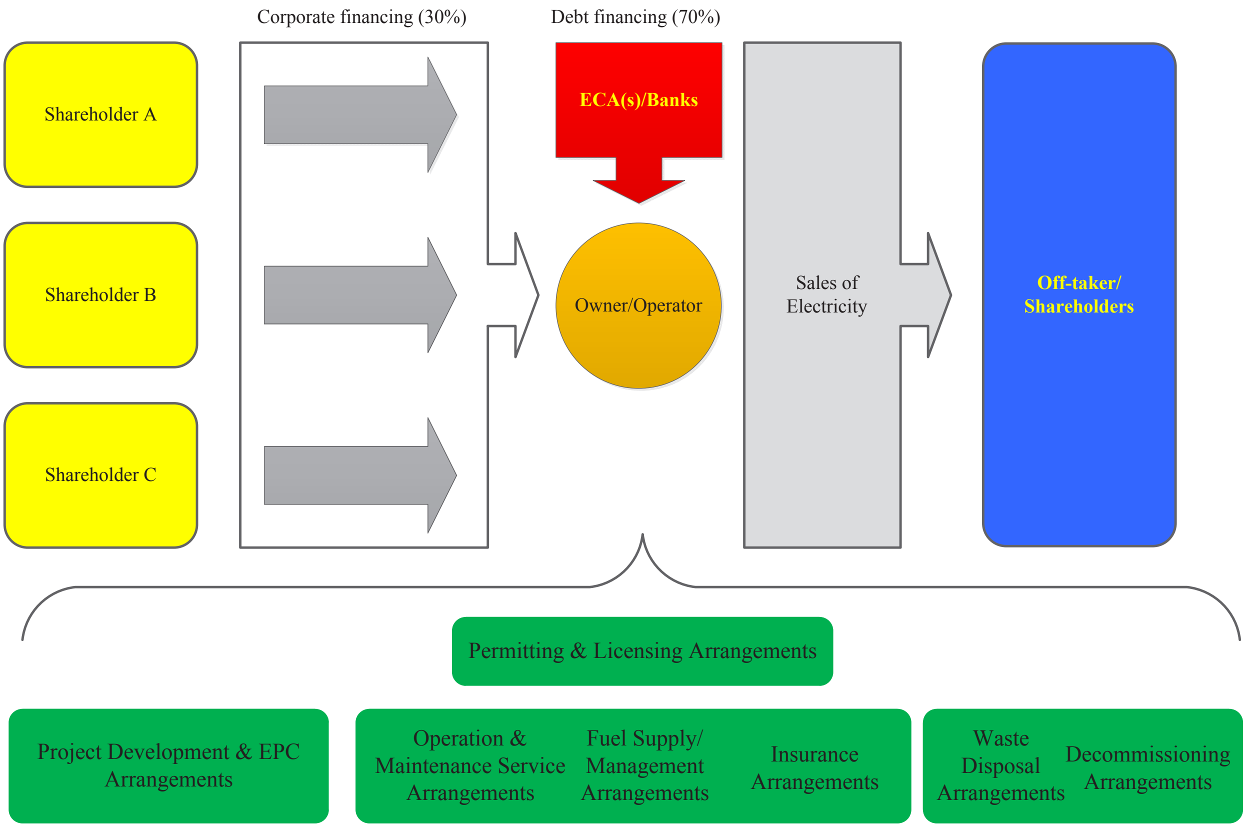

FIG. 15. Example of a project based ownership and commercial structure.

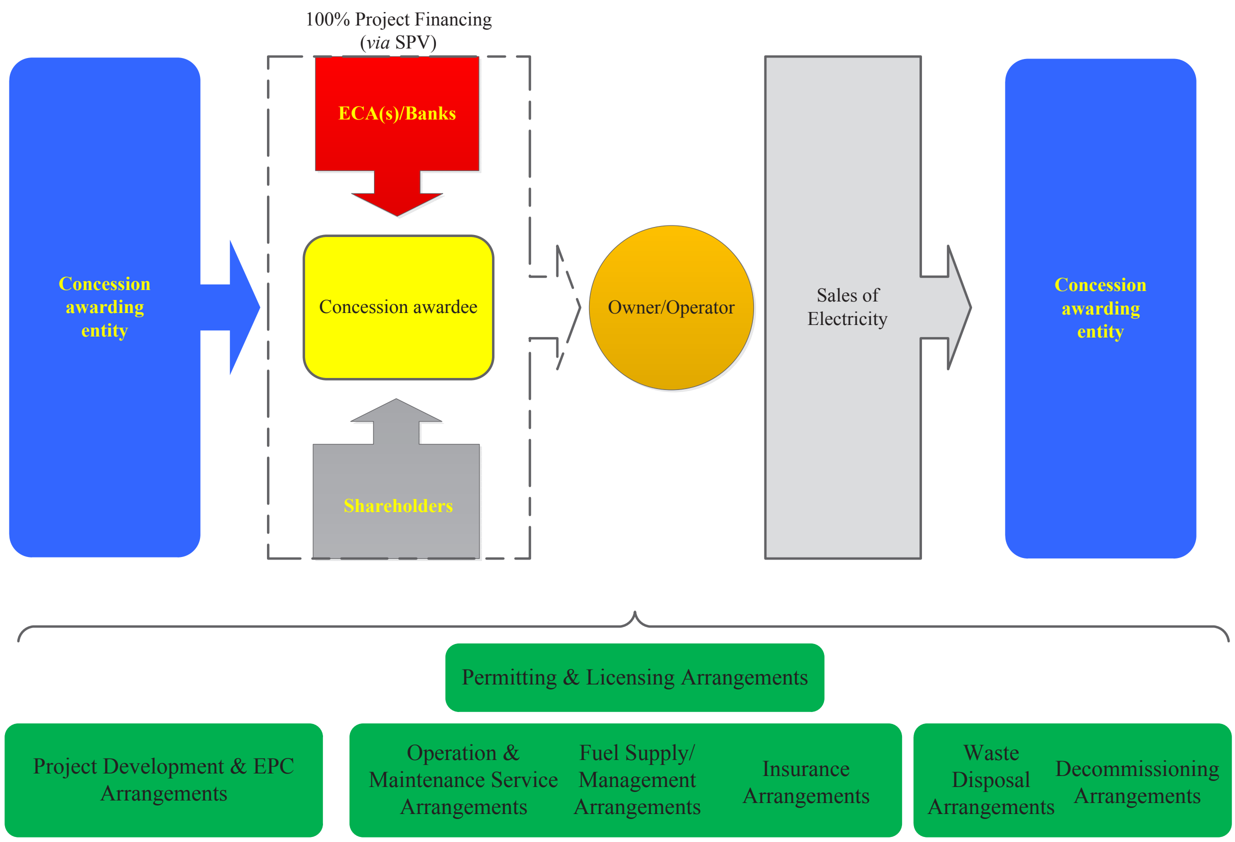

FIG. 16. Illustrative project based ownership and commercial structure.

Sections 4.3.1–4.3.3 (and their respective variants) outline the close relationship that exists between the selection of a financing model, the contractual environment that is typically required to support it and the room subsequently available for allocating risk between the various stakeholders involved in the investment proposal.

5. SOURCES AND COSTS OF FINANCING

5.1. INTRODUCTION

The first part of this publication has focused on the way in which risk allocation — via commercial contracts, credit enhancement and ownership structures (and associated recourse implications) — can be used to effectively allocate risk between various commercial stakeholders. In the process of negotiating various agreements such as electricity off-take agreements and EPC contracts with these commercial stakeholders, the NPP new build project developer will also effectively be determining the nature (amount, time profile, risk) of the residual revenue available to pay the financial stakeholders.

In Section 5, the focus will shift to the way in which rights to this future residual revenue stream are allocated to those financial stakeholders in return for their providing the financing that any NPP project will require.

5.1.1. Revisiting the conceptual framework

To provide a framework for thinking about this issue it will be useful to revisit the overall conceptual framework introduced in Section 1. Figure 17 is based on Fig. 1, Section 1.1, and is designed to focus attention on the idea that the difference between (1) the *revenues* that a project developer or owner will receive from its customer(s) — in this case an electricity utility — and (2) the *costs* that it will incur can be identified, and that this difference represents (3) the residual income that will be available to pay its financial stakeholders. This residual income will be referred to as the cashflow available for debt service (CFADS), following project finance practice,

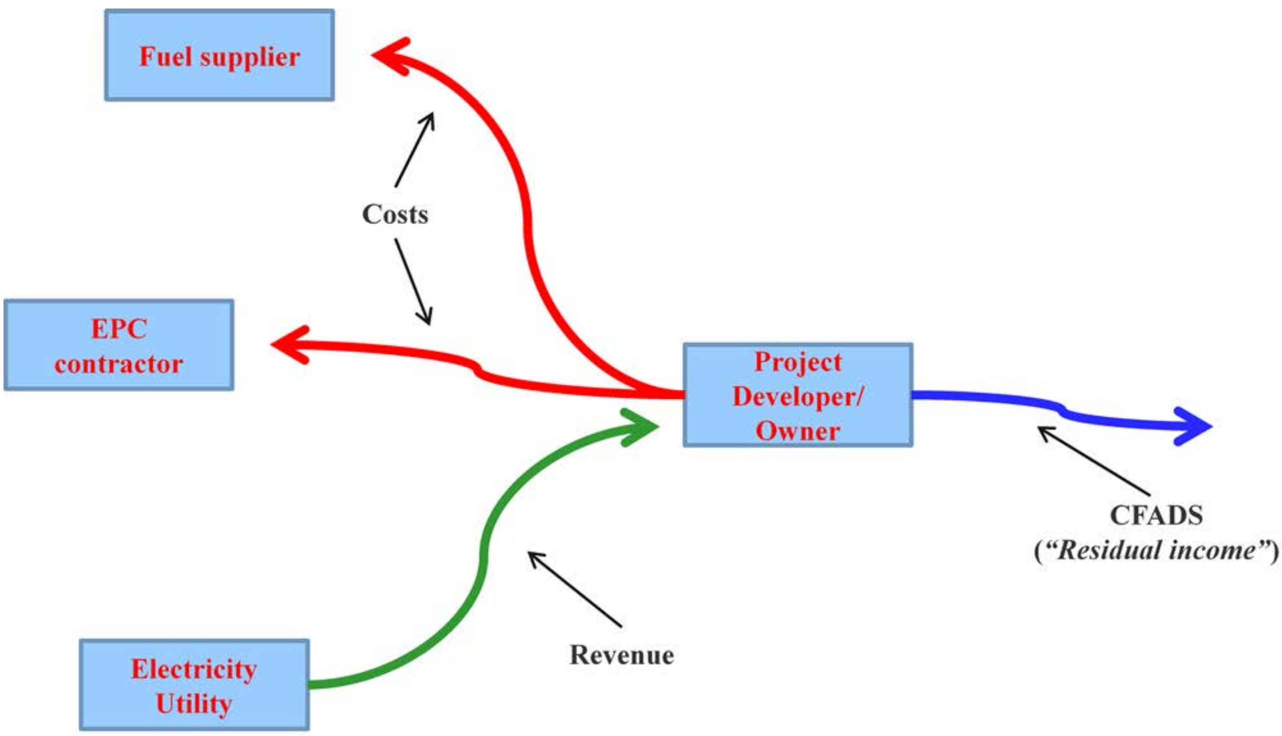

FIG. 17. Residual income available for financial stakeholders (CFADS).

although it is important to recognize that this cashflow will also be available to remunerate equity investors as well as to service debt (i.e. to repay principal and interest).

Given that the costs shown include payments to an EPC contractor — and that such payments will typically occur during a nuclear new build project's construction phase — Fig. 17 is perhaps best regarded as showing revenues, payments and residual income that will arise over the course of a project's *entire lifetime*. It should also be recognized that the residual income shown will in general be risky. In fact, it will inherit its risk characteristics from the framework of contracts between the project developer or owner and the counterparties shown on the left of Fig. 17; if the developer succeeds in pushing most of the project risk on to those counterparties within that framework, the residual income will be relatively stable, otherwise it may exhibit considerable volatility.

Figure 18 illustrates the division of this residual income between lenders and equity investors (shareholders), and five different types of claim on that residual income that they might hold (these types of claim, or 'instruments' are discussed further in Section 5.2). This residual income — and the risks associated with it — can be shared in various ways between a project's financial stakeholders (via loan agreements, equity agreements etc.). In the search to identify sources for the amount of financing required to make a project viable, a project developer will offer different shares of the available residual income to different financial stakeholders; the developer will attempt to sculpt the division of this residual income to induce different stakeholders to offer amounts of financing that will, in aggregate, be sufficient to finance the project.

A key thread running through this section is that in order to induce these different stakeholders to offer financing they must be offered a return that is in excess of some minimum threshold of acceptability. This minimum threshold will be referred to in what follows as a 'hurdle rate'. The hurdle rate notion will be useful in allowing the simple conceptualization of stakeholders' willingness to provide financing. It will be argued that conceptually a stakeholder's 'basic' hurdle rate will reflect its own cost of capital; factors that tend to lead stakeholders to be willing to lend at rates of return that differ from this basic hurdle rate can be conceptualized as leading to adjustments to that basic hurdle rate, resulting in an 'adjusted' hurdle rate. Typically, this adjusted hurdle rate might be expected to be higher than the stakeholder's own cost of capital, reflecting the inherent riskiness. Additional factors tending to raise the adjusted hurdle rate further could reflect, for example, concerns that the CFADS projected to result from a proposed risk allocation would leave financing stakeholders with a high level of risk exposure. Factors tending to reduce the adjusted hurdle rate could include benefits from involvement expected to be received by the stakeholder. Again, conceptually, the notion of an adjusted hurdle rate can be useful in thinking about aspects of a deal that may be prohibitive for a particular type of stakeholder; the presence of such an aspect may be regarded as essentially adjusting the basic hurdle rate to infinity.

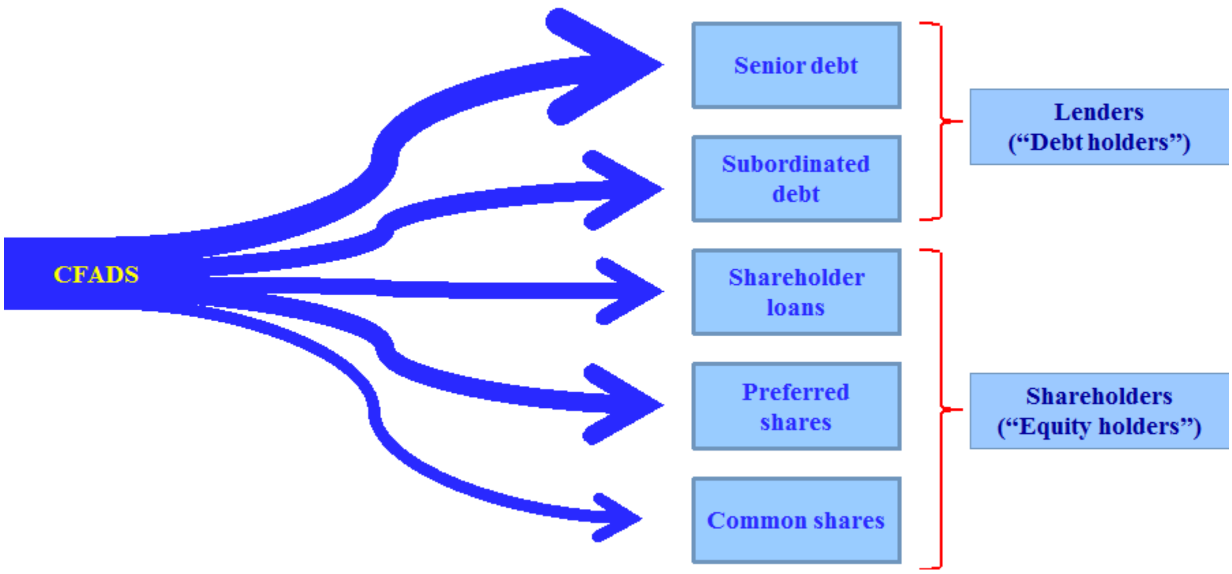

FIG. 18. Dividing residual income (CFADS) between financial stakeholders.

As implied by Fig. 1, the process of devising an acceptable allocation of risk and reward — in this case one that induces potential financial stakeholders to provide the finance needed for the project — will be an iterative one. In fact, given the link between the volatility and volume of the residual income available to be divided among lenders and equity providers and the degree to which risk can be shifted on to commercial stakeholders such as the EPC contractor, the process of arriving at a viable financing plan must be regarded as part of the more general process of arriving at agreements with non-financial stakeholders.

It is often natural to envisage the negotiations that constitute this iterative process as being primarily concerned with cost minimization — i.e. with shifting risk on to commercial stakeholders such as the fuel supplier or EPC contractor at the minimum cost that can be achieved — while treating the revenue side (captured in the electricity off-take agreement) as essentially fixed.

However, it is important to recognize that in most cases the project development process around an NPP new build project will include discussions with an electricity off-taker; the merchant plant model has not proved to be an attractive one for NPP developers. Insofar as these discussions involve power price, they will typically lead to developers — and particularly their financial modelling teams — developing the project from a perspective different to that found in most textbooks. Specifically, rather than treating the cost of electricity as an input to a modelling exercise designed to calculate the return that an investor could expect from financing a project (and comparing that return with its hurdle rate), the modelling exercise will rather treat the return to investors as an input that is designed to calculate the resulting cost of electricity. As will be discussed further in Section 5.8.2, the financial modelling that will typically be carried out to quantify the cashflows and general economics of a project will typically take place on a cost recovery principle, meaning that the new NPP's cost structure determines the revenue requirement (or cost recovery tariff, or electricity price) in each calculation period.

To reiterate, the development of a new NPP project can be regarded — from a financing perspective — as a search to agree all the necessary contracts with key stakeholders with conditions such that *all* are satisfied that the return they will receive is acceptable given the risk they are taking. In that context, a number of key questions arise in considering this process, including:

— What are the sources of financing available to new NPP projects (e.g. banks, ECAs) and are these available at every stage of the life cycles of such projects?
— To what extent will the returns typically regarded as 'acceptable' by different sources of financing (i.e. by different financial stakeholders) differ?
— To what extent will different financial stakeholders make their participation in a new NPP project contingent on other requirements being met?
— What determines financial stakeholders' acceptable returns, i.e. the minimum returns that they will accept in return for providing financing?
— How will the cost of finance provided by different financial stakeholders affect project economics?

5.1.2. Overview

The structure of Section 5 is as follows. In Section 5.2, a summary of types of financing is provided, along with some stylized facts on financing costs. The key role of the priority of the claims on residual asset values that different types of financial instruments offer their holders is discussed. Section 5.3 introduces the idea that the cost of financing from a particular financial stakeholder can be characterized by means of a hurdle rate — a minimum return that stakeholder will require if they are to contribute finance to the project. The discussion will be intuitive and informal, introducing the general hurdle rate idea in Section 5.3.1, moving on in Section 5.3.2 to describe the determinants of stakeholders' hurdle rates, and describing the way in which stakeholders will decide whether or not to provide finance to a project by comparing the return on offer to their own hurdle rate in Section 5.3.3.

Section 5.4 emphasizes the different nature of the risks faced by a nuclear project during different phases of its life cycle, and the reluctance of some potential stakeholders to be exposed to the risks associated with particular phases. These differing appetites for the risks arising during different project phases will necessarily help determine the 'field of the possible' within which risk can be allocated to different stakeholders. Section 5.5 introduces the notion of 'debt to equity' — the ratio of debt financing to equity financing in the overall financing of a project — stressing the relative conservatism of successful nuclear financing to date.

Having dealt with many of the general considerations relevant to the question of sources and costs of financing in preceding sections, Section 5.6 addresses some of the specific issues that arise in the context of the equity component of any financing package, with Section 5.6.1 outlining the types and sources of equity and introducing some ways of thinking about what constitutes a reasonable and/or likely cost of equity (i.e. benchmarking the cost of equity).

Section 5.7 focuses on the other component of financing packages for nuclear projects, i.e. debt, starting by outlining the types and sources of debt in Section 5.7.1 before going on to outline the key liquidity metrics that lenders will use to evaluate the riskiness of a given project in Section 5.7.2, and ending by examining approaches to benchmarking the cost of debt.

Section 5.8 emphasizes the idea that the process of identifying and negotiating financing for an NPP project will be an iterative and challenging one. The process of locating the point at which all the financial stakeholders in a project (equity investors and lenders) are satisfied with the returns they will receive for their financing contribution to the NPP project is properly viewed as part of the broader process of satisfying all (potential) project stakeholders, not least because shifting various risks on to non-financial stakeholders will be a vital prerequisite for mitigating the risks to which financial stakeholders and lenders in particular will be exposed. Such mitigation will be vital for ensuring the participation of (conservative, risk averse) stakeholders. Finally, Section 5.9 explores the possible advantages of a phased approach to financing nuclear projects.

It should be noted that throughout this section the discussion will rely on many of the ideas and concepts of a true project finance approach; while no new build NPP project has yet been financed on such a basis, the key issues and challenges that will attend any type of financing for such a project are best explained within such a project finance framework. For clarity, however, the pure project finance approach focuses exclusively on the project under consideration (the NPP project) as the *sole* source of revenues, and the *only* asset to which lenders and investors will have recourse in the event that the project falls into financial distress. This contrasts with the corporate financing model, under which investors and lenders can expect to have access to corporate revenues generated by the project developer, and to other assets on that developer's balance sheet in the event that revenues from the project are not sufficient to meet financial commitments. It also contrasts with the sovereign model, in which a sovereign host government takes an equity stake in the project, as well as potentially providing debt financing directly, or facilitating debt financing via the provision of a sovereign guarantee, and in which taxpayers constitute another potential source of revenues.

Although no NPP project has ever been project financed, this financing model is discussed extensively in this publication because many of the key ideas that underlie the financing of NPP projects (whether in pure project finance, a corporate or a sovereign context) are best explained within a project finance context. For example, one of the key messages of this publication — regarding the relationship between the efficient allocation of risks between project stakeholders and its potential for reducing the cost of finance — can be most clearly set out in a framework without the additional complicating factors present in a corporate financing model (such as the financial strength of the corporation or the rating of its debt by rating agencies).

5.2. STYLIZED FACTS ON FINANCING COSTS

Nuclear new build projects (with the exception of those developed and therefore financed on state budget allocations) are generally financed based on a combination of equity and debt funding. For each of these two components, various instruments exist, as outlined in Table 6.

Based on Table 6, the following stylized facts may be noted:

- As a matter of principle, access to equity is more onerous than access to debt, owing to the direct relationship that exists between exposure to risk and the cost of capital.
- The same reasoning applies to the pricing of debt, which depends on, inter alia, tenors and the degree of seniority; (senior) corporate debt market is historically the cheapest source of liquidity in the global capital markets.

TABLE 6. SUMMARY RANGE OF FINANCIAL INSTRUMENTS

Risk of exposure to bankruptcy →

	Financial instrument	Funding source
Equity		
Pure equity		
	Shares (common and preferred)	Shareholders
	Rights issues	
Quasi-equity		
	Convertibles	Shareholders, capital markets
	Shareholders' loans	Shareholders
Debt		
Junior debt		
	Bonds	Capital markets
	Loans (short and medium term)	Banks
Senior debt		
	Bonds	Capital markets
	Loans (short, medium and long term)	Banks

— Beyond the level seniority, the pricing of debt is also influenced by the degree of structuring involved in its arranging: in most instances, an unsecured loan in its simplest and most standardized form is going to be cheaper than a secured one for a given maturity. This is essentially due to the fact that the risk associated with such structuring[8] will typically generate a premium, which will subsequently be reflected in the price of that secured facility.

Figure 19 arranges potential types of finance along a continuum that ranks them a priori from relatively high cost to relatively low cost. This ranking embodies some of the stylized facts noted above (e.g. both long term and short term senior debt are less expensive than subordinated debt, but long term senior debt is more expensive than short term senior debt).

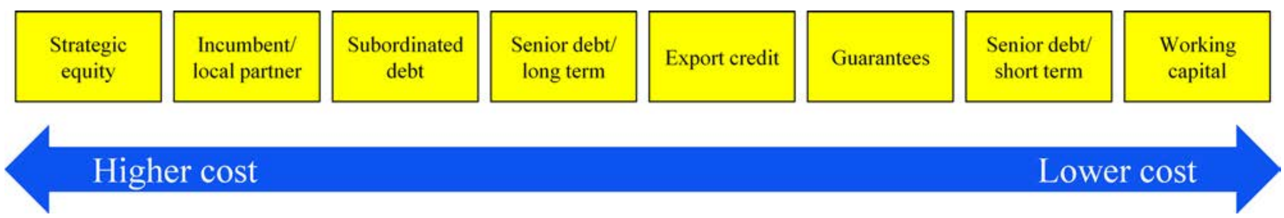

FIG. 19. Sources of finance.

[8] For example, the risk of a fault in the design/implementation of the structure put in place, or in the mechanism to execute it.

5.3. CHARACTERIZING FINANCING COSTS

In considering the cost and sources of financing for an NPP project a useful distinction can be drawn between direct and indirect sources. This distinction recognizes that finance to an NPP project will usually be provided via entities that must first themselves raise finance in some way. Those entities may either borrow or issue shares to raise that finance. Their cost of doing so (i.e. their *own* 'cost of capital') will play a large part in setting the price they will charge for providing financing to the NPP project. When they do advance financing to the project they may or may not choose to retain some of the risk profile; it is conceivable that a financing entity might borrow in order to fund an equity injection into an NPP project — effectively transferring additional risk on to its existing shareholders (since the lenders from whom it borrowed will enjoy priority over those shareholders should it come to resolving claims on the company's residual value in the event that the NPP project causes it financial distress).

The distinction outlined above will be reflected in the difference between the organization of the material in Section 5.3 and in Sections 5.6 and 5.7. The remainder of Section 5.3 will focus on the costs of finance of the financing entities (cost of capital) as a key determinant of what they will charge an NPP project developer for financing. Specifically, it will argue that financing entities will make financing decisions on the basis of a comparison between the returns available from the NPP project and hurdle rates, which may be viewed as consisting of a basic hurdle rate corresponding to their own cost of capital, and an adjustment reflecting both particular risk/return type considerations that arise in the context of a particular NPP project and other factors. In Section 5.3.1, a (strictly heuristic) introduction to the hurdle rate notion is introduced. In Section 5.3.2, the determinants of financing entities own cost of capital are examined, and in Section 5.3.3, a simple model of the decision whether or not to provide financing to an NPP project is introduced. It is important to note that this decision will be based on the adjusted (rather than basic) hurdle rate for each potential financing entity; however, the discussion of key determinants of actual financing costs (which will, of course, implicitly be a discussion of adjusting basic hurdle rates) will be postponed until Sections 5.6 and 5.7.

5.3.1. Hurdle rates: An intuitive introduction

The degree to which a (potential) financial stakeholder may be willing to lend to, or take an equity stake in, a nuclear development project can be characterized by employing the notion of a hurdle rate. A (potential) stakeholder's hurdle rate is the minimum rate of return it must expect to earn on the amount of financing it is contemplating providing for it to be willing to provide that financing.

It is important to recognize that a very wide range of considerations will factor into a financing stakeholder's hurdle rate.

Many of these will be recognizably related to risk/return factors. For example, an equity investor will generally set a lower hurdle rate (i.e. require a lower rate of return to induce it to take an equity stake in a project) when considering a less risky project than it would when considering a more risky project. Such an investor would be more likely to invest in (i.e. would set a lower hurdle rate for) a nuclear power project whose revenue risk had been allocated away from the project per se and on to electricity consumers via some form of electricity off-take agreement.

However, not all determinants of hurdle rates will be so evidently of this risk/return nature. Different potential stakeholders may perceive benefits from taking a financial stake in a project that extend beyond, for example, the dividends that an equity investor might expect to earn on its shares. As a further example, a consortium of energy intensive consumers might be willing to set a somewhat lower hurdle rate than might be justified on purely risk/return grounds insofar as it wishes to obtain benefits in terms of energy supply security from such an investment. Figure 20 illustrates a simple conceptualization of the hurdle rate idea. The basic rate shown will reflect the potential financial stakeholder's own cost of capital, an idea that will be discussed further in Section 5.3.2. Some factors that may to lead to the actual hurdle rate diverging from this basic rate are also shown. It should be noted that in general, the hurdle rate applied to a potential finance provider will tend to exceed the basic rate by a risk premium reflecting the risk inherent in providing finance (i.e. the risk of non- or only partial repayment of the finance provided and/or agreed return) even before any of the adjustments shown.

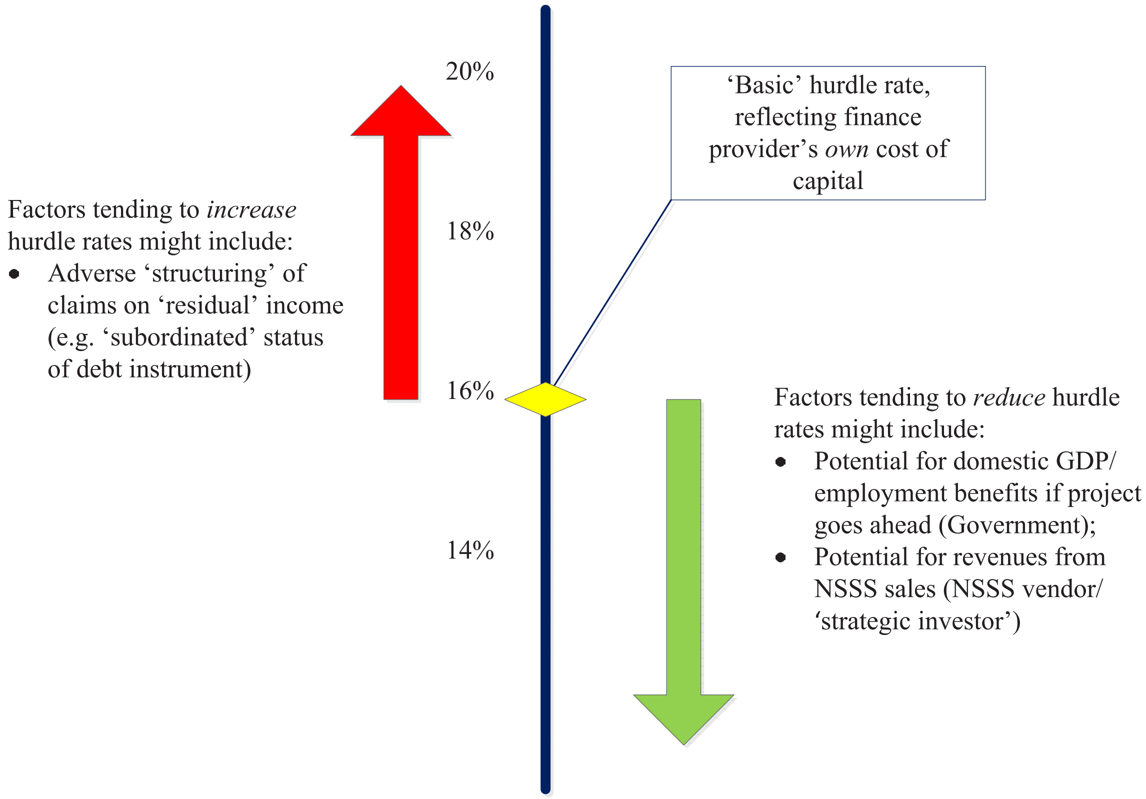

FIG. 20. Factors influencing financial stakeholders' hurdle rates.

5.3.2. Determinants of stakeholders' hurdle rates

In essence the basic hurdle rates employed by financial stakeholders contemplating providing financing to a nuclear project are based on those stakeholders' own cost of capital — i.e. the cost of raising the capital they will provide. At the stage at which they are deciding whether or not to make such an investment, those stakeholders will typically rely on benchmarking their cost of capital, i.e. estimating its likely cost ex-ante. Only after a final investment decision has been taken will the true cost of capital become known — when stakeholders actually raise that capital in the market by issuing debt or equity, or when the opportunity costs of providing financing from their own reserves can be computed based on observing the returns available on those reserves elsewhere. It should be noted that the implicit assumption here is that the project will follow a corporate financing model rather than an alternative project financing model (which would involve the issuance of debt and or other instruments by a specially set up SPV whose assets would likely be just those of the project itself as opposed to those of the project stakeholders' balance sheets).

The cost of capital borne by such sponsors is usually benchmarked by: (a) estimating the cost of equity, which represents purely the cost of raising incremental equity from existing or new shareholders; (b) estimating the cost of debt; and (c) assessing the WACC based on the assumed proportions of debt and equity in the overall amount that will be financed.

The remainder of Section 5.3.2 will focus on the estimation of the cost of equity (Section 5.3.2.1), the estimation of the cost of debt (Section 5.3.2.2) and the calculation of the WACC (Section 5.3.2.3).

5.3.2.1. Estimated cost of equity

The cost of equity to a company can be estimated in various ways. In its most basic form, the cost of equity can be calculated from a dividend capitalization model that estimates the cost of equity as a rate given by Eq. (2):

$$\textit{Cost of equity} = [\textit{Current dividend payout per share}] + [\textit{Dividend growth rate}] \quad (2)$$

This approach relies on a strong correlation and linearity of future dividends to current ones, which may be appropriate for a business in a very steady market with a high level of predictability of earnings (and by extension, the components of earnings: revenues, operating expenses, financial costs, depreciation, one off and exceptional gains and losses, taxes and, of course, retained earnings and cash levels).

Though certain utilities operate in environments that can be considered highly stable and predictable from a financial perspective, financial and energy market liberalization (in various forms) has, over the past 30 years, forced most of the world's utilities and their investors into a less predictable business environment. Over the past 20 years, many of the world's nuclear utilities have been exposed to increasing levels of market risk, as well as political intervention in domestic energy markets. Imposing increasing market pressure on once publicly owned businesses, such as power and water utilities, highway operators and airport owners, has proven one of the most pervasive developments of the global political economy over the past 25 years.

As governments have increasingly turned to investors and external lenders to finance infrastructure (or, alternatively, as they realize their dependence on external finance to deliver new infrastructure investments), it has been increasingly necessary for them to clarify and establish the cost of equity (or required return) for such investments.

An arguably more sophisticated approach to estimating a company's cost of equity than the dividend capitalization model is the capital asset pricing model (CAPM), which is perhaps the most commonly used tool to assess (or establish) the cost of equity for new infrastructure and energy investments. Under the CAPM model shown in Eq. (3):

$$\textit{Cost of equity} = \textit{Risk free rate} + \beta\ [\textit{Market premium}] \tag{3}$$

The principle of CAPM is that investors will seek a return on their equity investment that is a function of (a) the risk free rate, and (b) the riskiness of the investment itself relative to other equity investments. The risk free rate, as described above, represents the lowest risk investment in the market, typically government local currency borrowings. The market premium is the difference between the expected (equity) market rate of return and the risk free rate of return. Beta (β) represents the correlation of a company's share price with the broader equity market. A company whose shares move in perfect tandem with the broader equity index would carry a β of 1. A company whose share price reacts more sharply to broader movements in the equity market would have a β value greater than 1. When assessing a new business or investment, it is common to use the historical relative share price movements of a peer group to benchmark the beta value of the investment.

Governments may occasionally become equity shareholders in a new build project for various reasons. However, unlike corporations, they do not have shareholders, and subsequently fund themselves essentially from public sector resources (e.g. taxation, borrowing and money printing). For the purposes of this publication, the public sector's cost of capital may be taken to be represented by the cost of the domestic government debt.

5.3.2.2. Estimated cost of debt

In order to estimate its own cost of debt, a potential financial stakeholder in a nuclear development project may either draw on its own recent experience in securing debt financing (likely from either banks or via bond issues) or else may attempt to identify a recent debt financing that has taken place on terms comparable to those that it is considering (in terms of tenor, structure, etc.).

Arguably the simplest approach will be to assess the cost of its own recent borrowings. It is important to recognize, however, the relatively unusual nature of the commitment (either equity or debt) that would typically constitute part of a nuclear new build project financing, in particular its likely (very) long term nature. Some potential stakeholders (e.g. power utilities) may be familiar with borrowing for the purpose of making such long term commitments; others may not be.

If the potential financial stakeholder has issued bonds in the past, and if these are trading in a reasonably liquid secondary market, yields on these bonds relative to others will provide useful information on likely borrowing costs.

Furthermore, and — again — insofar as the potential financial stakeholder has issued bonds in the past, the credit rating of these bonds (if any) will provide important guidance as to the likely cost of borrowing. Credit ratings are an indicator of lender requirements, but are not a complete tool to estimate or predict debt costs. They are developed from a qualitative and quantitative analysis of the likelihood of a borrower's defaulting on its debt obligations. The credit rating scales published by the major agencies are shown in Fig. 21. Broadly, the higher a bond is rated, the lower will be the yield associated with it; the yields associated with the bonds issued by any particular potential nuclear finance provider will provide some guidance to what such an issuer might expect to pay were it to seek to (partially) fund its financing of that project via the issuance of similarly structured bonds.

In terms of quantifying the spread between the yield on investment grade versus high yield (or 'junk') bonds — and hence the likely additional cost of borrowing by an entity whose financial health (current balance sheet strength, outlook) justifies only a junk status — Fig. 22 is informative. The bond market generally follows the trend set by the risk free sovereign issuers, therefore, after 2008, bond yields fell steadily in both subinvestment grade and investment grade markets. However, the financial crisis of 2007–2008 showed the higher volatility of low-rated bonds, whose yields briefly exceeded 20%. Unrated sovereign and quasi-sovereign borrowers can typically rely on the bilateral credit arrangements with other sovereign borrowers, multilaterals and their agents (such as ECAs).

If it does not have recent borrowing experience, a would-be borrower may attempt to identify a recent debt financing that has taken place on terms comparable to those that it is considering (in terms of tenor, structure, etc.). Clearly this latter approach depends to a high degree on the transparency of relevant recent debt financing transactions, and it may be challenging for the potential financial stakeholder to identify a recent debt financing transaction that matches the one it is contemplating itself in all significant details, such as tenor, whether the loan is denominated in domestic or foreign currency terms, whether the associated rate will be fixed or floating, etc. If no information that permits the matching of a transaction is available, it might be thought that the use of a non-matching transaction may be of limited value. Concretely, for example, to what extent should a utility that is not based in the United States of America rely on the terms of a recent debt issuance by the United States Government, in US dollar terms, as guidance regarding how much it should expect to pay for its own borrowing in domestic currency terms?

	Moody's	S&P	Fitch	Meaning
Investment grade	Aaa	AAA	AAA	Prime
	Aa1	AA+	AA+	High grade
	Aa2	AA	AA	
	Aa3	AA−	AA−	
	A1	A+	A+	Upper medium grade
	A2	A	A	
	A3	A−	A−	
	Baa1	BBB+	BBB+	Lower medium grade
	Baa2	BBB	BBB	
	Baa3	BBB−	BBB−	
Junk	Ba1	BB+	BB+	Non-investment grade speculative
	Ba2	BB	BB	
	Ba3	BB−	BB−	
	B1	B+	B+	Highly speculative
	B2	B	B	
	B3	B−	B−	
	Caa1	CCC+	CCC+	Substantial risks
	Caa2	CCC	CCC	Extremely speculative
	Caa3	CCC−	CCC−	In default with little prospect for recovery
	Ca	CC	CC+	
		C	CC	In default
			CC−	
	D	D	DDD	

FIG. 21. Credit rating classes used by different rating agencies.

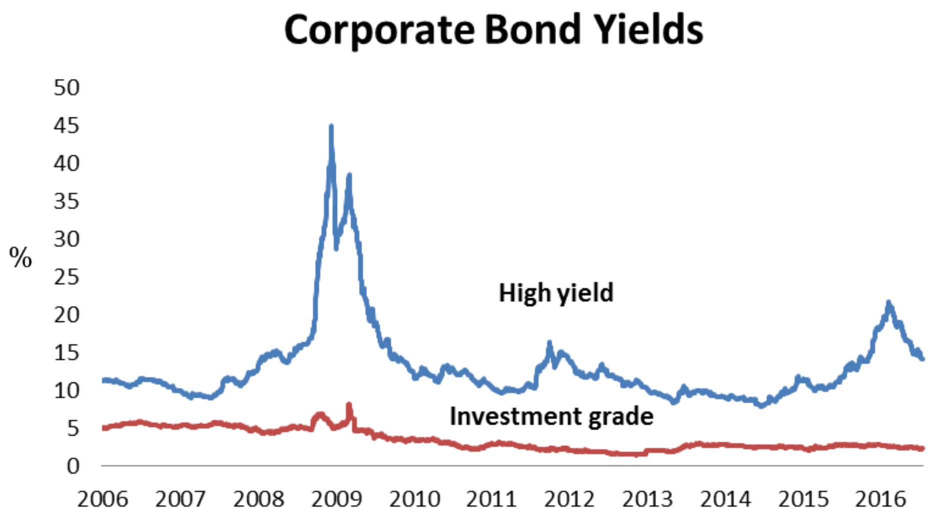

FIG. 22. Spread between 'investment grade' and high yield (junk) bonds 2006–2016 (Source: Federal Reserve Bank of St. Louis FRED Data [6]).

Although an obvious answer to this question might be that the utility should not rely on this guidance, it is possible that the terms and cost of the US Government issuance may contain valuable information, if only that, for example, the fact that the issuer had offered a 50 basis point higher coupon relative to that that it had offered 18 months ago might suggest (all other things being equal) that the likely cost of all forms of debt might have increased by roughly a comparable amount over the same period. The basic underlying idea here is that the cost of debt can be viewed as being composed of a number of components — or premiums — added to a risk free rate. If the risk free rate can be observed, and if these premiums can be regarded as having been stable over a period, then the size of the movement in the risk free rate over the last 18 months can be viewed as a good benchmark for movements in the cost of different types of debt; in other words, the cost of debt for a project of given riskiness may be expected to be 50 basis points higher today than the cost of the debt for an equally risky project 18 months ago.

As far as the observability of the risk free rate is concerned, the rate paid on US Treasury Bills of a given tenor is typically treated as a proxy for the risk free rate for US dollar denominated debt of that tenor.

Additional information may be inferred if it is possible to identify, or even price some of the premiums that together might add up to the spread between the risk free cost of debt (US Treasury bill rate, in US dollar terms) and the cost of, for example, a debt financing by a non-US utility in domestic currency terms. In such a case, and if the borrower were to undertake only to repay an amount denominated in domestic currency terms, it might be expected that its cost of borrowing would certainly exceed an amount equal to the US Treasury bill rate plus the cost (expressed in percentage terms) of the lender insuring (e.g. in the futures market) against an increase in the value of the US dollar relative to that of the domestic currency.

Similarly, turning to a consideration of whether the rate associated with a debt financing will be fixed or floating, the cost of obtaining a loan with a fixed rate (essentially transferring the risk of interest rate movements to the lender) might well be estimated by notionally decomposing that cost into an (observed) cost for a floating rate loan plus the (observed) cost of swapping a floating rate for a fixed rate loan.

The main point of the preceding discussion is that even where lack of transparency prevents a would-be borrower from identifying a recent debt financing transaction that exactly matches the one it is contemplating itself in all significant details, it may nonetheless be possible to develop a notional synthetic debt financing transaction that will match its own closely enough to provide some benchmarking type guidance on likely costs.

5.3.2.3. (Estimated) WACC

The WACC, which was introduced in Section 2.3, is the overall cost of financing that would be incurred by a (potential) financial stakeholder raising the amount that it will provide to the nuclear new build project in some form, and may be regarded as the basic hurdle rate. The calculation takes into account the relative weightings of equity and debt in the overall amount of financing, and is represented on an after-tax basis by Eq. (1). It will correspond approximately to the basic hurdle rate shown in Fig. 20. As noted in Section 5.3.1, however, this basic rate may be viewed as being adjusted by prospective financial stakeholder to reflect additional factors, including those factors that are not necessarily reflected in the nuclear development projects pure risk/return profile.

5.3.3. Modelling the basis of financial stakeholders' decisions: Project returns versus hurdle rates

A (potential) financing provider's decision on whether or not to provide financing to a project can be modelled as a simple comparison of the return expected from providing finance to that project versus the provider's adjusted hurdle rate. The nature of the adjustment that the potential provider will make to its basic hurdle rate (which will be based on its own cost of capital, WACC) has been touched on in Section 5.3.2, and will be discussed further in Sections 5.6 and 5.7. However, before discussing the metrics that different NPP finance providers will compare to their hurdle rates in deciding whether to provide financing, it is important to note that — in principle — any adjustment to reflect project specific risk/return characteristics could be made either to the basic hurdle rate or to the metric that (potential) finance providers will compare to the adjusted hurdle rate.

For example, in taking into account the risk involved in a particular project, a potential equity investor could either risk adjust its basic hurdle rate by increasing it by an appropriate amount, or else adjust the metric by decreasing it (i.e. computing the equity IRR (see Section 5.3.3.1.) based on risk-adjusted net revenues). This equivalence of approach can lead to confusion and should be borne in mind, particularly in considering the risk-adjusted return on capital (RAROC) metric outlined in Section 5.3.3.1.

5.3.3.1. Returns of interest to different financial stakeholders

Equity internal rate of return (equity IRR) is arguably the key metric for equity investors. In general, the IRR of a project is the discount rate that makes the net present value (NPV) of all (e.g. positive and negative) cashflows arising from a particular investment or project equal to zero. Focusing more specifically on equity, the equity IRR is the discount rate that makes the NPV of an equity injection (negative cashflow from an investor's perspective) and subsequent returns on that injection (e.g. dividends) equal to zero. This measure is typically expressed as a post-tax, deflated (real) value in percentage terms.

RAROC is a key metric for lenders. It is calculated the same way as an IRR is calculated, with the important distinction that the risk profile of the borrower will generate a risk adjustment to project revenues, based on an estimate of the probability of that borrower's defaulting — often as embodied in its credit rating (a further discussion of RAROC can be found in Ref. [7]).

5.3.3.2. Comparing project returns with stakeholders' hurdle rates

In general, and as is stated in most finance textbooks (e.g. Ref. [8]), the decision on whether to finance any project, including a new build NPP, can be modelled as a comparison of the internal rate(s) of return (IRR) generated by the particular debt instruments or form of equity used to finance that project and the potential financer's (or respective provider of such instrument's) own hurdle rate (see Fig. 23). So, for example, the potential provider of a senior debt tranche will design or analyse the terms of the loan agreement in order to calculate the IRR implied by those terms (including any fees, etc.). If the IRR exceeds their own hurdle rate, they will — according to the model — provide the senior debt.

As discussed in Section 5.3.1, the hurdle rate may not always be strictly defined by the financing party's own cost of capital (as defined by their own WACC). For example, an equity investor, or a (partial) project owner, may choose to invest equity with an expected return that is lower than their own cost of funds. This is often the case for nuclear utility project owners, whose broader businesses include assets of varying risk profiles and return levels. Project owners may opt to accept a lower notional or expected return than their own cost of capital, in the expectation that an upside event would be likely to materialize. Alternatively, the project owner may be prepared to accept a lower expected return because the project provides other, non-dividend-related benefits, such as electricity supply to an affiliate within the group (the utility's supply business, for example); the development or construction aspects are seen as an important learning curve by the utility's head office; or there may be other revenue streams

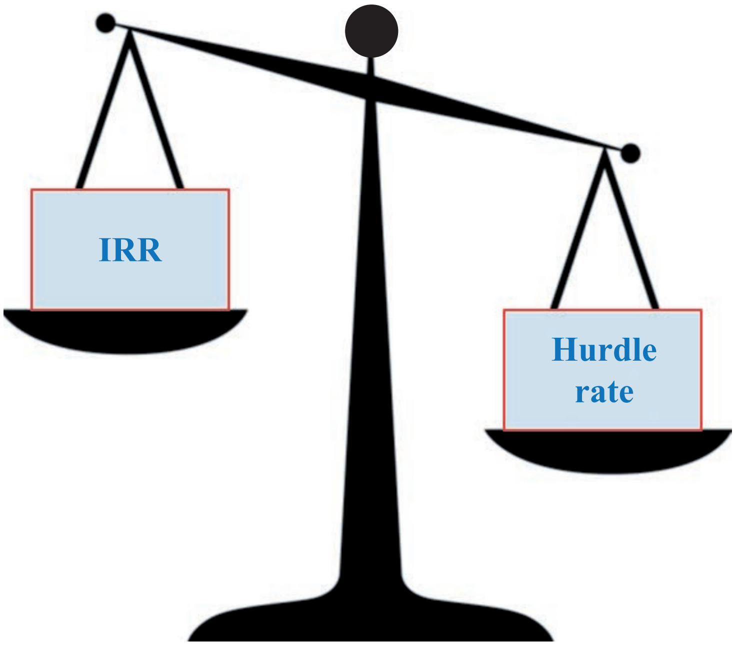

FIG. 23. IRR versus hurdle rate as a model of the financing decision.

that are not accounted for in the equity IRR, such as operation and maintenance (O&M) fees, fuel supply and servicing fees, and development fees, all of which would be paid out (to the owner's affiliates) above the dividend line. Such arrangements are common, as they enhance an owner group's returns while ensuring further control and protection of the project through the provision of such ancillary services. In all cases, the adjustments made to a stakeholder's hurdle rate can be conceptualized to reflect such considerations in the framework provided in Fig. 20.

5.4. FINANCING SOURCES AND TYPES AVAILABLE IN DIFFERENT PROJECT PHASES

The choice of an ownership and commercial structure defines, to some extent, the scope within which risk, including financial risk, may be transferred and allocated. This choice also influences the shape of the financing plan that needs to be put into place in order to deliver the investment proposal successfully. Ensuring bankability is a critical factor of success for procuring a new NPP. In that context, the early development of a resilient financing plan resulting from those choices contributes to managing the financial risk that is embedded in them, and supports its successful execution.

In that context, it is essential for the developer of the new NPP, and more broadly for the various stakeholders, to develop early in the investment planning process a clear understanding for the appetite and the tolerance for risk that potential finance providers, and more particularly debt providers, tend to typically display in the case of a nuclear new build project. Table 7 provides a generic summary of those appetites, and in particular how they may differ by project phase.

The terms used in Table 7 are defined as follows. Tier 1 shareholders are assumed to be core investment shareholders with an active role in the preparation, financing, delivery and operation of the investment, based on their skills, expertise, experience, etc. These would typically be utilities with experience in nuclear generation, for example. Tier 2 shareholders are assumed to be minority shareholders with a secondary, although active, role in the preparation, procurement, delivery and possibly the operation of the investment. These would typically be utilities without nuclear generation experience, or large suppliers (e.g. the vendor of the NSSS). Tier 3 shareholders are assumed to be minority shareholders with no appetite for a role in the preparation, procurement, delivery and operation of the investment. These would typically be financial investors (e.g. hedge funds, infrastructure funds, individual investors) buying on the primary or secondary equity capital markets, and looking for an income stream based on long term (revolving) cashflows.

TABLE 7. APPETITE OF (LONG TERM) FINANCE PROVIDERS FOR NEW NPP FUNDING

	Funding sources	Project phases			
		Development	Construction	Operation	Back end
↓ Decreasing capital loss exposure	EQUITY				
	State budget	✓	✓	✓	✓
	Tier 1 shareholders	✓	✓	✓	?
	Tier 2 shareholders	?	✓	✓	
	Tier 3 shareholders		?[2]	✓	
	DEBT[1]				
	Bond markets		?[3]	✓	
	Bank debt		✓	✓	

[1] It is assumed that the debt under consideration is senior. It may be unsecured or secured (e.g. backed by a collateral, which can be sold to repay the senior debt holders in case of default from the borrower to meet its debt service obligations).

[2] Depending on the ownership structure and the undertakings of the Tier 1 shareholders (notably with regards to completion), selected infrastructure funds might have some (limited) appetite for investing in a new build project during its construction phase.

[3] Depending on the ownership structure and the undertakings of the Tier 1 shareholders (notably with regards to completion), selected investors might have some (limited) appetite for lending money to a new build project during its construction phase.

Based on Table 7, and for simplicity purposes, the following may be noted:

— Risk encountered during both the development and the construction periods is primarily an equity risk from a funding perspective, e.g. a risk to be borne mainly by the owner of the new NPP and its shareholders.
— As a follow-up, providers of debt financing are not prepared, under existing market conditions, to take the risk of construction for a new build project. The onus is, therefore, primarily on the owner of the new NPP and its shareholders, but also on the other stakeholders with a critical role during construction (e.g. contractors, suppliers) to provide satisfactory undertakings with regards to cost overruns and delays, and completion (including a completion guarantee).
— During construction, commercial banks and, to some extent, certain ECAs are the main source of debt financing. This is mainly due to their experience in financing large capital intensive infrastructure projects and in managing the changes and variations typically encountered during the long construction periods of such projects. The pool of banks is, however, more limited when it comes to financing nuclear new builds, which is due to the specifics of that industry.
— After COD and during the operation period, and in line with the risk profile of an NPP, the universe of (long term) finance providers is broader (including funds and institutional investors), with more debt products available on the market (notably long dated bonds).

5.5. DEBT TO EQUITY RATIO

Among the various issues to be considered when preparing a funding plan for a new investment, the choice of an appropriate debt to equity ratio is, therefore, of critical importance, in particular in the context of the development of a new NPP based on a corporate or a project based ownership structure.

To date, successful financing structures for nuclear new build projects have been conservative (as opposed to, for example, more innovative project finance type approaches). This is due to the fact that historically most nuclear power projects have been developed on the basis of either sovereign programmes or corporate structures. Typically, the features likely to be found in most corporate structures[9] include relatively low debt to equity ratios[10]; strong and long lasting commitments from the owner of the new NPP, in particular during the development and construction phases; and (in most instances), direct recourse to the shareholders of the owner of the new NPP. That type of structure may arguably be more expensive from a strict WACC point of view as the infusion of more equity will increase the WACC. It may also prove to be more onerous for the owner of the new NPP and its shareholders, who would need to factor into the overall capital cost of the investment the cost of any (direct or indirect) guarantee and/or undertaking they would provide in addition to their equity commitment. Furthermore, it may not maximize the provision of (long term) debt financing by financing sources from the private sector (e.g. commercial banks). However, it generally tends to support a successful and timely delivery of the investment as well as speedier raising of the debt financing. The increased speed is primarily because although the lenders would look at the economics of the new NPP project, they would ultimately be looking at the overall business activities and creditworthiness of the owner of the new NPP, and, if need be, at the credit standing of its shareholders. Any such analysis is likely to be relatively straightforward. By comparison (using the example of the IPP model developed for financing new conventional thermal power plants), lenders would be looking into the details of, inter alia, the economics and the contractual arrangements of a new NPP project, which would be developed on a project based structure. This is because, as noted, the lenders would only have limited recourse to the shareholders for a defined period of time (usually the construction phase), and would then only rely on the investment's future cashflows from operation to service their debt (e.g. payment of interest and repayment of principal).

A brief focus may be introduced at this stage on the recent attempts seen in nuclear new build projects to develop a more sophisticated underlying contractual basis for a selected number of corporate based ownership and commercial structures with a view to improving the debt to equity ratio of the underlying investment proposal. Although not project financing per se, it is broadly understood, although few details on the structure of these transactions are available in the public domain at present, that those investment proposals have been trying to allocate a degree of construction and operation related risk to third parties, which would otherwise have been borne entirely by the owner of the new NPP and its shareholders.

These attempts are based on a series of detailed risk sharing contractual arrangements, which have been developed to support what remains otherwise essentially a corporate based ownership of the assets. Furthermore, it may also be noted that these ownership structures have themselves become more complex, e.g. not dependent on one single shareholder, but shared between a number of equity stakeholders. While the final balance of the obligations and responsibilities of the various parties involved remains to be ascertained with more clarity, it may be noted that the leverage targeted by some of these investment proposals has been somewhat higher than that typically found in straightforward corporate based transactions, with debt to equity ratios in the region of 70:30.

5.6. EQUITY FINANCING

5.6.1. Types of equity, sources of equity and qualitative benchmarking of equity cost

Careful and early planning of an appropriately sized funding programme is critical to support the construction of a nuclear new build project, owing to the quantum of the investment. The owner of a new NPP needs, therefore, to attract a broad range of finance providers (e.g. equity investors and debt providers) over the life cycle of the plant. However, the owner needs to acknowledge upfront in the process that said financial partners will have different requirements and rationale for considering an involvement in the financing of a nuclear new build project.

[9] The following discussion focuses on the corporate based structure. This is to highlight the focus and the importance given by the finance providers to sound and bankable metrics. (From a lender's perspective, a sovereign based structure arguably relies on a less detailed analysis, since it is recognized that the residual risk ultimately lies with the credit standing of the host government.)

[10] While IPP projects for conventional thermal power plants have typically been developed worldwide based on debt to equity ratios of up to 90:10 for contracted plants and 70:30 for merchant plants, corporate based transactions have been more accustomed to ratios in the region of 60:40. For NPPs, although no project financing has been successfully put into place to date as noted, recent attempts to develop more structured corporate based schemes (e.g. corporate structures with an extended contractual basis in order to allocate risk, to some degree and under certain circumstances, to third parties) envisaged debt to equity ratios in the 60:40 to 70:30 range.

In particular, it is important to remember that for equity investors that such rationale will most likely have little to do with their assessment of a pure risk/return analysis only[11]; other factors will drive their decision, as illustrated in Table 8.

TABLE 8. RANGE AND MOTIVATION OF POTENTIAL EQUITY INVESTORS IN A NUCLEAR NEW BUILD PROJECT

Would-be investor	Selected key drivers
Government	— National interest (e.g. development of national programme) — Political support — Risk sharing — Partnership (sovereign, commercial, technological, etc.) — Energy diversity and security
Nuclear utility	— Geopolitical relationship between sovereigns — Partnership opportunity with local incumbent — New build construction and project management role — Long term rationale for country risk
Non-nuclear utility	— Capacity expansion through diversification — Partnership with owner/operator — New build experience — Political relationship building
Contractors (primarily vendor of NSSS and supplier of large equipment)	— Finance of equipment purchase by client — Equity in lieu of collateral/performance security — Temporary (e.g. bridge) finance (e.g. until COD)
Energy users	— Certainty of long term supplies — Economics of pooled purchasing power — Avoiding of offshoring manufacturing facilities
Distribution company	— Certainty of long term supplies — National interest, strategic sector
Trader	— Access to long term supplies — Economics of pooled purchasing power
Financial investor	— Consistency with long term investment strategy — Relationship rationale — Financial return versus risk profile

A number of the would-be investors listed in Table 8 would be regarded as contributors of so-called strategic equity — as strategic partners in an NPP project. An important example of the strategic equity that is increasingly sought by NPP project developers is vendor equity. Vendor equity represents an increased degree of commitment by vendors (e.g. NSSS suppliers) over and above that made when vendors, for example, facilitate financing from sources such as relationship banks or ECAs, or when they provide short term credit (e.g. construction loans). In providing equity — i.e. in providing financing in return for a share in future net incomes generated by a project — a vendor takes on more risk than would be the case if it were to restrict itself to merely facilitating financing or providing short term credit; from a risk perspective, shareholding is a riskier proposition than lending, and much riskier than simply selling. Compared with other sources of finance, vendor equity may be expected to be relatively expensive; however, it may have the added advantage in ensuring that a key contributor to the

[11] Even a financial investor, if acting as a shareholder, would almost certainly only do so as part of a broader commercial (or financial) arrangement within the context of a long term relationship with the owner of the new NPP or its shareholders.

success of an NPP project has an interest in ensuring that project's success. Vendor equity is likely to constitute a relatively small part of overall financing in many cases; it may also be contingent on provision of an exit strategy (e.g. the guaranteed right to sell shares to other shareholders after a certain point in the project life cycle).

The utilities in Table 8 might be potential sources of incumbent or local partner equity. Joint ventures are often the preferred approach for nuclear investors, and in that context, a utility that is incumbent in and familiar with a particular market can be an attractive partner for an NPP project developer. Incumbent and local partners may have experience with dealing with local regulators, and can often make an in-kind equity contribution (such as site and/or infrastructure).

5.7. DEBT FINANCING

The nature of the debt financing negotiation (between project developer and potential lender) will typically reflect the nature of the broad risk/return profile that lenders accept in agreeing to participate in the financing of a project. Lenders enjoy a potentially more limited downside than equity investors (since they enjoy priority in claims on residual project value in the event that a project suffers financial distress, resulting, for example, in the need to seek additional financing, or even bankruptcy). However, lenders also suffer from a more limited upside; in the event that the project is more successful than anticipated it is the equity investors who will enjoy the resulting economic benefits. In a sense, the best outcome lenders can ever hope for is that will be repaid (both the money they lend and the interest that was agreed).

In this context, potential lenders to an NPP project (or any project) will focus considerable attention on a given project's ability to service its debt, i.e. to repay the principal and interest. In general, lenders' appetites to take on risk regarding such repayment will be limited. Insofar as a project's ability to service its debt is uncertain, lenders will typically be unwilling to lend to that project, regardless of the interest rate that is offered.

This downside risk aversion manifests itself in the two step nature of the debt financing process, and in a focus (during the first of those two steps) on the evaluation of liquidity metrics designed to assess a project's ability to service its debt.

During the first step of a lending process, lenders will focus primarily on allocating and mitigating risks. Depending on the ultimate risk allocation and security package agreed, they will negotiate remuneration, but this discussion comes after the risk profile of the project has been agreed.

However, there are risks that banks will not enter into. This implies that said risks would need to be borne by the equity providers, if the transaction were to reach financial close (for example, banks would likely be unwilling to take the completion risk of a nuclear new build project, even if the sponsors were to double the margin of the senior debt).

Much of Sections 2–4 has covered the issue of risk allocation, and during the first step of a lending process many of the issues and approaches discussed will be relevant to providing lenders with assurance that their exposure to various risks will be limited. After briefly introducing the types and sources of debt in Section 5.7.1, the focus of Section 5.7 will turn in Section 5.7.2 to a discussion of the metrics that lenders use to assess projects' viability in terms of their ability to service their associated debt. By way of an example of how these (and other) liquidity metrics are employed in the lending sphere, Fig. 24 sets out the boundaries of what is typically acceptable to banks contemplating lending to a power utility, as well as the range of metrics that would qualify a utility's bonds for different ratings.

The ways in which the cost of debt can be benchmarked are discussed in Section 5.7.3. The first part of this discussion is perhaps most relevant to a consideration of how a bank or other lender might benchmark its own cost of capital and, in particular, the way in which a basic hurdle rate can be viewed as being modified in light of a range of factors.

5.7.1. Types and sources of debt

There are two main sources for raising debt in order to finance large, capital intensive infrastructure projects, namely the bank market and the debt capital markets. Within that context, there is a broad range of debt instruments that can be used to finance the construction of a new NPP; commercial bank loans and bonds are the most commonly used instruments to raise the sort of long term financing that is needed by a nuclear new build project.

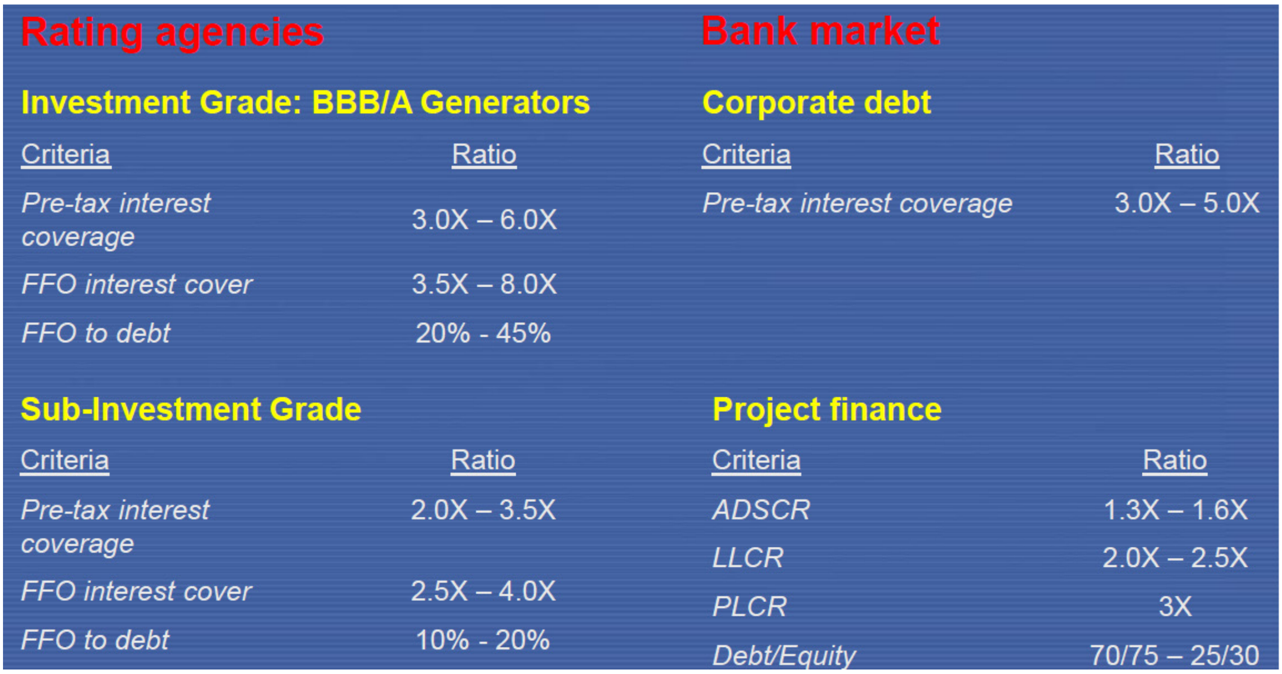

FIG. 24. Financeability metrics for power utilities.

In addition to raising equity, the owner of a new NPP will, therefore, draw major benefits by deploying these tools in a complementary way, based on their respective advantages and relative disadvantages. Although it is difficult to enter into greater detail at this stage,[12] the following may still be noted in connection with loans and bonds.

Based on the expertise and experience of their teams, commercial banks can usually bring valuable structuring skills to bear, which may lead to more tailor-made loan financing solutions to support the specificities of an investment. Furthermore, commercial banks can display some flexibility during the construction phase, when the original disbursement schedule of their loan may need to be revisited in order to adapt to a revised construction schedule. However, under the prevailing market circumstances, banks have little incentive at the time of writing[13] to stretch the maturities of their loans to their fullest extent; they may eventually do so but at a (relatively) higher price. Nevertheless, certain combinations of bank loans and insurance coverage may allow for longer maturities, in particular for the financing of exports through the use of export credits.[14]

Compared with bank loans, bonds offer (very) long tenors of up to 40 years,[15] which are well suited, as a matter of principle, to the financing requirements of assets such as nuclear new build projects, which have long economic lives. However, the money raised through a bond is typically made available to the borrower in one single (large) lump sum, which may not fit well with a new build project's spending curve and may subsequently trigger an onerous cost of carry. Furthermore, bonds have a rather non-flexible amortization profile, which makes them arguably ill-suited to adapt to changes in an investment's cashflow stream due to a longer than expected construction phase, for example.

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[12] The specifics of an investment proposal may impose particular requirements and/or restrict the use of certain financial products, for example.

[13] No increase in incentive is expected for the years to come, notably owing to the new regulatory environment for banks and financial institutions (e.g. Basel III, Solvency II).

[14] See the appendix of Ref. [2] for a more detailed presentation of ECA backed loans for the financing of nuclear (new build) projects.

[15] As noted, the world of corporate bonds is very developed, with standard tenors at 3, 5, 7 and 10 years; certain issuers with a strong financial credit history can raise bonds with 20, 30 and even 40 year tenors. Project bonds have been widely discussed for a number of years; however, these instruments are more suited to the refinancing of projects in activity than of projects in construction.

5.7.2. How debt providers measure risk acceptability using liquidity metrics

Debt service cover ratio (DSCR) represents one of the fundamental risk metrics for project lenders. Defined generally as CFADS[16] divided by the debt service requirement in the given period (interest and principal repayments), the DSCR has a major impact on a project's cost of capital. A risky project will attract a higher DSCR requirement from the lenders, providing a strong period by period cashflow buffer against downside risks (such as lower electricity sales and prices or lower plant availability). Lenders will assess and propose the DSCR constraint within a broader debt sizing framework to assess the maximum credit capacity for the project. Other things being equal, a high DSCR will have a scissor effect on a project's cost of capital, since the excess cashflow (if any) after debt is serviced will typically fall into the shareholders' account (provided no other unfunded liabilities exist in the project at that time). Hence, a DSCR of 2.0X would channel 100% of the full debt service requirement (i.e. the amount of the unused DSCR cushion) into the shareholders' accounts, providing a return in that period. This can push up equity returns, making the project cost of capital uncompetitive. A variant of DSCR is the average debt service coverage ratio (ADSCR), which is the average of the period by period DSCRs over the life of a loan.

Loan life cover ratio (LLCR) represents another important variable in the assessment of a project's credit capacity. LLCR is the measure of a project's expected CFADS over the remaining life of the debt (up to the contractual maturity date). This represents another important cashflow based coverage measurement, which is powerful because it captures total project CFADS and compares it with debt outstanding (the ratio would obviously have to be greater than 1.0X at any point in time, and for large, stable cashflow infrastructure projects, it can usually be seen in the 2–3X coverage territory). LLCR is less reliable than DSCR, however, as it uses forecast rather than actual period CFADS, which are discounted to a present value figure. Importantly, however, LLCR is influenced by the debt tenor, so the longer the repayment period, the longer the capture of CFADS under this calculation. A variant of LLCR is project life cover ratio, in which lenders calculate the present value of the CFADS over the full project life (beyond the final maturity date of the loan). This can be justified on the assumption that secured lenders theoretically can control a project's CFADS until the loan is fully repaid.

5.7.3. Benchmarking the cost of debt

Loans exhibiting the following risks will be subject to bankability analysis and premium pricing (i.e. lenders will set a higher hurdle rate in contemplating lending involving these risks):

- Structuring risk, for example, when cashflows may be encumbered or lenders are in a structurally subordinated position;
- Greenfield or construction risk, when project completion is necessary for debt to be repaid;
- Documentation risk, when cashflows depend on the terms of asset specific agreements (such as concession, or acquisition or divestment);
- Due diligence risk, when the borrower's risk profile and repayment capacity must be independently assessed by the lenders (such as market risks, operating risks, regulatory risks);
- Underwriting or syndication risk, when an arranger commits to and funds a loan or bond ahead of general syndication (for loans) or book building (for bonds);
- Liquidity risk, when a loan commitment is made and held over a long period of time, or the loan tenor is long, and the asset cannot be profitably funded by the lender, usually owing to market disturbances;
- Pricing risk, when market conditions or the borrower's condition changes such that the loan or bond price (a function of its margin or coupon and maturity profile) no longer reflects the original risk profile of the loan or bond (which may force the lender or investor to take a mark to market write-down on the asset);
- Asset–liability mismatch risk, when the loan or bond profile cannot be matched to the lender's or investor's funding source (this can happen in amortizing loans or bonds, typically in long term project finance).

These and other factors are summarized in Fig. 25.

[16] A somewhat related measure is that of the flow of funds from operations, which is the cashflow after meeting operating expenses, including taxes, interest and preferred dividends but before inflows or outflows related to working capital.

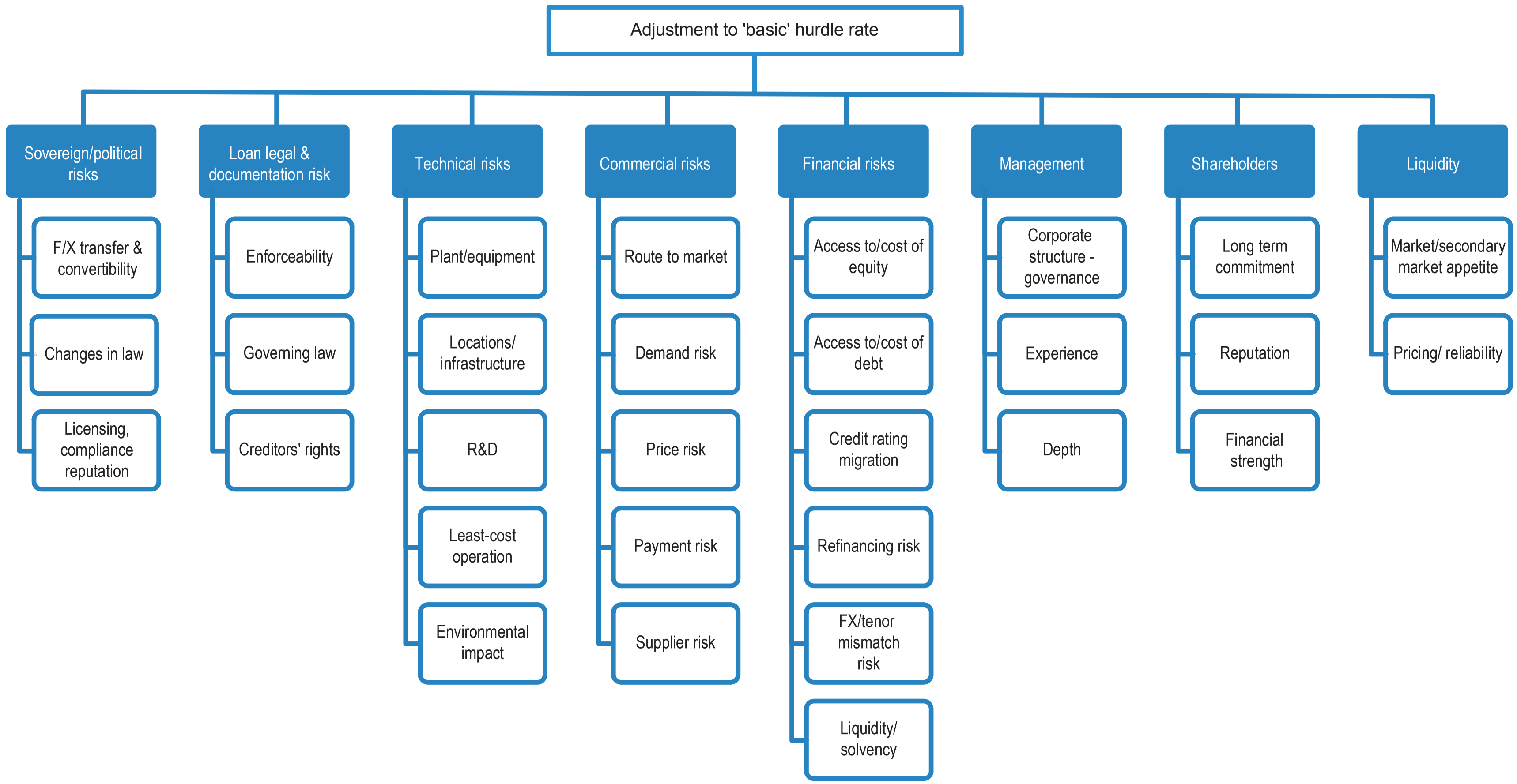


FIG. 25. Adjusting the ‘basic’ hurdle rate.

5.8. FINDING AN ACCEPTABLE PROJECT RISK ALLOCATION

As illustrated in Fig. 1 in Section 1.1, the overall process for risk allocation for an investment in a nuclear new build is sequential and iterative. It involves identifying, analysing and (re-)allocating the project risks between the stakeholders in the new build project, and typically in return assigning parts of the project's expected revenue streams to these same stakeholders. This process can be viewed as a search for the point at which every project stakeholder is satisfied with the share of the project's overall revenue stream that the project developer has offered them, given the risks that they have been allocated. The discussion in the context of the financial stakeholders above suggests that this search can be viewed as a process whereby the project developer proposes revenue shares to stakeholders and those stakeholders decide whether to accept or reject these proposals by comparing the implied return metrics (e.g. equity IRR for equity providers) to their own adjusted hurdle rates. This idea will be outlined further in Section 5.8.1, where the notion of the tendering authority, or utility negotiating an electricity off-take agreement, as a third class of financing stakeholder that must be satisfied with the eventual risk allocation (in addition to investors and lenders) will be emphasized. Section 5.8.2 introduces a broad framework for thinking about the overall process of reaching an acceptable overall project risk allocation for all stakeholders (not only financial stakeholders) in a project.

5.8.1. Introducing a third financing stakeholder

As discussed above, the risk/return profile that is eventually acceptable to the owner of the new NPP, and more broadly to the various stakeholders involved in the procurement and the delivery of the investment, may be thought of as the point of convergence of various factors, including the project economics, shareholders' and other stakeholders' requirements, and market standards. In deciding whether to participate in a project, investors and lenders will evaluate the key metrics that concern them, relative to their own adjusted hurdle rates. Figure 26 illustrates this idea by highlighting the metrics that will be of concern to the three different classes of financing stakeholders, and the interdependence between the actions needed to satisfy each stakeholder. Assigning a larger share of project revenues to lenders will, all other things being equal, lead to a lower share being available for investors, and vice versa. Ensuring that all lenders and investors are satisfied when they assess the revenue streams and returns on offer by the project developer (as captured by the metrics shown in Fig. 26) against their adjusted hurdle rates is the key challenge in financing a nuclear new build project.

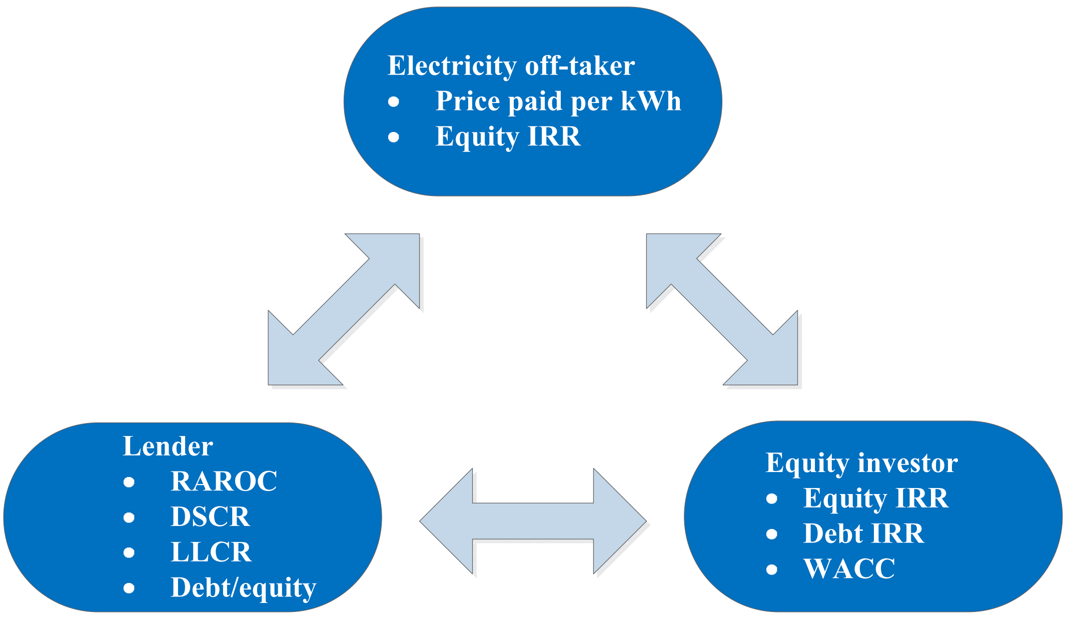


FIG. 26. Metrics of interest to different stakeholders.

Figure 26 introduces a third class of financial stakeholder: the tendering authority or electricity off-take agreement counterparty (labelled the ‘electricity off-taker’ in the figure). Clearly one approach to ensuring that all lenders and investors are satisfied with their share of project revenue streams (i.e. their returns) is to increase the value of the overall revenue stream by increasing the per kW·h payment terms in the electricity off-take agreement. However, there may be some reluctance on the part of the tendering authority to allow the cost of electricity from a new NPP to be out of line with, for example, current or projected wholesale electricity costs in the market. In this sense, the challenge of reaching a point of equilibrium is a matter of reconciling three classes of financing stakeholders to a set of arrangements that specify electricity price, returns to lenders and returns to investors.

Reaching the point of equilibrium is based on a combination of, inter alia, in principle expectations (in terms of maximum exposure to financial liabilities, profitability targets, etc.) and a comprehensive and detailed analysis of the specifics of an investment. A broad economic analysis is subsequently needed in order to determine the ‘field of the possible’, which can bring together the different expectations and requirements from all the stakeholders involved in the preparation and the procurement of the investment proposal. Such analysis will be refined during a succession of phases and steps, each of which will move a succession of financing proposals closer to an eventual point of convergence in an acceptable set of returns, as will be outlined in Section 5.8.2.

5.8.2. Locating financing in the overall search for acceptable risk allocation

The process of allocating risk to the financing stakeholders, and achieving agreement on the returns that those stakeholders will receive, is essentially part of a broader process of allocating risk across *all* project stakeholders, including commercial stakeholders (such as EPC contractors), financing stakeholders (such as ECAs) and parties involved in guaranteeing the project’s revenue stream (for example, an electricity utility or set of electricity wholesalers). This process can be viewed from the perspective of the project developer concerned as a series of steps, as shown in Fig. 27.

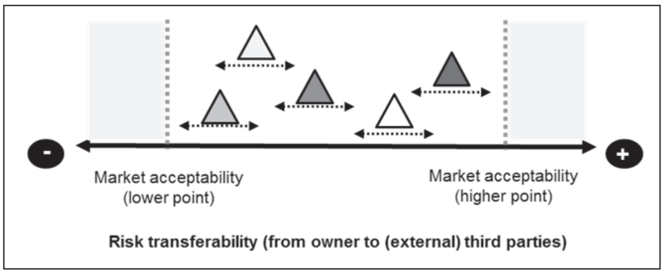
As mentioned previously, the overall process of risk allocation is sequential and iterative, based on the various stages identified above and the developments of the commercial and contractual negotiation between the various stakeholders. Once the various contractual arrangements have been agreed and the project risks (including the financial risk) have subsequently been allocated and adequately mitigated, an ultimate assessment of the investment case is performed by the owner of the new NPP and its equity shareholders, before a final approval is given.

As noted already, the economic analysis of an investment opportunity for a nuclear new build is based on an exhaustive due diligence process (covering legal, regulatory, technical, economic and financial matters) that includes the definition of an investment base case; the preparation of (long term) financial projections to assess its resilience; and the testing of a broad range of costs and price variation scenarios in order to stress test it. Financial modelling is a tool to assist in that part of the decision making process. In fact, it is one of the key tools to be used by the future owner of a new NPP in order to develop a bankable investment proposal for its construction and financing; for an investment proposal to be bankable, it would need to demonstrate, inter alia, that it will generate sufficient cashflows in the future, benefit from an appropriate collateral and have a high probability of success (in its implementation and operation).

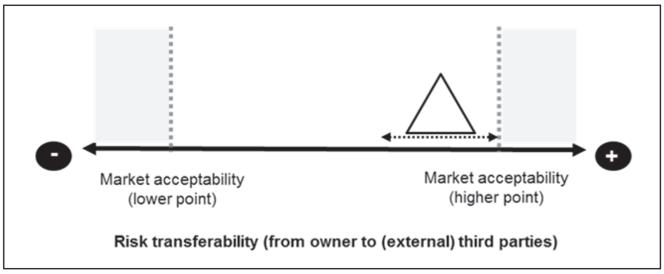
Long term financial projections will be developed by the owner of the new NPP very early on, and will then be updated on a regular basis, as and when the ownership and commercially related input changes and/or the technical, economic assumptions etc. vary. A financial model needs to be designed to that effect. The purpose of the financial model is, inter alia, to illustrate how project risks and risk allocation (inputs) will flow through the NPP’s cashflows and capital structure, and to generate a series of financial metrics that will allow key stakeholders (e.g. primarily equity investors and lenders) to assess the project risk profile, and more broadly the economic sense of the overall investment opportunity, notably in terms of both: (a) bankability (e.g. minimum investor and lender thresholds); and (b) capital recovery risk (e.g. ability to service debt and pay dividends across various project structures, and each structure’s ability to withstand downside risks).

When developed on a standalone basis, the financial model is typically designed on a cost recovery principle, meaning that the new NPP’s cost structure determines the revenue requirement (or cost recovery tariff or electricity price) in each calculation period. As the majority of the costs of an NPP are capital recovery related (e.g. equity and debt), the revenue requirement (e.g. a cost recovery tariff) is calculated by the financial model at a level that must satisfy the given risk parameters of the owner of the new NPP and the finance providers (in particular, the lenders).

In Step 1, the various project risks are priced individually, based on a preliminary in principle allocation to the relevant parties.

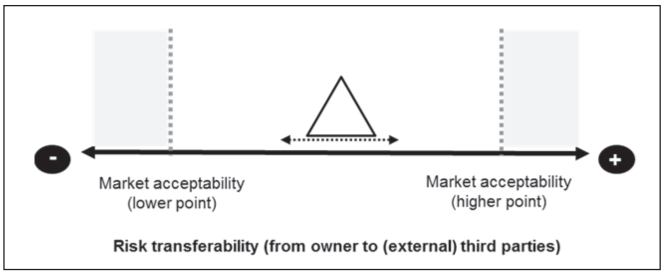


In Step 2, the combination of the various project risks leads to a specific risk profile for the new build project, upon which a first assessment of the project's cost of capital can be undertaken by the owner of the future NPP.



In Step 3, now that the project has been assessed, its cost of capital can be tested against any relevant benchmark(s).
A typical interval of acceptability for cost of capital would be between the minimum cost of funding required for financing a business of a similar nature, including a premium for the project (based on a conservative ownership and contractual structure) and the maximum cost of funding that could be sustained by the project's economics and would be acceptable to the market.

Step 4 is a detailed assessment; based on the outcome of the preliminary round of assessment of the project risks and the cost of capital, the owner and other stakeholders (e.g. suppliers, contractors) enter into more detailed discussions about various key parameters of the investment, including project and financing costs. Further to such negotiation, a revised allocation of the project risks is likely to lead to the revisiting of their pricing and hence of the cost of capital.



In Step 5, the project's cost of capital, once re-assessed, can again be tested against any relevant benchmark(s), as outlined in Step 3 above; it should be noted that the outcome of Step 5 may lead to another series of iterations between the parties, before an equilibrium may eventually be found between risk allocation and the cost of capital.

FIG. 27. Allocating risk across all project stakeholders, from the perspective of the project developer.

5.9. PHASED FINANCING

As a follow-up, it would subsequently be perfectly reasonable for the owner of a new NPP to give due consideration to a phased approach to the financing of the investment. The objective would be to better match the financing of the NPP with its risk profile in order to more carefully manage — and ultimately to reduce — the overall cost of capital of the new build project. In particular, the differentiating of the funding structures during the various phases of its life (as noted, there are four phases in the life of an NPP, including the development, construction and operation period) could be envisaged. With such a strategy, the owner of the new NPP could revisit the original balance of the funding sources used and the usage of the various funding instruments selected. In that context, the development of a refinancing strategy needs to be considered early and factored into the overall economic assessment of the investment proposal, which would — for example, after COD — lead to the reviewing of the funding structure originally put in place in order to reach financial close.

As illustrated in Fig. 28, a nuclear new build project becomes a less risky investment proposal from both an equity investor's and a lender's point of view once the NPP has started its commercial operations. This is because the construction risk has disappeared, the NPP's teething problems in its early years of operation have been (or are being) rectified, and the NPP delivers more stable and revolving cashflows, based on its regular production of baseload electricity.

A refinancing strategy may, therefore, be developed and implemented by the owner of the new NPP, whereby some new long term debt could be raised, which would be used to repay: (a) the debt originally raised for the project and replace it with new debt raised on the debt capital markets; and (b) a portion of the shareholders' equity invested in the project.

As a result, the shareholders should be able to improve the economics of the NPP project, and ultimately the profitability of their investment in it. That overall objective would be supported by, inter alia, the following benefits:

— Better pricing for the newly raised debt, mainly because it would be borrowed after the NPP has achieved completion and commercial operation has started. The construction risk would, therefore, no longer be relevant to the assessment of the project risks, which should support a downward revision of the interest rate, and more particularly of the margin charged to remunerate the risk.

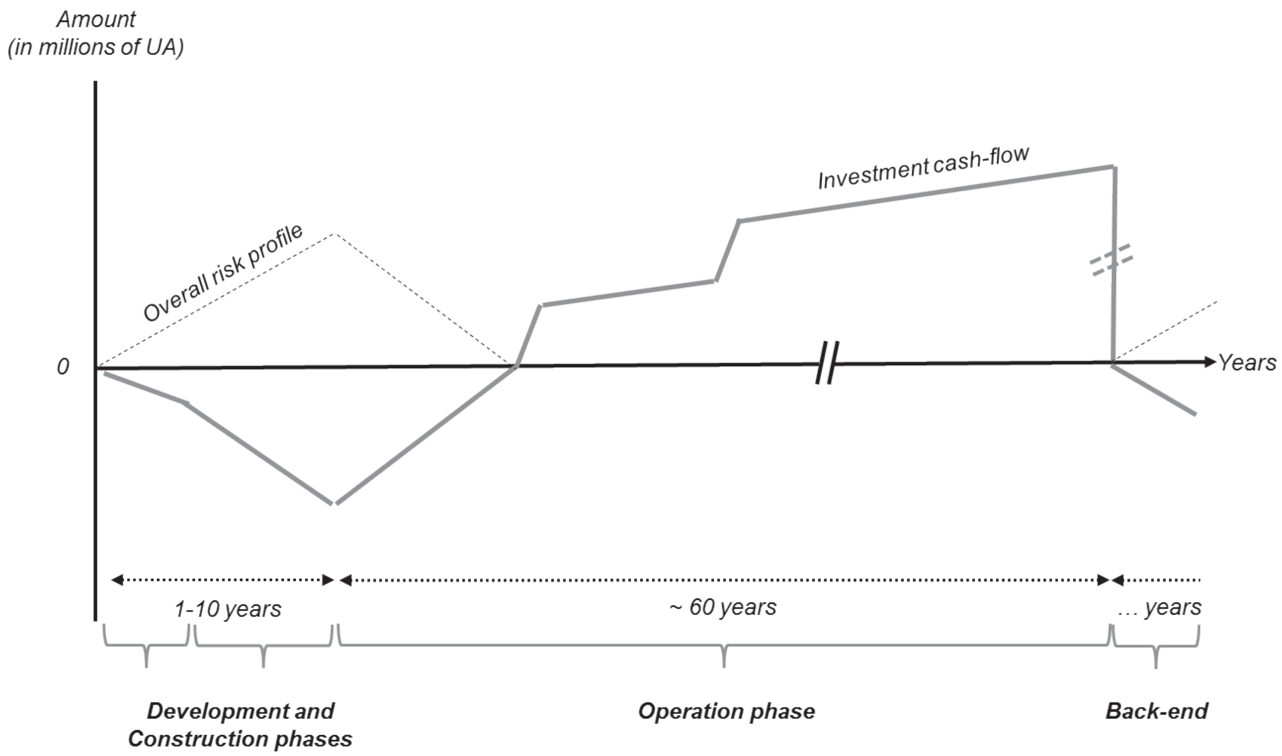


FIG. 28. Illustrative overall cashflow profile of a nuclear new build project.

— Longer tenors for the newly raised debt based on the replacement of the bank debt raised to reach financial close with tenors of up to a maximum of 18 years. This is the longest maturity achievable to date for bank debt through an ECA backed bank loan, based on the latest OECD rules [9] for export credits for the nuclear sector, and a typical linear amortization[17] profile by debt to be raised primarily on the debt capital markets (e.g. bonds) with tenors of up to 25 or 30 years and with balloon or bullet[18] repayment profiles.
— Early equity release combined with an improved debt to equity ratio is achieved through the payment of an early exceptional dividend further to the repayment of a portion of the shareholders' equity invested at inception and during the construction phase, using part of the newly borrowed debt to that effect.

Further, when put in the context of a de-risking of the investment,[19] the combination of the replacement of equity with (new) debt and the refinancing of the debt originally raised should eventually lead the owner of the new NPP to seek to maximize to the fullest extent possible[20] the debt to equity ratio of the project, subsequently increasing the leverage of the transaction, and ultimately supporting a more favourable stream of dividends for the shareholders over time.

Finally, depending on the ownership and commercial structure selected to procure and deliver a new build project, it may be relevant, and necessary in some instances, to plan early for the refinancing of the investment in a new NPP. As a consequence, there will likely be benefits (and, to a certain extent, a need) to reflect such a possibility in the contractual arrangements supporting the delivery of the investment when they are drafted and negotiated (e.g. during the development and the preparation phases). In particular, this would be very relevant in the context of a structured corporate based scheme or a project based structure.

6. CONCLUSION

A number of key themes and messages have pervaded this publication, and may perhaps be usefully revisited in this conclusion.

One of these is that a nuclear new build project poses a set of unique challenges when compared with, for example, a coal-fired generation project. Although these may originate in the technical, engineering, social, political or regulatory spaces, they will potentially have a profound impact on the profitability of a project, and will thus be of concern to both equity investors and lenders. It is in this sense that it can be argued that all risk is financial risk.

A second key theme of this publication is that the management of these risks is crucial to inducing investment in — or lending to — a new build NPP project. From a project developer's perspective, one way of managing these risks is by allocating them via contract to other project stakeholders, particularly to those who are better placed to manage them, while recognizing that it may be costly to do so (in that it is likely that a risk premium will have to be paid to stakeholders who are willing to take ownership of such risks). Both the project developer (insofar as they retain significant ownership of particular risks, which is highly likely) and the stakeholders to whom risk has been successfully allocated by the project developer will typically attempt to employ a systematic approach to risk identification and mitigation; there are a range of tools available to assist them in this. Insofar as it can be demonstrated to potential investors and lenders, successful risk management (both allocation and mitigation) will reduce the cost of financing a new build NPP project.

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[17] Amortization refers to the process of paying off a debt over time through regular payments, based on an amortization schedule detailing each periodic instalment. For each, a portion is for the payment of interest ('I'), while the remaining amount is applied to the repayment of the principal ('P'). There are two types of instalment: (a) the constant one, whereby (P + I) remains the same throughout the amortization schedule; and (b) the one with a constant P.

[18] In a 'mortgage-style' repayment profile, the debt is repaid following a straight line (e.g. linear) amortization profile; in the case of a balloon payment, the debt repayment schedule combines a series of regular payments and a large end-payment; in the case of a bullet repayment, the debt is repaid all at once at the end of its maturity.

[19] As noted, after COD has been reached and the NPP is in commercial operations, the overall level of risk of the investment is reduced substantially.

[20] Based on the revised economics of the investment, when the NPP is to generate stable and revolving long term cashflows.

A third central theme of this publication is that the key to obtaining financing for any project is providing finance providers with a prospective stream or share of project revenues that meets their risk–return requirements (as captured by their notional hurdle rates). As an NPP new build project developer seeks to obtain financing, they may be viewed as exploring different approaches to dividing the CFADS (and equity compensation) between potential sources of finance. In doing so, they are attempting to find the point at which all sources of finance (e.g. banks, sovereign wealth funds) are satisfied with their prospective returns from involvement in the project. If there is potential flexibility on the revenue side of the project (for example, via potential adjustment to the price of electricity contemplated by an electricity off-take agreement with a power off-taker) then seeking such a point becomes both more challenging and — arguably — more likely to succeed (since additional scope for flexibility exists).

A fourth and final key theme may be simply stated as: *risk drives (financing) structure,* and *structure drives the cost of capital*. This theme reflects the innate conservatism of lenders (whose only upside from lending to a project is recovery of their principal and interest) rather than investors, the value they place on liquidity based risk metrics and the relatively inexpensive nature of the financing they provide. Put simply, if a project can be structured in a way that maximizes the share of debt in that project's financial structure (perhaps to a figure of around 70%), it will achieve the lowest possible cost of capital. A bigger share of debt in a project's financing (and correspondingly lower share of equity) will improve project economics, leading to (for example) a lower electricity price for off-takers. This theme links to the earlier one regarding the unique nature of the financing challenges raised by a new build NPP project; the capital intensive nature of such investments leads to their economics being highly sensitive to the cost of capital. Once again, risk and its allocation is key to project economics.

Appendix

THE ROLE OF EXPORT CREDIT AGENCIES IN THE FINANCING OF NUCLEAR POWER PROJECTS

A.1. BACKGROUND

Nuclear new build projects are very particular investment proposals, which are unlikely to be undertaken on a straightforward economic basis by equity shareholders and by lenders. This is due to, inter alia, their extended life cycles, their very long term underlying commitments vis-à-vis waste management and decommissioning, the evolving nature of their risk management and the magnitude of their financing requirements.[21] In addition, other factors also apply, all implying a degree of political involvement[22] that makes the investment case even more complicated.

As a result of the recent financial and economic crisis, the availability of sizable budgets from public sector players for long term investments in NPPs has been under stress in various parts of the world for a number of years now, and the situation is unlikely to change dramatically in the near future with many State budgets in need of rebalancing, particularly in Europe. The capacity of private sector stakeholders to take over the responsibility for funding such investments has also been challenged following the impact of, inter alia, the liquidity crunch on banks' funding strategies in Europe during summer 2011, the recent macroeconomic policies on leverage, or the latest regulation that, ultimately, tends to re-direct the banks' debt lending activities towards transactions requiring financing with shorter maturities.

Within this context and among the range of financing instruments that are available and that offer long term maturities, export finance remains a tool of reference for various stakeholders, including the providers (e.g. sellers) of equipment and services and the lending banks. Furthermore, the characteristics of this product make it also perfectly compatible with the requirements of the financing plans typically put in place to fund large, capital intensive investments in infrastructure, such as NPPs.

A.2. THE BASICS OF EXPORT FINANCING AND THE ROLE OF ECAs

A.2.1. Export financing

As a matter of principle, export financing is related to the provision of financial solutions, risk cover and advisory services associated with the financing of import or export contracts, with capital goods and/or services as underlying assets. According to the prevailing general understanding, export financing is also closely associated with the support provided by ECAs to the sellers, e.g. the companies signing export contracts of goods and/or services with their clients, who are based in a different country to the ECA.

A.2.2. ECAs and their role

An ECA is a financial institution or agency that provides trade financing to domestic companies for their international activities in order to promote exports. It can be a private entity or a (quasi-) governmental agency. An ECA provides various, mainly long term (e.g. with repayment terms of 2 years or more), financing services to these companies, including insurance covers, loan guarantees and direct loans.

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[21] The nearly unquantifiable nature (from a financial point of view) of any grave nuclear accident could also be noted, although it would more likely be a critical issue for the equity shareholders or for the insurers than for the lenders to a new build project, who would not lend money with such maturities.

[22] Such involvement includes the quest for energy independence and energy security and the implementation of policies to decarbonize the energy sector.

For an exporter, the primary objective of the involvement of an ECA is to remove the risk and uncertainty of payments from its clients when exporting outside its home country. Such uncertainty may come from: (a) the risk of loss arising from manufacturing; or (b) the credit risks borne by either: (i) suppliers under their commercial contracts; or (ii) banks under their credit agreements.

The ECA takes all or part of[23] the risk from the exporter, and shifts it to itself for a premium. Per the Knaepen Package [10], such a premium must allow the ECA to cover potential losses and its operating costs. Finally, ECAs can also underwrite the commercial and the political risks of investments in overseas markets that are typically deemed to be high(er) risk.

A.2.3. What are the risks covered by an ECA?

Risk materializes when a buyer of equipment or services or a borrower does not fulfil its payment obligations under the commercial contract or credit agreement, respectively. Through the provision of its cover, an ECA will, therefore, mitigate risks generated by the occurrence of an event of a political, or of a commercial nature.

For that purpose, political risk would typically include the following:

— A decision from the government of a foreign country (usually the country of the buyer) that prevents the performance of the commercial contract or the credit agreement;
— A general moratorium decreed by the government of the debtor country;
— Political events, economic difficulties or legislative measures preventing or delaying the transfer of funds paid by the debtor;
— Force majeure (including war, riot, natural hazard).

As far as the commercial risk is concerned, the standard triggering events would be likely to include:

— Insolvency of the debtor;
— Default by the debtor;
— Arbitrary repudiation or refusal.

An ECA undertakes a detailed analysis of risk during the due diligence process it carries out for each potential transaction, and then decides to which of the eight categories of country risk and which of the eight categories of buyer risk as defined in Ref. [11] it will eventually allocate an operation. Based on such a rating, the ECA will subsequently define the terms and conditions applicable to its cover for an operation.

A.3. EXPORT CREDIT AGENCIES AND EXPORT CREDITS

A.3.1. A brief introduction to the OECD Arrangement

As a cornerstone of the trade finance business, the OECD Arrangement on Officially Supported Export Credits (the ‘Arrangement’) [11] has been providing a framework of reference for the orderly use of officially supported export credits since 1978. However, it is not legally binding, but is an informal agreement between the various OECD member countries.

As a key objective, the Arrangement seeks to ensure a level playing field for official support [11][24] to export, in order to “encourage competition among exporters [from the OECD exporting countries] based on quality and price of goods and services exported rather than on the most favourable officially supported financial terms and conditions”. Furthermore, specific appendices are provided for a limited number of sectors and financing techniques, namely: NPPs, shipping, civil aircrafts, renewable energy and water projects, and project finance.

[23] In the case of insurance or a loan guarantee, the percentage of cover provided by the ECA may vary, impacting on the level of premium to be paid by the exporter. As a matter of principle, certain ECAs like to leave the exporter with a certain level of residual risk (generally 5%) in order to have an alignment of their interest with those of the exporter and the lending banks.

[24] As defined in Article 5 (a) of the Arrangement [11].

The Arrangement therefore provides a detailed range of guidelines to determine what an export credit can finance; identify the starting point of credit of a facility[25]; define the terms of repayment of a loan (for the principal and the interest); detail the calculation principles of the insurance premium to be paid to the ECA; and provide a 'safe haven' clause for interest rates. A safe haven clause provides that export credit practice that conforms with the interest rate provisions of an international undertaking is not considered a prohibited export subsidy, thus providing some protection against the risk of action on the grounds of illegal subsidization.

A.3.2. The structure of an export credit

As illustrated in Fig. 29, an export credit[26] financing structure implies the interaction of a number of different stakeholders, each with a specific role.

In summary:

— A company (the 'exporter', or the 'seller') signs a commercial contract with its client (the 'buyer'), according to the terms of which the seller will supply certain goods and/or services, and the buyer will pay for these upon the attainment of certain milestones.

— The buyer may have to borrow money from commercial banks in order to make the payments due under the terms of the commercial contract. To that effect, the buyer (also known as the 'borrower') will enter into a credit agreement with a group of lenders (the 'lenders') and undertake to, inter alia, service the debt (i.e. pay interest and repay the debt principal) over a period of time agreed in advance, i.e. the repayment period.

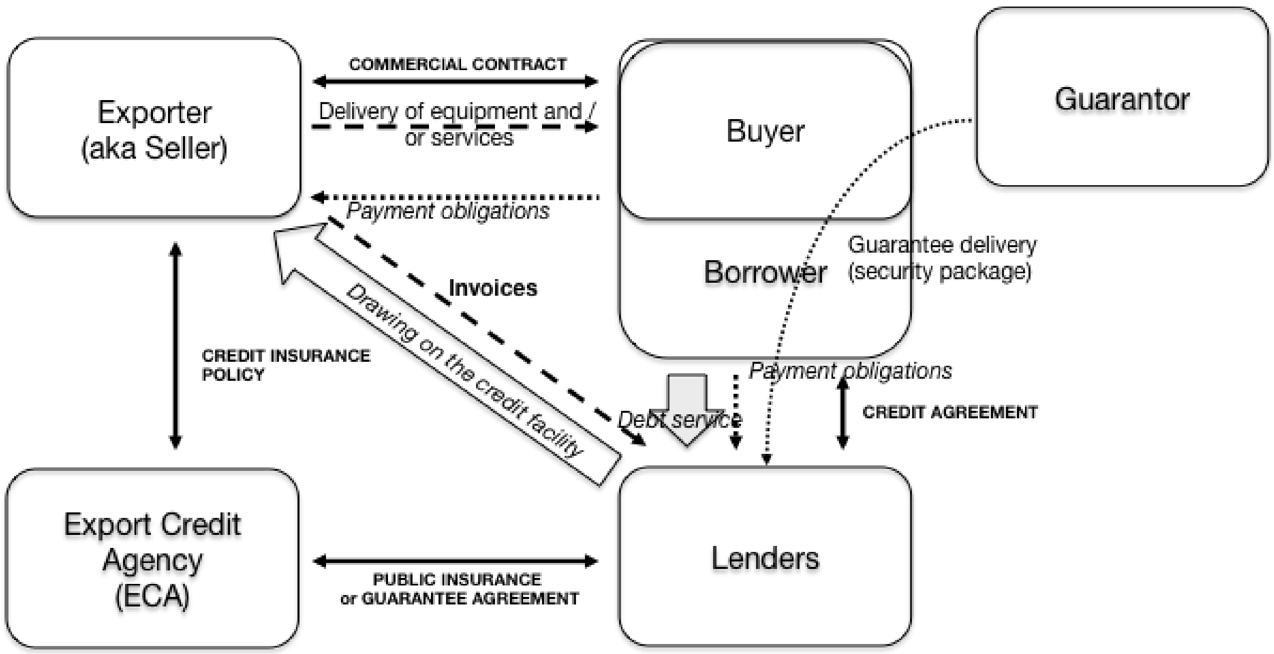

FIG. 29. An export credit financing structure.

[25] The starting point of credit of the facility is determined by the ECA on a case-by-case basis as being the date upon which the exporter's contractual commitments are fulfilled. The starting point of credit depends on the specification of the commercial contract, and a (minimum) 15% down payment will be paid before the starting point of credit can be effective.

[26] An export credit is also commonly called a buyer credit. This is because the facility that is arranged in favour of the borrower per the terms of the loan agreement will provide financing to the buyer to perform its payment obligations under the commercial contract. In the rest of this section, both terms are used indistinctly.

— The exporter and/or the lenders may want to protect themselves against the risk of non-performance by the buyer of its undertakings, per the commercial contract or the loan agreement. As a result, both parties may seek to put adequate risk insurance arrangements into place for the financing of the commercial contract. The exporter may subsequently seek an insurance cover (against commercial and political risks) in the context of its commercial contract and the loan facility attached to it. Against the payment of a premium by the exporter, the ECA will issue an insurance policy, which will provide appropriate risk cover to the parties, essentially against the risk of non-payment by the buyer.
— Depending on various criteria, including the nature, extent and magnitude of the risks to be covered, the standing of the borrower and the country risk category of the buyer or borrower, the ECA may require that a third party (the 'guarantor') provide a guarantee for the performance of the borrower's payment obligations.
— Once the insurance arrangements are put in place to the satisfaction of the ECA and the lenders, and financial close[27] has taken place, the credit facility available under the loan agreement may be drawn down to pay for the supplies of goods and/or services under the commercial contract.

A.3.3. The extent of export credit facility finance

As illustrated in Fig. 30, the amount of the export credit facility that can be arranged to finance a commercial contract depends on, inter alia, the value and the amounts of the various components of the commercial contract itself.

Therefore, based on the guidelines provided in the Arrangement, a distinction needs to be made in the commercial contract between the exported part and the local part in order to size the loan facility. The exported part mainly consists of the exportation of goods and/or services that will be sourced primarily in the country of origin of the exporter (e.g. the national part), or also in other countries (e.g. the foreign part) that are neither the country of origin of the exporter, nor the country of origin of the buyer. As far as the local part is concerned, it mainly consists of the works that will be sourced in the country of the buyer.

In the commercial contract, the conditions of payment shall envisage a downpayment of no less than the equivalent of 15% of the exported part, which will be paid by the buyer before any drawdown can be made by the borrower under the export credit facility. An export credit facility can be arranged to finance 85% of the exported part plus a portion of the local part for an amount equivalent to up to 30% of the value of the exported part.[28] An additional debt facility, e.g. a commercial loan, may also be arranged by the lenders in order to provide the buyer with a complementary financing solution for the downpayment and of the portion of the commercial contract that is not financed by the export credit (i.e. the portion of the local part that is not eligible for the buyer credit).[29] However, such a loan facility will not benefit from any insurance or guarantee cover from the ECA.

A.4. THE ROLE OF EXPORT CREDIT AGENCIES IN INFRASTRUCTURE PROJECTS

A.4.1. Export credit agencies as a provider of large amounts of financing

Nuclear projects, whether they are new build or rehabilitation projects, are traditionally very large consumers of equipment and services. In a new build project, lots such as the nuclear steam supply system, the turbine island and the instrumentation and control package typically represent up to 80% of the total overnight costs of a project. These packages are heavily reliant on expensive, large and/or sophisticated pieces of equipment, which are usually manufactured by a limited number of specialized and experienced suppliers.

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[27] Financial close is the date of availability for initial drawdown of the long term financing required to fund the performance of the commercial contract. It is taking place after the loan agreement has been signed, and any condition precedent to initial drawing envisaged in such agreement has been duly satisfied.

[28] It is to be noted that the decision to incorporate a certain proportion of the local part in the total amount of the export credit facility ultimately depends on the ECA's decision. (There have been instances in which the ECA accepted to incorporate a smaller portion of the local part than originally requested by the exporter in its request for insurance.)

[29] The combination of an export credit and a commercial loan can, therefore, provide a long term financing solution to the buyer for the total amount of the commercial contract it has signed.

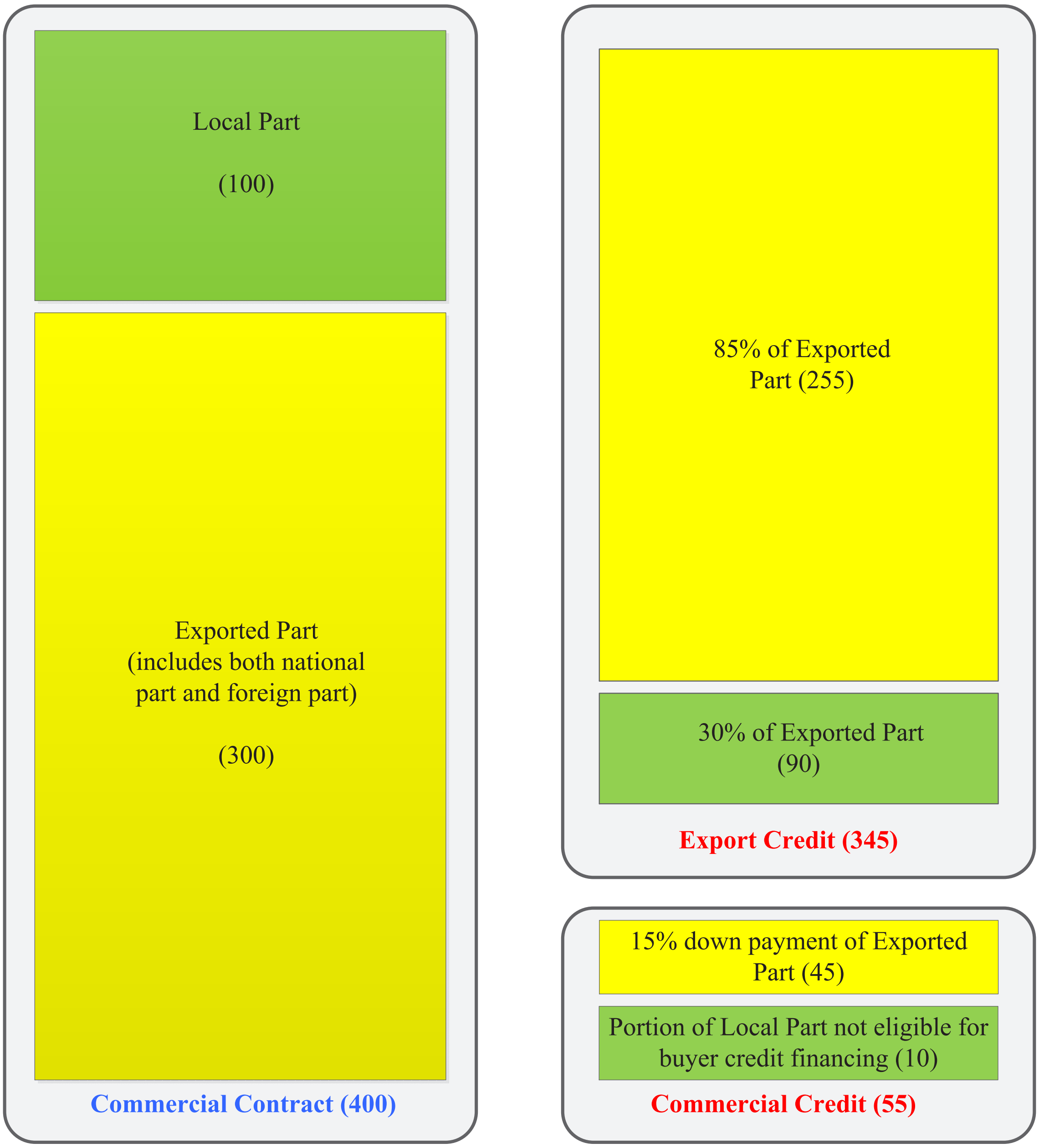

FIG. 30. Potential amounts of export credit facility.

Those features provide, therefore, a natural field of application for ECA backed export credits; the ability to offer a financing solution for an amount equivalent to 85% of a very substantial proportion of the overnight costs of a new build project is indeed a very strong argument for the seller when negotiating a commercial contract with its buyer.

A.4.2. Export credit agencies as a provider of long loan tenors with competitive terms and flexible repayment terms

In 2009, the OECD revised certain key parameters of an export credit facility in order to make them more in line with the sector's specific requirements. Per the Sector Understanding for NPPs (see Ref. [9], appendix II), the repayment period of an export credit for a nuclear project has been extended to 18 years (from 12 years for standard export credits and 14 years for project financed transactions) in order to best reflect the requirements of its economics. Therefore, the combination of: (a) a drawing period of 5 to 7 years and (b) a repayment period of 18 years can push the overall duration of an export credit up to 25 years, and consequently provide an all-in maturity more in line with other debt capital market instruments (e.g. bonds).

As noted above, the Arrangement provides a range of guidelines to ensure a fair competition framework between officially supported export credits from the OECD countries. Such guidance includes a safe haven clause for interest rates with the commercial interest rate of reference (CIRR) and a minimum interest rate for fixed rate loans with ECA support; CIRR is not offered by all ECAs. A specific CIRR exists for the nuclear sector, with longer maturities.

Among the CIRR's key features, the following may be noted:

— It is available for the currencies of the participants in the arrangement;
— It is based on the yield of government bonds plus a spread of 100 basis points (100 basis points = 1.00%);
— It changes every month;
— It can be reserved for 120 days against the payment (by the borrower) of a reservation cost of 20 basis points.[30]

Based on their construction (e.g. government bonds yield plus a spread of 100 basis points), CIRRs tend to be very competitive, as illustrated in Fig. 31. However, in practice, the borrower will pay an all-in interest rate, which will comprise the CIRR plus a margin charged by the lenders. Such margin varies from one transaction to the next and depends on, inter alia, the lenders' cost of liquidity (see Section 6), the tenor of the loan, the currency of the loan and the credit risk of the transaction.

The attractiveness of the export credit offering is further enhanced by the choice (made by the borrower[31]) between three possible types of repayment schedules for the buyer credit.

CURRENCY	INTEREST RATE / REIMBURSEMENT from 15 January 2015 to 14 February 2015		
	<=5 years	>5-8.5 years	>8.5-10 years
EUR	0.96%	1.14%	1.38%
USD	2.06%	2.64%	2.98%

CURRENCY	MINIMUM INTEREST RATE FOR NEW NUCLEAR POWER PLANTS from 15 January 2015 to 14 February 2015					
	<11 years	>=11-12 years	>12-13 years	>13-15 years	>15-16 years	>16-18 years
EUR	(*)	1.38%	1.70%	1.82%	1.99%	2.04%
USD	(*)	2.98%	3.26%	3.33%	3.45%	3.50%

FIG. 31. Commercial interest reference rates. (*) CIRR according to article 20 of the Arrangement.

[30] Practically speaking, the CIRR that will be applicable to a loan agreement can vary between the date of application by the exporter until the date upon which the ECA issues its insurance policy. In order to avoid variations that could eventually be costly (a change in the CIRR by a few basis points could have a material impact in the context of the large quantum of financing involved for NPP projects), the exporter may reserve (i.e.. lock) for 120 days the rate quoted in its application documents. As a result, the exporter has a 4 month window to finalize its arrangements, instead of the standard monthly period.

[31] That choice may, from time to time, be subject to the ECA's approval.

The repayment of the debt principal and the payment of the interest combine in equal instalments:

— The repayment of the principal in equal instalments with variable payments of interest;
— A tailor-made repayment profile is an option provided that:
  - The repayment of the principal takes place at least every 12 months;
  - No single repayment of the principal (or series of the principal repayments) within a 6 month period exceeds 25% of the total amount of the principal;
  - The first repayment of the principal occurs not later than 12 months after starting point of credit and is no less than 2% of the total amount of principal;
  - The maximum weighted average life of the repayment period is 9 years, and the repayment period is limited to 15 years;
  - The payment of interest takes place at least every 12 months, and the first payment of interest takes place not later than 6 months after the starting point of credit.

As a consequence, and given the specific requirements of an NPP, the choice of a particular profile may subsequently better support the operating cashflow profile of a nuclear (new build) project.

A.4.3. Export credit agencies as a provider of early support to large size and high value export projects

For exporters of capital equipment or project related goods and services, the ability to offer financing solutions to their clients (i.e. buyers) has become an increasingly critical competitive advantage in gaining new business, especially for exports to new and/or emerging markets. Often, this is because buyers in these markets do not necessarily have access to sufficiently large sources of funding in their own capital markets. Furthermore, the provision of long term financing solutions has now become an integrated part of most large capital intensive projects, which are being tendered through international competitive bidding processes.

As a result, ECAs are usually keen and ready to support their exporters at an early stage, e.g. at bid stage, or before the signature of a commercial contract. This is because one of the key roles for a country's ECA is to support sales from its exporters, and in particular the export of (high) value added products and services, which subsequently broaden the employment of its workforce, promote the development of the latest production methods, or the acquisition of new skills.

Typically, ECAs will therefore be able to provide relatively detailed and specific input (although such input will be of indicative nature at this stage)[32] with regard to the terms and conditions of their support, including the level of cover envisaged for the political and the commercial risk, the estimated insurance premium and the requirements to be expected in terms of security package.

A.5. SKILLS AND EXPERIENCE OF EXPORT CREDIT AGENCIES THAT ARE RELEVANT TO NUCLEAR POWER PLANT PROJECTS

Like most large investments, NPP projects rely on a variety of sources for their financing based on a combination of: (a) equity to be provided by the shareholders in a project; and (b) debt to be provided by the lenders. Among the sources of debt funding, ECAs have been playing a key role for many years with the provision of insurance products and/or long term financing instruments. They have subsequently developed a wealth of experience in various fields, as detailed in Sections A.5.1–A.5.3.

[32] Ultimately, said terms and conditions may be revisited prior to the finalization of a commercial negotiation and the arranging of the underlying financing for it, depending on the results of the more detailed analysis of the transaction to be undertaken by the ECA during its due diligence process. Furthermore, the final terms and conditions on offer eventually need to be validated by the senior management of the ECA, and approved by representatives from the ministry of finance of the exporter's country.

A.5.1. Extension of specific political support

NPP projects, and more particularly nuclear new build projects, present specific features that tend to magnify the challenges faced by large capital intensive infrastructure projects. Among others, they have very long cycles (approximately 100 years, notwithstanding the even longer requirements for the management of the waste produced), a broader range of stakeholders, including the very particular role played by the government of the host country of a project, and a strong dependence on public acceptance over the long term. In that context, ECAs often tend to act as extensions of the political support that may be provided by the public authorities of the exporter's country, while acting within the guidance provided by the Agreement. As seen in recent examples of new build projects, an ECA can, therefore, be involved in a project through the combination of various instruments, including a direct loan, insurance cover to an export credit, and/or a supplier credit.[33] In other instances, an ECA may, in the context of a specific transaction, increase the quantum of its cover to such level that the prudential rules of management of its portfolio of assets normally accepted are bypassed, hence increasing substantially its exposure to a client, a country or even the nuclear sector for a certain period of time. Finally, an ECA may also provide its guarantee to stakeholders investing in a particular project, if such investment is seen as being of strategic importance by the public authorities of the exporter's country.

A.5.2. Dedicated skilled human resources

In various respects, nuclear new build power plants present features that are similar to other major investments in infrastructure projects, including lengthy and comprehensive preparation and development phases that may stretch up to 10 years; long construction periods with multiple technical, human and organizational challenges, etc.; the critical nature of certain key milestones, such as the award of construction permits and completion of the works; complex contractual arrangements integrating a variety of stakeholders (including shareholders, suppliers, contractors); and eventually the (very) large quantum of the investment.

ECAs have, therefore, developed dedicated teams, skills and expertise to analyse, structure, procure and monitor financing solutions for nuclear transactions. These teams have also built good working relationships with a number of commercial banks, which have historically been involved in the financing of the nuclear sector. Based on such common ground, both ECAs and these banks are used to working together to finding and implementing practical solutions to the requirements of long term financing to the sector and their resources can be deployed to deal with the unforeseen events 'typically' to be encountered in such large investment programmes, namely delays, changes in orders, cost overruns, etc. that may take place during the life of a project, and more particularly during its construction phase.

A.5.3. Environmental and social aspects

As part of the Arrangement, the OECD has developed a series of detailed recommendations on environmentally and socially related matters, which have to be taken into account by the various parties involved in a project if they seek to obtain support from an ECA [12]. In view of the particularities of a nuclear project, these have a particular relevance for transactions in this industry. Therefore, an ECA will follow a procedure strictly, before it can take a decision and provide its support to a particular transaction.

In particular, the following may be noted:

— *Project categorization:* Any project submitted to an ECA needs to be screened and categorized. There are three categories (A, B and C), each varying according to the potential environmental and social impact of the project. Nuclear typically belongs to category A, which is 'high risk'.
— *Environmental and social review:* A comprehensive assessment of a transaction's potential environmental and social impacts needs to be performed by an independent consultant who has, to the extent possible, international standing and an established reputation. In the environmental and social review, the consultant

[33] In the case of a supplier credit, the ECA provides its cover directly to a supplier, e.g. the exporter itself, or a subcontractor. The cost of that credit (any fee to arrange that facility and the interest due) will subsequently be charged by the supplier to the buyer through the incorporation of these costs in the price of to be paid by the buyer, per the terms and conditions of the commercial contract.

shall, inter alia, review the standards, practices and processes that the parties (including the exporter, the buyer and possibly the local authorities of the host country) intend to apply in order to mitigate and monitor the impact of the project during its development, construction and operational phases. As a part of that exercise, the results of any public consultation launched in connection with the preparation of such a project will also need to be provided to the ECA and analysed by its teams. An outline of the broad scope of the ECA's review is presented in Fig. 32 for illustrative purposes.
— *Project evaluation:* Based on the outcome of its environmental and social due diligence, the ECA will evaluate each transaction. Should any issue, shortcoming or improvement be identified as a result, it may subsequently require that additional research or preparation be undertaken, and that an environmental and social action plan be designed, implemented and be monitored during the life of a transaction. When an insurance policy is to be provided, the ECA may stipulate conditions to be fulfilled in relation with environmental and social aspects, e.g. conditions precedent, monitoring, etc.
— *Communication:* Finally, for category A projects, ECAs have an obligation to disclose general information on the project, and require that environmental information be made publicly available.

For its evaluation, and as shown in Fig. 33, a civil nuclear project will be benchmarked against three levels of standards, namely (a) those of the host country, (b) the International Bank for Reconstruction and Development's (aka the World Bank's) safeguard policies if relevant to the transaction, or the International Finance Corporation's (IFC's) performance standards, and (c) any relevant internationally recognized industry standards not addressed by the World Bank Group[34], including those of the IAEA.

Aspects of ECA Review

Social

- Land acquisition process
- Public consultation
- Cultural and historical assets
- Resettlement (including economic and household aspects)
- Site security (as applicable)
- Working conditions
- Safety and major hazards assessment and management for workers/communities
- Natural hazards, including project's ability to cope with such hazards

Environmental

- Sustainable use of natural resources
- Impact on ambient air (including emission of radionuclides)
- Waste water treatment and disposal
- Hazardous material storage and handling
- Waste management and disposal
- Noise and noise abatement
- Surface water and groundwater quality
- Natural protected areas/ biodiversity
- Liability

FIG. 32. Broad scope of an ECA's review.

[34] The World Bank Group comprises the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA), the IFC and the Multilateral Investment Guarantee Agency (MIGA).

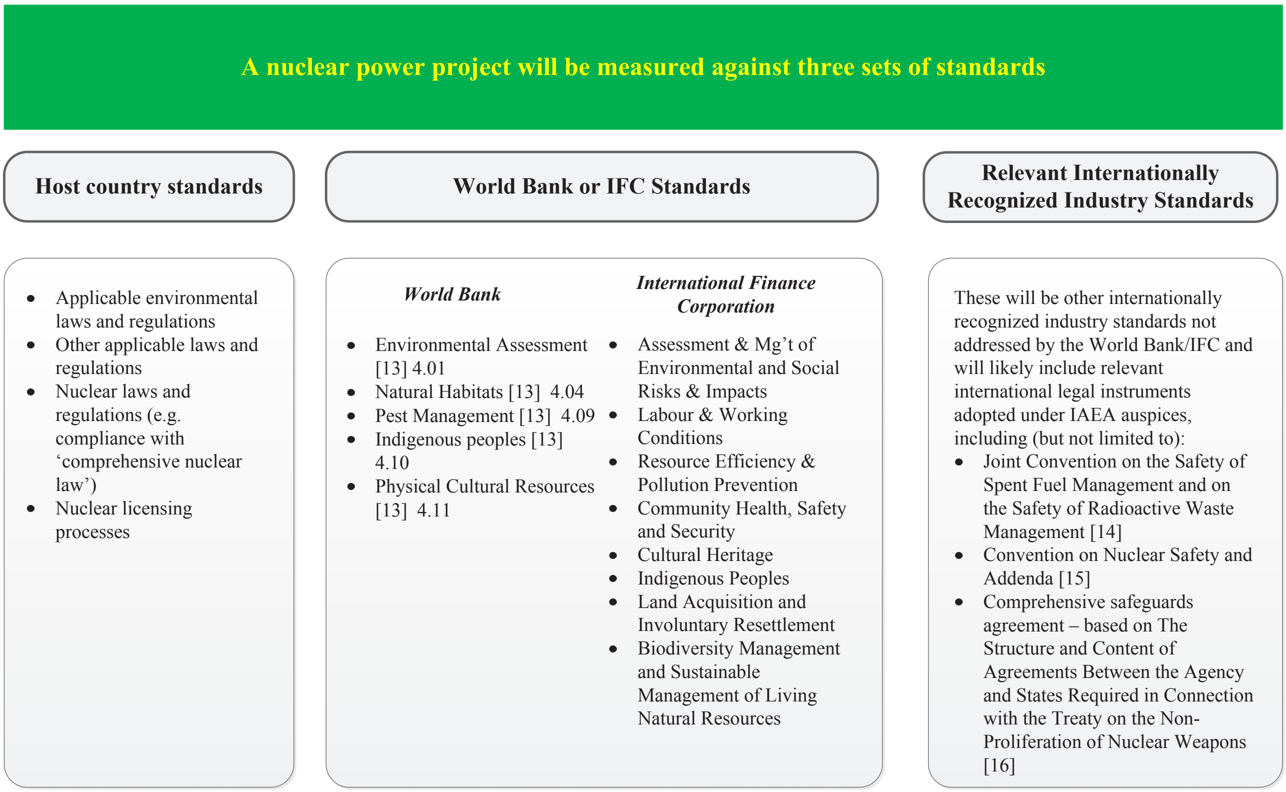

FIG. 33. Benchmarking a nuclear project against three levels of standards.

The procedures described above are of a relative prescriptive nature and may appear cumbersome from the outset. However, they provide a sound basis for taking ethical decisions and actions for the various stakeholders in a project, which may eventually prove to be very beneficial in the long run, in particular in the context of the strong dependence of any nuclear project on public acceptance and cross-party political support.

A.6. THE CURRENT SITUATION OF EXPORT CREDIT AGENCIES

A.6.1. Support to long term bank debt financing

As a consequence of the financial crisis that started in 2008 and of the liquidity crunch that followed during summer 2011, the recent changes that took place in the financial markets have led to a renewed emphasis on the critical nature and the added value of the ECAs’ involvement in a long term debt financing plan.

Following the beginning of the crisis, the governments and regulatory authorities of the most advanced economies promoted the revision of a series of prudential rules [17][35] applicable to providers of debt financing. As a result, there has been a strengthening of the rules for most commercial and investment banks, which until then had been active in the financing of large capital intensive investment in the infrastructure sector. Among others, the guidelines for accounting and booking (long term) loans were revisited, and the banks’ cost of capital subsequently increased substantially. This is primarily because banks now have to set aside larger amounts of capital (e.g. equity) to match their liabilities (e.g. the loans they carry in their books). The main objective is, therefore, to improve the banks’ short to medium term cash positions through tougher liquidity and solvency ratios. It is also to bolster their longer term resilience to help them withstand any negative revision that might occur in the prices of their assets,

[35] These rules are commonly referred to as Basel III [17] for the banking industry and Solvency 2 for the insurance industry. Basel III is a comprehensive set of reform measures, developed by the Basel Committee on Banking Supervision, to strengthen the regulation, supervision and risk management of the banking sector. Solvency 2 is a fundamental review of the capital adequacy regime for the European insurance industry aiming at establishing a revised set of EU-wide capital requirements and risk management standards in order to increase protection for policyholders.

which could lead to unsustainable imbalances between their assets and their liabilities.[36] In that context, owing to a more favourable treatment of ECA backed facilities under Basel III regulation, the involvement of an ECA in a transaction ultimately promotes some form of additionality through facilitated access to a broader pool of banks. Banks would otherwise be less likely to provide competitively priced large amounts of debt financing with long tenors to large capital intensive operations.[37]

A.6.2. Export credit agencies' support of market liquidity

As already noted, ECAs contribute to strengthening the economics of the projects they are involved in through the enhancement of the terms and conditions of their credit facilities with, inter alia, their competitively priced fixed interest rates in various currencies, the longer tenors they are in a position to offer to transactions with long term economic horizons, or sculpted (profiled) repayment schedules that follow typical cashflows from operations. As a result, and depending on the credit rating of their countries of origin, ECAs can, therefore, also support the liquidity of the bank debt markets through access to securitization and broader distribution channels. For example, some banks have been able to segregate high quality assets consisting of selected export credits backed by AAA rated ECAs, which they carried in their books, to pool them into ad hoc structures, which could subsequently be monetized, and eventually to sell those to long term investors, such as pension funds or insurance companies. By doing so, banks have been able to reduce the volume of credits in their books, deleverage and free some capital for extending their lending capacity to new transactions.

A.6.3. Export credit agencies' support for financial innovation

Finally, ECAs have also undertaken a review their forms of support in the past few years, and certain of them have been working towards the development of new products and/or services to adapt to the latest market trends. Among the revised approaches that appear now to be taking ground for financing large infrastructure projects, fresh effort are put to the development of funding structures based on bond financing, in particular with a focus on the construction period, which is the riskiest phase in the life of a nuclear new build project from a financier's point of view.[38] The stakeholders' objective is to attract and tap a broader pool of providers of long term financing outside the traditional group of lending banks (e.g. insurance companies, pension funds), which are looking for long term investment opportunities offering revolving and stable cashflows in order to match their liabilities (which themselves have distant horizons). In that context, it is possible that different capital structures could be developed and put into place during: (a) the construction; and (b) the operational period, in order to raise the amount of long term financing required by large infrastructure projects.[39] Therefore, the ECAs are now developing

[36] For example, a series of negative (and brutal) changes in the credit quality of a bank's portfolio of clients would most likely lead to a dramatic revision in the price of its assets, which would impact on the strength of its balance sheet, and ultimately on its share price. It is likely that, as a result, a new round of valuations of the bank's businesses would be triggered, which would eventually create a new drop in its share price, and so on. Since banks have developed numerous and complex business relations, this sort of negative spiralling effect could have dramatic consequences for the banking industry and force many of them to bankruptcy, hence creating a systemic risk for financial markets worldwide. In 2008, this is precisely why governments of most countries took special measures in order to avoid such a chain of events developing.

[37] At its peak, the crisis led to the near shutting down of the bank debt market, and even after the most acute phases of the crisis, banks were reluctantly considering committing substantial amounts of credit (above €50 million) with tenors superior to 10 years.

[38] Although there are obviously many other technology, operation, organization related risks etc. throughout the life of a nuclear (new build) power plant, the quantum of the financial risk reaches its peak during the construction phase for the finance providing parties; this is because, in a worst case scenario, the total amounts of equity and of debt would have been infused and drawn down respectively, while the NPP would not be completed and, therefore, could not start its commercial operations, hence not generating any cashflow to service the debt and pay dividends.

[39] Traditionally, a single capital structure was put into place to raise funding for new investments, which would remain the same during the construction and the operation periods: debt was drawn during construction and repaid during operation. Looking forward, it is likely that the debt originally drawn during construction would be refinanced soon after the start of commercial operations: new debt would be borrowed in order to repay the original one. The new debt would most likely have better terms and conditions (since the construction risk would no longer be relevant), and could be based on different financing instruments, including bonds with longer tenors (up to 30 years versus a maximum of 18 years for ECA backed bank debt).

new approaches to ensure that the insurance coverage they have been able to provide to date to bank debt facilities can also be applied to bond (re)financed structures.

A.7. CONCLUSION

As presented above, export credit is today a critical instrument to mobilize long term financing for large, capital intensive projects in the infrastructure area, in particular for nuclear new build projects. Among others:

— The recourse to export credit allows for longer term maturities, the mobilization of a large quantum of debt financing (in particular during the sensitive construction phase of a project), the preservation of banking limits, etc. in the context of stricter prudential rules to be applied by banks.
— Export credit offers specific fixed interest rates with attractive all-in pricing, flexibility with drawing schedules under the credit, which can match the constraints of commercial contracts.
— Additional complimentary financing may be offered to finance 100% of the value of a commercial contract, which can represent up to 80% of the total overnight cost of a nuclear new build project.

In addition to their traditional key role in backing export credit facilities, ECAs are now increasingly keen on covering direct risks of corporate financing, or contemplating more project finance orientated types of structures. In that context, it is reasonable to expect that they will become a pivotal partner for arranging and financing large projects, such as NPP projects.

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GLOSSARY

average debt service cover ratio. The average of the period by period debt service cover ratios over the life of a loan.

bankability. The willingness of banks to provide (long term) lending to an investment, and subsequently to hold illiquid assets (e.g. loans) on their books over the long term.

bank debt. Money owed to one or more banks. Depending on the ownership and contractual structure and the overall security package available, commercial banks may be prepared — under conditions defined in advance — to provide long term debt financing to fund the construction and the operations of a nuclear new build project. In the nuclear sector, banks tend to work in close cooperation with export credit agencies to that effect.

bond market. A financial market in which participants can issue new debt (on the primary market), or buy and sell debt securities (on the secondary market). Investors in such a market would typically be corporations or individuals in search of an income stream based on long term (revolving) cashflows.

cost of capital. The rate of return required or demanded on funds deployed by shareholders or lenders to finance an investment. Such a rate is typically calculated as an IRR for equity, over the life of the investment, or debt, over the life of the debt.

cost of funds. The interest rate paid by financial institutions for the funds that they deploy in their business. For (commercial) banks, the cost of funds is determined by the interest rate paid to depositors on financial products; this is closely related to — and often used as a synonym for — the cost of capital.

debt. An amount of money owed by one party (the debtor, e.g. the borrower) to another one (the creditor, e.g. the lender). Debt is subject to contractual terms regarding the interest, the tenor, the repayment profile, etc. From an accounting point of view, debt is a liability. There are different types of debt (e.g. senior or junior), each giving the lenders a different priority level in being repaid if the borrower goes into liquidation.

debt service cover ratio. The predicted (or actual) ability of a project to generate sufficient cashflow over a given period to service the full debt requirements in that period (e.g. payment of interest plus repayment of the principal) after operating expenses and taxes have been paid. It is calculated (annually) as the ratio for the period of the forecasted (or actual) cashflow (after deduction of operating expenses and taxes, but before debt service and dividend distributions) to debt service.

electricity off-take agreement. An agreement between the project developer or owner–operator and a counterparty who agrees to take the electricity produced by the NPP on the terms and conditions set out in the agreement.

equity. In finance and accounting, the value of an ownership interest in a business (e.g. a company) that is spread among shareholders. Equity is risk capital: in the case of bankruptcy, all creditors (ranked in order of priority) are paid against the proceeds of the assets; shareholders are paid last, and receive whatever is left after all liabilities have been extinguished (e.g. assets less liabilities).

export credit facility. An arrangement which makes a specific amount of funding available from a lender for the purpose of paying a seller for goods or services that it is exporting to a buyer. The facility may be drawn down in one of two ways. Either the lender may disburse the funds to the seller directly as it meets its commitments to the buyer, or it may reimburse the buyer after it has made a payment to the seller itself.

equity internal rate of return. The internal rate of return that equity providers receive on their investment.

field of the possible. The set of risk allocation arrangements, contributions to the overall financing and returns on those contributions that are acceptable to financing stakeholders.

financial close. In the case of lending, this means the date of availability for initial payment of the equity financing required to fund an investment. It takes place after the shareholder agreement has been signed, and any condition precedent to initial payment envisaged in such agreement has been duly satisfied. In the case of borrowing, financial close means the date of availability for initial drawdown of the (long term) debt financing required to fund an investment. It is taking place after the loan agreement has been signed, and any condition precedent to initial drawing envisaged in such agreement has been duly satisfied.

financial risk. The combination of different risks associated with the financing of an asset, the occurrence of which would increase the probability of a financial loss that would subsequently impair the ability of the investment to provide an appropriate return to its key stakeholder(s).

forward contract. A non-standardized contract between two parties to buy or to sell an asset at a specified future time at a price agreed upon today (in contrast to a spot contract, which is an agreement to buy or sell an asset today).

futures contract. A standardized contract between two parties to buy or sell a specified asset of standardized quantity and quality for a price agreed upon today (the futures price) with delivery and payment occurring at a specified future date (the delivery date);

debt to equity (*or* gearing ratio). The relationship between a company's debt and the equity it has from its shareholders. Expressed as a percentage, the financial debt to equity ratio is obtained by dividing the debt by the shareholders' equity.

interest rate. The rate at which interest is paid by a borrower for the use of money that they borrow from a lender. The (interest) base rate is the interest rate at which the central bank of a country lends money to commercial banks. It is a key rate of reference, which influences all the other interest rates in the economy.

internal rate of return. The discount rate that makes the net present value of all (e.g. positive and negative) cashflows from a particular investment or project equal to zero. The project internal rate of return is typically used to evaluate the attractiveness of a project: if the IRR exceeds the investor's required rate of return, the project is desirable; if it falls below the required rate of return, the project should be rejected. Another type of internal rate of return is debt internal rate of return. Crucially, debt internal rate of return reflects the cost of borrowing on a more comprehensive basis than simply the headline rate of interest attached to a loan; it does so by factoring in any additional costs associated with that loan, such as one off or upfront fees charged to arrange the loan. The debt internal rate of return is expressed in terms of per cent per annum.

loan life cover ratio. The loan life cover ratio is calculated as the ratio of the present value of the forecasted cashflow (after deduction of operating expenses, but before debt service and dividend distributions) over the remaining life of a loan to the total outstanding debt.

margin. The return in excess of the risk free interest rate that an investment is expected to yield as a compensation for investors who take the extra risk. (The risk free interest rate is the theoretical rate of return of an investment with no risk of financial loss. It represents the interest that an investor would expect from an absolutely risk free investment over a given period of time.)

option. A contract that gives the buyer the right, but not the obligation, to buy or sell an underlying asset or instrument at a specified strike price on or before a specified date. The seller has the corresponding obligation to fulfil the transaction (e.g. to sell or buy), if the buyer exercises the option.

project life cover ratio. The project life cover ratio is calculated as the ratio of the present value of the forecasted cashflow (after deduction of operating expenses, but before debt service and dividend distributions) over the remaining life of a project to total outstanding debt.

return on equity. The amount of net income returned as a percentage of shareholders' equity. It is expressed as a percentage and calculated as the ratio of net income to shareholder's equity. The return on equity measures a corporation's profitability by revealing how much profit a company generates with the money its shareholders have invested.

risk-adjusted return on capital. A regulatory measure for a bank of the expected return on equity after deduction of operating expenses and loss provisions for the cost of risk.

swap. A contractual agreement between two counterparties to exchange the cashflows of one party's financial instrument for those of the other party's financial instrument.

tenor. The length of time until a loan becomes due for repayment; often used to describe the length of time until the final instalment of the loan repayment schedule is due for repayment.

term sheet. A short, high level document — typically one or two pages — setting out the material terms and conditions that the negotiating parties agree will be satisfied by the more detailed final agreement that is under development.

weighted average cost of capital. The average rate of return required or demanded on funds deployed (e.g. equity and debt) to finance an investment. Such rate is typically calculated as a weighted average IRR for: (i) equity, over the life of the investment; and (ii) debt, over the life of the debt.

LIST OF ABBREVIATIONS

BOOT	build, own, operate and transfer
BOT	build, own and transfer
CAPEX	capital expenditure
CAPM	capital asset pricing model
CCGT	combined cycle gas turbine
CFADS	cashflow available for debt service
CIRR	commercial interest rate of reference
COD	commercial operation date
DSCR	debt service cover ratio
ECA	export credit agencies
EPC	engineering, procurement and construction
FRM	financial risk management
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IDC	interest during construction
IFC	International Finance Corporation
IRR	internal rate of return
LC	letter of credit
LLCR	loan life cover ratio
MIGA	Multilateral Investment Guarantee Agency
NPP	nuclear power plant
NPV	net present value
O&M	operation and maintenance
PRR	project risk register
RAROC	risk-adjusted return on capital
RfP	request for proposals
ROE	return on equity
SPC	starting point of credit
SPV	special purpose vehicle
WACC	weighted average cost of capital

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Key

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