NECG response to NERSA Consultation Paper: Concurrence With Ministerial Determination On Procurement Of 2,500 MW Of Nuclear Generation

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I. Introduction

On 23 November 2020, the National Energy Regulator of South Africa (NERSA) released a Consultation Paper on "Concurrence with the Ministerial Determination on the Procurement of 2,500 MW Generation Capacity from Nuclear."

Nuclear Economics Consulting Group (NECG) is a stakeholder in the international nuclear power sector, with relevant nuclear power sector experience in South Africa. This document provides our input on the questions raised in the NERSA Consultation Paper. NECG provides general comments on the NERSA consultation and DMRE determination in Section II and provides relevant information on NECG in Section III.

Detailed comments on NERSA questions are provided in Appendix A. For additional, supporting information we provide, in Appendix B, a copy of a related submission we made to DMRE in September 2020 on the South African nuclear new build program.

II. General Comments

Nuclear power has been a success in South Africa, with the Koeberg nuclear power plant providing a reliable source of clean electricity for the Cape region.

NECG supports the DMRE Determination. We note that developing a new nuclear project is a large and complicated undertaking. The broad scope outlined in the DMRE Determination, therefore, is justified. However, the general nature of the DMRE approach presents the risk that a suboptimal approach could be chosen.

NERSA's Consultation Paper identifies significant Questions that must be answered to find an approach to new nuclear build in South Africa that is financially and economically feasible. A new nuclear power plant in South Africa might be owned by ESKOM (i.e., with costs of ownership recovered in customer tariffs) or owned by a different party with ESKOM buying the plant output (i.e., with power purchase costs recovered in customer tariffs). In both cases, the financial viability of ESKOM is required.

Developing an approach to electricity regulation that can move ESKOM to financial stability is required for any new nuclear build programme in South Africa. NECG's specific Comments to NERSA's detailed Questions are provided in Appendix A. These comments attempt to give useful input to help guide the process.

III. NECG

Nuclear Economics Consulting Group (NECG) considers itself a stakeholder in and consultant to the international energy community, with special interest and experience in the nuclear power industry.

NECG and its experts are independent of commercial, political, or ideological interests. NECG helps decision makers and their stakeholders make good decisions – for or against nuclear project undertakings, and on the right process to reach those decisions – founded on analytical rigor and objectivity informed by real-world international industry experience. NECG applies in-depth analysis to complex economic, business, regulatory, financial, geopolitical, and other nuclear industry challenges.

A. General Qualifications

NECG's international experts have created and helped implement corporate and government strategies, conducted research and studies, written detailed subject matter reports, provided recommendations on marketing and business strategies, provided advice on multiple issues, and provided expert testimony for corporations, law firms, and government authorities. NECG also collaborates with other firms that need deep and specialized nuclear industry expertise for proposals, client engagements, and project execution.

NECG experts have global reach and past performance covering all facets of the nuclear industry. NECG experts combine consultancy experience with extensive real-world operational and corporate leadership. NECG experts have worked in the nuclear industry and on nuclear projects around the world at all stages. Our work is informed by extensive experience in the electricity industry, electricity industry restructuring, and assessing the impact of electricity reform on the nuclear power industry.

NECG's focus is on:

- Nuclear Industry (i.e., national nuclear programs; electricity industry reform; and nuclear fuel cycle approaches);
- Nuclear Business / Transactions (i.e., new nuclear projects, strategies, and due diligence; and
- Special Projects (i.e., expert testimony; financial viability/bankability; PPAs and other project contracts)

The International Atomic Energy Agency (IAEA), the International Framework for Nuclear Energy Cooperation (IFNEC), the European Commission, and U.S. and European national organizations have recognized and included multiple NECG Affiliates as nuclear power industry experts. Our team members have also helped write significant international guidance (e.g., for IAEA, NEA, IFNEC, and other organizations) on nuclear power project and programme development and financing. We also serve on the faculty of IAEA training courses (held at Argonne National Laboratory and Texas A&M University) and Technical missions for IAEA member states, responsible for instruction on NPP financing, project economics, project development, electricity market structure, risk, and legal matters, and overall project structuring.

More information on NECG expertise is available at https://nuclear-economics.com/expertise/.

NECG helps clients with insightful analyses, including:

- Evaluate new nuclear project business models and financing approaches;
- Structure nuclear projects, PPAs, and related arrangements;
- Support positions in nuclear industry legal and regulatory disputes;
- Review government and regulator decisions about nuclear power projects;
- Develop project risk registers to identify and assess risks, and then develop risk allocation, mitigation, and management approaches;
- Develop and implement effective nuclear industry strategies;
- Realize/ maximize localization, industrialization, I.P. and T.T. and skills development in South Africa; and
- Provide advice on the electricity industry and electricity industry restructuring issues related to the new nuclear build programme.

NECG helps companies and governments evaluate options and make thoughtful and effective decisions related to the nuclear power industry. By applying proven and innovative approaches, clearly and convincingly communicating evidence-based, independent findings and results to clients, we have successfully worked with sellers, buyers, regulators, law firms, debt and equity fund providers, and other nuclear project stakeholders on a range of issues.

NECG experts have worked on nuclear projects around the world at all stages. A key part of our work is our extensive experience in the electricity industry and electricity industry restructuring. Our insights into nuclear economics and electricity industry issues help clients understand how nuclear power projects fit into various electricity industry structures, markets, and approaches.

We note that the NECG team comes from various professional, national, and jurisdictional backgrounds, giving us a global, multi-cultural and comprehensive approach to the provision of nuclear power industry advisory services, with strong attention to the local business context.

Several NECG experts have worked on previous South African nuclear power plant development activities since 2007, providing us with an understanding of the South African nuclear power plant context and possibilities.

B. Relevant Competencies

NECG has extensive specialist experience in analyzing and presenting international lessons learned and developing suitable scenarios for possible solutions in the South African context. These are the key topics we can cover and the task areas NECG can evaluate and offer advice in South Africa for nuclear power:

- Economics and Electricity Market Design;
- Programme Organization and Governance;
- Programme Development;
- Programme Support (technical and other support needs);
- Procurement Strategies;
- Localization Strategies;
- Financing and financial support systems (e.g., credit, guarantees, electricity rates); and
- Implementation Support.

C. NECG Experts

NECG is an international group of experienced nuclear power industry professionals linked by commercial Affiliate agreements.

The NECG team with relevant experience in South Africa includes Edward Kee, Ruediger Koenig, Paul Murphy, and Fabienne Pehuet.

Edward Kee
CEO and Principal Consultant

Edward Kee, based in the United States, is an expert in nuclear economics. Mr. Kee provides advice to governments, investors, regulators, regulated and unregulated electricity companies, nuclear companies, and other parties.

Ruediger Koenig
NECG Affiliate

Ruediger (Rudy) Koenig, based in Germany, has extensive international experience in clean energy. In nuclear, he has been responsible for suppliers in the front and back-end, decommissioning, and has helped a large European utility investor develop, implement, and ultimately sell several nuclear new build projects. In 2014 he worked on a major nuclear power plant project at ESKOM.

Paul Murphy
NECG Affiliate

Paul Murphy is a legal expert on developing and financing nuclear power projects, representing governments/developers/owners, lenders, investors, technology providers, and contractors.

Fabienne Pehuet
NECG Affiliate

Fabienne Pehuet, based in France, is an expert in Energy Policy / Strategy, Nuclear Economics, Nuclear Program Development, Nuclear Industry / Supply Chain, Nuclear Waste Management, Decommissioning, Nuclear Power Plant Projects, Nuclear Fuel Cycle, and Uranium Mining.

If asked to assist in the South African nuclear new build process, we could bring in additional NECG experts as needed and could collaborate with other firms providing advice.

As requested by NERSA, NECG indicates herewith our interest in making oral representation to the Regulator in public hearings to be held after the closure of the written comments period.

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Appendix A – NECG Comments on NERSA Questions

Appendix A is a table with NECG comments on NERSA questions separated into seven groups.

A. Capacity Allocation (2019 IRP Context)

NERSA Questions		NECG Response		
		Section	Comments	Ref
1	Is this 2 500MW of nuclear capacity section 34 determination compliant with the IRP 2019 as gazetted by the Minister of Mineral Resources and Energy?	A	For this Consultation, NECG defers and refers to other comments and widely available information in support of these arguments: NECG generally agrees with the assessments justifying nuclear energy as a "no-regrets" option for South African energy supply after 2030 because of: • widely recognized benefits of nuclear energy for future decarbonized energy system and • existing relevant domestic competencies and resources. NECG supports the idea of nuclear energy as a baseload, clean energy generation option for South Africa, providing long-term stability to the grid. We recognize the benefits of baseload generation in a country of South Africa's size and ambition, and where the only viable baseload options are nuclear and hydro, given climate mitigation necessities. Since hydro is subject to natural and environmental limitations, nuclear offers important capacity options. In addition to established large reactor designs, SMRs can be considered either an addition or a future option. Due to the size, complexity, and upfront cost of investments in new nuclear capacity, a "no-regret option" requires a highly flexible, iterative decision-making and development path, which we outline below.	
2	In light of the decommissioning of a significant amount of base load capacity by 2030, and South Africa's reliance on natural resources extraction and beneficiation as significant drivers of economic development, should this baseload capacity be added post 2030 and why?			
	Is this an important consideration in the broader integrated industrial policy and why?			
3	What other base load options are available that the country could invest in?			
	Justify the preferred option?			
4	Comment of the type of technology in the Determination in line with the following:			
	i. Energy security considering both security of supply and security of demand.			
	ii. Efficient, effective, sustainable, and orderly development and operation of the electricity supply industry from production through to consumption.			
	iii. The interest of present and future electricity customers is safeguarded against, inter alia, stranded assets, environmental impact, and energy security.			
	iv. Use of diverse energy sources and energy efficiency.			
	v. International best practices.			

NERSA Questions		NECG Response		
		Section	Comments	Ref
	vi. Mitigation of climate change by the reduction of greenhouse gasses and other environmental imperatives.			
5	Provide what you consider to be the risks and challenges associated with the allocated capacity in terms of the objects of the Electricity Regulation Act mentioned in question 3 above.			
6	Comment on the lead time for the deployment of nuclear power plant of circa 10 years, from design, licensing, construction, and commissioning.	A	Ten years may be considered a minimum lead-time, under otherwise optimal circumstances. For the context of and purposes intended under IRP 2019, a longer lead-time should be anticipated. Deployment by 2035 as a "defined moving target in a range 2032-2037" (as explained below) should be deemed appropriate. This ten-year period included the planning stages and procurement process. Preparation should commence as soon as possible, but in an "iterative step-wise process" as defined below. Best practice suggests the engagement of a small, interdisciplinary team of independent experts, which could help DMRE design such a process and move quickly and strategically through the initial set-up. It would be essential to design the process based on international best practice and without prejudice to strategic considerations: while political and other preferences must ultimately be considered, they should be channeled in an efficient integrated proceeding.	See Sections B and E below.
	i. Considering the lead time above, what would be the most suitable time to commence preparations if nuclear was to be a no-regret option to replace the base load capacity to be decommissioned post 2030?			

NERSA Questions		NECG Response		
		Section	Comments	Ref
7	What would be the advantages brought about by SMRs, and is it possible for these to complement intermittent technologies such as renewables?	A	Deployment of large reactors and SMRs is not mutually exclusive and could even be mutually beneficial. SMR application-based approaches (e.g., autonomous off-grid islanded operation, desalination, hydrogen production, process heat, etc.) could be of particular interest to South Africa under flexible generation options, considering the intermittency challenges presented by renewables and disparate regional demand. SMRs could provide advantages in financing, investment risk, localization, grid requirements, flexibility, especially in the context of electricity systems heavily impacted by intermittent technologies. It is doubtful that SMRs alone could achieve the objectives specified in IRP 2019 (capacity and timing): • it is yet to be determined whether and when a sufficiently mature industrial-scale SMR technology and manufacturing capability will be available and economically feasible; and • whether SMRs could offer a significant benefit compared to large nuclear reactors in a South African context. As set forth below, Item #29, the SMR option could be reevaluated in the future. Depending on the SMR design considered, it is possible to target deployment in the 2030s, recognizing that such a technology selection would have to be balanced against FOAK considerations from two perspectives, both of which would not be assured by the time of selection: • technology readiness for regulatory approval (which may be achieved by a reference plant elsewhere, after the time of selection but before the start of the nuclear safety license application process in South Africa), and • commercial feasibility (which would presume industrial economies of scale in manufacturing and construction of SMRs have been achieved by the time of project execution in South Africa).	See Sections B and E below.

NERSA Questions		NECG Response		
		Section	Comments	Ref
8	Comment on the impact of nuclear technology on the electricity tariff and how this may affect demand for electricity in the longer term, and how this may affect future investment decisions and how long the investment cycle is, where applicable.	A	The stable cost of nuclear electricity serves to modulate the future price of electricity. Lifetime nuclear electricity generation costs are predictable at the time of project implementation and very predictable over the plant's operating life after construction is completed. Future electricity price/ tariff levels can allow economic sustainability of the nuclear plant. For financing purposes, long term, secure offtake structures are necessary, and we would recommend that a structure is established that supports both debt and equity financing, based on a robust financial model. To the extent strong offtake economics are achieved, the nuclear project should contemplate an aggressive post-COD refinancing strategy, especially if government-sourced financing is needed during construction. In considering electricity pricing, we also recommend that the analysis be done on a Total System Cost basis instead of a Levelized Cost of Electricity basis. Total System Cost more accurately assesses the benefits of nuclear power relative to other alternatives.	

B. Technology Costs

NERSA Questions		NECG Response		
		Section	Comments	Ref
9	Comment on the costs of mature and commercially available nuclear power generation technologies. Provide your comments in line with a mandate to ensure that:	B	Four factors drive costs of nuclear power technologies: • Costs of materials; • Cost of labor during construction; • Costs of risk/uncertainty; and • Costs of financing. Factors (1) and (2) are relatively stable and might be favorable for South Africa. Factors (3) and (4) are what drive nuclear new build costs in international projects. Establishing a programme to getting control of these factors is key.	See Section E below.
	i. investment in the electricity supply industry is facilitated;			
	ii. universal access to electricity is facilitated; and			

NERSA Questions		NECG Response		
		Section	Comments	Ref
	iii. competitiveness, customer and end-user choice are promoted.		These include: developing processes and resources to minimize regulatory uncertainties, delays, changes, and to maximize the ability to bound site-specific conditions/challenges. Since the cost of financing is significant, both in terms of the rates and interest and duration, the Government plays a key role in driving down financing costs, which can lower the overall cost of capital when combined with a refinancing strategy reduces the total project cost. Operation and Maintenance costs, future Retrofits, and the Nuclear Back-end (decommissioning, waste management, and disposal) add a small but relatively predictable additional cost. Note that the "environmental cost" of new nuclear capacity is marginal in South Africa, since it only adds incremental volumes to an existing nuclear legacy.	
	Comments on costs should incorporate overall cost of the technology and must not be limited to overnight cost.			
10	**What would constitute modular scale and at what cost would it be affordable for the South African economy?**	**B**	While modular construction can be utilized for large reactors (e.g., the top-down modular construction approach used in several reactor designs), the concept of modularity applies more clearly to SMRs. In that context, the traditional rule is 300MWe and below. That said, SMRs allow for scaling, fleet phasing, and linked financing, all of which can create interesting project structures in the SMR context. We note, too, that certain designs (e.g., NuScale) have developed a nuclear power plant concept that has modularity as a key design feature (i.e., the power plant has 12 reactor modules in a single facility). However, modularity benefits presuppose an existing industrial manufacturing supply chain and sufficient economies of scale to have been reached. It is uncertain when and which designs may reach this status.	See Sections C, D, and E below.

NERSA Questions		NECG Response		
		Section	Comments	Ref
11	Comment on the cost of other suitable base load technology options the country can consider – whether referenced in the IRP 2019.	B	NECG defers to and references other sources in this regard but notes that analyses of system costs often do not recognize and adequately value inherent services that nuclear plants (as well as coal) provide to the energy system besides dispatch capability (large fast ramps): e.g., frequency control, nor do models properly value energy security, energy diversity, emissions-free generation, or long asset life. These should be considered when evaluating alternative options. Because of global concern for carbon emissions, external finance sourcing to support coal generation is exceedingly difficult. Because hydro can still be developed in a way that meets internationally-recognized environmental standards, hydro (whether inside South Africa or elsewhere in the southern African region) can still be an option. Nuclear power provides the greatest optionality from a baseload perspective when factoring in environmental goals.	
12	Comment on the most suitable pace (timing between power units) at which South Africa should implement the nuclear build programme.	B	Assuming two large reactor units are built, these would usually be built at the same power plant site in a sequence with 12-18 months between the two reactors, but this may differ by design, site conditions (space and climate/weather), and other issues. The use of SMR designs to meet an overall target of 2,500 MW will require careful timing and pace linked to the SMR design selected. The SMR design might also influence how quickly generation could come online, noting the difference between a design with inherent modularization in reactors (NuScale) versus other designs where scaling would have to be on a total plant basis.	
13	Comment on the procurement of this capacity now for build beyond 2030.	B	In the case of an SMR option, the procurement process would need to be extended to achieve sufficient clarity for nuclear power plant designs that are not yet built and have no reference unit. More time may be needed for these new SMR reactor designs to evaluate design maturity, lessons from reference unit(s), and transfer of knowledge for safety regulator review.	See Section E below

C. The Generator

NERSA Questions		NECG Response		
		Section	Comments	Ref
14	Provide your comments on Eskom or any future entity of the unbundled Eskom as the generator of the new generation capacity. Provide your comments under the following three scenarios:	C	NECG refers and defers to other sources in this regard, but note that: • In view of the existing qualifications of ESKOM as an internationally recognized best-in-class nuclear operator, ESKOM should be engaged in the operation of a new nuclear plant in South Africa; • ESKOM's role could be established in various ways (whether as owner/operator, contracted operator, or others), which should be developed in the context of the future procurement and project development process; and • From a nuclear sector financing perspective, the owner/operator's credit analysis will be important, but that export credit agencies will expect a sovereign guarantee, regardless of the ownership vehicle.	See Section E below.
	a) Status quo remains, that is, Eskom is not unbundled and remains a state-owned vertically integrated utility.			
	b) Eskom being unbundled and Generation, Transmission and Distribution are separate state-owned entities.			
	c) Eskom is not viable and privatised, but as outlined in (a) or (b) above.			
15	Comment on the feasibility of a partnership between Eskom and other juristic person in view of Eskom's current balance sheet. What would the risks to electricity customers associated with this arrangement be?			
16	Give your comments with regard to the ownership model:			
	a) IPP owned;			
	b) joint venture (RSA & IPP);			
	c) state utility owned; or			
	d) any other applicable model.			

D. The Buyer

NERSA Questions		NECG Response		
		Section	Comments	Ref
17	Provide your comments on the chosen buyer for the capacity. Provide your comments under the following three scenarios:	D	As noted above, new nuclear power plants would commence operation in the mid-2030s. Accordingly, the Buyer's role needs to be seen in that context, which will evolve. Simultaneously, as noted above, the full faith and credit of the State will be needed to finance the nuclear plant construction. ESKOM's role in this context needs to be developed and adjusted over time. Any restructuring should also consider whether external equity is desired, whether during construction or under a refinancing strategy (with the latter being a function of the offtake structure, as noted above). An initial "target structure" would be developed during the procurement process with the potential suppliers and their financial backers (usually governmental agencies). For lack of certainty on future designs, the current Status Quo would need to be the reference case by default.	
	a) Status quo remains, that is, Eskom is not unbundled and remains a vertically integrated utility, with the Single Buyer situated within the System Operator.			
	b) Eskom being unbundled and Generation, Transmission (Wires and System Operator that includes Single Buyer Office) and Distribution are separate entities.			
	c) Eskom being unbundled and Generation, Transmission (Wires) and Distribution are separate entities. A form of ISMO is instituted, with the System Operator also encompassing a Single Buyer Office.			
	d) Eskom is not viable and privatised, but as outlined in (a) to (c) above			
18	How should the cost recovery be handled to ensure that the generator earns its revenue.	D	If ESKOM is the owner and builder of the new nuclear power generation, the cost recovery approach (both for investment and operating costs) must be clearly defined before project development. This approach will need to provide the long-term certainty about cost recovery that ESKOM requires to obtain funding for the nuclear project. This approach will likely need to be separate from and longer-term than the current MYPD process. Similar issues apply if ESKOM is a buyer of power from a new nuclear power project owned and operated by a different entity. The nuclear project company will also require long-term revenue certainty provided through a long-term power contract with ESKOM. The cost recovery approach for these long-term nuclear power contracts will determine the level of counterparty risk perceived by the nuclear project company. The additional financial risk that a private nuclear project company holds (i.e., compared to state-owned ESKOM) may mean that the nuclear power contract and the regulatory approach to ESKOM's recovery of costs are even more important than if ESKOM is the owner and operator of the new nuclear project.	
	The response should be in terms of the ownership models outlined in question 15 above.			

NERSA Questions		NECG Response		
		Section	Comments	Ref
19	Provide what you consider to be the risk associated with the chosen buyer.	D	The buyer is a key, critical factor in establishing a nuclear new build programme, and lack of clarity or rigorous accounting of this fact has led to failures of other international nuclear new-build programmes. The buyer's credit quality determines the availability and cost of credit; the buyer's funding determines how to balance politically and economically mandated electricity rates versus cost of generation and cover resulting shortfalls. Construction completion is the main risk associated with the chosen technology vendor; project management and risk allocation among stakeholders, including lenders and equity partners, are two closely related points of attention for project feasibility and future success. Predictability over future electricity prices is also the main enabler of nuclear projects. We note that geopolitical factors have risen in importance in the nuclear sector in recent years; consequently, the bilateral relationship will need to be considered part of the overall decision.	
20	Must the buyer be paid only for power required by the system, i.e. the generator takes the risk for reduction in demand?	D	This question appears to be referring to the potential that the nuclear generator's entire output is not needed to meet system demand, requiring the nuclear power plant output to be curtailed. Adding the risk that the buyer or the generator will be required to take the financial consequences of curtailment (i.e., less revenue for a nuclear power plant with fixed generating costs) will have large implications for project financial returns. A nuclear generator may not have the financial capability to bear the offtake price or volume risk. Stability in the offtake structure (ability to dispatch at a financeable price) will drive all financing considerations, along with the ability of the Government of South Africa to provide sovereign guarantees.	

NERSA Questions		NECG Response		
		Section	Comments	Ref
21	In the event that Eskom as an organ of state is designated as generator and buyer, how will this arrangement affect the fairness, transparency, competiveness and cost effectiveness of nuclear procurement as far as electricity customers are concerned? Should this arrangement be encouraged?	D	The nuclear procurement should be set up in a manner to ensure maximum insulation from political influence that might be exerted on an organ of state but also from lack of acting in the public interest as may occur in a purely private entity with a lack of governance and transparency. There are best practices how to address these challenges. However, in the case of a nuclear procurement the "last call" is always with the State, so an arrangement that channels and ringfences this involvement should be encouraged. We recognize that government-to-government models are prevalent in the nuclear sector in recent years; nevertheless, even in a G2G structure, a competitive environment can be created.	

E. Procurement Process

NERSA Questions		NECG Response		
		Section	Comments	Ref
22	Provide your comments on the DMRE as the designated procurer capacity.	E	NECG considers state bodies, when acting in their government capacity, as not best positioned to be the procurer of a nuclear power plant project. The identification of Key Buying Factors is critical. While the price is one component, it is not the only one, and an undue focus on project price has resulted in bad decisions being made. The totality of the offering, with an emphasis on project deliverability, is of greatest primacy. Simultaneously, introducing Key Buying Factors other than price and strict technical and commercial factors elevates the need for governance and oversight. A state-owned entity organized with the following principles in mind may be well-positioned to procure nuclear capacity in South Africa.	Please refer to Appendix B
23	Which another organ of state is best positioned to be the procurer of this capacity and why?			

NERSA Questions		NECG Response		
		Section	Comments	Ref
24	Provide your comments in respect of juristic persons that may partner with the state or the nature of the partnership for purposes of this procurement.		• Access to relevant Governmental bodies and decision-making processes; • Transparent oversight (e.g., by Parliament and relevant Departments); • Ability to hire professionals as well as engage contractors (individual and corporate), also internationally, at private market rates/fees; and • Ability to negotiate contracts with some degree of distance from public procurement rules provided that a compliance and control framework is established. To that end, such a ringfenced entity should engage an interdisciplinary group of subject matter experts with international nuclear project-specific experience across reactor technologies and jurisdictions to best serve the goals of the program.	
25	Which funding model would be suitable for this capacity to ensure a lowest price for the consumer?	E	As demonstrated by recent analysis coming out of the U.K. nuclear program, a government-supported model will lead to the most efficient funding model. Moreover, such a model can be refinanced after the project enters commercial operation, if done properly, such that the government's financial position in the project can be reduced. NECG has published various public domain information describing "Strawman" models to benchmark best practices.	
26	What is the most cost-effective model of plant construction (e.g., turnkey approach, split package approach and multi-contract approach) to avoid excessive cost overruns, noting that the recent Eskom new build was a multiple EPC contract approach, managed by Eskom.	E	The effective model will consider the cost of construction, owners cost, methods and cost of financing, localization strategy, nuclear and other regulatory and licensing/permitting processes, both from the South African and the vendor perspectives. An effective model will be developed during the procurement and development process. For reference purposes: this will most likely be a hybrid model, turnkey in structure but with elements of split-package and multi-contract approaches, as well as target costing, and reflecting some of the collaborative contracting approaches that have been utilized in non-nuclear megaprojects in the U.K., U.S., and Australia. In NECG's opinion, models as applied in UAE, Turkey, Belarus, and Bangladesh may not be feasible or desirable in the South African context).	Please refer to comments on question #29

NERSA Questions		NECG Response		
		Section	Comments	Ref
	To what extent should Eskom be involved in the actual construction management of the build programme?	E	ESKOM may have two roles: • Mandatory - as an experienced nuclear power operator in South Africa, without which the development, construction, and commissioning cannot be effectively and efficiently performed; and • Optional - other roles that can be developed in the process with potential suppliers.	
27	In the event a non-turnkey solution is preferred, how should the nuclear build work under construction (WUC) be dealt with in the future Multi-Year Price Determinations (MYPDs), given the long lead times of the technology?	E	NECG defers and refers to other sources regarding South African electricity tariff regulation. Regarding our Comment to Questions #26 and #27, we note that a bespoke contracting, funding, and implementation model will likely also require bespoke rate regulation.	
28	In the event the generator is in partnership with Eskom and another juristic person, should this jointly operated asset qualify under Eskom RAB when considering the MYPD application?			
29	Provide your view on the method chosen for the procurement of the new generation capacity.	E	Procurement should follow an iterative, stepwise method that allows for sufficient time to de-risk the project before the start of construction. • Step 1: identify serious options (technology and suppliers) and their necessary conditions and select three or four for the next step. • Step 2: negotiate two Agreements with each of those potential suppliers (i) a nominal Contract Model for Implementation (term sheet) and (ii) an Early Works Contract (i.e., to de-risk the project, rather than expedite future project execution).	Please refer to Appendix B

NERSA Questions		NECG Response		
		Section	Comments	Ref
			• Step 3: based on the results from Step 2, select at least two potential suppliers to perform the Early Works in parallel (Note this requires the funding of both suppliers to perform partly redundant efforts, but this is essential for the further process). • Step 4: based on the Early Works results from both potential suppliers, reevaluate the options and either select a single partner or return to Step 1 or Step 2. • Step 5: with the single partner, continue the development process to reach "FID-Final Investment Decision" and issue "FNTP – Final Notice to Proceed." • Step 6: start the Construction phase or cancel the programme. Steps 1 and 2 could be accomplished within a period of 2 years after start (e.g., 2022-2024). Steps 3 and 4 could be accomplished in a period of 2 years (e.g., 2025-2027). If there are no resets at the end of stages 2 or 4 (e.g., due to new alternative baseload options, changed economic parameters, etc.), Steps 5 and 6 would lead to a completion date around 2034/35. This process would be "open book" until the end of Step 5. The budget to achieve Step 4 could be at about USD 100 million, but the budget to conclude Step 5 would be more than USD 1 billion. Accordingly, topics such as those raised in this Consultation would be reconfirmed at least at the end of each of the five Steps and would need to be locked in by around 2030. For reference: a highly streamlined process, under optimal conditions, might be as follows: after the initial selection of a bidding group via an RFI, down-select to 2/3 could be done inside of 1 year. Bids and selection of a preferred bidder could be another 18-24 months. Early works could be 1 year, and then the time from Financial Notice to Proceed (FNTP) to Commercial Operation Date (COD) for the first unit would be another 5-6 years. This corresponds to the minimum ten years needed to achieve a start-up by 2032.	

NERSA Questions		NECG Response		
		Section	Comments	Ref
30	State how the procurement process proposed can be reconciled with Eskom being the designated generator of this power.	E	A provisional electricity price should be established under an initial financial model, and it should be reassessed under a process established according to Question/Comment #29 above. Assuming the plant is technically complete and connected to the grid, three factors need to be reconciled: (1) the as-built cost of the plant accrued at the time of grid connection, and (2) the Levelized Cost of Electricity and Services sold by the Generator to the Buyer, and (3) the present value of future electricity sales revenues achieved by the Buyer. It will be the ultimate responsibility of the State to ensure that the Generator is insulated from any shortfalls to the extent the supplier of the nuclear technology does not share in the responsibility and cost.	Please refer to comments on questions #21 and #29
31	Provide what you consider to be the procurement-related risks associated with the capacity in this Determination.	E	NECG considers there are four inter-related types of risks: • The time needed for procurement, development, and construction spans a period greater than ten years, implying that there is a great certainty that key parameters for the project will change in highly uncertain ways; • The Procurer will be subject to "certain uncertainties" that will not be resolved until finalization of the project (i.e., grid connection); • Potential suppliers and their (often government) stakeholders will offer undertakings (scope, schedule, quality, cost) which will be subject to conditions that are not controllable in the context of the nature of a nuclear new build programme; and • No commercial (privately held) entities will be able to bear these risks Accordingly, the entire process is (a) uncertain, (b) subject to political agreement and support, and (c) subject to multiple external influences. The procurement process must be designed to allow them to be pro-actively managed. The goals of the program must be clear, and government support must be sustained. The electricity regulation process that determines cost recovery must be well-established, with appropriate risk allocation to support project development and financing. The entire program must have an active	Please refer to Appendix B

NERSA Questions		NECG Response		
		Section	Comments	Ref
			stakeholder engagement strategy, such that support for the program remains, given the tenor of the effort. Careful thought must be given to the bilateral partner (at a geopolitical level) to have confidence that the relationship will endure throughout the programme's life and that negative dependencies are not created. South Africa should be very sensitive to the "offer too good to be true" trap. As such, it must have a team that can fully evaluate the offering, reaching an independent judgment as to the project's deliverability.	
32	**Comment on the socio-economic impact of nuclear new build programme on South Africa (e.g. job opportunities and localisation).**	**E**	Given the existing competencies in South Africa, both directly as well as potentially (after training and qualification/certification) available for civil construction, nuclear fuel supply, as well as the supply of nuclear grade components, systems, and services: a nuclear new build programme would have substantial positive socio-economic impacts directly and indirectly, during construction and operation. Furthermore, to the extent that South Africa can partner with the reactor technology supplier, there may be a possibility of developing export opportunities. Tax revenue can also be deployed to create tangible benefits for the local community and the country, as revenue can support infrastructure and human resources development. Stable baseload energy supply and ancillary benefits provided by nuclear power plants (as noted above) are a pre-condition to certain industrial activities, e.g., in mining and processing. However, depending on the procurement and development process, this could also negatively affect the time and cost of the new build programme (as well as the choice of technology supplier). NECG'S proposed procurement process reflects these considerations.	Please refer to comments on Question #29

F. Other

NERSA Questions		NECG Response		
		Section	Comments	Ref
33	Do you agree with the Determination as provided by the Minister?	F	In general, NECG agrees with the Determination. South Africa needs reliable and clean baseload generation that is provided by nuclear power. The broad scope outlined in the DMRE determination, therefore, is justified. However, the general nature of the DMRE approach presents the risk that a suboptimal approach could be chosen. NERSA's Consultation Paper identifies significant Questions that must be answered to find an approach to new nuclear build in South Africa that is financially and economically feasible. Further suggestions for consideration are provided in Appendix B hereto.	

Appendix B – 2020 NECG Submission to DMRE

NECG provides, in a separate PDF document, a submission we made to the Department of Mineral Resources and Energy (DMRE) on 14 September 2020. This Submission was in response to the DMRE RFI on the South African Nuclear New Build Programme.

RFI Response: Nuclear New Build Power Procurement Programme

The Republic of South Africa
Department of Mineral Resources and Energy

14 Sep 2020

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Contents

Context of this Submission

Nuclear Economics Consulting Group (NECG) submits this response to the RFI on Nuclear New Build Power Procurement Programme.

NECG is interested in assisting the South African Department of Mineral Resources and Energy (DMRE) in establishing a South African Nuclear New Build Programme.

NECG provides practical professional expertise related to the global nuclear power industry, as discussed in more detail in Section III below.

This submission outlines our understanding of DMRE's needs and NECG's capabilities to help meet those needs.

NECG is offering support to DMRE on:

- *Nuclear power project business models;*
- *Procurement strategy;*
- *Contracting approach;*
- *Funding/financing issues;*
- *Interaction with the electricity industry in South Africa; and*
- *"Lessons learned" on "best practices" from other nuclear power projects.*

I. Value Proposition

A. Issues for DMRE and South Africa

The information requested by the DMRE RFI is focused on information from nuclear power plant vendors.

These vendors will likely provide information that is intended to influence decision-makers in South Africa to move forward with a new nuclear build programme that is based on that vendor's technology and on geopolitical objectives of the vendor's home country.

However, nuclear power plant vendor information submitted in response to this RFI will not constitute binding commitments or actionable offers.

B. How NECG can Help

NECG strongly believes that the South African DMRE will benefit greatly from having advice from an independent firm that is not linked to any nuclear power plant vendor or vendor consortium.

NECG will combine its deep experience in the entire lifecycle of nuclear power plant projects and programmes worldwide with its role as an objective, third-party analyst, and its vendor agnosticism to provide DMRE with fact-based decision support and operational guidance in its pursuit of a new nuclear power plant build programme.

In this submittal to the RFI, we would like to highlight three contributions NECG can deliver to help DMRE create a viable nuclear new build programme for South Africa:

- **Client Perspective:** Provide DMRE with context for a nuclear program, based on experience in other national new build efforts, on what has been successful or not, on strengths and weaknesses, and on other lessons learned;

- **Supplier Perspective:** Support DMRE in analysis of vendor RFI submittals and provide benchmarks against approaches that vendors have taken in other international nuclear programmes, with a focus on promises made, conditions required, and issues to be considered; and

- **Organizational challenges:** Assist DMRE define and create the organization required to undertake a national nuclear new build program. Up to a certain point this can be a loose project set-up, in accordance with IAEA's Nuclear Energy Programme Implementing Organization (NEPIO) concept. However, at some point in the future there will be a need for corporate structures to deal with investment, liability, contracting, financing, and other aspects of a very large enterprise.

  This nuclear "Holding Company" structure might be placed under the umbrella of Eskom, or it may be a new special purpose vehicle (SPV) ("SPV"), with or without

foreign (vendor) investment. In the transition from DMRE, to a NEPIO, to a Holding Company, to nuclear new build project implementation, progressive organizational structures will be needed for internal governance as well as external interfaces.

Further details on how NECG can assist are provided below.

A nuclear plant project requires a long-term commitment from multiple parties that is supported by a clear view of economic issues early in the project development process to ensure success – NECG can help provide that view.

C. Overall Purpose of RFI

Section 3.7 outlines the overall purpose of the RFI.

> *3.7 The purpose of this Request for Information (RFI) document is to provide an improved understanding of the experience of different Nuclear Power Plant vendors and obtain information from NPP vendors relating the financial and technical aspects. These will include costing and financing of respective NPP technologies; plant design features; license ability of plant design in South Africa; feasibility for construction at sites in South Africa; and a detailed project management plan; as well as indicative contracting models, such as Engineering Procurement Contract (EPC), Engineering Procurement Contract Management (EPCM), Build Own and Operate (BOO), Build Own and Transfer (BOT) and Build Own Operate and Transfer (BOOT).*

The key areas in Section 3.7 where NECG can help DMRE are in providing an assessment and evaluation of comparative contracting and financing approaches, cost outcomes in other projects, and alternative contracting/ownership models. NECG is uniquely qualified to provide insights from the perspectives of economic regulators, lenders, investors, suppliers, host governments, and project companies. We can also add insights into areas not listed, such as partnering and localization strategies or long-term supply-chain development strategies and contracts for spare parts, services, and fuel.

Most importantly, NECG team members will provide "lessons learned" and "best practices" analyses and examples in our advice, consulting reports and other work products, and in training/discussion sessions.

D. Funding and Financing Models

Section 4.3.6 covers funding and financing models for new nuclear power plants.

> *4.3.6 **Financing solutions and related conditions.** Provide detailed information on the possible permutations and conditions related to funding and financing models and mechanisms for the Conventional Power Reactors, taking into account the need to cushion capital costs whilst ensuring affordable tariffs to be passed on to the consumer. Lessons learnt from current and past NPP projects (successes and failures of the model*

and mechanism) should be shared, and recommendations on most optimal models and mechanisms should be justified in detail.

NECG has extensive experience with actual nuclear power plants, multiple nuclear power plant projects, nuclear power feasibility studies, and various approaches to funding and financing schemes for new nuclear power projects. NECG experts regularly teach these subjects for IAEA training courses and have assisted with the development of guidance by the IAEA, NEA, and IFNEC. As an example, DMRE can refer to the 2019 article authored by Fabienne PEHUET, "Conditions and possibilities for financing new nuclear power plants."[1]

We can provide DMRE with lessons learned and well-supported tailored recommendations on funding and financing approaches for a new nuclear power plant project in South Africa.

E. Localisation and Skills Development in South Africa

Section 4.3.7 covers the related issues of localization, industrial development, I.P. and technology transfer, and skills development.

4.3.7 ***Localisation, Industrialisation, I.P. and technology transfer, and Skills development model****. Demonstrate the I.P. and technology transfer extent, skills development and localization content, and industrialisation commensurate with the envisaged Conventional Power Reactor as well as examples of same implemented in other foreign NPP projects. Further, outline enablers to the realisation of localisation, industrialisation, I.P. and technology transfer and skills development within the South African context.*

Any country that is looking to make the enormous investment in one or more nuclear power plants would like for the nuclear power project to be more than a one-way transfer of wealth to a set of foreign vendors.

Using a new nuclear power build programme to utilize existing relevant South African expertise and industrial capacity will be important, as will using the new nuclear power build programme to extend and enhance that expertise and capability.

NECG can help DMRE analyze how to do this by laying out the inherent conflicts and competing demands between a country's new nuclear power project (i.e., cost, schedule, and quality), the extent of localization, and export credit financing from supplier countries.

NECG would map out stakeholder perspectives, including from the buying country, the nuclear power project developer/owner, the vendor, the vendor's home country, and the international financial community. NECG experts will also specifically draw upon their prior experience in the South African context and apply it towards this analysis.

[1] See https://doi.org/10.1093/jwelb/jwy032

NECG can enable DMRE to command a 360-degree view of the nuclear power new build requirements and considerations.

F. Contracting Approach

Section 4.3.8 covers the contracting approach and models for a South African nuclear new build programme.

> *4.3.8* ***Contracting Approach.*** *Please provide a detailed analysis (including pros and cons) of contracting models for the Conventional Power Reactor with recommendations for the most feasible approach and justifications thereto given the South African context.*

Section 3.7 in the RFI refers to several new nuclear power project contracting models:

- Engineering Procurement Contract (EPC);
- Engineering Procurement Contract Management (EPCM);
- Build Own and Operate (BOO);
- Build Own and Transfer (BOT); and
- Build Own Operate and Transfer (BOOT).

This list of contracting approaches includes nuclear power plant ownership and operation approaches that go well beyond the procurement of the nuclear power plant. Contracting approaches that incorporate long-term ownership and operation by a third party (e.g., BOO) will require the resolution of more, and more difficult, issues before the actual development of the new nuclear power plant is started.

An additional key consideration is the inevitable link between a new nuclear power project and the geopolitical objectives of potential nuclear power plant vendors.

Some of these contracting and project structure approaches are consistent with stated intent in name only (e.g., EPC) or are somewhat theoretical and remain untested.

NECG notes that other contracting and project ownership models are available that could be feasible in the South African context. NECG would provide a more comprehensive set of contracting and project ownership structure options to DMRE, to include target price / fee-at-risk, cost reimbursable, hybrid, phased, and collaborative contracting models.

NECG would assist DMRE with an assessment of the strategic and operational costs, benefits, risks, and feasibility of the different contracting and project structure approaches. We would also provide real-world lessons about where and how these models have worked and why these models have worked, both in actual and proposed nuclear power projects and in conventional power projects.

For example, a BOO model will require a long-term power contract between the nuclear power plant owner and a large credit-worthy power buyer, probably Eskom, with National Treasury guarantees that may impose high costs and risks on South Africa compared to other approaches.

G. Organizational Design

As mentioned above, DEMR will need to develop an organizational framework to progress from NEPIO (essentially Government acting in its sovereign capacity) to an ultimate corporate structure to implement the nuclear new build project. Even if a 100%-foreign owned BOO model were selected, there would still be South African interfaces needed (at a minimum, power offtake and credit support). Until the final decision is made and implemented, intermediate structures will be needed. These require decisions on:

- Organizational structure and governance;
- Human Capital Management;
- Roles and responsibilities, processes, systems, procedures;
- Interface with South African counterparties (regulatory, asset owners, suppliers, and other parties) as well as foreign contractors (nuclear vendors and others); and
- Other relevant issues (e.g, fuel cycle, spare parts and maintenance support, back-end liability responsibilities, and funding).

NECG has supported major international state-owned entities in these questions, both directly and indirectly (e.g. via renowned international strategy consulting firms and law firms) as well as through first hand participation in such programs by NECG Affiliated experts.

H. Electricity Industry Issues

Any new nuclear power plant project in South Africa will need to address issues in the South African electricity industry. These issues include a move to independent power projects, long-standing proposals to de-integrate Eskom, and bulk power system reliability.

Eskom will likely either be the owner/operator of a new nuclear power plant or the counterparty to a long-term power off-take contract with another nuclear power plant owner/operator. Important parties to a new nuclear power plant project, including vendors, lenders, investors, and ECAs, will focus on the creditworthiness of Eskom as an owner or as the counterparty to a power contract.

NECG is keenly aware that Eskom faces challenges in multiple areas that will need to be addressed or resolved as a part of a new nuclear power build programme.

NECG will draw on our earlier work in South Africa (e.g., the 2008 Nuclear One procurement project) and our work in multiple other countries on the interaction between the electricity industry and a new nuclear power plant project to assist DMRE on these important topics.

II. NECG

Nuclear Economics Consulting Group (NECG; www.nuclear-economics.com) provides strategic, practical, and actionable advice on complex economic, business, and legal issues facing the nuclear industry. Our work is based on analytical rigor and objectivity that is tempered by extensive real-world industry experience in both the electricity industry and the nuclear power industry.

NECG experts and industry practitioners bring wide and deep expertise and first-hand experience working with public and private sector clients on nuclear power projects and programmes. NECG's experience includes advising clients on successful nuclear power projects and programmes and analyses of unsuccessful or failed nuclear power projects and programmes. NECG experts have also been engaged in litigation and arbitration cases related to failed nuclear power projects and programmes.

The lessons from both successful and failed projects and programmes, as allowed by non-disclosure agreements, will inform our work on this engagement.

NECG capabilities range from nuclear power project procurement and financing to nuclear waste strategies. We help clients with insightful analyses of nuclear project economics, including how to:

- Evaluate new nuclear project business models and identify financing sources and map out approaches to achieve an optimal financing structure;
- Structure nuclear projects, PPAs, and related arrangements;
- Support positions in nuclear industry legal and regulatory disputes;
- Review government and regulator decisions about nuclear power projects;
- Develop project risk registers to identify and assess risks, and then develop risk allocation, mitigation, and management approaches;
- Develop and implement effective nuclear industry strategies;
- Realize/ maximize localization, industrialization, IP and TT and skills development in South Africa; and
- Provide advice on the electricity industry and electricity industry restructuring issues related to the new nuclear build programme.

NECG assists companies and governments in evaluating options and making thoughtful and effective decisions related to the nuclear power industry. By applying proven and innovative approaches, clearly and convincingly communicating evidence-based, independent findings and results to clients, we have been successful working with sellers, buyers, regulators, law firms, debt and equity fund providers, and other nuclear project stakeholders on a range of issues.

NECG experts have worked on nuclear projects around the world at all stages. A key part of our work is our extensive experience in the electricity industry and electricity industry restructuring. Our insights into nuclear economics and electricity industry issues help clients understand how nuclear power projects fit into various electricity industry structures, markets, and approaches.

Several NECG experts worked on previous South African nuclear power plant development activities since 2007, providing us with an understanding of the South African nuclear power plant context and possibilities.

Finally, we note that the NECG team comes from a variety of professional, national, and jurisdictional backgrounds, giving us a global, multi-cultural and comprehensive approach to the provision of nuclear power industry advisory services.

III. Conclusion

NECG has the expertise and qualifications to provide advice and recommendations to DMRE. We can provide an objective and unbiased review of the submissions by other parties and help DMRE reflect this in the South African nuclear new build programme.

We will be happy to provide more information on NECG's capabilities or other issues.

If requested, NECG will prepare a detailed proposal, with commercial arrangements, on how we would assist DMRE.

Appendix A: NECG Capabilities

A. NECG Capabilities

NECG has expertise and capability in areas that will be important as South Africa considers a nuclear new build programme:

- **Structuring nuclear projects** – Our work with new nuclear (and non-nuclear) energy infrastructure projects is based on decades of work with power projects and the electricity industry. Our work with conventional IPPs and merchant power projects over several decades gives us insight into issues faced by merchant nuclear projects.
- **Analyzing electricity markets** – The most important issue for any power plant investment is the future value of nuclear electricity. The value of nuclear electricity may be related to electricity market prices or capacity expansion alternatives for traditional regulated and government utilities. Nuclear power plants, with long development periods and even longer operating lives, require a long-term analysis of the value of nuclear electricity.
- **Advising on new nuclear power projects** – The owners, investors, lenders, vendors, and other parties involved in a new nuclear power project need sound advice on a range of issues. NECG provides advice on appropriate financial and contractual structures and assessments of risk. NECG Team members will deploy their extensive project finance experience and bring that discipline to assessing risks and recommending mitigation strategies.
- **Nuclear legal, project development, and project structuring:** NECG provides rigorous independent review of these areas based on a well-rounded understanding of these areas honed over hundreds of engagements. We have provided expert opinions on related issues countless times.
- **Financial analysis and modelling** – NECG experts have developed and reviewed the complex financial analyses and models used in nuclear power plant projects. A well-developed financial model is a key tool that will allow nuclear project participants to assess risk and return and to support decisions to participate in the project.
- **Procurement programmes** – Developing and implementing strategies for nuclear procurement programmes is critical. NECG has helped in tender development, bid evaluation, and negotiation of key terms for nuclear tenders. We can work for investors, vendors, or regulators on these issues.
- **Conducting due diligence for nuclear investments and transactions** – Detailed, quantitative, and independent assessment of nuclear power projects is needed by owners, investors, lenders, regulators, and other parties in a nuclear power plant project or transaction. NECG provides assessments of the financial, regulatory, and market issues facing nuclear projects.
- **Risk assessment** - NECG provides risk assessments and advice on how to operationalize the financial, regulatory, and market issues facing nuclear projects.

- **Supporting regulatory approvals and rate cases** – Nuclear power investments are recovered through rates by traditional regulated and government utilities. NECG assists in the regulatory approval process by providing analyses of prudence and economic soundness of a nuclear power project investment.
- **Providing advice and expert testimony in litigation and arbitration** – NECG provides consulting and testifying experts in nuclear regulatory disputes, litigation cases, and international arbitration cases.

B. NECG as nuclear power industry expert

The global nuclear power industry is highly fragmented. This industry involves many technical issues, diverse reactor and power plant designs, engineering and manufacturing issues, and resource options. The nuclear power industry is closely regulated from public health, safety, and security perspectives, including oversight of technology export given the dual-use (i.e., some aspects of civilian nuclear power may have nuclear weapons applications) nature of the technology. Additionally, there are ongoing risk and strategic communications considerations that accompany all nuclear-related decisions internal to DMRE and across other governmental, public, and private stakeholders.

The nuclear industry is in a period of industry consolidation as new international market entrants are vying for market share and increasingly competing with established industry incumbents. The presence of large state-owned nuclear power plant vendors is a reality, with these national nuclear vendors bringing capabilities and funding that are linked to their broader geopolitical objectives, presenting options and issues for nuclear power plant buyers.

The nuclear industry, more than other industries, may present data gaps, inadequate availability of information, and a need for experienced judgment that adds to the complexity of conducting a commercial/business/ market due diligence analysis of any nuclear new build proposal.

In our view, a team of dedicated and experienced nuclear industry professionals who work with DMRE and other South African entities providing decision support on an intensive basis during the entire process is needed to ensure success in a nuclear new build programme. The complexities of the nuclear power industry, its incumbent and emerging players, geopolitical maneuvering, and demands for energy diversification, resilience, and sustainability increase the need for advice.

NECG provides such a team of **highly qualified and respected** nuclear industry professionals.

C. NECG Values

NECG's values support our capability to support clients.

1. Credibility

NECG's stature, integrity, and tenure in the industry and our deep industry business/market knowledge bring structure, focus, and gravitas to our work. Interacting with a small number of

very experienced and knowledgeable NECG industry experts will be more efficient and effective than approaching a wide range of nuclear industry contacts.

NECG's team has most of their careers in one or more aspects of the nuclear industry and has an excellent degree of knowledge about relevant issues.

2. Timely Advice

The deep and current knowledge base of the NECG team will allow us to provide quick and thoughtful answers to key questions and insights into strategic issues.

NECG can provide a rapid response to questions that would take weeks for a generalist consulting firm to research and answer. Even better, we can help frame questions that are relevant, rather than starting with a blank slate and using the client engagement to develop an understanding of the industry like some generalist consulting firms do. Understanding the complicated nuclear industry jargon and terminology, and reading between the lines, is also important to framing proper questions and getting answers quickly.

3. Deep Knowledge

We have, through a combination of direct work experience, previous consulting client projects, research for papers and reports, and litigation cases, cultivated information about relevant nuclear power industry issues. NECG's experience allows us to provide quick, but well-informed and well-supported, views and recommendations on relevant issues for DMRE. Moreover, our experiences are not limited to one jurisdiction – we are an international team, bringing a global perspective to our analysis and advisory services.

4. Higher Value

In getting a faster result from our deep knowledge base, NECG experts will be less expensive than generalist consultants. If we need to conduct additional research to support our views and opinions, we focus that research in a way that a generalist consultant cannot do. Rather than going down dead ends, we can focus on relevant areas.

5. Objective and unbiased

NECG is not linked to any nuclear power plant vendor or to any business model, allowing us to provide DMRE with objective and unbiased advice. We can also help DMRE assess the objectivity and factual basis of responses of other parties (e.g., nuclear power plant vendors).

Appendix B: NECG experts

Nuclear Economics Consulting Group (NECG) has assembled a team of nuclear industry experts. The members of this group of NECG experts are prepared to act as an independent nuclear industry expert team to assist DMRE.

NECG will also draw on its entire group of Affiliated Experts (i.e., see https://nuclear-economics.com/expertise/) to carry out the work of the Industry Expert Panel as required. We can add more and different NECG experts as needed.

D. Edward Kee

Edward Kee is the CEO and founder of Nuclear Economics Consulting Group (NECG) based in Washington DC.

Mr. Kee is an expert on nuclear power economics and provides strategic and economic advice to companies and governments on nuclear power and electricity industry issues. He has testified as an expert witness in U.S. and international legal and arbitration cases.

Edward Kee detailed CV (PDF)

Edward has been focused on nuclear industry and economics issues for most of his consulting career. He has successfully managed NECG affiliate teams in multiple client engagements to provide credible and comprehensive analyses to clients on nuclear industry issues.

Mr. Kee has provided advice to multiple countries hoping to establish a nuclear power programme, including Malaysia, Singapore, Turkey, and Saudi Arabia. He was a subject matter expert and client advisor in multiple nuclear power industry due diligence, project development, programme development, and financing engagements. Mr. Kee has authored numerous articles on nuclear power and the electricity industry in publications including World Nuclear News, Nuclear Engineering International, ANS Nuclear News, Nuclear Power International, Bulletin of the Atomic Scientists, The Electricity Journal, and Public Utilities Fortnightly.

There are several areas of Mr. Kee's expertise/experience that are directly applicable to this engagement:

- Retained to provide an independent review of the due diligence effort for one of the potential buyers of Westinghouse and, when his client was selected as the preferred bidder, shifted to a strategic advisor role during the lengthy government approval process.

- Joined a leading U.S. investment bank to offer financial and industry expert advice to the Unsecured Creditor Committee in the Westinghouse bankruptcy process

- Conducted recent detailed economic analyses of U.S. nuclear power plants, focused on the causes of and potential for early retirement; NECG has a detailed reactor-by-reactor

database; NECG was retained by US DOE to prepare a detailed report on this topic that will be released on about 20 October 2017

- Testifying and consulting expert in a Canadian uranium tax matter that involved preparation of a detailed analysis of the global nuclear fuel markets and the factors driving demand and supply in those markets

- Part of the team providing the US DOE Loan Guarantee Office with a detailed due diligence report on state regulatory and electricity market risks for Vogtle (application funded) and Summer (application suspended) nuclear power projects

- Involved in new nuclear programmes and procurement efforts outside the U.S., many of which have involved assessment of reactor designs available in the market (e.g., Saudi Arabia, South Africa, Singapore, U.K., Turkey, Malaysia, Vietnam, Lithuania, Finland, Czech Republic, and Poland)

- Has written and published papers and given presentations on relevant topics including early retirement of U.S. nuclear plants, global nuclear power plant markets and shift to national companies, and the role of government in the nuclear power industry

E. Ruediger Koenig

Ruediger (Rudy) Koenig is an NECG Affiliate based in Germany.

Rudy works as an independent advisor and interim manager serving investors and suppliers in the clean energy industrial value chain.

Ruediger Koenig detailed CV (PDF)

He has 30 years of executive experience in the international nuclear industry and is familiar with the key issues, players, and programmes worldwide, as well as their historical context. Rudy has held multiple executive responsibilities, structuring complex business transactions in large capital projects, and managing lean business operations.

He has been a key player in the European new build programme where he helped develop, implement, and ultimately sell several new build projects in different countries for a European utility investor, RWE. This included roles as Alternate Executive Director at Horizon Nuclear Power Ltd. (U.K.) and as Chairman of the New Build Task Force at FORATOM, the European nuclear industry association. Between 2008 and 2012 his responsibilities included the procurement for a large nuclear new build programme in the U.K. where Westinghouse, Areva, and (initially) GE presented EPC bids (RFI, RFP, BAFO) for up to six reactors at 2 sites. This involved vendor assessments of their technical, commercial, managerial, and other competencies. He also gained first-hand insights in nuclear new build projects involving suppliers from Russia, Japan, and China.

Rudy also has extensive supply-side experience in the front- and back-end of the nuclear fuel cycle and in decommissioning and remediation.

In his advisory capacity Mr. Koenig has supported various international new build and other nuclear projects. He is Advisory Board Member of Asia Nuclear Business Platform, PowerGen Europe, and other industry panels. He serves as an independent expert on a nuclear programme board of the European Commission.

In 2014, Rudy was independent lead negotiator for ESKOM (South Africa) in the final contract negotiations in a competitive tender for the replacement of the Koeberg steam generators (a $600 mm project).

F. Paul Murphy

Paul Murphy is an NECG Affiliate based in the U.S.

Paul is also the Managing Director of Murphy Energy & Infrastructure Consulting, LLC.

Paul focuses on multiple aspects of the nuclear industry – from legal and policy matters, including international regulatory and treaty frameworks and issues regarding nuclear liability, to strategies for creating and financing nuclear power programmes and the identification and mitigation of associated risks – representing developers/owners, investors, lenders, and contractors on nuclear projects internationally.

Paul Murphy detailed CV (PDF)

Paul is recognized as an expert in the development and financing of nuclear power programmes by the International Atomic Energy Agency (IAEA), the OECD's Nuclear Energy Agency (NEA), the International Framework for Nuclear Energy Cooperation (IFNEC), and the U.S. government. Paul currently serves on the IAEA's Technical Cooperation Program team, which assists member states in developing civilian nuclear power programmes.

Paul regularly teaches financing, contracting, and project development for the IAEA, Argonne National Laboratory, and Texas A&M University for their international training programmes, and serves as a guest lecturer at the U.S. National Defense University. Paul has served (as a five-time appointee) to the U.S. Secretary of Commerce's Civilian Nuclear Trade Advisory Committee, and he serves on ASME's Clean Energy Technology Advisory Panel. He is a three-time selection to the Who's Who Legal / Energy and a member of the International Nuclear Law Association. He serves as a consultant to the U.S. Department of Energy (DOE) for international projects. Paul also currently serves as Special Advisor to The Nuclear Alternative Project, which undertook a DOE-funded feasibility study of SMR's for Puerto Rico.

Paul is a graduate of Princeton University's Woodrow Wilson School for Public and International Affairs and a graduate of Harvard Law School.

G. Fabienne Pehuet

Fabienne Pehuet Lucet is an NECG Affiliate based in France.

Fabienne provides consulting Strategy and Development Services to companies in various industries; a sizeable part of her work relates to the nuclear and other power generation industry value chain. She is a Nuclear Markets and Projects Expert with 30 years' experience in the industry.

Fabienne Pehuet detailed CV (PDF)

Fabienne's experience in the nuclear power industry business dates from 1990 when she joined Cogema. With AREVA until 2012, she held senior management positions with global responsibilities in Strategy, Finance, Marketing, Large Projects and Offers, and International Partnerships. She developed a keen expertise in energy policies and all areas of nuclear industry, fuel cycle, nuclear power projects and the related supply chain.

Financing Energy infrastructure Projects is a mature area of her expertise.

From 1990 until 2001, she contributed to all strategic issues related to COGEMA main business lines, including uranium mines closures (France) or development (Canada, Kazakhstan), change of industrial process for uranium enrichment, back end strategies for Spent Nuclear Fuel, fuel manufacturing plants etc…

From 2003 until 2008, she led the Marketing of new group AREVA formed in 2001 with COGEMA, Framatome, Siemens nuclear, Technicatome and T&D as CMO (with a 200 staff globally). Her action was decisive in positioning AREVA as a global player on the international nuclear markets: nuclear technology and fuel cycle industry.

In 2007 she initiated the AREVA Partnership proposition for large nuclear projects. She led the extensive localization and partnership program presented to South Africa as part of the 2007 (Nuclear One and fleet) tender. Similar programs were developed with the UK and other countries, all adapted to the local context for the nuclear project development; Fabienne became more familiar with the nuclear industry supply chain and institutional players in many countries and internationally.

After 2012, she provided advice in areas directly related to this engagement, of which: several assignments on nuclear waste and Decommissioning and Dismantling markets in France and in the EU (27 countries) and for new build nuclear projects (UAE, Saudi Arabia) as NECG team member.

Fabienne provides expertise and training to IISS, the IAEA (of which Financial Analysis of Energy Projects) and teaches the Master's Course "Nuclear Economics" at University Paris Dauphine. She authored reference articles about "Financing nuclear power projects", published by IFRI (2015) and JWELB (2019) and gave multiple presentations for a variety of audiences (IAEA, SFEN, OECD/NEA, FRS…).

H. Daniel Lipman

Daniel Lipman is an NECG Affiliate based in the U.S.

Dan Lipman is a career nuclear industry professional, the last twenty-three years at an executive level, heading the new reactor business for Westinghouse Electric Company (WEC) and servings as Vice President – Suppliers & International Division at the Nuclear Energy Institute (NEI).

Dan Lipman's detailed CV (PDF)

He recently has undertaken assignments as strategic advisor, board member, operating partner, and executive in support of new reactor and fuel-cycle projects, working both domestically and internationally, including with both emerging and existing nuclear technology developers. He has lived and worked in multiple countries and U.S. locations.

Dan began his career in the last new build era as a start-up and construction site staffer. He worked to bring units in Korea and the U.S. into initial operations. He has worked in the operating fleet as site manager, service provider, and fleet advisor, focusing on engineering, outage, and renewal parts support, as well as on-site problem-solving under operating limits. More recently, Dan has supported fleet operators through his tenure on the IAEA's new technical working group on operations, which advises on best practices to fleets around the world. In his tenure at NEI, Dan has worked on supply chain, fuel cycle, and market solutions impacting the U.S. operating fleet, including public acceptance, media, and communications campaigns.

The bulk of Dan's recent experience is in international civil nuclear trade and cooperation, reactor sales, new technology development, R&D, technology transfer, and organizational development related to companies dedicated to this space. He has a particular interest in emerging nuclear markets, having led trade missions to several countries; performed due diligence on nuclear companies; participated in pertinent multi-lateral negotiations and government-related meetings; and has served four years on the advisory committee on international nuclear trade to the U.S. Secretary of Commerce, spanning the last two Administrations.

Dan led the new reactor business for Westinghouse Electric Co. During his tenure, the AP1000 received its design certification in the U.S. and he initiated licensing applications in several countries and new R&D projects. During this time, WEC obtained contracts for all AP1000's in China and the U.S., plus other commitments for AP1000 deployment. He has developed global organizations to deliver equipment, engineering, supply management, and construction services. He is experienced in a variety of types of EPC contracts and delivery options and global plant sales, including the negotiation of technology transfer, joint ventures, and plant partnerships in a variety of countries. Dan subsequently led a large organization, including supply chain, strategic planning, quality management, and sustainability activities. These organizations were newly established, growing to contain several thousand staff, including organized labor.

At NEI, Dan focused on nuclear energy policies benefiting the U.S. supplier community through international trade. He has testified before Congress five times on U.S. treaties. Dan has played an important role in advancing the Gen IV reactor development agenda with branches of the U.S. government, the U.S. Congress and with international organizations. International cooperation has been a specialty during his tenure at NEI, including as chair of the Nuclear Security Industry Summit, WNA working group participation, and numerous trade and industry meetings.

I. Amjad Ghori

Amjad Ghori is an NECG Affiliate based in the U.K.

Amjad is a seasoned Financial Advisory Executive with more than 25 years of banking and development finance experience gained from leading and closing multiple "First-of-a-Kind" power and social infrastructure projects on a global basis. His extensive experience traverses roles as a Corporate and Project Finance Banker, a Power Developer, a Financial Advisor and, most recently, a recognized expert in Nuclear financing and SMRs lecturing and leading workshops under the aegis of the IAEA, IFNEC, and USTDA.

Amjad Ghori detailed CV (PDF)

Amjad has been an active player in the nuclear sector dating back to 2008, having lead Financial Advisory teams working on behalf of public and private sector clients developing NPP transactions in Bulgaria, Lithuania and Finland during his 11-years as a Managing Director in Credit Agricole – CIB's ("CACIB") Structured Finance Advisory Group based in London. The Advisory teams were tasked with reviewing and recommending changes to draft Project Agreements and initial Financial Models of the proposed transactions. In TVO's OL4, Amjad and his team were asked to specifically craft the appropriate financing-related clauses in the Bid documents to ensure that Bidders understood the importance of including a bankable financing framework as part of their overall Bid submission.

Amjad's Transaction Advisory background and experience is deeply rooted in Project Finance, which provides the perfect platform from which to analyze project specific risks and recommend mitigation strategies to ultimately achieve bankability. Conversely, while a truly non-recourse project financing has yet to be achieved for a nuclear NPP, Amjad's recent collaboration with the UK Government's Business, Energy and Industrial Strategy ("BEIS") as part of an Expert Finance Working Group ("EFWG") resulted in identifying a handful of limited-recourse options that could potentially be deployed for financing new nuclear projects that were then recommended to Parliament and published in the attached: Market framework for financing small nuclear.

Amjad's extensive power and infrastructure project development experience also gives him the skills to identify and assess qualitative and quantitative "Must-Haves" that an equity investor requires. The combination of advisory and development experience allows Amjad to assess the viability of a transaction's proposed commercial, contractual, and financing structure and probability of success.

Amjad is also a frequent lecturer on nuclear financing and has conducted workshops in nuclear financing under the IAEA umbrella in the US, France, and Sri Lanka. He is also increasingly sought out to participate in Workshops and Panel discussions on SMRs in person (IFNEC in November 2019 and Abu Dhabi in February 2020) or in Webinars (June 2020 and September 2020).

Prior to joining CACIB, Amjad spent 10-years as a Senior member of CMS Energy's in-house Financial and Strategic Advisory group that raised in excess of US$ 5.0 bn in financing for several ground-breaking, "Pathfinder" IPP and IWPP projects in Abu Dhabi, Morocco, and India. Amjad was also a key member of the Development Teams entrusted with investing CMS's equity in these landmark transaction

Amjad has a B.A. in Economics from Boston College and completed his coursework towards a M.A. from the Johns Hopkins School of Advanced International Studies (SAIS) with an emphasis in U.S. Foreign Policy.

J. Melissa Hersh

Melissa Hersh is an NECG Affiliate based in the U.S.

Melissa (Mel) Hersh is a global strategy and risk expert who regularly advises governments, international organizations, federally funded research and development centers (FFRDCs), and Fortune 500 companies on enterprise risk and strategic communications across a variety of security and defense, energy, agricultural and global health issues.

Melissa Hersh detailed CV (PDF)

Besides being an Affiliate of the Nuclear Economic Consulting Group she is also a Research Associate at the Center for Emergency Management & Homeland Security in the Watts College of Public Service and Community Solutions at Arizona State University (ASU) where the curricula she developed and taught as a Faculty Associate on U.S. Cyber and Information Security is still being taught as part of ASU's online MA degree-granting program in Homeland Security & Emergency Management. She is currently a Member of the Board on U.S. Army RDT&E, Systems Acquisition, and Logistics (BARSL).

Mel has been a consultant to the U.S. Department of Energy's Idaho National Lab, NATO Centres of Excellence, as well as non-profit and development organizations. She is currently focusing on hybrid threats to the energy and supporting electricity sub-sector including cyber-physical systems security and information influence operations, the role of nuclear power and geopolitics, the use of unmanned and counter-unmanned systems, and third-party risk management related to supply chain security.

Previously held positions include VP, Supply Chain Risk Management, Marsh Risk Consulting; Technical Expert on CBRNe issues, United Nations and the World Health Organization; and researcher and consultant to various international think tanks.

She frequently contributes with articles to publications such as The National Interest, Defense News, Defense One, European Energy Review, The Hill, and The Diplomat. She was educated at The London School of Hygiene & Tropical Medicine, The Medical College of Wisconsin, and Skidmore College.

Areas where Mel's expertise can contribute to strengthening DMRE's nuclear new build power procurement programme include:

- Strategy and Enterprise Risk Consulting
- Non-and Counterproliferation
- Investment Screening and Contract Structuring
- Third-Party Risk and Supply Chain Security
- Geopolitical Risk Analysis
- Strategic Communications
- Building Communities of Interest and International partnerships
- Cyber-Informed Decision-Making and Securing Energy Infrastructure

K. Edward Davis

Edward Davis is an NECG Affiliate based in the U.S.

Edward Davis is a senior nuclear industry consultant with over 40 years of nuclear industry experience in a number of senior management roles, including engineering, business development, project finance, marketing, strategic planning as well as governmental affairs.

Edward Davis detailed CV (PDF)

In his long career, Mr. Davis has developed a wide range of knowledge on energy and environmental issues both domestic and internationally and has a keen understanding of governmental policymaking, regulatory compliance, state rate making, as well as legislative and political affairs.

Currently, Mr. Davis serves as President and Managing Director of the Pegasus Group where he is responsible for providing strategic consulting services to a wide range of clients in the energy and electric utility industries as well as Federal agencies in a number of strategic areas. Mr. Davis is a subject matter expert in his field and has testified before US Congress and State Public Utility Commissions on nuclear energy issues.

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