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PEGASUS GLOBAL HOLDINGS, INC.®

Memo to State of Alaska
Alaska State Legislature
Legislative Budget & Audit Committee

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I. Executive Summary

The root cause of the emergence of risks in megaprojects and the resultant negative impacts are typically decisions that are made pre-financing that lock in potential risks. Locked-in risks are much more difficult to mitigate.

Generic megaproject risks include supply risk, inadequate front-end planning, technology and First of a Kind (FOAK) risks, scope creep, lack of competent management, and insufficient contract competencies. Much of this paper focuses on construction risk, and it is a fact that most megaprojects have significant cost overruns and schedules slips. The items above are factors, as well as the accuracy of the initial estimates. Internal factors (the portfolio and project commercial context, the project development and delivery) and external factors (regulatory and geopolitical challenges) also play a role. This gives rise to key questions – "Who bears the risk of cost overruns and the price of that risk? What is the impact of cost overruns on the commercial viability of a project?" A familiar example, the Trans-Alaska Pipeline (TAPS) is revisited as it provides numerous examples of some of the issues common to megaprojects.

Once the project is completed, operational risk also becomes an issue, given the long lead-time for the project from commitment to completion. This encompasses financing, the market risk of the product being produced (off take risk consisting both of volume and price, as well as the creditworthiness of the off takers).

All these risks have implications for ownership structure and corporate governance.

Project-specific risks for the Alaska LNG Project (Project) include:

- Price-competitiveness of the LNG produced by the Project. The Project was shown not to be a competitive investment in the current market for the oil & gas companies originally involved in the ownership structure; however, ownership by the State of Alaska (State), financing mechanisms, and other specific fiscal reliefs support reduced break-even points for the Project. Yet, additional prices risks do remain, such as the impact of potential tariffs resulting from the ongoing U.S./China trade dispute. This could manifest both in higher costs for raw materials and tariffs imposed on the LNG produced by the Project. Ultimately, it could affect the ability to finance the Project.
- Construction activity in the LNG sector. This could affect the availability of, and prices of key components and of labor. Increased supply from more LNG facilities also could affect LNG prices negatively from a seller's perspective.
- Challenges resulting from the change in ownership structure from one in which owner-partners also are suppliers of feedstock to one in which the State is the sole owner and is reliant on significant external financing. These include understanding why the previous potential owners withdrew from the Project, and how to allocate appropriately through contracts the risks those potential owners identified, including the risk of cost overruns.
- The challenges of Arctic construction – building in permafrost, weather and environmental issues, logistics, labor supply, short construction windows, and lack of infrastructure, to mention a few.

There is good news, however, in that there are successful megaprojects that deliver on the fundamental value drivers within their control to demonstrate to buyers, financiers, and investors that they can manage risks, deliver on time, and be cost competitive. And they do. The success of the proposed Project, like those, will depend on: capital efficiency, supply chain management, alignment of Engineer Procure Construct (EPC) to supplier interests, risk-based EPC contract, strong project governance, timely project delivery, securing long-term offtake agreements, disciplined and robust procurement and systems, and proactive stakeholder management.

Throughout the Project, actions should be taken, and decisions should be made to mitigate the risk to the State under the following two scenarios:

- During the Project, cost overruns exceed the ability of responsible parties to pay for them regardless of the language of the applicable contracts and the commitments therein.
- After the Project commences operation, proceeds from the sale of the LNG produced by the plant are insufficient to service the debt and provide an acceptable return to equity investors.

To mitigate these risks, Pegasus-Global Holdings, Inc. (Pegasus-Global) recommends the State consider taking the following initial steps:

- The Final Environmental Impact Statement (FEIS), when published, should be assessed by Alaska Gasline Development Corporation (AGDC) for potential impacts on schedule and cost. The AGDC assessment should be reviewed by an outside expert.
- Once the final role for AGDC on the Project has been determined, a readiness review should be conducted by an outside expert to confirm that AGDC has the appropriate project governance, controls and expertise in place. This review should also include a detailed review of the initial project estimate and schedule, including the assumptions relied upon for each, before a Final Investment Decision (FID) is made.
- Ownership documents, financing agreements, supply agreements, the EPC contract and offtake agreements should be structured and managed to mitigate the risk to the State keeping in mind the scenarios set forth above. Within these agreements, consideration should be given to additional financial security measures that could be taken in the form of irrevocable lines of credit from financiers and/or performance and payment bonds from those constructing the various segments of the project as discussed in Section X.C. This would include:
    - Outside expert review of the procurement and due diligence processes, and of the terms and conditions of the financing agreements and other contracts.
    - Ongoing Independent Monitor review and reporting to the State of management control, contractor performance and counterparty financial metrics.
- Require realistic estimates, schedules and updates consistent with industry standards. Again, the estimates and schedules, should be reviewed and validated by an Independent Monitor.

II. Introduction

Pegasus-Global Holdings, Inc. was retained by the State of Alaska, Alaska State Legislature, and Legislative Budget and Audit Committee to provide assistance to the Legislature regarding the nature of megaprojects including why some LNG projects experienced significant cost overruns and delays while others were successfully completed on time and within budget. Within this context, we provide insight as to the general challenges faced by megaprojects and provide specific project risks that may be experienced by the current proposed Project. Included in our observations are financing and contractual risks and our observations and recommendations as to actions the State may wish to take to minimize the risk of a similar result to that experienced with the execution of the TAPS project.

There is a perception among the public that large complex projects are always delivered late, over budget, and with deficiencies. In a 2017 E&Y research paper, it was determined that "development and execution performance on large projects is extremely poor, with overruns an unfortunate standard."[1] The E&Y research further showed that across a database of 365 current megaprojects, 64% of the oil and gas megaprojects overran their cost estimate and 73% overran their schedule estimate with the average of the cost overruns on megaprojects reviewed to be 59%. While this is true, it does not mean that successful delivery of megaprojects cannot be accomplished. Successful delivery of a megaproject means that it meets stakeholder expectations, functions efficiently, and was delivered under, at, or close to the initial budget and schedule. Two primary factors are characteristics of successful megaprojects: 1) competent management consistent with stakeholder expectations, particularly with regard to anticipated cost and schedule and 2) competent and sufficient staff capability, supporting processes and available resources. There is a temptation to publish a cost and schedule early in the project's life cycle, but caution should be used in the value of such early estimates where substantial unknowns exist as it takes a strong, wise, informed and credible manager to effectively understand and commit to a specific cost and schedule. At the appropriate time, developing and communicating a "range of probable cost" is necessary and desirable.[2]

While several LNG projects have seen significant cost overruns, other LNG projects have been successfully completed. Marathon Oil's EG LNG Train 1, 3.72 mtpa $1.5B, built on Bioko Island near the city of Malabo in Equatorial Guinea was completed with an excellent safety record, under budget and ahead of schedule. The Front-End Engineering and Design (FEED) and the FID were both completed in June 2004 with the first LNG cargo on 24 May 2007. The government was a 25% equity owner with the remainder of the ownership consisting of Marathon Oil, Mitsui & Company, Ltd, and Marunbeni Gas Development Company, LTD. Marathon Oil attributed its success on the EG Train 1 project to several specific reasons, including:

- Highly experienced and motivated negotiating teams
- Government high-priority for the project
- Shareholder alignment
- Self-financed
- No need to locate gas supply
- Synergy of the partners between gas supply and LNG production (same operator-Marathon Oil)
- Highly experienced third-party advisors
- Experienced staff

- Infrastructure built prior to start of project
- Development of work processes and procedures for management of new company sourced from several sources including Marathon, development by staff and support by outside consultants,
- Detailed Business Plan and Project Execution Plan followed throughout the project
- Government cooperation
- Community Relations budget
- Contracts Committee
- Safety-OSHA Recordable Incident Rate (ORIR) of 0.66 with over 17 million craft labor hours
- Team of ConocoPhillips (LNG proven technology) and Bechtel Incorporated (Bechtel) (GC) selected to prepare FEED
- Project fully developed in detail during FEED
- Lump Sum Turn Key (LSTK) contracts negotiated after the completion of FEED
- Proven EPC LNG contractor-Bechtel with multi-project LNG experience
- Proven third party engineers
- Proven vendors
- Proven subcontractors
- Availability of lessons learned from previous similar projects (this was the eighth of its kind)
- Use of Bechtel specifications and standards
- EPC Contract risk reviews and inclusion of contract incentives for safety, cost and plant performance and inclusion of provisional sums to reduce owner risk of project cost overruns
- Early ordering of long-lead risk items before FID to meet the aggressive schedule
- Self-supply for all utilities
- Project Management Team (PMT) involved in the design with focus on integration
- Highly experienced PMT
- Minimal changes to the FEED
- Craft training
- Strong cost forecasting model that was updated whenever potential cost overruns were anticipated and were required to be defended

Other LNG projects have similar success stories, many for the same reasons including the largest Russian LNG, the $27B Yamal 17.4 mtpa LNG built by the Russian company Novatek and co-owned by Novatek, Total SA, and China CNPC and the Silk Road Fund. It was completed in three phases above the Arctic Circle on time and on budget in accordance with the FID. The second and third trains were completed ahead of schedule by six months and one year respectively.

Other successful LNG projects include the Singapore 11 mtpa LNG on Jurong Island where the initial phase was completed on time and budget. The fourth tank of this four-tank project is one of the largest in the world.

The first 7.8 mtpa Train of the $18.5B Santos Ltd Gladstone LNG (GLNG) on Curtis Island in Queensland, Australia was completed on time and budget in January 2015. The overall project consists of three LNG facilities (two trains each), 420 km of underground pipeline, and two trains liquefaction. Despite Train 1 being completed on time and on budget, as of July 2018, the overall project was still on schedule but was experiencing a 15% cost overrun. However, the other LNG projects as part of the overall Gladstone LNG project experienced cost overruns with the Queensland Curtis LNG Project (QCLNG) now costing a $20.4B, a 36% overrun and the Australia Pacific LNG Project (APLNG) at a 7% cost overrun.

The Ormen-Lange Norwegian LNG project was completed essentially on time and budget. The plan for development and operation was submitted to the Ministry of Petroleum and Energy in December 2003 at an estimated cost NOK 66 billion. Phase 1 of the development involved the gas pipeline, the land-based process plant, and offshore installations on the gas field itself was completed within the total budget of 2003 NOK 50 billion. Despite being one of the largest and most demanding industry projects carried out in Norway, the field started production almost two weeks ahead of the 1 October 2007 planned schedule. One strategy noted to have resulted in the successful delivery was the manner in which contracts were awarded by dividing the project into modules and awarding separately to individual contractors and to award some of the long-lead procurement contracts prior to sanction to maintain the overall schedule. Another strategy that resulted in successful completion, as opposed to the Snohvit Norwegian LNG project, was the use of proven technology versus a new and untested technology. Finally, planning for execution in a harsh environment, including recognition of those risks and how those risks can affect cost and schedule was a major differential from what occurred during the execution of the Snohvit project, which experienced significant cost and schedule overruns.

Another large LNG project completed on time and budget was the $15.6B Sabine Pass re-purpose 22.5 mtpa LNG built by Cheniere Energy which included six trains, two berths, and five LNG storage tanks. After a contract risk review, an EPC contract was executed with Bechtel at attractive economics with risk allocation provisions that locked in cost and schedule and allowed Bechtel to proceed under a Limited Notice to Proceed (LNTP) to begin engineering, early procurement and on-site infrastructure. Stage 1 consisted of the first two trains, 6 and 12 months ahead of schedule. Four trains were completed within 17 months safely, within budget and schedule, while Train 5 is currently undergoing commissioning and Bechtel was engaged in November 2018 as the EPC contractor for Train 6.

Review of the successful projects show that the common denominators included early third-party independent and robust risk assessments, contract risk reviews, and third-party independent monitoring throughout project completion among other successful factors noted earlier.

III. History of the Trans-Alaska Pipeline System (TAPS)

A. Project Structure

We begin this discussion of megaprojects with a look back at the construction of the TAPS, which provides examples of many of the issues that will be highlighted herein. The TAPS was announced in October 1968 by a consortium comprised of three oil companies, including majority owners British Petroleum (BP), the Atlantic-Richfield Company (ARCO) (now part of BP), and Humble Oil (now ExxonMobil).[3] In February 1969, the consortium was expanded to include five additional oil companies that held Prudhoe Bay leases.

The initial TAPS organization proved ineffective, as the organization's managerial staff was comprised of representatives from each of the partner companies. This arrangement led to infighting amongst the group, severely hampered decision-making abilities on the project, and led to insufficient budgets as the operating funds were provided directly by the owner companies.[4]

In 1970, the consortium reorganized as the Alyeska Pipeline Service Company (Alyeska). While still dependent on operating funds from the owner companies, this reorganization was intended to result in a more streamlined structure.[5] Construction of the TAPS was managed by two primary contractors -- Bechtel had responsibility for the pipeline (and initially construction management services before being relieved of that responsibility) and Fluor Alaska (Fluor) for the stations and terminal.[6] Work was performed under a reimbursable cost-plus-fixed-fee and fixed overhead contractual arrangement.[7]

The cost-plus-fixed-fee contractual arrangement lacked the incentive for the contractors to minimize costs as compared to a fixed-price contract, including labor costs being reimbursable with labor overruns not affecting the contractors' fee. However, given the lack of definitive design and the challenging climate in which the project was executed (unknown soil conditions, unknown productivity impacts, etc.), there was a lack of adequate information to negotiate a fixed-price contract without absorbing a massive risk premium.

B. Challenges Faced

Alyeska faced difficulties with its project control systems throughout the execution of the project, with cost control being specifically identified as inadequate at the onset of construction and requiring modifications throughout the construction period.[8] The U.S. Government Accountability Office (GAO) in reviewing the TAPS found *"Alyeska's cost reporting system initially could not provide detailed up-to-date information on actual costs. The May 1975 budget control estimate was not based on such actual costs because of inconsistent and erroneous coding of costs in 1974 and early 1975. Furthermore, even though Alyeska's first overall pipeline cost center report was not published until September 1975, at that late date the report could not use actual costs since no central computerized system to collect actual cost by control center had been developed. It was not until December 1975 – the end of the second construction year – that this cost control system began to function properly."*[9]

While the majority of the construction cost overruns were attributed to significantly more labor hours required than estimated (see **Section III.C.** below), there were several unexpected site conditions and construction difficulties that contributed to the challenges faced. The GAO identified several of these factors, including:[10]

- More groundwater during warmer months than anticipated, requiring continuous pumping on sections of ditch for underground pipe and interfering with vertical support installation.
- Ditches for underground construction often had to be deeper and wider than planned.

- Soil conditions varied drastically from one location to the next, which prevented the vertical support depth from being determined in advance. That, in turn, contributed to out of sequence work, as longer vertical supports were not always readily available.
- Permafrost was harder to move and drill than planned, requiring increased time and blasting.
- Number of sites for obtaining backfill materials for underground pipe was fewer than planned, and the amount of hauling was consequently greater than planned.
- Alignment tolerances for aboveground and valve support structures and for underground valves were far more critical than planned. Additionally, temperature changes and slight settlement of vertical supports caused sufficient movement of the pipe, requiring realignment.

Beyond site conditions, the cold climate during winter months in the region significantly affected productivity. This impact was magnified after schedule slips pushed more work into the winter months, where temperatures with wind chill reached as low as minus 100 degrees. Also contributing to the lower than anticipated productivity was a lack of sufficiently qualified craft labor.

C. Construction Cost Overruns

The feasibility estimate of the TAPS completed in 1968 was $1.046 billion. However, before construction was initiated, the estimate was already growing. The initial cost increases were largely the result of adjustments to the engineering challenges faced, including changing from an initial plan to bury the entire pipeline due to issues that would have been present with the permafrost. Other environmental planning issues further contributed to early cost increases, including a four-year delay in the start of construction as environmental lawsuits were resolved.[11] At the start of preconstruction (roads, camps, site preparation, etc.) in May 1974, the estimate was $4.088 billion; this grew to a control budget of $6.375 billion in April 1975, shortly after the start of pipeline construction. Final costs of the project when it was completed in 1977 reached $7.94 billion.[12]

The GAO report identified several factors that contributed to the cost increases. Specific to the feasibility estimate, issues included:

- Contained no allowance for cost escalation (and no expectation of a four-year delay to the start of construction).
- Included only a 10% contingency (substantially less than what is typical for initial estimates with minimal engineering).
- Substantially underestimated the amount of elevated pipeline required (anticipated 240 miles versus 422 miles actually required).
- Did not anticipate the need to construct a highway bridge across the Yukon River.
- Did not anticipate the need to construct a 361-mile gravel-surface road from the Yukon River to the Prudhoe Bay oil field.
- Assumed a system and design having a much lower level of environmental standards than what was subsequently required.
- Gave no consideration to the magnitude of the support structure (e.g. camps, airstrips) that would be required.

- Contained no provision for a work pad south of the Yukon.
- Included no provisions for the vapor recovery facilities at the Valdez terminal and at pump station number 1, which were required for maintaining air quality standards.
- Contained no provision for the sophisticated ballast water treatment system required to meet water quality standards.
- Did not anticipate the sophisticated elevated pipeline system needed, in part, to meet seismic and thermal stipulations, but rather contemplated an aboveground system consisting of pipeline mounted on wooden piles or raised gravel.

When the control budget of $6.375 billion was established, design engineering was approximately 90% complete, preconstruction activities were substantially complete, and pipeline construction (ditching for buried pipe and erection of supports for elevated pipeline) had just begun.[13] Alyeska recommended contingency for this control budget be set at $330 million (or 5.2% of the budget), but the owners determined that no contingency should be included under the impression that including it might negatively influence Alyeska's ability to minimize costs.[14]

As mentioned above, the control budget increased approximately $1.5 billion to a final cost of approximately $8 billion. The bulk of this increase was attributed to a 54% increase in labor hours needed compared to what was anticipated (or 19.8 million hours) due to Artic conditions not fully appreciated in the early feasibility and design resulting in unplanned site conditions and construction difficulties, which also caused increases in associated support activities and equipment requirements.

D. Lessons Learned / Outcome

The State of Alaska receives taxes and royalties from the crude oil produced within the State, which is based on the oil's value after the tariff cost that the pipeline owners charge transporting the crude oil. In essence, the higher the tariff amount, the more that is reduced from the oil's value before taxes and royalties are applied – thus reducing the amount collected by the State. With Alyeska able to include the construction costs of the pipeline in the initial tariff amounts, the impact to the state was calculated at up to $500,000 per day for every dollar increase in the tariff.[15]

The State, through the Alaska Pipeline Commission (APC), sought to open an investigation into the TAPS construction in order to determine if any amounts were attributable to mismanagement and could be disallowed from the tariff calculation. The final investigative report concluded that of the $8 billion it cost to complete the TAPS, $1.5 billion were imprudently incurred ($1.2 billion relating to the pipeline and $300 million relating to the Valdez terminal).[16] The investigation found that nearly all of the problems and cost overruns resulted from a lack of planning and preparation in the early stages of the project.[17] Similarly, the GAO report examining the TAPS construction identified five lessons learned: 1) first and subsequent cost estimates should be viewed with skepticism; 2) as much site-specific data as is economically practicable should be obtained; 3) technical and geological uncertainties should be thoroughly investigated; 4) government approval should be contingent on detailed planning for management control, including budgetary controls; and 5) the [future] Alaska natural gas pipeline project's expenditures should have an ongoing Government audit to protect the public interest.[18]

The GAO also identified the prevalence of unrealistically low initial project assessments/estimates within the industry, which was attributed to three primary factors: 1) the teams responsible for the feasibility assessment become promoters rather than objective evaluators and feared a realistically high estimate might result in a project's early rejection; 2) estimates that start low and gradually rise over time are more acceptable than those that are initially realistic; and 3) final costs will tend to rise to meet any approved estimate/available funds.[19] The conclusion reached by the GAO was that *"Lacking historical data, the most reliable basis for establishing budget estimates is the development of preliminary engineering design based on as much site-specific data as is economically practicable. Further, in the absence of relevant experience, it is the estimator's duty to emphasize the problem of inexperience and to attempt a quantification of the risks. Risks must be accommodated in the estimate by contingency allowance."*[20]

Although the TAPS went into operation in 1977, the ratemaking case before FERC was not concluded until 1985, when the State agreed to a TAPS Settlement Methodology with the pipeline owners that essentially traded off past refunds to the State in exchange for lower future tariffs.[21] Over the course of the planning, development, completion, and settlement of the TAPS, Alaska experienced four different governors, each of which had their own political interests and objectives as it pertained to the TAPS.[22] Given the challenges faced in reviewing the tariffs filed by each of the owners, the GAO recognized in its report that *"A clear and specific requirement in the right-of-way agreements that provided the Government with direct access to project files and records for conducting an audit while construction proceeded could have eliminated the doubt, both on Alyeska's and the Government's part, about which costs should be permitted to be eventually recoverable through the tariff."*[23]

In 2004, the Strategic Reconfiguration (SR) Project was initiated to replace four pump stations and upgrade the control systems and was viewed as the most significant TAPS project since its initial construction. However, despite the GAO report and other lessons learned, repeat issues arose on the conception, planning and execution of the SR Project.[24] Findings of the prudence review of the SR Project under the FERC proceeding revealed:[25]

- Retainage of an engineer that lacked Alaskan experience and failed to manage the project effectively
- Poorly defined SR Project scope at sanction leading to poor cost and schedule estimates that were based on preliminary engineering
- Failure to complete more detailed engineering prior to developing cost and schedule estimates and sanctioning the project which if done would have resulted in a better-defined scope and more realistic higher cost estimates and a longer schedule
- Reduction of project contingency to an unrealistic level in an effort to make the SR economics appear more robust
- No meaningful oversight by Alyeska of its engineer
- Failure to rely on its own internal Alyeska project and risk assessments instead of recognizing warning signs prior to sanction based on the knowledge and work of independent third-party assessments conducted by the TAPS carriers

- Failure of Alyeska to follow its own internal procedures and prematurely sanctioned the project based on incomplete engineering, which resulted in grossly inaccurate cost estimates, excessive design changes, delays and increased costs
- Instead of cancelling the project at the Supplement 1 decision point, the decision by Alyeska to take over the project despite insufficient resources to do so.

To quote George Santayana, "Those who cannot remember the past are condemned to repeat it."

IV. Overview of Megaprojects and Why They are Different than Traditional Construction Projects

Megaprojects are generally defined within the industry as very large-capital investment projects (costing more than $1B USD) that attract a high level of public attention or political interest because of substantial direct and indirect impacts on the community, environment, and companies that undertake such projects.[26] Other attributes of a megaproject include:

- execution of an engineered facility or structure which is complex or unusual;
- an extended execution schedule (greater than four years measured from initial concept development to final completion);
- multiple equipment and material suppliers;
- multiple specialty trade contractors;
- multiple project stakeholders/investors; and,
- multi-national party stakeholder involvement.

Challenges that one faces on a typical construction project are orders of magnitude less challenging than one faces on a megaproject. The technological complexities of megaprojects, in and of themselves, mean that each megaproject presents unique challenges, any of which may have a direct bearing on the context within which the management of a project should be examined and judged. Because of the size, duration, and complexity of any megaproject, establishing the context within which the management and execution of that project should be examined for reasonableness or prudency must be individually set to reflect the unique factors that existed during the execution of that project. This often includes a lack of suitable projects from which to benchmark against, as each megaproject features its own complexities and environment in which it is executed. Flyvbjerg, who has written about megaprojects perhaps more than any other individual, cites the following challenging characteristics of megaprojects:[27]

- Inherently risky due to long planning horizons and complex interfaces.
- Technology that is often not standard.
- Decision-making and planning are often multi-actor processes with conflicting interests.
- Project scope or ambition level often changes significantly over time.
- Unplanned events are often unaccounted for, leaving budget contingencies inadequate.
- Misinformation about costs, benefits, and risks is the norm.
- Result is cost overruns and/or benefit shortfalls with a majority of projects.

Actual management of a megaproject is more complex than the management of a typical construction project. For example, in a megaproject there is simply not a "one-size-fits-all" or "best" methodology for allocating or contracting for the numerous different sub-scopes of work required. The sheer size and complexity of most megaprojects generally results in an execution methodology that involves multiple delivery methodologies and contracting approaches. For example, the specialty trade elements of a process or power generation megaproject may in themselves cost more and take longer than the average construction project, requiring the use of multiple specialty trade contractors, each working on an element of the whole and each under a different tailored contractual agreement. A typical construction project may hire one specialty trade contractor to execute the entire scope of that specialty work; on a megaproject, management will have to work with multiple contractors in order to gain sufficient resources to execute that trade specialty scope of work.

The above is a summary of only construction-related risk, which typically is covered, in one fashion or another, by the sponsors of the project. Before construction begins, by definition, megaprojects present a huge overall funding requirement and, typically, no revenue is received from the project until the entire project is completed. After completion, to the extent feedstock for the project is dependent upon third party suppliers, the creditworthiness of those suppliers is a risk. The volume offtake risk can be transferred to off takers. Successful transfer of this risk depends however, on the project operating successfully and meeting its output goals as well as the creditworthiness of the off takers (and the overall credit profile of off takers in the LNG industry has been declining). The price offtake risk often remains with the borrower.[28]

V. Typical Problems Encountered on Megaprojects Resulting in Cost Overruns

As previously noted, studies have indicated that a majority of oil and gas megaprojects experience cost overrun and schedule slip. There also seems to be a relationship between size and cost performance – *i.e.* the larger the project, the higher the likelihood of poor cost performance relative to budget.[29] Given the size and complexity of megaprojects, it is no surprise that there is a seemingly endless list of problems that can be encountered during execution. Some of the more frequently occurring issues include:[30]

- Underestimated project cost
- Order of magnitude cost estimates based on preliminary design
- Constantly escalating labor and material costs
- Inadequate front-end planning
- Inadequate schedules
- Insufficient cost monitoring
- Scarce labor resources (quality and availability)
- Lack of competent management (owner and construction manager)
- Lack of adequate technical data
- Poor communication
- Multiple design professional and construction management firms
- Failure to monitor construction performance
- Insufficient contractor competencies
- Lack of integrated processes
- Huge logistics problems
- Complex environmental issues
- Insufficient contract terms and conditions
- "Fast tracked" design and construction schedules

- Inadequate risk and liability assessments
- Lack of program oversight
- Stakeholder conflicts
- Remote locations
- Contractor creditworthiness

Many of the above issues are inherently related – for example, problems faced by remote locations are amplified by lack of front-end planning (particularly logistics planning), poor communication, scarce labor resources, and poor management – thus, like the interfaces that comprise a megaproject, interfaces amongst the many issues that are regularly encountered must be recognized.

Other studies, such as one conducted of the oil and gas industry in 2012 by Schlumberger found the most common root causes of unsuccessful megaproject (based on percentage weight given during interviews) to be:[31]

- People and organization (26%) – difficulty matching skills to project demands and geography.
- Technical challenges (21%) – accepting technical challenges that are not prepared to be met.
- Governance (18%) – “top-down” targets and lack of end-to-end accountabilities affect projects’ lifecycle value.
- External stakeholders (14%) – maintaining relations and expectations with governments, JV partners, communities, etc. increasingly a challenge.
- Contracting and procurement (12%) – fundamental driver of project value; challenges in tight service market and lack of internal competency.
- Project management processes (9%) – often not properly implemented and resourced; processes alone do not prevent mistakes and key risks go unmitigated.

Other issues affecting megaprojects, such as those that could potentially impact the proposed Alaskan LNG Project are discussed below in greater detail.

A. First of A Kind (FOAK) Projects, Either in Terms of New Technologies, First-Time Combinations of Technologies or Scale

With FOAK projects, the foremost challenge revolves around the unknown (including “known unknowns” and “unknown unknowns”) – in particular, the lack of documented experience that exists in whatever the FOAK components of the project include, and how those FOAK components integrate with the more traditional project components. Examples of FOAK project components include:

- New design/innovation/software unique to the project;
- New equipment/devices/material;
- New installation method/tools/processes;
- New interfaces of technologies;
- Work that is new to the performing and/or oversight group;
- New location for the type of project;
- Unprecedented scale (>10x, >20x, >50x).

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Impacts of FOAK project features/aspects can result in cost and/or schedule overruns as well as failure to meet production and/or performance estimates and thus must be given appropriate consideration during the risk management process.

B. Underestimation of Initial Project Cost

Flyvbjerg cites three main explanations for inaccuracies in forecasts of costs (and benefits) to megaprojects: technical, psychological, and political-economical.[32] Technical explanations center on shortfalls in data and experience, which results in imperfect forecasting. The substantial unknowns that surround virtually all megaprojects – in particular, the FOAK aspects discussed above – unfortunately have the frequent result of generating unrealistically low initial project estimates. Psychological explanations including "planning fallacy" and "optimism bias"; which involves an overly optimistic planning process that discounts or ignores rational weighting of risks and probabilities and overinflates project benefits. Political-economic explanations involve the deliberate overestimating of benefits and/or underestimating of costs in order to make a project appear more competitive for approval and funding. Unrealistically low estimates stem from both a lack of adequate data, including lacking awareness of the lack of data, *and* either unintentional or intentional framing of the project to make it appear more attractive.

1. Inadequate risk modeling including failure to adequately identify risks

An estimate is only as good as its inputs, and often with projects that drastically exceed their initial estimates there was poor risk identification and planning early in the project. As noted by the Project Management Institute (PMI),[33]

> *"Project Risk Management addresses the uncertainty in project estimates and assumptions. Therefore, it builds upon and extends other project management processes. For instance, project scheduling provides dates and critical paths based on activity durations and resource availability assumed to be known with certainty. Quantitative risk analysis explores the uncertainty in the estimated durations and may provide alternative dates and critical paths that are more realistic given the risks to the project."*

When risks – both those identified and those unidentified – manifest, the cost impacts can be substantial, thus making the identification of risks and planning of risk management a critical component to a project's success. Assumptions about views on the nature of the future are important to consider when evaluating a megaproject's risk management program, with the following four categories serving as a fundamental basis to evaluate different categories of risk:[34]

- Risk Category 1: *a priori* probability – *"The decision-maker's view is that they are able to assign objective probabilities to a known range of future events on the basis of mathematically 'known chances', e.g. the probability of throwing a six with a perfect die is 1 in 6."*
- Risk Category 2: statistical probability – *"The decision-maker's view is that they are able to assign objective probabilities to a known range of future events on the basis of*

empirical/statistical data about such events in the past, e.g. the probability of being involved in a building fire."

- Uncertainty Category 1: subjective probability – *"The decision-maker's view is that they have a known range of possible future events but lack the data necessary to assign objective probabilities to each. Instead they use expectations grounded in historical practice to estimate the subjective probability of future events – akin to scenario planning."*
- Uncertainty Category 2: socialized – *"The decision-maker's view is that they face a situation in which the nature and range of future events is unknown, not simply hard to understand because of a lack of relevant data. The future is inherently unknowable, because it is socially constructed and may bear little or no relation to the past or present."*

Essentially the above categories move from known and readily quantifiable (Risk Category 1) to "unknown unknowns" (Uncertainty Category 2) that lack data, which will only actually exist once the situation manifests and requires a reaction. While obviously nearly impossible to accurately predict the magnitude of these "unknown unknowns" in advance, it is important for stakeholders to recognize the uncertainty that accompanies all megaprojects.

Identifying and evaluating risks on a megaproject is extremely critical as *"it can affect both the cost-benefit analysis during the whole process of a project, and the demand, production costs, execution time, and financial variables."*[35] The more robust the risk planning, the more accurate the cost and schedule estimates are likely to be. One study identified nine primary groups of risks within megaprojects to be considered in risk planning:[36]

1. *"Design risks are those related with the planning phase of the megaproject, such as delivery method, contract formation, and scope control.*
2. *Legal and/or political risks are derived from changes in the governing policy of the country* [or state] *where the megaproject is developed i.e. authorization criteria, political actors, changing government regulations, cancellation of a concession.*
3. *Contractual risks include those derived from the renegotiation of the contract, such as the midstream change of project scope, and issues caused by imprecision and vagueness in the contract.*
4. *Construction risks are usually the most significant in the whole life of the megaproject, not only of the construction phase. Cost overruns (or cost escalation), project schedule, coordination problems, and inappropriate design or accident during the construction are examples classified within this section.*
5. *Operation and maintenance risks are those related with the operational phase that can affect the operation cost, operation capacity or quality, such as economic viability issues, unnecessarily high operations costs, poor construction quality, and operator incompetence.*
6. *Labour risks are related with the workers linked to training, language, accident cost, and culture.*
7. *Clients/users/society risks are those which affect revenues. These risks include: (a) demand risks such as inflation, price trends, price range; (b) market risks, such as variations in the client's requirement, existence of the market; (c) social profitability risk*

which puts into question if the project provides the expected benefits to society; (d) impact on local groups' risk arises when the inhabitants of an area are a source of risk due to not being managed correctly; (e) environmental risks, which are usually called environmental impact assessments (EIAs); and (f) reputational risks, including media and marketing control.

8. *Financial and/or economic risks encompass a variety of events related with the financing and performance of the megaproject. These are composed of: (a) economic risks related with the investment or economic structure of the megaproject, such as lower-than-expected profitability, and inappropriate metrics about the project; (b) financial risks due to the high level of leverage which exerts an impact on the megaproject solvency; (c) liquidity risks, such as financial restrictions, availability of funds, and downgrading of credit ratings; and (d) foreign-exchange and interest-rate risk derived basically form long-term interest rates and foreign exchange rate.*
9. *Force majeure, such as war, natural disasters, extreme weather conditions, terrorism."* However, force majeure can, and perhaps is more likely to occur in not the country where the project is being built, but in countries where key components are being fabricated or from which key raw materials are being supplied.

The identification and qualification/quantification of risks provides a critical input into developing realistic cost estimates for a megaproject, but also provides the foundation for planning risk responses and monitoring and controlling risks during execution. As noted by the PMI,[37]

> *"Risk identification should be performed as early as possible in the project lifecycle, recognizing the paradox that uncertainty is high in the initial stages of a project so there is often less information on which to base the risk identification. Early risk identification enables key project decisions to take maximum account of risks inherent in the project and may result in changes to the project strategy. It also maximizes the time available for development and implementation of risk responses, which enhances efficiency since responses taken early are often normally less costly than later ones."*

2. Selection of insufficient estimate confidence levels and contingency

Owners establish contingency levels based on an acceptable risk level, degree of uncertainty, and the desired confidence levels for meeting baseline requirements. When used to absorb the impacts of uncertainty, the contingency is a form of risk mitigation.[38] AACE provides that contingency is *"An amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, or effect is uncertain and that experience shows will likely result, in aggregate, in additional costs."*[39] AACE also identifies that contingency typically covers such uncertain "items, conditions, or events" as: planning and estimating errors and omissions; minor price fluctuations; design developments and changes within the scope; and, variations in market and environmental conditions. In summary, contingency typically falls into one of three categories: 1) cost estimating uncertainty; 2) schedule estimating uncertainty; and/or, 3) discrete risks. Contingency typically excludes: major scope changes; extraordinary events (e.g. major strikes, natural disasters); management reserves; and, escalation or currency effects.

Generally, contingency is expected to be expended during the execution of a project or program as the uncertainties manifest.[40]

Contingency development for a megaproject should be based on consideration of the work plan and an identification of those risks that could happen (including the multitude of FOAK-related risks) and the associated potential cost and schedule impact. These risks are then typically modeled through a probabilistic simulation, which in turn, provides various outcomes for management consideration relative to selected probability levels (sometimes referred to as "confidence levels") with each outcome identifying an appropriate amount of contingency based on those modeled risks and probability levels.

By utilizing a higher confidence level that considers a higher percentage of the risks and resulting impacts to emerge over the life of the project and thus uses a contingency to estimate the total project cost (i.e. by utilizing a contingency amount that corresponds to the high confidence number selected in order to account for those identified risks should they emerge, a P90 confidence level would mean that there is a 90% probability the actual cost will be within the estimate provided), the owner and stakeholders greatly reduce the likelihood of cost overruns. Using a lower confidence level (e.g. P50), may not adequately address the complexities and risks inherent with the execution of a megaproject (particularly given the extended duration of execution and heightened complexities as compared to a typical project), thus increasing the risk of a cost overrun.

C. Inappropriate and/or Inexperienced Project Director and Management Organization

Because of the size and complexity of megaprojects, their execution requires not only a significant number of laborers, but also a complex organizational structure that has the capabilities to address the multitude of challenges faced by a megaproject. As noted by McKinsey, *"Investors and owners need to take an active role in putting together the project team. It is not enough for them to have a vague theoretical overview of how the project should work. They need to create a detailed, practical approach to deal with such likely eventualities as managing quality risks, escalating contractor's costs, or replacing a high-tech supplier. An experienced project manager is not enough; players must assemble a team that has all the requisite skills, including legal and technical expertise, contract management, project reporting, regulatory approval, stakeholder management, and government and community relations."*[41]

A survey by Russell Reynolds conducted amongst megaproject owners and contractors identified three critical competencies for successful megaproject leaders: process (governance, stakeholder management, and project life cycle management), productivity (efficiency and quality), and people (culture and morale).[42] An evaluation on megaproject lessons learned included the observation that *"On too many projects we have heard the owner comment, when problems start to arise, that the contractor promised to staff the project with his 'A' team, but in the owner's opinion he got the 'D' team. On the other side imagine the observations of the contractor regarding the owner or construction management team. We are reminded of the warnings that are displayed on TV when a dangerous stunt is being shown, 'do not try this at home.' Based on the performance history of megaprojects, owners and contractors should not undertake projects for which they are not qualified."*[43] Without the appropriate leadership and team in place, when issues arise on a megaproject (a given), there is a risk that the issues will be identified late, addressed inappropriately, or not communicated effectively, which in turn gives rise to additional issues that further strain the cost and schedule of the megaproject.

Beyond the management structure, craft and skilled labor demand present an additional challenge for megaprojects. This challenge is made more difficult for projects in remote regions (such as the Arctic) where it is regularly a challenge to meet the labor requirements and often requires higher pay and benefits to attract the necessary talent. For the Alaska LNG Project, studies have found an estimated 12,000 direct jobs will be created during construction, including: 3,500 truck drivers, 2,300 laborers, 1,500 pipefitters/pipeline welders, 1,600 camp support personnel, 1,300 heavy equipment operators, 450 ironworkers, 400 electricians, 300 carpenters, in addition to hundreds of engineers, surveyors, and construction managers.[44] While the Alaska Department of Labor and Workforce Development report provided recommendations on how to alleviate potential labor shortages, it will be critical for the State to implement and continue to monitor these efforts, particularly as other megaprojects within the State and region compete for the same set of workers.

D. Failure to Structure a Procurement/Contracting Strategy that Addresses Risk Allocation to the Most Appropriate Party

As previously stated, in a megaproject there is simply not a “one-size-fits-all” or “best” methodology for allocating or contracting for the numerous different sub-scopes of work required in a megaproject. The sheer size and complexity of most megaprojects generally results in an execution methodology that involves multiple delivery methodologies and contracting approaches. In general, risk should be assigned to the party best able to manage and mitigate (or benefit and save contingency if the risk does not manifest). Of course, for the risk to be appropriately assigned, robust preplanning must take place to ensure the risks have been identified, which can then be used in the contracting strategy used on the megaproject.

There are many types of contracting and procurement strategies that can be employed when constructing a megaproject of this size and complexity, and usually one will see several methods used within each project. The contract approach describes the legal terms and conditions that bind an owner and contractor to execute an engineering or construction scope of work. The most common descriptors involve payment method and/or schedule and include the following types of contracts:

- In a **Lump Sum** or **Fixed Price** contract (generally used interchangeably), the price is fixed regardless of the difficulties the contractor may experience during the implementation of the work, <u>even though the total cost of the work may turn out to be greater than the contract price</u>. Under this contract type, typically the contractor usually assumes most of the risk associated with cost and performance, and <u>the contractor’s estimated cost of that risk will be included in its price</u>. (See **Section X** regarding enhancing risk allocation in EPC contracts). Remedies contained in the contract are the only relief for which the contractor can apply. This means that the use of this

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contracting mechanism is most often applied when there is a well-defined scope of work, scope changes are unlikely and there are few unknowns.

- **Unit price** contracts typically involve a fixed price for the supply and/or installation of a particular unit or element of quantity ($/unit, $/linear foot or $/cubic yard, etc.). The unit rate is all-inclusive and includes labor, equipment, materials, overhead, and profit. The total amount paid to the contractor remains open until completion of the project, because the payment is made to the contractor based on units of work actually done as the work is completed.
- A **Time and Materials** contract is an arrangement under which the contractor is paid a pre-determined hourly rate for labor (by defined categories of labor or sometimes on a composite crew basis) and equipment is charged at hourly rates; each of these rates incorporate all benefits, management, overhead and profit.
- In a **Cost-Plus** contract, the contractor is paid its actual labor expense (the hourly rate paid to its employees) plus an adder, usually a percentage, to cover benefits, management overhead and profit. Equipment rates (per hour or per hour used) are also specified. Cost plus allows for greater variety of labor types and rates without additional contract negotiation. A cost-plus contract is often based on the contractor's cost to perform the work plus a fixed fee or cost plus a percentage of the project cost. Based on preliminary design and project specifications, the contractor arrives at a project target estimate and fee arrangements include fixed amounts, monthly fees, percentage of total cost, or fee plus incentives that may be based on schedule, productivity, and total project cost. Often cost-plus contracts will contain a **Guaranteed Maximum** amount, whereby a contractor agrees to perform all services as defined in the contract document guaranteeing that the total cost to the client will not exceed a stipulated maximum figure. These provisions will often contain special share-of-the-savings arrangements to provide incentive to the contractor to minimize costs below the stipulated maximum.
- **Bonus Penalty** arrangements can be found in several types of contracts wherein the contractor is guaranteed a bonus (often in the form of a fixed sum of money) for each day the project is completed ahead of a specified schedule and/or below a specified cost, and agrees to pay a similar penalty for each day of completion after the schedule date or over a specified cost up to a specified maximum. Additionally, owners may require strict specifications, quality measures, delivery requirements, or safety guarantees. Each of these can be the subject of bonus or penalty provisions in the contract. Liquidated damages are also common in contracts, which are very similar to the penalty provisions without the bonus provision.

Every construction project has a unique context in which it is being contemplated and constructed, and a risk profile that will reflect that context; there is a portfolio of risk elements that may arise at certain points during execution of the full project scope of work. Ideally, the owner's goal should be to apportion the risk elements in that portfolio among the participants involved in the planning and execution of the project to the party in the best position to manage, control, or mitigate the impact of those risks. The contract approaches used on a project should be specifically formulated by the owner to match context of the project and the risk profile in order to give each project participant the optimal structure within which to manage, control, and complete their scopes of work while minimizing the impact of the risk elements that are present in each of those scopes of work. This is the *ideal* approach, but the ability to secure a particular contract approach depends on the availability in the market for such an approach.

It is a construction industry maxim that the more risk an owner sheds the greater the cost of the contract. This maxim has been proven to be true repeatedly because a contractor bidding a fixed price for the total risk of project's cost is going to not only cover the direct cost of that project but must also include in its fixed price a contingent amount to cover any and all potential cost impacts, including both realistic and remote risks. Finally, the contractor will also include a hefty profit as compensation for assuming most of the risk. Even if the project is executed to perfection and none of the contingency is used, under those contract conditions, the owner must pay the contractor that total sum agreed upon at the execution of the contract.

Within procurement, and particularly for smaller scopes of work, there is often a tendency to weigh price competitiveness heavily when evaluating bidders. Unfortunately, this may lead to a vendor/contractor being awarded work that lacks the necessary expertise to deliver their scope of work in a manner that supports the overall megaproject (including lack of quality). Additionally, price advantages at the time of bidding may be erased during execution with claims and change orders that quickly increase the price. Thus, while price is certainly a factor for consideration in reviewing bids, it must be within the overall context of the technical capabilities of the vendor/contractor, including the additional risk assumed by the owner if those technical capabilities are lacking.

Additionally, the contract terms and conditions should not only support the allocation of certain risks to the contractor/vendor, but also include appropriate audit/oversight clauses to ensure the risks are being managed appropriately, as the owner still has exposure if the contractor does not appropriately manage its risks. Furthermore, the owner (or its representatives) must have experienced and adequate staff to manage each of the contracts, including managing change orders and variations, addressing claims and contract amendments, and ensuring compliance with the contractual requirements, as this is a key cornerstone in facilitating successful projects. Appropriate contract management also provides the most direct way for the owner to monitor contractor performance and take immediate action should performance fall below expectations. Industry studies have shown that proper structuring, monitoring, and enforcement of contracts can result in savings of up to 4.5% of the contract's value.[45]

E. Insufficient Information to Develop Effective Project Controls and Schedules

Without proper project controls processes and systems and without experienced personnel in the project controls group, it makes it extremely difficult for the owner and other relevant stakeholders to have an accurate awareness as to the status of cost and schedule. In many instances, the initial processes and systems are developed prior to FEED completion in order to support the project's initial development but are not reassessed for functionality and scalability. This can result in gaps in the project controls processing and can lead to a failure to have accurate and timely information, which itself can prevent trends and issues from being identified in time for corrective action to take place while minimizing any related impact.

A lack of adequate project controls has been cited as one of the primary factors common among distressed projects, *i.e.*,[46]

> *"Specifically, they do not have robust risk-analysis or risk-management protocols and do not provide timely reporting on progress relative to budgets and timelines. The data used to report on project progress are typically outdated (as they generally rely on payments to contractors rather than on actual work performed) and not aligned with the true progress of the project. In addition, baselines get adjusted time and again, and contractors and owners use different metrics to measure progress. It is problematic when there are multiple estimates of the cost and time performance of the project relative to the baseline, which means there is no common understanding of performance. This limits the partners' ability to figure out how to accelerate project delivery and control cost overruns."*

The issue of insufficient project controls was demonstrated recently on one megaproject in which the evaluator noted,[47]

> *"The single greatest weakness has been in project controls. The project has lacked, from the beginning, sufficient qualified planners to evaluate and approve baseline schedules, schedule updates and monitor the contractor performance. There has been little effort to enforce project scheduling requirements. As a result, baseline schedules were submitted late, and in almost every instance well short of project or industry standards. It took a year to receive an acceptable baseline schedule from one prime contractor, at which time their work was over a year late. It took another three months to get the contractor to accurately update the schedule to provide a realistic date for completion of key milestones. It took up to two years in that instance to convince the owner's project manager of the need to consider the schedule in evaluating solutions to problems as they arose and to compel the contractor to address their schedule deficiencies."*

Virtually all EPC contracts contain clauses detailing the scheduling requirements including type of scheduling software, various submittal requirements (e.g. when the baseline schedule is due, process for reviewing/approving, etc.). However, some have suggested that while these schedule requirement clauses are well intentioned, they can run counter to the complexity of a megaproject, where it might be implausible for a contractor to *"quickly develop sufficient reliable information to allow the development of fully detailed and resourced critical-path networks for submission to the owner for review and approval within a few weeks of contract start."*[48]

That said, and as noted in the example above, without the right scheduling expertise in the owner's project controls group, it makes adherence to any scheduling requirements difficult to monitor and maintain, which in turn can drastically increase the likelihood of an inaccurate schedule. Furthermore, in order to effectively monitor the project's progress, earned value systems that can track cost and schedule performance must be in place and supported by submittal of the appropriate project data.

F. Design Schedules, Scope and Schedule Creep

The essence of a project schedule on a large and complex project is similar to that of a conventional project, in that it establishes the start, duration and completion dates of the activities that compose the project as well as the integration and sequencing of such activities. A major difference when scheduling a large complex project with a long duration is that it is often necessary to utilize overlapping execution staging on the project as way to mitigate the time impact conventional sequential staging would have to a project's already long duration (or "fast-tracking" the project). "Overlapping execution staging," also referred to as "fast-track scheduling," means that project tasks are not performed sequentially, where each stage of the project must be entirely completed before the next stage begins, but that parts of some tasks are performed concurrently. For instance, rather than completing all of the detailed engineering before construction, the engineering is scheduled so that design for the first construction activities (*e.g.* civil and site work) are completed allowing construction to commence, while the remaining detailed engineering continues concurrently. Other activities are similarly scheduled so that the time for completing the entire project can be compressed, thereby saving time, and therefore cost. The downside to this fast track approach is that unidentified design issues are not discovered until later in the project execution as detailed design becomes more complete, which in turn can have ripple impacts to both schedule and cost as these unforeseen issues must be resolved. While schedule contingency or float can absorb some of these unexpected issues, this extra time built into the schedule must also account for other project execution issues (e.g. low productivity, inclement weather, procurement delays, permit delays, and other execution risks).

An additional design challenge results from the complexity of megaprojects themselves, as they include substantial amounts of individual document and design reviews from the owner/owner's representative, which, if not appropriately staffed, can cause significant delays and/or force the contractor to proceed at-risk in order to meet other schedule obligations.

Research on megaprojects has shown that ensuring early-stage design and engineering is performed, with some suggesting 3-5% of the total project's capital cost be spent to support this,[49] will often result in far better results during execution. Studies have shown that performing this early project-definition work can reduce project timelines and costs by approximately 20%.[50] This success is attributed to the design process raising certain design and constructability issues before construction starts.

G. Cultural Differences, Whether Inside the Organization or Outside

The organizations that build megaprojects are seemingly as large and complex as the megaprojects themselves, which presents its own set of issues, particularly with the flow of information from what is occurring on the ground up to the owner-level. A typical organizational structure utilized on megaprojects would be:[51]

- Layer 1: Subcontractor » Contractor
- Layer 2: Contractors » Construction Manager/Managing Contractor
- Layer 3: Construction Manager » Owner's Representative

- Layer 4: Owner's Representative » Project Sponsor
- Layer 5: Project Sponsor » Business Executive

As noted by one commentator, *"This is a problem because each layer will have a view on how time and costs can be compressed. For example, the first three layers are looking for more work and more money, while the later ones are looking to deliver on time and budget. Also, the authority to make final decisions is often remote from the action."*[52]

Megaprojects commonly involve a diverse set of participants, including *"legislators, government agency executives, a range of private firms providing expertise from several planning disciplines, multiple engineering design disciplines, construction companies of multiple specialties and their construction workers, who may be represented by up to 15 separate craft-based unions in the US."*[53] This can lead to misunderstandings arising in the standard frameworks and rules each group is accustomed to following. Where these misunderstandings are left unresolved, it can result in dissolved relationships and conflicts that strain the overall project performance. In addition, cultural factors may differ significantly in the diverse cultures which exist around the world. Differences in economic and religious ideologies, languages, and ethnicities are all factors that must be taken into account in preparing for and executing a megaproject.

VI. Cost Overruns in Arctic Projects and Unique Factors Affecting the Likelihood of Cost Overruns

In addition to the logistical issues and the expected harsh environment of ambient winter conditions, freezing temperatures and high chilly winds that can significantly reduce productivity or result in work stoppages, one of the biggest risks in the Arctic region today is the threat posed by climate change. Studies have identified that the Arctic region is warming more rapidly than anywhere else on earth with Barrow, Alaska setting a record in 2011 with 86 consecutive days above freezing (from the previous record of 68 days in 2009).[54] The loss of productivity and working hours during the winter is somewhat mitigated by the long daylight hours found during the summertime construction season. Careful planning and scheduling are required to ensure the summertime construction season is fully utilized.

While construction over permafrost has been performed successfully in the past, including on the TAPS, permafrost related challenges still exist and due to climate change may be different than those challenges faced during the TAPS construction.[55] The stability of the foundations rely on the spatial distribution of ground ice, and the thawing and settling of the ground ice can threaten the stability of the pipeline. The impacts of climate change could cause increased thaw and settle cycles over the lifespan of the pipeline, potentially leading to unanticipated permafrost conditions, which may be difficult to predict, requiring that special considerations for the unknown conditions be made at the design and engineering phases of the project. The softening of the permafrost could also present challenges in accessing the remote locations of the project, making the transportation of craft labor, heavy construction equipment, and supplies to the locations more challenging than anticipated.

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Beyond the effects of climate change and challenges presented by the permafrost, the Arctic has long been a challenging climate with brutal winters and unpredictable weather that can change drastically within a single day. The TAPS, for example, was shut down in January 2012 due to weather conditions reported as "not uncommon," with the closure causing an estimated daily loss of $18.1M to the State from lost taxes and royalties.

The availability of experienced craft labor and project managers is significantly lower in the Arctic. However, the turnover rate of craft labor is lower on Arctic projects, as competing projects tend to be significantly farther away reducing the ease for craft to move from one project to another. There are 12 LNG liquefaction projects in various stages of development in the U.S., predominantly located along the Gulf Coast.[56]

Construction projects in the Arctic also face challenging environmental concerns such as avoiding damage to permafrost, wetlands mitigation, migratory bird restrictions, returning salmon and fish windows. As explained in **Section III.B** and **III.C**, the TAPS experienced significant cost overruns that were attributed to environmental issues including: more groundwater during warmer months that anticipated, soil conditions that varied drastically from one location to the next, and permafrost being harder to move and drill than planned. [57] Oil and gas projects in the Arctic also typically draw more attention from environmental groups, not only through legal challenges, such as those experienced on the TAPS, but with on-site protests that can cause productivity impacts or even cause the construction site to be temporarily shut down.

VII. Cost Overruns in Megaprojects for Oil and Gas Projects Around the World

In addition to the 2017 E&Y study discussed earlier, other studies have documented similar results of oil and gas megaprojects, with Wood Mackenzie finding that the top 15 oil and gas megaproject overruns in the last decade resulted in a cumulative $80 billion over budget.[58] The reasons for cost overruns involve a combination of those issues identified in **Section III** above; for instance, a study of oil and gas project performance found that as projects become larger and larger,[59] they are more likely to experience cost overruns than non-megaprojects. The reasons why size has driven cost overruns is largely tied to the complexity of the project, for instance:[60]

- The higher the cost, the more likely for a project to be executed by a joint venture to lower the financial exposure of a single firm. However, joint ventures (JV) are difficult to align the interests and objectives of each of the partners. Often the risk of misalignment is not considered in the initial estimate preparation, which can affect project performance when JV partners are at odds with one another in how to execute the project.
- Use of new and/or limited technology typically offers the benefit of improved operating efficiency, but during project execution there may be a lack of suppliers and resources for the technology, challenges with interfaces to older technologies, and lack of historical cost data to use in forecasting.

- High number of sub-scopes with high complexity due to the large number of interfaces and dependencies amongst different scopes of work, increases challenge of integration, communication, project management, etc. Additionally, if any one-piece encounters schedule slippages, there is a strong likelihood for delays to ripple across several other related scopes.

The Kashagan oil field project within the Caspian Sea in Kazakhstan saw its Phase 1 development costs increase from $24 billion,[61] to double that by the time the first batch of crude oil was produced. Technical challenges such as high-pressure reservoirs with high sour gas content; freezing weather conditions including pack ice; and pipeline leaks brought about significant to delays and cost increases to the project.[62]

Another one of the more publicized projects in recent history was Chevron's Gorgon LNG project off the coast of Western Australia, which was approved in 2009 at an estimated cost of $37 billion, with costs ultimately increasing to $69 billion.[63] Chevron's CEO at the time of the project, John Watson, reflected on the project noting,

> *"There have been many lessons learnt and we try to be introspective on what we have done well and what we can improve on.*
>
> *For example, we are going to do more engineering and logistics ahead of time on projects, so we can be absolutely certain on what the requirements will be, what the cost will be.*
>
> *We are going to do more work with the supply chain to ensure we understand costs before we get started.*
>
> *Those are the responsibilities of our company and our contractors to make sure when we make final investment decisions, we have a very strong understanding of what the requirements are going to be, so we can deliver a project on schedule and on budget."*[64]

One industry veteran who worked on the Gorgon LNG project as a contractor expressed concerns that the Alaska LNG Project is on a path to repeat some of the same mistakes; specifically, the hot air circulation, which cut Gorgon's production by 13% (costing Chevron up to $500 million per year and hampering its ability to fulfill its contracts).[65] Another potential Gorgon LNG issue that could arise on the Alaska LNG Project is the carbon sequestration process. On the Gorgon LNG project, technical issues have delayed the carbon capture and storage portion of the Gorgon LNG project by almost two years;[66] while on the Alaska LNG Project, ExxonMobil's Senior Manager previously estimated the gas treatment plant with CO_2 recovery at approximately $10 billion – or roughly a quarter of the Project's total cost estimate.[67]

VIII. Impact of Potential Cost Overruns on the Alaska LNG Project Completion

Generally, the primary categories of project risk include:

- Execution/construction risks
- Operating risks
- Financial and economic risks
- Legal/Regulatory risks
- Political risks

All these risks are interrelated and each one will affect different projects differently. Both internal and external risk factors relating to the above primary risk categories could pose threats to the Alaskan LNG Project.[68]

Internal Risk Factors

Internal risk factors that could pose threats to successful completion include 1) Portfolio and Project Commercial Context, 2) Project Development, and 3) Project Delivery.

The commercial context in how the Alaska LNG Project is being developed is critical to its success including what skills and resources are available, the cost of capital, the partners that will be involved, the expected return for project participants, and what risk will be allocated by each stakeholder. Resources alone will prove to be a challenge, both from the availability and capability of engineers and contractors given the competing LNG Canada Project recently approved in British Columbia.

The following table summarizes the similarities and differences between the Alaska LNG Project and the LNG Canada Project.

Factor	Alaska LNG	LNG Canada
Ownership	AGDC (100%)	Shell (40%); Petronas (25%); PetroChina (15%); Mitsubishi Corp. (15%); Kogas Canada LNG Ltd. (5%)[69]
Project Components:		
Pipeline	800 miles ($8.6B)	416 miles ($4.8B) – to be built, owned, and operated by TransCanada Corp.[70] Other sources indicate it is $6.2B[71]
LNG Processing & Storage	-Three LNG trains -Two 240,000 m^3 storage tanks -Transfer approx. 12,500 m^3 of LNG per hour -Two loading berths to accommodate LNG carries up to 217,000 (Q-Flex) -Approx. 20 million LNG tons per year[72]	-Two LNG trains (expected to later be expanded to four) -Approx. 14 million LNG tons per year[73] -Two 225,000 m^3 storage tanks[74] -Two loading berths -Approx. 14 million LNG tons per year initially (up to 28 million tons w/expansion)[75]
Project Cost	$43.4 (including pipeline, owner's cost, contingency)	$30B ($40B fully developed – i.e. four trains) [Canadian $][76] Other source indicate it is $40B for the initial two-train plant[77] *Note: appears, but unclear, if pipeline cost is excluded from this project estimate.*
EPC Contractor	TBD	JGC-Fluor joint venture ($14B contract, lump sum basis)[78] *Note: not including pipeline*

Factor	Alaska LNG	LNG Canada
Supply/Offtake	75% capacity for debt payment; 25% retained by owner for market sales	Each partner responsible for own supply and to individually off-take and market its share[79]

As discussed earlier, it will be essential to consider design, procurement, construction, commissioning and operational issues, including external factors such as cycles of extreme weather, during the FEED Stage as failure to appropriately consider these factors can have a detrimental effect in subsequent project phases. Far too often early project decisions are based too heavily on cost with insufficient emphasis placed on quality despite the known impacts that poor quality can have on cost and schedule.

Aggressive estimates and optimism bias must be avoided in this upcoming FID phase of the Project. Where optimism bias goes unrecognized or unchallenged, there is a risk that as the Project moves forward, added unknowns and unnecessary risks will emerge that could challenge the viability of the cost estimate.

How the Project will be delivered should be addressed now. This includes how the Project will be managed including the AGDC organization, the EPC contractor selection and how sufficient experienced and trained personnel will be recruited and retained. Further, how is the "upstream" infrastructure at Pt. Thompson and Prudhoe which is necessary to produce the gas and move it in from new wells to gathering lines to the new plant for processing going to be constructed and how has this been considered in the cost estimate provided to the State?

<u>External Risk Factors</u>

External risk factors that are often responsible for cost overruns and schedule delay include regulatory and legal challenges and geopolitical challenges.

Regulatory challenges should be identified including how AGDC will address issues arising from the FEIS review as well as how health, safety and environment (HSE) will be managed throughout the Project. The importance of infrastructure development prior to construction of the main LNG phase of the Project cannot be overstated. The development of water, power, rail, road, and accommodation projects to gain access to resources is essential to a smooth execution and the challenge of these often costly and time-consuming activities can be exacerbated by remote locations and extreme climatic conditions.

While all the internal and external risk factors discussed above could affect the proposed Project, one of the most significant risks faced by the Project is the geopolitical challenge. Currently the Project is being proposed to be financed by the Bank of China and CIC Capital Corporation (CIC Capital) with 75% of the LNG offtake to be contracted to the Chinese. However, while the Bank of China and CIC Capital have assisted with the financing of other global LNG projects, they have been only one of several entities providing financing and such financing has typically come into project execution in latter parts of the respective projects, thus having little influence into the initial project planning and development. In addition, the Alaska LNG Project is potentially significantly larger and the financing significantly larger than any of the prior Bank of China or CIC Capital financed projects. Further, depending on the outcome of ongoing negotiations to reach a definitive agreement (including the announcement on January

3, 2019 that the deadline for such negotiations would be extended until June 30, 2019), the conditions may not commit the Bank of China or CIC Capital to remain in the Project creating the risk of its withdrawal at some point in the future. Outside factors that could prompt such a decision include diplomatic and security issues, financial and supplier market uncertainty including a global economic turndown, commodity constraints and pricing, exchange rate fluctuations, civil and workforce disruption and transformation in the natural gas industry. It is critical to determine how controllable these risk factors are and the extent to which they could transfer the risk to the State, including the risk of significant cost overruns should the Chinese for whatever reason at some point withdraw from the Project. Clearly the external environment and regulatory-and policy related changes are less controllable or predictable than project management issues, stakeholder conflicts, and resource constraints. While less predictable, they are risks that can and should be modeled and accounted for in the cost and schedule estimates, including selecting a high confidence level in the risk model. As part of the governance structure for the Project, the State should have the absolute right to ensure that it is not unknowingly assuming project-related risk through, for example, financing agreements or offtake agreements. As will be discussed below in **Section XI** below, actions can be taken by the State to further reduce the risk and/or prepare for those risks should they emerge.

Other risk factors which could impact the Alaska LNG Project are discussed below.

A. Appetite to Complete the Project vs. Sunk Costs and Stranded Investments

Albert Hirschman was an economist who was as interested in practice as in theory and who successfully sought influence on policy from his ideas. One commentator has written on Hirschman's "Hidden Hand" principle as it pertains to megaprojects. As noted, Hirschman *"observed that humans are 'tricked' into doing big projects by their own ignorance. He saw this as a positive because just as humans underestimate the difficulties in doing large-scale projects they also underestimate their own creativity in dealing with the difficulties…"*[80] The idea that starting a megaproject with an unrealistically low budget in order to get it approved, with at least partial knowledge that costs were likely to be understated was demonstrated by former San Francisco mayor Willie Brown in his comments on the cost overruns on the San Francisco Transbay Terminal megaproject:[81]

> *"News that the Transbay Terminal is something like $300 million over budget should not come as a shock to anyone. We always knew the initial estimate was way under the real cost. Just like we never had a real cost for the* [San Francisco] *Central Subway or the* [San Francisco-Oakland] *Bay Bridge or any other massive construction project. So, get off it. In the world of civic projects, the first budget is really just a down payment. If people knew the real cost from the start, nothing would ever be approved. The idea is to get going. Start digging a hole and make it so big, there's no alternative to coming up with the money to fill it in."*

The line of thinking outlined by Hirschman and practiced by Brown is that it is appropriate to start with an unrealistically low estimate if it allows the project to move forward. Once it is approved and under execution, and more realistic costs are determined, it is too late to reconsider the project due to the large investment and the existence of a partially completed project. Thus, understanding what was involved in the risk assessment and risk modeling including the chosen confidence level will be essential prior to locking in decisions at the FID, including any financing agreements and EPC contracts.

B. Risks of Contractor Financial Capability to Absorb Overruns

No EPC contract is “risk free” and not all risks can be transferred from the owner to the EPC contractor. Nearly all contracts for megaprojects include EPC milestone payment schedules that correspond to progress on the project. This is intended to minimize the financial risk of the contractor to complete the works by providing payment for certain milestones along the way. However, if substantial risks manifest beyond the contingency allowance of the contractor’s budget, it may lead to a scenario in which the contractor lacks the financial strength to absorb such losses. This may in turn lead to the owner having no choice but to terminate the contract and even considering large performance and payment guarantees, there likely will be additional costs required to be absorbed by the owner as a result of suspending the project and replacing the original contractor. Thus, prior to executing an EPC contract, appropriate financial reviews of the contractor should be conducted, and parental guarantees included in the contract as appropriate. Understanding the contract risk allocation through a contract risk review prior to the EPC contract execution should be undertaken to ensure the appropriate allocation of risk and who are in the best position to own and control that risk.

C. Challenges to Economic Feasibility of Project

While cost is one factor in evaluating a project, the benefits or output of the completed project is another factor. Unfortunately, not only do megaprojects frequently encounter cost overruns, but also often have benefits that fall short of what was projected at the project’s onset. An example is the Channel Tunnel linking the United Kingdom to France that saw significant cost overruns:[82]

> *“This project was originally promoted as highly beneficial both economically and financially. At the initial public offering, Euro-tunnel, the private owner of the tunnel tempted investors by telling them that 10% ‘would be a reasonable allowance for the possible impact of unforeseen circumstances on construction costs.’ In fact, costs went 80% over budget for construction…and 140% over budget for financing. Revenues have been one half of those forecasted. As a consequence, the project has proved non-viable, with an internal rate of return on investment that is negative, at minus 14.5% with a total loss to the British economy of US$17.8 billion; thus, the Channel Tunnel detracts from the economy instead of adding to it.”*

While there are tangible benefits to the tunnel, notably fast and convenient transportation, each passenger is in fact heavily subsidized by the investors in the project as a result of the significant cost overruns. Similarly, while well-intentioned financiers and equity partners have expressed interest in investing in the Alaska LNG

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Project, should future risks emerge as previously discussed, at what total project cost can the State bear to balance providing a benefit of offtake contracts that may not provide the same return on investment (ROI) as currently anticipated?

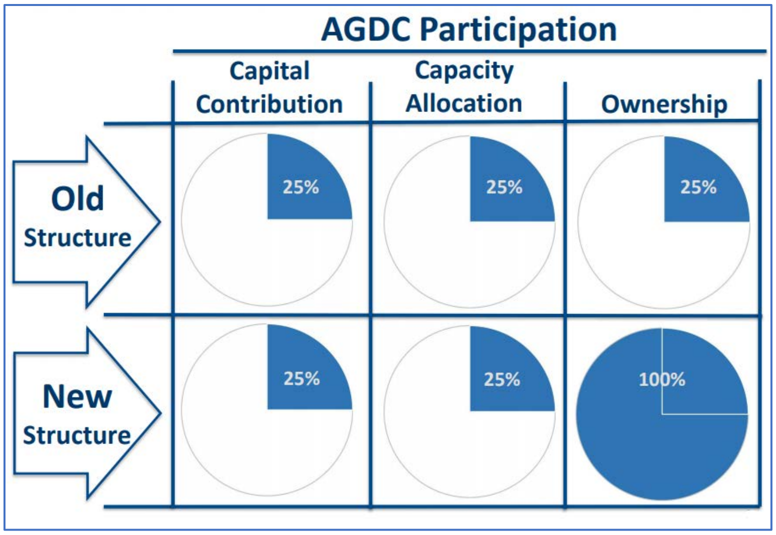
IX. Alaska LNG Project Ownership Structure

When initially proposed, the Alaska LNG Project envisioned major oil and gas companies BP, ConocoPhillips, and ExxonMobil to invest in and own much of the Project, with the State taking a minority role in project ownership and development.[83] With downward pressure on energy prices in early 2016, these oil and gas companies proposed a new approach in which the State could take over the Project or allow it to be shelved until the markets rebounded to align with the companies' return requirements. It is unclear whether the State has been fully debriefed by these former partners (that are in business to develop projects such as this one) as to the risk analyses and other potential factors that led them to drop their ownership position in the Project. If such a debriefing has occurred, and if the new ownership structure is intended to manage those perceived risks, that connection has not been made apparent.

The new ownership structure keeps AGDC's capital contribution and capacity allocation at 25% as was previously established by the original ownership structure, but now with 100% ownership (with the remaining capital being debt-financed). An assessment on the new ownership structure determined that:[84]

> *"**State-led project needs credibility boost***
> *Any transition to a state-led project raises serious questions about execution and governance.*
> *State needs to upgrade its capabilities—and will bear the cost of this.*
> ***Don't expect to outsource risk***
> *It's hard to see why third parties will join this project and accept a sub-par return.*
> *State cannot expect to take on full control while outsourcing risks to others.*
> ***State cannot avoid partner veto***
> *State cannot hope to find investors who will not ask for veto rights over FID (at least).*
> *(i.e. No investor will surrender the right to veto a boondoggle).*
> ***Don't overdo financial engineering***
> *Return is a project-level, not a sponsor-level, concept—it should match project risk.*
> *Leverage increases risk, which increases the expected return on equity.*
> ***Focus on risk-return***
> *What returns are acceptable for AK LNG? And how much risk is the state willing to take?"*
> [bold emphasis in original]

The figure below from a January 2018 AGDC presentation to the Joint Senate Resources and Finance Committee depicts the difference between the original and current ownership structures.[85]



In November 2017, AGDC signed a Joint Development Agreement (JDA) with China Petrochemical Corporation (Sinopec), CIC Capital Corporation (CIC Capital), and Bank of China. The JDA provided that for 75% of the project debt financing, 75% of the capacity (for the life of the loan) would be granted to China.[86] The JDA also provided the potential for Chinese companies to invest in a minority interest in the project and provide engineering, fabrication, and/or construction services. Initially, Sinopec expressed interest in participating in the construction management efforts through its engineering and construction subsidiary, but has since tempered that slightly to be open to a role as a subcontractor.[87] On October 2, 2018, AGDC, Sinopec, CIC Capital, and the Bank of China signed a supplemental agreement to the JDA that reaffirmed the parties' intent to negotiate and conclude definitive agreements by December 31, 2018 (recently extended to June 30, 2019).[88]

X. Contracts as a Tool to Mitigate Risks to AGDC and to the State of Alaska

Today the commercial risk in offshore and frontier regions is huge. Projects are often packaged as a single megaproject requiring a long development period. Then, as an industry, we try to control risk contractually, with non-negotiable terms, and generally thru lump sum pricing. The contractual risks are exacerbated by contracting approaches that are driven by transparency requirements of national oil and gas companies or the financial community funding many of the projects. To create further commercial complexity, local content requirements have been handed down to the lowest tiers of the execution hierarchy, where there is the least capability.[89] The issue, as discussed herein, is that risk in all forms is not being effectively managed. Execution is delayed, costs of execution soar, and the parties must protect their commercial status, including maintaining the ROI as much as possible. Owners must minimize capital expenditure impacts. Contractors must recover real out-of-pocket costs and some profit. Risk shedding has become everyone's game. Owners are forced to reduce exposure through even transfer or even equity risks to entities whose business model is based on near term execution profits and slim capitalization. Needed ROI requires maintenance of production timing and production cost requirements. In reality, contractors can and should only accept risk that can be reasonably defined. Out of commercial necessity, both owners and contractors are employing “hardball” project management/contract administration that further breeds mistrust and further exacerbates the conditions and context that bred the mutual mistrust in the first place.

There are several project contracts/agreements that will be executed over the course of the Project including:

- Basic Sponsorships;
- Licenses, Permits;
- Financing;
- Operations and Maintenance (O&M);
- Input/Supply;
- Output/Offtake; and
- EPC and other Procurement or Construction subcontracts.

A. Allocation of Risk Among Partners

The change in ownership structure (discussed in **Section IX**) increases the necessity to focus on several areas. First, feedstock supply agreements, and the creditworthiness of those suppliers, become critical. If the plant, once operational, cannot obtain sufficient raw materials, it will not produce sufficient output to service the debt and earn an acceptable return for equity holders. Second, the offtake contracts and the creditworthiness of those parties become critical as they will be repaying the debt.[90] The nature of the purchase commitments pursuant to those contracts, the way pricing is established, and numerous other provisions will all affect the risk being borne by the State. Potential fallout from the current U.S./China trade dispute exacerbate this risk, both in terms of increased construction costs (tariff on Chinese materials used in construction) and increased cost of product (tariff on US LNG). The risk, of course, being that the cost of the LNG produced by the Project becomes uncompetitive in the market thus threatening, once again, repayment of debt and return on equity. Relatedly, as a final agreement continues to be negotiated between the State, AGDC, and the Chinese entities that are party to the JDA, the framework for pricing and financing (including how cost overruns will be addressed both between owner and financer and owner and EPC contractor) remains a critical area of focus for the State. Between the State and the Chinese entities contemplating financing a portion of the Project, details such as the minimum level of funding from a letter of credit and other assurances can reduce (but not eliminate) the exposure the State has to cost overruns. Similarly, the EPC contract can include provisions such as those identified in **Section X.C.** below that help limit the State’s exposure to the challenges and risks faced by the Project.

Ultimately, the change in ownership structure should not change the fundamental principle that the State should have absolute transparency into the risk it is accepting, and it should understand how it is mitigating the risk and the cost of that mitigation. Similarly, it should understand the risk being assumed by its partners and be comfortable that the State is not paying an unreasonable amount for its partners to assume that risk.

Before contract risk allocation can take place, risks need to be identified with some thought as to ownership. Risks are best identified prior to the development of the contract through a risk profile exercise at the feasibility stage of the project. By identifying the risks at an early stage of the project and assessing their potential impact, decisions can then be made as to how best to manage those risks to either control them or absorb them should those risks manifest over the course of project execution. [91]

What a contract actually allocates is some level of risk responsibility to manage and control a particular risk element and some amount of liability should an allocated risk affect the project. The fallacy is in believing that an owner can simply "allocate and then forget" a risk via a contract with another party. More and more often, neither responsibility to manage nor liability for a risk element is decided until after project completion, at which time, the courts, arbitrators or mediators decide the extent to which each of the parties share responsibility.

Risk ownership must translate into risk allocation. Risk allocation must allocate risk to the party most capable of managing that risk and balance risk allocation to ensure alignment between the owner and contractor on project objectives. There are typically four basic principles to risk allocation methodology:

- Control: Risk should be allocated to the party in the best position to control and manage variables relevant to the identified risk.
- Clarity: The allocation decisions should be clearly articulated and defined in the relevant project contract and contract documents.
- Consistency: Risk allocation decisions need to be expressed in all relevant contract documents in a consistent manner
- Fairness: Achieving the first three principles will go a long way in achieving the fourth, fairness, which simply means risk allocation should be conducted in a balanced, clear and consistent manner.

For those risks that present significantly uncertainty, the parties should consider negotiating a reasonable baseline that would clearly define the parameters of what risk is to be assumed by the contractor and how risk would be measured when actual events exceed that baseline and lead to cost and/or schedule impacts. Innovative contract drafting can assist in how risk is allocated in various contract clauses, especially if it pertains to:

- Differing ground conditions;
- Severe weather conditions;
- Unusual or technically challenged portions of the work;
- Change of law or regulation;
- Currency fluctuations;
- Cost of materials;
- Cost and availability of labor;
- Force majeure; and
- Failure to perform obligations.

Owners should also address how lender concerns will be addressed including:[92]

- Repayment risk:
    - o Little or no recourse to the sponsors, only to the project assets
    - o Lenders focus on risk allocation, project cash flows, size of initial equity investment, creditworthiness of contractors and off takers

  - EPC and other project contract terms that permit effective exercises of remedies.
- Privity of contract and direct agreements
  - Lenders have few direct contracts with major project parties, such as contractors, suppliers and offtakes
  - Direct agreements with such other project participants spell out their rights.
- Termination clauses, compensation and step-in rights
  - Provide contractual terms of rights and remedies.
- Bank vs. Bond Debt
  - Bank debt formerly predominated
  - Capital markets are now more familiar with project finance
  - Nevertheless, complex financing documentation still required for bond debt

B. Benefits of and Limits to EPC Contracts

EPC contracts are a standard type of contract arrangement for executing large and complex energy and infrastructure projects. The EPC contract presents advantages and disadvantages to both the owner and the contractor.[93] Advantages of an EPC contract to the owner include:

- Shifting risk to the contractor for integrating the performance of all subcontractors, including designers.
- Shifting supply chain solvency risk to the contractor.
- Providing early cost certainty.
- Sizing remedies – liquidated damages, liability caps, performance bonds – to the total cost of the work, thus covering a significant portion of the owner's potential exposure.
- Minimizing the administration burden on the owner, and
- Providing for flexible financing options.

There will be owner obligations with the owner typically providing access to fuels, utilities, ports, roads, site title, and other infrastructure and supplies and for the facility itself for testing and commissioning. An EPC contract should specify how, and by whom these will be provided with remedies for non-delivery. No transfer of risk is accomplished without some give and take. In addition, owners executing a project under an EPC contract should take the following considerations into account:

- Shifting risks to the EPC contractor results in a risk premium paid by the owner for the contractor's contingency and risk exposure.
- Limits the owner's ability to make design changes without an onerous change order process.
- Minimizes the contractor's incentive to aim for higher than minimum compliant standards (e.g. differing interpretations of environmental requirements, such as what was encountered on the TAPS).
- Limits the owner's ability to influence means and methods for execution.
- Limits the amount of risk transferred due to express liability limits and bonding limitations of the contractor.
- Increases the likelihood of contractor claims to alleviate realized risks (e.g. claims for unforeseen site conditions, low productivity, weather impacts, etc. even when contractual language is strong).

Additionally, while some may consider lump sum contracting approaches to provide the owner a "locked" price, the terms and conditions generally provide exceptions for which the contractor may be entitled to additional funds (e.g. unforeseen site conditions, design changes, force majeure events, changes in law, etc.). Even when the contract is more favorable to the owner in such conditions because of the amount of money at stake on megaprojects, it is almost a given that the contractor will file claims during or after completion of the project. Regardless of owner liability, the owner will have legal and administrative costs to evaluate and respond to such claims.

C. Recommendations for Specific Terms in the EPC Contract to Protect from Cost Overruns and Costs of Unforeseen Contingencies

Understanding that megaprojects are by nature extremely complex with a high degree of uncertainty is important for contract development. Within the construction industry there has been discussion on a "complete contract" versus an "incomplete contract." Where complete contracts have *"the capability to mitigate adverse effects while specifying everything in detail"*, incomplete contracts *"still have the duties and controls but recognize that it is just not possible to anticipate every future incident and contingency."*[94] Some take the position that while there is often emphasis on "getting the contract right," it would also *"appear inevitable that no complete contract can be drafted for contracts that are complex"* and that *"incomplete contracts that recognize that they contain uncertainty will require collaborative processes between contract parties to be realized which are beyond the familiar comfort zone of well-known contract practice."*[95] In addition, *"Owners who wish to transfer risk to their contractors and the supply chain often believe that this can be achieved by tightening up contract terms and increasing the amount of details in the contract documents despite little evidence to support this view. There is a lack of recognition that megaprojects require incomplete contracts due to their inherent complexity and uncertainty."*[96]

Key concepts of an EPC agreement include:[97]

- Single point of responsibility – *"The contractor is responsible for all design, engineering, procurement, construction, commissioning and testing activities. Therefore, if any problems occur the project company need only look to one party – the contractor to fix the problem and provide compensation. As a result, if the contractor is a consortium comprising several entities the EPC Contract must state that those entities are jointly and severally liable to the project company."*
- Fixed price contract – *"Risk of cost overruns and the benefit of any cost savings are to the contractor's account. The contractor usually has a limited ability to claim additional money which is limited to circumstances where the project company has delayed the contractor or has ordered variations to the works."*
- Fixed completion date – *"EPC Contracts include a guaranteed completion date that is either a fixed date or a fixed period after the commencement of the EPC Contract. If this date is not met the contractor is liable for delay liquidated damages ("DLDs"). DLDs are designed to compensate the project company for loss and damage suffered as a result of late completion of the facility. To be enforceable in common law jurisdictions, DLDs*

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must be a genuine pre-estimate of the loss or damage that the project company will suffer if the facility is not completed by the target completion date. The genuine pre-estimate is determined by reference to the time the contract was entered into.
DLDs are usually expressed as a rate per day which represents the estimated extra costs incurred (such as extra insurance, supervision fees and financing charges) and losses suffered (revenue forgone) for each day of delay.
In addition, the EPC Contract must provide for the contractor to be granted an extension of time when it is delayed by the acts or omissions of the project company…"

- Extension of time – *"A relatively standard extension of time (EOT) clause would entitle the contractor to an EOT for:*
  - *an act, omission, breach or default of the project company;*
  - *suspension of the works by the project company (except where the suspension is due to an act or omission of the contractor);*
  - *a variation (except where the variation is due to an act or omission of the contractor); and*
  - *force majeure,*

  which cause a delay on the critical path and about which the contractor has given notice within the period specified in the contract. It is permissible (and advisable) to make both the necessity for the delay to impact the critical path and the obligation to given notice of a claim for an extension of time conditions precedent to the contractor's entitlement to receive an EOT."
- Performance guarantees – *"The project company's revenue will be earned by operating the facility. Therefore, it is vital that the facility performs as required in terms of output, efficiency and reliability. Therefore, EPC Contracts contain performance liquidated damages ("PLDs") payable by the contractor if it fails to meet the performance guarantees.*
  PLDs must also be a genuine pre-estimate of the loss and damage the project company will suffer over the life of the project if the facility does not achieve the specified performance guarantees. As with DLDs, the genuine pre-estimate is determined by reference to the time the contract was signed."
- Caps on liability – *"…EPC contractors will not, as a matter of company policy, enter into contracts with unlimited liability. Therefore, EPC Contracts for oil and gas projects cap the contractor's liability at a percentage of the contract price. This varies from project to project, however, a cap of 100% of the contract price is common. In addition, there are normally sub-caps on the contractor's liquidated damages liability. For example, DLDs and PLDs might each by capped at 20% of the contract price with an overall cap on both types of liquidated damages of 30% of the contract price.*
  There will also likely be a prohibition on the claiming of consequential damages. Put simply consequential damages are those damages which do not flow directly from a breach of contract, but which were in the reasonable contemplation of the parties at the time the contract was entered into. [This used to mean types of damages like loss of profit]*. However, loss of profit is now usually recognized as a direct loss on project financed projects and, therefore, would be recoverable under a contract containing a standard exclusion of consequential loss cause. Nonetheless, care should be taken to state explicitly that liquidated damages can include elements of consequential damages.*

…

In relation to both caps on liability and exclusion of liability it is common for there to be some exceptions. The exceptions may apply to either or both the cap on liability and the prohibition on claiming consequential losses. The exceptions themselves are often project specific, however, some common examples include in cases of fraud or willful misconduct, in situations where the minimum performance guarantees have not been met and the cap on delay liquidated damages has been reached and breaches of the intellectual property warranties."

- Security – *"It is standard for the contractor to provide performance security to protect the project company if the contractor does not comply with its obligations under the EPC Contract. The security takes a number of forms including:*
    - *a bank guarantee or bond for a percentage, normally in the range of 5-15%, of the contract price. The actual percentage will depend on a number of factors including the other security available to the project company, the payment schedule (because the greater the percentage of the contract price unpaid by the project company at the time it is most likely to draw on security i.e.: to satisfy DLD and PLD obligations the smaller the bank guarantee can be), the identity of the contractor and the risk of it not properly performing its obligations, the price of the bank guarantee and the extent of the technology risk;*
    - *retention i.e.: withholding a percentage (usually 5%-10%) of each payment. Provision is often made to replace retention monies with a bank guarantee (sometimes referred to as a retention guarantee (bond));*
    - *advance payment guarantee, if an advance payment is made; and*
    - *a parent company guarantee – this is a guarantee from the ultimate parent (or other suitable related entity) of the contractor which provides that it will perform the contractor's obligations if, for whatever reason, the contractor does not perform."*
- Variations – *"The project company has the right to order variations and agree to variations suggested by the contractor. If the project company wants the right to omit works either in their entirety or to be able to engage a different contractor this must be stated specifically. In addition, a properly drafted variations clause should make provision for how the price of a variation is to be determined. In the event the parties do not reach agreement on the price of a variation the project company or its representative should be able to determine the price. This determination is subject to the dispute resolution provisions. In addition, the variations clause should detail how the impact, if any, on the performance guarantees is to be treated. For some larger variations the project company may also wish to receive additional security. If so, this must be dealt with in the variations clause."*
- Defects liability – *"The contractor is usually obliged to repair defects that occur in the 12 to 24 months following completion of the performance testing. Defects liability clauses can be tiered. That is the clause can provide for one period for the entire facility and a second, extended period, for more critical items."*
- Intellectual property – *"The contractor warrants it has rights to all intellectual property used in the execution of the works and indemnifies the project company if any third parties' intellectual property rights are infringed."*

- Force majeure – *"The underlying test in relation to most force majeure provisions is whether a particular event was within the contemplation of the parties when they made the contract. The event must also have been outside the control of the contracting party. There are generally three essential elements to force majeure:*
    - *it can occur with or without human intervention;*
    - *it cannot have reasonably been foreseen by the parties; and*
    - *it was completely beyond the parties' control and they could not have prevented its consequences.*

  ...

  There are 2 aspects to the operation of force majeure clauses:

    - *the definition of force majeure events; and*
    - *the operative clause that sets out the effect on the parties' rights and obligations if a force majeure event occurs.*

  ...

  The preferred approach for a project company is to define force majeure events as being any of the events in an exhaustive list set out in the contract. In this manner, both parties are aware of which events are force majeure and which are not.

  ...

  An operative clause will act as a shield for the party affected by the event of force majeure so that a party can rely on that clause as a defence to a claim that it has failed to fulfil its obligations under the contract.

  An operative clause should also specifically deal with the rights and obligations of the parties if a force majeure event occurs and affects the project. This means the parties must consider each of the events it intends to include in the definition of force majeure events and then deal with what the parties will do if one of those events occurs."

- Suspension – *"The project company usually has the right to suspend the works."*
- Termination – *"This sets out the contractual termination rights of both parties. The contractor usually has very limited contractual termination rights. These rights are limited to the right to terminate for non-payment or for prolonged suspension or prolonged force majeure and will be further limited by the tripartite or direct agreement between the project company, the lenders and the contractor. The project company will have more extensive contractual termination rights. They will usually include the ability to terminate immediately for certain breaches or where the contractor becomes insolvent and the right to terminate after a cure period for other breaches. In addition, the project company may have a right to terminate for convenience. It is likely the project company's ability to exercise its termination rights will also be limited by the terms of the financing agreements."*
- Performance specification – *"Unlike a traditional construction contract, an EPC Contract usually contains a performance specification. The performance specification details the performance criteria that the contractor must meet but does not dictate how they must*

be met. This if left to the contractor to determine. The specification must be detailed enough to ensure the project company knows what it is contracting to receive but not so detailed that if problems arise the contractor can argue they are not its responsibility."

- Exclusive remedies – *"An exclusive remedies clause limits the project company's right to recover for any failure of the contractor to fulfill its contractual obligations to those remedies specified in the EPC contract.*

  ...

  The most significant risk for a project company in an EPC Contract is where there is an exclusive remedies clause and the only remedies for delay and underperformance are liquidated damages. If, for whatever reason, the liquidated damages regimes are held to be invalid, the project company would have no resource against the contractor as it would be prevented from recovering general damages [e.g. breach of contract, breach of warranty, negligence, etc.] *at law, and the contractor would escape liability for late delivery and underperformance of the facility."*
- Fail safe – *"In contracts containing an exclusive remedies clause, the project company must ensure all necessary exceptions are expressly included in the EPC Contract. In addition, drafting must be included to allow the project company to recover general damages at law for delay and underperformance if the liquidated damages regimes in the EPC Contract are held to be invalid."*
- Dispute resolution – General provisions may include:
  - *"having a staged dispute resolution process that provides for internal discussions and meetings aimed at resolving the dispute prior to commencing action (either litigation or arbitration);*
  - *obliging the contractor to continue to execute the works pending resolution of the dispute;*
  - *not permitting commencement of litigation or arbitration, as the case may be, until after commercial operation of the facility. This provision must make provision for the parties to seek urgent interlocutory relief i.e.: injunctions and to commence proceedings prior to the expiry of any limitations period. If the provision does not include these exceptions it risks being unenforceable; and*
  - *providing for consolidation of any dispute with other disputes which arise out of or in relation to the construction of the facility. The power to consolidate should be at the project company's discretion."*

Other innovative clauses that can best allocate risk include the provision of shared contingency allowances to account for the high risks such as encountering differing site conditions. Fund accounts for the costs of bonds and insurance, which can be costly, are another method to limit exposure and can help offset contractor risk premiums. Fund accounts typically reimburse a contractor dollar for dollar with any excess amounts not used to be paid to the contractor on achievement of Substantial Completion. Even estimated quantities can be a source of increased risk to the EPC contractor and thus exposure due to quantity fluctuations can be provided for by a renegotiation of the commodity pricing for a portion of the final adjusted quantities in excess of an agreed percentage of the original estimate. These are only a few examples of other innovative contractual clauses that can be used in EPC contracting for megaprojects like LNG projects.

The new construction environment is dictating that the owner and contractor reevaluate how they do business under an EPC contract. Every risk has an associated price, whether that price is visible or hidden. Visible risk cost estimates appear in the project tenders as contingency or insurance cost and can be compared. It is the onerous contract clauses that promote hidden costs. How risk is allocated will have a significant impact on how a project is financed. The owner can certainly transfer many risks to the contractor, but needs to recognize that by doing so, there is a cost to that risk premium. Allocating risk to the party most able to control and manage it is always a starting point, but there are caveats in doing so.

Innovative risk sharing agreements have become the best method of allocating risk and reducing the total contract price. Carefully thought out clauses relative to risk allocation and risk exposure limitations, as discussed herein, that do not grossly and inequitably allocate all the risk to the contractor positively impacts overall project performance and the owner-contractor working relationship. In return, disputes will also be minimized.

XI. Questions to Ask, Recommendations for a Path Forward Based on What is Currently Known about the AGDC LNG Project Including Additional Tools that Should or Could be Used to Protect AGDC and the State of Alaska from Cost Overruns and Costs of Unforeseen Contingencies

A. Questions

Based on the publicly available information, there are still many unanswered questions that the State should ask AGDC including:

- What are the specific program objectives and how will they be measured?
- What are the detailed components of the current estimate and have they been independently vetted and challenged? In particular, what drove the decrease from the preliminary $45-$65 billion estimate to the current $43.4 billion estimate?
- Has a formal risk review been performed to identify and quantify the risk elements that have the potential to affect successful attainment of program objectives and if so, how and when was the risk review performed and at what confidence level is the current estimate?
- Have the functional management roles and responsibilities necessary to fulfill management and operational control tasks been identified along with potential candidates with the necessary experience and expertise to successfully overcome risks and impediments to the successful execution of those fundamental requirements?
- Have preliminary program management and execution plans been developed?
- Have formal policies, procedures, and processes under which the program and project management will function to successfully meet the program obligations and objectives been developed including setting and formalizing delegations of authority and

boundaries on autonomy for each functional management position at both the program and project management levels?

- Has recruitment begun for staff that has the background and qualifications necessary to fill the functional positions at both the program and project management levels begun?
- Has a proposed EPC contract been drafted and how have the risks been allocated?

B. Performance Audits

After the TAPS was finished, it was noted that "*some escalating costs may have been avoided*" if auditing had occurred "during rather than after *construction*."[98] Pegasus-Global recommends the State undertake an independent audit focused on determining if the actual practices being implemented and followed conform to established policies, procedures and processes established at the program level. Audits should be considered at crucial points during the Project execution. For example,

- An audit of the completed project plan to ensure that the project scope, cost, schedule, and quality requirements were developed following the applicable policies, procedures and processes and met the objectives of the overall program.
- An audit of the project procurement plan and actions to ensure that they meet the conditions set within the policies, procedures, and processes set by program management; meet the objectives set for the project; and meet the overall program objectives.
- Periodic audits conducted over the life of the Project, at a minimum annually, to ensure the overall program is being executed in accordance with the policies, procedures, processes and objectives.

C. Contract Risk Reviews

Once a contract is executed, the risks are "locked in" with few opportunities to revise without impact to cost and schedule. While financiers may promise to absorb cost overruns, current LNG financing has yet to determine whether the offshore financiers will have the wherewithal or the capability to continue funding the Project at the billions of dollars expected let alone potential cost overruns arising from risks arising from the EPC contract. The State should consider conducting an independent contract risk review of the EPC contract prior to its execution reserving the right to require revisions and/or additional risk allocation clauses to minimize costs and lengthy disputes.

D. Specific Detailed Monthly Reporting from AGDC to the LBA Committee on Progress

As discussed in **Section IV.E** current and accurate information is critical for monitoring the performance of a megaproject. In particular, detailed monthly reporting provides the stakeholders with knowledge needed to make informed decisions during the Project's execution. The LBA Committee should provide clear direction on the information and updates that it considers critical to monitor the progress and performance of the Project. The content and nature of this information and update will change as the Project progresses. An Independent Monitor (discussed below) can assist the LBA Committee in defining its information needs, both initially and as the Project progresses.

E. Independent Project Monitor with monthly or quarterly reporting to LBA Committee

Historically performance of a project was not independently assessed until the project was completed. However, at that point, the knowledge from those on the ground may be difficult to capture and it is too late to implement any needed corrective action. Recently oversight committees have utilized an increased reliance on Independent Monitors to monitor the status of ongoing activities within megaprojects. Frequently, such monitoring activities are two-phased:

- An initial phase that involves a due diligence assessment of initial work products, processes, and governance structure (sometimes referred to as a readiness review); and
- An ongoing phase that provides regular updates as to the current status of the project during its execution.

The use of Independent Monitors has been applied to projects such as the Southern Company's $25B Vogtle Units 3 and 4 Project, Mississippi Power Company's $7.5B Kemper IGCC Project, the $6B Pacific Park commercial/residential complex (formerly named "Atlantic Yards"), and Public Service Electric and Gas (PSE&G)'s $1B Energy Strong Program. The benefit of utilizing an Independent Monitor is it provides stakeholders not directly involved in executing the project (owners, regulators, etc.) with a non-biased view of how the project is progressing and allows such stakeholders the opportunity to provide questions on the project's status where additional attention can be provided, essentially flattening the project's organizational layers (as discussed in **Section V.G.**).

F. Summary of Recommendations

To mitigate the risks to the State described herein, Pegasus-Global recommends the following initial steps:

- The FEIS, when published, should be assessed by AGDC for potential impacts on schedule and cost. The AGDC assessment should be reviewed by an outside expert.

- Once the final role for AGDC on the Project has been determined, a readiness review should be conducted by an outside expert to confirm that AGDC has the appropriate project governance, controls and expertise in place. This review should also include a detailed review of the initial project estimate and schedule, including the assumptions relied upon for each, before an FID is made.

- Ownership documents, financing agreements, supply agreements, the EPC contract and offtake agreements should be structured and managed to mitigate the risk to the State keeping in mind the identified risk scenarios. Within these agreements, consideration should be given to additional financial security measures that could be taken in the form of irrevocable lines of credit from financiers and/or performance and payment bonds from those constructing the various segments of the project as discussed in Section X.C. This would include:

    - Outside expert review of the procurement and due diligence processes, and of the terms and conditions of the financing agreements and other contracts.

- Ongoing Independent Monitor review and reporting to the State of management control, contractor performance and counterparty financial metrics.

- Require realistic estimates, schedules and updates consistent with industry standards. Again, the estimates and schedules should be reviewed and validated by an Independent Monitor.

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