Consideration of adequate Contracts and Contract Types for Large Underground PSPs - Experiences of FIDIC Emerald Book for the Paldiski Underground PSP

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Abstract
The increasing development of renewable energies in Europe and worldwide requires the capacity for temporary energy storage and to provide flexible back-up power and stability to energy grids. Pumped-hydro storage plants are the most relevant large-scale storage technology, ready to support power systems’ stability, already available today. Commercially viable sites for conventional pumped-hydro storage plants are however very limited due to various aspects including insufficient head difference or the project’s environmental impact and footprint. The Zero Terrain pumped-hydro storage concept can be used in regions which traditionally lack environmental prerequisites for hydro power projects, by placement of the lower reservoirs of pumped-hydro storage plants underground and using existing surface water bodies as upper reservoir. The Paldiski pumped-hydro storage plant in Estonia is the first project which follows the Zero Terrain concept, for which the procurement process for the implementation works start in 2023. The project with a total installed generation capacity of 520 MW will utilize the Baltic sea as upper reservoir and ten underground water storage caverns, with a total storage volume of approx. 5 million m³, as lower reservoir. The paper summarizes different procurement strategies and contract types, which were considered and discussed for large underground pumped-hydro storage plants in general and for the Paldiski pumped-hydro storage plant in particular. Key pros and cons of the different types under consideration of the substantial underground works with limited available geotechnical information, risk allocation, lender’s interests, procurement time, etc. are discussed in the paper. Furthermore, particular experience gained during developing the Paldiski pumped-hydro storage plant tender documents with the finally selected contract type FIDIC Conditions of Contract for Underground Works, 2019 (“FIDIC Emerald Book”), as one of the first projects on the market using this contract type, will be presented, including concepts to set up technical and commercial documents and form sheets for different type of underground structures in accordance with the requirements of the FIDIC Emerald Book.

1. Need for Long-Term Energy Storage
Pumped hydropower storage projects play a vital role in the clean energy transition nowadays worldwide. This form of energy storage has provided flexible power services to grids since the beginning of the 20th century and is a proven technology since then. At present, the pumped storage projects are accounting for over 94 per cent of installed global energy storage capacity, and over 99 per cent in terms of energy stored (IHA). Pumped storage projects (PSP’s) have been used for load-shifting and balancing of inflexible sources of power generation. The Intergovernmental Panel on Climate Change stated that reducing emissions to meet a 1.5°C limit will require a rapid transition of energy production and reduction of CO2 emissions by increasing the amount of variable renewable energy production by wind and solar technologies. Pumped storage projects have the capability to adapt to the changing power system requirements incurred by variable renewable energy sources by being flexible in pumping and generation modes at all times. Thereby, they are enabling higher penetrations of variable renewable sources at lower system costs. Furthermore, pumped storage projects are able to balance variable nature of wind and solar by providing reliable energy on demand for sustained periods, while also avoiding the need for their curtailment during periods of excess supply, which further supports their increased deployment. Renewable energy resources are expected to continue to displace dispatchable fossil generation, and therefore power system flexibility becomes more increasingly important to ensure the reliability of electrical grids. For this purpose, the storage capacity of recent pumped storage plants has increased substantially from 4 - 6 hours to capacities between 12 - 30 hours to be able to store the energy production of specific technologies in the markets.
Currently, the global installed capacity of pumped storage projects is approximately 160,000 MW, with a total energy stored of about 9,000 GWh worldwide (IHA). IHA is expecting a growth in many parts of the world with up to additional 78,000 MW of capacity to be commissioned in the next decades.

For pumped hydropower systems as for other hydropower projects, the head between the upper and the lower water level is the decisive parameter for the project definition together with the stored amount of energy and the installed capacity. In general, the higher the head between the water levels, the more attractive the project is from financial point of view. Consequently, pumped storage projects are developed in mountainous regions, which provide the natural head for development. In countries without suitable terrestrial conditions and natural heads available, the development of pumped storage projects may become a challenge. This is the reason for the idea of a Zero-Terrain pumped storage scheme which was developed in and for Estonia. The concept and the prototype project Paldiski is described and used as a reference in the following chapters.

2. Zero-Terrain Concept and Paldiski PSP Prototype Project

The Paldiski PSP project is the first prototype project of the Zero-Terrain concept develop by Energiasalv Pakri LLC, based in Tallinn, Estonia. The project was conceived in 2008 and developed further to its present scheme, a 520 MW underground pumped storage plant, located in Paldiski Bay in Estonia, successfully permitted since end of 2022. During times in which a surplus of renewable energy is produced, Paldiski PSP stores energy in the Baltic sea by pumping water from large underground storage caverns to Paldiski Bay. During times in which there is lack of renewable energy in the grid, Paldiski PSP can produce up to 520 MW of clean hydropower energy by releasing water from Paldiski Bay back to the underground storage caverns for 12 continuous hours. This is equivalent to a production of 6 million kWh of clean electrical energy. The big advantage of the Zero-Terrain concept and Paldiski PSP is the possibility of storage capacity extension on a long term basis at very low additional cost and therefore adaptation to actual future market needs. In another word, first investment is considered as the project lifetime investment.

The energy store follows the Green Tiger Energy Roadmap and fulfils the three goals of the energy trilemma:

- energy security,
- affordable price, and
- providing no environmental harm, providing renewable energy.

The Paldiski PSP greenfield project is currently developed by a consortium of investors consisting of Sunly, Alexela, Vool, Warmeston, Combiwood and Kiikri Kodu and has received conditional terms and conditions from debt financiers and a Letter of Support from the Ministry of Economic Affairs and Infrastructure of Estonia. The developers are in detailed discussions with the National Government, gneiss off-taker partners and other counterparties about revenue guarantees with highly promising progress.

The overall concept of the scheme, as shown in Figure 1, consists of an intake at the Baltic sea, connected with ten underground storage caverns with a total volume of 5 million m³ via a combination of vertical pressure shafts and an inclined headrace tunnel. Three vertically arranged reversible pump-turbines with an installed unit capacity of 173 MW, at a rated net head of 615 m and approximately 32 m³/s design discharge each, will be
installed in the underground powerhouse cavern, located at an approximate elevation of -700 meters. A vertical shaft and a separate inclined access tunnel enable access to all underground structures. The main underground structures of Paldiski PSP are illustrated in Figure 2.

![Fig. 2. Paldiski PSP underground pumped storage plant main underground structures including powerhouse cavern, transformer cavern and underground storage caverns (acting as lower reservoir)](image)

During the Pre-FEED and FEED Study phase, financed by the European Union, several configurations of the project have been investigated. As part of the studies, geotechnical investigations have been carried out. With the available budget, in total three coring boreholes were done to determine the geotechnical parameters in the granite at a depth of down to approximately 750 meters. Even if in total almost 2,000 m of core drilling logs have been sampled and analyzed for the purpose of establishment of the geological baseline report, the available information about the underground conditions is limited since the extend of underground structures is extraordinarily large and spread over a large area inland from the Baltic sea coast, with a distance of approximately 8 km and width of 1 km.

3. Evaluation of Procurement Strategies and Contract Type

3.1 Procurement Strategy

After successful completion of the Pre-FEED- and FEED phase of the Paldiski PSP project, before starting preparation of the tender documents, various procurement strategies were discussed, inter alia, the traditional tendering, the staged approach with Early Contractor Consultation (ECC) and Early Contractor Involvement (ECI) as well as the approach of an alliance contract between the contractor and the employer. These procurement strategies were analyzed and evaluated under consideration of the technical, financing and permitting opportunities and challenges for large underground PSP projects and in particular for the Paldiski PSP project.

The Paldiski PSP project is characterized by a significant percentage of costs from underground works. Out of the total estimated project cost, about 60-70% are costs for underground works, namely for the construction of vertical shafts, tunnelling system for access and waterways, powerhouse and the transformer caverns as well as storage caverns acting as lower reservoirs. Therefore, the final project cost is highly dependent on actual geotechnical parameters in the project area, which at the stage of tender preparation is defined by a limited number of borehole drillings and related in-situ and laboratory tests. Besides the actual geotechnical parameters, the project cost is also influenced by the procurement strategy and contractual set-up and risk allocation related to the underground conditions. Despite the fact, that the granite at the depth below -200 meters is expected to be of excellent quality, the number of drillings carried out in comparison to the extent of the entire structures and elements of the plant located in the underground is limited. Due to the remaining unknowns, the related risk for the project implementation cannot be defined precisely and therefore the geotechnical risks need appropriate consideration for engineering and implementation, but also already during the procurement stage by application of the appropriate procurement strategy, since on one hand the final project cost can be optimized by optimal risk sharing between the involved stakeholders. On the other hand, the interest and conditions of financing institutions, potential lenders or private investors need to be considered when selecting the procurement strategy.

The traditional tendering approach, with a request for tenders including a tender design and detailed design developed by an engineer, can be considered as the fastest tendering strategy, with a clear definition of responsibilities of stakeholders involved. The tender documents will define a reference design based on the available information (including geotechnical underground parameters), based on which tenderers are requested to provide their offers. This approach is especially attractive in case the base for the reference design and consequently for the related offers is mature and no significant changes are to be expected during
implementation, so that the scope of works to be offered by the tenderers is comparable and the risk allocation can be well defined and considered identically by all tenderers while tendering. This procurement strategy provides most comfort to lenders and investors as well as to the employer e.g. with regards to project permitting, since the final product/project, which is to be procured, is already well defined before the procurement is initiated. However, this strategy bears the risk of cost and time overruns during project implementation, in case fundamental definitions and assumptions made during the procurement stage are not mature and are subject to changes. Projects tendered on a non-mature basis with a traditional tendering approach can lead to speculation of tenderers resulting in incomparable offers, including significant risk provisions by tenderers for additional cost and time extensions. Furthermore, in general such a tendering approach limits the motivation of tenderers to provide alternative technical solutions, because of the additional efforts with mostly unclear prospect of success. In case of Paldiski PSP project, a traditional tendering approach can only lead to satisfactory results in case the risks, because of the limited information about the underground condition, are well addressed and appropriately allocated in the tender documents and conditions of contract.

In recent years, the strategy of involving contractors at an early stage of projects has become more and more popular. Through contractors’ involvement during early stages, when project details or even concepts are yet to be defined, the contractor’s special capabilities, experiences and know-how is utilized to develop the project to an executable level. The involvement of contractors can provide significant value through the value engineering process applied during ECC and ECI phases, especially in case of unique technical project challenges. The pre-requisite for application of an ECC / ECI strategy is as a minimum a general reference design (Pre-FEED), developed by an engineering consultant, which is shared with different contractors under competitive condition in order to select a partner for the ECC / ECI phase, which is capable and experienced enough to add value to the project and to develop the most cost-efficient technical solutions. This procurement strategy provides benefits to the employer since time, cost and technical details are verified and developed under consideration of direct experience and capabilities of a contractor and a more realistic project price level is determined before reaching financial close. Furthermore, at the time of conclusion of an ECI phase, the design level reaches a detailed design level of 80%. On the contrary, the final project definition and related time and cost for the project are only available at a very advanced stage of the ECI procedure, and therefore permitting as well as financing is often challenging. With regards to underground risks, this procurement strategy provides the advantage that together with the ECI contractor, particular measures and investigations can be defined to reduce the risks under consideration of the particular technical solutions and designs, before final concepts are developed, and design and implementation starts.

Furthermore, in recent years alliance contracts, also known as Integrated Project Delivery (IPD) contracts, have been applied in the infrastructure industry. These alliance contracts are based on the idea, that alliance partners, including the employer and contractors, work as a team to achieve the common goal of implementing a profitable project. The employer decides at an early stage through workshops and preliminary budget estimations, which contractor(s) might be suitable for the implementation of the project under an alliance partnership. In this way, a close cooperation is established between the employer and contractors as well as risks and possibilities are shared including commercial gains and pains of the project until project completion. This means, while direct project costs are paid by the employer under a full open-book philosophy, profit rates of all alliance partners are adjusted depending on the final project cost compared to the pre-defined project target cost. This strategy is best applied during a very early stage of project development, when principal concepts can still be developed with contribution of the alliance partners. However, even if projects have been developed to a FEED level, forming an alliance for further optimization can be a beneficial approach for both, the employer and other alliance partners. As for ECC / ECI, this procurement strategy provides the possibility to defined particular measures and investigations for reducing the underground risks under consideration of the particular technical solutions and designs.

The principal thoughts expressed above have to be adapted to the actual conditions to the market and particularities of large underground pumped storage projects in any case. Today, there is a high demand for infrastructure projects around the world in general and the energy sector especially. It might happen, that the number of interested parties in a project becomes limited and that a real competitive situation could hardly be achieved. Therefore, latest experience shows, that the involvement of contractors or partners during early stages of projects can enhance the successful achievement of financial close and trustful and cooperative partnership throughout a project cycle from initiating until end of the liability period or even beyond can be developed.

### 3.2 Contract Type

Since the implementation of large pumped storage projects in general involves various stakeholders, with the employer, the contractor(s) and lenders being key players, the way of defining the responsibilities, tasks, risks and cooperation with each other, is of essential importance for a project’s success. While the interest in and the
number of open contracts (e.g. alliance contracts, IPDs) for infrastructure projects is increasing, traditional closed contracts are mostly used in infrastructure projects, including hydropower.

Under consideration of requirements of lenders and private investors as well as to reach successful permitting of the project at an early stage, a closed contract was evaluated being best suited for the Paldiski PSP project. Since FIDIC contracts are well established in the infrastructure market and in hydropower business, it was mutually decided with the employer, to use FIDIC condition of contract for the project. For Paldiski PSP, the following conditions of contract (CoC) were considered and evaluated for their application:

- CoC for EPC/Turnkey Project (FIDIC Silver Book)
- CoC for Plant and Design-Build (FIDIC Yellow Book)
- CoC for Underground Works (FIDIC Emerald Book)

It shall be noted that due to the limited available time until financial close, project interfaces, the employer’s company structure but especially due to the limited information about the particular underground conditions, CoC for Construction (Red Book) were considered inappropriate for the Paldiski project with its significant amount of underground works.

In the following, the main considerations for the three potential contract types for underground PSP projects and the Paldiski PSP project are summarized.

FIDIC Silver Book contracts are often the preferred option for financing institutions, lenders and private investors, since the contract price as well as the time for completion are defined and fixed at the time of contract award and rarely subject to changes due to the unbalanced risk allocation between the employer and contractor. Under FIDIC Silver Book contracts, the contractor is required to take more risks compared to other contract types and consequently, in general, contractors offer higher contract prices in contrary. However, the limited information about the underground condition of Paldiski PSP would require the contractors to accept and price significant risks related to the geophysical parameters and their potential impact on construction of the significant underground structures of the project. Market interest in the implementation of large underground PSP plants on such a basis are continuously decreasing and the number of responses to requests for tender are expected very limited or are mainly characterized by substantial cost overrun due to high risk provisions. The introductory note to the FIDIC Silver Book even clearly states, that Conditions of Contract for EPC/Turnkey Projects are not suitable for use […] if construction will involve substantial work underground or other areas which tenderers cannot inspect, (FIDIC). Consequently, this contract type has very limited applications for large pumped-storage plants with substantial underground works and should only be considered in case the physical underground conditions are well-known and investigated to sufficient extent. Therefore, this contract type was not taken into further account for the Paldiski PSP project.

FIDIC Yellow Book contracts, without mature modifications to the contract’s principles, provide a balanced risk sharing between the contractor and employer and therefore, in general, lead to comparable and reasonable offers and price level. The contractually agreed contract price and time for completion are based on a clearly defined scope of works and shall only be subject to changes in case of variations or unforeseeable physical conditions for the contractor. Consequently, for pumped storage plants without significant subsurface works, these conditions of contract could be well suited. For the Paldiski PSP project, the available information about the underground condition is very limited and consequently, it needs to be expected that the design and therefore the project cost and time for completion would be subject to significant changes during project implementation and that the final project cost and implementation time would only be known at a very late stage of the project. While this is often addressed retaining project contingencies, the magnitude of underground works for the Paldiski PSP project of approximately 60-70 % compared to the overall project works, would require an unreasonably high amount of contingencies. Furthermore, under FIDIC Yellow Book contracts, the adjustment of the contract price and time for implementation due to changes in the underground conditions is normally initiated and solved by claim procedures. While the theoretical procedures are well defined in FIDIC contracts, achieving conclusions and agreement on contractor’s claims are often very time consuming, increase dissatisfaction on employer’s and contractor’s side and often lead to dispute resolutions, adjudication or arbitration, mainly because the basis on which cost, and time increase are evaluated by the employer, contractor and engineer differ significantly.

FIDIC Emerald Book provides additional clauses to the FIDIC Yellow Book addressing this topic for excavation and lining works (underground works). These clauses provide the contractual basis and tools for adjusting the contract price and time for completion on a pre-defined basis and applying a of clear mechanism in case the subsurface condition relevant for the underground works differ from those defined in the contract. Therefore, this type of contract is considered best suited for large underground pumped storage plants, as Paldiski PSP, due to the balanced risk allocation for all known risks and clearly defined mechanism and provision of tools to handle potentially varying underground conditions. Especially, for Paldiski PSP, with its large content of underground works and limited geophysical information, the FIDIC Emerald Book allows the employer and the private sector
to accept the remaining unknowns and risks related to underground works, since the mechanism of calculating the potential impact on the project cost and implementation time are defined. The risk for claims during implementation is considerably reduced compared to FIDIC Yellow Book contracts. The tools included in the FIDIC Emerald Book further allow running and evaluating case studies at time of receiving tenders with a very reliable forecast of scenario costs and completion times and therefore to finally set-up and adjust project contingencies before contract award.

4. Use of the FIDIC Emerald Book

In the following, same fundamental documents and tools of the FIDIC Emerald Book are summarized and their use for the Paldiski PSP project is described in brief.

The Geotechnical Baseline Report (GBR) is the essential document which presents the adopted geotechnical baselines and controls the risk allocation between the parties. Compared to conventional GBRs, the GBR in FIDIC Emerald Book is much more comprehensive and has the highest contractual priority of all technical documents. It shall cover the following items:

- general project information, including construction methodology
- geological and hydrogeological conditions in the project area
- potential risks and mitigation measures for these risks for the excavation and lining works of underground structures
- agreed ground conditions with respect to geotechnical behaviour
- agreed classes for underground excavation and support
- geological/geotechnical layouts, profiles and sections
- typical drawings for excavation and support classes
- criteria for attribution of excavation and support classes

The GBR is defined as the only contractual source related to the risk allocation of the ground conditions. The subsurface physical conditions, which are described in the GBR are accepted as foreseeable. Ground conditions outside the descriptions in the GBR are regarded as unforeseeable. While the risks for the underground condition remain with the employer, the risks related to the construction rates and cost for the defined range of possible ground conditions defined in the GBR, are allocated to the contractor. Time and cost risks related to the unforeseeable conditions outside of the GBR definitions are again allocated to the employer. As the GBR directly defines the baseline to be assumed by the tenderer and contractor, an overconservative GBR may result in higher offers which are subject to price reduction during implementation, whereas a non-conservative or even optimistic GBR is expected to lead to increasing cost during implementation, or even provide claim potential for the contractor in case risks or potential ground conditions are not described in the GBR as foreseeable conditions.

In addition to the GBR, the FIDIC Emerald Book also defines a Geotechnical Data Report (GDR), which contains the basic geological, geotechnical and hydrogeological data, generally obtained from the site investigations performed up to contract award. The GDR thus is very much alike similar reports in other contract types. It is part of the contract documents but shall not be used for the allocation risk regarding ground conditions for excavation and lining.

The design concept adopted and the information in the GBR represents the employer’s preferred risk allocation. The interpretations in the GBR may also be based on other sources of information such as previous construction experience. In this regard, the GBR presents information beyond the existing data and may deviate from the factual data given in the GDR or other information sources. However, the GBR is the governing document for the tenderer and the contractor is deemed to make his proposals based on the information contained in the GBR, even if that information does not correspond by other available data.

The GBR according to FIDIC Emerald Book requires a more precise description of the geotechnical parameters, ground behavior and risks during construction which are specified as being “Agreed” between all parties as baseline for the project implementation. Consequently, statements related to the ground behavior shall be described in quantitative terms (e.g. deformation rate, inflow rate) to the extent practicable to improve time and cost certainty during construction.

Basically, the GBR is expected to be developed by the Employer. However, according to the adopted procurement strategy, it may be requested that tenderers develop their own GBR as part of their tender, e.g. as part of an alternative proposal. In any case, to the extent permitted by applicable law, the initial GBR prepared
by the Employer may be revised during the negotiations between the parties at the tender stage. If there is such a negotiation, a final GBR for the contract is agreed by all parties.

FIDIC Emerald Book involves the procedures to adjust the time for completion and contract price based on the actual ground conditions encountered during underground excavations, to the extent that these conditions are within the range defined in the GBR. The time for completion is adjusted on the base of the Schedule of Baselines and the contract price is adjusted by measurements of the excavation and lining works and in the Bill of Quantities.

The Schedule of Baselines, prepared by the Employer, “sets out the anticipated activities or items of work for the Excavation and Lining Works and their corresponding quantities consistent with the conditions described in the GBR, corresponding to each drive and/or other area of work within the Sections and/or Milestones in the Completion Schedule” (FIDIC Emerald Book, Sub-Clause 8.2.2). Each activity or item of work is completed by the contractor with its tendered production rates (e.g., 8 meters/day for the excavation of the headrace tunnel in rock support class 1). The Schedule of Baselines is therefore a “bill of quantities” for the time entitle ment for excavation and lining of the contractor for each drive or other area of work (e.g. headrace tunnel excavation works, surge shaft lining works, etc.), according to the conditions as described in the GBR. During the execution of the works, the realized quantities of all such items are measured and multiplied by the contractually agreed time. The finally adjusted time for completion for the respective structure is calculated by a simple computation, applying the contractual progress rates to the effectively performed quantity of each item in the Schedule of Baselines. This approach and tool reduce the need for claims substantially since the methodology for time adjustment is pre-defined at the time of tender and agreed at the award of the contract. Only in case of subsurface ground conditions that are not described in the GBR (so-called “Unforeseeable Physical Conditions), the Contractor will need to claim if it wants to request an extension of time for completion.

Concepts formalized in the FIDIC Emerald Book by the new definition of the GBR and introduction of the Schedule of Baselines brings significant advantages especially in cases of long tunnels and shafts with variable rock/soil conditions or in case of limited information about the actual underground conditions.

The main access and ventilation shaft in Paldiski Project is briefly presented as a sample in this paper. As per the factual report based on the drilling campaign and other field and laboratory tests, the geological layers consist of the upper protorozoic and paleozoic sedimentary bedrock and the lower folded paleoproterzoic metamorphic and igneous crystalline basement. The shaft alignment passes through the upper sedimentary formations up to about a depth of about 180 m. In the light of the existing investigation data, three different rock mass classes for sedimentary layers as Class IV (GSI>60), Class V (40<GSI<60) and Class VI (15<GSI<40) have been defined. The support systems have been determined, based on the empirical approaches, past experience from similar projects and preliminary finite element analyses, which are shown in Figure 3.

![Fig. 3. Excavation/Support Classes for the Access/Ventilation Shaft in Sedimentary Layers](image)

Under the sedimentary formation, the shaft will be excavated within the strong crystalline rock. The rock mass conditions are highly favorable for underground excavations and no systematic support has been considered necessary in crystalline rock, which has been classified as Class I. It has been considered that only in locally very limited areas, spot bolting or local shotcrete-wire mesh may be needed during construction. The Schedule of Baseline according to FIDIC Emerald Book has been prepared based on this evaluation of rock/support classes, as partially shown in Figure 4.
Fig. 4. A part of the Schedule of Baselines for the access/ventilation shaft.
The figures are not real project values but indicative for the paper. Note: The description of the different items (“Work Categories”) and the estimated quantities are prepared by the employer, and the production rates are offered by the contractor.

5. Conclusion
Adequate risk allocation in hydropower projects in general, and in particular in case of large pumped storage plants, is challenging. Different procurement strategies and contract types need to be evaluated under consideration of the technical, financing and permitting aspects for each project individually. However, especially for projects with a substantial amount of underground works, reasonable risk sharing with regards to subsurface conditions is key for a project success. This gets even more relevant in case the information about the actual geophysical underground conditions is limited and therefore, changes to the assumed condition are to be expected during implementation. FIDIC Emerald Book for underground works provides the contractual basis and tools for adjustment of the contract price and time for completion on a pre-defined basis and application of clear mechanism in case the subsurface condition relevant for the underground works differ from those assumed as a baseline in the contract. Therefore, this type of contract is considered best suited for large underground pumped storage plants, since this concept allows employers and the private sector as well as financing institutions to accept the limited remaining unknowns and underground risks. The tools included in the FIDIC Emerald Book further allow running and evaluating case studies latest at time of receiving tenders with a very reliable forecast of scenario costs and completion times and therefore to finally set-up and adjust project contingencies before contract award.

Therefore, FIDIC Emerald Book is considered as one of the most promising contract types for the 520 MW Zero-Terrain underground pumped storage plant Paldiski PSP in Estonia, considered at this stage, while other procurement strategies are still under evaluation and the final decision about how this prototype project will be tendered will be made in the 4th Quarter of 2023.

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The Authors CVs

Mr. Robin Enderle graduated in 2012 as MSc. from the Faculty of Mechanical Engineering of the University of Stuttgart, Germany. In 2012 he joined the consulting firm Fichtner, Germany, where he is active as Senior Project Manager and Senior Expert for Electro-Mechanical Systems and Equipment and is acting in both functions for the Paldiski PSP project. In his current position Mr. Enderle is responsible for project management, studies, technical assessments, due diligences, transient simulations and tender strategies, documents and procedures for hydropower projects in Europe, Africa and Asia.

Dr. Ersan Yildiz took his PhD degree in 2007 from the Civil Engineering Department of Middle East Technical University, Turkey. Until 2019 he worked as a geotechnical and dam engineer at Temelsu International Eng. Serv. Inc. in many local and international hydropower projects. His main specialties include embankment and RCC dams, tunnels, slopes, geotechnical earthquake engineering and numerical modelling. Between 2019-2022 he worked in Tractebel, Germany as a senior geotechnical/tunnel engineer in major hydropower projects in different countries including Germany, Nepal, Pakistan and Philippines. Since 2022, he is continuing his career in Fichtner, Germany as a Senior Engineering Consultant in hydropower department for worldwide projects.

Dr. Sebastian Palt has more than 25 years of experience and is the Projects Director of Fichtner’s hydropower department. He is a senior expert at Fichtner for project management of complex multipurpose projects and has vast experience in planning, design, implementation and management of hydropower projects worldwide, both in the private and public sectors. He has worked on planning hydropower plants of different sizes from small to large schemes as well as managing project execution with international development banks in Europe, Africa, Asia, and Central and South America.

Matthias Neuenschwander is the current animateur of ITA Working Group 3 – Contractual practices. He holds a MSc in civil engineering from ETH Zurich, Switzerland, and is the Managing Director of Neuenschwander Consulting Engineers Ltd. Matthias has 35 years of experience in hydropower and underground works as a contractor, designer, supervisor, advisor, expert witness, mediator, adjudicator and arbitrator. He chaired the joint FIDIC-ITA task group 10 entrusted with the publication of the Emerald Book until its presentation in 2019.

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