

“Conditions of Contract for Underground Works - The Emerald Book Sees the Light of Day”

by **Hon. Peter Vickery QC FCIArb FACICA**¹

Prof. Arnold Dix,² Vice President of the International Tunnelling Association (ITA), Executive Council Member ITA, Emerald Book Special Advisor and Principal of ALERP Consulting Group Australia, is thanked for his review and comments.

ABSTRACT

The construction of tunnels and underground works carries with it unique and challenging risks. At the same time, projects which involve working underground are growing, particularly in areas involved with urban infrastructure, transportation and hydro energy.

The joint enterprise task force of specialist representatives drawn from FIDIC and ITA – AITES has recently produced the ‘Emerald Book’ - a new standard form contract purpose-designed to accommodate the range of issues typically faced in underground construction which call to be addressed to ensure an equitable allocation of risk and efficient management.

Tunnelling and other Underground Works carry with it a series of distinct risks which are specific to this mode of construction. The commercial risks associated with Underground Works are principally sourced from the ‘known unknown’ of significant geotechnical uncertainty’. Projects conducted in this sphere will generally involve uncertain subsurface conditions which will not be fully ascertainable during the tender bidding process.

The Emerald Book conditions include several new concepts designed to accommodate risks that are unique to Underground Works. These include the central role of a Geotechnical Baseline Report (GBR); adjustment of Time for Completion, Adjustment of the Contractor’s Remuneration; and guidance as to the Preparation of Tender Documents and the Selection of Contractors. The Emerald Book promises to have numbers of advantages to significantly enhance the prospects of successful outcomes in Underground Works projects.

¹ Hon. Peter Vickery QC LLB (Melb.) LLM (Kings College, Lond.) FCIArb FACICA is a Queens Counsel (QC) and former a Judge of the Supreme Court of Victoria (2008 - 2018). He retired from the Supreme Court on 8 May 2018 after serving as Judge-in-Charge of the Technology, Engineering and Construction List (the TEC List). He now works as an Arbitrator; Referee; DRB Panellist; Mediator; ENE Evaluator and conducts Expert Determinations. He is the Patron of the Society of Construction Law, Australia (SOCLA). He Lectures at the University of Technology Sydney (UTS) and has been appointed to lecture in the Construction Law Masters Program, Melbourne University. <https://www.petervickeryqc.com/>

² Professor Dix hold degrees in law and science. He is Adj Assoc Professor of Tunnel Engineering, Tokyo City University. Arnold Dix is Vice President of the of the International Tunnelling Association (ITA), Initiating Chairman, Reviewer and iTutor of the ITA-FIDIC Conditions of Contract for Underground Works and ITA Contractual Practices Checklist projects. He sits on the Committee, USA NFPA 130 & 502 Fire and Life safety Road and Rail Tunnels standards. He is a Scientist (Geology) and a Barrister, Victorian Bar. <http://www.arnolddix.com/>

Introduction

The construction of tunnels and underground works carries with it unique and challenging risks. At the same time, projects which involve working underground are growing, particularly in areas involved with urban infrastructure, transportation and hydro energy.

As Dr. Wout Broere³ said in the abstract to his article "Underground Space: Solving the Problems of Today's Cities":⁴

"The world-wide trend of increased urbanisation creates problems for expanding and newly-developing cities alike. Population increase leads to an increased demand for reliable infrastructure, nowadays combined with a need for increased energy efficiency and a higher environmental awareness of the public. The use of underground space can help cities meet these increased demands while remaining compact, or find the space needed to include new functions in an existing city landscape. In many cases, underground solutions to urban problems are only considered if all other (above ground) options have been exhausted. When underground solutions are considered and evaluated from the planning or initial project stages onwards, more optimal solutions will become possible."

However, a dominant risk factor unique to these works is the 'known unknown'⁵ of the actual subsurface conditions, particularly at the time of planning and tendering, including uncertain and unascertainable ground and groundwater conditions, often at considerable depths. The Snowy 2.0 hydro-electricity project in the Snowy Mountains of Australia for example will involve underground excavation and tunnelling works between dams at Tantangara and Talbingo to depths of up to one kilometre.⁶

Sir Harold Harding has said of tunnel investigations:⁷

"The only bore hole that can be relied upon to describe the ground conditions precisely would be one the length of the tunnel and several feet larger in diameter."

³ Dr Wout Broere is the assistant professor of Underground Space Technology at Delft University of Technology (TU Delft), The Netherlands.

⁴ Tunnelling and Underground Space Technology, Volume 55, May 2016, pp. 245-248.

⁵ Derived from an oft-quoted observation of Donald Rumsfeld (21st United States Secretary of Defense).

⁶ See www.snowyhydro.com.au (last observed 7 July 2019).

⁷ Sir Harold Harding DSc, BSc (Eng), FEng, Presidential Address, Proceedings of the Institution of Civil Engineers, November 1963.

On 7 May 2019 FIDIC⁸ and ITA – AITES⁹ broke new ground in dealing with this long-standing dilemma. The Conditions of Contract for Underground Works was launched at the World Tunnel Congress 2019 in Naples, Italy. This followed years of study undertaken by a joint enterprise task force of specialist representatives drawn from FIDIC and ITA – AITES. The result has been the ‘Emerald Book’ - a new standard form contract purpose-designed to accommodate the range of issues typically faced in underground construction which call to be addressed to ensure an equitable allocation of risk and efficient management. Use of this form of contract may also be appropriate in other types of works that include elements of significant geotechnical uncertainty.

The Emerald Book has been the result of extensive work over an extended period. It has been in part based upon investigation of international best practice in contracting for underground construction works and tunnelling carried out by ITA-AITES over the last fifteen years. This work in turn was further informed by “The ITA Contractual Framework Checklist for Subsurface Construction Contracts” of April 2011.¹⁰ It was the first truly international effort to address the need for a specialised Underground Works contract. ITA and FIDIC special advisors who contributed to the various drafting and revision stages of the project and those who contributed input were drawn from across the globe.¹¹

The Emerald Book has also been built upon the 2017 edition of FIDIC’s ‘Yellow Book’, which governs contracts for Plant and Design build.¹² This has been modified by the Emerald Book to accommodate the hazards and difficulties typically encountered by underground works. The first edition of the Yellow Book was published by FIDIC in 1999 and has been in widespread use for now two decades. It has long been recognized for its principles of balanced risk sharing between the Employer and the Contractor in projects where the Contractor designs and constructs the works, and may provide plant, in accordance with the Employer’s requirements, including combinations of civil, mechanical, electrical and/or construction works.

Commenting on the launch of the Emerald Book, President of the International Tunnelling and Underground Space Association, Professor Tarcisio Celestino said: “The Emerald Book will bridge an important gap. Despite all of the technological

⁸ FIDIC, the International Federation of Consulting Engineers, (the Fédération Internationale des Ingénieurs-Conseils) is the global representative body for national associations of consulting engineers.

⁹ Founded in 1974, the International Tunnelling and Underground Space Association (ITA) aims to encourage the use of the subsurface for the benefit of public, environment and sustainable development and to promote advances in planning, design, construction, maintenance and safety of tunnels and underground space. ITA is supported by 78 Member Nations and 266 Corporate or individual Affiliate Members.

¹⁰ “The ITA Contractual Framework Checklist for Subsurface Construction Contracts”, April 2011, ISBN 978-2-9700634-7-9.

¹¹ Brazil, People’s Republic of China, Australia, USA, France, Italy, United Kingdom, Columbia, Chile, Portugal, Norway, Japan, Germany, Jordan, Switzerland, India, South Africa and Ethiopia.

¹² The Yellow Book in turn was published by FIDIC as an update of the FIDIC 1999 Conditions of Contract for Plant and Design-Build (Yellow Book), First Edition.

developments of equipment and techniques in the field, many underground construction projects end up unsuccessful because of contractual disputes. The book brings together the result of the expertise and respectability of ITA-AITES and FIDIC in the fields of contracts and specificities for underground constructions.”

This article approaches the Emerald Book from an Australian perspective. However, the principles discussed are of general application. It adopts, wherever possible, the definitions contained in the Emerald Book (Sub-Clause 1.1).

Underground Works Risks

In the contemporary context, tunnelling and other Underground Works carry with it a series of distinct risks which are specific to this mode of construction.

Five features are identified in the opening Notes to the Emerald book which are features of Underground Works compared to other works.¹³ Three of those are said to predominantly characterise Underground Works:

- The method of excavation and ground support are major factors for the successful realization of the project, and therefore part of the Works;
- Physical access to the Works is often limited to just a few locations or even a single location, which places serious constraints on construction logistics and the environment; and
- The land beneath which the Works are to be constructed, typically belongs to a number of parties.

To these, are added two other important features that, while not unique to Underground Works, are characteristic of all such works:

- They require extensive investment in contractor’s equipment; and
- Underground excavation and lining works are very time-consuming.

Developing the nature of these risks a little further, Underground Works risks may be divided into two principal categories – the physical and the commercial.

Physical Risks

During the course of the first Snowy Hydro Scheme project in Australia (1949-1974) officially 121 workers lost their lives in industrial accidents, with most fatalities caused by operating plant in confined spaces.¹⁴

The *Guide for Tunnelling Work*, Safe Work Australia (the WSA Guide),¹⁵ describes and underscores a range of physical health and safety risks associated with tunnelling

¹³ Opening Notes - Emerald Book.

¹⁴ Siobhan McHugh, *Life and death on the Snowy*, Irish Times, 16 October 1999.

¹⁵ *Guide for Tunnelling Work*, Safe Work Australia, November 2013. Safe Work Australia (SWA), is an Australian Government statutory agency established in 2009.
<https://www.safeworkaustralia.gov.au/tunnelling> (last observed 3 July 2019).

work. For this purpose, in the WSA Guide, tunnelling work is said to include constructing a tunnel and supporting systems and associated temporary work. A supporting system means a system necessary to construct the tunnel, for example a ventilation system.

Construction work carried out in or near a tunnel or associated excavation is defined as high risk construction work under the WHS Regulations administered by Comcare.¹⁶ Risk management planning at the start of a tunnelling project is critical to preventing deaths caused by tunnelling work.¹⁷

The complexity of tunnelling work means there are often numbers of parties and many persons involved. All those participating in tunnelling work are exposed to health and safety duties and risks when carrying out the work and often, more than one party and person has the same duty. ¹⁸ Table 1 of the WSA Guide, ¹⁹ sets out a summary description of the health and safety duties of the major project participants in relation to tunnelling work prescribed by the WHS Act and Regulations.

Section 3 of the WSA Guide describes the common physical hazards and risks associated with tunnelling work. They are said to include:

- confined spaces with build-up of gas and fumes;
- rock falls (including those caused by the dynamic behaviour of rocks as they are disturbed and adverse reaction to the excavation and ground support processes);
- failure of floor or roadway;
- scaling;
- high water and mud inflow;
- gas inrush;
- falls from height;
- loss of electricity and lighting;
- moving plant in confined spaces;
- manual activities and tasks;
- loss of concentration through heat stress, noise, ingress of hazardous chemicals and dust; and
- fire and explosion from flammable gases and vapours

¹⁶ Comcare is the safety, rehabilitation and compensation commission of the Commonwealth government. It administers the *Work Health and Safety Act 2011* (WHS Act) and *Work Health and Safety Regulations 2011* (WHS Regulations) in the Commonwealth jurisdiction. The WHS Act and WHS Regulations implement model work health and safety laws that have also been adopted in most of the Australian states and territories.

¹⁷ *Ibid.*

¹⁸ *Ibid* at 1.2.

¹⁹ *Ibid* at pp 4-5.

Other sections of the WSA Guide go on to underline the physical risks associated with tunnelling work.²⁰

These considerations dictate that safe systems of work and effective control measures are essential to be put in place for tunnelling projects.²¹

Commercial Risks

The commercial risks associated with Underground Works are principally sourced from significant geotechnical uncertainty. Projects conducted in this sphere will generally involve uncertain subsurface conditions which will not be fully ascertainable with sufficient precision during the bidding process.

Risks arising out of foreseen properties of the ground and obstacles in the course of construction may also be expected to occur.

The impact of this level of uncertainty will be reflected in the cost of the Excavation and Lining Works, which largely depend on the subsurface physical conditions and/or ground reaction(s) to such works. Further, the Time for Completion of the Works, of a Section or any Milestone may largely depend on the subsurface physical conditions that are encountered during excavation. This in turn gives rise to the likelihood of adjustment of Time for Completion due to the difference between the contractually agreed and the encountered subsurface physical conditions.

The typically long duration of Underground Works will also give rise to commercial risk. This will impact on the high cost of investment in specialised equipment and associated costs of depreciation, interest, leasing and maintenance. It will also bear upon the stable retention of personnel and contractors who have gained valuable project experience. The need to secure and maintain contractors with staff of sufficient specialised calibre and experience in constructing underground works is a critical factor in project success.

A range of environmental factors will also present themselves as commercial risks. These issues may typically include: construction logistics and physical access constraints; dealing with very large volumes of extracted spoil in often sensitive environments; and third-party interests in the surrounding land and land beneath the constructed works.

Underground Works and Construction Risk

Construction is inherently a risky business.²² In his 1994 review into the construction industry's procurement and contractual arrangement practices in the United

²⁰ WSA Guide - Controlling the Risks, Section 4 pp. 29-48; Air Quality and Ventilation, Section 5 pp. 49-55; Plant Use Management Section 6 pp. 56- 60; 7. Elimination of Fire and Explosion pp. 61-63 and Other Risks pp. 63-70.

²¹ *Ibid* Controlling Risks in Tunnelling Work, Section 4 pp. 6-21.

²² See Andrew Burr, *Delay and Disruption in Construction Contracts* (Routledge, 5th ed, 2016) 13 [2-001].

Kingdom, Sir Michael Latham remarked that '[n]o construction project is free of risk. Risk can be managed, minimised, shared, transferred or accepted. It cannot be ignored'.²³

A similar view was expressed by the Supreme Court of Victoria in *APN DF2 Project 2 v Grocon Constructors (Victoria) & Ors (No 2)*²⁴ where the managing Judge²⁵ observed:

"It is widely accepted that each construction project is a unique endeavour. As such, each is a risky venture, and therefore is vulnerable to disputation. This is so because every construction project, whether large or small, is something of an experiment.

As has been said:²⁶... [t]he construction of every capital asset involves unique design, procurement and construction challenges. Different locations and site conditions, construction methods, equipment and materials, and the assembly and management of a team of people to design, procure and construct each asset invariably mean the construction process is essentially one of creating a prototype."

If the level of risk is such in the usual above ground construction project, how much greater is the level of risk in one involving Underground Works.

Allocation of Principal Risks under the Emerald Book

General Approach to the Risks of Unexpected Subsurface Conditions

The considerations earlier discussed give rise to very significant challenges for those responsible for the allocation of risk in contracts for Underground Works.

As earlier observed, a significant, if not the dominant challenge with Underground Works is that, particularly at the early stage of the project at the time of the tender process, they will often involve uncertain or unexpected subsurface conditions. These conditions in many cases will not be fully ascertainable, or at best will be unsatisfactorily imprecise, at this point. As a general principle, it is desirable that the risk arising from uncertain subsurface physical conditions, in a balanced regime should not be assigned entirely to the Contractor. A major task of the joint FIDIC-ITA task force in producing the Emerald book has therefore been to provide a balanced risk allocation to accommodate the risk factors.

In rising to meet the challenge, the Emerald Book conditions include several new concepts to accommodate risks that are unique to Underground Works. Further, the goal to achieve a clear allocation of the risk is a significant attribute of the Emerald

²³ Sir Michael Latham, *Constructing the Team: Final Report of the Government/Industry Review of Procurement and Contractual Arrangements in the Construction Industry* (Her Majesty's Stationary Office, 1994) 14.

²⁴ [2014] VSC 597 [89]. This passage was cited in *WTE Co-generation v RCR (No 3)* [2016] VSC 674 at [56].

²⁵ The author Vickery j (as he then was).

²⁶ See: Cooperative Research Centre for Construction Innovation, *Guide to Leading Practice for Dispute Avoidance and Resolution: An overview* (2009) cited in Gerber and Ong *Best Practice in Construction Disputes Avoidance, Management and Resolution*, (LexisNexis Butterworths 2013) 7.

Book conditions of contract. This feature will also no doubt contribute to dispute avoidance.

In general terms this is achieved in the Emerald Book of conditions through a mechanism which incorporates the concepts of unforeseen and foreseeable site conditions. The Employer adopts the risk of unexpected subsurface conditions, thereby taking the burden of worse than predicted conditions but enjoying the benefit if conditions are better than anticipated. Whereas the Contractor bears the performance risk and therefore benefits from faster rates of production, and conversely suffers the detriment of slower rates of production.

Use of a Geotechnical Baseline Report (GBR) in Risk Allocation

The key mechanism used in the Emerald Book to resolve the allocation of risk is the novel use of a document called the Geotechnical Baseline Report (GBR). This document prepared by the Employer as part of the tender documents. It is the contractual source of risk allocation between the parties related to subsurface physical conditions (Sub-Clauses 1.1.51 and 4.10.2) and is central to the allocation of risk in the Emerald Book.

In sum, all subsurface physical conditions not addressed in the GBR will be considered 'Unforeseeable', with the consequence that the risk is allocated to the Employer. On the other hand, risks set out in the GBR defined as 'Foreseeable' are assigned to the Contractor. 'Unforeseeable' in turn is defined as "not reasonably foreseeable by an experienced contractor by the Base Date (28 days before close of tender). Notwithstanding the foregoing, all subsurface physical conditions described in the GBR are deemed to be foreseeable, and all subsurface physical conditions outside the scope of conditions described in the GBR are deemed to be Unforeseeable" (Sub-Clause 1.1.101).

The Emerald Book also provides invaluable guidance on drafting contractual documents, including GBRs.

The Opening Notes of the Emerald Book explain the GBR mechanism in the following terms:

"The Geotechnical Baseline Report or GBR is defined as the single contractual source of risk allocation related to subsurface physical conditions to the Parties. Equally important to the physical conditions of the ground, the GBR addresses the reaction of the ground to excavation and support under the contractually agreed construction methodology. All subsurface physical conditions not addressed in the GBR shall be considered Unforeseeable. The risks arising out of the foreseen properties of the ground, obstacles and adverse reaction to the excavation and ground support processes are assigned to the Contractor, as well as the production rates and cost of performing the Works under the same conditions. Conversely, the risks arising out of unforeseen physical conditions of the ground, obstacles, and adverse reaction to the

excavation and ground support processes are allocated to the Employer, warranting extension of time and/or reimbursement of cost to the Contractor.”²⁷

Guidance as to the contents and use of the GBR is also contained in the Guidelines to the Emerald Book.²⁸

The GBR is to be distinguished from the Geotechnical Data Report (GDR), which also has work to do in the Emerald Book. If an alternative construction method for Excavation and/or Lining works is agreed between the parties, and if the GBR is silent on one or more parameters that are relevant to such alternative method, reference may be made by the Contractor to the GDR to integrate or amend the GBR accordingly (Sub-Clause 4.10.3). However, for the GDR to assume contractual force, the agreement of the Engineer is required. The GDR is recommended to be issued to tenderers as part of the invitation to tender to enable them to make their own interpretations and assessments of the risks associated with the baseline statements in the GBR.

Thus the design concept chosen by the Employer and the GBR amounts to an interpretation of the expected subsurface physical conditions adapted to the preferred risk allocation selected by the Employer.

Due to the critical importance placed on the GBR, the Emerald Book includes detailed guidance notes on its function and preparation.²⁹

As to content, the GBR requires disclosure of geological and geotechnical information describing the subsurface physical conditions. This information is designed to serve as a basis for the execution of the Excavation and Lining Works, including the relevant descriptions, data, information and warnings of anticipated physical and behavioural conditions, design and construction methods, and the likely reaction of the ground to such methods. The GBR is also required to include parameters that will assist to convey and highlight key project constraints such as ground and groundwater conditions.³⁰

The GBR is to be a detailed document, with the physical and behavioural statements to be described using quantitative terms to the extent practicable, and where possible, the selected baseline parameters are to be capable of being confirmed by data gathered in the field.³¹ The Emerald Book Guidelines go to some length to make recommendations on GBR content³² which include an example table of contents of a GBR together with appendices.³³

²⁷ Opening Notes - Emerald Book.

²⁸ Geotechnical Baseline Report - Emerald Book Guidance Section 4.2 p 81 and Appendix A pp. 85-90.

²⁹ Appendix A - The Geotechnical Baseline Report - Emerald Book pp. 85-90.

³⁰ *Ibid* p 86.

³¹ *Ibid* p 86.

³² *Ibid* pp 87-88.

³³ *Ibid* pp 89-90.

Critically, the GBR allocates the risk of subsurface physical conditions between the parties, and in terms that are expressed as clearly as possible in what is designed to be a practical working document embodied in the Emerald Book.³⁴

The central role of the GBR in the contractual scheme is underscored by two factors:

First, it is the only contractual definition of the foreseeable subsurface physical conditions for the Underground Works and serves as the basis for the preparation of the Tender and Execution of the Works. As such because it is provided at the tender stage, it will work to have a direct effect on bid prices. Pursuant to the conditions of contract for Underground Works, both the GBR and the GDR are to be made available to the Contractor 28 days prior to the latest date for submission of the Tender (Sub-Clauses 2.5 and 1.1.4) as part of the Employer's wider obligation to provide all relevant information in the Employer's possession on the topography of the site, on hydrological, climatic and environmental conditions at the Site and adjacent property, and on the geological, geotechnical and hydrological data of the subsurface of the Site.

Second, the risk allocation in the GBR is dependent on the Employer's preferred level of risk acceptance. As such, the drafting of the GBR will directly influence allocation of risk. An overly cautious GBR may result in higher bid prices, whereas an overly simplified GBR may excuse a contractor from otherwise foreseeable risks.

It is to be noted that the GBR falls within Sub-Clause 1.5 para (f) in the priority of documents forming part of the Contract. As such it has a mid-range priority within the contractual regime.

On the other hand, the GDR falls within Sub-Clause 1.5 para (l) "any other documents" in the priority of documents forming part of the Contract. As such it has the lowest priority within the contractual regime.

Adjustment for Time for Completion

The Time for Completion of the Works, of a Section or any Milestone in underground works projects more than likely will largely depend on the subsurface physical conditions that are encountered during the excavation phase. Time for Completion needs to be adjusted by the variation of these predicted conditions within the limits defined by the GBR, insofar as this variation affects the critical path of the Works, or of a Section or any Milestone.³⁵

The Emerald Book provides a greater degree of flexibility in its mechanism for time of Completion that relates directly to ground conditions.

In the case where more onerous physical conditions are encountered which are higher than that described in the GBR, the Time for Completion should be extended, while

³⁴ *Ibid* p 85.

³⁵ Opening Notes - Emerald Book.

in the case where the less onerous physical conditions encountered is higher than that described in the GBR, the Time for Completion should be reduced.³⁶

Accordingly, the Contractor's Tender is required to include production rates for each excavation drive or zone, based upon the conditions described in the GBR.

Measurement and Basis of Completion Time, Payment and Adjustments

The Emerald Book also provides a flexible mechanism for remuneration geared to ground conditions.

The evaluation of the time for the excavation and support depends on the expected subsurface physical conditions and on the production rates submitted by the tenderer. As the subsurface physical conditions are within the risk sphere of the Employer and the production rates are within the risk sphere of the Contractor, the time available to the Contractor for the Underground Excavation and Lining works is to be measured and adjusted against the difference between the subsurface physical conditions expected (as described in the GBR and as quantified in the Schedule of Baselines) and the subsurface conditions actually encountered.³⁷

The Schedule of Baselines is to be prepared by the Employer and completed by the Contractor as attached to the Letter of Tender and included in the Contract. Included in the Schedule of Baselines are the Completion Schedule, the Schedule of Rates and Prices and the Schedule of the Contractor's Key Equipment. It may also include data, quantities, lists and Schedules of Payments and/or Schedules of Performance Guarantee (Sub-Clause 1.1.84).

A Completion Schedule is required to demonstrate the Time for Completion of the Milestones, based on the sequential logical links between the Milestones with Times for Completion that are based on and consistent with the production rates provided by the Contractor in the Baseline Schedule for the excavation and Lining works, and with the Times for Completion of the other works (Sub-Clause 8.2.1).

The Schedule of Contractor's Key Equipment is to be prepared to include those items of the Contractor's Equipment that need to be made specifically available for the execution of the Works and are deemed essential for it to carry out the Works, as opposed to other Contractor's Equipment that can be readily replaced (Sub-Clause 4.17).³⁸

The estimated quantities of the excavation, ground support, ancillary measures and lining, as well as the corresponding production rates is required to be included in the Schedule of Baselines (Sub-Clause 8.2.2). This schedule 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.

³⁶ *Ibid.*

³⁷ Guidance Notes - Emerald Book, Section 2.4 p 78.

³⁸ Guidance Notes - Emerald Book, Section 2.5 p 78.

A major portion of the costs incurred by the Contractor is related to time rather than to quantities produced, in particular, technical, commercial and administrative overheads, depreciation leasing costs, depreciation and the like. It is recommended in the Guidance section that the Bill of Quantities shall therefore provide for time related items which allow for corresponding adjustments in the Contract Price according to the adjustments in Time for Completion.

The Bill of Quantities sets out the quantities, units of measurement and applicable unit rates and prices for all Excavation and Lining Works (Sub-Clause 13.8.2).

The quantities are to be measured in accordance with Sub-Clause 13.8 and the Contract Price and Time for Completion of the relevant Milestone shall be adjusted accordingly (Sub-Clause 13.8). The Contractor is to be responsible for the measurement, save as otherwise agreed (Sub-Clause 13.8.1). The measurement, with supporting material, is to be submitted to the Engineer who is then required to proceed under Sub-Clause 3.7 to agree or determine the measurement (Sub-Clause 13.8.1).

The time allowed in the Completion Schedule and/or the Programme for completion of the Works, Sections and/or Milestones comprising the Underground Works, is to be re-assessed (ie. reduced or extended) by the Engineer by applying the production rates provided by the Contractor to the measured quantity of each item of work or activity in the Schedule of Baselines. Based upon this assessment, an adjustment is to be calculated for such Time for Completion based on the logical sequential links provided in the Completion Schedule and/or the relevant Programme (Sub-Clause 13.8.3).

Correspondingly, the Contract Price is to be adjusted by the Engineer by valuing each relevant item in accordance with Sub-Clause 13.8.1, adjusted in accordance with Sub-Clause 13.8.3.

Adjustment of the Contractor's Remuneration for Time-related Charges

Due to the typically long duration of underground works and to the high cost of investment in equipment, an important portion of the cost to the Contractor, such as depreciation of and interest for equipment, overhead charges and the like, is time-related, whilst the remainder of the cost depends on the volume or quantity of the performed works. Hence, the adjustment of Time for Completion (if any) due to the difference between the contractually agreed and the actually encountered subsurface physical conditions should also lead to an adjustment of the Contractor's remuneration for time-related charges.

The Bill of Quantities for Excavation and Lining Works is therefore required to distinguish between time-related rate items, quantity-related rate items and fixed rate items for the performance of the Works (Sub-Clauses 13.8.2 and 13.8.3).

Preparation of Tender Documents and Selection of Contractor

A feature of this standard form contract for underground works is its inclusion of comprehensive guidance for Employers in preparing tender documents for projects using the conditions. This is set out in the Guidance Notes included in the Emerald

Book, and as such, are not intended to be included in the Underground Works Contract. The Emerald Book Guidance section underlines the importance of the tender process to the development of an appropriate contract for Underground Works and a successful outcome for the project. As it recommends, the preparation of the tender documents requires a “dedicated time frame, independent of the time allocated by the Employer to any previous design stages.”³⁹

This section also emphasises the importance of risk allocation particulars being included in the tender documents for Underground Works by Employers providing detailed information about the anticipated subsurface physical conditions, including expected ground and groundwater risks identified by the Employer and the design considerations relating to these risks that the Employer has taken into consideration when formulating the Employers reference design.⁴⁰

The section entitled ‘Guidance for the Preparation of Tender Documents’ is of particular relevance.⁴¹ It notes that the Emerald Book provides internationally acceptable, comprehensive, best practice procedures “designed to increase the probability of receiving responsive clear and competitive tenders using FIDIC forms of contract.”⁴² This approach emphasises the importance placed upon the quality of the tender documents prepared by the Employer and the likely impact of those documents in turn on the quality of the contract negotiated and on the ultimate success of the project.

Of note is that it is recommended in the Emerald Book that the tender documents for Underground Works should include detailed information about the anticipated subsurface physical conditions, including expected ground and ground water risks identified by the Employer and the design considerations relating to these risks that the Employer has taken into consideration when formulating the Employer’s Reference Design.⁴³

It further recommends that sufficient investigation of the subsurface physical conditions, of access limitations to the Site and the potential influence of the Works on the surrounding ground, ground water table and on the surface should be carried out by the Employer and the results provided to tenderers in the tender documents.

The concept of the Employer’s Requirements is central to defining the Works and scope to be performed by the Contractor (Sub-Clause 1.1.39). It means the document entitled as such included in the Contract, and any other additions and modifications to the document made in accordance with the Contract. The document describes the purpose(s) for which the Works are intended, and specifies the Employer’s Key Personnel and required equipment (if any), the scope and any preliminary design carried out by or on behalf of the Employer (being the Employer’s Reference Design), and design and/or other performance, technical and evaluation criteria for the Works.

³⁹ Emerald Book Guidance Section 2.1 p 77.

⁴⁰ *Ibid.*

⁴¹ Guidance Notes - Emerald Book pp. 73- 84.

⁴² *Ibid* p. 73.

⁴³ Guidance Notes - Emerald Book Section 2.1 p. 77.

The tendering process for underground works requires a high degree of preparation of the Employer's Reference Design. It is recommended that the Employer's Reference Design should be:

- (a) compatible with the Employer's Requirements, and the Employer's preferred assessment of acceptable physical risks;
- (b) be based on and consistent with the conclusions of the preliminary investigations in the GDR;
- (c) cover the Permanent Works and the excavation and support procedure for the Underground Excavation and Lining Works; and
- (d) be consistent with the GBR and the various Schedules.⁴⁴

Accordingly, FIDIC and ITA strongly recommend that the Employer engages a team with sufficient experience in the design, procurement and management of underground works to undertake these and other preparatory tasks, as well as providing the team with sufficient time for careful and thorough preparation of the tender documents. The tendering process must also allow for sufficient time for tenderers to prepare their proposals of appropriate quality.

Finally, the relevant experience of the Contractor is of paramount importance to the success of underground works. FIDIC and ITA strongly recommend that Employers take care in engaging with high quality selection processes to ensure the skill and experience of the Contractor.

Safety of the Workforce

Safety of the workforce is dealt with by the mechanism of an Employer's indemnity in favour of the Contractor. This works to provide incentive for the Employer to guard against workers suffering bodily injury, sickness, disease or death which is attributable to any negligence, wilful act or breach of contract by the Employer, the Employer's Personnel, or any of their respective agents (Sub-Clause 17.5).

Dispute Resolution

Given the complexity and risks associated with Underground Works, issues will inevitably arise in the progress of the works which will call to be resolved.

The Emerald Book adopts the well-known FIDIC dispute resolution structure which is provided for in Clause 21 'Disputes and Arbitration' (Sub-Clauses 21.1-21.8). This tiered system derived from other FIDIC standard form contracts in its 'rainbow' suite, includes the appointment of a standing dispute avoidance/adjudication board (a DAAB) (Sub-Clauses 21.1 - 21.4 and APPENDIX 'General Conditions of DAAB Agreement pp. 117-125 and Annex 'DAAB Procedural Rules' pp. 126-132). Of note is the Guidance to Clause 21 provided in the Emerald Book (Guidance pp. 50 to 56), and a sample 'Dispute Avoidance / Adjudication Agreement' provided in the 'Forms' section of the Emerald Book (Forms pp. v-vi).

Reference to ICC arbitration is provided for disputes not resolved at the DAAB level (Sub-Clauses 21.6- 21.8).

⁴⁴ *Ibid* Section 3.2 p. 79.

The architecture of the Emerald Book dispute resolution system should be well suited to the demands of Underground Works. Indeed, the appointment of a standing dispute avoidance/adjudication board (a DAAB), could be considered an essential contractual provision given the unusually high level of uncertainties, and hence risks, involved in these works.

Further, given the extensive duration of most large-scale Underground Works and the technical disciplines involved, a three person DAAB would appear to be preferable to the appointment of a single member. This would work to ensure that the desired level of Underground Works technical and legal expertise is retained from the outset, and that the continuity and security in the knowledge base developed by the Board in the course of the project, is retained and is able to be passed on to any newly constituted Board, should that become necessary as the Works are managed to completion.

Conclusion

At the launch of the Emerald Book in May of this year, FIDIC contracts committee chair Zoltán Záhonyi said: “Working together, FIDIC and ITA-AITES have created a contract that we believe, and hope will command the respect and authority of the tunnel engineering and construction sector and that both clients and contractors can use with confidence. The new Emerald Book addresses several critical areas that should lead to the smoother running of contracts in the growing tunnelling and underground works sector.”

Indeed, it should. Underground works projects involve managing numbers of unique risks, including the ‘known unknown’ of subsurface physical conditions. The Emerald Book, produced by the joint FIDIC and ITA-AITES Task Group after years of endeavour, looks to have surfaced on solid ground in achieving a balanced risk allocation for underground works contracts. As such, it is set to significantly enhance the prospects for positive project outcomes in these challenging enterprises.

For countries like Australia, which has a regular need to attract the expertise of international contractors to execute Underground Works, working with a familiar internationally based contract such as the Emerald Book, will assist to provide comfort and encourage high quality tendering for the provision of their valuable services.

Sir Alan Muir Wood ⁴⁵ has said of tunnels:

“It has been said that a tunnel is a long cylindrical hole through the ground, with a geologist at one end and a group of lawyers at the other. Yet more dire is the present day phenomenon of lawyers at each end.”
“Uncertainty is a feature that is unavoidable in tunnelling. But it can be understood and controlled so that it does not cause damaging risk.”

⁴⁵ Sir Alan Marshall Muir Wood FRS FREng FICE (8 August 1921 – 1 February 2009) was an eminent British civil engineer.

The Emerald Book will contribute significantly to understanding and managing the risk. It will provide a safer contractual space to advance the contemporary imperative for underground solutions in the built environment of today.