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A CODE OF PRACTICE FOR RISK MANAGEMENT OF TUNNEL WORKS

2nd EDITION (May 2012)

*Prepared
by*

The International Tunnelling Insurance Group

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Note on drafting:

Where this Code of Practice uses the words 'shall' and 'must', the procedure to which it applies is compulsory. Where the word 'should' is used then the procedure is recommended best practice.

NOTE AND ACKNOWLEDGEMENT BY ITIG TO BTS, IMIA & ITA

This code has been based on 'The Joint Code of Practice for Risk Management of Tunnel Works in the UK' which was prepared jointly by the British Tunnelling Society (BTS) and the Association of British Insurers (ABI) and published in September 2003.

The Code has been modified after discussions with the International Tunnelling Association (ITA) and the International Association of Engineering Insurers (IMIA) , notably to recognise that some of the provisions in the original Joint Code would not necessarily be appropriate or legal in all nations, regions, or cities which would require specific amendments to the Code.

The code is intended as a project management tool to promote best practice in risk management and reduce the occurrence of accidents. It is difficult for one document to be uniformly applied to all geographical and work situations. Final adoption of all or parts of the code should be resolved by the interested parties.

The agreement of the BTS and the ABI for the preparation and subsequent publication of this code is gratefully acknowledged.

ACKNOWLEDGEMENT BY THE ITA

ITA supports the principles and the spirit of the use of Risk Management and generally agrees with the principles of the code. ITA supports ITIG in this initiative to ensure that Risk Management principles are incorporated into the implementation of tunnel and underground projects.

ACKNOWLEDGEMENT BY THE IMIA

The International Association of Engineering Insurers (IMIA) fully supports the principles of Risk Management addressed in this Code. IMIA supports the initiative of ITIG and will display this Code of Practice in the IMIA Web Site: www.imia.com

1. OBJECTIVE OF THE CODE

1.1 The objective of this **Code** is to promote and secure best practice for the minimisation and management of risks associated with the design and construction of tunnels, caverns, shafts and associated underground structures including the renovation of existing underground structures, referred to hereafter as **Tunnel Works**. It sets out practice for the identification of risks, their allocation between the parties to a contract and **Contract Insurers**, and the management and control of risks through the use of **Risk Assessments** and **Risk Registers**.

Terms identified in italics in this Code are defined/described in Appendix A..

1.2 The scope of this **Code** applies to the project development, design, contract procurement for construction and construction stages of **Tunnel Works**, wherever these may be carried out geographically, the operation of **Tunnel Works** so far as any stipulated maintenance period and the impact of **Tunnel Works** construction on **Third Parties** including infrastructure.

1.3 The **Code** excludes the operational performance of tunnels and underground structures other than that included within any stipulated maintenance period under a construction contract.

1.4. The Code is intended to operate in parallel with and does not derogate from:

a) statutory duties, responsibilities and requirements of **Local National Legislation** relating to health and safety, the design and subsequent implementation of construction activities in respect of **Tunnel Works**,

b) **Local National Standards and/or Codes of Practice** appropriate and applicable to design and construction of **Tunnel Works** including those relating to workmanship and materials;

c) recommendations for and guidance on health and safety practices as set out in British Standard BS6164:2011 (Code of practice for safety in tunnelling in the construction industry) and any subsequent revisions or equivalent appropriate and applicable **Local National Standards and/or Codes of Practice**.

1.5 Where the provisions of the **Code** are more extensive and/or more onerous than any recommendations, statutory requirements, duties, responsibilities or Standards/Codes of Practice set out in Clause 1.5 above, the requirements of the **Code** shall apply in addition.

1.6 In the absence of specific **Local National Legislation** and/or **Local National Standards and/or Codes of Practice** dealing with such matters as set out in Clause 1.5 above, the **Insured** shall notify **Contract Insurers** of the provenance of Standards and/or Codes of Practice that will apply on a **Tunnel Works** project which relate to health and safety practices (including those applicable to the provision and operation of plant and machinery), design and construction (including materials and workmanship matters).

1.7 The **Insured** shall provide the statutory legislative requirements, Standards and/or Codes of Practice to prevail during the **Tunnel Works** in Schedule 1 to this **Code**.

1.8 A suggested 'Schedule of Deliverables' for use by **Contract Insurers** is given in Appendix B. It should be acknowledged, however, that the schedule as presented cannot and shall not be seen as exhaustive. The 'deliverables' on any particular **Tunnel Works** project will be determined by the project requirements, as set out in **Contract Documentation**.

2 COMPLIANCE WITH THE CODE

2.1 Compliance with the **Code** as it applies to construction projects involving **Tunnel Works**, should minimise the

risk of physical loss or damage and associated delays. It follows that Insurance contracts covering **Tunnel Works** should benefit from provisions which enable Insurers to enforce the requirements of the **Code**.

- 2.2 **Contract Insurers** will reserve the right to enter and inspect any **Tunnel Works** insured under an Insurance Contract and/or related documents within a reasonable time once a request is made. The purpose of any inspection is to assess compliance with the Code.
- 2.3 **Contract Insurers** may decide to add a specific provision or endorsement to their Policy to ensure that the principles and guidelines given in the **Code** are followed. There is no mandatory form of such provision or endorsement but a "Model Endorsement" is available for consideration.
- 2.4 The Insured should always take advice from their Insurance Advisers as to the insurance implication of non-compliance with the **Code**.

3 INTRODUCTION

- 3.1 Hazard identification and the management of risk to ensure their reduction to a level 'as low as reasonably practicable' (ALARP) shall be integral considerations in the planning, design, procurement and construction of **Tunnel Works**. So far as it is reasonably practicable, risk should be reduced through appropriate design and construction procedures.
- 3.2 Responsibility for risk management shall be explicitly allocated to relevant parties to a contract so that they are addressed adequately and appropriately in the planning and management of a project and that appropriate financial allowances can be made.
- 3.3 The use of a formalised **Risk Management** procedure shall be employed as a means of documenting formally the identification, evaluation and allocation of risks.

4 RISK ASSESSMENT AND MANAGEMENT

4.1 General

- 4.1.1 **Risk Management** is the systematic process of:
- a) identifying hazards and associated risks, through **Risk Assessments**, that impact on a project's outcome in terms of costs and programme, including those to third parties;
 - b) quantifying risks including their programme and cost implications;
 - c) identifying pro-active actions planned to eliminate or mitigate the risks;
 - d) identifying methods to be utilised for the control of risks;
 - e) allocating risks to the various parties to the Contract.
- 4.1.2 For the purpose of this **Code**, 'Risk' is defined as the combination of the consequence (or severity) of a 'hazard' and its likelihood, that is:

Risk is a function of the consequence/severity of a hazard and the likelihood of occurrence of the hazard

- 4.1.3 A 'hazard' is defined as an event that has the potential to impact on matters relating to a project which could give rise to consequences associated with:
- a) health and safety;
 - b) the environment;
 - c) the design;
 - d) the programme for design;
 - e) the costs for the design;
 - f) the construction of the project;
 - h) the costs associated with construction;
 - i) third parties and existing facilities including buildings, bridges, tunnels, roads, surface and subsurface railways, pavements, waterways, flood protection works, surface and subsurface utilities and all other structures/infrastructure that shall be affected by the carrying out of the works.

4.1.4 Hazards shall be identified and evaluated on a project-specific basis and their consequent risks shall be identified and quantified by **Risk Assessments** through all stages of a project (**Project Development Stage, Construction Contract Procurement Stag,, Design Stage,, Construction Stage** and operational stage for any stipulated maintenance period).

4.1.5 The nature of the hazards (and hence their consequent risks) will be dependent on the stage of a project under consideration.

4.2 Risk Assessment

4.2.1 **Risk Assessment** is the formalised process of identifying hazards and evaluating their consequence and probability of occurrence together with strategies as appropriate for preventative and contingent actions.

4.2.2 **Risk Assessments** required at each stage of a project shall be summarised in appropriate **Risk Registers**. **Risk Registers** shall clearly indicate the party responsible for the control and hence management of an identified risk (respecting any Contract responsibilities and liabilities), as well as mitigation measures.

4.2.3 The parameters to be used in the assessment of risks, in terms of probability of occurrence of a hazard and its severity of impact/consequence on cost, programme, environment, third parties and existing facilities shall be both project specific and appropriate to the project stage under consideration.

4.2.4 Insurance should not be considered as a contingency or mitigation measure in risk assessments for **Tunnel Works**.

4.3 Risk Registers

4.3.1 The processes of **Risk Assessment** and the subsequent preparation of **Risk Registers** are required to

identify and clarify ownership of risks and shall detail clearly and concisely how the risks are to be allocated, controlled, mitigated and managed. The systems used to track risks shall enable the management and mitigation of risks through contingency measures and controls to be monitored through all stages of a project.

- 4.3.2 **Risk Registers** shall be 'live' documents that are continually reviewed and revised as appropriate and available for scrutiny at any time. They shall provide an auditable trail through the life of a project to demonstrate compliance with the **Code**. They shall identify hazards, consequent risks, mitigation and contingency measures, proposed actions, responsibilities, critical dates for completion of actions and when required actions have been closed out.

5 CLIENT ROLE AND RESPONSIBILITIES

- 5.1 The **Client** shall have demonstrable technical and contract management competence appropriate to the type, scope and extent of the project to be planned, designed and procured for construction in:

- a) **Project Development Stage** studies;
- b) **Design Stages**;
- c) **Construction Contract Procurement Stage** procedures including selection of a **Form of Contract**;
- d) **Construction Stage** and management.

- 5.2 Such competence shall be demonstrable and evaluated on the basis of:

- a) the **Corporate Competence** of the **Client** body in relation to the proposed project and/or;
- b) the competence of individual staff within the **Client** body including their availability for the project.

- 5.3 In the absence of appropriate experience for any part of the project, the **Client** shall appoint a **Client's Representative**. The appointment of a **Client's Representative** should be based on a structured selection exercise. The criteria for the selection and appointment of a **Client's Representative** should be similar to those with which the Client assesses his own capability at the outset and include consideration of the following:

- a) the **Corporate Competence** of the company including references from previous clients (which should be followed up);
- b) the competence of staff;
- c) named Key Personnel;
- d) an assessment of the project planning competence including the planning, procurement, execution and interpretation of site and ground investigations;
- e) design capability including competence in the type of **Tunnel Works** to be designed and associated construction techniques;
- f) capability in respect of the management (or procurement in the case of design-construct arrangements) of design, **Design Checking** and review procedures and the preparation of appropriate

design-related **Risk Assessments and Risk Registers**;

- g) capability in respect of the identification and management during the **Design Stage** of health and safety design-related matters including those relating directly to operatives and all other persons directly engaged on the **Tunnel Works** as well as such matters arising from design arrangement(s) that will impact on **Third Parties** and the preparation of appropriate **Risk Assessments and Risk Registers**;
 - h) presentation by **Key Personnel** proposed for the project and confirmation of their availability;
 - i) financial stability of the company/organisation.
- 5.4 The **Client** shall take full responsibility for the information prepared by him (or by his **Client's Representative**) and issued to tenderers as 'works information'.
- 5.5 The **Client** shall ensure that provision is made for the appointment(s) of an identified individual or individuals who is/are suitably qualified and experienced and hence competent in risk management practices and responsible for the identification, collection, collation and coordination of hazards and associated risks and the development and preparation of appropriate **Risk Assessments and Risk Registers** for each and all stages of a **Tunnel Works** consistent with the requirements of this **Code**.
- 5.6 The **Client** shall identify and make available arrangements for checking of designs, construction supervision and monitoring of the **Tunnel Works**.
- 5.7 The **Client** shall develop and maintain during the course of the **Tunnel Works** (or have developed and maintained on his behalf) an **Overall Management Organisation Chart** which should identify reporting structures and lines of communication between the **Client (or Client's Representative), the Designer(s) and the Contractor** including supervision and monitoring of the **Tunnel Works**. The Chart should be accompanied with curricula vitae of key personnel from these organisations to support and demonstrate the competence of those persons designated for the design, construction and project management of the works.
- 5.8 The **Client** shall take into account all other matters relating to his role and responsibilities referred to in subsequent sections of this **Code**.

6 PROJECT DEVELOPMENT STAGE

6.1 General

6.1.1 For the purpose of this **Code**, the **Project Development Stage** includes:

- a) project feasibility studies;
- b) site and ground investigations;
- c) assessment and evaluation of project options and the identification of a preferred project option and Form of Contract for construction (for example design and construct or design-construct);
- d) project design studies appropriate to the **Form of Contract** for construction.

6.1.2 The scope of work required under the **Project Development Stage** shall not be constrained by programme considerations or the terms and conditions for the appointment of a **Client's Representative**. The **Client** shall ensure that sufficient time and budget are available to:

- a) investigate and subsequently demonstrate the technical viability of a project prior to proceeding to the **Construction Contract Procurement Stage**;
- b) prepare designs appropriate to the **Form of Contract** to be adopted.

6.2 Site and Ground Investigations

6.2.1 The nature, scope and extent of site and ground investigations to be carried out shall be based on the nature, scope and extent of the project, its location and its geological/hydrogeological environments. Site and ground investigations shall be designed, planned and procured by personnel who are suitably qualified and experienced and hence competent in respect of the nature of the site and ground investigations required for the proposed **Tunnel Works**.

6.2.2 Site and ground investigations shall be carried out in accordance with applicable **Local National Standards and/or Codes of Practice**. In the absence of such, the basis, including any other internationally recognised Standard (for example Eurocode 7 Geotechnical Design" on which site and ground investigations are carried out shall be clearly stated. Site and ground investigations carried out by or on behalf of the Client should be phased appropriate to the pertaining physical and geological environments and be so designed and planned to:

- a) identify, so far as reasonably practicable, artificial (man-made) and natural (geological/hydrogeological) hazards (including gases such as methane, radon) and hence enable consequent risks to be assessed (which influence the design and construction of the project, including those that affect third parties);
- b) provide sufficient information on pertaining site conditions, ground (including artificial and natural ground) and groundwater conditions, previous history of the project site including any constraints of an engineering significance relevant to the works to be carried out (such as mining/mineral extraction, contamination) in order to enable realistic and reliable assessments of different tunnelling methodologies (including temporary and permanent support/lining requirements and health and safety issues) to be made in terms of technical viability, cost, programme and impact to third parties;
- c) enable the financial and technical viability of the project to be confirmed from preliminary design studies;
- d) enable alignment options to be compared and the feasibility of the options in terms of cost, programme and Constructability to be evaluated.

6.2.3 Site and ground investigations shall be executed by organisations who are suitably qualified and experienced and hence competent for such work and supervised by suitably qualified and experienced and hence competent personnel by (or on behalf of) the **Client** to ensure that the results of the investigations are reviewed contemporaneously and the scope of the investigations is amended or revised to suit the conditions being encountered in relation to the proposed nature and scope of the project.

6.2.4 The results of site and ground investigations, including laboratory and field testing, shall be recorded factually in accordance with **Local National Standards and/or Codes of Practice** or, in their absence, internationally recognised appropriate Standards or Codes of Practice. The method of reporting shall be stated clearly and unequivocally. Any departure whatsoever from any Standards, Codes or other practices referred to or acknowledged in the factual reports shall be identified and clarified so as to obviate any ambiguity

in the reporting of factual data.

6.3 Assessment and Evaluation of Project Options

6.3.1 Assessments and evaluations of project options should be carried out during the **Project Development Stage** by the **Client** (or on his behalf by the appointed **Client's Representative**). For a selected alignment or alignment options, such assessments and evaluations should take into account:

- a) the geology (including the potential for gases of a potentially harmful nature) and the hydrogeology
(as characterised by site and ground investigations);
- b) tunnelling methodologies (and other methodologies as appropriate associated with works such as caverns, shafts, adits) appropriate to the nature of the ground and the environment (for example, open- and closed-face tunnel boring machines, partial face tunnelling machines (roadheaders, excavators), drill and blast) for the selected alignment or the alignment options;
- c) temporary and permanent ground support systems (for example, sprayed concrete linings, rockbolts/dowels, pre-cast concrete segmental linings, cast-iron segmental linings, cast in-situ concrete linings);
- d) ground and groundwater treatment measures (for example, the use of compressed air, grouting, dewatering/depressurisation, ground freezing) and their impact on the environment and to **Third Parties** (for example, groundwater abstraction/depressurisation leading to settlements, noise, vibrations);
- e) ground movements and settlements at the ground surface and their impact on a **Third Party** or subsurface ground movements and their impact on buried structures such as utility services, adjacent tunnels and underground structures;
- f) environmental considerations including dust, noise, vibrations, traffic, plant movements;
- g) associated costs, health (including occupational health considerations), safety and programme implications;
- h) appropriate forms of contract;
- i) hazardous materials including gasses, chemicals, other pollutants or naturally occurring substances that could be injurious to health or affect durability;
- j) all other particular factors relevant to the proposed project location, geology and environment.

6.3.2 The assessments and evaluations of project options shall include the identification and evaluation of associated option-related hazards and consequent risks. These shall be presented in formalised **Risk Assessments** for each identified project option. The **Risk Assessments** shall be continually reviewed and revised as appropriate during the **Project Development Stage** to take into account the results of site and ground investigation results and further and better information that becomes available during this Stage.

6.3.3 For identified project options (in terms of, for example, alignment, tunnelling methodology, environmental, **Third Party** considerations, etc), the **Client** should establish (or have established on his behalf) overall estimates of cost and time for each project option with costs assigned to programme activities. Furthermore, cost and programme sensitivity tests should be undertaken to determine the projected out- turn costs and programme durations in relation to project-option related risks and appropriately assigned confidence levels, taking into

account possible mitigation measures to obviate or minimise identified risks.

- 6.3.4 By such means, the **Client** shall determine (or have determined on his behalf) a technically viable preferred project option or options.

6.4 Project Development Design Studies

- 6.4.1 The **Client** should prepare (or have prepared on his behalf) a preliminary scheme design or detailed scheme design appropriate to the **Form of Contract** to be adopted (see Section 7) for the preferred project option (or options).

- 6.4.2 A **Risk Assessment** shall be carried out and a **Risk Register** shall be prepared for the preferred project option (or options). This **Risk Register** should include the perceived hazards and associated risks for the preferred project option (or options) and indicate potential mitigating measures with comprehensive explanations for their basis, based on the studies carried out during the **Project Development Stage**. This **Risk Register** shall be included within the information provided to tenderers during the **Construction Contract Procurement Stage**.

7 CONSTRUCTION CONTRACT PROCUREMENT STAGE

7.1 General

- 7.1.1 For the purpose of the **Code, the Construction Contract Procurement Stage** includes:

- a) the preparation and issue of **Contract Documentation** for **Tunnel Works** for tendering purposes;
- b) the selection or Pre-qualification of contractors for tendering;
- c) tender assessment.

7.2 The Preparation of Contract Documentation for Tendering Purposes

- 7.2.1 The preparation of **Contract Documentation** for tendering purposes shall take due regard of the type of contract to be awarded (for example, design and construct or design-construct) and the **Form of Contract** (for example standard forms of Contract published by the International Federation of Consulting Engineers (FIDIC), the Institution of Civil Engineers (United Kingdom) or Local National forms appropriate to **Tunnel Works**, or particular forms previously prepared by or for a **Client** which have been proven to be appropriate by precedent experience for **Tunnel Works**).

- 7.2.2 The selection of a Form of Contract by the Client and the drafting of its detailed terms should take due regard of the allocation of risks to the parties to the Contract (under the proposed Contract) and consequently the liabilities to the parties to the Contract.

- 7.2.3 All **Contract Documentation** (as well as subcontract documentation for **Tunnel Works** as appropriate) shall clearly demonstrate how the parties to each contract are to comply with this **Code**. Consequently, such contract (and subcontract) documentation should clearly and explicitly set out the responsibilities and duties of the parties to each contract and the responsibility for meeting the cost of **Insurer's Remedial Measures**.

- 7.2.4 **Contract Documentation** (as well as sub-contact documentation for **Tunnel Works** as appropriate)) shall include full disclosure of those hazards and associated risks identified at the **Project Development Stage** for the preferred project option (or options) in the form of a project **Risk Assessment**.

- 7.2.5 **Contract Documentation** (as well as subcontract documentation for **Tunnel Works** as appropriate) shall include **Ground Reference Conditions** prepared by the **Client** (or prepared on his behalf) or shall require each tenderer to submit with their tender their own assessment of Ground Reference Conditions, the requirements of which shall be defined and fully described in the **Contract Documentation**.
- 7.2.6 When prepared by (or on behalf of) the **Client**, the **Ground Reference Conditions** shall be issued to tenderers as integral and formative information on which tenders shall be based and the **Client** shall take responsibility for the information so issued.
- 7.2.7 When prepared by a tenderer, the **Ground Reference Conditions** shall be used by the **Client** in the tender assessment process.
- 7.2.8 **Ground Reference Conditions** prepared either by the **Client** or by a tenderer shall form part of the Contract and shall provide the basis for comparison with ground conditions encountered in relation to those assumed and allowed for at the tender stage by the **Contractor**. The **Ground Reference Conditions** shall provide the baseline against which encountered conditions can be assessed and compared. **The Ground Reference Conditions** shall also identify hazards appropriate to the site and ground conditions established from the investigations to permit associated risks to be assessed and catered for at time of tender, consistent with the **Contract Documentation** requirements.
- 7.2.9 **Contract Documentation** (as well as subcontract documentation for **Tunnel Works** as appropriate) shall clearly identify key **Method Statements** to be submitted with a tender that the **Client** or his Representative considers critical for the construction of the works.
- 7.2.10. Notwithstanding the issue of a project **Risk Register** in the contract documentation, tenderers are required to prepare and submit their own project **Risk Register** for submission with a tender based on specific **Risk Assessments** appropriate to the methods of working allowed for (described in **Method Statements**) with descriptions of risk mitigation/control/contingency measures.
- 7.2.11. **Contract Documentation** (as well as subcontract documentation for **Tunnel Works** as appropriate) should clearly set out the information required for assessment of tenders together with the criteria and their weighting on which the evaluation of the tenders will be based.
- 7.2.12. Sufficient and adequate time and resources should be allocated for the preparation of **Contract Documentation** before release for tendering purposes for **Tunnel Works** without the need for subsequent supplementary documentation (including addenda, corrigenda) during the tendering period.

7.3 Selection or Pre-qualification of Contractors for Tendering Purposes

- 7.3.1 This is a key activity and shall have dedicated time and resources allocated by the **Client**. The selection or **Pre-qualification** of contractors for tendering purposes shall require contractors to demonstrate relevant experience.
- 7.3.2 The requirements for selection or **Pre-qualification** shall be prescribed. Appropriate information to be sought should include:
- a) experience obtained in the last 10 years with a list of relevant projects and **Clients**. Previous **Clients** should be contacted for references (for example on matters relating to the contractor's performance, working relationships);
 - b) performance details on previous relevant projects;
 - c) financial status;

- d) any proposed 'joint venture' arrangements;
- e) key staff available with the required qualifications;
- f) current work load and available resources;
- g) proposed use of subcontractors and supply chain and details of any long term working relationships;
- h) a focused technical submission on the proposed project which demonstrates technical understanding of the requirements for the project.

7.4 Time for Tendering

- 7.4.1 Provision shall be made by the **Client** for reasonable time for tendering to reflect the type of contract, the complexity of the project and the requirements of the contract documentation in terms of a tender submission.

7.5 Tender Risk Register

- 7.5.1 For all contracts, the tenderer shall be required through the **Contract Documentation**, to provide the **Tender Risk Register** for the benefit of the **Contract Insurers**. This **Tender Risk Register** should demonstrate how the tender submission adequately and appropriately caters for risks identified and to be allocated to the **Contractor** including their management and control procedures, proposed contingency measures and the cost and programme implications of the implementation of contingency measures.

8 DESIGN STAGES

8.1 General

- 8.1.1 For the purpose of the **Code**, **Design Stages** include preliminary and detailed designs for permanent **Tunnel Works** and temporary works designs during the **Construction Stage** of a project.
- 8.1.2 The principles to be adopted during the **Design Stages** shall apply equally for the designs for permanent works and the designs for temporary works, howsoever defined in the **Code**. The design process for safety-critical works and/or temporary works that support the ground during construction shall be the same as for permanent works.
- 8.1.3 The design processes for safety-critical temporary works, and/or any temporary works that support the ground during construction, shall be the same as for permanent works.
- 8.1.4 Prospective **Designers** should be provided with a brief, be it from the **Client** or **Contractor**. The prospective **Designers** should review this brief and identify any deficiencies or omissions that could lead to a risk to the project. The **Client** or **Contractor** shall be required to address these issues and make adjustments to the terms and scope of engagement prior to awarding the design commission.

8.2 Transfer of Information Between Designers

- 8.2.1 Where a design is transferred between **Designers** for different **Design Stages** of a **Tunnel Works** project, the **Client** shall ensure that all information developed and collated during the previous **Design**

Stage is made available to the **Designer** of the following stage, including **Risk Assessments** and **Risk Registers**.

8.2.2 The **Designer** appointed and responsible for the following **Design Stage** shall be required to evaluate this information and make recommendations to the employing party (**Client** or **Contractor**) as appropriate for further investigations and/or studies for the subsequent **Design Stage** to fulfil the brief for appointment.

8.3 The Design Process

8.3.1 The fundamental objective of the design process is that of achieving a design where the risk of failure or damage to the **Tunnel Works** or to a **Third Party** from all reasonably foreseeable causes, and including health and safety considerations, is extremely remote during the construction and the design life of the **Tunnel Works**.

8.3.2 Risks from high consequence, low frequency events that could affect the works or a **Third Party** must be explicitly considered in the design process.

8.3.3 The **Designer** shall prepare documentation which shall include but not necessarily be limited to:

- a) a description of the element to be designed;
- b) the design requirements and criteria to be adopted;
- c) a geotechnical assessment that shall evaluate the geological and geotechnical information available (including the presence or generation of harmful gases), ground and groundwater contamination) and ascribe design values for the pertaining assessed ground and groundwater conditions for the purpose of design with justification in the light of information provided (including **Ground Reference Conditions**);
- d) a description of the method of design (including reference to any applicable Codes and/or Standards);
- e) a description of the method(s) of analysis to be used for the design and justification thereof;
- f) a Design **Risk Assessment** which shall consider the impact on the design and hence its implementation (not only on the **Tunnel Works** but also to a **Third Party**) of any realistic variation in the design criteria and/or design values adopted, based on the information available in relation to the anticipated/proposed method(s) of construction. The Design **Risk Assessment** shall take account of potential failure mechanisms and include mitigation/contingency measures appropriate to the anticipated/proposed method(s) of construction;
- g) the checking procedure to be implemented for the Design.

8.3.4 Calculations, analyses and assessments should also consider intermediate stages of construction.

8.3.5 The design process shall include, where appropriate, sensitivity studies to assess the impact of:

- a) construction tolerances;
- b) variation in geotechnical design values;
- c) variation in materials characteristics;

- d) variation in workmanship and geometry;
- e) methods of construction and the implementation of mitigation/contingency measures;
- f) natural Perils exposure in the region of the project such as flood, storm, seismic or tidal effects.

8.3.6 The design process shall include an assessment of the impact of construction on **Third Party** infrastructure. In this respect, the **Designer** shall assemble as far as reasonably practicable all available records of foundations and other structures/artificial obstructions which could affect and/or be affected by the **Tunnel Works**.

8.4 Design Checks

8.4.1 All designs shall be subject to a design check to ensure that a design to meet the fundamental requirement of 8.3.1 has been achieved.

8.4.2 The extent and scope of design checks shall be appropriate to:

- a) the complexity, degree of difficulty and type of construction of the **Tunnel Works** (including excavation/support sequencing for intermediate construction stages if applicable);
- b) the level of risk (to the **Tunnel Works** and/or a **Third Party**) assessed from the Design **Risk Assessment**;
- c) any statutory or other requirements by a **Client** or a **Third Party**.

8.4.3 Design programmes shall allow for sufficient time for the appropriate level of checking.

8.5 Constructability Issues

8.5.1 The **Designer** shall ensure that adequate construction expertise is available to undertake formal reviews of the design to assess and confirm the appropriateness of the design in terms of **Constructability**, including health and safety considerations and impacts on **Third Parties**.

8.5.2 The **Designer** shall take account of the impact of staged or sequential excavations to ensure the feasibility of construction stages and hence the appropriateness of the design. Provision shall be made by the **Client** for ensuring that the **Designer's** intent/requirements are adhered to during construction.

8.5.3 The **Designer** shall ensure that the site investigation is planned and designed to obtain, inter alia, ground and groundwater information and geotechnical properties appropriate for the construction of the **Tunnel Works**, recognising the likely method(s) of tunnelling/excavation that may be employed.

8.5.4 Where appropriate, the design shall detail excavation/support sequences and identify appropriate monitoring measures during the works for the range of anticipated ground and groundwater conditions and shall also include for the provision of contingency measures. The **Designer** shall ensure the design is consistent with the fundamental requirements of 8.3 in terms of geotechnical variability, workmanship and construction tolerances.

8.5.5 Where an 'observational method' is to be used, there must be compliance with the relevant requirements of

CIRIA Report R185¹ for the **Tunnel Works** or a Local National equivalent. In particular, where the design is based on or includes any element of an 'observational' approach for its implementation during the **Construction Stage**, the **Insured** shall ensure that the **Designer** shall have in place prior to the commencement of the **Construction Stage** pre-planned and pre-designed contingency measures. Such contingency measures shall allow for all resources (including but not limited to personnel, equipment, plant and materials) to cater for events which have not been predicted but observed based on monitoring which reveal at any time during the works that ground conditions and/or ground and/or underground structure behaviour is more adverse than that predicted. Such contingency measures may include (but shall not necessarily be limited to) increased monitoring frequency, ground treatment, additional support measures, modifications to the excavation/support sequencing. Furthermore, the **Insured** shall ensure that the **Designer** provides a sufficient number of suitably experienced and qualified and hence competent persons during the execution of the design for the **Tunnel Works**, so that the works are implemented at the **Construction Stage** to the absolute satisfaction of the **Designer** including the implementation of any pre-planned contingency measures.

8.6 Validation of Design During Construction

8.6.1 Provision shall be made in a Contract for sufficient monitoring of **Tunnel Works** during the **Construction Stage** to ensure that the design being implemented remains valid at all times. Such monitoring shall include the monitoring of the performances of the ground and groundwater, the **Tunnel Works'** structures and adjacent structures potentially affected by the **Tunnel Works** as appropriate to the method(s) of working adopted during the **Construction Stage**.

8.6.2 Where the design is based on or includes any element of an 'observational' approach for its implementation during the **Construction Stage**, the **Insured** shall ensure that the **Designer** provides a sufficient number of suitably experienced and qualified and hence competent persons during the execution of the design for the **Tunnel Works** so that the works are implemented at the **Construction Stage** to the absolute satisfaction of the **Designer**.

9 CONSTRUCTION STAGE

9.1 General

9.1.1 This section of the Code identifies the elements of current best practice that a **Contractor** is required to comply with as a minimum - in addition to any statutory requirements - prior to and during construction and should be read in conjunction with the remaining sections of the **Code**.

9.2 Pre-construction Activities

9.2.1 Following **Contract Award**, but prior to commencing on site, time shall be allowed in the programme for pre-construction activities including:

- a) the preparation and submission of a **Project Risk Management Plan** incorporating a
Construction Stage Project Risk Register;
- b) the preparation and submission of Health and Safety, Quality, and Environmental Plans;
- c) the preparation of a **Management Plan**;

¹ "The Observational Method in ground engineering: principles and applications" (1999) published by CIRIA, London, UK

- d) the identification, design (as necessary under the Contract) and procurement of items which involve long lead items (such as tunnel boring machines, for example);
- e) pre-construction Planning and **Method Statements**
- f) obtaining all necessary statutory consents;
- g) **Constructability** reviews.

9.3 Risk Management Procedures

9.3.1 The **Project Risk Management Plan** shall include the **Construction Stage Project Risk Register** which records all project-related risks identified for the **Construction Stage** of the project and includes the project-related risks brought forward from the Client's pre-contract **Risk Register**.

9.3.2 The **Construction Stage Project Risk Register** shall identify the owners of the risks, actions and measures required to mitigate the impact of the identified project-related risks on the **Tunnel Works**. The **Construction Stage Project Risk Register** may include the health and safety risk assessments related to the construction works/activities (in respect of any pertaining statutory or legislation requirements).

9.3.3 The **Project Risk Management Plan** shall identify the means and methods for:

- a) regular monitoring and review of the **Construction Stage Project Risk Register** by risk owners appropriate to the construction programme and activities for the **Tunnel Works**;
- b) the means of identifying and formally recording hazards and associated risks which arise during the course of the **Construction Stage**;
- c) identifying progress in the reduction/mitigation of the overall impact and number of risks;
- d) updating of the **Construction Stage Project Risk Register** and hence identifying any changes to the **Project Risk Profile** during the **Construction Stage** of the **Tunnel Works**.

9.4 Contractors' Staff and Organisation

9.4.1 Prior to commencing work on site and thereafter whenever there is a significant change, as required by the Contract, the **Contractor** shall submit an overall Site Organisation Chart for the approval of the Client or the Client's Representative. This Chart should identify the reporting structure and lines of communication of **Key Personnel** and those persons nominated for safety critical work and **Self-Certification** (where required under the Contract).

9.4.2 The Site Organisation chart shall be in sufficient detail to enable the **Client** or the **Client's Representative** to identify how and with whom the **Contractor** intends to manage the works. The chart shall be submitted together with the names and curriculum vitae of all **Key Personnel** to demonstrate the competence of those persons who will be employed in the management of the **Tunnel Works**.

9.4.3 In addition to the names and curriculum vitae of all **Key Personnel**, the **Contractor** shall provide details of the roles and responsibilities of those personnel identified.

9.4.4 Within the period stipulated in the Contract, the **Contractor** shall provide for approval (by the **Client** or the **Client's Representative**) his policy on employment of skilled operatives. The policy should set out how the **Contractor** shall ensure that all operatives have the necessary competency to carry out the processes required

for the construction of the works and shall include details of the **Contractor's** training policy.

9.4.5 Within the period stipulated in the Contract, the **Contractor** shall provide a training plan which shall indicate how he intends to ensure that all staff are and will remain adequately and suitably trained for the positions and responsibilities that they are to hold.

9.4.6 As part of the organisation structure, the **Contractor** shall develop and implement a procedure for the dissemination of information including the methods he shall employ to ensure that feedback from sections of the works are communicated to all parts of the project.

9.5 Constructability

9.5.1 Throughout the duration of any **Tunnel Works** contract, the **Contractor** shall carry out **Constructability** reviews jointly with the **Designer**. The frequency of such reviews shall be consistent with the requirement of ensuring that the construction methods being employed and to be employed are suitable and appropriate in the light of the nature and scope of the works and the monitoring of the works.

9.6 Methods and Equipment

9.6.1 Prior to commencement of any operation or process in connection with construction of the **Tunnel Works**, the **Contractor** shall provide the **Client** or the **Client's Representative** with fully detailed **Method Statements**, **Inspection and Test Plans** and **Risk Assessments** as required and defined under the Contract.

9.6.2 **Method Statements** shall clearly and unequivocally detail the methods and resources with which the **Contractor** intends to construct the works and should cover all aspects of the works including specification, design, environment, health and safety and quality. **Method Statements** shall reflect and demonstrate compliance with accepted current best practice and standards for the operations intended to be carried out.

9.6.3 **Inspection and Test Plans** shall clearly and unequivocally detail how the **Contractor** intends to inspect, check and certify the works throughout the construction process and should detail 'hold' points requiring approval by others such as the **Designer**, **Client** or **Client's Representative** in accordance with the Contract requirements. **Inspection and Test Plans** should identify those sections of the specification which are being referred to and the tolerances permitted.

9.6.4 **Risk Assessments** shall deal with specific risks associated with the construction methods, plant, equipment and materials to be employed including fire related risks associated with the working environment, construction methods, specific plant, material and equipment to be used in the construction of the works, having due regard to any **Local National Legislation** and/or **Local National Standards and/or Codes of Practice** relating to health and safety. **Risk Assessments** shall demonstrate that the hazards and associated risks involved in the construction process have been fully identified and assessed. The **Construction Stage Project Risk Register** shall demonstrate that appropriate **Method Statements** have been developed to include all mitigation measures necessary to reduce the impacts of identified risks to acceptable levels.

9.6.5 The **Method Statements** and **Inspection and Test Plans** shall indicate what monitoring and checking shall be carried out, by whom and at what intervals. Quality records shall be produced and provided to satisfy compliance with the Contract requirements. Procedures for dealing with non-compliances shall be included.

9.6.6 A register of approved signatures shall be maintained together with authority levels for all staff employed in the checking and certifying of **Inspection and Test Plans** and quality records.

9.6.7 In the case of a **Self-Certification** Contract, the **Contractor** shall additionally demonstrate how he shall

control and maintain the independent supervision of the construction checking process.

9.6.8. The **Method Statements** shall identify what equipment and/or method it is intended to be used for the works and the criteria for selection of that method or equipment, particularly with regard to the risks identified in the **Construction Stage Project Risk Register**.

9.6.9. Where project critical equipment or methods such as tunnel boring machines (TBMs) or sprayed concrete linings (SCL) are to be used, a separate statement shall be prepared setting out the basis of the selection of the equipment or method with regard to operation, ground conditions, safety systems, maintenance, environmental monitoring, access, settlement, emergency procedures.

9.7. Management Systems

9.7.1. Following award and prior to commencement on site, the **Contractor** shall provide the **Client** or the **Client's Representative** with a copy of his Health and Safety Plan, Quality Plan and Environmental Plan together with an overall **Management Plan**.

9.7.2. In addition to the requirements of the Health and Safety, Quality and Environmental Plans, the overall **Management Plan** shall identify and demonstrate the systems the **Contractor** intends to use to manage and control the construction process with regard to the requirements of the Contract and also with regard to identifying that the **Contractor** is working to current accepted best practice.

9.7.3. This **Management Plan** should include as a minimum procedures for the management and control of the following:

- a) documents;
- b) design;
- c) **Self-Certification** (where required under the Contract);
- d) procurement of materials, equipment, and designs (either for temporary or permanent works, according to the requirements of the Contract);
- e) planning;
- f) training;
- g) emergency procedures;
- h) control and calibration of test and inspection equipment;
- j) survey.

If any of the above are included in other project-specific Plans (such as the Quality Plan for example), the **Management Plan** should merely include a reference to the relevant sections of the other project-specific Plans to avoid duplication.

9.7.4. The **Contractor shall** provide the **Client** or the **Client's Representative** with an Audit Plan that demonstrates how he intends to audit the construction process with both internal and external audits.

9.7.5. The **Contractor** shall implement a regular management review of all systems and procedures to ensure

continuing compliance with the requirements of the Contract and shall update all procedures as necessary.

9.8. Monitoring

- 9.8.1. Monitoring of the construction processes shall be carried out by use of **Inspection and Test Plans**, audits and management reviews.
- 9.8.2. For any process, the **Method Statements** and **Inspection and Test Plans** shall ensure that the critical parameters are clearly identified and monitored in such a way as to be able to be confirmed by audit that they are in compliance with the requirements of the Contract and/or **Third Parties** involved.
- 9.8.3. With particular regard to **Tunnel Works** in urban areas and where **Third Party** equipment or structures are at risk, **Method Statements** shall clearly identify 'trigger levels' at which contingency action shall be taken. The **Method Statements** shall clearly identify the reporting roles and responsibilities and what actions are to be taken and by whom at each trigger level.
- 9.8.4. Where risks are identified from the **Construction Stage Project Risk Register** that have a high severity rating but which have been mitigated by the construction methods to an acceptable level, the **Contractor** shall provide the **Client** or the **Client's Representative** with an outline Emergency and Contingency Plan for dealing with the risk in the event that it is realised.

9.9. Management of Change

- 9.9.1. Any changes to the design and/or method of working which result in greater assessed risks to the project or a **Third Party** shall be notified to the **Contract Insurers** immediately.
- 9.9.2. All **Value Engineering** proposals submitted for approval to the **Client** or the **Client's Representative** shall include a statement setting out in full, technical benefits as a consequence of the proposals together with any variation in the Project **Risk Assessments**. Full specifications and drawings as appropriate shall be prepared and approved by the **Client** before implanting the change.
- 9.9.3. All design changes instructed by the **Client** or the **Client's Representative**, or design changes introduced by the **Contractor** on design-construct contracts, during the Contract shall be reviewed by the **Contractor** and revised **Risk Assessments** submitted as appropriate for approval prior to carrying out the works.
- 9.9.4. Any modifications to safety critical equipment and/or procedures shall be undertaken only by competent persons and be subject to review by the **Designer** and the **Contractor**.
- 9.9.5. Regular monitoring of ground conditions shall be undertaken and any significant changes from those envisaged at commencement of the Contract shall be reviewed with the **Client** or the **Client's Representative**. The significance and potential impact of such changes in ground conditions shall be evaluated in relation to **Method Statements**, **Inspection and Test Plans** and **Risk Assessments**. The overall **Management Plan** and **Construction Stage Project Risk Register** shall be revised as necessary.
- 9.9.6. All changes in the construction process or design from that envisaged at commencement of the Contract shall be identified, reviewed and the **Construction Stage Project Risk Register** revised accordingly.

SCHEDULE 1

APPLICABLE LEGISLATION, STANDARDS AND CODES OF PRACTICE

(To be completed by the Insured)

APPENDIX A: Definitions and Terms used in this Code

ALARP - *'as low as reasonably practicable'*

A principle used for defining a level of risk that can be achieved and that is acceptable to all those that may be affected by the risk being realised.

Client

The final owner of the ***Tunnel Works*** and the procurer of goods or services. The purchase is generally governed by a contract.

Client Brief

The performance specification created by the ***Client*** that details the requirements of the completed works. Within the brief there will be details of intended usage of the works, capacity requirements, and lifespan specification. Additionally there should be an indication of overall budget available and proposed time for delivery.

Client's Representative

An individual, or company, that has been retained by the ***Client*** to look after the interests of the ***Client***.

Code

The Code of Practice for Risk Management of Tunnel Works.

Constructability

An objective review of the Design by experienced individuals to assess the practicalities of constructing the designed works.

Construction Contract Procurement Stage

The stage of a ***Tunnel Works*** project which involves the preparation and issue of Contract Documentation for tendering purposes following the selection or pre-qualification of contractors for tendering and tender assessment.

Construction Stage Project Risk Register

A register that records all project-related risks identified for the ***Construction Stage*** of the project and includes and identifies the project-related risks brought forward from the ***Client's*** pre-contract ***Risk Register***, the owners of the risks and actions and measures required to mitigate the impact of the identified project-related risks on the ***Tunnel Works***.

Construction Stage

The stage of a ***Tunnel Works*** project that involves all aspects relating to the implementation of designs for completion of the works to the requirements of the ***Client*** or ***Client's Representative***.

Contract Award

The award of a construction contract to a principal ***Contractor*** by the ***Client***.

Contract Documentation

Documentation that defines the scope of works, the nature, the Form and Conditions of Contract (including specifications for the works), and the apportionment of risk and payment mechanisms.

Contract Insurers

The collective nomenclature for the providers of the ***Contractors All Risk Insurance*** and/or ***Third Party Liability Insurance*** for a ***Tunnel Works*** project. The ***Contract Insurers*** may be a single company, or a

number of insurers operating in a co-insurance arrangement. In the instance of co-insurance there is likely to be a nominated Lead Insurer who will be the main point of contact for the **Insured**.

Contractor

The organisation appointed by the **Client** for the implementation for the **Tunnel Works**, appropriate to the Form of Contract.

Contractors All Risks Insurance

Under **Contractors All Risk Insurance** (commonly referred to as 'CAR Insurance'), insurance cover is typically provided for physical loss or damage to the contract works and may include/allow for physical loss or damage to construction plant and equipment or machinery. In addition it may also include cover for removal of debris; architects, engineers or surveyors fees; and expediting expenses. A 'CAR' policy may be effected by the **Client** or by the **Contractor** engaged for the work and can include all subcontractors. The cover typically begins at the start of the work except for items of construction plant and the like which are generally only covered after they have been unloaded at the site. The cover terminates when the completed project is handed over or any completed part is taken over or put into service. In respect of construction plant and the like, cover terminates when such equipment is removed from the site. A maintenance period, usually 12 months, can be incorporated in addition to the period of construction. The maintenance cover is for physical loss or damage to the works occurring during the maintenance period stipulated in the provisions of the clauses in the contract relating to the works.

Corporate Competence

The competence of an organisation as a whole gained through precedent experience in relation to the nature, form and extent of **Tunnel Works** proposed and the services to be provided.

Design Checking

The management process for checking the robustness of the Design, including numerical accuracy of the calculations, the dimensional accuracy of the drawings and the constructability of the overall concept.

Design Stage(s)

The stage or stages of a **Tunnel Works** project which involve the preparation of preliminary and/or detailed designs for permanent **Tunnel Works** and temporary works designs during the **Construction Stage**.

Design Statement

A document that details the method(s) of design, the parameters to be used in the design, the standards to be adhered to when undertaking the design.

Designer

The individual/organisation chosen to undertake the design process. Different **Designers** may be appointed for different stages of the design process. The **Designer** is typically a firm of consulting engineers but may be the design unit of a contractor, or an individual.

Form of Contract

The contractual arrangement between the purchaser of services/goods and the provider of the services/goods. There are standard Forms of Contract that cover all procurement routes.

Ground Reference Conditions

Definitive statements about the nature, form, composition and structure of the ground (both artificial and natural) and groundwater together with geotechnical properties of the ground which serve as a basis for construction Contract tendering purposes and for the subsequent application of the contract with respect to the conditions actually encountered during **Tunnel Works**. The **Ground Reference Conditions** represent a contractual definition of 'what is assumed will be encountered'. However, the provision of such Conditions in the Contract is

not a warranty that the Conditions will be encountered.

Inspection and Test Plan

A description and definition of the methods and procedures to be used to maintain and check quality within the construction process

Insured

The ***Insured*** is the collective nomenclature for the insured parties named in the Insurance Policy. This is likely to include the ***Client*** and the Principal ***Contractor***, and may include subcontractors and design professionals (for their on-site activities).

Insurer's Remedial Measures

Those measures required by contract Insurers following identification of a breach of the ***Code*** to ensure subsequent compliance with the ***Code***.

Key Personnel

Named staff identified by an organisation that are nominated to undertake important roles within the work scope required.

Local National Legislation

The legal and legislative framework applicable in the country, region or area in which ***Tunnel Works*** are to be carried out which give rise to statutory duties, responsibilities and requirements to ***Clients*** and/or ***Client's Representatives*** and/or ***Contractors***.

Local National Standards and/or Codes of Practice

Standards and/or codes of practice relevant to the design and implementation through construction of ***Tunnel Works*** which represent good practice and which are applicable in the country, region or area in which the ***Tunnel Works*** are to be carried out.

Management Plan

A plan, in addition to the requirements of Health and Safety, Quality, and Environmental Plans, that identifies and demonstrates the systems and procedures the ***Contractor*** will use to manage and control the construction process. The ***Management Plan*** should include, as a minimum, procedures for the management and control of Documents, Design (where required), ***Self-Certification*** (where required), Procurement, Planning, Training, Survey and Control and Calibration of Test and Inspection Equipment.

Method Statement

A document prepared in advance of undertaking design or construction work that details the methods to be utilised, the people required to undertake the work, the equipment required to undertake the work, and any supporting documentation necessary to undertake the work. In addition the ***Method Statement*** will contain an assessment of the hazards that may be encountered when undertaking the work, and any mitigation measures that are to be taken during the work to reduce the probability of occurrence of a hazard to ***ALARP***.

Pre-qualification

A process used by employers to assess prospective suppliers against pre-determined criteria.

Project Development Stage

The stage of a ***Tunnel Works*** project which includes project feasibility studies, site and ground investigations, and the assessment and evaluation of project options including identification of a preferred project option (or options) and Form of Contract for construction.

Project Risk Profile

An assessment of the residual risks at any point in time during **Tunnel Works** which potentially impact on the outcome of the project.

Risk Assessment

The formalised process of identifying hazards and associated risks, of evaluating their consequence and probability of occurrence, and of preparing strategies as appropriate for preventative and contingent actions.

Risk Management

The overall systematic process of Risk Assessment and providing for risk mitigation and control.

Project Risk Management Plan

A document identifying the means and methods for the regular monitoring and review of the **Construction Stage Project Risk Register**, of formally recording hazards and associated risks which arise during the course of the **Construction Stage**; of recording progress in the reduction/mitigation of the overall impact/number of risks; and of updating of the **Construction Phase Project Risk Register** and hence any changes to the **Project Risk Profile** during the **Construction Stage** of the **Tunnel Works**.

Risk Register

A formalised record of risks identified from the **Risk Assessment** process including full descriptive details of mitigation and control measures, risk owners and with appropriate cross-references. The **Risk Register** is the primary means of recording and monitoring the **Risk Management** process.

Self-Certification

A Quality Assurance process whereby the **Contractor** self-inspects and certifies that the Works are compliant with the Design and Contract requirements.

Tender Documentation

Documentation prepared and issued by a **Client** when requiring the services or goods of a supplier that detail the services or goods required and issued.

Third Party

A party that is affected by the actions of two other parties that are in a contractual relationship.

Third Party Liability Insurance

Insurance purchased to cover the financial consequences of damage to third party property or bodily injury to third parties arising from the performance of the Contract.

Tunnel Works

Tunnels, caverns, shafts and associated underground structures howsoever constructed and including the renovation of existing underground structures.

Value Engineering

The process of adding value to a project (by for example reducing cost and/or time) during the design and construction process.

APPENDIX B: Schedule of Deliverables for use by Contract Insurers

Clause	Deliverable	Prepared by	Scope and Intent
CLIENT ROLE AND RESPONSIBILITIES			
5.7	Overall Management Organisation Chart	Client	The Client shall develop and maintain during the course of the Tunnel Works (or have developed and maintained on his behalf) an Overall Management Organisation Chart which should identify reporting structures and lines of communication between the Client (or Client's Representative), the Designer(s) and the Contractor including supervision and monitoring of the Tunnel Works . The Chart should be accompanied with curricula vitae of key personnel from these organisations to support and demonstrate the competence of those persons designated for the design, construction and project management of the works.
PROJECT DEVELOPMENT STAGE			
			The Client shall develop and maintain during the course of the Tunnel Works (or have developed and maintained on his behalf) an Overall
6.2.4	Site Investigation - Factual Reports	Client	To assess ground conditions and obtain an understanding of the level of investigations carried out
6.3.2	Risk Assessments of Project Options	Client	To demonstrate that risks associated with project options have been assessed at an early stage
CONSTRUCTION PROCUREMENT STAGE			
7.2.3 - 4	Contract Documentation	Client	To assess level of information supplied to tenders including disclosure of hazards and associated risk identified during the Project Development Stage
7.2.5 & 7.2.8	Ground Reference Conditions	Client or Tenderers	To assess identified site and ground conditions hazards established from investigations
7.2.9	Key Method Statements	Tenderers	To assess construction methods, materials and plant identified by tenderers
7.2.10	Risk Assessment	Tenderers	To assess tenderers' perceptions and attitude to risk
7.5.1	Tender Risk Register	Tenderers	To demonstrates how the tender submission adequately and appropriately caters for risks identified and to be allocated to the Contractor.
DESIGN STAGES			
8.1.3	Design Brief	Client / Contractor	To confirm that scope of works has been identified appropriately
8.3.5	Schedule of Third Party Infrastructure	Designer	To demonstrate that Third Party exposure and an assessed level of damage have been carried out
8.5.1	Constructability Reviews	Designer	To demonstrate that appropriate assessments of the constructability of the design have been carried out, such assessments including health and safety considerations.
CONSTRUCTION STAGE			
9.2.1	Project Risk Management Plan	Contractor	To demonstrates the means and methods of regular monitoring and review of the Construction Stage Risk Register by risk owners for the Construction Stage

9.3.1	Construction Stage Project Risk Register	Contractor	To confirm the owners of risks, actions and measures to mitigate the impact of the risks during the Construction Stage including risks identified by the Contractor as well as project related risks brought forward from the Client's Risk Register
9.4.1	Site Organisation Chart	Contractor	To provide information on the reporting structure and lines of communication of key personnel and persons nominated for safety critical work and self-certification (where required under the Contract)
9.4.5	Training Plan	Contractor	To demonstrate how the Contractor intends to ensure all staff are and will remain adequately and suitably trained for the positions and responsibilities that they are to hold

9.6.2	Method Statements	Contractor	To demonstrate and confirm working methods and plant, materials and level of labour to be used.
9.6.3	Inspection and Test Plans	Contractor	To demonstrates the Contractor's and Client's attitude to quality control and quality assurance
9.6.4	Risk Assessments	Contractor	To demonstrate that hazards and associated risks involved in the construction works have been fully identified and assessed for inclusion in the Construction Stage Risk Register.
9.6.7	Independent Supervision Assurance	Contractor	To demonstrate how the Contractor will control and maintain independent supervision of the construction checking process in the case of Self-Certification
9.6.8	Plant Selection Criteria	Contractor	To identify key plant and the maintenance regime e.g. level of spares, frequency of inspection, Maintenance staff (to be included in Method Statements)
9.7.1	Management Plan	Contractor	To identify and demonstrate the systems the Contractor intends to use to manage and control the construction process with regards to the requirement of the Contract and also with regard to identifying that the Contractor is working to current accepted best practice
9.7.4	Audit Plan	Contractor	To demonstrates the Contractor's approach to internal and external auditing of the construction process
9.9.2	Value Engineering Proposals	Contractor	To identify deviations from the original design, changes in methods to be used, changes to design parameters and implications including risks, perceived benefits accompanied by appropriate risk assessments